# JOURNAL PAPER INSTRUCTIONS TO AUTHORS

## General

The paper should be valuable and should not have been published or submitted for publication in any other Journals. The text should be complete with abstract, introduction, material and methods, results, discussion and reference. The text must not exceed 15 pages for sciences papers and 25 for the humanities

## Content Text

The content text must be Normal, 10 pt., Times New Roman, at least 12 lines spaced, and justified. Each paragraph should be spaced after 6 pt. The first line of the paragraphs should not be indented.

## Footnotes

Footnotes should not be used.

## Page Margins

The paper size should be A-4 size and page margins must be 2.5 cm top and bottom, 3 cm left and 2 cm right.

## Page Numbers

Include page numbers. The page numbers should be placed in the lower right hand corner.

## Titles

The paper title must be capitalized, bold, centered, 11 pt., and spaced after 18 pt. Main titles and abstract title should be capitalized 9 pt., aligned left, bold, spaced before 12 pt., and after 6 pt., and numbered as (1., 2.,3.). Principle subtitles must be written in 10 pt, bold, aligned left.

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The name(s) of the author(s) should be written only in the first page, capitalized, 8 pt, normal, centered, and spaced after 18 pt.
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ALI MUHAMMED1, JALAL AMEEN 2 and DLOVAN ASSAD 2

The authors' names should not cover all line and if there are more than, 3 or 4 writers the rest should be spaced to the line below, and writers also should be single spaced. The writers from the same department or the institution should be numbered by different numbers and indicated in the line below in 8 pt, as the following:

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2 Department of Soil & Water Science, College of Agriculture, University of Duhok, Kurdistan Region, Iraq

## Abstract

Abstract body should be 8 pt., bold, aligned left, and single spaced. The abstract must not exceed 300 words. (4-6) keywords must be provided at the end of abstract. The keywords title must be capitalized, 8 pt., aligned left, and Italic. The keywords should be written in 8 pt., Italic, and their initials should be capitalized. Paragraphs in the abstract should be spaced after 6. (See below)

***KEYWORDS***: *Erosivity factor, Rainfall, Fournier index, Water Quality*

Summary should be provided also in Kurdish and Arabic at the end of the paper.

## Figures and Tables

Except the tables, all the graphs, maps and photographs must be named as figures. Tables and Figures should be numbered consecutively by Arabic numerals. The tables and figures must not exceed the page margins and must be on one page. All Table outline border should be (1 ½ pt.), inside border should be (½ pt.); table details should be Arial font and written with 7 pt. the figure and table names must be written with 8 pt. style. Names must be written in the middle on top for the tables with space 4 after and for the diagrams/figures, underneath on the bottom with space 4 before and 12 after. If the figure and table names have to be more than one line, the line spacing should be single spaced, and the terms of "Figures" and "Tables" must be bold. (See below)

**Table (1):** The effect of pepper shoot & root aqueous extract on the growth of different other plants:

| | Shoot Extract | | | | | Root Extract | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Plant type | Conc. % | Root length (cm) | Shoot length (cm) | Intact plant length (cm) | Inhibition % | Conc. % | Root length (cm) | Shoot length (cm) | Intact plant length (cm) | Inhibition % |
| Okra | 0 | *25.7 a** | 27.8 a | 53.5a | - | 0 | 25.7a | 27.8a | 53.5a | - |
| | 5 | 25.00a | 26.77a | 51.77a | 3.23 | 1 | 24.50a | 27.00a | 51.50a | 3.73 |
| | 10 | 24.50a | 25.95a | 50.45a | 5.70 | 2 | 23.87a | 25.65a | 49.52a | 7.43 |
| Sorghum | 0 | 21.6a | 27.2a | 48.8a | - | 0 | 21.7a | 27.2a | 48.9a | - |
| | 5 | 13.00b | 17.25b | 30.25b | 38.03 | 1 | 9.8b | 25.5ab | 35.3b | 27.6 |
| | 10 | 6.00c | 5.50c | 11.50c | 76.44 | 2 | 9.4b | 22.6b | 31.9 b | 34.6 |


**Figure (1)**: xxxxxxxxxxxxx

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Bullets and numbers should be indented 1 cm from the left margin and hanging indent should be 0.5 cm. Each line of bullets and numbers should be single spaced.

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References should be indicated in the typescript by giving the author's name, with the year of publication in parentheses, as detailed in the APA style guide. All lines after the first line of each entry in your reference list should be indented one cm from the left margin (hanging indentation). If several papers by the same author(s) and from the same year are cited, a, b, c, etc. should be put after the year of publication. The references should be listed in full at the end of the paper in standard APA format. For example:

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For online documents:

- Standler, R. (2000). Plagiarism in colleges in the USA. Retrieved August 6, 2004, from www.rbs2.com/plag.htm
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# CONTENTS

# A COMPARATIVE STUDY ON SOME SEMEN CHARACTERISTICS AND TESTOSTERONE LEVEL OF BLACK GOAT AND MERIZ BUCKS*

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## ABSTRACT

**Over the period from 1st October 2009 to 1st March 2010, 29 and 57 ejaculates were obtained by electro ejaculator from five of each of black goat and Meriz bucks, 2-3 years of age, respectively raised at Animal farm, College of Agriculture, University of Suliamany. Scrotal circumference was measured at weekly interval and blood samples were withdrawn at biweekly interval for testosterone determination.**

**Results revealed that Black bucks yielded significantly higher volume (0.97 vs. 0.70 ml), concentration (113.50 vs. 81.72 x $10^7$/ml), total number of sperms per ejaculate (116.29 vs. 58.31 x $10^7$), mass motility (83.07 vs. 71.18 %) individual motility (89.47 vs. 80.17 %), live sperm (78.93 vs. 57.41 %) and lower abnormal sperms (7.00 vs. 22.31 %) than Meriz bucks.**

**Although a non significant effect of month of collection was noticed in all seminal traits except percent live sperm, however, semen quantity and testosterone level was at its highest during November.**

***KEYWORDS:*** Semen, Testosterone, Meriz, Black goat

## INTRODUCTION

The achievement of high levels of fertility and prolificacy in sheep and goat relies not only upon the female members but also upon their male consorts (Alkass et. al., 1982). Seasonal changes in semen characteristics of local bucks have been reported (Hussain, 1995; Al-Saadon, 2004; Hussien 2005; Al-Dohuky, 2006) as well as in other breeds of goat (Karagiannidis et. al., 2000; Webb et. al., 2004; Bitto et. al., 2008; Talebia et. al., 2009). Furthermore, there is likely to be considerable variation between breeds in their reproductive performance and characterization of these breeds in their own environment would provide pertinent information for improvement (Mekasha et. al., 2008).

Despite the importance of the above consideration, information on reproductive traits of male black goat and Meriz in particular is very scarce. Therefore, the aim of this study was to investigate the effect of breed together with monthly changes on some seminal traits and testosterone level of black goat and Meriz bucks.

## MATERIALS AND METHODS

Five Black goat (BG) and 5 Meriz bucks (M), aged 2-3 years, with initial body weight of 50-60 kg for BG and 30-40 kg for M were used at the farm of the college of Agriculture, University of Suliamany for this study. All bucks were clinically examined and in particular for their genital organs by a veterinarian before commencement of the experiment. Bucks were housed in individual pens, and each was offered 600 gm concentrate plus 700 gm of hay daily (12.4 MJ/Kg) and had free access to water.

Semen samples were collected at weekly interval from each buck over the period 1st October, 2009 to 1st March, 2010 by electro-ejaculator. Seminal volume was recorded directly from the graduated collecting tube. Color was assessed according to the method of Evan and Maxwell (1987). Hydrogen-ion concentration was estimated with pH indicating paper. Individual and mass motility was examined microscopically immediately after collection according to Avdi et al. (2004). Sperm concentration per ml was estimated by the use of a haemocytometer counting chamber. Semen smears were prepared according to Campell et al (1956) for the determination of percentages of live and abnormal sperms. Scrotal circumference was measured at weekly interval as described by Alkass (1979).

Blood samples (10 ml) were withdrawn from jugular vein at fortnightly interval, and testosterone concentration was determined by

* Part of M.Sc. Thesis submitted by the second author.

using radioimmunoassay (Kit, AIA Testosterone, Immunotech Sas-130 av.de. Taassigny-B.P. 177-13276 Marsille Cedex 9, France).

General Linear Model (GLM) within statistical program SAS (2005) was used to analysis the factors (breed and month of collection) affecting the studied traits. Other analysis was also done for the effect of month only for black goat bucks. Duncan Multiple Range Test (Duncan, 1955) was used to detect the significant differences between the levels of each factor affecting the studied traits. Correlation coefficients among semen traits were computed.

## RESULTS AND DISCUSSION

**Sexual behavior and response to ejaculate:**

The result of the current study indicate that four out of five BG and all M bucks showed sexual desire and to ejaculate by electro-ejaculator during October throughout December. However, during January and February, one BG (20%) and all M bucks (100%) fail to ejaculate. Such a decrease in sexual activity of both breeds and in particular M is similar to observation of Hussain (1995) who noticed a reduction in the number of Iraqi native bucks that show sexual desire and hence to ejaculate commencing from mid January up to the end of February. Similarly, Delgadillo et al. (1999) in Mexico showed a decrease in the sexual activity of Creole bucks from January to April. Such reduction in sexual activity according to Fabre (2000) was attributed to the rate of testosterone secretion.

**Semen characteristics:**

Results presented herein indicate that BG yielded significantly ($p < 0.05$) larger seminal volume (0.97 vs. 0.70 ml), and total number of sperm per ejaculate (116.29 vs. 58.31 $X10^7$) and a non significant increase in sperm concentration (113.50 vs. 81.72 $X10^7$ /ml ) than M bucks ( Table 1). Since BG are heavier in weight and their scrotal circumference is greater than M bucks (Table 3), such result is expected because of the positive relationship between scrotal circumference and ejaculate volume and sperm output (Coulter et al. 1997). This result is in accordance with those reported earlier by Webb et al. (2004), Hussien (2005) and Abi-Saab et.al. (2008).

It appears from Table (1) that the highest volume (0.91 ml) and sperm concentration (113.90 $X10^7$/ml) and total number of sperms per ejaculate (112.20 X $10^7$ ) for both breeds was recorded during November, however, the effect of month of collection was not significant. Similarly, no seasonal variation was observed in ejaculate volume (Greyling and Grobbelaar, 1983) and sperm concentration by Al-Dohuky (2006) while working on Iraqi native bucks.

Concerning the effect of month of collection on ejaculate volume and total number of spermatozoa per ejaculate of BG bucks only, the present results revealed a significant differences among months, yet the highest being in October ( 1.10 ml and 152.86 X $10^7$, respectively) and fall down toward January. Also, Hussian (1995) while working on Iraqi native bucks indicated that the ejaculate volume was significantly higher in autumn with lowest volume in winter and spring.

**Table (1):** The effect of breed and month of collection on some semen characteristics (Means ± S.E).

| breeds and month effect | | Overall means | Black buck | Meriz | October | November | December |
|---|---|---|---|---|---|---|---|
| Semen characteristics | No. | 67 | 38 | 29 | 27 | 22 | 18 |
| | Volume ml | 0.85±0.03 | 0.97± 0.05 a | 0.70±0.04 b | 0.87± 0.06 A | 0.91±0.06 a | 0.76±0.07 a |
| | Color | 3.22 ±0.15 | 3.44± 0.19 a | 2.93±0.24 a | 2.55± 0.27 A | 3.90±0.14 b | 3.38±0.24 b |
| | pH | 8.08 ±0.05 | 7.92± 0.07 a | 8.27±0.08 b | 8.07 ± 0.12 a | 8.18±0.09 a | 7.96±0.03 a |
| | Mass Motility % | 77.93 ±2.06 | 83.07± 2.02 a | 71.18±3.64 b | 75.42± 3.90 a | 79.31±3.54 a | 80.00±2.58 a |
| | Individual Motility % | 85.44± 1.74 | 89.47± 1.55 a | 80.17±3.27 b | 82.96± 3.32 a | 87.72±2.78 a | 86.38±2.48 a |
| | Concentration X $10^7$ / ml | 99.74± 9.68 | 113.50±13.5 a | 81.72±13.1 a | 88.96± 14.91 a | 113.90±17.8 a | 98.61±18.41 a |
| | Live sperm % | 69.62 ±3.29 | 78.93± 2.33 a | 57.41±6.33 b | 60.50± 6.63 a | 69.04±4.75 a | 84.00±1.39 b |
| | Abnormal % | 13.62± 1.74 | 7.00± 0.57 a | 22.31±3.35 b | 10.89± 2.10 a | 15.75±3.24 a | 15.13±4.09 a |
| | No. of sperm ejaculate X $10^7$ | 91.19 ±11.27 | 116.29±17.1 a | 58.31±10.6 b | 90.64±18.91 a | 112.20±22.5 a | 66.35 ±13.44 a |

Means with different letters within groupings differ significantly ($p<0.05$)

In the present work, M bucks posses significantly ($p < 0.05$) lower mass (71.8 vs. 83.07%) and individual motility (80.17 vs. 89.47%) compared to BG bucks. Such difference could be attributed to higher number of dead and abnormal sperms noticed in the former breed (Table 1). Also, the higher pH of semen collected from M bucks may contribute for such difference, and this result was confirmed by the negative correlation between the two traits (Table 4). The results presented in Tables 1 and 2 indicate that month of collection had no significant effect on both traits neither for both breeds together nor for BG bucks only. This result is in agreement with the finding of other investigators (Vinha, 1980; Dham, 2002 and Al-Saadon, 2004).

**Table (2):**. The effect of month on some semen characteristics in Black buck (Means ± S.E).

| Semen characteristics | Overall Means | Months | | | | |
|---|---|---|---|---|---|---|
| | | October | November | December | January | February |
| No. | 57 | 12 | 12 | 14 | 8 | 11 |
| Volume ml | 0.90±0.04 | 1.10± 0.08 a | 1.02±0.09 Ab | 0.82±0.08 bc | 0.66±0.05 C | 0.83±0.07 bc |
| Color | 3.47 ±0.14 | 2.75± 0.35 b | 4.16±0.20 A | 3.42±0.30 ab | 3.50±0.32 ab | 3.54±0.24 ab |
| pH | 7.91 ±1.24 | 7.73 ± 0.19 a | 8.11±0.11 A | 7.93±0.04 a | 7.81±0.08 a | 7.95±6.46 a |
| Mass Motility% | 83.01 ±1.55 | 81.00± 4.99 a | 88.33±1.12 a | 80.35±3.16 a | 83.75±3.23 a | 82.27±3.52 a |
| Individual Motility% | 89.73± 1.19 | 87.91± 3.04 a | 94.16±0.56 A | 86.78±3.08 a | 90.62±2.57 a | 90.00±2.69 a |
| Concentration X $10^7$ / ml | 119.15± 11.7 | 133.16± 22.70 a | 131.66±26.8 a | 81.07±19.8 a | 112.25±31. a | 143.72±32.1 a |
| Live sperm % | 70.06 ±2.70 | 76.66± 6.62 a | 74.25±2.40 A | 84.89±1.24 a | 45.62±7.39 b | 57.18±5.20 b |
| Abnormal % | 8.46± 0.66 | 6.66± 1.29 b | 6.54±1.05 B | 7.67±0.66 b | 9.93±1.09 ab | 12.45±2.39 a |
| No. of sperm ejaculate X $10^7$ | 111.78 ±13.0 | 152.86±31.90 a | 144.16±35.1 ab | 61.05 ±16.4 b | 75.40±22.3 ab | 122.68±27.6 ab |

**Means with different letters within groupings differ significantly (p<0.05).**

Semen collected from M bucks possessed significantly ($p < 0.05$) lower percent live sperm (57.41 vs. 78.93%) and higher incidence of abnormal sperms (22.31 vs. 7.00%) compared to those semen collected from BG bucks (Table 1). It is known that the morphological characteristics of spermatozoa are influenced by several factors including the genetic-make up, the physiological stage of the animal, nutrition, climatic factors and disease (Barth and Oko, 1989; Dowset and Knott, 1996 and Dana et al., 2000). Also, Greyling and Grobbelaar (1983) indicated that the percentage of live sperm yielded by the technique of the artificial vagina was significantly higher than those of semen collected by elrctro-ejaculator. However, no obvious reason (s) could be offered for such higher percentage of dead sperms in M bucks and further studies is needed to clarify this point.

Variation in the percentage of live sperm due to month of collection was significant ($p < 0.05$). The lowest value was recorded in October (60.50%), followed by a steady rise up to December (84.00%). Such result is in agreement with the finding obtained by other workers (Ahmad andNoakes, 1996; Webb et al., 2004). While monthly variation in the percent of abnormal sperm lacked significancy when both breeds were analyzed, which are in agreement with those reported by Skalet et al. (1988) and Abi-Saab et al. (2008) who reported that the percentage of abnormal sperm did not show significant seasonal variation. On the other hand, a significant variation in the percent abnormal sperm exist in semen of BG bucks only being a steady rise from October toward February (Table 2).Such result resemble those of earlier investigators (Vinha, 1980; Hussian, 1995; Talebia et al. 2009) who indicated an increase in the percent of abnormal sperm during most months of winter and continue to spring.

The color of semen was not differ significantly between the two breeds (3.44 vs. 2.93) (Table 1) which seems to agree with the finding of others (Dauda, 1984; Oyeyemi et al. 2000). However, a significant effect ($p < 0.05$) of month of collection on color was observed. Such result is expected because of the positive relation between semen color and sperm concentration ($r = 0.457$) (Table 3).Also, Kamal et al. (2005) noticed similar result.

pH value observed herein (8.08) is higher than those reported by other workers (Hussian, 1995; Hembram et.al., 2009). Method of collection may partly contribute for such difference between studies.

**Testosterone level (T)**

Concentration of T of BG bucks increased from 8.82 ng /ml in October to 11.15 ng/ml in November, followed by a steady decline toward February ( 1.16 ng /ml), while in M bucks a steady rise in T level from October (0.99 ng/ml) up to February (2.09 ng/ml). Since the release of T is episodic, therefore, the different pattern of changes in this hormone of the two breeds throughout a year with more frequent sampling is needed.

**Scrotal circumference (SC)**

Black goat bucks had significantly ($p < 0.05$) larger SC (25.70 cm) than did M bucks (18.89 cm) (Table 3). Since significant correlation between SC and body weight was observed (Kridli et al. 2005), and the BG bucks are considerably heavier in weight than M bucks, therefore, this result is expected. Also, SC was at its highest during October (24 cm), followed by a steady decline toward January (21.35 cm) and starts to increase during February (22.26 cm) (Table 3). Similarly, Al-Ghalban et al. (2004) and Ahmed et al. (2004) reported that month of the year significantly affected SC.

**Table (3):** The effect of breed and month of testosterone and scrotal circumference (Means ± S.E.).

| Breeds & Months Effect | No. of observation | Testosterone ng/ml | No. of observation | Scrotal circumference cm |
|---|---|---|---|---|
| Overall mean | 100 | 4.20±0.63 | 200 | 22.30± 0.28 |
| Black buck | 50 | 6.95± 1.13 a | 100 | 25.70± 0.19 a |
| Meriz | 50 | 1.46± 0.18 b | 100 | 18.89± 0.24 b |
| October | 20 | 4.91± 1.53 ab | 40 | 24.00± 0.54 a |
| November | 20 | 6.22± 2.02 a | 40 | 22.58±0.64 b |
| December | 20 | 5.13 ±1.58 ab | 40 | 21.51± 0.63 c |
| January | 20 | 2.89± 0.84 ab | 40 | 21.35± 0.64 c |
| *February* | 20 | 1.88± 0.36 b | 40 | 22.26± 0.58 bc |

**Means with different letters within groupings differ significantly (p<0.05)**

**Correlation coefficients:**

It is evident from Table (4) that all correlation coefficients among different seminal traits calculated for both breeds are expected. Such results are in agreement with those reported earlier in various breeds of goats (Patil, 1976; Chahal et al. 1979,; Greyling and Grobbelaar, 1983; Webb et al. 2004; Abi-Saab et al.2008).

It can be concluded that a breed differences exist in most seminal traits, as well as variation among months of the study. However, further studies throughout a year are needed to gain more knowledge about the sexual behavior of the two breeds.

**Table (4):** Correlation coefficients between various semen characteristics (No. = 67)

| Semen traits | Color | pH | Mass motility | Individual motility | Conc. X $10^7$ / ml | Live sperm % | Abnormal % | No. of sperm ejaculate |
|---|---|---|---|---|---|---|---|---|
| Volume ml | 0.339 ** | - 0.356 ** | 0.221 N. S | 0.228 N. S | 0.222 N. S | 0.062 N. S | - 0.263 * | 0.528 ** |
| Color | | - 0.207 N. S | 0.405 ** | 0.386 ** | 0.457 ** | 0.180 N. S | - 0.027 N. S | 0.411 ** |
| pH | | | - 0.332 ** | - 0.264 * | - 0.453 ** | - 0.389 ** | 0.172 N. S | - 0.492 ** |
| Mass Motility | | | | 0.959 ** | 0.420 ** | 0.250 * | - 0.261 * | 0.338 ** |
| Individual Motility | | | | | 0.375 ** | 0.193 N. S | - 0.215 N. S | 0.341 ** |
| Conc. X $10^7$/ml | | | | | | 0.308 ** | - 0.001 N. S | 0.899 ** |
| Live sperm % | | | | | | | 0.031 N. S | 0.243 * |
| *Abnormal %* | | | | | | | | - 0.147 N. S |

**N.S. Not significant * P ≤ 0.05 ** P ≤ 0.01**

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**ڤەکولینا بەراوردیا ساخلەتێن تاڤکی وئاستێ هورمونێ تیستیستیرونی یێ نێرییێن رەش ومەرەزی کورتی**

**کومکرنا 29 و 57 هەلاڤێتنا هاتە کرن بڕێکا ئامیرێ هاندانا کارەبێ ژ پێنج نێرییێن پەزێ رەش ومەرەزی ب ژیێ 2-3 سالان ل دیف ئێك دا ئەوێن هاتینە بخودانکرن ل کێلگەها گیانەوەری یێ کولیژا چاندنێ سەر ب زانکویا سلێمانیێ ڤە دماوێ 1 چریا ئێکێ 2009 تا 1 ئادارا 2010 .**

**هەروەسا چارچوڤێ تورەکا گونی هاتە پیڤان دهەر حەفتیەکێ دا و سامپل ژخوینێ هاتنە وەرگرتن هەر دوو حەفتیا جارەکێ داکو ئاستێ هورمونێ تیستیستیرونی بهێتە هەلسەنگاندن.**

**ئەنجاما دیارکرن کو نێرییێن پەزێ رەش سەرکەفتنەکا بەرچاڤ هەبوو دقەباریێ هەلاڤێتنێ دا ( 0.97 بەراورد ب 0.75) ، تیراتیا تووبا (113.5 بەراورد ب 81.72 ×10 7 ) ، هژمارا تووبا دهەر هەلاڤێتنەکێ دا ( 116.29 بەراورد ب 58.31 ×10 7 ) ، لڤینا بکوم ( 83.07 بەراورد ب 71.18 % ) ، لڤینا بتنێ ( 89.47 بەراورد ب 80.17 ) ، ریژا تووییێن ساخ ( 78.93 بەراورد ب 57.41 % ) وکێمترین ریژا تووییێن نە ئاسایی (7.00 بەراورد ب 22.31 % ) وسەرەرای نەبونا چ گوهرینێن بەرچاف دناڤ بەرا مەهێن جیاوازدا دساخلەتێن تاڤکی دا ژبلی ریژا تووییێن ساخ ، بەلێ جوراتیا تاڤکی وئاستێ هورمونێ تیستیستیرونی دبلندترین ئاستدا بوون دمەها چریا دووێ دا .**

**دراسة مقارنة لصفات السائل المنوي ومستوى هورمون التيستيرون لذكور الماعز والمرعز**

**الخلاصة**

**تم جمع 29 و57 قذفة بواسطة جهاز التحفيز الكهربائي من خمسة ذكور لكل من الماعز الاسود والمرعز بعمر 2-3 سنة على التوالي مرباة في الحقل الحيواني التابع لكلية الزراعة/جامعة السليمانية خلال المدة من 1 تشرين الاول 2009 لغاية 1 أذار 2010. كما تم قياس محيط الصفن اسبوعياً واخذت عينات من الدم مرة كل اسبوعين لتقدير مستوى هورمون التيستيرون.**

**أشارت النتائج بان ذكور الماعز الاسود قد تفوقت معنوياً في حجم القذفة (0,97 مقارنة ب 0,75 مل). تركيز النطف (113,50 مقارنة ب 81,72 ×10 7 ), عدد النطف بالقذفة الواحدة (116,29 مقارنة ب 58,31 ×10 7 ), الحركة الجماعية (83,07 مقارنة ب 71,18%), الحركة الفردية (89,47 مقلرنة ب 80,17%), نسبة النطف الحية (78,93 مقارنة ب 57,41%) و أوطأ نسبة النطف مشوهة (7,00 مقارنة ب 22,31%). وعلى الرغم من انعدام الفروقات المعنوية بين الاشهر المختلفة في صفات السائل المنوي باستثناء نسبة النطف الحية, الا ان نوعية السائل المنوي و مستوى هورمون التيستيرون كانت على افضل خلال شهر تشرين الثاني.**

# EFFECT OF THE ENTOMOPATHOGENIC FUNGUS, *Beauveria bassiana* (Bals.) Vuill. ON THE REPRODUCTIVE POTENTIAL OF POPLAR LEAF BEETLE *Melasoma populi* L.

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## ABSTRACT

**The effect of the Entomopathogenic fungus, *Beauveria bassiana* on reproductive potential of female survivors, egg viability and total egg production of poplar leaf beetle *Melasoma populi* L. was investigated. Prepupae, pupae and newly emerged adults were treated with spore suspension of *B. bassiana* ($1 \times 10^8$ conidia / ml). Another group of adults were reared on sprayed poplar leaves with similar inoculum of the pathogen . Egg production and hatching percentage were monitored daily over a 7- week period. Overall reproductive capacity (mean No. eggs/female survived from fungus inoculums) were significantly lower as compared with control. The total number of eggs per surviving female were 222.50, 163.50, 119.49 and 138.24 eggs for pre-pupa, pupa, adult and leaves treated, respectively as compared with 299.75 in control after fourth week . Pre-oviposition, ovipostion, post-oviposition and the longevity of females and males were shorter in treated individuals compared with control. The lowest percentage hatching was 76.04% in eggs deposited by treated adults as compared with 98.42% in control.**

***KEY WORDS**: Reproductive potential , Melasoma populi , Beauveria bassiana , Entomopathogenic fungi .*

## INTRODUCTION

The big problem faced poplar plantation in Iraq is the severe infestation by insects and diseases, especially on the young trees after three years and above (Saieed and Yahya 1994 ) .One limiting factor for poplar progressive is the severe defoliation by leaf beetle which is related to family Chrysomelidae . The most wide spread species and injuries to poplar and willow is *Melasoma populi* L. which has two or three generations yearly (F.A.O. 1980 ). In Iraq the poplar leaf beetle adults hibernated in the soil under the cover of dead leaves. The first and second instar larvae , live in colonies and mainly attack the apical leaves of plants in nurseries. The females feeding are more than the male and the total consumption area of poplar leaves by male and female through their life were 78.85 $cm^2$ and 325.61 $cm^2$ respectively (Hassan 2003).

There is growing interest in the exploitation of naturally occurring entomopathogenic microorganisms for the control of crop pests. Today many entomopathogens are used for the control of invertebrate pests in glreenhouses, row crops, orchards, ornamentals, stored products and forestry (Lacy *et.al* 2001). However the interactions that occur between the fungi and the insects are exceedingly complex and are dependent upon specific host-pathogen interaction (Hajek and Leger,1994 ; Rafeek and Bahaa 2005) . El-Sinary and Rizk (2007) mentioned that the sex ratio of greater wax moth *Galleria melonella* was clearly effected when treated with *Beauveria bassiana*. Fargues *et.al*. (1991) demonstrated a reduction in the total number of eggs laid by Colorado potato beetle *Leptinotarsa decemlineata* (Say), surviving from *Beauveria bassiana* treatment at 22ºC but not at 25ºC. Mulock and Chandler (2001) stated that from the field and laboratory studies, *Beauveria bassiana* generally required 5-10 days between the initiation of an infection and death of the host in adult corn root worm, therefore the timing of treatment critical to effectively reduce oviposition .

The ultimate aim of adult poplar leaf beetle management is to reduce oviposition therefore it is important to study the effect of the most common entomopathogenic fungus *Beauveria bassiana* on the reproductive potential of the *Melasoma populi* adult and some other biological aspects such as pre-oviposition period, oviposition period and post-oviposition period.

## MATERIALS & METHODS

### 2-1: Preparation of Fungal inoculum

A local strain of *B. bassiana* (isolated from infected sunn insects *Eurygaster integriceps* Put. in Duhok region) was obtained from Mycology

bank/ Plant Protection Department/ School of Plant Production/ Faculty of Agriculture and Forestry/ Duhok University, under the No. BEG-11 (Assaf , 2007). Fungus was grown on Potato Dextrose Agar (PDA) for 6-7 days at 25 ± 1°C . The concentration of fungal suspension was diluted to ($10^8$) spore / ml. Spore concentration was determined by hemocytometer .

**2-2: Preparation of poplar leaf beetle *M. populi***

The adults of *M. populi* were collected from poplar leaves and then transferred to laboratory , kept in wooden cages measured (35×35×35 cm) with one face made of glass while other sides were covered by sieves The cage was also supplied with young poplar branches fixed inside a jar filled with water (Hassan 2003) .

**2-3: Bioassays :**

After mating and laying eggs, the newly hatched larvae that obtained from adults rearing cages were divided into four groups. The first group, the larvae reared until pre pupation, then treated with the *B. bassiana* suspension. The second group, the larvae reared until pupation, then treated with the *B. bassiana* suspension. The third and fourth groups were reared until adult stage emergence then, the part of them was treated with *B. bassiana* suspension directly whereas, the another part was reared on a spraying poplar leaves by a same inoculum for subsequent spore pickup by the insect. Each group was sprayed with 4 ml fungal suspension/ replicate. Control treatment was sprayed with distilled water using parfan sprayer (50 ml capacity).

After mating among the survivor adults in each treatment, 1:1 male-female pairs were placed in individual plastic, screened, cages (20 cm high and 8 cm in diameter) supplied with young branches fixed inside a jar and filled with water. Cages were held at 24.55 °C , 59.89 % R.H. and monitored daily in order to record pre-ovipostion period, oviposition period, number of eggs laid per female and post-oviposition period. In addition determining the egg hatching percentage, the male and female longevity and pupation period in case of prepupae and pupae treatment .

**2.4: Statistical analysis :** Data were tatistically analyzed using Complete Randomized Design (CRD) with four replications and SAS program. The means were compared using Duncan's multiple range test at $P \leq 0.05$ .

## RESULTS AND DISCUCSSION

The Mortality of different stages was recorded 12 days after spraying with spore suspension. The data represented in Table (1) proved that *B. bassiana* was virulent on the different stages of *M. populi* causing different mortality on pupae (74.36%), adults (65.22) and adult reared on sprayed poplar leaves (70.23%).

**Table (1)**: Effect of spore suspension of *Beauveria bassiana* on some biological characters at different stages of *M. populi*

| Stage treated | Corrected Mortality % | Periods of Survived adults (day) | | | | |
|---|---|---|---|---|---|---|
| | | Pre-Oviposition | Oviposition | Post-Oviposition | Female age | Male age |
| Prepupae | 31.98 b | 18.98 ± 2.39 a | 23.00 ± 0.27 ab | 6.75 ± 0.32 b | 48.05 ± 1.93 ab | 19.75 ± 0.85 b |
| Pupae | 74.36 a | 15.5 ± 1.55 ab | 22.75 ± 2.29 ab | 3.00 ± 0.19 b | 41.25 ± 1.93 b | 21.75 ± 1.54 b |
| Adults | 65.22 a | 11.00 ± 0.02 b | 13.12 ± 2.00 c | 17.00 ± 2.18 a | 41.12 ± 2.50 b | 21.50 ± 2.50 b |
| Adults (reared on sprayed Poplar leaves) | 70.23 a | 10.50 ± 0.50 b | 25.50 ± 3.50 a | 7.00 ± 0.20 b | 43.00 ± 3.35 b | 12.75 ± 1.70 c |
| ***Control*** | 4.57 c | 20.19 ± 1.20 a | 31.30 ± 3.23 a | 16.06 ± 0.34 a | 67.55 ± 3.62 a | 38.94 ± 3.14 a |

Means followed by a common letter within the same column are not significantly different at the 0.05 level by DMRT

The obtained results were in harmony with the work of Watt and LeBrun (1984) who stated that the *B. bassiana* reduced the adult emergency of Colorado potato beetle. The percentage of potato tuber moth emergence showed a highly progressive decrease with the increase of concentration of *B. bassiana* (Hafez *et.al.*, 1994) . *B. bassiana* proved to be successfully infected larvae, pupae and adults of many insects (Tanada and Kaya, 1993 ; McCoy *et.al*. 1988) .

Adults infected by the fungus didn't show change in their color, whereas dead adults in the control treatment darkened. These results agreed with Gindin et.al. (2006 ) who demonestrated that the Red palm weevil adults did not change their color when killed by *B. bassiana* spores . After incubation of cadavers under moist conditions, fungi emerged and formed conidia with conidiophores on the dorsal and ventral surfaces of the adult insects (Figure.1).

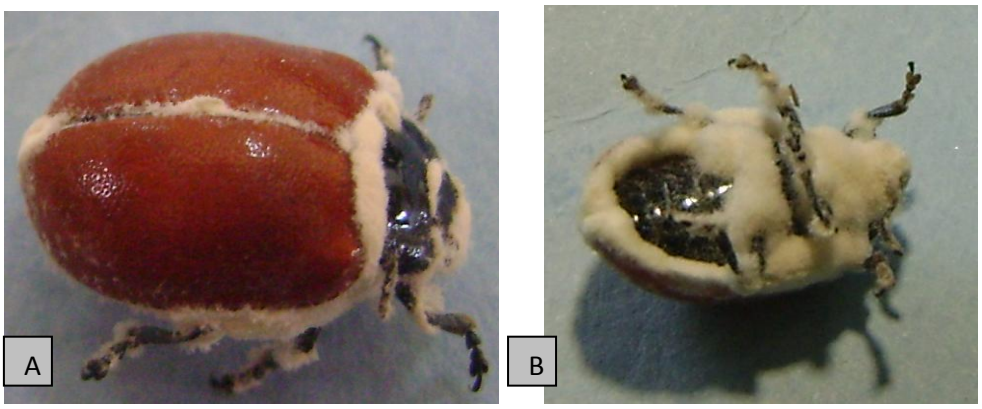


**Figure. (1):** Adult of *M. populi* infected with *B. bassiana* A- Dorsal view B- Ventral view

Results in table 1 showed that the pre-oviposition, oviposition and post-oviposition period was significantly affected by *B.bassiana* suspension in all four stages treated when compared with the control. The length of pre oviposition period in adults treated with spore suspension of the fungus was significantly decreased as compared with control , whereas there is no significant differences in treated prepupae (Table 1). The mean pre oviposition period of M. populi under laboratory conditions was 24.8 ± 1.16 days (Hassan 2003).

The lowest oviposition period recorded in the treated adults reached 13.12 ± 2.00 day that significantly differed from the same period in control which reached 31.30 ± 3.23 days. This result agreed with Gindin et.al. (2006) who stated that the red palm weevil females contaminated with the dry spore formulation had a shorter oviposition time than the control ( 7-11 days compared with 30-45 days) and with Kim (2007) who stated that the reproductive period of cotton aphid *Aphis gossypii* treated with *B.bassiana* was shorter than in control.

Post oviposition period was shorter also in different treated stages, since the lowest period recorded in pupae stage treated was 3.00 ± 0.19 days as compared with 16.06 ± 0.34 days in control. This result agreed with that of Assaf (2007) who recorded a slightly effect on post oviposition period of sunn pest *Eurygaster integriceps* Put. when treated with different concentrations of *B.bassiana* where this period decreased from 6.33 in control to 2.67 days in treated females.

The longevity of the emerged adults was significantly shorter after exposure to *B.bassiana* in the all four stages treated methods as compared with control (Table1). The lowest female age recorded in pupae treated reached to 41.12 ± 2.50 day that didn't differ from the other stages treated except the control (67.55 ± 3.62). Hassan (2003) stated that the *M. populi* female longevity ranged between 47-70 days with an average of 59.20 days under laboratory conditions.

Statistical analysis results showed that the male longevity was clearly affected by *B.bassiana* regardless to the stages treated. Therefore male age was reduced to 12.75± 1.70 days in adults reared on sprayed leaves from 38.49±3.14 days in control . These results are in agreement with those of Kim (2007) and Zaki (1998) who reported that longevity of cotton aphid *Aphis gosspyii* and Cowpea aphids *Aphis crassivara* were decreased by increasing the dose of *Lacnicillium attenuabum* and *Beauveria bassiana* spore, respectively, and they demonstrated that the high infection rates by entompathogenic fungi could reduce the life span of the pests which could lessen crop damage. Assaf (2007) stated that the *B.bassiana* had a significant effect on the sunn pest *Eurygaster integriceps* Put. adults longevity especially at high concentrations.

The duration of the pupation was slightly prolonged to 5.36 ± 0.25 and 6.40 ± 0.11 days in prepupae and pupae treated with *B.bassiana* from 4.57 days in control. Hafez *et.al* (1994) stated that the duration of the *Phthorimaea*

*operculella* treated prepupae and pupae was significantly prolonged to 8.9 ± 0.47 and 15 ± 0.01, respectively as compared with 6.25 ± 0.25 days in control.

In order to evaluate the possibility of fungal infection transmission from the infected females to eggs within the oviposition tunnels, the survivors adults treated with fungus suspension were allowed to oviposit. The total number of egg deposited by female survivors at the end of the study was lowest in all four stages sprayed with *B. bassiana* suspension as compared with control (Table 2). The mean number of eggs per surviving female at the end of study was 222.50, 163.50, 119.49 and 138.24 eggs for pre-pupa, pupa, adult and leaves treated , respectively as compared with 583.50 egg in the control.

**Table (2)** : Fecundity of survivors female *M. populi* treated with *B. bassiana* in different stages

| Stage treated | Mean Cumulative No. eggs / surviving female | | | | | | |
|---|---|---|---|---|---|---|---|
| | Oviposition week | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| **Prepupae** | 30.25 bc | 92.5 b | 184.05 b | 222.5 b | __ | __ | __ |
| **Pupae** | 47.00 b | 65.30 c | 126.20 b | 163.50 c | __ | __ | __ |
| **Adults** | 35.77 b | 73.99 b | 119.49 b | __ | __ | __ | __ |
| **Adults (reared on sprayed Poplar leaves)** | 24.75 c | 82.25 b | 90.33 c | 138.24 c | __ | __ | __ |
| ***Control*** | 123.5 a | 203.25 a | 287.75 a | 299.75 a | 451.33 a | 511.40 a | 583.50 a |

Means followed by a common letter within the same column are not significantly different at the 0.0 5 level by DMRT

These results agreed with those of Malavannan *et.al.*(2010) who stated that *B. bassiana* had the ability to arrest the fecundity of tobacco caterpillar *Spodoptera litura* completely. Reduced fecundity in Colorado potato beetle surviving treated with *B.bassians* was shown to be temperature dependent by Fargues *et.al.* (1991). Noma and Stickler (2000) reported a reduction in the oviposition rate of lygus bugs treated with *B.bassiana* but only in insects that did not produce spores at the end of the experiment. Assaf (2007) stated that the mean number of eggs deposited by female sunn insect *Eurygaster integriceps* Put. treated with *B.bassiana* suspension was significantly affected at high concentration and this is in line with our result which showed that inoculum at $10^8$ spore concentration inhibited egg production completely.

There was no significant difference in percentage hatch in eggs collected from any of the four stages of *M.populi* that treated with *B.bassiana* as compared with control (Figure.2). However it's clear that the egg hatching percentage was lowest in all four treated stages than in control. The highest hatching percentage was (98.42%) recorded in control and reduced to 70.92 % in pre-pupa. This result agreed with that of Fargues *et.al.* (1991) who found that *B.bassiana* treatment had no significant effect on egg viability in surviving female of Colorado potato beetles. Assaf (2007) mentioned that the *B. bassiana* concentrations had no effect on egg hatching percentage of sunn pest deposited by females mated with treated males.

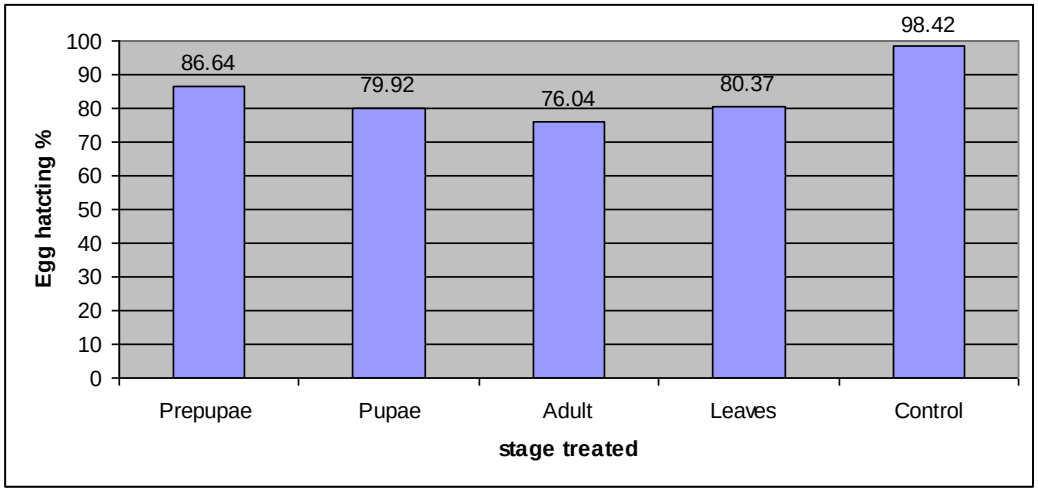


**Figure. (2)**: Percentage hatch of eggs collected over time from *M. populi* survivor females treated with *B. bassiana* in different stages .

However, N'Doye (1976) observed a reduction in fertility of eggs laid by surviving *Chilo suppressalis* walker when infected with *B.bassiana* as larvae, whereas Nnakumusana (1985) noted a reduction in egg viability of mosquitoes infected with the entomopathogenic fungus, *Aspergillus parasiticus* speare.

The present study showed that, in addition to direct effect on adults mortality, fungal treatment reduced female fertility. Therefore, as a tool for the management of adult *M.populi* and subsequent damage, the current results suggest that, the treatment of prepupae, pupae, adults and poplar leaves with *B.bassiana* conidial suspension can significantly reduce the number of eggs deposited depending on the resulting beetle mortality regardless to the application methods. However, in the present study we were unable to prove that such infection transfer occurred.

Ideally, we would like to use artificially inoculated females as vectors of infection to their progeny *via* egg contamination during oviposition. This character may interfere with fungus transfer from female hydrophobic surface to the egg under humid conditions during oviposition into the plant tissue.

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# کارتێکرنا کەرووێ نەخوشکەرێ مێش ومووران *Beauveria bassiana* (Bals.) Vuill. لسەر لێهاتوویا زاوزێ بونا کێزا بەلگێن سپێنداران *Melasoma populi* L.


**پوختە**

**ڤەکولین لسەر کارتێکرنا کەرووێ نەخوش کەرێ مێش ومووران *Beauveria bassiana* هاتە ئەنجام دان، ئەوژی لسەر ریژا داوی پێگەهشتنا هێکان وکویێ گشتیێ هێکێن هاتینە داناین ژلایێ کێزێن بەلگێن سپێنداران *Melasoma populi* ئەوێن زیندی ماین پشتی ب هەڵواسراوێ سپوریێ کەروی هاتینە رەشاندن، ئەڤە هەمی پشتی کرموکێن بەری ببنە پیوپا، پیوپا وکێزێن تازە دەرچوین رەشاندین ب هەڵوسراوێ کەرووێ *Beauveria bassiana* ($1 \times 10^8$ سپور/مل)، هەروەسان کومەکا دی یا کێزان هاتنە بخودانکرن لسەر بەلگێن سپێنداریێن رەشاندین هەر ب وێ چەندیا هەڵوسراوێ کەرووی، روژانە چاڤدێریا دانانا هێکان وریژا تروکاندنێ هاتە کرن وبو ماوێ 7 حەفتیان.**

**بشێوەکێ گشتی لێهاتووێ زاوزێ بونێ (ژمارا هێکان/ کێزا زیندی مای پشتی رەشاندنێ) کێمتر بو بەرامبەر کێزێن سالوخەتا کونترولی، ئەوژی ژمارا گشتی یا هێکان/کێزەکا مێ 222.50، 163.50، 119.49 و138.24 هێك بون دسالوخەتا کرموکێن بەری ببنە پیوپا، پیوپا، کێزان وبەلگێن رەشاندی، ولدیف ئێك، بەرامبەر کونترولی 299.75 هێك، ئەوژی پشتی 4 حەفتیان ژ دەست پێکا هێك دانانێ.**

**ماوێ بەری هێك دانانێ، ماوێ هێك دانانێ، ماوێ پشتی هێك دانانێ وژیێ نێرومێیان بێن کێزێن رەشاندی کێمتر بو ژ یێ کێزێن سالوخەتا کونترولی، هێکێن هاتینە رەشاندن کێمترین ریژا تروکاندنا هێکان لێ خویا بو (76.04%) بەرامبەر هێکێن کێزێن کونترولی (98.42%).**


## تأثير الفطر الممرض *Beauveria bassiana* (Bals.) Vuill. على الكفاءة التناسلية لخنفساء اوراق القوغ *Melasoma populi* L.


**الخلاصة**

**تم دراسة تأثير الفطر الممرض للحشرات *Beauveria bassiana* على الكفاءة التناسلية ، نسبة نجاح البيض و العدد الكلي للبيض الموضوع من قبل البالغات الباقية على قيد الحياة لحشرة خنفساء اوراق القوغ *Melasoma populi* . حيث تم رش يرقات قبل التعذير ، العذارى و الحشرات الحديثة الخروج بمعلق الفطر *Beauveria bassiana* ($1 \times 10^8$ بوغ/ مل ) و ايضا تم تربية مجموعة اخرى من الحشرات الكاملة على اوراق القوغ المعاملة بنفس تركيز المعلق السبوري و تم مراقبة وضع البيض و نسبة فقس البيض يوميا لفترة 7 اسابيع .عموما كانت الكفاءة التناسلية ( عدد البيض / بالغة باقية على قيد الحياة بعد الرش ) اقل معنويا مقارنة بمعاملة السيطرة حيث كان العدد الكلي للبيض/ انثى 222.50 , 163.50 , 119.49و138.24في معاملة يرقات قبل التعذير ، العذارى ، البالغات و الاوراق المعاملة على التوالي مقارنة ب 299.75 في معاملة السيطرة بعد اربعة اسابيع من وضع البيض . كانت فترة ما قبل وضع البيض ، فترة وضع البيض، فترة ما بعد وضع البيض و عمر الاناث و الذكور في الافراد المعاملة اقصر مقارنة بمعاملة السيطرة . اقل نسبة فقس البيض كانت 76.04 % للبيض الموضوع من قبل البالغات المعاملة مقارنة ب 98.42 % في معاملة السيطرة.**

# EFFECT OF DIET SUPPLEMENTED WITH ASCORBIC ACID ON: 2-SOME PHYSIOLOGICAL, HAEMATOLOGICAL AND BIOCHEMICAL CONSTITUENTS OF BLOOD OF MERIZ GOAT.*

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## ABSTRACT

**This work was undertaken at the Animal Farm, Department of Animal Production, College of Agriculture, University of Duhok during the period from 14th June to 14th September 2009, where a total of twenty weaned (3-4 month old) male Meriz kids with an average live body weight of 13.48 ± 0.62 kg were divided randomly into 4 equal treatment groups and received 0, 750, 1000 and 1250 mg/kg diet of vitamin C for duration of 90 days. Rectal temperature and respiration rate was recorded at weekly intervals. Also, blood samples from the jugular vein was collected at the start, mid and at the end of the experimental period for determination of some haematological parameters (haemoglobin, packed cell volume and N/L ratio), some biochemical attributes (serum protein, globulin, albumin, urea, Creatinine) and the concentration of T3 and T4.**

**Results revealed that Kids received a supplementation of vitamin C possessed nonsignificant lower body temperature than control group. Also, a significant (P<0.01) decline occurred in rectal temperature as the period of the experiment advances. Haemoglobin, packed cell volume and N/L ratio averaged 9.87 ± 0.32 g/dl, 22.20 ± 0.53 % and 0.57 ± 0.05, respectively. With the exception of N/L ratio, treatment had no significant effect on the studied traits. The mean serum total protein, albumin, globulin, urea and creatinine was 5.77 ± 0.08 g/dl, 2.69 ± 0.06 g/dl, 3.08 ± 0.06 g/dl, 36.64 ±1.63 mg/dl and 1.05 ± 0.03 mg/dl, respectively.**

**No significant effect due to supplementation of vitamin C was observed on these traits. Also, result indicates that supplementation of vitamin C to kids had a significant effect on T3 only.**

***KEY WORDS:*** Ascorbic acid, rectal temp., haematological, biochemical, Meriz.

## INTRODUCTION

In farm animals exposure to different environmental stresses elicit various physiological and psychological changes including the decrease in activity, feed intake and rumination, while the water intake, evaporative loss through sweating, respiration rate and rectal temperature increase, in respective order (Marai and Habeeb, 1994) . Some of these are emergency reactions which are related to the activation of the adreno-medullary axis and resulted in release of catecholamine which mobilizes for short response to metabolic adjustments (Dentzer and Mormede, 1983). The other is the general adaptive syndrome described by Selye (1936) involves the activation of the pituitary-adrenal cortex resulted in release of corticosteroids which in turn extend the metabolic effects of catecholamine and adrenocortiopic hormone (ACTH). Furthermore, it has been reported that exposure to heat stress is accompanied by a decline in concentrations of glucose, total protein, albumin, globulin, total lipids, cholesterol, urea nitrogen, creatinine, red blood cells, hemoglobin and haematocrit (Abd el-Samee, 1991; 1992; Abd el-Samee, *et al*., 1992 ; Marai, *et al*., 1991; 1992 a, b), blood hormones especially anabolic hormones such as growth hormone, insulin, insulin-like growth factor (IGF 2), somatotropin, triiodothronine, thyroxin and aldosterone (Dede, *et al*., 1989; Ashour, *et al*., 1995).

It is well documented that the biological functions of ascorbic acid are based on its ability to provide reducing equivalents for a variety of biochemical reactions for this reason the vitamin can reduce most physiologically relevant reactive oxygen species (Buettner, 1993).As such, the vitamin functions primarily as a cofactor for reactions requiring a reduced iron or copper metalloenzyem and as a protective antioxidant that operates in the aqueous phase both intra-and extracellularly (Englard and Seifter, 1986; Halliwell and Whiteman, 1997; Tsao, 1997).

* Part of M.Sc. thesis submitted by the third author

This work aimed to study the effect of supplementation ascorbic acid on physiological, hematological and biochemical constituents of blood of Meriz goat.

## MATERIALS AND METHODS

The current study was conducted at the Animal production Farm, Department of Animal Production College of Agriculture, University of Duhok, during the period from 14th June to 14th September 2009, where a total of twenty weaned (3-4 month old) male Meriz kids with an average live body weight of 13.48 ± 0.62 kg were used in this study. At the start of the experiment, the kids were weighted and divided randomly into 4 equal treatment groups (5 kids each) and received (0, 750, 1000 and 1250 mg/kg feed ) of vitamin C* for duration of 90 days. Full details of feeding and management were given in our previous paper part 1 (Alkass et al., 2010).

Rectal temperature was carried out with the aid of a digital clinical thermometer and respiration rate was determined by counting flank movements and recorded as frequency per minute. Both were recorded at 12 a.m at weekly interval.

Blood samples (10 ml) were collected from the jugular vein at 9:00 am. in the morning before feeding at the start, mid and at the end of experiment. Sub sample (2.5ml) of collected blood was emptied into a test tube containing ethylenediamine tetra-acetic acid (EDTA) as an anticoagulant, for analyzing some haematological parameters, while the another sub sample (7.5ml) was emptied into glass sterile test tube without anticoagulant, and left for 2 hrs in the room temperature and then centrifuged (3000 RPM) for 15 minutes and the serum was separated by micropipette and emptied into tubes and stored at -20C° until analysis for total protein, albumin, globulin, creatine, urea, Triiodothyronine (T3) and Thyroxin (T4), was done

Hemoglobin concentration was determined according to cyanmetha- emoglobin method (Vankampen and Zijlstra, 1965), the packed cell volume (PVC) was determined by the microhaematocrit method (Archer, 1965) using a heparinized microhematocrit capillary tube for collecting blood from the samples. Blood smears were prepared on microscope slide and dried at room temperature and stained with wrights Giemsa stain. Differential leukocyte counts were carried out as described by Schalm *et al* (1975).

Blood urea was determined using urea kits from Labkit Company (Spiny). (Young, 2001), and creatinine (mg/dl) was determined by Jaffe Kinetis method using analyzing material (Kit) produced by Biocide Hycel, France. Total protein and albumin was determined by Biuret and BCG methods, respectively using analyzing Kit provided by Biocode Hycel company, France. Globulin was calculated as the difference between total protein and albumin. Blood T3 and T4 was determined using T3 and T4 kits from BioMerieux ® Sa Company (France), by automated method using Biochemical auto analyzer mini vidas machine.

The data obtained was analyzed using the GLM (General Linear Model) within SAS (2005) program as in the following models:

**$Yijk = \mu + Ti + Pj + Tp(ij) + eijk$**

Where:

Yijk = Observational value of the $k^{th}$ animal.

$\mu$ = Overall mean.

Ti = Effect of $i^{th}$ treatment (T = 1, 2, 3, 4).

Pj = Effect of $j^{th}$ period (P = 1, 2, 3).

TP (ij) = Effect of interaction between $i^{th}$ treatment and $j^{th}$ period.

eijk = Experimental error assumed to be NID with $(O, \sigma^2 e)$.

For rectal temperature and respiration rate, the above model was used but the period was 7 instead of 3.

## RESULTS AND DISCUSSION

### The Rectal Temperature and The Respiration Rate.

The maximum and minimum ambient temperature ranged between 34 to 44.5°C and 14 to 29°C, respectively and relative humidity between 13% and 37%. Although analysis of variance revealed that treatment had no significant effect on rectal temperature, yet it appears from Table (1) that Meriz kids received a supplementation of vitamin C possessed lower rectal temperature (39.40, 39.41, and 39.38°C) compared to control group (39.50 °C). Also, it appears from Table (1) that rectal temperature was significantly ($P<0.01$) declined from the highest value (39.76°C) at the start of the experiment to 39.30°C at the end of the experiment. From the treatment x period interaction, it seem that the minimum (39.06°C) and maximum (39.92°C) rectal temperature was recorded for kids received a 750 mg/kg ration of vitamin C during the second and first periods of

*Arab Veterinary Industrial Co. (AVICO) Amman, Jordan.

the experiment, respectively. Increasing ascorbic acid in the diet prevents the negative influences of corticosteroid hormones by reducing their synthesis and this improves the performance of heat stress animals (Kutlu, 2001), and it was reported that regulation of body temperature by ascorbic acid certainly helps to maintain homeostasis in homoeothermic animals (Kutlu, 2001). Similarly Abd El-Monem *et al*. (2008) reported that rectal temperature of lambs was not affected significantly by using ascorbic acid at levels 500, 750 and 1000 mg/kg diet. Average values for respiration rate of different treatment groups as well as during the various period of the experiment are presented in Table (1). Furthermore, statistical analysis revealed that treatment had no significant effect on respiration rate, whereas the period affected significantly ($P<0.01$) this trait. It appears that weekly variation in respiratory rate in all treatment groups was closely related to that in ambient temperature. The increased in respiration rate is an attempt to increase respiratory evaporation (Al-Haidary, 2004). Similarly, Abd El-Monem *et al* (2008) reported that respiration rate of lambs was not affected by supplementation of vitamin C.

**Table (1):** Effect of supplementation of vitamin C and period on respiration and rectal temperature of Meriz goat (Mean ± s.e).

| Effect | No. observation | Respiration (breath/min) | Rectal Temperature (°C) |
|---|---|---|---|
| overall mean | | 54.58 ± 3.32 | 39.42 ± 0.07 |
| Treatment | | | |
| 1 | 35 | 51.11 ± 2.22 a | 39.50 ± 0.05 a |
| 2 | 35 | 56.57 ± 2.38 a | 39.40 ± 0.06 a |
| 3 | 35 | 56.20 ± 3.13 a | 39.41 ± 0.06 a |
| 4 | 35 | 54.45 ± 2.51 a | 39.38 ± 0.05 a |
| Period | | | |
| 1 | 20 | 55.40 ± 2.09 bcd | 39.76 ± 0.11 a |
| 2 | 20 | 46.35 ± 2.61 d | 39.44 ± 0.06 bc |
| 3 | 20 | 48.20 ± 2.58 cd | 39.49 ± 0.04 b |
| 4 | 20 | 49.10 ± 2.86 cd | 39.41 ± 0.08 bc |
| 5 | 20 | 60.25 ± 4.24 ab | 39.34 ± 0.06 bc |
| 6 | 20 | 57.00 ± 3.42 abc | 39.23 ± 0.05 c |
| 7 | 20 | 65.80 ± 3.71 a | 39.30 ± 0.04 bc |

Means with different letters within each column differ significantly, other wise they do not differ significantly.

**Haematological parameters**

In the current investigation, the haemoglobin concentration (Hb), packed cell volume (PCV) averaged 9.87 ± 0.32 g/dl and 22.20 ± 0.53 % respectively (Table 2). These averages are within the normal range (8-12 g/dl) for haemoglobin concentration and (22-38 %) for PCV (Kahn, 2005) recorded for goats (Sirois, 1995). Results also revealed that supplementation of vitamin C to the diets of kids at different rates had no significant effect on studied traits. Similarly, Yen and pond (1981) reported a decrease for haemoglobin concentration in vitamin C supplemented weaning pigs. On the contrary, vitamin C increased PCV and hemoglobin concentration in rabbit (Yousef, 2004).Ghanem *et al* (2008) stated that vitamin C supplementation alleviated the effect of dehydration on PCV but not haemoglobin. This suggests further experimentation to elucidate the effect of vitamin C on these traits. No significant effect was noticed among the period of sample collection throughout the experiment in PCV (Table 2). However, a significant rise in Hb concentration was recorded with the advances of sample collection. This elevated level of haemoglobin throughout the experiment could be attributed to the decrease in plasma volume due to water shortage in the body (Purohit *et al*, 1972; Laden *et al*, 1987).

The overall mean of N/L ratio (0.57 ± 0.05) observed in the current investigation is close to the value (0.65) recorded in goats under stress (Minka and Ayo, 2007). Also, kids supplemented with 750, 1000 and 1250 mg of vitamin C /kg feed showed significant increase in N/L ratio compared to control group (Table 2). Thus, an increase in neutrophil : lymphocyte ratio and a decrease in lymphocyte count obtained in the current work are consistent with the finding that neutrophilia which occurs during stress state stimulates the anterior pituitary gland to secrete ACTH. The circulating ACTH in turn induces the adrenal cortex to produce glucocorticoids, involved in the mobilization of neutrophils from body pool into the peripheral circulation (Adenkola *et al*., 2009).

**Table (2):** Effect of supplementation of vitamin C, period and their interaction on some hematological parameters of Meriz goat (Mean ± s.e).

| Effect | No. observation | PCV (%) | Hb (g/dl) | N/L (%) |
|---|---|---|---|---|
| overall mean | | 22.20 ± 0.53 | 9.87 ± 0.32 | 0.57 ± 0.05 |
| Treatment | | | | |
| 1 | 15 | 22.60 ± 0.41 a | 10.45 ± 0.43 a | 0.35 ± 0.04 c |
| 2 | 15 | 21.46 ± 0.72 a | 9.23 ± 0.49 b | 0.47 ± 0.06 bc |
| 3 | 15 | 22.13 ± 0.63 a | 9.91 ± 0.46 ab | 0.83 ± 0.10 a |
| 4 | 15 | 22.60 ± 0.67 a | 9.90 ± 0.45 ab | 0.62 ± 0.08 b |
| Period | | | | |
| 1 | 20 | 22.45 ± 0.55 a | 8.67 ± 0.25 c | 0.46 ± 0.06 b |
| 2 | 20 | 21.55 ± 0.38 a | 9.60 ± 0.27 b | 0.69 ± 0.09 a |
| 3 | 20 | 22.60 ± 0.62 a | 11.36 ± 0.41 a | 0.57 ± 0.06 ab |

Means with different letters within each column differ significantly, other wise they do not differ significantly.

**Biochemical constituents of blood**

Mean total protein, albumin and globulin concentrations averaged 5.77 ± 0.08, 2.69 ± 0.06 and 3.08 ± 0.06 g/dl, respectively (Table 3). The value obtained in the current work for protein concentration is similar to those reported earlier by Hobi (2004). In the present work, dietary ascorbic acid supplementation did not affect significantly serum total protein, albumin and globulin. Also, Abd El-Monem *et al* (2008) showed that administration of ascorbic acid to lambs elicited non significant increase in the albumin, globulin and total protein levels. Also, it appears from Table (3) that both total protein and albumin for all treatment groups tended to decrease at the mid of the experiment, followed by a rise at the final sample collection. The reason behind this increase in serum total protein during the third collection period may be due to water loss and the hyperconcentration of blood and reduced blood volume, (Karnib, 2009).

**Table (3):** Effect of supplementation of vitamin C, period and their interaction on some biochemical attributes in blood of Meriz goat (Mean ± s.e).

| Effect | No. observation | Total protein g/dl | Albumin g/dl | Globulin g/dl | Urea mg/dl | Creatinine mg/dl |
|---|---|---|---|---|---|---|
| overall mean | | 5.77 ± 0.08 | 2.69 ± 0.06 | 3.08 ± 0.06 | 36.64 ± 1.63 | 1.05 ± 0.03 |
| Treatment | | | | | | |
| 1 | 15 | 5.90 ± 0.07 a | 2.77 ± 0.05 a | 3.12 ± 0.05 a | 39.78 ± 2.75 a | 1.06 ± 0.03 ab |
| 2 | 15 | 5.84 ± 0.11 a | 2.66 ± 0.12 a | 3.17 ± 0.11 a | 36.81± 1.94 ab | 1.02 ± 0.04 ab |
| 3 | 15 | 5.62 ± 0.12 a | 2.67 ± 0.08 a | 2.94 ± 0.7 a | 33.93 ± 2.10 b | 1.00 ± 0.03 b |
| 4 | 15 | 5.74 ± 0.11 a | 2.64 ± 0.09 a | 3.09 ± 0.06 a | 36.07 ± 1.35 ab | 1.13 ± 0.06 a |
| Period | | | | | | |
| 1 | 20 | 5.80 ± 0.08 a | 2.70 ± 0.03 b | 3.10 ± 0.07 a | 41.94 ± 1.71 a | 1.14 ± 0.01 a |
| 2 | 20 | 5.51 ± 0.06 b | 2.39 ± 0.05 c | 3.11 ± 0.06 a | 35.59 ± 1.87 b | 0.95 ± 0.05 b |
| 3 | 20 | 6.01 ± 0.10 a | 2.97 ± 0.07 a | 3.03 ± 0.07 a | 32.40 ± 1.23 b | 1.06 ± 0.30 a |

Means with different letters within each column differ significantly, other wise they do not differ significantly.

Although analysis of variance revealed no significant effect of treatment on urea, yet the differences between means (Duncan ,1955) indicated that control group tended to have significantly the highest value (39.78 ± 2.75 mg/dl) followed by Kids received a supplementation of vitamin C at the dose of 750 (36.81 ± 1.94 mg/dl), 1000 (33.93 ± 2.10 mg/dl) and 1250 mg/kg diet (36.07 ± 1.35 mg/dl).

For lambs, Abd El-Monem *et al* (2008) indicated that the serum urea was not affected significantly with three doses of vitamin C used, however, it was reported that exposure of animals to heat stress is accompanied by a decline in concentration of urea (EL-Sobhy, 2005).

Creatinine averaged 1.05 ± 0.03 mg/dl (Table 3). Although analysis of variance indicated that supplementation of vitamin C at different rates to the diets of Meriz kids had no significant effect on this trait, however, differences among mean was noticed, the highest and lowest values were recorded for kids received 1250 and 1000 mg/kg vitamin C, respectively. (Table 3). Such results agree with the finding of Abd El-Monem *et al* (2008) who noticed that supplementation of vitamin C to lamb resulted in a non significant effect on creatinine.

**Triiodothyronine (T3) and Thyroxin (T4)**

In the present study, results revealed that supplementation of vitamin C to the diets of Meriz kids had a significant ($P<0.05$) effect on T3 only. The lowest (118.39 ng/dl) and highest values (149.89 ng/dl) was attained by kids received 1250 and 750 mg/kg diet of vitamin C, respectively. Also, there is a tendency of a decreasing in serum T4 with vitamin C supplementation. This finding disagree with the result of Abd El-Monem *et al* (2008) who showed that serumT3 and T4 were increased with ascorbic acid supplementation to the diets of lambs. Such contrary result may be due to the degree of heat stress to which the animal has been exposed, species, feed intake and composition of diet.

Many investigators have reported that exposure of animals to heat stress is associated with a significant depression in thyroid gland activity which result in a lowering of thyroid hormone levels (Ross *et al*., 1985), and this effect is probably initiated at the hypothalamic level (Yousef and Johnson, 1985).

**Table (4):** Effect of supplementation of vitamin C, period and their interaction on T3 and T4 of Meriz goat (Mean ± s.e).

| Effect | No. observation | T3 (ng/dl) | T4 (µg/dl) |
|---|---|---|---|
| overall mean | | 136.80 ± 6.77 | 6.26 ± 0.25 |
| Treatment | | | |
| 1 | 15 | 139.54 ± 9.70 ab | 6.62 ± 0.43 a |
| 2 | 15 | 149.89 ± 8.67 a | 6.61 ± 0.28 a |
| 3 | 15 | 139.39 ± 12.41 ab | 5.97 ± 0.33 a |
| 4 | 15 | 118.39 ± 8.78 b | 5.85 ± 0.32 a |
| Period | | | |
| 1 | 20 | 117.35 ± 9.20 b | 5.48 ± 0.28 b |
| 2 | 20 | 130.84 ± 6.76 b | 5.97 ± 0.24 b |
| 3 | 20 | 162.21 ± 7.47 a | 7.35 ± 0.21 a |

Means with different letters within each column differ significantly, other wise they do not differ significantly.

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# كارتێكرنا زێدەكرنا ترشیێ ئەسكوربیك ئەسید دئالیكێدا لسەر:
# 2- هندەك سالوخەتێن فسیولوجییێن پەزێ مەرەزی.

**پوختە**

**ئەڤ ڤەكولینە هاتییە ئەنجام دان ل پروژی خودانكرنا گیانەوەرا ل بشكا بەرهەمێ گیانەوەری ل كولیژا چاندنیێ زانكویا دهوك ژ 14 خزیرانێ تا 14 ئیلونێ 2009 كو 20 گیسكیت چیرا ێین شیرڤەكری (3-4 مەهان)و بریژا سەنگا وان یادەستپێكی 13.48 ± 0.62 كیلوگرام بون و هاتنە دابەشكرن ل سەر چار گروپان كو ئالەفێ وان یێ تێكەلكری بو دگەل ڤیتامین C بـ ڤان ریژان 0 ، 750 ، 1000 و 1250 مل گرام /كیلو گرام ئالف وبو ماوێ 90 روژا.**

**پلا گەرماتیا پێسیرێ وریژا هەناسێ هاتنا تومارکرن هەفتیانە. هەروەسا سامپلێن خوینێ دهاتنە وەرگرتن وكومكرن ژ رها خوینا حەفكێ ل دەستپێكێ ونیڤ ودوماهی یا ڤەكولینێ بو پشكنینا سالوخەتێن خوینێ(Hb،PCV وریژا N/L )، و هەروەسا هندەك سالوخەتێن بایو كیمیاوی (پروتینێ گشتی، ئەلبومین، گلوبیولین، یوریا وكریاتینین) دیسان تیراتیا هرمونێ T3 و T4.**

**ئەنجاما گەهاند كو گیسكێن ئالیكا تێكەلكری دگەل ڤیتامین C پلا گەرماتیا گیانێ وان كیمتر بو بشێوەیەكێ نـە بەرچاف بەروارد دگەل گروپێن دی. هەروەسا پلا گەرماتیا پێسیرێ هاتە خوارێ بشێوەیەكێ بەرچاف دگەل بورینـا قوناغێن ڤەكولینێ. ریژا Hb، PCV وریژا N/L 9.87 ± 0.32 غم/دسی لـتر ، 22.20 ± 0.53٪ و 0.57 ± 0.05 بـون لـدویف ئێكدا ودەست كاریا ئالـەفی چ كارتێكرنێن بەرچاف لـسەر سالوخەتێن ڤەكولینێ نەبون ژبلی ریژا تـەپكێن سپی یێن وەك هەڤ وتەپكێن سپی یێن لـەمفاوی. ریژا پروتینێ گشتی، ئەلبومین، گلوبیولین، یوریا وكریاتنین 5.77 ± 0.08 غم/دسی لـتر، 2.69 ± 0.06 غم/دسی لـتر 3.08 ± 0.06 غم/دسی لـتر 36.64 ± 1.63 ملغم/دسی لـتر و 1.05 ± 0.03 ملغم/دسی لـتر لـدیف ئێكدا، چ كارتێكرنا بەرچاف یا تێكەلكرنا ئالیكێ دگەل ڤیتامین C لـسەر ڤان سالوخەتا نەبون.**

**هەروەسا ئەنجاما دیاركرن كو ئالیكا تێكەلكری دگەل ڤیتامین C كارتێكنا بەرچاف بتنیێ لـسەر هرمونێ T3 هەبو.**

**تاثير اضافة فيتامين C في العليقة على:**

2- بعض الصفات الفسيولوجية في ماعز المرعز.

**الخلاصة**

**أجريت هذه الدراسة في مشروع تربية الحيوان/قسم الانتاج الحيواني كلية الزراعة/جامعة دهوك خلال المدة 14 حزيران لغاية 14 ايلول 2009 حيث تم توزيع 20 من جداء المرعز المفطومة ( 3-4 أشهر) وبمعدل وزن ابتدائي 13.48 ± 0.62 كغم الى أربعة مجاميع لتتغذى على اضافة من فيتامين C قدره صفر, 750 , 1000 و 1250 ملغم/كغم علف و لمدة تسعون يوماً.**

**تم قياس درجة حرارة المستقيم والتنفس مرة واحده اسبوعياً. كما اخذت عينات من الدم من الوريد الوداجي لتقدير الهيموغلوبين، حجم الكريات المرصوصة، ونسبة خلايا البيض المتعادلة الى الخلايا البيض اللمفاوية. وكذلك سيرم البروتين، الغلوبيولين والالبومين واليوريا والكرياتنين وتركيز هرموني الدرقية T4,T3 .**

**تشير النتائج بان اضافة فيتامين C قد ادى الى خفض غير معنوي في درجة حرارة المستقيم مقارنةً بمعاملة السيطرة، كما لوحظ انخفاض معنوي (P < 0.01 ) في درجة حرارة المستقيم بتقدم مراحل التجربة. بلغ معدل الهيموغلوبين وحجم الخلايا المرصوصة ونسبة خلايا البيض المتعادلة الى الخلايا البيض اللمفاوية 9.87 ± 0.32 غم/دسي لتر و22.20 ± 0.53% و0.57 ± 0.05 على التوالي باستثناء نسبة خلايا البيض المتعادلة الى الخلايا البيض اللمفاوية لم يكن للمعاملة تاثير معنوي في الصفات قيد الدراسة. كما بلغ معدل البروتين والالبومين والغلوبيولين واليوريا والكرياتنين 5.77 ± 0.08 غم/دسي لتر و 2.69 ± 0.06 غم/دسي لترو 3.08 ± 0.06 غم/دسي لتر و 36.64 ± 1.63 ملغم/دسي لتر و 1.05 ± 0.03 ملغم/دسي لتر على التوالي، ولم يكن للمعاملة تاثير في هذه الصفات. كما يتضح من النتائج بان اضافة فيتامين C قد ادى الى خفض تركيز الدرقين فقط.**

# EFFECT OF FOLIAR SPRAY OF ZN, $GA_3$ ON TRANSPLANTS GROWTH OF OLIVE (*Olea europaea* L.) CVS. BAESHIKE AND NEBALI*

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## ABSTRACT

**Olive transplant( Nebali and Baeshike cultivar) were sprayed four times during the seasons 2008 and 2009 with three levels of Zn(0, 25and 50 mg.l$^{-1}$) in the form of $ZnSO_4.7H_2O$, and four levels of $GA_3$ (0, 500, 1000 and 1500 mg.l$^{-1}$). To study the effect of Zn and $GA_3$ on vegetative, and root growth of one year old of two olive cultivars. The transplants were left under nursery conditions till 20 June, 2009.Results indicate that nebali cultivar significantly dominated Baeshike cultivar in stem length, leaf area, total chlorophyll percentage, shoot root ratio, root number per transplant. Stem length, stem diameter, number of primary branches were significantly increased with the increase of Zn levels to 25 mg.l$^{-1}$, while total chlorophyll percentage, shoot root ratio were significantly increased with the increase of Zn levels up to 50 mg.l$^{-1}$. Foliar of $GA_3$ at 500mg.l$^{-1}$ significantly increased stem length, diameter, number of primary branches per transplant, root number per transplant. Increasing $GA_3$ level up to 1000 mg.l$^{-1}$ significantly increased leaf area, shoot root ratio, total chlorophyll percentage. Most of the interactions (cultivar × Zn, cultivar × $GA_3$ and Zn × $GA_3$) showed significant effects on the most characteristics studied.**

***KEY WORDS*:** Foliar Application, ZN, $GA_3$, Olive, Transplants

## INTRODUCTION

*Olea europaea* L. is a member of the Oleaceae family. The two main products obtained from olive are oil and table olives are typical Mediterranean products, whose nutritional and economic importance is well-known. Indeed, consumption of olive oil and table olives has shown to be associated with a variety of health benefits, including a lower incidence of heart diseases and certain types of cancer (**Perez-Jimenez et al., 2005).**

The importance of olive fruit, due to heavy loading and dietetic value, that the fruit is good source of vitamins (A, D, E, K, C and B) and mineral elements like K, Ca, Mg and P **(Ibrahim and Khlaef, 2007)**. In addition, olive oil is filled with monounsaturated fatty acids and has many antioxidative properties. The major antioxidants in olive oil are phenolic compounds **(Stark and Madar, 2002).** It is more important today to reduce the initial non-productive period of new plantation. This can be achieved by providing conditions favorable. The root system of olive tree develops and extends quickly during the first few years. Fertilizers and plant growth regulators play an important role in improving the growth of young trees during the first years of plantation **(García et al., 1999).**

GAs are involved in many growth and developmental processes. GAs stimulate stem elongation by promoting cell elongation and cell division. Cell elongation may involve GA-induced activity of the enzyme xyloglucan endotransglycosylase (XET) and expansions **(Taiz and Zeiger, 2002)**. The growth of many plants can be promoted by the application of the appropriate gibberellins which stimulate the development of lateral branching and increase the total length of shoots on the treated young trees (**Davies, 1995**). **Al-Hamadany (2004)** studied the effect of iron in combination with $GA_3$ on vegetative growth, root growth and mineral composition of three olive cultivars and stated that transplants height, stem diameter, number and length of shoot, leaf area, the length of main root, stem diameter, and total chlorophyll were significantly increased with the increases of iron and $GA_3$ levels. **Sayed et al. (2004). Al-Aa'reji and Al-Hamadany** (**2006)** noticed that treated olive transplants with four concentrations of $GA_3$ (0, 50, 100 and 150 mg.l$^{-1}$ $GA_3$) led to a significant increase in the stem high and diameter, leaves number, leaf area and the amount of total chlorophyll. **Mostafa and Saleh (2006)** found that treating olive with 250 mg.l$^{-1}$ of gibberellic acid ($GA_3$), the results indicated that gibberellic acid ($GA_3$) treatments significantly increased the vegetative growth

* Part of the thesis of the first Author

parameters, number of new growing shoot tips, shoot diameter, number of leaves, total area of leaves developed compared with the untreated trees.

Zinc is a trace element that is required by plants for healthy growth. Trace elements such as zinc are only needed in small quantities from the soil, but when they are short supply, serious problems can occur; Zinc deficiency is now a common problem on alkaline (high pH) soils that contain high natural levels of calcium carbonate. **(Dart, 2007)**. Zinc plays an important role in many biochemical reactions within the plants. It is important in the formation of the growth hormone auxin. Auxin is produced by shoot tips, and controls cell division, leaf and shoot growth and fruit development. It needed by leaf cells to form chlorophyll. Its regulates starch formation and proper root development, also required to enable plants to withstand lower air temperatures and helps in the biosynthesis of cytochrome a pigment and maintains plasma membrane integrity and synthesis of leaf cuticle **(Maerschel et al., 2007). Al-Khawage (2007) s**tudied the effect of girdling and a mixture of micronutrients (contain 0.05 % cheated Zn, Fe, Mn and 0.05% boric acid) and a mixture of macronutrients (containing 0.5% from each of Urea or the phosphoric acid, Potassium sulphate and Magnesium sulphate) on growth of Manzanillo olive trees grown in sandy soil stimulated shoot length, number of leaves, shoot and leaf area. **Farahat et al. (2007)** studied that application 40 ppm of ascorbic acid and 40 ppm Zinc separately promoted all the mentioned characters as well as chemical constituents content chl (a), chl (b) and when used 40 ppm ascorbic acid and 20 ppm Zinc they increased all growth parameter except dry weight of shoots and fresh weight of roots as compared with the control. The aims of this study are to study the effects of Zn and $GA_3$ on the vegetative growth, root growth and chlorophyll contents of two olive transplants cv. (Baeshike and Nebali).

## MATERIALS AND METHODS

This investigation was conducted during the growing season of 2008 - 2009, in the nursery of the Agriculture College, University of Duhok, Kurdistan region, Iraq. One year old clonal transplants of two olive (***Olea europaea* L**.) cultivars, namely Nebali and Baeshike grown in polyethylene bags containing 3Kg of soil, kept in the lath house of Horticulture Department, College of Agriculture / Duhok University, till planting. As summer was dry, the transplants were irrigated with tap water as needed. The soil was first plowed following by disking than hand spading followed by disking than hand spading followed by raking. 30cm deep holes were made at a distance of one meter between lines and 70cm between the holes. Olive transplants were thoroughly irrigated before transferred to nursery lines on 22. Sept. 2008. The transplants were planted in the holes and irrigated as necessary with tap water. They were planted without removing the polyethylene bags to maintain root system undamaged. Table (1) shows the different components of the soil of the nursery.

**Table (1):** Some Physical and Chemical Properties of Nursery Soil

| **Properties** | **Average Value** |
|---|---|
| Volumetric distribution of soil separates | |
| Sand % | 3.40 |
| Silt % | 55.0 |
| Clay % | 41.60 |
| Texture | Silty clay loam |
| Available nutrient content | |
| Total-N % (Kjeldhal method) | 0.200 |
| Phosphorus ($mg.l^{-1}$) (Olsen method) | 5.03 |
| Potassium (meq/L) | 0.335 |
| Calcium carbonate % | 17.02 |
| Organic mater % | 1.180 |
| Ph | 7.48 |
| Electrical conductivity ($ds.m^{-1}$) | 2.35 |

At Soil Department Laboratory, College of Agriculture, Duhok University

The transplants were foliar sprayed four times; 20 August, 20 September, 20 October 2008 and 24 April, 2009 with three levels of Zn (0, 25 and 50 $mg.l^{-1}$) in the form of $ZnSO_4.7H_2O$ which contained (23% Zn), and four levels of $GA_3$ (0, 500, 1000 and 1500 $mg.l^{-1}$). The transplants were left under nursery conditions till 20 June, 2009. The experimental was arranged as Factorial including Randomized Complete Block Design (R.C.B.D) with three variables (cultivars, Zn and $GA_3$) and five replicates with one transplant per unit. The results were analyzed statistically and the comparison were made using Duncan's multiple range test at 5% probability (**Al-Rawi and Khalaf-Allah, 1980).** All the data were tabulated and statistically analyzed with computer using **(SAS system, 2000**).

**Measurment**

**1- Mean of Stem Length (cm):**It was measured at the end of investigation 20 June, 2009 using the measuring tape.

**2- Mean Stem Diameter (mm):**It was measured at 5cm above soil surface using Vernier.

**3- Primary Branches Number per transplant:** The numbers of primary branches were calculated at the end of the investigation.

**4 - Leaf Area ($cm^2$):** The average leaf area was determined by gravimetric method according to **Drovnic et al.** (**1965).**

**5-Total Chlorophyll (%):** It was determined in 20 June, 2009 by using a chlorophyll measurement device (Chlorophyll meter, SPAD-502, Konica Minolta). The estimated Chlorophyll in leaves represent its ratio to the rest of pigments present in the leaves.

**6- Roots Number per transplant**: Average roots number was calculated in three transplants randomly chosen from each treatment.

**7- Shoot / Root Ratio:** This ratio was determined by weighting the shoots and roots of three transplants randomly chosen from each treatment (**Goss, 1973**).

## RESULTS

**1- Stem Length (cm):**

Results in table (2) showed that transplants of Nebali cultivar had significantly higher stem length compared with the Baeshike cultivar. The transplants treated with 25 $mg.l^{-1}$ Zn gave highest stem length (66.67cm), and the transplants received 1500 $mg.l^{-1}$ $GA_3$ had higher stem length as compared with the untreated transplants. Nebali transplants foliar sprayed with 25 $mg.l^{-1}$ Zn had the highest stem length (70.92cm). On the other hand, Nebali transplants treated with 1500 $mg.l^{-1}$ $GA_3$ showed maximum stem length (76.33cm) which significantly surpassed other interactions. The treated transplants with 25 $mg.l^{-1}$ Zn $\times$ 500 $mg.l^{-1}$ $GA_3$ significantly increased stem length, also foliar spray of Nebali transplants with 25 $mg.l^{-1}$ Zn $\times$ 500 $mg.l^{-1}$ $GA_3$ increased stem length (113.82%) as compared with the other interactions.

**Table (2):** Effect of Cultivar, and Foliar Spray of Zn and $GA_3$ and Their Interactions on Stem Length (cm) of Olive Transplants.

| cultivars | Zn($mg.l^{-1}$) | $GA_3$ ($mg.l^{-1}$) | | | | cultivar × Zn | Main cultivar |
|---|---|---|---|---|---|---|---|
| | | 0 | 500 | 1000 | 1500 | | |
| Baeshike | 0 | 41,00 l | 55,33i-k | 73,67c | 58,67g-i | 57,17c | 61,08b |
| | 25 | 67,00e | 64,67ef | 59,33f-i | 58,67g-i | 62,42b | |
| | 50 | 60,00f-i | 73,00cd | 63,67e-h | 58,00h-j | 63,67b | |
| Nebali | 0 | 45,33 l | 64,33e-g | 60,33f-i | 68,33de | 59,58c | |
| | 25 | 52,67jk | 87,67a | 63,67e- | 79,67b | 70,92a | 64,36a |
| | 50 | 56,33i-k | 52,33k | 60,67f-i | 81,00b | 62,58b | |
| Cultivar × $GA_3$ | Baeshike | 56,00e | 64,33cd | 65,56bc | 58,44e | Main Zn | |
| | Nebali | 51,44f | 68,11b | 61,56d | 76,33a | | |
| Zn × $GA_3$ | 0 | 43,17f | 59,83de | 67,00bc | 63,50cd | 58,38c | |
| | 25 | 59,83de | 76,17a | 61,50de | 69,17b | 66,67a | |
| | 50 | 58,17e | 62,67d | 62,17d | 69,50b | 63,13b | |
| Main $GA_3$ | | 53,72c | 66,22a | 63,56b | 67,39a | | |

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% level.

**2- Stem Diameter (mm):** No significant difference was noticed between the two cultivars. Foliar spray with Zn and $GA_3$ significantly increased stem diameter as compared with the untreated transplants.The highest stem diameter (10.63mm) was recorded in Nebali cultivar treated with 25 $mg.l^{-1}$ Zn which was significantly difference from the other interaction. On the other hand, the stem diameter in Nebali transplants sprayed with 500 $mg.l^{-1}$ $GA_3$ (10.84mm) was significantly superior. Stem diameter in transplants received 25 $mg.l^{-1}$ Zn and 500 $mg.l^{-1}$ $GA_3$ was (11.82mm) was significantly higher than other interactions. The highest stem diameter (13.91mm) was recorded in Nebali transplants treated 25 $mg.l^{-1}$ Zn and 500 $mg.l^{-1}$ $GA_3$, whereas the lowest value for stem diameter (6.30mm) was recorded in the untreated Nebali transplants (table 3).

**Table (3):** Effect of Cultivar, and Foliar Spray of Zn and $GA_3$ and Their Interactions on Stem Diameter (mm) of Olive Transplants.

| cultivars | Zn($mg.l^{-1}$) | $GA_3$ ($mg.l^{-1}$) | | | | cultivar × Zn | Main cultivar |
|---|---|---|---|---|---|---|---|
| | | 0 | 500 | 1000 | 1500 | | |
| Baeshike | 0 | 6,73jk | 8,90f-h | 9,39d-g | 10,20b-e | 8,81d | 9,47a |
| | 25 | 9,61c-g | 9,73c-g | 9,22e-h | 9,52c-g | 9,52c | |
| | 50 | 11,14b | 10,05bf | 10,44b-d | 8,73gh | 10,09b | |
| Nebali | 0 | 6,30k | 10,50b-d | 7,41ij | 10,54b-d | 8,69d | 9,63a |
| | 25 | 9,16e-h | 13,91a | 8,84f-h | 10,61bc | 10,63a | |
| | 50 | 9,18e-h | 8,11hi | 9,80c-g | 11,15b | 9,56c | |
| Cultivar × $GA_3$ | Baeshike | 9,16bc | 9,56b | 9,68b | 9,48b | Main Zn | |
| | Nebali | 8,21d | 10,84a | 8,68cd | 10,77a | | |
| Zn × $GA_3$ | 0 | 6,52f | 9,70b-d | 8,40e | 10,37b | 8,75b | |
| | 25 | 9,38cd | 11,82a | 9,03de | 10,07bc | 10,07a | |
| | 50 | 10,16bc | 9,08de | 10,12bc | 9,94bc | 9,83a | |
| Main $GA_3$ | | 8,69c | 10,20a | 9,18b | 10,13a | | |

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncan's multiple range tests at 5% level.

**3- Primary Branches Number per Transplant:** Table (4) reveal that transplants of Baeshike cultivar had significantly higher primary branches number than transplants of Nebali cultivar. Transplants treated with Zn at rate of 25 $mg.l^{-1}$ had significantly higher primary branches number as compared with the control. Transplants that received 500 $mg.l^{-1}$ $GA_3$ showed a significant increase in primary branches number. Interactions significantly affected primary branches number, Baeshike transplants treated with 25$mg.l^{-1}$ Zn gave (5.17) primary branches number per transplants, where as transplants of the same cultivar treated with 500 $mg.l^{-1}$ $GA_3$ gave (5.33) primary branches number. Low levels of 25 $mg.l^{-1}$ Zn and 500 $mg.l^{-1}$ $GA_3$ resulted in significantly higher primary branches (7.67) in Baeshike cultivar compared with the other interaction while the lowest number of primary branches per transplant (2.33) was noticed in the untreated in Nebali transplants.

**Table (4):** Effect of Cultivar, and Foliar Spray of Zn and $GA_3$ and Their Interactions on Primary Branches Number per Olive Transplants.

| cultivars | Zn(mg.l$^{-1}$) | $GA_3$ (mg.l$^{-1}$) | | | | cultivar × Zn | Main cultivar |
|---|---|---|---|---|---|---|---|
| | | 0 | 500 | 1000 | 1500 | | |
| Baeshike | 0 | 2,67gh | 4,00d-f | 4,67b-d | 3,67d-g | 3,75bc | 4,39a |
| | 25 | 5,33bc | 7,67a | 3,33d | 4,33c-e | 5,17a | |
| | 50 | 4,67b-d | 4,33c-e | 4,00d-f | 4,00d-f | 4,25b | |
| Nebali | 0 | 2,33h | 4,00d-f | 3,67d-g | 3,67d-g | 3,42cd | 3,53b |
| | 25 | 3,33e-h | 3,33e-h | 3,67d-g | 5,67b | 4,00b | |
| | 50 | 3,00f-h | 3,00f-h | 2,67gh | 4,00d-f | 3,17d | |
| Cultivar× $GA_3$ | Baeshike | 4,22b | 5,33a | 4,00bc | 4,00bc | Main Zn | |
| | Nebali | 2,89d | 3,44cd | 3,33d | 4,44b | | |
| Zn × $GA_3$ | 0 | 2,50e | 4,00cd | 4,17cd | 3,67cd | 3,58b | |
| | 25 | 4,33bc | 5,50a | 3,50cd | 5,00ab | 4,58a | |
| | 50 | 3,83cd | 3,67cd | 3,33d | 4,00cd | 3,71b | |
| Main $GA_3$ | | 3,56b | 4,39a | 3,67b | 4,22a | | |

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% level.

**4- Leaf Area (cm$^2$):** Table (5) showed that significant differences in leaf area due to the cultivar. Nebali transplant had significantly superior average leaf area compared with the Baeshike cultivar. Zn at 25 mg.l$^{-1}$ decreased average leaf area significantly. 1000 mg.l$^{-1}$ $GA_3$ treatment significantly increased average leaf area (7.89 cm$^2$) compared to the untreated transplants. The highest value for the average leaf area (8.41cm$^2$) was observed in the interaction of Nebali transplants treated with 50 mg.l$^{-1}$ Zn.Spraying Nebali cultivar transplants with 1500 mg.l$^{-1}$ $GA_3$ increased average leaf area significantly.The interaction between three factor showed that the highest value of leaf area (9.70cm$^2$) was recorded in Baeshike transplants received 1000 mg.l$^{-1}$ $GA_3$ only which was significantly superior than the other interactions.

**Table(5):** Effect of Cultivar, and Foliar Spray of Zn and $GA_3$ and Their Interactions on Leaf Area (cm$^2$) of Olive Transplants.

| cultivars | Zn(mg.l$^{-}$) | $GA_3$ (mg.l$^{-1}$) | | | | cultivar × Zn | Main cultivar |
|---|---|---|---|---|---|---|---|
| | | 0 | 500 | 1000 | 1500 | | |
| Baeshike | 0 | 4,40j | 6,03g-i | 9,70a | 6,13g-i | 6,57c | 6,20b |
| | 25 | 5,13ij | 4,97j | 5,43h-j | 6,37e-g | 5,48d | |
| | 50 | 7,33d-f | 6,57e-g | 7,43c-d | 4,87j | 6,55c | |
| Nebali | 0 | 6,30gh | 8,23b-d | 8,12b-d | 8,95ab | 7,90b | 8,04 |
| | 25 | 7,92b-d | 7,65cd | 8,12b-d | 7,59c-e | 7,82b | |
| | 50 | 8,28b-d | 8,39b-d | 8,53bc | 8,43b-d | 8,41a | |
| cultivar× $GA_3$ | Baeshike | 5,62c | 5,86c | 7,52b | 5,79c | Main Zn | |
| | Nebali | 7,50b | 8,09a | 8,26a | 8,32a | | |
| Zn × $GA_3$ | 0 | 5,35h | 7,13c-f | 8,91a | 7,54b-d | 7,23a | |
| | 25 | 6,53fg | 6,31g | 6,78e-g | 6,98dg | 6,65b | |
| | 50 | 7,81bc | 7,48be | 7,98b | 6,65fg | 7,48a | |
| Main $GA_3$ | | 6,56c | 6,97b | 7,89a | 7,06b | | |

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% level.

**5-Total Chlorophyll (%) measured by SPAD:** Total chlorophyll percentage (measured by SPAD) in leaves of Nebali cultivar contained significantly higher chlorophyll percentage (75.18%) compared with leaves of Baeshike (73.12%). Chlorophyll percentage in leaf of transplant treated with 50 mg.l$^{-1}$ Zn significantly surpassed as compared with other treatment. Foliar application of 1500 mg.l$^{-1}$ $GA_3$ significantly increased percentage of total chlorophyll. Chlorophyll percentage in leaf of Baeshike transplants treated with 50 mg.l$^{-1}$ Zn (77.97%) was superior significantly than other interactions. Regarding cultivar× $GA_3$ interaction, leaf of Nebali transplants treated with 1500 mg.l$^{-1}$ $GA_3$ contained the highest percentage of chlorophyll (77.78%). Cultivars × Zn× $GA_3$ interaction significantly influenced percentage of total chlorophyll in leaves (table 6).

**Table (6):** Effect of Cultivar, and Foliar Spray of Zn and $GA_3$ and Their Interactions on Total Chlorophyll (%) •• in Leaf of Olive Transplants.

| cultivars | Zn(mg.$^{-1}$) | $GA_3$ (mg.l$^{-1}$) | | | | cultivar × Zn | Main cultivar |
|---|---|---|---|---|---|---|---|
| | | 0 | 500 | 1000 | 1500 | | |
| Baeshike | 0 | 64,07k | 68,80i-k | 76,27c-g | 64,67k | 68,45d | 73,12b |
| | 25 | 70,90g-j | 70,23g-i | 75,70c-h | 74,97c-h | 72,95c | |
| | 50 | 85,87a | 74,27d-i | 71,57g-j | 80,17bc | 77,97a | |
| Nebali | 0 | 66,43jk | 84,80ab | 73,40d-i | 77,47c-e | 75,53ab | 75,18a |
| | 25 | 72,60e-i | 71,87f-i | 73,13d-i | 77,33c-f | 73,73bc | |
| | 50 | 77,73c-e | 73,67d-i | 75,17c-h | 78,53cd | 76,28a | |
| cultivar× $GA_3$ | Baeshike | 73,61cd | 71,10d | 74,51bc | 73,27cd | Main Zn | |
| | Nebali | 72,26cd | 76,78ab | 73,90cd | 77,78a | | |
| Zn × $GA_3$ | 0 | 65,25e | 76,80bc | 74,83cd | 71,07d | 71,99b | |
| | 25 | 71,75d | 71,05d | 74,42cd | 76,15bc | 73,34b | |
| | 50 | 81,80a | 73,97cd | 73,37cd | 79,35ab | 77,12a | |
| Main $GA_3$ | | 72,93b | 73,94ab | 74,21ab | 75,52a | | |

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% level.
••chlorophyll was measured by SPAD.

**6- Root Number per Transplant:** Table (7) shows the that Nebali cultivar had significantly more root number than Baeshike transplant. Zinc levels had no significant influence on root number compared with the control, whereas treating transplants with 500 mg.l$^{-1}$ $GA_3$ increased root number per transplant significantly. The highest number of root per transplant (23.08) was observed in Nebali transplants treated with 50 mg.l$^{-1}$ Zn. Interaction between Nebali transplants with 500 mg.l$^{-1}$ $GA_3$ increased root number significantly. Zn × $GA_3$ also significantly influenced root number per transplant. Baeshike cultivar treated with 0 mg.l$^{-1}$ Zn × 500 mg.l$^{-1}$ $GA_3$ produced the highest number of root per transplant (36.0) while the lowest root number per transplant (12.00) was observed in the untreated transplants of Baeshike.

**Table (7):** Effect of Cultivar, and Foliar Spray of Zn and $GA_3$ and Their Interactions on Root Number per Olive Transplants.

| cultivar | Zn (mg.l$^{-1}$) | $GA_3$ (mg.l$^{-1}$) | | | | cultivar × Zn | Main cultivar |
|---|---|---|---|---|---|---|---|
| | | 0 | 500 | 1000 | 1500 | | |
| Baeshike | 0 | 12,00h | 36,00bc | 19,67d-g | 17,00g | 21,17b | 19,83b |
| | 25 | 19,67d-g | 17,67fg | 19,67d-g | 17,67fg | 18,67c | |
| | 50 | 16,67g | 23,33d-f | 21,33d-f | 17,33g | 19,67bc | |
| Nebali | 0 | 12,33h | 26,00bc | 19,00e-g | 20,00d-g | 19,33c | 21,81a |
| | 25 | 16,67g | 29,33b | 29,33b | 16,67g | 23,00a | |
| | 50 | 29,33b | 22,00de | 21,33d-f | 19,67d-g | 23,08a | |
| cultivar× $GA_3$ | Baeshike | 16,11e | 25,67a | 20,22c | 17,33de | Main Zn | |
| | Nebali | 19,44c | 25,78a | 23,22b | 18,78cd | | |
| Zn × $GA_3$ | 0 | 12,17f | 31,00a | 19,33de | 18,50e | 20,25a | |
| | 25 | 18,17e | 23,50bc | 24,50b | 17,17e | 20,83a | |
| | 50 | 23,00bc | 22,67bc | 21,33cd | 18,50e | 21,38a | |
| Main $GA_3$ | | 17,78c | 25,72a | 21,72b | 18,06c | | |

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% level.

**7 - Shoot / Root Ratio:**

Nebali transplants had significantly superior shoot root ratio compared with Baeshike cultivar. Sprayed transplants with 50 mg.l$^{-1}$ Zn shoot root ratio increased significantly.The highest value of shoot/ root ratio (2.48) was observed in transplants treated with 1000 mg.l$^{-1}$ $GA_3$. The effect of interaction between cultivars× Zn shows the highest value of shoot/ root ratio (2.43) in Nebali treated with 50 mg.l$^{-1}$ Zn. Nebali cultivar treated with 1500 mg.l$^{-1}$ $GA_3$ resulted in an increased in shoot root ratio significantly as compared to the untreated transplants. Spraying transplants with 50 mg.l$^{-1}$ Zn× 1000 mg.l$^{-1}$ $GA_3$ gave a significant increase of shoot root ratio (3.36) compared to the other interaction. Interaction of Nebali cultivar × 50 mg.l$^{-1}$ Zn ×1000 mg.l$^{-1}$ $GA_3$ shows highest value of shoot root ratio (4.17) which was significant with other Interaction (table 8).

**Table (8):** Effect of Cultivar, and Foliar Spray of Zn and $GA_3$ and Their Interactions on Shoot Root Ratio of Olive Transplants.

| cultivar | Zn(mg.l$^{-1}$) | $GA_3$ (mg.l$^{-1}$) | | | | cultivar × Zn | Main Cultivar |
|---|---|---|---|---|---|---|---|
| | | 0 | 500 | 1000 | 1500 | | |
| Baeshike | 0 | 1,65gh | 1,71f-h | 2,49cd | 1,88d-h | 1,93bc | 2,02b |
| | 25 | 1,78f-h | 2,03c-h | 1,80f-h | 1,81f-h | 1,86c | |
| | 50 | 2,25c-g | 1,86e-h | 2,55c | 2,47c-e | 2,28a | |
| Nebali | 0 | 1,60h | 1,51h | 2,33c-f | 3,18b | 2,16ab | 2,24a |
| | 25 | 2,32c-f | 2,29c-f | 1,51h | 2,46c-e | 2,14a | |
| | 50 | 1,55h | 1,40h | 4,17a | 2,60c | 2,43a | |
| Cultivar × $GA_3$ | Baeshike | 1,89c | 1,87c | 2,28b | 2,05bc | Main Zn | |
| | Nebali | 1,82c | 1,74c | 2,67a | 2,75a | | |
| Zn × $GA_3$ | 0 | 1,62f | 1,61f | 2,41bc | 2,53b | 2,04b | |
| | 25 | 2,05c-e | 2,16b-d | 1,66ef | 2,13bcd | 2,00b | |
| | 50 | 1,90d-f | 1,63f | 3,36a | 2,54b | 2,36a | |
| Main $GA_3$ | | 1,86b | 1,80b | 2,48a | 2,40a | | |

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncan multiple ranges test at 5% level.

## DISCUSSION

**Gibberellic acid**: The use of gibberellic acid for boosting the growth vigor of various horticultural plants is old and well documented. $GA_3$ is widely reported to stimulate vegetative growth parameters (**Steven, 1994)**. **Al-Kafaji and Muslat, (1995)** attributed the growth improvement of $GA_3$ treated plants to the influence of $GA_3$ on cell wall and cell cytoplasm. They found that $GA_3$ highly increased cell size and cell numbers which finally reflected on tissue size, and they referred the osmosity of cell solutes to the impact of $GA_3$ on mRNA transcription which is responsible for enzyme synthesis, especially those involved in chlorophyll synthesis. The increase of shoot root ratio was closely correlated with the change in activities of sugar metabolizing enzymes induced by GA application **(Ramezani and Shekafandeh, 2009**).

**Zinc**: Is an essential element for tryptophan synthesis, one of the auxin IAA precursor **(Taiz and Zeiger, 2002**). Auxin is produced by shoot tips and control cell divisions, leaf and shoots growth. Zinc is also needed by leaf cell to form the green pigment chlorophyll. Zinc plays an important role in many biochemical reactions. It is a part of several enzymes such as carbonic anhydrase superoxide mutase and Catalase which prevent oxidative in plant cell. Addition of Zinc to deficient plant greatly stimulates auxin synthesis thereby making it essential for cell elongation and growth **(Marschner, 1996 and Tiaz and Zeiger, 2002).** It is well known that Zinc acts as co-factor of many enzymes and affects many biological processes such as photosynthesis reactions, nucleic acids, metabolism, protein and carbohydrates biosynthesis. **Hafez and El-Metwally (2007)** found that foliar application with Zinc, significantly increased leaf area. They attributed that to the role of Zn in plant such as photosynthesis reactions, nucleic acid metabolism, protein and carbohydrate biosynthesis.

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**پوختە**

**نامێن زەیتونا هاتنە رەشاندن جار جارا ل هە ردوو وەرزێن شینبوونێ 2008 و2009 یێ ب سێ تیراتیێن زنکی (چنە, 25 و50 ملغم /لـتر) جوری کبریتاتێن زنکی یێن ئافی $ZnSO_4.7H_2O$ ئەوێ 23٪ ژ Zn تێداهەی وچوار تیراتێن ترشێ جبرلینێ (چنە, 500, 1000 و 1500 ملغم/لـتر) ژبو تاقیکرنا کارتێکرنا زنك ی وترشێ جبرلینی ل سەر شینکاتێ وروبهێن دوو جوّرین زەیتونا ب تەمەنێ ئیك سال. نمام هاتنە دانان ل ژیرّ کاودنێن نەمامگەهێ تا 20ێ حزیرانا 2009ێ. جوّرێ نیبالی سەرکەفتنەکا بەر جافــ دیارکر ل سەر جوّرێ بەعشیقی وساخلەتێن درێژاهیا قەدی بوّ هەر نمامەکێ وروبەرێ بەلگا وپێکهاتیێ هەمیشە یی یێ کلوروفیلی وریژەیا شینکاتێ بو ریها وژمارا رویها بوّ هەر نمامەکی. زیدەبوونەکا بەرچافـ هاتە تومارکرن دساخلەتێن شینکاتی وروبها وەکی دریژاهی وتیرەیا قەدی وژمارە ودرێژاهیا لقێن بوهەر نمامەکێ. تیراتیا 50 ملغم /لـتر Zn بوویە ئەکەرێ زیدەبوونەکا بەرچافـــ وپێکهاتێ بەلگان ژکلوروفیلی وریژەیا شینکاتیێ بو رویها.**

**رەشاندن بجبرلینی بتیراتیا 500 ملغم /لـتر بوویە ئەگەرێ زێدەبونەکا بەرچافـ ودرێژاهی وتیرەیا قەدی و ژمارە ودرێژاهیا لقێن بنەرەتی وژمارا رویها. زێدەکرنا تیراتیا $GA_3$ بوو 1000 ملغم /لـتر بوویە ئەگەرێ زیدەبونەکا بەرچافـــ دروبەرێ بەلگان وریژا شینکاتێ بوّ رویها بوّ هەر نمامەکێ وپێکهاتێ کلوروفیلی وکێشەیا ددەمێ بەراوە ردکرنێ دگەل کونترولی.**

**زورّبەی لێکدانا دناڤبەرا فاکتەرێن هاتینە تاقیکرن (جوّر ×Zn , جوّر ×$GA_3$ , Zn ×$GA_3$) کارتێکرنێن بەرچاڤ دیارکرن ل سەرساخلەتێن هاتینەتاقیکرن.**

# تأثير الرش الورقي بالزنك وحامض الجبرليك في نمو شتلات الزيتون صنفي بعشيقي و نيبالي (*Olea europaea* L.)

**الخلاصة**

رشت شتلات الزيتون صنفي بعشيقي ونيبالي اربع مرات خلال الموسم 2008 و2009 بثلاث تراكيز من الزنك(0، 25 و50ملغم/لتر) على هيئة كبريتات الزنك المائية $ZnSO_4.7H_2O$ وأربعة تراكيز من حامض الجبرليك ( 0، 500، 1000 و 1500ملغم/لتر). بهدف دراسة تأثير الزنك وحامض الجبرليك في النمو الخضري والجذري لصنفين من الزيتون بعمر سنة واحدة. وضعت الشتلات تحت ظروف المشتل لغاية 20 حزيران 2009. أظهر الصنف نيبالي تفوقا معنويا على الصنف بعشيقي في صفات طول الشتلة, و المساحة الورقية ونسبة الكلوروفيل الكلي ونسبة المجموع الخضري إلى الجذري وعدد الجذور/شتلة. زيادة تركيز الزنك إلى 25ملغم/لتر أدى إلى زيادة معنوية في طول وقطر الساق وعدد وطول الأفرع الرئيسية لكل شتلة ، بينما أدى التركيز 50 ملغم /لترZn إلى زيادة معنوية في نسبة الكلوروفيل الكلي ونسبة المجموع الخضري إلى الجذري. الرش بالجبرلين وبتركيز 500 ملغم /لتر أدت إلى زيادة معنوية في طول وقطر الساق وعدد الأفرع الرئيسية وعدد الجذور. إن زيادة تركيز الجبرلين إلى 1000 ملغم /لتر أدى إلى زيادة معنوية في المساحة الورقية ونسبة المجموع الخضري إلى الجذري ونسبة الكلوروفيل الكلي . معظم التداخلات بين العوامل المدروسة (الصنف× Zn ، الصنف × $GA_3$ ، Zn × $GA_3$ ) أظهرت تأثيرا معنويا في معظم الصفات المدروسة.

# EVALUATION OF THE ENTOMOPATHOGENIC FUNGI, *Beauveria bassiana* (bals.) VUILL. AND *Paecilomyces farinosus* ( DICKS EX FR.) AGAINST THE POPLAR LEAF BEETLE *Melasoma populi* L.

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## ABSTRACT

**Laboratory bioassays were conducted in order to evaluate the pathogenicity of *Beauveria bassiana* and *Paecilomyces farinosus* as biocontrol agents against poplar leaf beetle *Melasoma populi* L. with three concentrations ($10^6$ , $10^7$ and $10^8$ ) spores / ml for each fungus . Results indicated that both fungi were pathogenic to all stages of poplar leaf beetle although their capability were differs according to the fungus species and exposure duration . The lowest hatching percentage of eggs was 35.50 when treated by *Beauveria bassiana* ($10^8$ concentration) compared with 97.63 % in the control treatment. First and second instar larvae were more susceptible to the fungi than the third instar . The larval mortality percentages increased significantly with *B. bassiana* at $10^8$ spores/ml and reached 100% in both 1st. and 2nd. Instar larvae . There were significant differences between both fungi when the pupae sprayed with different fungus concentration and recorded 74.36 at $10^8$ spores/ml of *B. bassiana* . Cumulative adult mortality of 70.23% and 65.22% was achieved after 12 days from spray leaves and insects directly with spore suspension respectively.**

***KEY WORDS :*** *Biological control , Melasoma populi , Beauveria bassiana ,Paecilomyces farinosus*

## INTRODUCTION

The big problem faced poplar plantation in Iraq was the severe infestation by insects and diseases, especially on the young trees (after three years and above), (Saieed and Yahya, 1994 ) .One limiting factor for poplar progressive is the severe defoliation by leaf beetle which is releated to family Chrysomelidae . The most wide spread species and injuries to poplar and willow is *Melasoma populi* L. which has two or three generations yearly(F.A.O. 1980 ). Hassan (2003) in Iraq stated that the poplar leaf beetle adults hibernated in the soil under the cover of dead leaves, the first and second instar larvae , live in colonies and mainly attack the apical leaves of plants in nurseries , the female feeding more than the male and the total consumption area of poplar leaves by male and female through their life were 78.85 $cm^2$ and 325.61 $cm^2$ respectively and the average daily consumption area of poplar leaves by larvae at 22.62 °C. and 50.05% R.H. was 0.53, 4.20 and 12.93 $cm^2$/individual/day that was equal to 1.93 %, 15.27% and 47.07% from the poplar leaf area for the first, second and third larval instars, respectively .

The successful development of *Beauveria bassiana* (Bals.) Vuill. Within hosts is based on simply overcoming the host hemocyte response (Hou and Chang 1985). Numbers of granulocytes are dramatically reduced three days after fungal challenge and added that the cellular – defense response is the initial target of metabolites produced by *B. bassiana* (Hung *et.al*.,1993). The ecological conditions especially temperature degree and relative humidity play a very big role in host - entomopathogenic relationships especially fungal agents (Luz *et.al.*, 1998 ). Reid *et.al*. (2004) mentioned that the infection of fungal entomopathogenic depend on the high humidity that the spore required to penetrate the insect cuticle . There are differences in infection range and development of *Paecilomyces farinosus* (Dicks ex Fr.) and *Beauveria bassiana* (Bals.) Vuill. (Tanada & Kaya 1993).

Because there is no any biological agents recorded on *Melasoma populi* L. until today in Iraq (Hassan, 2003), the aim of this study is to test the susceptibility of the various stages of poplar leaf beetle *Melasoma populi,* to the entomopathogenic fungi *B. bassiana* and *P. farinosus* , in order to develop formulation and application strategies suitable for future use in biological control .

## MATERIALS & METHODS

**2-1: Fungi inoculums preparation**

Two entomopathogenic fungi, *B. bassiana* and *P. farinosus* were isolated from infected sunn insects *Eurygaster integriceps* Put. which collected from Gara mountain / Duhok region in 2007 . The specimens were identified in laboratory / plant protection department / Agricultural college / Duhok university , and kept under the No. BEG-11 and PEG-12 , respectively (Assaf , 2007). Fungi were grown on Potato Dextrose Agar (PDA) for 6-7 days at 25 ± 1°C . Three concentration of each fungi suspension prepared ( $10^6$ , $10^7$ and $10^8$ ) spores / ml of water . Spore concentration were determined by hemocytometer .

**2-2: Preparation of poplar leaf beetle *M. populi***

**2-2-1: Adults Rearing**

The adults of *M. populi* were collected from the poplar leaves and then transferred to laboratory, kept in wooden cages measured (35×35×35 cm) with one face made of glass while other sides were covered by sieves. The cage also supplied with small branches fixed inside a jar and filled with water (Hassan, 2003).

**2-2-2: Immature Stages Rearing**

The newly hatched larvae that obtained from adults rearing cages were differentiated individually in a covered petri – dish of 9 cm diameter provided by a moistant filter paper with fresh poplar leaves. It was found more reliable to wrap up the leaf petiole with cotton wool soaked in water in order to keep the leaves fresh (Hassan , 2003) .

**2-3 Treatments :**

The experiments were done under laboratory conditions at 24.55 °C and 59.89 % R.H. . The treatment included three concentration of each fungi ( $10^6$ , $10^7$ and $10^8$ ) spores / ml of water in addition to control treatment in four replicates .

**2-4 : Pathogenicity of *B. bassiana* and *P. farinosus* to *M. populi* eggs :**

Eggs for bioassay (1 day old ) were obtained from egg-laying cages ( Adult rearing cages ) . Each replicate included one mass of egg ( average number of eggs/ mass is 54 egg ) (Hassan , 2003). The egg masses were spread out in a petri- dish (9 cm) in diameter , provided by a miostant filter paper in bottom and then sprayed with fungi suspension ( 2 ml / replicate ) . The control treatment was sprayed only with water by a new parfan sprayer (50 ml capacity) . The keen observation was recorded daily until hatching and then the hatching percentage was also recorded .

**2-5 : Pathogenicity of *B. bassiana* and *P. farinosus* to *M. populi* larval instars and pupae stage :**

Each replicate included 6 individuals spread out individually in a petri- dish of 9 cm diameter , containing miostant filter paper in bottom . The individuals were sprayed with fungi suspension ( 2 ml / replicate ) while the control treatment was sprayed with water by a new parfan sprayer (50 ml capacity) . Fresh leaves were supplied daily to the larvae . The mortality percentage was recorded after 1,2and 3 days for first and second instar and after 2,4 and 6 days for third instar larvae . The mortality percentage of pupae was also recorded in the period of adults emergence.

**2-6 : Pathogenicity of *B. bassiana* and *P. farinosus* on *M. populi* Adults :**

**2-6-1: On -plant trial :**

An initial experiment was designed to compare the effectiveness of two application methods : (a) spraying the adults directly with spore suspension (b) spraying the poplar leaves. For method (a) , groups of 5 adults were sprayed with 2 ml of spore suspension / replicate in three concentration ($10^6$ , $10^7$ and $10^8$ ) spores / ml in a petri- dish of 9 cm diameter lined with miostant filter paper , and supplied with fresh leaves daily while the control treatment sprayed with water by a new parfan sprayer (50 ml capacity) . For method (b) the poplar leaves were sprayed with 2 ml of spore suspension / replicate in three concentration ($10^6$ , $10^7$ and $10^8$ ) spores /ml in a petri- dish 0f 9 cm diameter lined with miostant filter paper too, then a group of 5 adults added to the treated leaves , when the leaves had eaten , clean fresh leaves were provided for the live adults . The mortality percentage was record after 4 ,8 and 12 days

**2-6-2 : In –litter trials :**

On the day of treatments , amount of fallen litter was collected from under poplar trees . The litters , which were a mixture of over 1-2 years of decomposing leaves , was cut and thoroughly mixed (Parker *et.al* ,2003 ) . To each clear plastic screw-top jar, 25g litter were added , leaving about 2 cm of space in which the insects could around freely . Three concentration of each fungi ( $10^6$ , $10^7$ and $10^8$ ) spores / ml of water in 4 replicates / concentration / fungi were used . To each jar, 5 ml of the conidial suspension( 0.2 ml / g litter ) was sprayed onto the surface of the litter with new parfan sprayer

(50 ml capacity) . Five adults were placed in each jar ( 20 individuals / concentration ) , after the spray had dried to avoid the possibility of insects being directly treated . The jars were held in the laboratory at 22C$^{o}$ under natural light conditions . On the second day of application , the jars were inverted to encourage the insects to crawl through the litter and come in contact with the treatment . On the fifth day, the adults in each jar were removed ; mortality counts were taken and the live insects placed in a clean jar with fresh poplar leaves . Mortality was assessed again on the tenth day, at which time dead insects removed and fresh poplar leaves were added . A final mortality count was taken after 15 days treatment (Parker *et.al* , 2003 ) .

To confirm that death of poplar leaf beetle adults and other stages were due to mycosis , the dead individuals were removed at the assessment period and surface sterilized by washing in 2% sodium Hypochloride (NaOcL) for 3 minutes followed by rinse in sterile distilled water . The cadavers were then placed in Petri dishes on filter paper moistened with sterile distilled water and they were put in PDA media inside an incubator at 25C to examined for external sporulation of fungus .

**2.7: Statistical analysis :** Cumulative mortality counts obtained from experiments were corrected for natural mortality using Abbott's formula ( Abbott, 1925) . Data were statistically analyzed using Complete Randomized Design (CRD) with four replications and using SAS program . The means were compared using Duncan's multiple range test at $P \leq 0.05$.

## RESULTS AND DISCUSSION

**3-1: Pathogenicity of *B. bassiana* and *P. farinosus* on *M. populi* eggs :**

The results (fig.1) showed that there were no significant differences on the percentage of eggs hatching between the entomopathogenous fungi *B. bassiana* and *P. farinosus* .

The highest percentage of hatching was recorded in the control treatment (97.63%) which was not differ from the $10^{6}$ concentration of both fungi *B. bassiana* (76.66% )and *P. farinosus* (80.44 % ) . The lowest percentage of hatching (35.50 %) was recorded in$10^{8}$ concentration of *B. bassiana* with no significant difference from *P. farinosus* which was 49.71**.**

Both fungi type showed that they have ability to effect the eggs . The characteristic symptoms as loss turgor (shrinkage ) and darkening of the eggs appeared after 2-3 days from treatment , this results were inagreement with ( Gidin et.al., 2006 ) .

The differences among the entomopathogenous fungi potential for parasitism due to there ability to produce the Kitenase enzyme which play an essential role in decomposing the kitin that present in eggs wall then help the fungi hyphe to enter and destroy the internal contents of eggs and consumed them ( Salih et.al.,1999 and Burges, 1981) . Although that the percentage of hatching was high , the ost newly hatched larvae were died after hatching or don't develop to the next stage .

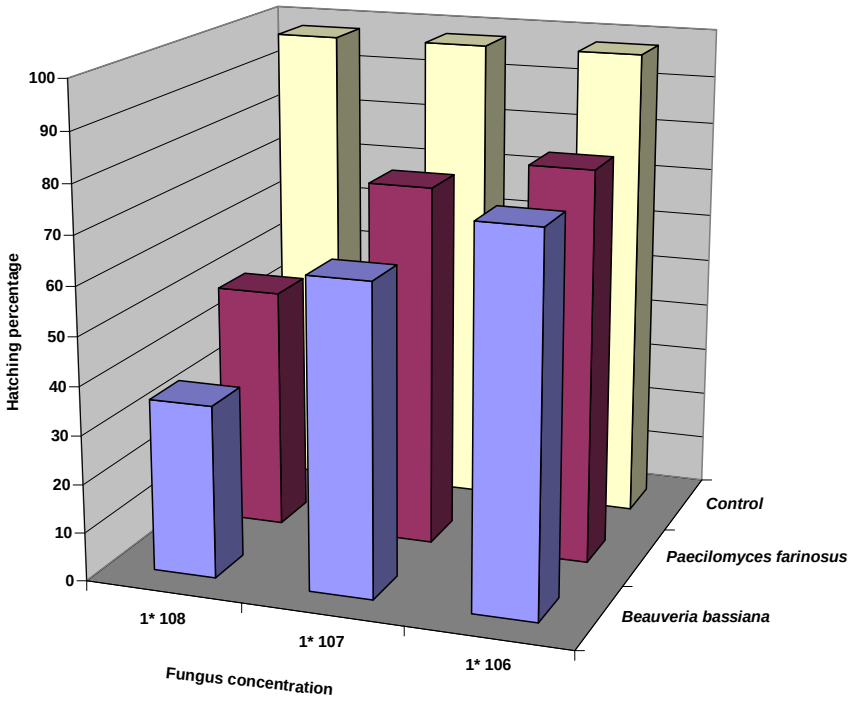


**Fig.(1):** Effect of fungus type and concentration on hatching percentage of poplar leaf beetle eggs

**3-2 : Pathogenicity of *B. bassiana* and *P. farinosus* to *M. populi* larval instars :**

Pathogencity studies in table (1) indicated that both types of fungi *B. bassiana and P. farinosus* were found to be pathogenic to poplar leaf beetle larvae, however there was a variation in their infectivity against poplar leaf beetle . The percentage of mortality ranged between 65.22 - 100% after three days of treatment in first instar larvae and all of them were significantly higher than the natural mortality in the control treatment which was 4.17 % . In second instar larvae the percentage of mortality was 4.76 % after one day of treatment by *P. farinosus* **(**$10^6$ concentration ) which not differ from control (2.50%) , and 100% after three days of treatment by *B. bassiana* ($10^8$ concentration ) which significantly higher than the other concentration of fungi in exception with *B. bassiana* ($10^7$ concentration ) which was 74.36 % .

The results showed that the percentage of mortality was decreased with the larvae development in age and increased with increasing the time of exposing . In the third instar larvae , the highest percentage of mortality was reached to 79.51 % after six days from treatment by *B. bassiana* **(**$10^8$ concentration**)** . The lowest percentage of mortality was also recorded in *P. farinosus* treatment (33.39 %) after six days too and its non differ significantly from the other treatment .

The results indicated that all individuals of first and second instars larvae died in most treatments after three days of exposing to *B. bassiana* with high concentration and these results were not found in case of *P. farinosus* in except with $10^8$ concentration after three days in the first instar larvae which reached 95.65% . The lowest percentage of mortality was in third instar larvae which reached 12.93 % when treated by $10^6$ concentration of ***P. farinosus*** .

These variances among the mortality percentage with different fungi concentration agreed with Al-barroni and Hejaze (1994) who mentioned that the effect of entomopathogenic fungi was differ according to the type of insect and the spore suspension concentration that used in each treatment . Also these results agreed with Parker et.al. (2003) , Olson and Oehing (1999) , Wriaght *et.al*. (2000) and Assaf (2009) who stated that the mortality percentage was weakness in low concentration and its duplicate by increasing the spore concentration . Inglis et.al. (1997) , and Sabbour and Abd-El-Aziz (2007) stated that accumulative mortality percentage increased gradually by increasing the period of exposure . El-Sinary and Risk (2007) mentioned that larval mortality increased as the fungal concentration dose increased . Quesada-Moraga et.al.(2006) explained that the efficiency

of entomopathogenic fungi began clearly after 48 h from inoculation and the hyphae penetrated the integument inside the trachea and the epithelial and epidermal cells .

The results showed that the first instar larvae was more sensitive to entomopathogenic fungi (*B. bassiana* and *P. farinosus*) than the other instars , because it has a thin cuticle wall that allowed the fungi to enter easily and consumed the internal contents by exacretion of enzymes and also because this instar was affected by the biotic factors especially entomopathogenic and the climatic factors specially the temperature degree and humidity percentage . This agreed with Story et.al. (1989) and Vannien et.al.(2000) who mentioned that there is a negative correlation between the mortality percentage and the insect develop .

**Table (1) :** Pathogenicity of different concentrations of *Beauveria bassiana* and *Paecilomyces farinosus* to poplar leaf beetle*Melasoma populi* larvae .

| Fungi | Concentration Conidia / ml. | Corrected mortality (%) for larvae instars | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1st. instar larvae | | | 2nd. instar larvae | | | 3rd. instar larvae | | |
| | | 1 day after treatment | 2 days after treatment | 3 days after treatment | 1 day after treatment | 2 days after treatment | 3 days after treatment | 2 days after treatment | 4 days after treatment | 6 days after treatment |
| *B. bassiana* | 1* $10^6$ | 16.67 abc | 39.13 d | 78.26 bc | 9.52 bcd | 14.29 bc | 53.38 bc | 23.17 abc | 23.17 bc | 38.54 bc |
| | 1* $10^7$ | 20.83 abc | 56.50 bc | 100 a | 28.57 a | 42.86 a | 74.36 ab | 28.29 ab | 33.35 b | 53.90 ab |
| | 1* $10^8$ | 33.33 a | 73.91 a | 100 a | 33.29 a | 47.62 a | 100 a | 33.42 a | 74.40 a | 79.51 a |
| *P. farinosus* | 1* $10^6$ | 8.33 bc | 21.74 e | 65.22 c | 4.76 cd | 14.13 bc | 43.59 c | 7.81 bc | 12.03 bc | 12.93 cd |
| | 1* $10^7$ | 12.50 abc | 43.47 c | 69.56 c | 19.04 abc | 33.31 ab | 64.10 bc | 12.93 abc | 17.99 bc | 23.20 bcd |
| | 1* $10^8$ | 25.00 ab | 56.41 b | 95.65 ab | 23.81 ab | 42.83 a | 69.23 bc | 18.05 abc | 27.95 bc | 33.39 bcd |
| *Control* | | 0.00 c | 4.17 f | 4.17 d | 0.00 d | 0.00 c | 2.50 d | 2.38 c | 2.38 c | 2.38 d |
| *B. bassiana* | | 23.61 a | 56.51 a | 92.75 a | 23.79 a | 34.92 a | 75.91 a | 28.29 a | 43.64 a | 57.32 a |
| *P. farinosus* | | 15.28 a | 40.54 b | 76.81 b | 15.87 a | 30.09 a | 58.97 b | 12.93 b | 19.32 b | 23.17 b |

Means followed by a common letter within the same column are not significantly different at the 5% level by DMRT

**3-3 :Pathogenicity of *B. bassiana* and *P. farinosus* to *M. populi* pupae stage :**

Mortality percentage in case of pupae stage was determined depending on the number of adult insects emergency , and the individuals that can not emerged from pupae stage considered from the died individuals .

The data in ( fig.2 ) showed a high significant differences between fungi type and spore concentration on the pupae mortality percentage . *B. bassiana* ($10^8$ concentration) scored a highest mortality % reached 74.36 % and differ significantly from all other concentration . Also the *B. bassiana* ($10^7$ concentration) has an obvious effect on pupae mortality as 69.23% but it was not significantly differ from *B. bassiana* ($10^6$ concentration) and *P. farinosus* (**(**$10^8$ concentration ) which recorded 28.21 and 23.08 % , respectively .

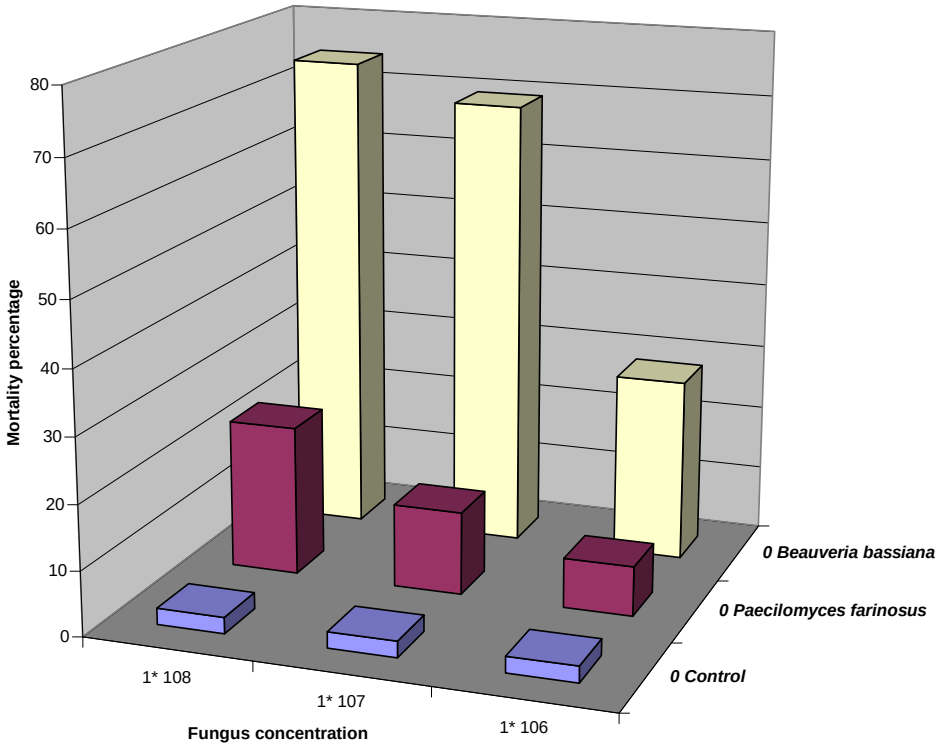


**Fig. (2):** Effect of fungus types and concentrations on mortality percentage of poplar leaf beetle pupae

The previous obtained results were in harmony with results gained by Watt and LeBrun (1984) who stated that the *B. bassiana* effected on the Colorado potato beetle pupae and reduced the adult emergency from pupation . The percentage of potato tuber moth emergence showed a highly progressive decrease with the increase of concentration of *B. bassiana* (Hafez *et.al*., 1994) . Tanada and Kaya (1993) and McCoy *et.al*. (1988) mentioned that the *B. bassiana* infected successfully larvae, pupae and adults of many insects .

**3-4 : Pathogenicity of *B. bassiana* and *P. farinosus* to *M. populi* Adults :**

**3-4-1 : On -plant trial :**

Table (2) indicated that there were no significant differences between the two application methods in spite of that when the adults sprayed directly by fungus suspension could provide better adhesion relative than the leaves treated . The maximum mortality percentage reached 70.23 % after 12 days when the leaves sprayed by *B. bassiana* ($10^8$ concentration) and not differ from the mortality percentage of adults sprayed by the same fungi , concentration and period which reached 65.22% . 43.63% was the maximum mortality percentage which recorded when the leaves sprayed by *P. farinosus* ($10^8$ concentration) and not differ from the percentage ( 40.37%) that recorded when the adults sprayed by *B. bassiana* ($10^7$ concentration) .

**Table (2) :** Pathogenicity of different concentrations and two application methods of *Beauveria bassiana* and *Paecilomyces farinosus* to poplar leaf beetle *Melasoma populi* adults .

| Fungi | Concentration Conidia / ml. | Corrected mortality (%) for Adults | | | | | | Average | |
|---|---|---|---|---|---|---|---|---|---|
| | | 4 days after treatment | | 8 days after treatment | | 12 days after treatment | | | |
| | | Insects treated | Leaves treated | Insects treated | Leaves treated | Insects treated | Leaves treated | Insects treated | Leaves treated |
| *B. bassiana* | 1* $10^6$ | 4.76 b | 5.99 b | 10.56 bc | 6.24 c | 15.53 d | 10.72 d | 10.28 ef | 7.65 f |
| | 1* $10^7$ | 9.25 b | 6.32 b | 30.42 ab | 19.64 bc | 40.37 b | 37.97 c | 26.68 cd | 21.31 de |
| | 1* $10^8$ | 28.57 a | 37.57 a | 45.34 a | 40.47 a | 65.22 ab | 70.23 a | 46.38 a | 49.40 a |
| *P. farinosus* | 1* $10^6$ | 4.35 b | 0.00 b | 9.26 bc | 4.14 c | 14.62 d | 4.14 d | 9.41 ef | 2.76 f |
| | 1* $10^7$ | 8.70 b | 0.00 b | 15.50 bc | 4.75 c | 34.78 c | 11.75 d | 19.66 cd | 5.50 f |
| | 1* $10^8$ | 23.81 a | 6.25 b | 36.01 a | 12.94 bc | 39.13 bc | 43.63 b | 32.98 bc | 20.94 de |
| *Control* | | 0.00 b | 0.00 b | 3.98 c | 6.67 c | 3.98 d | 6.67 d | 2.65 f | 4.45 f |
| *B. bassiana* | | 14.19 a | 16.60 a | 28.77 a | 22.12 a | 40.37 a | 39.64 a | 27.78 a | 26.12a |
| *P. farinosus* | | 12.28 a | 2.08 b | 20.26 b | 7.28 b | 29.51 b | 19.84 b | 20.68 b | 9.73 b |

Means followed by a common letter within the same period are not significantly different at the 5% level by DMRT

In general the results in table 2 indicated that the mortality of poplar leaf beetle adults differed according to the fungus type and there was a significant differences between *B. bassiana* and *P. farinosus* regardless of the period after treatment or the application methods . The maximum average percentage of mortality by *B. bassiana* reached 40.37% after 12 days of treatment while the maximum average percentage of mortality by *P. farinosus* reached 19.84% .

Adults killed by the fungus didn't change color,whereas dead adults in the control treatment darkened. After incubation of cadavers under moist conditions , fungi emerged and formed conidia with conidiophores on the dorsal and ventral surfaces of the adult insects . This results agreed with Gidin et.al. (2006 ) who mentioned that the Red palm weevil adults did not change in color when killed by *B. bassiana* spores .

**3-4-2: On-litter**

It could be concluded from the data showed in table (3) that there was a positive correlation between the adult mortality percentage and the fungal concentration doses . The highest score was obtained when the *B.bassiana* concentration was $10^8$ spores/ ml after 5, 10, 15 days and average which was 54.51, 61.11, 66.34 and 60.21 % respectively . The lowest mortality percentage recorded by *P. farinosus* ($10^6$ concentration) which was 0.00, 0.00, 12.51 and 4.17% and not differ when compared with the mortality percentage of control treatment after the same period which recorded 0.00, 0.00, 4.76 and 1.59 % respectively . Also results indicated that the mortality associated with fungal treatment was significantly greater than in the control in every instance except on day 5and 10 for the low concentration of *P. farinosus* .The field efficacy of entomopathogenic fungi towards various pests depends on many factors , often related to the behavior of the insect host in natural habitat . The soil is the natural habitat of fungi and , since the poplar leaf beetle adults hibernated beneath the fallen leaves , herbs, trunk cracks and inside the cleavages of soil, particularly around the roots until the next spring (Hassan, 2003) it is theoretically possible to infect them with fungal spores.

**Table (3) :** Pathogenicity of different concentrations of *Beauveria bassiana* and *Paecilomyces farinosus* to poplar leaf beetle *Melasoma populi* adults (litter trial) .

| Fungi | Concentration Conidia / ml. | Corrected mortality (%) for Adults | | | Average |
|---|---|---|---|---|---|
| | | 5days after treatment | 10 days after treatment | 15 days after treatment | |
| *B. bassiana* | 1* $10^6$b | 27.78 b | 31.58 b | 38.89 b | 32.75 b |
| | 1* $10^7$ | 35.32 b | 35.32 b | 41.18 ab | 37.27 b |
| | 1* $10^8$ | 54.51 a | 61.11 a | 66.34 a | 60.21 a |
| *P. farinosus* | 1* $10^6$ | 0.00 c | 0.00 c | 12.51 c | 4.17 c |
| | 1* $10^7$ | 33.33 b | 34.69 b | 36.18 b | 34.73 b |
| | 1* $10^8$ | 35.29 | 38.89 b | 47.50 ab | 40.56 b |
| *Control* | | 0.00 c | 0.00 c | 4.76 c | 1.59 c |
| *B. bassiana* | | 39.20 a | 42.67 a | 48.36 a | 43.41 a |
| *P. farinosus* | | 22.87 b | 24.53 b | 32.06 b | 26.49 b |

Means followed by a common letter within the same column are not significantly different at the 5% level by DMRT

These results agreed with Parker (2003) who mentioned that the effect of fungal treatments on *Eurygaster integriceps* adults was already evident on day 5 post-application and on day 15 recorded the highest mortality percentage .Gindin et.al. ( 2006 ) stated that since the Red Palm Weevil pupae occasionally inhabit the soil , it is possible to infected by fungal spores , however , pupation occurs inside a cocoon and young adults remain in the cocoon for 8-14 days , which gives rise to doubt about the feasibility of implementing fungi in soil .

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# هەلسەنگاندنا شیانێن کەرووان *Beauveria bassiana* (Bals.) Vuill. و *Paecilomyces farinosus* ( Dicks ex Fr.) دژی کێزا بەلگێن سپیندارا *Melasoma populi* L.


## پوختە

ئەڤێ ڤەکولینێ چەندیا شیانێن توش بونا هەردوو کەرووان *Beauveria bassiana* و*Paecilomyces farinosus* دژی قوناغێن کێزا بەلگێن سپیندارا *Melasoma populi* L. بخوڤە گرتیە دکاودانێن لابورێ دا ب سێ ریژێن سپورێن کەرووان (10$^6$، 10$^7$، 10$^8$)سپور/مل. هەر دوو کەرووان شیانێن دیارێن توش بونێ هەبون لسەر قوناغێن کێزا بەلگێن سپیندارا، لێ جیاوازی هەبون دناڤ بەرا هەردوو کەرووان ودەمێن توش بونێ دا. هێکێن ب کەرووێ *Beauveria bassiana* (10$^8$ سپور/مل) هاتینە رەشاندن کێمترین ریژا تروکاندنێ تومارکر 35.50٪ بەرامبەر هێکێن کونترولی (97.62٪) کرموکێن ژیێ ئێکێ ودوویێ پتڕین هەستیار بون ب هەر دوو کەرووان ژ کرموکێن ژیێ سیێ، کو ریژا مرنا کرموکێن هەر دوو ژیێن ئێکێ ودوویێ یێن ب کەرووێ *Beauveria bassiana* هاتینە رەشاندن گەهشتە 100٪، وریژا مرنا کرموکێن ژیێ ئێکێ یێن ب کەرووێ *Paecilomyces farinosus* (10$^8$ سپور/مل) هاتیە رەشاندن گەهشتە 95.65٪. دیسان جیوازی هەبو دناڤ بەرا هەر دوو کەروان لسەر پیوپان وبریژێن جودا جودا، کو بلندترین ریژا مرنێ گەهشتە 74.36٪ دەمێ هاتینە رەشاندن ب کەرووێ *Beauveria bassiana* (10$^8$ سپور/مل). هەر وسان بلنترین ریژا مرنا کێژێن تەمام هاتە تومارکرن پشتی 12 روژان ژ رەشاندنێ ب کەرووێ *Beauveria bassiana* بریژا 10$^8$ سپور/مل کو گەهشە 70.23، 65.22٪ دەمێ بەلك وکێژ ئێك سەر هاتین رەشاندین ولدیف ئێك.


# تقييم كفاءة الفطرين *Beauveria bassiana* (Bals.) Vuill. و *Paecilomyces farinosus* ( Dicks ex Fr.) ضد خنفساء اوراق القوغ *Melasoma populi* L.


## الخلاصة

تناولت هذه الدراسة تقييم كفاءة الفطرين*Beauveria bassiana* و *Paecilomyces farinosus* ضد حشرة خنفساء اوراق القوغ *Melasoma populi* تحت ظروف المختبر و بثلاثة تراكيز لابواغ الفطرين (10$^6$ ، 10$^7$ و 10$^8$ ) بوغ/مل . اظهر الفطران قدرتهما الامراضية على كل مراحل حياتية الحشرة و تباينت هذه الكفاءة تبعا لنوع الفطر و فترة التعريض .وجد أن نسبة فقس للبيض بلغت ادناها (35.50 %) عند معاملتها بالفطر *B. bassiana* ( 10$^8$ بوغ / مل ) مقارنة بمعاملة السيطرة ( 97.63 %) .كما أظهرت يرقات العمر الاول و الثاني حساسية اعلى للفطرين مقارنة بيرقات العمر الثالث للحشرة حيث بلغت نسبة الموت بلغت 100% ليرقات العمر الاول و الثاني عند معاملتها بالفطر *B. bassiana* (10$^8$ بوغ/مل) و 95.65 % ليرقات العمر الاول عند معاملتها بالفطر *P. farinosus* (10$^8$ بوغ / مل) . كما اظهرت النتائج اختلافات معنوية بين تأثير الفطرين عند معاملة العذارى و بالتراكيز المختلفة حيث سجلت اعلى نسبة موت 74.36% عند معاملتها بالفطر *B. bassiana* ( 10$^8$بوغ/مل) كما سجلت اعلى نسبة موت بعد 12 يوما من المعاملة بابواغ الفطر *B. bassiana* عند التركيز 10$^8$ بوغ / مل حيث بلغت 70.23 % و 65.22 % رش الاوراق و الحشرات بأبواغ الفطر على التوالي .

# HETEROSIS, GENE ACTION AND HERITABILITY IN FABA BEAN(*Vicia faba L.*)

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## ABSTRACT

**Sixteen genotypes of faba bean (*Vicia faba* L.) including four parents (Italy, Spania, Turkish and Duhok) and their complete hybrids with their reciprocals were tested using a randomized complete block design with three replications. Analysis of variance results for yield and some of its components showed highly significant differences for all traits, indicating wide genetic variability. Results indicated that Fl's exhibited significant heterosis for all studied traits. Significant additive genetic variance was shown for days to flowering, no. of pods/plant, no. of seeds/pod, dry seed yield/plant 100-dry seed weight and protein percentage. The ratios of $\hat{\delta}^2 GCA / \hat{\delta}^2 SCA$ exceeded unity for number of seeds/pod indicating the importance of additive gene action for this triat, while low $\hat{\delta}^2 GCA / \hat{\delta}^2 SCA$ (less than unity), revealed the pre dominance of non-additive gene action for other traits. Narrow sense heritability was high for: plant height, no. of branches/plant, no. of seed/pod, dry seed yield/plant and protein percent which indicate to additive gene action for these traits. Average degree of dominance was more than unity for all traits except no. of seeds/pod indicating the presence of over dominance for these traits.**

***KEY WORD:*** *Diallel, gene action, hetrosis, faba bean*

## INTRODUCTION

Faba bean (*Vicia faba* L.) is one of the most important legume crops in Iraq and widely considered as a good resource of protein, starch, cellulose and mineral (Hacisfererogullan et. al., 2003) for human. The genetic improvement of various traits depends on the nature and magnitude of genetic variability in addition to hybridization which offers new recombination and release a new materials for improvement and helps the breeders to identify the best combination to be crossed either to exploit heterosis, or build up the favorable fixable gene, therefore the yield itself may not be the best criterion for selection, so that breeding for high seed yield is associated with yield and its components; number of branches/plant, pods/plant, seeds/plant and 100-seed weight (Rowlands, 1955).

Superiority of hybrid over mid parents for seed yield was associated with manifestation of heterotic effect for yield components i.e. number of branches, pods, seed/ plant and 100 seed weight (Attia *et al.* 2002; Attia and Salem, 2006; El-Hady *et al.* 2006; El-Harty *et al.* 2009).

Combining ability analysis helps the breeders to identify the best combiners which may be hybridized either to exploit heterosis. Al-Adary 1987-in arabic. (Abdalla *et al.* 2001; Attia and Salem 2006; Al-Kummer *et al.* 2006) reported that both $\delta CA / SCA$ and SCA variance was important for yield and components (Darwish *et al.* 2005; El-Hady *et al.* 2006; El-Hady *et al.* 2007 and El-Harty *et al.* 2009 revealed that non-additive effects were more important for number of branches, pods seed yield/ plant than additive effects.

Estimates of heritability for different traits were calculated by several researchers using different materials and methods reported that heritability values were high for 100-seed weight and low to moderate for seed yield, number of branches, pod, and seeds/plant (El-Hady *et al.* 1998; Abdalla *et al.* 2001; Attia *et al.* 2002).

The present study aimed to determine the heterosis, general and specific combining ability and nature of gene action of some faba bean hybrid combination.

## MATERIAL AND METHODS

Four faba bean genotypes: (Italy, Spain, Turkish and Duhok) were obtained from research station of Agriculture, Duhok. were crossed in all possible combination 4×4 diallel cross design excluding reciprocals and hybrid during 2009 growing season in Experimental field of Agriculture Colleges, Duhok university.

The Parents and their 12 $F_1$'s hybrid seeds were sown in a randomized complete block design RCBD with three replication in 2010 season. Each block include 12 $F_1$'s and four parents.

Seeds were planted in single hills, 20cm a part. Each genotype was represented by one row, 5 meters long, and 50cm in between. At maturity six individual plants were taken at random from each entry and data for the following traits were recorded: days to flowering, plant height (cm), number of branches/plant, number of pods/plant, number of seeds/pod, dry seed yield/plant (g), 100-dry seed weight (g) and protein percentage according to macro kileldhl (A.O.A.C. (1980).

Heterotic effects of Fl's were estimated as deviation of $F_1$ from mid parents using the following formula:

Mid parent heterosis = $\tilde{F}_1 - (P_1 + P_2) / 2$

Analysis of variance for combining ability and additive ($\hat{\delta}^2 A$), dominance ($\hat{\delta}^2 D$) and environmental ($\hat{\delta}^2_E$) where calculated according to Griffing (1956 b) method I, fixed model where:

$$\hat{\delta}^2 A = 2\hat{\delta}^2 GCA$$

$$\hat{\delta}^2 D = 2\hat{\delta}^2 SCA$$

$$\hat{\delta}^2 E = MSE / r$$

Where $\hat{\delta}^2 GCA$, $\hat{\delta}^2 SCA$ refers to variance effect of general and specific combining ability

Heritability in broad sense $(H)^2$ and narrow sense heritability ($h^2$) and average degree of dominance (ā) were calculated as following formula:

$$\hat{H}^2 = \hat{\delta}^2 G / \hat{\delta}^2 P \times 100$$

$$\hat{h}^2 = \hat{\delta}^2 A / \hat{\delta}^2 P \times 100$$

$$\bar{a} = \sqrt{\frac{2\hat{\delta}^2 D}{\hat{\delta}^2 A}}$$

Where: $\hat{\delta}^2 G$ and $\hat{\delta}^2 P$ refers to total genotypic variance and phenotypic variance respectively.

## RESULTS AND DISCUSSION

Mean performance of parents and their crosses for all studied traits are presented in (table 1) There was highly significant differences among parent and their cross according to Duncan's Multiple-range test. The hybrid (1×3) with non significantly differences with (3×1) recorded highest number of seeds/pod (5.667g) and dry seed yield/ plant (15.206, 15.216) respectively, (2×4) hybrid was superior for (100-dry seed weight 43.133g) and protein percent which not differ with (4×3) hybrid for protein percentage (28.053, 28.33) respectively. Result showed that the hybrid (2×3) had the tallest plant (86.03cm) and highest number of branches/ plant (7.333).

For days to flowering the hybrid (4×1) exhibited the latest plant which record (84.00) day. These results are in accordance with those obtained by Attia *et al.* (2002); Salama *et al.* (2001); Attia and Salem (2006); Al-Kummer *et al.* (2006 in Arabic) and El-Hady *et al.* (2007).

Mean squares of genotypes, General and specific combining ability with reciprocals **(Table 2)** appeared highly significant at 0.01 probability levels for all characters, these referred to genetic variation among genotype for these traits. Similar results were obtained by El-Hady *et al.* (1991); Abdalla *et al.* (2001); Toker, C. (2004) and Al-Kummer *et al.* (2006 in Arabic).

The ratio of $\hat{\delta}^2 GCA / \hat{\delta}^2 SCA$ exceeded unity for number of seed/ pod, this indicates that this trait appears to be controlled by additive gene action, a direct selection could be useful for improved it. However low ratio of $\hat{\delta}^2 GCA / \hat{\delta}^2 SCA$ (less than unity), revealed the predominance of non-additive gene action for days to flowerings plant height, number of branches/ plant, number of pods/ plant, dry seed yield / plant, 100-dry seed weight and protein percentage. It could be concluded that both the additive and dominance have an important role in controlling the inheritance of studied traits. These result are similar to those obtained by Bakheit *et al.* (2002); Al-Kummer *et al.* (2006 in Arabic) and El-Harty *et al.* (2009).

Values of heterosis as deviation of $F_1$ from mid parent for all characters studied are presented in (Table 3). For days to flowering the crosses (1×2, 1×4, 2×3, 2×4, 3×4, 2×1, 4×2 and 4×3) shows significantly negative heterosis at 0.01 levels which is a favorable direction of earlist plant, while the crosses (3×1, 4×1, 1×4) and (1×3) revealed significantly positive heterosis.

For plant height (cm) four crosses (2×3, 2×1, 3×2) and (1×2) exhibited significantly positive heterosis at 0.01 and 0.05 levels respectively, other hybrid recorded negative highly significant heterosis.

Three hybrids (2×3, 2×1 and 3×2) exhibited significant positive heterosis at 0.01 levels and

two crosses (2×4 and 4×1), exhibit highly significant heterosis while other hybrids exhibited no significant heterosis for number of branches/ plant.

For number of pods/ plant five crosses (1×2, 1×4, 2×1, 2×4 and 4×1) revealed significantly negative heterosis at 0.01 levels and at 0.05 levels for (2×3), while positive heterosis at 0.01 level was recorded with (1×3) hybrid.

Six crosses (1×2, 1×3, 2×3, 2×1, 3×1 and 4×1) possessed positive significant heterosis at 0.01 at 0.05 levels and 0.05 level, for (3×4) and negatively at 0.05 levels with (2×4) hybrid for number of seeds/ pod.

The crosses (1×2, 1×3, 2×3, 3×1 and 3×2) recorded significantly positive heterosis at 0.01 levels and 0.05 levels with (1×4) for dry seed yield/ plant, where three hybrids (2×4, 3×4 and 4×1) exhibited significantly negative heterosis at 0.01 level and 0.05 level with (4×2 and 4×3) hybrids.

For dry seed weight/ plant the crosses (2×4, 3×1) and (2×1, 4×3) exhibited significantly positive heterosis at 0.01, 0.05 levels respectively, while other cross recorded negative heterosis at 0.01 levels except (1×3, 4×2) hybrid were not significant.

For protein percentage five crosses (1×4, 2×4, 4×1, 4×2 and 1×3) recroded significantly positive heterosis at 0.01 levels and 0.05 level with (3×2) hybrids. Other crosses exhibited significant negative heterosis was except (2×3) was not significant, different value of heterosis might be due to the genetic diversity of the parents with non-allelic interaction which increase or decrease the expression of heterosis (Hayman, 1958). These result are in accordance with these obtained by (Schill *et al.* (1998); Abdulmula *et al.* (1999); Abdalla *et al.* (1999); Darwish *et al.* (2005); and Al-kummer *et al.* (2006 in Arabic).

Table (4) shows the estimates of genetic and environmental components of variance with heritability in broad and narrow sense and average degree of dominance were A exhibited significant differences from zero for all character except number of branches/ plant indicating that additive gene was more important in controlling the inheritance of these traits.

Dominance genetic variance $\hat{\delta}^2_D$ revealed significant differences from zero for all characters except number of branches/ plant, as well as environmental variances $\hat{\delta}^2_E$ exhibited significant differences from zero for all studied traits. Similar results were obtained by El-Hady *et al.* (1991); Attia *et al.* (2002); Attia and Salem *et al.* (2006); Al-Kummer *et al.* (2006 in Arabic) and El-Hady *et al.* (2007).

Broad sense heritability recorded high value for all characters indicating that the differences between all trait due to genetic variation, while narrow sense heritability was high for plant height.cm, number of branches/plants, number of seeds/pods, dry seed yield/plant, and protein percentage. High value of narrow sens heritability indicates selection in early generation were recorded low heritability in narrow sense for days to flowering and 100-dry seed weight (g) and medium for number of pod/plant.

Estimates of average degree of dominance $\bar{a}$ were more than unity for all characters, except number of seed/pod, indicating that over dominance is controlling these traits. These result are in accordance with those obtained by Darwish *et al.* (2005), whom founded high narrow sens heritability for number of seed/pod; Salama *et al.* (2001). Attia and Salem (2006) recorded partial dominance for number of seed/ pod, and Al-Kummer *et al.* (2006 in Arabic) and El-Harty *et al.* (2009) refers to high value of Broad sense heritability of 100-dry weight and protein percentage.

**Table (1):** Mean performance of parents and their crosses for all studied traits.

| Geno types | Days to flowering | Plant height (cm) | No. of branches /plant | No. of pods/plant | No. of seed/pode | Dry seed yield/plant (g) | 100-dry seed weight (g) | Protein percentage |
|---|---|---|---|---|---|---|---|---|
| 1- | 78.66 def | 69.20 g | 5.33 ced | 17.00 bc | 4.66 b | 13.02 b | 30.14 d | 21.03 g |
| 2- | 8066 bc | 76.30 e | 5.67 ced | 20.00 a | 2.66 b | 8.63 g | 22.73 e | 20.24 h |
| 3- | 75.00 hi | 84.10 b | 6.00 bc | 15.01 de | 4.33 b | 11.04 d | 32.09 b | 23.08 e |
| 4- | 82.00 b | 61.96 i | 4.33 ef | 13.10 fg | 3.33 cd | 9.62 f | 25.06 i | 25.18 c |
| 1×2 | 76.00 gh | 73.13 f | 5.33 cde | 14.66 def | 4.66 b | 12.02 c | 27.02 g | 19.24 i |
| 1×3 | 78.00 ef | 65.03 h | 5.00 cde | 18.00 b | 5.67 a | 15.20 a | 31.21 c | 19.04 i |
| 1×4 | 70.33 L | 59.93 jk | 5.00 ced | 10.33 h | 4.00 bc | 12.07 c | 24.20 j | 24.04 d |
| 2×3 | 72.66 jk | 86.03 a | 7.33 a | 15.66 cd | 4.66 b | 12.00 c | 28.04 f | 21.32 g |
| 2×4 | 79.00 cde | 60.13 jk | 3.66 f | 13.01 fg | 2.33 e | 7.09 h | 34.13 a | 28.05 a |
| 3×4 | 71.00 ki | 66.26 h | 4.66 def | 14.66 def | 4.66 b | 8.47 g | 26.17 h | 24.11 d |
| 2×1 | 72.00 jki | 79.06 d | 6.66 ab | 12.66 g | 4.66 b | 11.12 d | 30.03 d | 20.21 h |
| 3×1 | 80.00 cd | 72.33 f | 5.66 bcd | 16.00 cd | 5.67 a | 15.21 a | 32.16 b | 21.04 g |
| 4×1 | 84.00 a | 59.40 k | 3.66 f | 8.00 i | 5.00 ab | 10.31 e | 26.88 g | 27.21 b |
| 3×2 | 77.00 fg | 82.26 c | 7.33 a | 18.00 b | 3.00 de | 10.66 ed | 26.04 h | 22.18 f |
| 4×2 | 74.66 hi | 60.93 ij | 4.66 de | 15.01 de | 2.66 de | 8.41 g | 27.20 g | 27.15 b |
| *4×3* | 73.33 ij | 65.46 h | 13.33 efd | 13.33 efd | 4.33 b | 9.59 f | 29.16 e | 28.03 a |

**Table (2):** analysis of variances for general and specific combining ability with reciprocate for all studied traits.

| S.O.V | D.F | Means square MS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Days to flowering | Plant height (cm) | No. of branches / plant | No. of pods/ plant | No. of seeds/ pode | Dry seed yield/ plant (g) | 100-dry seed weight (g) | Protein percentage |
| Replication | 2 | 1.0208 | 0.3439 | 0.1458 | 0.0833 | 0.27083 | 0.1132 | 0.0034 | 0.1019 |
| Geneotype | 15 | **49.731 | **252.1873 | **3.6444 | **26.7319 | **3.2875 | **16.2093 | **23.8089 | **29.7182 |
| GCA | 3 | **6.3009 | **312.2095 | **3.6018 | **21.1620 | **3.8564 | **19.7420 | **8.1620 | **32.0951 |
| SCA | 6 | **17.478 | **45.3641 | **0.8101 | 9.64400 | **0.47800 | **2.91421 | **9.2478 | **6.0585 |
| Reciprocals | 6 | **20.8148 | **8.6872 | **0.4259 | **2.0555 | **0.3333 | **0.7225 | **6.511 | **2.6950 |
| Error | 30 | **0.3106 | **0.1670 | **0.1078 | **0.2870 | **0.9027 | **0.0546 | **0.05002 | **0.02967 |
| $\hat{\delta}^2 GCA / \hat{\delta}^2 SCA$ | | 0.0436 | 0.8630 | 0.6218 | 0.2789 | 1.2141 | 0.8605 | 0.1102 | 0.6648 |

***, **** Significant at 0.05 and 0.01 levels of probability respectively.

**Table (3):** Heterotic effects of F1 relative to mid parents for different studied traits.

| Hybrids | Days to flowering | Plant height (cm) | No. of branches/plant | No. of pods/plant | No. of seed/pode | Dry seed yield/plant (g) | 100-dry seed weight (g) | Protein percentage |
|---|---|---|---|---|---|---|---|---|
| 1×2 | -3.667** | 0.383* | -0.167 | -3.833** | 1.00** | 1.193** | -2.415** | -1.392** |
| 1×3 | 1.167* | -11.617** | -0.667 | 2.00* | 1.167** | 3.17** | 0.093 | -3.015** |
| 1×4 | 010.00** | -5.65** | 0.167 | -4.667** | 0 | 0.747* | -3.402** | 0.933** |
| 2×3 | -5.167** | 5.833** | 1.5** | -1.833* | 1.167** | 2.160** | -2.375** | -0.34 |
| 2×4 | -2.333** | -9.00** | -1.333** | -3.5** | -0.667* | -2.037** | 7.233** | 5.338** |
| 3×4 | -7.5** | -6.767** | -0.5 | 0.667 | 0.833* | -1.863** | -2.405 | -0.018 |
| 2×1 | -7.667** | 6.317** | 1.167** | -5.833** | 1.00** | 0.293 | 0.593* | -0.422* |
| 3×1 | 3.167** | -4.317** | 0 | 0 | 1.167** | 3.18** | 1.043** | -1.018** |
| 4×1 | 3.667** | -6.183** | -1.167** | -7.00** | 1.00** | -1.01** | -0.722* | 4.11** |
| 3×2 | -0.833 | 2.067** | 1.5** | 0.5 | -0.5 | 0.827** | -4.372** | 0.517* |
| 4×2 | -6.667** | -8.2** | -0.333 | -1.5 | -0.333 | -0.717* | 0.3 | 4.435** |
| *4×3* | -5.167** | -7.567** | -0.167 | -0.667 | 0.5 | -0.743 | 0.585* | 3.898** |

*, ** Significant at 0.05 and 0.01 levels of probability respectively.
(0) zero value indicate to no significant heterosis.

**Table (4):** Additive $\hat{\delta}^2_A$, dominance $\hat{\delta}^2_D$ and environments $\hat{\delta}^2_E$ variances with haritability and average degree of dominance $\bar{a}$ for all studied traits.

| Hybrids | Days to flowering | Plant height (cm) | No. of branches/plant | No. of pods/plant | No. of seed/pode | Dry seed yield/plant (g) | 100-dry seed weight (g) | Protein percentage |
|---|---|---|---|---|---|---|---|---|
| $\hat{\delta}^2_A$ | 1.49756 | 78.01062 | 0.87349 | 5.21875 | 0.94155 | 4.92185 | 2.02800 | 8.01636 |
| | 0.996453± | 49.36466± | 49.36466± | 3.34606± | 0.60978± | 3.121495± | 1.29053± | 5.07468± |
| $\hat{\delta}^2_D$ | 17.16736 | 45.19711 | 0.70231 | 9.35300 | 0.38773 | 2.8595 | 9.19783 | 6.02886 |
| | 8.73935± | 22.6821± | 22.6821± | 4.820557± | 0.240068± | 1.45717± | 4.6239± | 3.02927± |
| $\hat{\delta}^2_E$ | 0.31064 | 0.16702 | 0.10787 | 0.28703 | 0.09027 | 0.05464 | 0.05002 | 0.02967 |
| | 0.077662± | 0.041756± | 0.041756± | 0.071759± | 0.02256± | 0.01366± | 0.01250± | 0.00741± |
| $H^2$ | 0.98362 | 0.99864 | 0.93593 | 0.98068 | 0.93640 | 0.993026 | 0.99556 | 0.99789 |
| $h^2$ | 0.07892 | 0.63230 | 0.51880 | 0.35122 | 0.663269 | 0.628102 | 0.17985 | 0.56955 |
| $\bar{a}$ | 4.78821 | 1.07644 | 1.26809 | 1.89324 | 0.907525 | 1.07795 | 1.07795 | 1.22643 |

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## کاریّ جینی، نفشی و هیّزا بیژیا ل باقلکا (*Vicia faba* L.) Faba bean

**پـوخـتـــه**

**ئەڤ ڤوکولینه یا هاتیه ئەنجامدان بو دیارکرنا شیانیّت کاریّ جینی ونفشی وهیّزا بیژیا یا چوار توخمیّت باقلکا (ئیتالی، ئەسپانی، ترکی و دهوك). ئو بیژیکرنا وان دگەل ئیّك دیار بو ژئەنجامیّ ڤەکولینیّ سەرکەڤتنا هندەك بیژیا لسەر دایك وبابا دڤان ساخلەتادا: رۆژییّت پیّتڤی بو گولدانیّ، دریژیا رووەکی، ژمارا تاکا/ رووەك، ژمارا کەلیکا/ رووەك، ژمارا توڤکا/ کەلیك، بەرهەمیّ توڤکیّت هشك/ رووەك، کیّشا 100 توڤکیّت هشك و ریژا پروتینی. و ئەنجامیّ ڤەکولینیّ دا دیار بو کو هیّزا بیژیا سەرکەفت برەنکەکیّ پشوەری دهەمی ساخلەتیّت وەرگرتیدا. هەروەسا جوداهی دناڤبەرا نفشادا یا سەرکەفتی بو برەنگەکیّ پیشوەری دهەمی ساخلەتادا ژبلی ژمارا تاکا/ رووەك، و ریژا هەلسەنگاندنیّ دناڤبەرا $\hat{\delta}^2 GCA / \hat{\delta}^2 SCA$ دیار بو کو پتر ژئیّکی (1) ل ساخلەتیّ ژمارا توڤکا/ کەلیك. ل ڤیّرە دیاردبیت گرنگیا کاریّ جینیّت زیّدەکری ل ساخلەتا ژمارا توڤکا/ کەلیك یا ڤیّ نڤشتی و کیّم بونا ڤیّ ریژیّ ژئیّکیّ دیار دکەت گرنگیا جینیّ نەزیّدەکری لسەر نفشتی. هەروەسا ریژا بیژیکرنیّ دزانینیّت بەرتەنگ دا یا بلندە لساخلەتیّ دریژیا رووەکی، ژمارا هشك/ رووەك، ژمارا توڤکا/ کەلیك، بەرهەمیّ توڤکیّت هشك/ رووەك، و ریژا بروتینی. ئەڤەژی دزڤریت بو کاریّ جینیّ زیّدەکری ییّ ڤان ساخلەتا. دەرئەنجامیّ سەرکوت کرنیّ پتر بو ژئیّکی ل هەمی ساخلەتیّت هاتینه وەرگرتن ژبلی ژمارا توڤکا/ کەلیك ئو ئەڤەژی دزڤریتەڤە بو سەر کونکرنا زیّدە بو هەمی ساخلەتا.**

**التوريث، الفعل الجيني، وقوة الهجين في الباقلاء( *Vicia faba* L.) faba bean**

**الخلاصة**

**أجريت الدراسة لاختبار الفعل الجيني والتوريث مع قوة الهجين لأربعة أصناف من الباقلاء وهي (إيطالي، إسباني، تركي ودهوك) وهجنها التبادلية الكاملة. أظهرت النتائج تفوق عدد من الهجن على متوسط الأبويين بصفات: عدد الأيام اللازمة للتزهير، ارتفاع النبات، عدد الأفرع/ نبات، عدد القرنات/ نبات، عدد البذور/ قرنة، حاصل البذور الجافة/ نبات، وزن 100 بذرة جافة ونسبة البروتين. أظهرت نتائج قوة الهجين بأنها كانت معنوية لمعظم الصفات ولأغلب الهجن. وكانت التباين الوراثي الإضافي معنوياً لكل الصفات ما عدا عدد الأفرع/ نبات، وعند تقدير النسبة بين $\hat{\delta}^2 GCA / \hat{\delta}^2 SCA$ وجدت بأنها كانت أعلى من الواحد لصفة عدد البذور/ قرنة مشيراً بذلك إلى أهمية الفعل الجيني الإضافي في وراثة تلك الصفة وانخفاض هذه النسبة الواحد يشير إلى أهمية الفعل الجيني غير الإضافي، وكانت نسبة التوريث بالمفهوم الضيق عالية لصفات: ارتفاع النبات، عدد الأفرع/ نبات، عدد البذور/ قرنة، حاصل البذور الجافة/ نبات ونسبة البروتين مما يدل على أهمية الفعل الجيني الإضافي لهذه الصفات معدل درجة السيادة كانت أكثر من الواحد لكل الصفات عدا عدد البذور/ قرنة مما يدل على وجود سيادة فائقة لتلك الصفات.**

# EFFECTS OF ROAD TRANSPORTATION ON SOME HEMATOBIOCHEMICAL and BIOCHEMICALS PARAMETERS OF BROILER CHICKENS

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## ABSTRACT

**To study the effect of road transportation on live body weight, and some haematological and biochemical parameters of broiler chicken at 49 days of age. Results revealed that road transportation caused a significant increase ($p<0.05$) in body weight losses, Heterophil /Lymphocyte** Ratio **(H/L ratio), serum glucose, serum cholesterol and creatine kinase enzyme, while the effect on Paced cells volume (PCV%), Haemoglobin (Hb), serum total protein and serum triglycerides,was not significant .**

## INTRODUCTION

There is a growing interest concerning the welfare problems associated with harvesting, transportation and pre-slaughter handling of broilers. Transportation is a multifactor process associated with a variety of stressors which may covertly reduce welfare (Ghareeb and Bohm, 2009).

Harvesting and transportation of broilers to the slaughterhouse causes a severe stress to the birds if not the severest in their short life. Immediately prior and during transportation birds may expose to a wide range of potential stressors including catching, handling, loading, motion, acceleration, impact, thermal demands imposed by the transport microclimate, fasting and withdrawal of water, restriction of behaviour, social disruption and noise. The adverse effect of these factors upon the bird may range from mild distress and aversion to injury and death. It has been reported that 40 per cent of mortalities in "dead on arrival" broilers are consequences of stress (Bayliss and Hinton, 1990) and that mortality increases with the transportation distance (Warris *et al*., 1990). Furthermore the stress connected with transit induces changes in the blood parameters of birds and the haematological examination is among the methods that may contribute to detect such changes in health status (Voslarova *et al*., 2006). The Heterophil/Lymphocyte ratio (H/L) has proved to be a valuable tool to study the effect of stress in chickens (Post *et al*., 2003). The aim of current study was to determine the effect of road transportation of birds from the farm to slaughter house on some hematological and biochemical's parameters of broiler chickens

## MATERIALS AND METHODS

Fourty mixed sex broiler chickens (49 day old) were obtained from commercial farms and randomly assigned to

4 treatment groups (10 birds each) and subjected to different transport periods from farm to slaughter house as follows:

T1 control = not transported, T2= transported for 1 hour, T3= transported for 2 hours, T4= transported for 3 hours. The transportation began at 9 pm under local climate (average ambient temperature range was $30C^0$).Birds were weighed before and immediately after transportation. Five birds from each treatments were selected randomly and 5 ml of blood was withdrawn from the wing vein of each birds to determine the PCV, Hb, H/L ratio and serum biochemical parameters. PCV% was determined by using micro-hematocrite method according to Archer, (1965).Hb was determined by Sahli method according to Lamberg and Rothstein, (1977). The H/L ratio was determined according to Gross and Siegel, (1983). Serum biochemical contents were determined by using appropriate laboratory kits (Biolab, France). Statistical analysis was carried out using statistically available software (Graph pad prism 5). Comparisons among groups were made using one-way analysis of variance (ANOVA) in combination with "Newman-Keuls Multiple Comparison Test" analysis. Newman test was used to compare all groups with each other.

## RESULTS AND DISCUSSION

The effect of transport on body weight loss and hematological parameters of broilers are presented in **Table (1)**.The percent of body weight loss and H/L ratio were significantly (P <0.05) increased in transported chickens and the highest rate of body weight loss (5.157%) and H/L ratio (1.557) were recorded for T4 as compared with the control. On the other hand the effect of transport on PCV% and Hb concentration was not significant (P >0.05) when compared with the control. These results are in agreement with the finding of Ondrasovicova *et al*., (2008) who reported decreases in broiler live body weight after 45 minutes and 2 hours of transportation as compared to the control. Also, Karaman, (2009) reported that the body weight losses significantly increased in broilers after 1, 2 and 3 hours of transportation. Also, Ghareeb, (2009) indicated that there was an increase in heterophils numbers of broilers after 24 hour of transportation. Similarly, Mitchell *et al*., (1992) observed a significant increase in H/L ratio in broiler after 216 minutes of transportation in July. While, Voslarova et al (2006) did not detect any effect of transportation in H/L ratio of Pheasant. The increase in the rate of body weight losses and H/L ratio indicated that the transportation of broilers to the slaughter house causes an economical loss to the poultry producers, and the journey was stressful to the chickens. Increase in H/L ratio is a physiological indicator of stress in birds (Altan *et al*., 2003).Plasma corticosterone is elevated following road journey (Satterlee et al. 1989). Corticisteroids produces modification of immunological functions such as lymphatic involution as a result of long term stress (Grandin, 1998).Which may be the reason of increasing H/L ratio.

Results given in **Table (1)** indicates that transportation had no significant effect neither on Hb concentration nor on PCV%.These results disagree with that observed by Ondrasovicova *etal*., (2008) who reported that Hb concentration significantly decreased in broiler after 45 minutes and 2 hours of transportation compared to the control, and Minka, (2008) showed a significant decrease in PCV% and Hb concentration in Shika Brown pullets after transportation.

**Table (1):** Effect of transport on body weight and some hematological parameters of broilers (mean ± standard error)

| Traits<br>Treatments | Weight loss% | PCV% | Hb g/dl | H/L ratio |
|---|---|---|---|---|
| **T1**<br>**Control** | 0<br>a | 30±0.816<br>A | 12.28±0.242 a | 0.632±0.079 a |
| **T2** | 3.752±0.895 b | 31±1.581<br>A | 12.4±0.611<br>a | 1.385±0.069 b |
| **T3** | 4.372±1.664 b | 30.5±1.555<br>A | 13.37±1.55<br>a | 1.364±0.097 b |
| ***T4*** | 5.157±0.301 b | 28.5±2.179<br>A | 12.8±1.2<br>a | 1.557±0.135 b |

Means with different letters for each trait was differ significantly

The effect of transport on some serum biochemical contents are summarized in **Table (2)**. Transport cause a significant increase in serum glucose level when as compared with the control.T3 and T4 had significantly higher serum glucose level as compared with T2. These results are in agreement with the finding of Najdam *et al*., (2005) who observed a significant increase in blood glucose after broiler transportation. Also, Alexandra *et al*., (2002) reported that blood glucose significantly increased in pigeons after transportation. On the other hand, Huff *et al*., (2008) found a significant decrease in serum glucose after transportation in turkey. Serum cholesterol and creatine kinase (CK) were significantly increased in transported chickens when compared with the control and the highest values were recorded for T4 group ( 114.2 mg/dl). This result agree with the findings of Ondrasovicova *et al*., (2008) who reported that serum cholesterol significantly increased in broiler after 45 minutes and 2 hours of transportation compared to the control. An increase in serum glucose and cholesterol may

be due to the stress from transportation. In acute stress, birds increase the concentrations of neurogenic amines (catecholamines) in the blood (Siegel, 1995). Neurogenic amines, such as epinephrine and norepinephrine potently activate the breakdown of glycogen to glucose in the liver (Elrom,2000) Moreover, catecholamines induce important metabolic changes such as increased lipolysis, glycogenolysis and gluconeogenesis (Ahrnes, 1996).Also creatine kinase (CK) increase glucose level in the plasma and leads as well to gluconeogenesis from labile protein as is indicated by an increase in non-protein nitrogen level (NPN), decreased in incorporation of glucose carbon into proteins and increased uric acid excretion (Halliay *et al*.,1977). CS produces symptoms associated with long term stress, including hypercholesteremia (Grandin, 1998).

Serum creatine kinase (CK) was significantly increased in transported chickens as compared with the control and the highest values were recorded for T4 group (668.4 IU/L). This result is in agreement with Mitchell *et al*., (1992) who reported that there was a significant increase in plasma creatine kinase in broiler after 216 minutes of transportation in July. Also Alexandra *et al*., (2002) reported that blood creatine kinase significantly increased in pigeons after transportation. An increased serum creatine kinase may be due to transport stress induced tissue dysfunction and damage are reflected by increased plasma activity of intracellular muscle enzymes including creatine kinase (Mitchell *et al*., 1992). Creatine kinase catalyses the reversible transfer of the phosphoryl group from phosphocreatine from ADP, to regenerate ATP and the transfer of high energy phosphate moiety is an important step in various processes in the body (Venkataraman *et al*., 2009)

The results given in **Table (2)** indicate that road transportation had change on the serum total protein and triglyceride content as compare with control group but statistically was non significance. These results disagree with Minka (2008) who showed a significant decrease in blood total protein content in Shika Brown pullets after transportation. Also, Huff *et al*., (2008) who showed a significant decrease in serum triglyceride after transportation in turkey. These disagree may be due to the time of transportation, the way of transporation and the composition of nutrition.

**Table (2):** effect of transport on some serum biochemical parameters of broilers (mean±standard error)

| Traits<br>Treatments | Glucose ml/dl | Protein<br>g/dl | Cholesterol<br>mg/dl | Triglyceride<br>mg/dl | CK<br>IU/L |
|---|---|---|---|---|---|
| **T1**<br>**Control** | 235±5.0<br>a | 4.575±0.52 a | 70±7.02<br>a | 63.5±6.50<br>a | 600±0.633 a |
| **T2** | 261.5±0.5 b | 4.225±0.26 a | 100.3±1.76 b | 68.67±5.60 a | 670.5±2.14 b |
| **T3** | 307.7±3.2 c | 4.75±0.56 a | 104.7±4.09 b | 67±13.59<br>a | 666.7±6.33 b |
| ***T4*** | 303.7±4.3<br>c | 4.95±0.28 a | 114.2±5.24 b | 65±4.35<br>a | 668.4±2.43 b |

Means with different letters for each trait was differ significantly

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**پوختە**

**لیکولینا کاریکەریا ڤەگوهاستنی ل سەر کێشا لەشی وهندەك پێڤەرێن خوینی وین بایوکیماوی یێن مریشکێن گوشتی یێن 49 روژ . لیکولینی دیار کر کو ڤەگوهاستنا مریشکا کاریگەریەکا دیار هەیە ل سەر ریژاH/L،شەکر، کولستیرول وانزیمی کریاتین کاینزی یێن سیرەمی ، بەلی کاریگەریکا نە دیار هەیە ل سەر ریژا% PCV، هیموگلوبین وجەوری سیانە و بروتینیت سیرەمی .**

**الخلاصة**

**دراسة تأثير النقل على وزن الجسم الحي لفروج اللحم ،وبعض مقاييس الدم والكيماء الحيوية لفروج اللحم بعمر 49 يوم. اثبتت الدراسة بان لعملية نقل الفروج تأثير معنوي في زيادة نسبة الفقد في الوزن الحجي وكذلك له تاثير معنوي في زيادة نسب كل من H/L ،سكر المصل،كولستيرول المصل وانزيم كرياتين الكاينيز،بينما التغير في كل من% PCV، الهيموكلوبين، والدهون الثلاثية وبروتينات المصل لم تكن معنويا مقارنة بالمجموعة الضابطة .**

# TAXONOMIC EVIDENCES FROM LEAF, FRUIT AND CUTICULAR STRUCTURE FOR IDENTIFYING *Pistacia* SPECIES IN KURDISTAN REGION OF IRAQ

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## ABSTRACT

**Leaf and fruit morphological characters in addition to leaf cuticular structure belonging to *Pistacia* species were examined to provide useful characters in distinguishing the species and refine taxonomic relationship. Characters of leaf apex, leaf base, leaf length/leaf width constitute useful taxonomic application. Number of drupes/cluster, fruit size, shape and color, Endocarp (shell) color, Kernel pulp shape and color, Testa color, are very useful diagnostic characters for identifying species.**

**Stomata of *P. vera, P. eurycarpa,* and *P. khinjuk* are amphistomatic, with much less density on the abaxial epidermal layer of *P. khinjuk*. The average stomatal size of the abaxial layer is always larger than the adaxial, while the average adaxial epidermal cell sizes are significantly larger than the abaxial epidermal cell sizes. The clivate multi-cellular trichomes are only present in *P. eurycarpa*.**

***KEY WARDS:*** *P. vera, P. eurycarpa, P. khinjuk,* Stomatal Density, Stomatal Index**.**

## INTRODUCTION

The distribution of wild *P. vera* L. is centered in Tadzhikistan, Kirgizia and North Afghanistan, and extends westward to the North part of Khurassan district in Iran, and the Kopet mountain range of South Turkmenistan (Zohary 1996). *P. eurycarpa* is one of the most widely distributed wild species. It is spread-more or less continuously-over the whole area from Northern and Western Pakistan, to central and southern Afghanistan, South and West of Iran, the Southeast Caucasus, Kurdistan region of Iraq, South Turkey, Syria, Lebanon, Jordan to Palestine. *P. khinjuk* occurs naturally in Egypt, Syria, Turkey, Iraq, Iran, Afghanistan and Pakistan. It is widely spread in the Provinces of Siirt, Hakkari, Bitlis, Gaziantep and some part of Mardin in the Southeast Anatolian region (Atli, *et al*. 1998).

Raider-Roitzsch (1969) in Forest trees in Iraq described 2 wild species of Pistacia: *P. atlantica* Desf., *P, khinjuk* Stocks, in addition to the cultivated Pistacio (*P. vera* L.). In flora of Iraq, Townsend and Guest (1980), described 3 species: *P. eurycarpa* Yalt., *P. khinjuk* Stocks, and *P. vera* L. Leila Pazouki *et al.* (2009) described 3 widely distributed *Pistacia* species in Iran: 1. *P. atlantica* Desf. with 3 subspecies: *P. atlantica* subsp. *kurdica*, *P. atlantica* subsp. *mutica*, and *P. atlantica* subsp. *cabolica*, 2. *P, khinjuk* Stocks, and 3. *P. vera* L. (wild type and cultivated). While, Davis (1967), in flora of Turkey, recorded 6 species distributing mostly in the south-east Anatolia: 1. *P. lentiscus* L., 2. *P. atlantica* Desf., 3. *P. eurycarpa* Yalt., 4. *P, khinjuk* Stocks, 5. *P. vera* L. 6. *P. terebinthus* L.

The monograph of *Pistacia* L. by Zohary (1952) was considered at that time the most comprehensive taxonomic treatise of the genus of the old world. Zohary in his monograph divided the genus into 4 subgenera namely: 1. *Lentiscella* Zoh.: *P. mexicana* HBK. and *P. texana* Swingle. 2. *Eu Lentiscus* Zoh.: *P. lentiscus* L., *P. saportae* Burnat, ant *P. weinmannifolia* Boiss. 3. *Butmela* Zoh.:*P. atlantica* Desf. (Zohary considered *P. eurycarpa* Yalt. Occurring in Iraq as a subspecies for *P. atlantica* Desf.. 4. *Eu Terebinthus* Zoh: *P. chinensis* Burge, *P. Khinjuk* Stocks. *P. palaestina* Boiss, *P. terebinthus* L. and *P. vera* L.

Kafkas and Perl-Treves (2001) argued for relationships among *Pistacia* species based on leaf and seed morphology as well as geographical distribution. Several researchers described fruit type, shell, nut and kernel in *P. vera* and the effect of pollen sources on fruit dimensions (Crane and Iwakiri, 1981; Riazi and Rahemi, 1995; Ka-ka and Ak, 1996). In Jordan, EL-Oqlah (1996) described *Pistacia* species: *P. atlantica*, *P. lentiscus*,and *P. palaestina*, from

the stand point of morphology and anatomy. Al-Saghir and Porter (2005**)** studied leaflet stomata distribution in the genus; moreover, Al-Saghir *et al.* (2006) investigated the anatomy of the leaves of 15 species of *Pistacia*, including all those species which occur in Kurdistan region.

The classification and delimitation of *Pistacia* species are still a mater of debate at least in Iraq, therefore, the morphology of leaf and fruit characters belonging to *Pistacia* species were examined; inflorescences and flowers were found to provide little evidences for taxonomic application (Mohannad Ghazi AL-Saghir, 2006), therefore flowers and inflorescences were discarded from the test. Details of leaf cuticular structure were studied aiming to utilize this information for providing more insights into taxonomy of *Pistacia* and to determine whether these features can provide useful characters in distinguishing the species and refine taxonomic relationship.

## MATERIALS AND METHODS

Field trips started early 2008 and continued during 2009. A total of 45 trees or shrubs, 15 for each species from the physiographic regions (Townsend and Guest (1985): MJS (Jabal Sinjar District), MAM (Amadiya District), MRO (Rowanduz District), FAR (Arbil District), MSU (Sulaimaniya District), and FKI (Kirkuk District) were sampled. 6 leaves from each 2 trees or shrubs representing the species in each district were removed from the herbarium specimens, with 30 measurements were taken for each of the following character per species:

Leaf length, leaf width, petiole length, apical leaflet length (L), apical leaflet width (W), L / W, leaflet blade apex, leaflet blade base.

**Fruit and Seed**

4 fruit clusters from each 2 trees or shrubs representing the species in each district were also removed. Measurements were taken for each of the following character per species:

Cluster length, cluster width, number of branchlets / cluster, number of drupes / cluster, drupe length, drupe width, drupe length / drupe width, pericarp thickness, pedicel length, Kernel length, kernel width, kernel thickness, kernel pulp color, testa color.

**Cuticular Structure**

3 trees from each species located in Amadiya, Rowanduz and Sulaimani districts were selected with exception of the *P. vera* which was collected from cultivated orchards in the area around Duhok city. 4 mature leaves from each tree or shrub were used for light microscope measurement. The samples were rehydrated using ethyl alcohol up to 90% then stored in 70% ethanol, and subsequently the leaves of each species were sampled randomly from the ethanol, washed in distilled water, dried, then immersed in equal volumes of glacial acetic acid and hydrogen peroxide, left in oven at 60 $c^o$ for 24-36 hours, depending upon the species. Adaxial and abaxial peelings from the macerated leaves were stained by safranin-glycerin jelly, mounted on microscope slides, covered by slides. The following parameters were scored, average of 50 measurements for each:

Abaxial and adaxial epidermal cell dimensions. Stomatal Dimensions. Epidermal cell density (number of epidermal cells / $mm^2$). Stomatal density (number of stomata / $mm^2$). Stomatal index%= (stomatal density/ (stomatal density + epidermal cell density)*100.

## RESULTS AND DISCUSSION

**Leaf Characters**

Means and ranges of leaf length, leaf width, and petiole and leaf length/leaf width are given in table (1).

Data indicate similarity between species in leaf length, slight differences in leaf width, leaf length/leaf width ratio and petiole length. The similarity in these parameters is more apparent between *P. eurycarpa* and *P. khinjuk* than between them and *P. vera*. Widest leaf widths are present in *P. vera*, but in most cases, because of high overlapping the differences do not prove taxonomically-significant. Number of leaflets/leaf shows high variability between and within species. More than 54% of *P. vera* leaves consist of 3 leaflets, while about 39% of leaves contain 5 leaflets, very few number of leaves consist of 7 leaflets. *P. eurycarpa* consists of the same range of leaflets of *P. vera*, but differ in structure; about 55% of leaves have 5 leaflets, while 25% have 7 leaflets, and only 20% of the leaves possess 3 leaflets per leaf. Comparing with *P. khinjuk*, more than 62% of the leaves consist of 5 leaflets, while more than 25% of leaves are composed of 7 leaflet, and very few (usually 4%) contain 9 leaflets. Leaflets of *Pistacia* species always differ in orientation; there is variability in arrangement within the leaf. This phenomena is more apparent in *P. vera* compared with the other two *Pistacia* species

When investigating leaflet sizes, it is revealed that the terminal leaflet size is only occasionally larger than the rest of the leaflets. The larger terminal leaflets ratio increases in certain trees of *P. khinjuk* from Barzan and Soran localities (MRO district). It is not known whether these larger leaflets are correlated with a certain variant of the genetic basis or not.

The values of the terminal blade length, blade width and consequently the ratio of blade length/blade width are very close to one another in *P. eurycarpa* and *P. khinjuk*. Data displayed in table (1) indicate that the terminal leaflet in *P. vera* is about one and half times as long as wide, while in *P. eurycarpa* and *P. khinjuk* the blade is about twice as long as wide. The apex of terminal leaflet of *P. khinjuk* is acute to acuminate, while that of *P. eurycarpa* is acute, the presence of some acute leaflets in *P. khinjuk* and some acuminate lealets in *P. eurycarpa* diminished the taxonomic application of this character. The blade base of *P. khinjuk* is more rounded in shape compared with that of *P. eurycarpa*. The high similarity between *P. khinjuk* and *P. eurycarpa*, in leaflet size, shape apex do not allow distinction between them on the basis of leaf characters only.

**Table (1):** Leaf Quantitative and Qualitative Characters.

| **Character** | **Statistics** | ***Pistacia vera*** | ***Pistacia eurycarpa*** | ***Pistacia khinjuk*** |
|---|---|---|---|---|
| Leaf length | Mean | 15.86 | 15.74 | 16.04 |
| (cm) | Range | 8.80-19.00 | 9.08-22.70 | 10.02-21.80 |
| Leaf width | Mean | 15.49 | 12.39 | 13.05 |
| (cm) | Range | 7.93-20.50 | 6.94-18.10 | 6.01-21.60 |
| Petiole length | Mean | 4.03 | 4.92 | 4.59 |
| (cm) | Range | 1.78-5.41 | 2.30-8.90 | 2.14-7.99 |
| Number of leaflets | | 3-5(-7) | 3-5(-7) | 3-7(-9) |
| Blade length | Mean | 8.77 | 6.74 | 6.43 |
| (cm) | Range | 5.14-11.46 | 2.77-10.24 | 3.50-10.84 |
| Blade width | Mean | 6.19 | 3.4 | 3.29 |
| (cm) | Range | 3.40-9.42 | 1.65-6.17 | 1.67-5.49 |
| Blade apex | Mean | 2.82 | 2.11 | 1.51 |
| 1=<50 $^{o}$ Acuminate | | 2-4.0 | 1-3.0 | 1-3.0 |
| 2= > 50 - 90$^{o}$ Acute | Range | | | |
| 3= > 90-150$^{o}$ Rounded | | | | |
| 4= > 150$^{o}$ Truncate | | | | |
| Blade base | Mean | 2.25 | 2.17 | 2.78 |
| 1=<50 $^{o}$ Acuminate | | 1-3 | 2-3 | 1-3.0 |
| 2= > 50 - 90$^{o}$ Acute | Range | | | |
| 3= > 90-150$^{o}$ Rounded | | | | |
| Blade length/ | Mean | 1.46 | 1.98 | 1.97 |
| Blade width | | 0.72-2.14 | 1.72-2.18 | 1.65-2.11 |
| | Range | | | |
| leaflet shape | | Ovate, broad lanceolate, orbicular or rounded | Ovate to broad lanceolate | Broadly lanceolate to ovate or elliptic |
| *Petiole shape* | | Flattened | Flattened, more or less rounded only in one side | Flattened- to more or less rounded |

**Fruits**

Fruits are produced as panicles or clusters, normally pedunculate, drupe pediceled or sessile, one-celled. *Pistacia* fruits are in lax clusters or panicles, whereas those of *P. khinjuk* and *P. vera* are firm, straighter and less pendulous compared with *P. eurycarpa*. Moreover, clusters of *P. khinjuk* are longer than the other two *Pistacia* species (table 2), but clusters of *P. eurycarpa* are significantly broader than the others.

Clusters of Pistacia species are mostly born at the tips of branches, very small number on the tips of lateral twigs; therefore, fruit clusters are mostly located at the boundary or the outer portions of tree canopy, only few are located within the canopy.

Drupes of *P. vera* are large (table 2), about twice as long as wide; the pericarp (the hall) is dry with little pronounced tip, orange red or yellow orange, ovoid elongate. Endocarp (shell) is smooth, apex rounded. Pedicel scar is elliptic-ovate, position of structure opening dorsal and ventral side.

Drupes of *P. eurycarpa* are broadly obovate or depressed-globular; (a character normally used to distinguish it from *P. atlantica*. (Davis, 1967), mostly broader than long, slightly compressed, length/width ratio 0.75-0.96. Ectocarp first whitish, gradually turning whitish-red, then bright green or bluwish green, smooth, resinous, mesocarp is pulpy, endocarp hard, bony, smooth, dark brown.

Drupes of *P. khinjuk* are smaller in size compared with *P. eurycarpa*, broadly obovoid or ellipsoid, apiculate, sometimes slightly elliptic, whitish-red in immature drupes, gradually becoming bright green or bluish-green in complete mature fruits. Mesocarp is also pulpy, endocarp is bony, but thinner in thickness compared with the endocarp of *P. eurycarpa* light brown, and smooth.

**Seeds**

Seeds of *P. vera* are easily recognized by their large sizes and ovate oblong shapes. Kernels are consequently large of satisfactory flavor. Mean seed length, width, and thickness are 13.17mm * 7.34mm *6.2mm. Kernel color is yellowish-green, testa reddish-brown (figure 2). *P. eurycarpa* seeds are oblong, mean length, width, and thickness is 5.01mm *7.38mm * 3.55mm. Kernel is bright green, testa dark-brown. Seeds of *P. khinjuk are* small, sometimes oblique, globular, occasionally compressed. Mean length, width, and thickness are 4.74mm * 3.78mm * 1.76mm. Kernel is whitish yellow, testa dark buff (Tables 2 and 3).

From the above results, it could be concluded that the color of the seed pulp (kernel) and testa (seed coat) may play an important taxonomic role in defining the plant, when only fruits are available.

**Table (2):** Fruits and Seeds Quantitative Characters. Measurements in mm.

| Characters | Statistics | *Pistacia vera* | *Pistacia eurycarpa* | *Pistacia khinjuk* |
|---|---|---|---|---|
| Cluster length | Mean | 114.4 | 117.7 | 129.2 |
| | Range | 59-148 | 75.8-163.8 | 66.1-208 |
| Cluster width | Mean | 71.68 | 86.22 | 75.42 |
| | Range | 39.5-118.6 | 43-126.2 | 40.8-154.5 |
| Peduncle length | Mean | 13.16 | 10.53 | 9.8 |
| | Range | 7.5-15.7 | 4.8-17.7 | 4.7-18.9 |
| Pedicel Length | Mean | 5.91 | 4.85 | 3.16 |
| | Range | 2.2-13.2 | 2-8.9 | 1.5-6.1 |
| Number of branchlets / cluster | Mean | 10.87 | 20.1 | 16.2 |
| | Range | 4-20 | 12-25 | 13-19 |
| Number of drupes/cluster | Mean | 46.27 | 113.7 | 85 |
| | Range | 15-94 | 72-184 | 65-112 |
| Fruit length (L) | Mean | 24.75 | 6.87 | 6.56 |
| | Range | 20.2-27.6 | 4.9-8.4 | 5.1-8.4 |
| Fruit width (W) | Mean | 13.32 | 7.97 | 5.08 |
| | Range | 11.4-15.4 | 6.1-9.3 | 4-6.3 |
| L /W | Mean | 1.86 | 0.86 | 1.29 |
| | Range | 1.59-2.1 | 0.75-0.96 | 1.17-1.52 |
| Fruit thickness | Mean | 12.81 | 5.48 | 3.47 |

| | | | | |
|---|---|---|---|---|
| | Range | 10.1-15.4 | 4-6.6 | 2.8-4.5 |
| Seed length | Mean | 13.17 | 5.01 | 4.74 |
| | Range | 7.95-16.55 | 4.14-5.93 | 3.74-5.83 |
| Seed width | Mean | 7.34 | 7.38 | 3.78 |
| | Range | 5.91-8.93 | 5.83-9.01 | 2.02-4.75 |
| Seed thickness | Mean | 6.2 | 3.55 | 1.76 |
| | Range | 4.91-8.93 | 2.65-4.4 | 1.18-2.25 |

**Table (3):** Fruits and Seeds Qualitative Characters.

| **Characters** | ***Pistacia vera*** | ***Pistacia eurycarpa*** | ***Pistacia khinjuk*** |
|---|---|---|---|
| Fruit color | Orange-red to yellow-orange | Green to bluish green | Green to bluish green |
| Endocarp (shell) color | Whitish | Dark-brown to dark reddish | Light-brown |
| Kernel pulp color | Yellowish green | Bright green | Whitish duff |
| Testa color | Reddish brown | Dark brown | Dark buff |
| Fruit shape | ovoid-elongate | Broadly ovoid or depressed globular | Broadly ovoid or ellipsoid sometimes oblique |
| Kernel shape | Ovoid-oblong | Oblong | Globular sometimes compressed |
| Fruit surface | Smooth | Smooth | Smooth |
| *Fruit size* | Large | Medium | Medium |





**Fig. (1):** *Pistacia vera*: 1. Mature fruits (drupes), 2-a Endocarp (the stone), b-Kernel. *P. eurycarpa*: 3. Mature fruits, 4. Endocarp, 5. Kernel,. *P. khinjuk*: 6. mature fruits, 7. Endocarp, 8. Kernel

**Cuticular Structure**

***P. vera***

The adaxial and abaxial epidermis cells have almost isodiametric polygonal with straight or slightly wavy walls. The wavy appearance is more evident at the adaxial walls.

Plasmodesmata of cell wall are very obvious at the abaxial surface (figure 2). Oil droplets spreading over the epidermal cells are very common. Cuticular striation is more evident on the abaxial surface with the outline of the epidermal cells is more or less visible on both surfaces. Epidermal cells always elongated over veins with almost straight walls. The striation is often intensive on the cuticle of the subsidiary cells obscuring their outlines. The role of the striation in taxonomy is insignificant, since environmental conditions are likely to be the driven force.

Table (4) summarizes mean and range for the epidermal cell dimensions. From data presented, it is apparent that the adaxial and abaxial cell surfaces are similar in their average values. Stomata are elliptic in shape, the average length/ width ratio reaches 1.68. Stomata are clearly amphistomatic, i.e. distributed over the entire abaxial leaf surface along with the adaxial stomata distribution (figure 2).

The close similarity between the adaxial and abaxial leaflet surfaces in epidermal cell sizes and density, stomatal size, density and index, in addition to the similarity in mesophyll distribution and structure, indicates clearly that the leaflets are bifacial or isobilateral. These results agree with those of Al-Saghir *et al*. (2006).

Trichomes exist on both the adaxial and abaxial epidermal layers, but are denser on the abaxial with higher over veins distribution. Trichomes are simple smooth unicellular, unbranched type and glandular. Trichomes feet are complex, surrounded by 7-9 variable, modified epidermal cells in very few cases the foot is simple, consisting of a single opening.

The adaxial epidermal cells are slightly smaller than the abaxial cells (table 4). This is the case in other species of *Pistacia*. On the other hand, stomata sizes are almost similar in both surfaces. Stomatal density in terms of the number of stomata per $mm^2$ and stomatal index are higher in the adaxial epidermis than the abaxial epidermis.

*P. eurycarpa*

Epidermal cells are irregular in shape on both surfaces. The anticlinal walls are coarsely or finely wavy or undulated. The role of wall undulation of the current species and other species of *Pistacia* is also not relevant. According to the view point of some researchers (Wagner, 1998) a positive correlation exists between the degree of undulation and growth temperature under long daylight conditions.

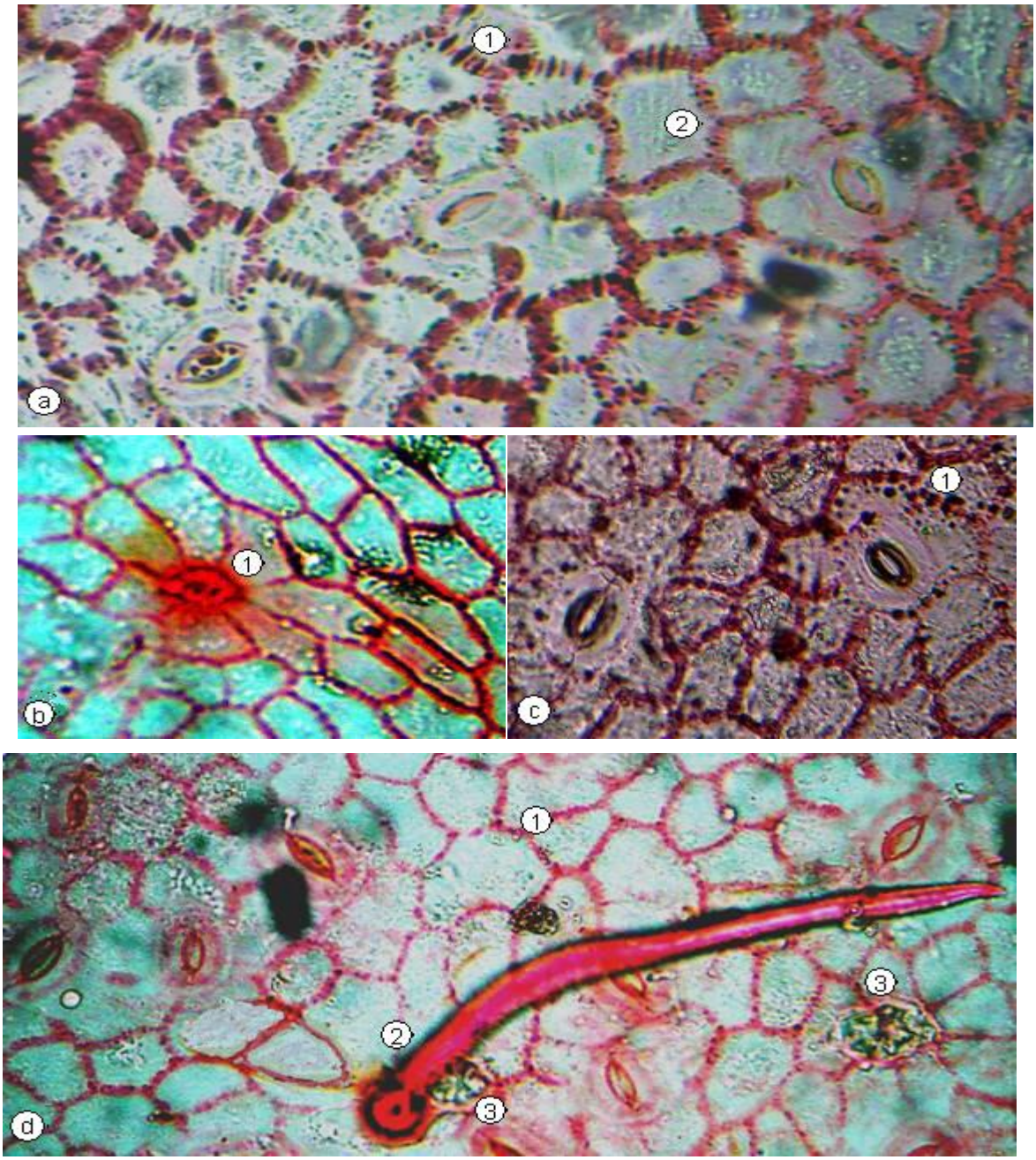


**Fig. (2):** *Pistacia vera*: (a). Abaxial epidermal surface (585x): 1. Plasmodsmata in the thick cell walls, 2. Faint cuticular striation, (b). Abaxial epidermal surface (520x): 1. Trichome base, (c). Abaxial surface (490x): 1. Resinous droplets, (d). Adaxial surface (490x): 1. Epidermal cells of almost straight wall, 2. Simple unicellular trichome, 3. Stomata of larger size, similar to those found in *P. eurycarpa* are also present on adaxial and abaxial surfaces of this species.

Plasmodesmata are also common in this species, on both surfaces, but are less obvious when compared with plasmodemata of *P. vera*.

The leaves are clearly amphistomatic, but more stomata occur on the adaxial surface (table 4). The stomata are anomocytic with 5 epidermal cells normally surrounding guard cells. The stomata are present only in areolae, none of them over veins. Some stomata are extra ordinary in size, often spreading over the abaxial face. These stomata are characterized by dense cuticular striation over cell surrounding the stomata. Stomata are mostly elliptic in shape; very few circular or ovate shapes are noticed.

In contrary to other species of *Pistacia*, there found two types of trichomes in this species

(figure 3) the very common simple, unicellular, unbranched trichome, while the other is the rare multicelular, unbranched, clivate type. Both types are present on both sides of leaf, more often at the axils of mid-rib and part of the epidermis over primary veins. Trichome basis is always complex consisting of numerous highly variable modified cells, radiating from a centrally located foot cell (figure 3). Trichome basis seems to play an insignificant taxonomic practice.

Cuticular striation forms a prominent feature of the species cuticular structure. It is common over all epidermal cells, but more extensive over stomata, radiating from guard cells, veins; including even the very fine veinlets, often obscuring outlines of the epidermal structures underneath. Crystals are only of druses type, largely arranging over veins, seldom elsewhere. Adaxial epidermal cells, like *P. vera*, are smaller in dimension compared with the abaxial ones. Stomata of adaxial and abaxial surfaces are nearly similar in dimensions. Stomata densities of the two faces greatly differ, with the adaxial stomata exceeding abaxial ones by 180 % (the same percentage value was found for *P. vera*). Data from table (4) show that the adaxial stomata index is about twice as great as the abaxial stomata index.

***P. khinjuk***

As figure (4) shows the epidermal cells on both surfaces are irregular in shape with straight or slightly curved anticlinal walls. Plasmodesmata are not visible under low magnification power. Crystals are solely prismatic, distributed over the adaxial and abaxial surfaces, not necessarily concentrated over primary veins. Cuticular striations are denser over the cuticle of the abaxial face as well as over stomata of the adaxial face obscuring boundaries of guard cells and the surrounding epidermal cells.

Stomata are highly variable in sizes and in shapes, with the elliptic outline being the most abundant; few of them are circular in shape. The orientation of stomata is random indication little or no effect of the vein on stomata orientation. Numbers of cells surrounding stomata are usually 6, in few cases, 8 epidermal cells are found encircling stomata.

Data presented in table (4) indicate that the leaflets of *P. khinjuk* are amphistomatic. The stomata have a distribution over the entire adaxial surface along with the abaxial stomata distribution, but in much lesser density compared with *P. vera* and *P. eurycarpa*. The abaxial surface of *P. khinjuk* contains only an average of 20.32 stomata per $mm^2$ compared with 195.52 stomata and 126.2 stomata for *P. vera* and *P. eurycarpa* respectively. The very low abaxial stomatal distribution for *P. khinjuk* may indicate more differentiation and adaptation to the environmental conditions prevailing in the region, and this feature may be taken as a diagnostic anatomical character for its separation from the other two closely related *Pistacia* species these results are in agreement with those of Mohannad, et. al. (2006) on 14 *Pistacia* species. Epidermal cell dimensions of the abaxial surface are always larger than adaxial epidermal cells (table 4). Likewise, the stomata dimensions (consequently stomata sizes) of abaxial surface are larger than the stomata dimensions of the adaxial surface.

Trichomes of simple, unicellular structure, typical for the family are common on both surfaces. No clivate, multicelular trichomes of *P. eurycarpa* are found here in the cuticular structure of *P. khinjuk* (Figures 2, 3 and 4).

**Table (4):** Epidermal Cells and Stomata Quantitative Characters.

| Characters | | | Statistics | *Pistacia vera* | *Pistacia eurycarpa* | *Pistacia khinjuk* |
|---|---|---|---|---|---|---|
| Adaxial | Epidermal cell | Length | Mean | 29.58 | 36.82 | 30.95 |
| | | | Range | 21.19-45.43 | 28.79-53.03 | 19.7 -48.48 |
| | | Width | Mean | 18.56 | 22.12 | 18.52 |
| | | | Range | 12.12-22.73 | 15.13-30.3 | 13.64-25.76 |
| | | Density | Mean | 802.4 | 838.5 | 973.75 |
| | | | Range | 755-840 | 821-860 | 941-995 |
| | Stomata | Length | Mean | 31.97 | 29.28 | 31.89 |
| | | | Range | 22.73-48.48 | 24.24-34.85 | 24.21-36.38 |
| | | Width | Mean | 18.94 | 17.88 | 22.92 |
| | | | Range | 15.13-24.24 | 15.14-21.23 | 18.16-27.29 |
| | | Density | Mean | 279.28 | 229.32 | 225.64 |
| | | | Range | 224-364 | 211-250 | 194-245 |
| | | Index | Mean | 22.794 | 21.624 | 17.642 |
| | | | range | 20,1-27.4 | 19.2-23.5 | 15-21 |
| Abaxial | Epidermal cell | Length | Mean | 30.83 | 38.52 | 37.08 |
| | | | Range | 18.18-40.91 | 22.73-60.61 | 19.7-53.03 |
| | | Width | Mean | 18.79 | 36.25 | 22.35 |
| | | | Range | 10.61-25.76 | 19.7-33.33 | 16.67-30.3 |
| | | Density | Mean | 935.75 | 982 | 1004.6 |
| | | | Range | 900-975 | 900-1035 | 947-1060 |
| | Stomata | Length | Mean | 32.92 | 31.17 | 36.89 |
| | | | Range | 27.25-39.41 | 25.76-37.88 | 30.3-42.42 |
| | | Width | Mean | 3.01 | 2.89 | 6.12 |
| | | | Range | 21.14 | 18.56 | 30.3 |
| | | Density | Mean | 195.52 | 126.2 | 20.32 |
| | | | Range | 172-230 | 111-142 | 17-25 |
| | | Index | Mean | 19.778 | 11.14 | 2.018 |
| | | | Range | 19.20.3 | 8-14 | 1.6-5.4 |

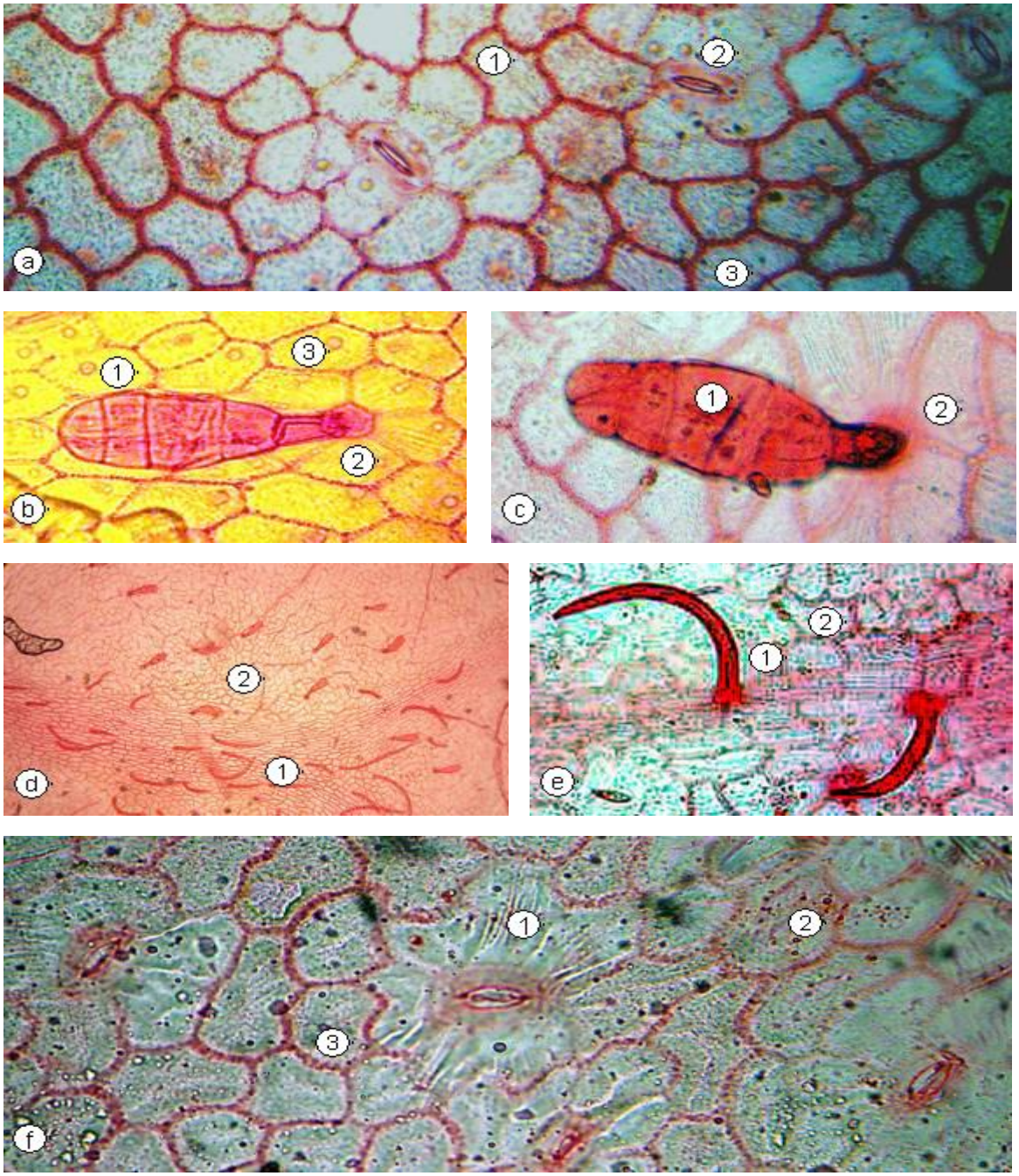


**Fig. (3):** *Pistacia eurycarpa*: (a). Abaxial epidermal surface (420x): 1. Undulated epidermal cell walls, 2. Elliptic shaped stomata, Plasmodsmata in the thick cell walls, 3. Faint cuticular striation, (b). Abaxial epidermal surface (525x): 1. Clivate trichome, 2. trichome foot, 3. Epidermal cells over a vein, (c). Abaxial surface (525x): 1. Clivate trichome, 2. foot, (d). Abaxial surface (80x), 1. Unicellular trichomes over a main vein, 2. Clivate trichomes on the axils of of a major vein, (e). Abaxial surface (340x), 1. Unicellular trichome, 2. Thick-walled epidermal cells, (f). Adaxial surface (420x), 1. Dense striation radiating from stomata, 2. Resinous droplets, 3. Plasmodsmata.

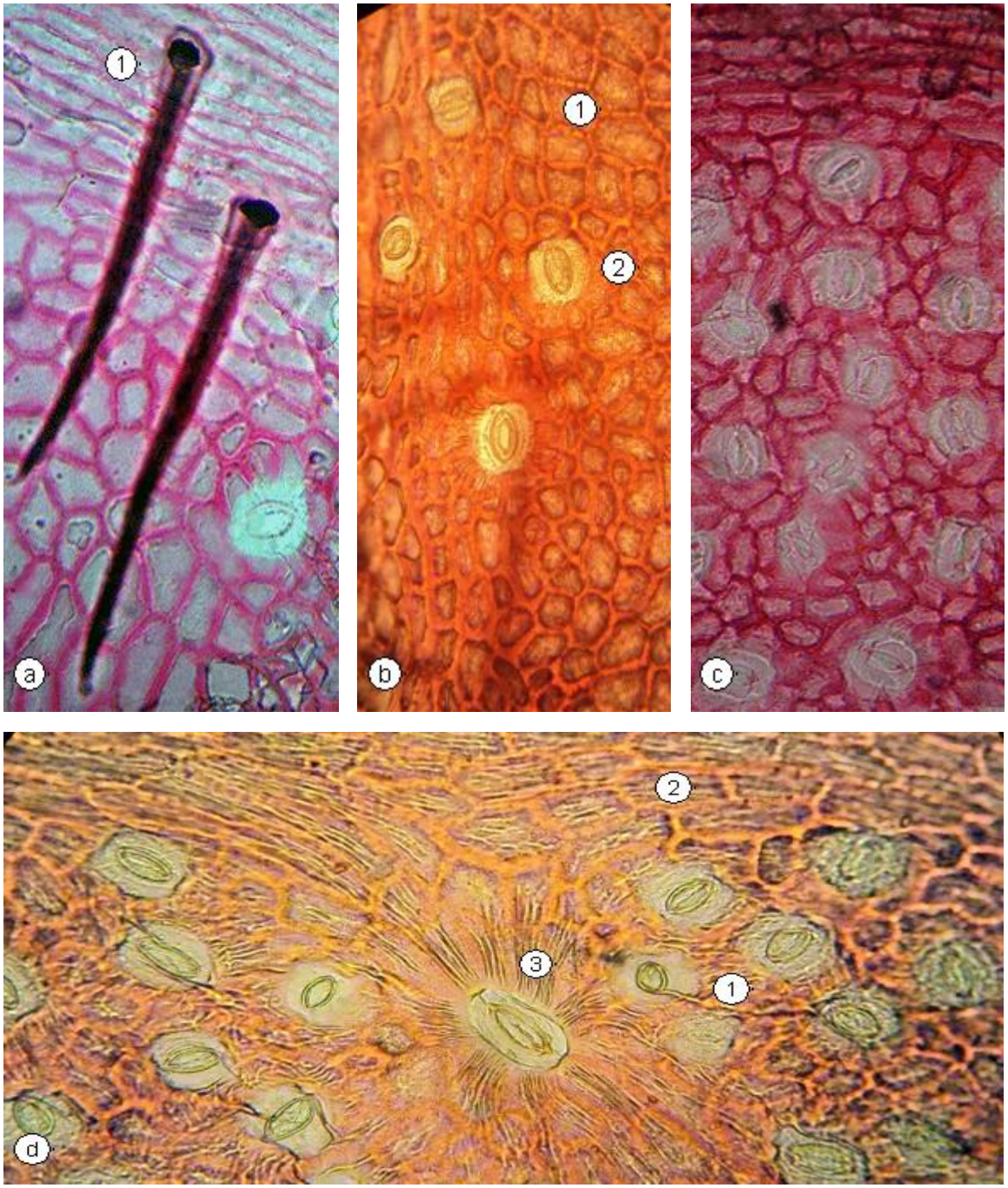


**Fig. (4):** *Pistacia khinjuk*: (a). Abaxial epidermal surface (245x): 1. Epidermal cells and the simple unicellular trichomes over veins, (b). Abaxial epidermal surface (245x): 1. Polygonal epidermal cells with almost straight walls, 2. Circular shaped stomata, (c). Adaxial epidermal surface with high stomatal frequency on areole (245x), (d). Adaxial epidermal surface (380x): 1. Circular shaped stomata, 2. Very thick-walled epidermal cells, 3. Cuticular striation extending from stomata.

**Conclusions (Cuticular Structure)**

In general, the epidermis structure of *Pistacia* species has many characters in common: The cuticle is relatively thick, and all species possess trichomes. Degree of undulation of the epidermal anticlinal walls is similar in different species. Moreover; the adaxial undulation is less prominent than the abaxial in the same species.

Stomata of *P. vera*, *P. eurycarpa*, and *P. khinjuk* are amphistomatic, with much less density on the abaxial epidermal layer of *P. khinjuk*. This may form an important character for taxonomic application. The average stomatal

size of the abaxial layer is always larger than the adaxial layers. On the other hand, the average adaxial epidermal cell sizes are significantly larger than the abaxial epidermal cell size.

The simple, unicellular, smooth trichomes are very abundant in all species, while the clivate-shaped, multicelular trichomes are common only in *P. eurycarpa*, (figure 3).

**Key to the Species of *Pistacia***

1. Leaflets 3-5, rarely unifoliate, ovate - orbicular; apex obtuse. Drupe 2.02- 2.76cm long x 1.14-1.54cm width, orange-red to yellowish ----------*Pistacia vera*

1. Leaflets 3-7, ovate - lanceolate; apex acute to acute-acuminate. Drupe 0.49-0.89cm long x 0.4-0.93cm width, green or bluish-green ---------- 2

2. Drupes broadly ovoid or depressed globular, length shorter than or at least equal to width, endocarp dark brown, kernel oblong, seed pulp bright green. Leaflets apex acute ----------*Pistacia eurycarpa*

2. Drupes broadly ovoid or ellipsoid, sometimes compressed and oblique, longer than wide; endocarp light brown; kernel globular, sometimes compressed; seed pulp whitish-yellow. Leaflet apex acute-acuminate ----------*Pistacia khinjuk*

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# نیشانێن تەکسونومی یێن سیمایێ بەلگی و فێقی وپێکهاتیێ پیستی بو ڤاڤارتنا جورێن رەگەزێ فستەقێ ل عیراقی دا

**پوختە**

**ساخلەتێن سیمایی یێن بەلکی وفێقی، زیدەباری پێکهاتیێ پیستی هاتنە تاقیکرن بو مەرەما پەیداکرنا ساخلەتێن گرنگ بو ناسینا جورا وزەلال کرنا پەیوەندییێن تەکسونومی ناڤبەرا واندا.**

**ساخلەتێن سەرو بنێ بەلگی ودرێژاهیا بەلگی لسەر پانیا وی پێکهاتییێن گرنگن دبارێ تەکسونومیدا. ژمارا فیقی د ئیشیدا، قبارە وشکل ورەنگ، رەنگێ دیواری ژنافدا، شکل و رەنکێ کاکلا توڤی تێنە هژمارتن گرنگترین ساخلەتێن ڤاڤارتنێ.**

**تێنە هژمارتن ژوان جورا ئەوێن سغور ل هەردوو لایان هەین بەلێ جورێ *P. khinjuk*، *P. eurycarpa*،*P. vera***

**بشێوەیەکێ گەلەك کێم سغور ل لایێ بنی یێن هەین.*P. khinjuk***

**قبارێ سەغرێ وەك تێکرا هەردەم بزە للایێ بنی بەلی پا قەبارێ خانێن پیستێ سەری وەك تێکرا هەردم بزە بشێوەکێ دیار ژ خانێن بنی. هەروەسا پیرتێ کلایفێت پتنێ ل *P. eurycarpa* یێن هەین.**

## الدلائل التقسيمية من مظهر الورقة والثمرة وتركيب الادمة لتميز انواع جنس الفستق في العراق

**الخلاصة**

لقد اختبرت الصفات المظهرية للورقة والثمرة، اضافة الى تركيب الادمة التي تعود الى جنس الفستق لتوفير صفات هامة في تميز الانواع ولتنقية العلاقات التقسيمية بينها.

ان صفات قمة وقاعدة الورقة وطول الورقة / عرضها تشكل تطبيقات تقسيمية هامة. عدد الحسلات / عنقود، حجم وشكل ولون الثمرة، لون الجدار الداخلي، شكل ولون البذرة وغلافها كلها تعد صفات تميزية هامة.

ذات ثغور موزعة على الوجهين العلوي والسفلي ***P. khinjuk***، ***P. eurycarpa*** ، ***P. vera*** تعتبر الانواع ***P. khinjuk***. ولكن بتوزيع اقل بكثير على الوجه السفلي لورقة

ان حجم الثغرة كمعدل يكون دائما اكبر على الوجه السفلي ولكن حجم خلايا بشرة الوجه العلوي كمعدل يكون دائما اكبر بشكل معنوي من حجم خلايا الوجه السفلي. كما ان الشعيرات الهراوية متعددة الخلايا موجودة فقط في ***P. eurycarpa***.

# SOIL ERODIBILITY FACTOR IN RELATION TO SOIL DEVELOPMENT IN SOME DUHOK GOVERNORATE LOCATIONS /NORTHERN IRAQ

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## ABSTRACT

**Soil erodibility (K-Factor) was determined in Duhok Governorate, northern of Iraq, in five locations (Duhok, Zakho, Zawita, Sarsenk and Amadia). The objective of this study is to determine relative (K-Factor) by indirect methods based on USLE (Universal soil loss equation) and nomograph then compare the results of nomograph with that mathematically determined by equation. According to the basic soil loss equation(A= R*K) we can use (K-Factor) to estimate soil loss (A) t./ha./year of the study locations when annual values of erosivity index( R ) is available, as well as evaluate soil development depending on the k-factor values. It can be seen that the determine K-factor values in the study locations by equation is considerably lower than that measured with using nomograph, but the correlation between the results of both methods are very strong, ($r^2$ = 0.90) .Soil erodibility values varied between (0.010 to 0.033) in Zawita and Amadia respectively, the other values are between negligible and low, according to the erodibility classification. The results indicated to negative correlation between soil organic matter and annual precipitation with (K-factor) values, ($r^2$=0.52) and ($r^2$=0.30) respectively, while positive relationship was observed between silt content and the measured (K-factor), (K = 628.19x+17.689) ($r^2$= 0.52). The difference in soil erodibility is due to the variations in particle-size distribution that is consider as the most important factor affecting on the (K-factor) value in Duhok governorate soils. The soils in Amadia are more erodible followed by Duhok and Zakho where as the least erodibility indices were found in soils of Zawita and Sarsenk, as a result of high organic matter content and high permeability in soils under forest cover therefore these soils were more stable and development as compared with arable soils in Amadia, Duhok and Zakho.**

***KEY WORDS*:** Erodibility factor**,** Nomograph, Erosion, Profile permeability, Development**.**

## INTRODUCTION

Soil erosion is a naturally occurring process on the land. The agents of soil erosion are water and wind, that are contributing in a significant amount of soil loss each year in north of Iraq. Soil erosion may be continues slow process that is relatively unnoticed, or it may be occurs at an alarming rate causing serious loss of top soil. The soil loss from farmland may be reflected in reduced crop production potential, lower surface water quality and damaged irrigation networks. The soil erosion problem is enormous, this problem is affecting the development of the soil. On the other hand soils development under farming sometimes brings about soil erosion, sedimentation and leaching. Soil erosion is a main reason of land development and land collapse, consequently restriction soil development. Soil erosion is the process of detachment and transport of soil particles caused by water and wind (Morgan, 1995). Many studies have examined the effect of soil properties on erosion, but with a wide range of methodologies, soil types, climatic conditions, and soil management histories, different properties have proven effective in different situations (David et al., 2003).

### Soil erodibility

Soil erodibility represents both susceptibility of soil to erosion and the rate of runoff, as measured under the standard unit plot condition. Soils that are high in clay content have low (K-factor) value, is about 0.05 to 0.15, because the soils in this case resistant to detachment. Coarse textured soils, such as sandy soils, have low K value, is about 0.05 to 0.2, because of low runoff even though these soils are easily detached. Medium textured soils, such as silty and loam soils, have a medium (K-factor) value, is about 0.25 to 0.4, because they are moderately susceptible to detachment and they produce moderate runoff. Soils having high silt content are most eroded than that of all other soils. They are easily detached (K-factor) values for these soils tend to be greater than 0.4 (Original unit).

The absence of direct measurements of the soil erodibility, researchers study soil erodibility and found strong correlation between certain soil properties and its erodibility which provide good possibility to develop procedure for

determination the erodibility of a soil without direct measurement of actual soil loss from natural or simulated rainstorm (Wischmeier and Mannering ,1969). The soil erodibility nomograph is a commonly method for estimating (K-factor) values, but it does not applied in some soils. On the basis of this finding and using data from simulated rainstorms and information from natural runoff plots, a convenient erodibility equation was derived and a simple erodibility nomograph was built by Wischmeier, et al (1971). Foster et al. (1981) applies the nomograph in physical measurements and adapts by David walker, (2004) in (SI units). El-Swaify and Dangler, (1976) are also estimated (K-Factor) values for volcanic soils of Hawaii with an alternative algorithm according to the erodibility nomograph. of Wischmeier and Smith (1978), in this case take into account silt, very fine sand, clay and organic matter content, as well as the structure of the surface layer and the permeability of the profile, all these factors are incorporated in the erodibility equation Wischmeier and Smith (1978). An estimation of (K-factor) value was used the nomograph for Egyptian soils to determining soil erodibility by Labib, (1981). In the Egyptian eastern desert, the values which might be expected for the USLE, are between (0-0.22) and (0-0.47) t./ha./h. (ha. MJ. mm). Updating the (K-factor) for RUSLE involved developing guides so the user could identify where the nomograph does not apply and estimate (K-factor) with using alternative methods. Erodibility data of different regions in the world have been reviewed, and an equation has been developed that gives a useful estimate of (K-factor) as a function of an average diameter of the soil particles. Vanelsande et al., (1984) found wide variations between measured values depending on the Wischmier nomograph, therefore all indirect methods of estimating erodibility were regarded as best substitutes for direct measurement from undisturbed soil. Goldman et al. (1986) indicated to several methods that can be used to estimate the (K-factor). Dangler et al. (1987) showed that any estimation of erodibility is some extent depending on the parent material with significant differences between residual oxisols and volcanic ash soils.

Recently, many researchers are used soil erodibility (K- factor) as an indicator of soil erosion (Barthe`s et al., 1999; Parysow et al., 2001, 2003) because the soil erodibility is a measure of soil susceptibility to detachment and transport by the agents of erosion. It is the integrated effect of processes and these processes are influenced by soil properties, such as particle size distribution, structural stability, organic matter content, soil chemistry, clay mineralogy and water transmission characteristics (Lal, 1994).

## MATERIALS AND METHOD

To investigate soil erodibility factor, that was conducted in Duhok governorate ,at five locations in north of Iraq ( Duhok , Zakho , Zawita , Sarsenk and Amadia ).Table (1) show the locations of the study area, altitude, longitude, latitude and annual precipitation .The study area , mostly located on (5-15%) slopes and are mainly utilized for wheat dry farming and orchards. The climate is semi-arid with an average annual precipitation of (764 mm) and a mean annual temperature of ($15C^0$) for at lest fifteen years ago. Rainfalls mostly occur in spring (from March to April) and autumn (from October to November) with rainfall intensity is usually lower than (10 mm /h).

**Table (1)**: Average annual precipitation and geographical information for study locations.

| Meteorology Station | Latitude | Longitude | Altitude | Precipitation Mm |
|---|---|---|---|---|
| Dohuk | 36° 50- N | 43° 00- E | 569m | 532.9 |
| Zakho | 37° 09- N | 42° 39- E | 404m | 618.84 |
| Zawita | 36° 54- N | 43° 08- E | 890m | 851.34 |
| Sarsenk | 37° 02- N | 43° 20- E | 1019m | 1000.50 |
| *Amadia* | 37° 05- N | 43° 29- E | 1202m | 817.73 |

**Determination of Soil Erodibility (K –Factor)**

Determine soil Erodibility (K-factor) either through an equation or by nomograph .The follows equation describe by Wischmeier and Smith (1978),to estimate soil erodibility factor.

$K= 2.8\times10^{-7}\ M^{1.14}\ (12\text{-}a)+4.3\times10^{-3}\ (b\text{-}2)+3.3\times10^{-3}\ (c\text{-}3)$

Where K = The soil erodibility factor in tone .hr/ $M_J$.mm.

M = (100-% clay) × (% very fine sand+ % silt),

a =% organic matter,

b =soil structure code.

c = profile permeability class.

**Soil Physical and chemical Analysis**

Erodibility of soil samples were calculated according to laboratory analyses and field data. Randomize composed surface soil samples (0-30 cm) were collected from study locations then drying and passing throw 2mm sieve and stored in sealed polyethylene bags in a cool, dry place for physical and chemical laboratory analysis. The particle size distribution consisted of sand fraction (0.1-2 mm), very fine sand (0.05-0.1 mm), silt (0.002-0.05) and clay (< 0.002 mm) was determined by Hydrometer method (Bouyoucos, 1962), table (2). Soil organic matter was determined according to Page et al.(1982), table (3).

**Table (2 ):** Soil particle size distribution and V.F.S .

| # | Location | Clay% | Silt% | V.F.S %* | Sand % |
|---|---|---|---|---|---|
| 1 | Duhok | 20.40 | 36.00 | 2.54 | 41.06 |
| 2 | Zakho | 54.50 | 39.00 | 1.05 | 5.45 |
| 3 | Zawita | 25.40 | 28.50 | 2.53 | 43.57 |
| 4 | Sarsenk | 15.40 | 20.00 | 5.82 | 58.78 |
| 5 | Amadia | 40.40 | 37.50 | 3.50 | 18.60 |

*****V.F.S = Very fine sand

***** Sand without very fine sand

**Separation of very fine sand**

Very fine sand (50-100 micron) separated from other soil particles by wet sieving with used sieve (50 micron) and (100 micron) then collected it in a container and drying in an oven at (105C) and determines the percentage of very fine sand in each soil sample depending on the weight and particle size distribution (Table,2). Generally two methods are used to determine soil erodibility (k- factor):

**1-** Direct method of determined soil erodibility. k=A/R*L.S*C*P (ton.ha.hr./ha.MJ.mm)metric unite (SI)

A= annual soil loss (ton/ha.) in (SI)

R= annual erosivity index in (SI), Wischmeier and Smith, (1961).factors L.S*C*P are constant =1.

**2-**Indirect method of determined soil erodibility depending on the laboratory analysis and soil profile permeability data. Both methods were applied to determine (k- factor).

**Soil profile permeability**

Soil permeability was determined in the field by "Inverse Augur" method, water flow into the soil per unit time with using handle augur and soil hole according to the following equation:-

$k = 1.1015r\ [Log\ (ho + r/2) – Log\ (ht+r/2)] / t$

Where:

- K= hydraulic conductivity (soil profile permeability) (m/day)
- ho= depth of water at start time . (cm)
- ht= depth of water at end time (cm)
- r = radius of auger hole (cm)

Soil structure code and permeability lass (Table, 3) were described depending on the National Soils Handbook No,430 430 according to table (Appendix, 1).

**Table (3):** Soil permeability, Structure type and organic matter percentage in study location.

| # | Location | Profile permeability | | | Structure type | | Organic matter % |
|---|---|---|---|---|---|---|---|
| | | **permeability (m/day)** | **Code** | **Description** | **Code** | **Description** | |
| 1 | Duhok | 0.886 | 3 | Moderate | 2 | Fine granular | 0.91 |
| 2 | Zakho | 0.928 | 3 | Moderate | 4 | Angular blocky | 0.31 |
| 3 | Zawita | 2.293 | 2 | Moderate to rapid | 1 | Very fine granular | 2.62 |
| 4 | Sarsink | 1.105 | 3 | Moderate | 2 | Fine granular | 2.48 |
| *5* | Amadia | 0.0168 | 4 | Slow to moderate | 4 | Sub angular blocky | 1.65 |

**Application data on the nomograph**

The value of (K-factor) can be approximately measured indirectly depending on the soil properties and soil profile data. The following data should be available: silt % + very fine sand%, Sand %, Organic matter %, soil structure code and profile permeability code. The nomograph (fig,1)consist of two parts the left section of the nomograph explain soil erodibility as function of silt% + very fine sand% (0.002-0.1mm), sand %( 0.10-2mm) and organic matter%. The right section of graph explains soil erodibility as function of the soil structure and permeability. The scale on vertical axis (silt%+ very fine sand%)ranged from (0-100%).The sand ranged from (0-90%) and organic matter content ranged from (0-4%) the point of intersection of straight line stated from (silt% + very fine sand%) with percent of sand and organic matter provide approximately value of (K-factor) and the point of intersection of soil structure and permeability makes this value more precise.

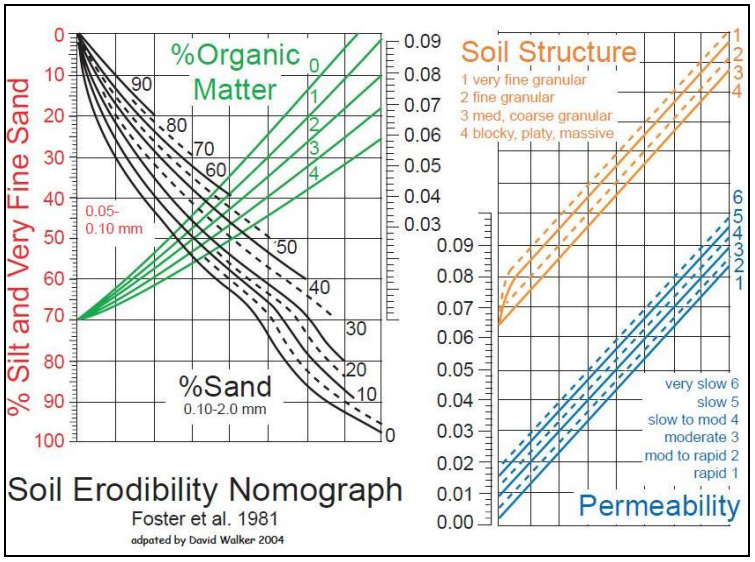


**Figure. (1):** Soil erodibility nomograph

Before considering how the nomograph can be used it is important to know what accuracy of it is. The first three soil characteristics were determined from laboratory analysis, structure and permeability were assigning by the field determination according to the (parameter value table).To obtain the value of soil erodibility (K-factor) by the nomograph with above mentioned characteristics. The following procedure should be follow:

**1.** The nomograph fig.(1) at the left side of vertical axis (silt +very fine sand) % (0.002-0.10 mm) and proceed horizontally to appropriate and curve (particle greater than 0.10 mm).

**2.** From intersection point of horizontal line (sand %) curve, precede vertical to the organic matter content curve %.
**3.** From intersection point proceed horizontal to correct structure.
**4.** Proceed vertically to the appropriate permeability.
**5.** Proceed horizontally to the soil erodibility scale on the left edge of the second section of the nomograph to read the last value of (K-factor).

**Table (4):** Soil erodibility values in study locations.

| # | Location | K-factor value determined by equation (SI unit) | K-factor value determined by nomgraph (Original unit ) | K-factor value determined by nomograph converted to (SI unit)*0.1317 |
|---|---|---|---|---|
| 1 | Duhok | 0.0293 | 0.25 | 0.033 |
| 2 | Zakho | 0.0257 | 0.21 | 0.028 |
| 3 | Zawita | 0.0104 | 0.085 | 0.011 |
| 4 | Sarsenk | 0.0171 | 0.10 | 0.013 |
| 5 | Amadia | 0.0330 | 0.25 | 0.033 |

## RESULTS AND DISCUSSION

The soil erodibility nomograph (Wischmeier et al., 1971) is a common method for determine (k-factor) value, but it does not used in all soils. Erodibility equation has been developed that gives a useful estimation of (K-factor) value as a function of an average diameter of the soil particles, organic matter content, soil structure and soil permeability.

The soil erodibility factor in locations under study can be determined with using nomograph (table,4) and (fig.1) in addition to using Wischmeier and Smith (1978).

$K= 2.8\times10^{-7}\ M^{1.14}\ (12\text{-}a)+ 4.3\times10^{-3}\ (b\text{-}2)+3.3\times10^{-3}\ (c\text{-}3)$

It can be seen that the measured of (K-factor) values in study locations with using the following regression equation is considerably lower than that determined with using nomograph but the relationship between them is very strong ($Y=0.866X+0.0058$)( $r^2=0.90$).

Generally determined the (K-factor) value by equation is systematically lower than that determined by nomograph (fig.2), same thing had shown by Zhang et. al.(2004) who obtain the differences factor between both result about (3.3–8.4), this is implies that the use of nomograph method to estimate soil erodibility would considerably over predict the rate of soil loss, and local relationship between soil properties and the (K- factor) is required for soil erosion prediction in any region.

The erodibility values of study locations were 0.10 and 0.25 in both Zawita and Amadia respectively. Other locations values were between negligible and low, according to the erodibility classification adopted by Presant and Acton (1984) and present in table (Appendix, 2).

Comparing the above results with that obtained in different soils of Sri Lanka to estimated (k-factor) value in the same unit (original unit) with using nomograph that developed by (Wischmeier et al., 1971), which are varied from (0.17) to (0.48). Al-swaify et al. (1982), prove that the tropical soils appear extreme variability in erosion susceptibility, with (k-factor) value varying from (0.06 to 0.48). Comparison of erodibility (K-factor) results with that obtained by Nekolve, (1983) in north of Iraq (Mosul- Duhok – Zakho, that are followed the second category of Nekolve classification), he found that the (k- factor) values ranged between (0.32-0.57) with using original units. These results corresponding (0.042-0.075)in (SI) units. Nekolve erodibility results are (2.7) times more than that obtained in this research while the results of erodibility (K- factor) values in this study (table, 4) are less than that obtained by Labib ,(1981) when determined soil erodibility in the Egyptian eastern desert who show that the (K-factor) values ranged between (0.022 -0.047), with using SI units .The results also showed that there is a negative correlation between organic

matter and (K-factor) value; increase in soil organic matter, mean decrease in K-factor value and then decrease soil loss ($r^2$=0.52) ,(fig. 3 ). Other relationship was developed between silt percentage and measured (K-factor) values according to USLE, where (K= 0.628.19x+17.689), ($r^2$ = 0.52) when soil (k-factor) value in t.h/MJ.mm and x-axis represent the (silt%)(fig.4).

The erodibility of certain soil is closely related to its particle-size distribution, permeability, organic matter content and structure. Generally organic matter content in Duhok and Zakho sites is low while its moderate in other remaining sites and the soil structure shows little variation, according to Wischmeier et al. (1971) criteria. The difference in soil erodibility is a mainly result of the variations in particle-size distribution among which silt and clay contents are the most important factor affecting k value for Duhok governorate soils. Increase in clay content, makes soil more resistant to water erosion and, consequently reduction soil erodibility, where as with an increase in silt content, the soil is more susceptible to water erosion, that leads to greater erodibility (fig.4). The relation between annual precipitation and estimate erodibility in locations under study show a weak relationship as ($r^2$=0.30),(fig.5). The results obtained indicated that the soil erodibility factor is able to isolate the effect of soil properties on soil loss and does not depend on the topographical factor such, slope, steepness and other factors as rainfall in USLE. On the other hand determine the (K-factor) value increased with time and will change over time if the soil properties are changed depending on the management practices.

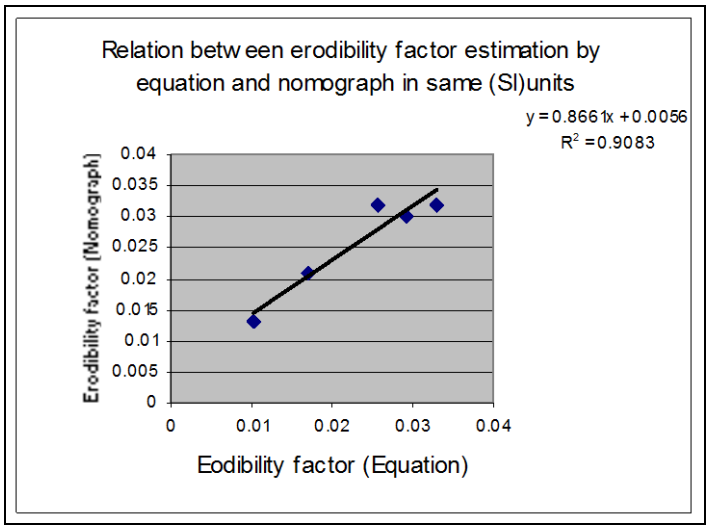


**Figure. (2):** Erodibility factor in both method equation and nomograph**.**

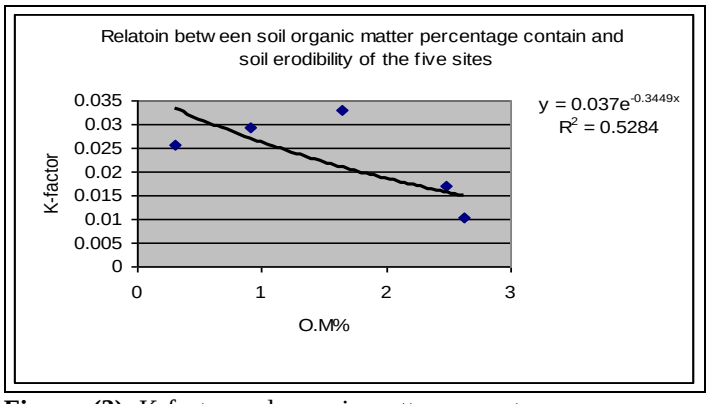


**Figure. (3):** K-factor and organic matter percentage

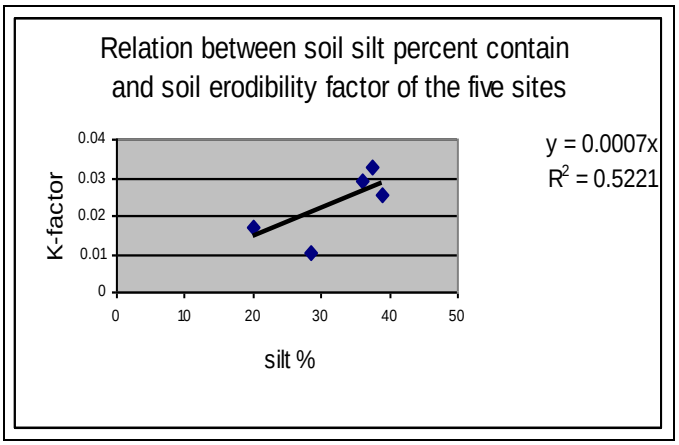


**Fig. (4)**: K-factor and silt percentage

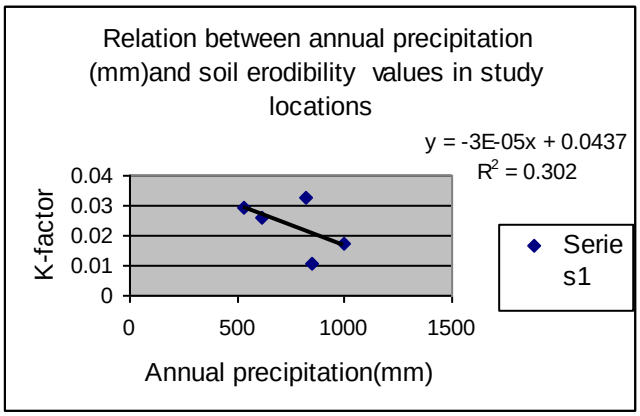


**Figure. (5):** Erodibility factor and Annual precipitation

After estimate the erodibility factor of the study locations, as show in table (4) we can easily measuring the annual soil loss in the study sites according to the base soil loss equation A= R*K (Wischmeier, and Smith,1961).

Where: A- is the total soil loss t/ha./year

R-is annual erosivity index in (SI) unit estimated by researcher (Sulaiman , 2007),in the same five locations.

K-is the determination results of the current research.

To illustrate the conversion K-factor results from nomograph (Original units) using by Wischmeier et al., (1971) to metric unit (SI) it need to divide k-factor value of this nomograph by 7.49 [(Agriculture hand book,No,703),1994] or multiply by 0.1317 as clear in (Table,4 ). Nomograph used by Foster et al., (1981) and adapted by David (2004), gave the direct value of erodibility (k-factor) with (SI) unit instead of Original units. (fig. 1).

**Erodibility and Soil Development:**

Soils loss by erosion is important because there is a direct relationship between soil depth and soil development. It's a valuable parameter to help in determine soil development. The results of the determined erodibility indices as shown in table (4), it can observed that the soil in Amadia has the highest erodibility indices (0.0330) followed by Duhok (0.0293) and Zakho (0.0257). The least erodibility indices were obtained in Zawita (0.0104) and Sarsenk (0.0174). The data obtained from this study will be useful in determining, the development of soil through knowing the (k-factor) value as a result of erodibility. At the same time, we can adequately check the menace of erosion on the soil formation as a result of accelerated soil erosion process. The results of erodibility indicated that the soils under forest land use in Zawita and Sarsenk were more stable and evolutionary development as compared to the arable soils in Amadia, Duhok and Zakho and they ascribed it to the higher organic matter content resulting in more stability of soil aggregates , in addition the soils under forest cover in Zawita and Sarsenk has higher permeability (2.293 m/day) and (1.105 m/day) respectively as compared with arable soils in

Duhok (0.886 m/day), Zakho (0.928m/day) and Amadia (0.0168 m/day). Furthermore high sandy soil content in Zawita (43.57%) and Sarsenk (58.78%) encourages high rate of permeability of water into the soil which induces landslide and erosion, where as with silt content increasing in Amadia (37.5%), Duhok (36%) and Zakho (39%) soils are more sensitive to erosion, which results in greater erodibility, therefore can be concluded that the soils under forest cover in Zawita and Sarsenk were more stable, development and less soil loss as compared with arable soils in Amadia, Duhok and Zakho. On the other hand soil loss was observed to be highly in arable soils as compared with forest cover soils under study.

## CONCLUSIONS

Soil erodibility has been determined in some location of Duhok Governorate. As shown from the results (K-factor) was varied in values, the higher (K-factor) value is observed in Amadia site, and the lower value of (K-factor) was recorded in Zawita. This research can be regarded as the best indicator of the ability of soils to resist erosion, with using indirect method by equation and compare the values with those obtained by using nomograph. The nomograph offers a means of determining (k-factor) values, when no actual measurements are available this method was applied because it is rapidly method and use in case of an available as measured under the standard unit plot condition .When more information becomes available, it will be possible to apply the universal soil loss equation quantitatively for practical purposes. Erodibility factor values are very important in order to knowing which region is critical for soil erosion and the most economical and realistic soil conservation practices can be formulated according to the relative erosion hazards of a region, rather than by giving a blanket recommendation to cover all plantation areas as is presently done and it helps to increasing knowledge to an understanding the soil susceptibility to erosion. The data obtained may be fit for the limited area and it need further information and researches to increasing knowledge in other locations in north of Iraq. According to relationship between (k-factor) and soil development can be concluded:

**1-** Soils under forest cover were more stable, evolutionary and less soil loss as compared with arable soils.

**2-** High organic matter content, high permeability and high sand percentage led to the soils become more stable, development and less soil loss and land collapse.

**3-** High silt percentage led to the soil become more sensitive to erosion which results in greater eroded of soil.

Finally the nomograph method to determine soil erodibility would considerably over-predicted the rate of soil loss, and local relationship between soil properties and the (K-factor) values is required for soil erosion prediction in any region**.**

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## Appendices

**Table, 1** parameter value table

| # | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| **b** | **Very fine granular** | **Fine granular** | **Medium to coarse granular** | **Blocky ,platy, massive** | **…….** | **…….** |
| ***c*** | **Rapid** | **Moderate to pid o rapid** | **Moderate** | **Slow to moderate** | **Slow** | **Very low** |

[National Soils Handbook No. 430 (USDA, 1983)]

**Table, 2** . Definition of erodibility classes

Class K- factor
(t.□ha/MJ.mm)
Percentage
area
1 Negligible <0.020 45.6
2 Low 0.020 - 0.039 46.3
3 Moderate 0.039 - 0.053 5.2
4 High 0.053 - 0.066 2.9
5 Very high 0.066 nil
Adapted from Presant and Acton (1984)

RUSLE (Revised Universal Soil Loss Equation)

**پوختە**

**فا كتەر یێ رامالینا ئاخی(K ) ها تە هلسنگاندن لپارزگەها دهوكی,باكورا ئیراقی لپنج دەڤەرا(دهـوك ,زاخـو ,زاویتە,سەرسنگ وئامیدیی) .ئەگەرا سەرەكی ژڤێ لێكولینێ بو هەلسەنگاندنا فا كتەر یێ رامالینا ئاخی(K ) بر یكا نەراستاخو بكارئینانا nomograph( USLE) (هاوكێشا گشتی بو دوڕاندنا رامالینا ئاخی)وبەرەوردیا ئنجاما لگل وان ئەنجامێت هاتینە وەرگرتن بریا هاوكێشا ماتمەتیكی .لدیف هاوكیشا بنەرەتیێ یا دوڕاندنا رامالینا ئاخی(A=R*K) ئەم دشین دوڕاندنا رامالینا ئاخی(A )t/ha/Year( ژمارەبكەن لدەڤەرێن لێكولینێ لدەمێ هەبونا فاكتەرێ (R )Index erosivity وهەلسنكاندنا جیبونا ئاخی لدیف فا كتەر یێ رامالینا ئاخی(K ) .ئەف لێكولینە دیارتكەت ئەنجامێت هاتینە وەرگرتن بریا هاوكێشا ماتمەتیكی كێمتر ژوان ئەنجامێت بریا nomographهاتینە وەرگرتن لهەر پێنج دەڤەرا لێ پێوندی لناف بەرا وان زورا تونده و ($r^2 = 0.90$). فا كتەر یێ (K ) لناف بەرا(0.010 – 0.033) دیاربو لزاویتە وئامیدیی لدیف ئیك ولدەڤەرین دی ناف بەرا گیم و گەلەك گیم هاتە دیاركرن لدێف هەلسەنگاندنا فـا كتـەر یێ (K ).ئەنجام لپنج دەڤەرا وەك دیار نافبەرا فا كتەر یێ (K )وكەرستێ ئندامی ( $r^2$=0.52) وبارانا نەگـەتیف بـو( $r^2$ =0.30) ,لێ پیوەندی ناف بەرا(K ) و(Silt) پوزەتیف بو لدیف هاوكێشا دیار(K = 628.19x+17.689) ) و ( = $r^2$) 0.52 .نەوەك هەڤی لهەبونا (Silt)(Clay) دبیتە ئەكەر بو جێوازیا نەرخێ فا كتەر یێ (K ).رامالینا ئاخی زور لئامێدیێ ,دهوكێ وزاخو ئەنجام دایە وكێمتر لزاویتە وسەرسنك ئەڤە یا بویە ئەكر پتر خوراگرتنا ئاخین دیماهیكێ وبتر گەشـە پێدان بو وان ئاخا وە گ براوەرد بو ئاخێن ئامێدیێ ,دهوكێ و زاخو.**

**الخلاصة**

**تم تقديرعامل تعرية التربة(K-factor ) في محافظةِ دهوك، شمال العراق،و في خمسة مواقعِ (دهوك، زاخو، زاويته، سرسنك والعماديه). الأهدافَ الرئيسيةَ لهذاالبحث هو تقديرعامل تعرية التربة (K-factor)بصورة تقريبية وبالطرقِ الغير مباشرةِ أعتماداعلى المنحنى القياسي ( nomograph) ومقارنة النتائج بتلك التي تم الحصول عليها وفق المعادلة العامه لحساب مفقودات التربة( USLE) . طبقاً للمعادلة الأساسية لمفقودات التربة (A= R*K) يمكن حساب هذه المفقودات (t/ha/Year) لمواقعِ الدراسةَ عند توفر العامل (R )erosivity Index كما تم تقيم درجة تطور التربة أعتمادا على قيم العامل(k) .وقد أظهرت النتائج التي تم الحصول عليها من خلال تطبيق المعادلة الرياضية بأن قيمة (K) الحسابية اقل إلى حدٍّ ما مِنْ تلك التي حصلنا عليها باستعمال المنحنى القياسي (nomograph)، لكن الإرتباطَ بين نتيجتي الطريقتين كان قوياً جدا ($r^2 = 0.90$). عامل تعرية التربة(K-factor )اظهر تَفاوتا في القيم تراوح بين (0.010 إلى 0.033) في كل من زاويته والعماديه على التوالي،اما القِيَم الأخرىفقد تراوحت بين الأهمال والمستوى الواطئِ، طبقاً لتصنيفِ عامل تعرية التربة. أظهرت النَتائجَ إرتباطَاً سا لباً بين %للمادة العضويةِ وقيم العامل(K )،( $r^2$=0.52) وكذلك وجد انَّ العلاقة بين معدل المطرِ السنويِ وقيم العامل(K ) كانت سلبية ضعيفة ($r^2$ =0.3)، في حين ظهرت علاقة إيجابية بين % للغرينِ وقيم العامل(K ) (K = 628.19x+17.689 ) ($r^2$ = 0.52).إن الإختلاف في قيم العامل(K ) يعزى الى الإختلاف في التوزيعِ الحجمي لدقائق التربة لما لها من اهمية كبيره ومؤثره في قيم العامل(K ) لتربِ الدراسة .أشارت النتائج الى أن ترَب منطقة العماديه هي الأكثر قابلية للتعرية يتبعها ترب منطقة دهوك وزاخو(جميعها ترب صالحة للزراعة)،في حين أن ترب منطقتي زاويتة وسرسنك(ترب غابات) هما الأقلّ تأثرا بالتعرية نتيجة لزيادة محتوى المادة العضوية والنفاذية العالية للترب تحت غطاء الغابات لذلك فأن هذه الترب كانت أكثر ثباتا وتطورا (عملية البناء)عند مقارنتها مع الترب الصالحة للزراعةَ في كلا" من العماديه ودهوك وزاخو.**

# A COMPARISON OF MILK COMPOSITION OF KARADI, HAMDANI, AND AWASSI EWES RAISED UNDER FARM CONDITIONS*

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## ABSTRACT

**A total of 417 milk samples of 172 ewes belonging to Karadi, Hamdani and Awassi breeds raised at four commercial farms in Erbil plain together with another flock raised at the college of agriculture, were collected at the start, mid and at the end of lactation during lambing season 2006/2007. Milk samples were analyzed chemically for its constituents using EKO milk total test. The overall mean of Fat, protein, lactose and solid non fat were, 4.57±0.09, 6.45±0.06, 4.59±0.01 and 11.98±0.08 %, respectively. Results revealed that a breed within flock, has a significant effect on fat, protein and solid non fat. It appears also that age of dam affected significantly percent of lactose only. Type of birth and month of lambing had no significant effects on all milk constituents. Fat increased significantly with the advances of lactation period.**

*KEYWORD:* Sheep breeds, flock, milk constituent

## INTRODUCTION

Although sheep in Iraq is mainly raised for lamb and mutton production (Alkass and Juma, 2005), yet large amounts of their milk are used for making cheese, butter and ghee, in addition to yogurt which is a sort at ferminated milk product widely used by farmers as a main source of animal protein (Eliya et al., 1972). Information concerning the composition of sheep's milk together with factors affecting it are very limited particularly under farm conditions. Therefore the aim of this work is to compare milk composition of Karadi, Hamdani and Awassi ewes raised on commercial flocks, together with some factors affecting it.

## MATERIALS AND METHODS

A total of 417 milk samples of 172 ewes belonging to Karadi, Hamdani and Awassi ewes raised at four commercial farms in Erbil plain together with another flock raised at the college of Agriculture, were collected at the start , mid and at the end of lactation during lambing season 2006-2007. On sampling day, the lambs were separated from their mothers at 7.00 p.m. On the following morning, ewes were hand milked at 7.00 a.m. and the samples of milk were collected. Then milk samples were analyzed chemically for their content of protein, fat, lactose and solid non fat percentages using EKO milk total test. General Linear Model was used to calculate Best Linear Unbiased Estimates effects (SAS, 2001) assuming the following model:

$$Y_{ijklmno} = \mu + FB_{i(j)} + A_k + T_l + P_m + S_n + e_{ijklmno}$$

Where:

$Y_{ijklmno}$ = observational value of animal, $\mu$ = overall constant mean associated with each observation, $FB_{i(j)}$ = Effect of $i^{th}$ breed (i = Karadi, Hamdani, Awassi) within $j^{th}$ flock (j = 1,2,3,4,5), $A_k$ = Effect of $k^{th}$ age of ewe (k =2,3,4,5, and over), $T_l$ = Effect of $l^{th}$ type of birth (l = single, twin), $P_m$ = Effect of $m^{th}$ stage of lactation (m = 1,3,5), $S_n$ = Effect of $n^{th}$ month of lambing (n = Nov, Dec, Jan), $e_{ijklmno}$ = Random error associated with each observation assumed to be NID with zero mean and $I\sigma^2_e$ variance. Also, Scheffe test within SAS (2001) was used to detect differences among least square means within each factor.

## RESULTS AND DISCUSSION

Overall mean of fat, protein, lactose and solid non fat were 4.57±0.09, 6.45 ±0.06, 4.59±0.01 and 11.98±0.08 %, respectively (Table 1). Such values are within the averages reported earlier for various breeds of sheep (Geenty, 1979; Kutaibani, 1981; Ridha et al., 1981 and pulina and Nudda, 2001).

*Part of M.sc. thesis submitted by first author

**Factors affecting composition:**

1.**Breed within flock:** Analysis of variance (Table 1) revealed that breed within a flock has a significant effect on fat ($p<0.05$), protein and solid non fat ($p<0.01$). Also, it seems (Table1) that fat percent was significantly ($p<0.05$), higher (5.49%) for Awassi ewes raised in flock 4 compared with the same breed raised in flock 2 (4.24%). Conversely, the highest (7.08%) and lowest (5.93 %) percent of protein was recorded for Awassi ewes in flock 2 and 4, respectively. However, such differences within breed for Karadi and Hamdani ewes raised on different flocks do not exist. Similar finding have been reported between breed within flock on the percentages of fat and protein (Gonzalo et al., 1994; Pulina and Nadda, 2001 and Nudda et al., 2002), of lactose (Gonzalo et al., 1994) and of solid non fat (Geenty, 1979). These differences may be due to the variation in genetic make up of ewes as well as environmental conditions and particularly the availability of food.

2.**Age of ewes**: With the exception of lactose, age of dam had no significant effect on fat, protein and solid non fat percentages (Table 1). Such results were in accordance with that reported by Hernandes and Hohenboken (1979). On the other hand, other investigators noticed a significant effect of age of dam on milk composition of different breeds of sheep (Popovici, 1970 and Fuerter et al., 1998). Such differences between studies could be due to sampling method and analyses, as well as sample size.

3.**Type of birth:** Type of birth had no significant effect on all milk constituents (Table 1). However an increase in fat percent (0.33 %) was noticed in ewes rearing single compared to those reared twins. This result could be due to limited number of observations for ewes rearing twins. Also, earlier workers including Peart et al. (1975) found that type of birth had no significant effect on both fat and protein percentage .

4.**Stage of lactation:** Only Fat percentage was affected significantly ($P <0.01$) by stage of lactation (Table 1). Fat averaged 3.78, 4.54 and 6.10 % at early, mid and at the end of lactation period, respectively. Such finding is obvious since the relationship between milk yield and fat percentage is negative. Also, this result was in agreement with those reported earlier (Gonzalo et al., 1994 and Pavic et al, 2002).

5.**Month of lambing**: It appears from Table (1) that month of lambing has no significant effect on all milk constituents studied.

**It can be concluded** from this study which is carried out under farm conditions that variation between breeds within flock, and within breed between flocks exist. Therefore, an opportunity to improve breeds for certain milk constituents (i.e. fat, protein) is feasible.

**Table (1):** Mean squares, Test of significance and Least square means ± S.E. for the factors affecting fat, protein, lactose and solid non fat % in milk of different Iraqi local ewes.

| Factors | d.f. or No | Fat (%) | Protein (%) | Lactose (%) | Solid non fat (%) |
|---|---|---|---|---|---|
| | | Mean squares or Means± S.E. | Mean squares or Means± S.E. | Mean squares or Means± S.E. | Mean squares or Means± S.E. |
| Overall mean | 417 | 4.57 ± 0.09 | 6.45±0.06 | 4.59±0.01 | 11.98 ± 0.08 |
| Breed within flock: | 7 | 7.787 * | 4.959 ** | 0.093 | 8.744 ** |
| Flock 1-Hamdani | 63 | 5.00±0.29 abc | 6.59±0.21 ab | 4.65 ± 0.05 ab | 12.29±0.26 abc |
| Flock 1-Karadi | 59 | 4.74±0.30abcd | 6.46±0.21 bc | 4.65 ± 0.05 ab | 12.20±0.27abcd |
| Flock 2 – Hamdani | 61 | 4.49±0.26 bcd | 6.73±0.19 ab | 4.63 ± 0.04abc | 12.42 ± 0.23 ab |
| Flock 2 – Awassi | 59 | 4.24±0.26 d | 7.08±0.19 a | 4.66 ± 0.04 a | 12.83 ± 0.23 a |
| Flock 3- Hamdani | 39 | 4.27±0.30 cd | 6.22±0.22 bc | 4.58 ± 0.05abc | 11.67 ± 0.27cde |
| Flock 3 – Kaeadi | 38 | 5.09±0.32 ab | 6.27±0.23 bc | 4.52 ± 0.05 c | 11.47 ± 0.29 e |
| Flock 4-Awassi | 47 | 5.49±0.34 a | 5.93±0.25 c | 4.53 ± 0.05 bc | 11.47 ± 0.31 de |
| Flock 5- Hamdani | 51 | 4.77±0.28abcd | 6.48±0.20 bc | 4.58 ± 0.04abc | 12.01±0.25bcde |
| Age of dam(years): | 3 | 3.522 | 3.241 | 0.203 * | 5.767 |
| 2 & less | 131 | 4.58 ± 0.19 a | 6.59 ± 0.14 a | 4.62 ± 0.03 ab | 12.11 ± 0.17 ab |
| 3 | 165 | 4.74 ± 0.19 a | 6.59 ± 0.14 a | 4.66 ± 0.03 a | 12.26 ± 0.17 a |
| 4 | 58 | 5.15 ± 0.27 a | 6.10 ± 0.19 b | 4.56 ± 0.04 b | 11.58 ± 0.24 b |
| 5 & more | 63 | 4.75 ± 0.27 a | 6.54 ± 0.19ab | 4.55 ± 0.04 b | 12.16 ± 0.24 ab |
| Type of birth : | 1 | 5.456 | 4.049 | 0.113 | 5.965 |
| Single | 351 | 4.97 ± 0.13 a | 6.31 ± 0.09 a | 4.57 ± 0.02 a | 11.85 ± 0.12 a |
| Twin | 66 | 4.64 ± 0.24 a | 6.60 ± 0.17 a | 4.62 ± 0.04 a | 12.20 ± 0.21 a |
| Stage of lactation: | 2 | 146.26 ** | 0. 916 | 0.108 | 2.704 |
| Test 1 | 169 | 3.78 ± 0.18 c | 6.41 ± 0.13 a | 4.63 ± 0.03 a | 11.92 ± 0.16 a |
| Test 3 | 164 | 4.54 ± 0.18 b | 6.55 ± 0.13 a | 4.58 ± 0.03 a | 12.17 ± 0.16 a |
| Test 5 | 84 | 6.10 ± 0.22 a | 6.41 ± 0.16 a | 4.59 ± 0.04 a | 11.99 ± 0.20 a |
| Month of birth: | 2 | 2.979 | 0.449 | 0.154 | 2.656 |
| Nov. | 56 | 4.72 ± 0.28 a | 6.56 ± 0.20 a | 4.63 ± 0.04 a | 12.27 ± 0.26 a |
| Dec. | 242 | 4.84 ± 0.19 a | 6.42 ± 0.14 a | 4.54 ± 0.03 a | 11.85 ± 0.17 a |
| Jan. | 119 | 4.86 ± 0.21 a | 6.39 ± 0.15 a | 4.62 ± 0.03 a | 11.96 ± 0.19 a |
| Residual | 401 | 2.979 | 1.567 | 0.076 | 2.411 |

** P<0.01 * P<0.05

Means having different letters within each factor/column differ significantly (P<0.05) according to Scheffe's test.

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**بەراوردکرنا پێکهاتێن شیّری میهێت کوردی و حەمدانی و عەواسی یێت خودانکری لکەرێت بازرکانی پوختە**

**417 سامپلێت شیری هاتنە کومکرن ێیت 172 میهێت کوردی و حەمدانی و عەواسی یێت خودانکری ل چار کەرێت بازرکانی و کەرێ پێنجێ یی کولیژا چاندنێ / زانکویا سەلاحەددین ل دەستپێك و نیڤ ودیماهیا وەرزێ بەرهەمێ شیری بو شلوڤەکرنا پێکهاتێت کیمیاوی یێت شیری.**

**رێژا هەر ئێك ژ رونی و لاکتوزی و کەرەستێن رەق نەییت رونی 4.57 ± 0.09, 6.45 ± 0.06, 4.59 ± 0.01, 11.98 ± 0.08 ٪ لدیڤ ئێك. هەر وەسا ئەنجام دیار بون کو جورێت پەزی دناڤ کەری دا کارتێکرنا بەرچاڤ هەبو د رێژا هەر ئیك ژ روون و بروتینی و کەرەستێن رەق نەییت رونی. دیسان دیار دبیت کو ژی کارتێکرنا بەرچاڤ هەبو تنێ درێژا لاکتوزی دا ژلایەکێ دی ڤە جورێ زانێ چ کارتێکرن نەبو لسەر پێکهاتێن شیری.**

**مقارنة لمكونات النعاج الكرادية والحمدانية والعواسية المرباة في قطعان تجارية**

**الخلاصة**

**تم جمع 417 نموذج حليب تعود ل 172 نعجة كرادية وحمدانية وعواسية مرباة في اربع قطعان تجارية وقطيع خامس يعود لكلية الزراعة/ جامعة صلاح الدين في بداية ووسط ونهاية موسم ادوار الحليب وذلك لدراسة مكونات الحليب الكيماوية. بلغ معدل كل من نسب الدهن والبروتين واللاكتوز والمواد الصلبة اللادهنية 4.57 ± 0.09, 6.45 ± 0.06, 4.59 ± 0.01, 11.98 ± 0.08 % على التوالي. كما تشير النتائج بان للسلالات ضمن القطيع تاثير معنوي في نسبة كل من الدهن والبروتين والمواد الصلبة اللادهنية. كما يتضح بان للعمر تاثير معنوي في نسبة اللاكتوز فقط, في حين لم يكن لنوع الولادة تاثير معنوي في مكونات الحليب.**

# FACTORS INVOLVED IN *EX VITRO* ROOTING OF *Acalypha wilkesiana, Ficus microcarpa var. crassifolia, Bougainvillea glabra* AND *Vitex rotundifolia* STEM CUTTINGS

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## ABSTRACT

**Greenwood terminal cuttings of *Acalypha wilkesiana* were treated with Dip 'N grow (1: 0.5 IBA: NAA) solutions in concentrations ranging from 0 to 4000 ppm of active ingredients, and inserted into 1:1 vermiculite: perlite. Six weeks after initial treatment the best rooting indices were found for 0 and 1000 ppm, while the best rooting percentage, 96.72%, was obtained with 1000 ppm. As well as, stem cuttings of *Ficus microcarpa* var. *crassifolia* were inserted into vermiculite, Styrofoam, and a mixture of vermiculite and Styrofoam to examine the effects of propagating medium on rooting cuttings. Six weeks after propagating, the best rooting index and percentage (3.37, 91.67%) were found for the mixture of vermiculite and Styrofoam medium. The highest number of survival cuttings (91.65%) was also obtained from the use of the mixture of vermiculite and Styrofoam. Middle and base stem cuttings of *Bougainvillea glabra,* were inserted into vermiculite medium to examine the effects of age of wood and presence or absence of leaves on root cuttings. Twelve weeks after propagating, the best rooting index and percentage were found for base with leaves cuttings (3.17 and 33.4%) respectively. Stem cuttings of *Vitex rotundifolia* were treated with IBA (1000 ppm), BA (100 ppm) and the combination between IBA and BA solutions and inserted into vermiculite. Nine weeks after initial treatment the best rooting indices were found for 1000 ppm IBA, while the best rooting percentage, 100% was obtained with 1000 ppm IBA and 100 ppm BA. The longest shoots were obtained from the combination between IBA and BA.**

***KEYWORDS:*** *Acalypha wilkesiana*, *Ficus microcarpa* var. crassifolia, *Bougainvillea glabra*, *Vitex rotundifolia*, *ex vitro* rooting, growth regulators, culture media

## INTRODUCTION

Native to Fiji and nearby islands in the South Pacific, Little-leaf copper Acalypha (*Acalypha wilkesiana*), also known as Joseph's coat, or fire dragon, grows under ideal, frost-free conditions as a spreading evergreen shrub with upright branches that tend to originate near the base. It can get up to 10 ft (3.1 m) tall with a similar spread. The leaves are alternate, elliptic to oval serrate; the flowers are small and inconspicuous, hanging in 4-8 inches (10.2- 20.3 cm). (Floridata, 2004).

Dip'N Grow is one of the most effective rooting hormones available. Propagators at nurseries and universities nationwide have increased their yields and found Dip 'N Grow to be more economical and easier to use than other rooting agents. Dip 'N Grow is a liquid concentrate that consists of 1.0% IBA and 0.5% NAA. It is easily diluted with water to the necessary strength (Dipngrow.com, 2004). Naphthaleneacetic acid (NAA) and indolebutyric acid (IBA) are the compounds most commonly used to promote rooting of cuttings. Both are available as solutions or powders and are often used in combination (Mohammed and Al-Younis, 1991). Many studies have revealed the positive effect of auxins in promoting rooting cuttings for different ornamental plants, such as the study of Morini and Isoleri (1986) of the effect of IBA and NAA on rooting of *Actindia chinesis* cuttings. As well as the study of Camiel (1985) on the effect of NAA, IBA and IAA auxins and their mixture on rooting of Carnation cuttings.

*Ficus microcarpa var. crassifolia* (*Moraceae*) also known as Green Mound, is native to Australia. It is a popular ornamental plant grown widely in many tropical regions of the world. It has heavy-textured leaves a little more than twice as long as wide - about four inches by almost two inches. They are widest a little above the midpoint of the blade with a blunt but obviously pointed tip. Foliage is dark green and quite dense and grown upright. It grows best in full sun with plenty water (Burch, 2004). Various substrates and mixtures of materials are used for rooting cuttings, but there is no single, ideal mix. An appropriate propagation medium

depends on the species, propagule type, season, and propagation system; cost and availability of medium components are other consideration. Vermiculite is a good medium for rooting cuttings because is able to absorb large quantities of water (3 to 4 gal per cubic foot), has a relatively high cation exchange capacity (CEC) and thus can hold nutrients in reserve for later release. Being sufficiently porous, Styrofoam is also a good medium for rooting cuttings so that excess water drains away, permitting adequate penetration of oxygen to the roots (Hartmann *et al*., 2002).

Native to South America, Bougainvillea (*Bougainvillea glabra*, *Nyctaginaceae*), also known as paper flower, is mostly evergreen or semi-evergreen dropping its leaves for a brief period in winter. Its woody, thorn-armored canes soar to great heights and then tend to flop over sprawling across whatever is adjacent. This can look rather sloppy so many gardeners trim their plants into shrubs removing the overly enthusiastically growing canes as they appear. Bougainvillea can be used as a houseplant or hanging basket in cooler climates (Schoellhorn and Alvarez, 2002; Scheper, 1999). It is known that the matured (base stem cuttings) wood cuttings (physiological or ontogenetic age) are better in rooting success than immature wood cuttings (middle or tip stem cuttings) (Hackett, 1985). The presence of leaves on cuttings exerts a strong stimulating influence on rooting. The stimulatory effect of leaves on rooting in stem cuttings is nicely shown by studies of Reuveni and Raviv (1981) with avocado.

Beach vitex (*Vitex rotundifolia*, *Verbenaceae*), is a shrub growth habit plant found on beaches, low growing habit to 2 inches with indefinite spread. Grey-green foliage and blue flowers in summer (Woody descriptions, 2005). Since the 1930's the plant growth regulator Indole-3-butyric acid (IBA) has been used for rooting of plant cuttings and other growth processes. So many articles have been written on it as the favorite single compound used to promote rooting. Useful compounds containing IBA are solutions and powders. Solutions of IBA dissolved in water are useful for more purposes than any other compound (Kroin, 1992). IBA is applied to plant cuttings for rooting using powder or liquid carrier. Different concentrations are used for different plant varieties, season, and other variables. Methods of using IBA in solution are Immerse, Total Immerse, Quick Dip, and Spray Drip Down. It is difficult to relate concentration to promote rooting when comparing IBA blended in powders and liquids (Blazich, 1988; and Bonaminoto, 1983). Variation is due to the method of application, retention, and use of the IBA by the plant tissue.

## MATERIALS AND METHODS

These experiments were carried out at Magon greenhouses of the University of Hawaii at Manoa, USA in the spring season of 2005. Greenwood terminal cuttings of Acalypha were harvested at the corner of St. John Building on the University of Hawaii campus. Cuttings were trimmed to 5 inches in length without regard to position of basal cut and bottom node. Foliage removed from basal 1.5 inches of the stem. The propagation medium was a 1:1 mixture of vermiculite and perlite, moistened and placed in 10" X 20" metal flats to a depth of 3 inches. Cuttings were inserted about 1 to 1.5 inches in to the medium following treatment. Cuttings were banded together of 10 cuttings. Bunches of cuttings were held in rooting hormone solution. Three flats of medium were prepared. Ten cuttings of each treatment were placed in random order in each flat. The rooting was compound of Dip 'N Grow (Astoria-pacific Co.), which contains 1% IBA and 0.5% NAA, in the stock solution. Stock diluted with water to prepare different concentrations. The concentrations used were 0, 1000, 2000, 3000, or 4000 ppm total active ingredient. Each concentration was replicated three times with 10 cuttings in each replicate, and the three replicates were randomly distributed among three flats. The rooting environment was under 30% shade, ambient outdoor temperatures with no bottom heat, and a misting cycle of eight seconds on with eight minutes between cycles. Cuttings were removed from their flats after six weeks from treatments, and numbers of rooted cuttings were counted and each cutting evaluated according to a scale of heavy, medium, light, alive but not rooted, or dead. A rooted index was calculated using a ranking method (Mahlstede and Lana, 1958 and O'Rourke and Maxon, 1948). Replication means were averaged for both percentages rooted and rooting index.

Tip stem cuttings of *Ficus microcarpa* var. crassifolia were harvested at the corner of Sherman lab Building on the University of Hawaii campus on January 19, 2005. Cuttings were trimmed to 5 inches in length without

regard to position of basal cut and bottom node. Foliage removed from basal 1.5 inches of the stem. The propagation media were vermiculite, Styrofoam, and a mixture of vermiculite and Styrofoam, moistened and placed in 10" X 20" metal flats to a depth of 3 inches. Cuttings were inserted about 1 to 1.5 inches in to the medium. Three flats of medium were prepared by separating between media by fiber wood intervals. Each treatment was replicated three times with 20 cuttings in each replicate, and the three replicates were randomly distributed among three flats. The rooting environment was under 30% shade, ambient outdoor temperature with no bottom heat, and misting of eight seconds on with eight minutes between cycles.

Cuttings were removed from their flats on March 16, 2005, and numbers of rooted cuttings were counted and each cutting evaluated according to a scale of heavy, medium, light, alive but not rooted, or dead. A rooted index was calculated as explained above.

After removing the tip of each branch of *Bougainvillea* harvested at the University of Hawaii campus (near Sherman building) February 2, 2005, sets of cuttings of the middle and the base of each branch had been made. Cuttings were made with leaves and without leaves and trimmed to 4 to 6 inches. The propagation medium was vermiculite, moistened, and placed in "10 X 20" metals flats to a depth of three inches. Cuttings were inserted about 1 to 1.5 inches into the medium. Each type of cuttings was replicated three times with 10 cuttings in each replicate, and the replicates were randomly distributed among the flats. The rooting environment was under 60% shade, ambient outdoor temperatures with no bottom heat, and a misting cycle of eight seconds on with 8 minutes between cycles. Cuttings were removed from their flats on April 20, 2005, and numbers of rooted cuttings were counted and each cutting evaluated according to a scale of heavy, medium, light, alive but not rooted, or dead. A rooting index was calculated as earlier explained.

Uniform mature-wood cuttings of beach vitex were harvested at the University of Hawaii campus near Pope lab in full sun February 9, 2005. Cuttings were trimmed to 4 to 6 inches in length, and basal leaves were removed. The propagation medium was vermiculite, moistened, and placed in "10 X 20" metals flats to a depth of three inches. Cuttings were inserted about 1 to 1.5 inches into the medium following treatments. Cutting bases were held in the rooting solution for 5 minutes. The rooting solutions consisted of three treatments, 0 (Control), IBA (1000 ppm), BA (100 ppm), and the combination of IBA and BA (used separately). Each treatment was replicated three times with 10 cuttings in each replicate, and the replications were randomly distributed among three flats. The rooting environment was under ambient temperatures with no bottom heat, and a misting cycle of eight seconds on with 8 minutes between cycles. Cuttings were removed from their flats on April 11, 2005, and numbers of rooted cuttings were counted and each cutting evaluated according to a scale of heavy, medium, light, alive but not rooted, or dead. A rooting index was explained eariler. Concerning the shoots, number and length of shoots were calculated for each cutting. Replication means were averaged for all calculations.

## RESULTS AND DISCUSSION

Stem cutting survival rates of Acalypha were high for all treatments (Figure 1).The highest percent rooted was obtained from the cuttings treated with 1000 ppm (Table, 1). The rooting index value did not reflect a trend from low to high concentration, although the best averages were 4.10, 4.17, and 4.47 for 500, 0, and 1000 ppm respectively. Heavy rooted cuttings occurred in 0, 500, and 1000 ppm treatments. Today, IBA and NAA are still the most widely used auxins for rooting stem cuttings and it has been confirmed that auxin is required for initiation of adventitious roots on stems, and indeed, it has been showed that divisions of the first root initial cells are dependent upon either applied or endogenous auxin (Chu and Cooper, 1950 and Dehgan, 1996). It can be noticed that the highest percent rooted were obtained from low auxin concentration treatments. The reason behind that may be due to the ideal endogenous auxin concentration in terminal cuttings which is quite enough to promote root initiation while by adding further exogenous auxin to the cuttings will influence rooting initiation because as it is known that auxins and even other plant growth regulators are usually added with low concentrations according to the plant requirements otherwise, they will inhibit a certain physiological process within the plant.

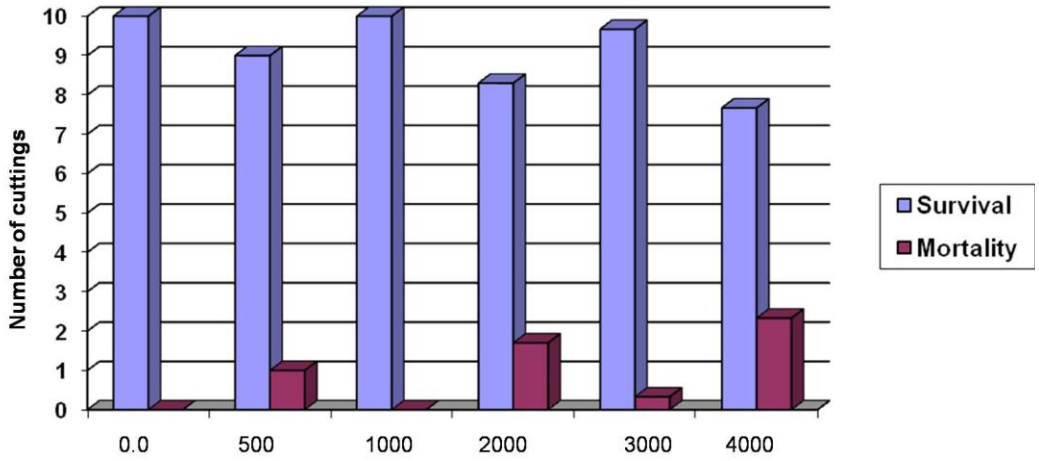


**Figure (1):** A. Survival and mortality of acalypha stem cuttings 6 weeks after treatment with various concentration of dip 'N grow rooting compound.

For *Ficus* rooting test results, Figure (2) reveals that the highest stem cutting survival rate was obtained from the use of the mixture of vermiculite and Styrofoam (18.33). The highest percent rooted and rooting index (91.67%, 3.37 respectively) were also obtained from the treatment of Vermiculite + Styrofoam (Table, 2). The high rooting index and percentage for *Ficus microcarpa var. crassifolia* stem cuttings in the mixture treatment of vermiculite and Styrofoam, is proving that this mixture provides an anchor system for the cuttings, nutrients that can be absorbed by roots, and oxygen (air space) for root respiration more efficiently than vermiculite or Styrofoam separately performance.

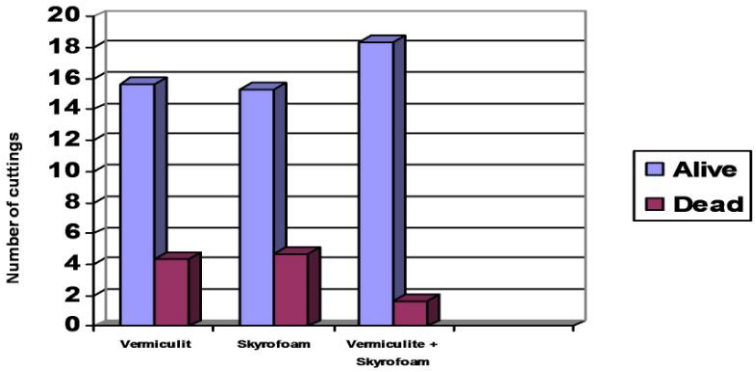


**Figure (2):** A. Survival and mortality of *Ficus microcarpa crassifoliastem* cuttings 7 weeks after propagated in different propagating media.

For *Bougainvillea* experiment, Stem cutting survival rates were low for all treatments (Figure 3). About one-third of the middle and base cuttings in presence of leaves rooted (Table, 3) while the middle cuttings without leaves did not root at all. The rooting index values (Table, 3) also were low but the best one was obtained from base cuttings in presence of leaves (3.17).

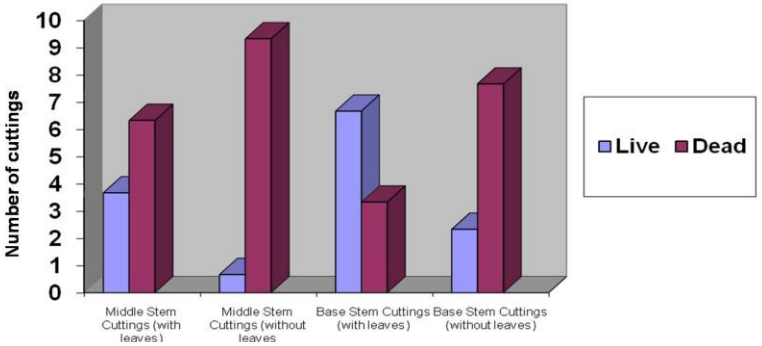


**Figure (3):** A. Survival and mortality of bougainvillea middle and base stem cuttings in presence or absence of leaves after 12 weeks from propagating.

The overall poor rooting may be attributed to the low quality of Bougainvillea cutting sources. Presence of leaves on Bougainvillea cuttings, promote root formation through their production of growth-promoting hormones and food materials (carbohydrates). Carbohydrates translocated from the leaves are important for root development. However, the strong root-promoting effects of leaves and buds are probably due to other, more direct factors (Breen and Muraoke, 1974). We conclude from this experiment that the base stem cuttings are better than middle cuttings and the presence of leaves is necessary for rooting.

Concerning *Vitex*, experiment, Stem cutting survival rates were high for all treatments (Figure 4) especially for IBA (1000 ppm) and BA (100 ppm). This might be due to the high endogenous auxin levels which reflect in the superiority of the BA treatment. The rooting index values (Table, 4 and Figure 4) reflected that the treatment with IBA (1000 ppm) gave the highest rooting index (3.93). Table (5) reveals that the highest number of shoots (5.6) was obtained from the control treatment, while the best length of shoots (6.7 inches) was obtained from the combination of IBA and BA. The overall good rooting may be attributed to the ideal environment and medium during rooting period as well as the high quality beach vitex cuttings. In this experiment, both roots and adventitious shoots have been initiated and developed. Auxins (IBA) promote root initiation as they do for stem cuttings while cytokinins (BA) are known to promote shoot development. It can be concluded from this experiment that we can use both auxins and cytokinins in order to obtain a good root cuttings further than obtaining good shoot formation.

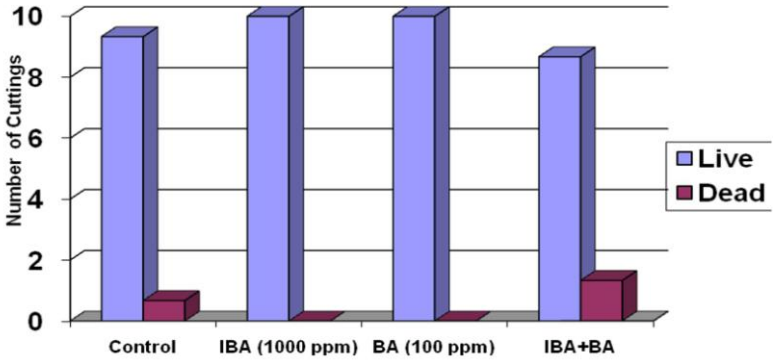


**Figure (4):** A. Survival and mortality of beach vetix stem cuttings 9 weeks after treatment with IBA and BA.

**Table (1):** Rooting percentage and rooting index values for *Acalypha wilkesiana* stem cuttings evaluated 6 weeks after treatment with various concentrations of Dip 'N Grow rooting compound.

| Dip 'N Grow (ppm) | Rooting Index* | Percent Rooted |
|---|---|---|
| Control 0.0 | 4.17 a | 96.67 a |
| 500 | 4.10 a | 90.00 a |
| 1000 | 4.47 a | 96.72 a |
| 2000 | 3.47 b | 73.23 b |
| 3000 | 2.83 c | 60.26 bc |
| *4000* | 2.44 c | 40.31 c |

Data represent means of three replicates

*Rooting index equivalent: 5= heavy rooting, 4= medium rooting, 3= light rooting, 2= alive but not rooted, 1= dead.

**Table (2):** Rooting index values and rooting percentage of *Ficus microcarpa* var. crassifolia stem cuttings evaluated 7 weeks after propagated in different media.

| Media | Rooting index* | Percent rooted (%) |
|---|---|---|
| Vermiculite | 2.70 b | 78.33 b |
| Styrofoam | 2.55 b | 76.67 b |
| *Vermiculite + Styrofoam* | 3.37 a | 91.67 a |

Data represent means of three replicates

*Rooting index equivalent: 5= heavy rooting, 4= medium rooting, 3= light rooting, 2= alive but not rooted, 1= dead.

**Table (3):** Rooting percentage and rooting index values for Bougainvillea middle and base stem cuttings in presence or absence of leaves after 12 weeks from propagating.

| Types of cuttings | Rooting Index* | Percent Rooted |
|---|---|---|
| **Middle stem cuttings+leaves** | 1.97 b | 30.1 a |
| **Middle stem cuttings without leaves** | 1.07 b | 0.00 c |
| **Base stem cuttings+leaves** | 3.17 a | 33.40 a |
| ***Base stem cuttings without leaves*** | 1.50 b | 16.70 b |

*Rooting index equivalent: 5= heavy rooting, 4= medium rooting, 3= light rooting, 2= alive but not rooted, 1= dead.

**Table (4):** Rooting index and rooting percentage values for Beach Vitex stem cuttings evaluated 9 weeks after treatment with IBA and BA**.**

| Treatments (ppm) | Rooting Index* | Percent Rooting (%) |
|---|---|---|
| **Control** | 3.00 b | 93.33 a |
| **IBA 1000** | 3.93 a | 100.00 a |
| **BA 100** | 3.63 a | 100.00 a |
| ***IBA + BA (1000+100)*** | 3.10 b | 83.33 b |

Data represent means of three replicates

*Rooting index equivalent: 5= heavy rooting, 4= medium rooting, 3= light rooting, 2= alive but not rooted, 1= dead.

**Table (5):** Number and length of shoots for Beach Vitex stem cuttings evaluated 9 weeks after treatment with IBA and BA.

| Treatments (ppm) | Number of shoots/cutting | Length of shoots/cutting (Inch) |
|---|---|---|
| **Control** | 5.6 a | 3.1 b |
| **IBA 1000** | 4.6 a | 3.4 ab |
| **BA 100** | 5.2 a | 5.1 a |
| ***IBA + BA (1000+100)*** | 4.9 a | 6.7 a |

Data represent means of three replicates

*Rooting index equivalent: 5= heavy rooting, 4= medium rooting, 3= light rooting, 2= alive but not rooted, 1= dead.

Figures 5, 6, 7 and 8 represent the photographs taken for the plants under experiment to declare the effects of the treatments tested subsequently.

**Figure (5):** *Ficus microcarpa crassifolia* stem cuttings 7 weeks after propagated in different propagating media: Vermiculite, Styrofoam + Vermiculite + Styrofoam.

Figure 6: Middle stem cuttings+leaves, middle stem cuttings without leaves, base

**Figure (6):** Middle stem cuttings+leaves, middle stem cuttings without leaves, base stem cutting+leaves, and base stem cuttings without leaves of *Bougainvillea* after 12 weeks from propagating in Vermiculite.

**Figure (7):** Dead, alive, light, medium, and heavy rooting cuttings of *Bougainvillea* after 12 weeks from propagating in Vermiculite.

**Figure (6):** Rooting cuttings for beach vitex evaluated 9 weeks after treatment with IBA and Cytokinin. From left to right, control, IBA(1000ppm),BA(100ppm),IBA+BA (1000+100ppm).

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# کارتێکرنا هندەك فاکتەرا ل سەر رویهدانا قەلەمێن رووەکێن *Ficus microcarpa Acalypha wilkesiana* جۆرێ کراسیفولیا و *Bougainvillea glabra* و *Vitex rotundifolia* دناف لەشێ زیندی


**پوختە**

قەلەمێن تەر ییّن رووەکێ Acalypha wilkwsiana هاتنە سەرەدەری کرن دگەل Dip'N Grow ئەوێ پێکهاتی ژ 1: 0,5 IBA و NAA وتیراتییّن ژێکجودا ژ 0,0 تاکو 4000 ppm ژکەرەستێ ئەکتیف. قەلەم هاتنە چاندن دبیافێ چاندنێ دا ئەوێ پێکهاتی ژتێکهەلێ فیرمیکیولایت وپرلایت (1: 1). پشتی بورینا شەش حەفتیا ژسەرەدەریا، باشترین رێبەرێ رویهدانێ ژهەردوو سەرەدەریّن کونترول و 1000 ppm. وبلندترین ریژا رویهدانێ (96,72٪) هاتە تومارکرن ژسەرەدەریا 1000 ppm. دیسان قەلەمێن رووەکێ *Ficus microcarpa* جۆرێ کارسیفولیا هاتنە چاندن دناف بیافێ فیرمیکیولایت وفلینی هەرئێك بتنێ وتێکهەلێ وان ب ریژەیا قەبارەیی 1: 1 ژبو تاقیکرنا کارتێکرنا بیافێ چاندنێ ل سەر رویهدانا قەلەما. پشتی بورینا شەش حافتیا ژچاندنێ، باشترین رێبەرێ رویهدانێ وبلنتدترین ریژەیا رویهدانێ وبلندترین ریژەیا مانێ (3,37 و 91,67٪ و 91,65٪ ل دویف ئێك دا) هاتنە تومارکرن ددەمێ چاندنا وان دناف بیافێ تێکهەل دا. هەروەسا قەلەمێن ناڤین و بنەرەت ییّن رووەکێ *Bougainvillea glabra* هاتنە چاندن دناف بیافێ فیرمیکیولایت ژبو تاقیکرنا کارتێکرنا ژیێ داری وهەبوون ونەبوونا بەلگا ل سەر قەلەما ل سەر شیانێن رویهدانێ. پشتی بورینا 12 حەفتیا ژچاندنێ، باشترین رێبەرێ رویهدانێ وبلندترین ریژەیا رویهدانێ (3,17 و 33,4٪ ل دویف ئێك دا) هاتنە تومارکرن ددەمێ بکارئینانا قەلەمێن بنەرەت وب بەلگڤە. دیسان قەلەمێن رووەکێ *Vitex rotundifolia* هاتنە سەرەدەری کرن بئوکسینی (IBA) ب تیراتیا 1000 ppm وسایتوکاینینی (BA) ب تیراتیا 100 ppm هەرئێك بتنێ ودگەل ئێك دا وقەلەم هاتنە چاندن دناف بیافێ فیرمیکیولایتی. پشتی بورینا نەھ حەفتیا ژچاندنێ، باشترین رێبەرێ رویهدانێ (3,93) هاتە تومارکرن ژسەرەدەریا 1000 ppm ژ IBA ودیسان ژ 100 ppm ژ BA. ودریژترین تایێن کەسك ددەمێ سەرەدەری کرن ب تێکهەلێ ئوکسینی وسایتوکاینینی.

# دراسة بعض العوامل المؤثرة في تجذير العقل الساقية لنباتات الحليفيا *Acalypha wilkesiana* والمطاط *Ficus microcarpa* صنف كراسيفوليا والجهنمية *Bougainvillea glabra* وكف مريم *Vitex rotundifolia* داخل الجسم الحي

**الخلاصة**

تم معاملة العقل الطرفية الغضة لنبات الحليفيا *Acalypha wilkwsiana* بمستحضر التجذير Dip'N Grow المكون من محلول 1: 0,5 IBA و NAA وبتراكيز مختلفة تراوحت بين صفر و 4000 جزء بالمليون من المادة الفعالة. وغُرست العقل في وسط الزراعة المكون من خليط من الفيرميكيولايت والبرلايت (1: 1). بعد مرور ستة أسابيع من المعاملات، تم الحصول على أفضل دليل تجذير لمعاملتي المقارنة و1000 جزء بالمليون. فيما تم تسجيل أعلى نسبة مئوية للتجذير (96,72%) لمعاملة 1000 جزء بالمليون. كذلك تم غرس العقل الساقية لنبات المطاط *Ficus microcarpa* صنف كراسيفوليا في وسط زراعي مكون من الفيرويكيولايت والفلين على حدة أو مخلوطين مع بعضهما بنسبة حجمية 1: 1 لإختبار تأثير وسط الزراعة في تجذير العقل الساقية. بعد مرور ستة اسابيع من الزراعة، وُجد بأن أفضل دليل تجذير وأعلى نسبة مئوية للتجذير وأعلى نسبة بقاء (3,37 و91,67% و91,65% على التوالي) تم تسجيلها عند الزراعة في مخلوط المادتين. العقل الساقية الوسطية والقاعدية لنبات الجهنمية *Bougainvillea glabra* تم غرسها في وسط الفيرميكيولايت لإختبار تأثير عمر الخشب ووجود وغياب الأوراق على التجذير. بعد مرور 12 أسبوعاً من الزراعة، أفضل دليل تجذير وأعلى سبة مئوية للتجذير (3,17 و 33,4% على التوالي) تم تسجيلهما عند زراعة العقل القاعدية المحتفظة بأوراقها. عوملت العقل الساقية لنبات كف مريم *Vitex rotundifolia* بالأوكسين (IBA) بتركيز 1000 جزء بالمليون والسايتوكاينين (BA) بتركيز 100 جزء بالمليون كل على حدة وكذلك متداخلين وغُرست في وسط الفيرميكيولايت. بعد مرور تسعة أسابيع من الزراعة، فإن أفضل دليل تجذير (3,93) تم تسجيله للمعاملة بـ1000 جزء بالمليون من IBA وأعلى نسبة مئوية للتجذير (100%) تم تسجيلها للمعاملتين 1000 جزء بالمليون IBA وكذلك 100 جزء بالمليون BA. وتم الحصول على أطول الفروع الخضرية عند معاملة العقل بخليط الأوكسين والسايتوكاينين.

# EFFECT OF PLANT DENSITY AND CULTURE MEDIA ON SOME GROWTH CHARACTERISTICS OF STOCK PLANT (*Mathiola incana* R.Br)

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## ABSTRACT

**The present study was conducted in the greenhouse of Horticultural Department / Agricultural College/ Dohuk University during the growing season 2009- 2010. The study consists of testing the effects of two plant densities of stock plant (*Mathiola incana* R. Br.) (2 and 4 plants / pot) and four different cultural media (sand, loam, peat moss and analyzed animal manure). The first density (2 plants / pot) appeared a significant superiority on the second density (4 plants / pot) in the vegetative characteristics (plant heights, number of branches, stem diameter, leaves number, dry weight of vegetative growth and chlorophyll percentage), as well as the flowering characteristics (number of flowers, length of flower spike) and length of roots. While the second plant density (4 plants / pot) was better in giving the highest dry weight of roots, the animal manure and peat moss medium gave significant superiority on the others media in all studied features. The interaction between planting densities and growth media also appeared significant differences in all the studied features. The interaction between the first density and the peatmoss and animal manure media gave the best results for all studied features.**

***KEYWORDS*:** Plant Density, Culture Media, *Mathiola incana*

## INTRODUCTION

Stock plant (*Mathiola incana* R. Br.) belongs to Cruciferae family, in the basin of Mediterranean sea (Badir *et.al.*, 1998). This plant is one of the important winter annuals which are planted abundantly in gardens because of its flowers beauty and its fitness for commercial plucking. It propagated by seeds in autumn. It is grow to about 40 – 60 cm in height. Its stem is hard woody with many branches. Leaves are longitudinally alternative with low piles and flowers are sited on a long of stem (flower spike). Their colors are several like white, pink, purple, red and blue, they are either single or doubled. The doubled flowers are more preferable in which their seeds are gained from the single varieties. Stock plant is one of the non avoidable in any home gardens because of its bright flower in a long clusters and strong fragrant order which spread everywhere. This makes these flowers vary lovable and highly desired in every gardens especially being well for picking. This plant usually cultured in pots for beautifying different places or in basins to decorate the home garden (Al-Ba'aly, 1967; Awadh and Dhaw, 1985).

The pioneer plant growers noticed the effect of plants on each other while growing together at the same area. Harper (1961) was the first author used the term of interaction to index the difficulties that are usually facing a certain plant when it is adjusting other plant of the same species or of others. Competition is a natural process. When amounts of growth elements are reduced competition will started (Milthorpe, 1961). Competition among the same species is more sever and danger from that of among different plat species. They revealed the reasons to the similarity among these plants in growth requirement for growth factors like light, water, nutrient elements and others. Studying plant density (plant spaces) among plants is one of the applied studies which highly affect crops productivity in general (Weaver and Clement, 1938). Esho (1983) noticed that planting at narrow spaces (20 cm) of cucumber had led to increase the length of the main stem and reduced the number of branches, fresh and dry weight of the plant. Planting at 40 cm caused an increase the number of branches and decreased the length of the main stem. Noraldeen (2002) had referred in his study on the effects of planting densities and planting date on same plant growth characteristics of Zinnia and Antirrhinum, that low planting densities caused significant increase in the rates of plant height of Antirrhinum and the number of leaves, stem diameter, shoot dry weight, number of blossoms and the number of flowers in a blossom for both plants as compared with the high planting densities.

Since there are many plants which spend their life cycle and they need a medium which

provides them with their different needs completely, so it is necessary to find many media consisted of a number of components in order to reach this purpose. It can be said that sand, loam and peat moss are the basic components of the special medium of seed planting (Salman, 1988). Waters *et.al*. (1970) mentioned that one of the important factors which should be noted and observed when choosing the planting medium is its ability of well ventilation, keeping a suitable level of moisture and being rich in nutrient materials. Tawajin (1987) also reported that adding organic manures to the growth medium leads to improving the plant growth and using clay or silt in the growth medium will limit the growth unless large amounts of organic materials, for about half of the size of the medium are added. Singh *et.al*. (2002) founded that there are no significant differences in plant height when four different planting media were used (soil, soil and peat moss (1:1), peat moss and fermented leaves (1:1), and peat moss only) but the plants planted in peat moss only or in the mixture of peat moss and fermented leaves, were characterized by giving the highest number of stems, branches and roots. Al-Mukhtar (2003) also found that the use of the media consisted of mixture of soil, sand, and animal manure have led to obtaining the best values in number of leaves, leaves area, tillers, and chlorophyll as compared with planting in other media when *Nephrolepis exaltata* is grown. Abdulrahman (2006) found that peat moss and the mixture of sand, loam and analyzed animal manure (1:1:1) media appeared a significant superiority on other media in all studied growth characteristics for *Antirrhinum majus*. Atif *et.al*. (2008) concluded that plant height; number of leaves/ plant, number of side branches and number of flowers were affected significantly when Zinnia plants grown in leaf manure mix. This was greater than silt and soil media.

This study was aimed to determine the most appropriate planting density and medium to increase the rate germination for this plant and to get the best options for both vegetative and flowery growth.

## MATERIALS AND METHODS

The present study was conducted in the greenhouse of Horticultural Department of College of Agriculture/ University of Dohuk during 15/9/2009 to 1/6/2010. Seeds which were collected from plants were planted in college gardens in growing season 2008-2009 by sowing in small wooden boxes by broadcasting. The seeds germinated after 12.5–15.5 days and germination percentage of used seeds reached 76 %.

The transplants were transplanted after 40 days later or after formation 2-4 pairs of true leaves into plastic pots of 22.5 cm in diameter and 21 cm in depth after filling the culture media (sand, loam, peat moss and analyzed animal manure for (sheep's) and then Metalaxyll fungicide was added (50% w.p.) by using two levels of plant density (2 and 4 plants / pot). Each replicate was represented by 3 pots. The daily temperature and the relative humidity inside the greenhouse also were recorded using thermo hygrograph and the temperature of the media was recorded by using normal mercury thermometer (Table 1).

**Table (1):** Monthly averages of maximum and minimum temperatures (°C) and relative humidity during the experiment period (2009 - 2010) inside the greenhouse and the temperature of culture media during the first five months from planting.

| Months | Temperature and relative humidity inside the greenhouse | | | Temperature of media(°C) | | | |
|---|---|---|---|---|---|---|---|
| | Maximum temp. (°C) | Minimum temp. (°C) | Relative Humidity (%) | sand | loam | Peat moss | Animal manure |
| October | 25.4 | 12.5 | 63.0 | 25.6 | 23.4 | 23.1 | 25.8 |
| November | 21.5 | 9.6 | 69.2 | 25.7 | 25.6 | 25.2 | 28.9 |
| December | 19.1 | 6.1 | 70.7 | 21.0 | 21.2 | 22.3 | 20.0 |
| January | 17.9 | 2.7 | 73.2 | 18.8 | 18.3 | 18.5 | 18.2 |
| February | 20.2 | 1.9 | 76.1 | 21.3 | 20.9 | 20.1 | 20.9 |
| March | 28.3 | 6.8 | 73.6 | | | | |
| April | 33.5 | 11.2 | 65.7 | | | | |
| May | 38.1 | 16.9 | 60.2 | | | | |

The studied factors consisted of tow plant density of stock plant (2 and 4 plants / pot) and four different culture media (sand, loam, peat moss, and analyzed animal manure).

The studied features were recorded at the fully flowering stage included the following:

**1.**Plant height (cm.)
**2.**Number of vegetative branches.
**3.**Stem diameter (cm).
**4.**Number of leaves.
**5.**Number of flowers.
**6.**Length of flower spike (cm).
**7.**Root length (cm).
**8.**Dry weight of vegetative growth (g).
**9.**Dry weight of roots (g).
**10.**Total chlorophyll percentage in leaves (%) by using digital parameter.

The experiment was applied by using Randomized Complete Block Design (RCBD) of two factors in three replicates. The angular conversion for the results of germination percentages and Total chlorophyll percentage then they have been analyzed by SAS program (1989- 1996). Duncan test under probability level (5%) has been used for means comparing (Al-Rawi and Khalaf-Allah, 1980).

## RESULTS

### 1- Plant height:

Table (2) revealed a significant effect of plant density on stock plant height where first plant density gave the highest height percentage (36.95 cm) while the shorter height was obtained in the second plant density (26.04 cm). The highest height of plants had been obtained from the planting in the peat moss medium (47.75 cm) which differed significantly from the other media. The lowest height had been obtained in sand medium (9.75 cm). The same table showed a significant difference for the interaction between plant density and culture media; the first density in the animal manure medium gave (52.27 cm) which has no differences significant as compared with the interaction of the first density and the peat moss medium, while the shorter height appeared for the second density and the sand medium (8.94 cm).

**Table (2):** Effect of plant density and culture media and their interactions on plant height (cm) of stock (*Mathiola incana*) plants.

| Culture media / Plant density | Sand | Loam | Peat moss | Animal manure | Density Means |
|---|---|---|---|---|---|
| 2 plants \ pot | 10.20 e | 36.38 c | 48.95 ab | 52.27 a | 36.95 a |
| 4 plants \ pot | 8.94 e | 15.20 d | 46.56 b | 33.45 c | 26.04 b |
| Media Means | 9.57 d | 25.79 c | 47.75 a | 42.86 b | |

***** Numbers carrying the same letter has no significant differences according to Duncan test under probability level of 5%.

### 2- Branch number / plant:

From the data in Table (3), it is clear that the plant density has a significant effect on branch number for stock plant; the higher number of branches was recorded for the first density (7.63 branches), while the minimum number of branches was obtained from the second density (3.33 branches). Moreover, the highest number of branches had been obtained from the planting in the animal manure medium (9.66 branches) which has no differences significant from the peat moss medium (9.63 branches). A significant difference for the interaction between plant density and culture media; the first density in the peat moss medium gave (14.00 branches) which didn't differ significantly as compared with the interaction the first density and the animal manure medium while the minimum branches number was recorded for the planting at the second density in the loam medium (1.25 branches).

**Table (3):** Effect of plant density and culture media and their interactions on number of branches of stock (*Mathiola incana*) plants.

| Culture media / Plant Density | Sand | Loam | Peat moss | Animal manure | Density Means |
|---|---|---|---|---|---|
| 2 plants \ pot | 0.67 d | 3.17 c | 14.00 a | 12.67 a | 7.63 a |
| 4 plants \ pot | 0.17 d | 1.25 d | 5.25 b | 6.65 b | 3.33 b |
| Media Means | 0.42 c | 2.21 b | 9.63 a | 9.66 a | |

* Numbers carrying the same letter has no significant differences according to Duncan test under probability level of 5%.

**3- Stem diameter:**

Table (4) showed that plant density significantly affect on stem diameter of stock plants; the first density gave the highest diameter of stem (5.15 cm) which significantly differed from the second density (4.20 cm). The planting in the animal manure and peat moss gave a significant high diameter (6.11 and 5.77 cm) respectively. The interaction between the first density and animal manure media gave the highest diameter of stem (6.36 cm).

**Table (4):** Effect of plant density and culture media and their interactions on stem diameter of stock (*Mathiola incana*) plants.

| Culture media / Plant Density | Sand | Loam | Peat moss | Animal manure | Density Means |
|---|---|---|---|---|---|
| 2 plants \ pot | 2.62 c | 5.79 ab | 5.82 ab | 6.36 a | 5.15 a |
| 4 plants \ pot | 2.55 c | 2.69 c | 5.72 b | 5.85 ab | 4.20 b |
| Media Means | 2.58 c | 4.24 b | 5.77 a | 6.11 a | |

***** Numbers carrying the same letter has no significant differences according to Duncan test under probability level of 5%.

**4. Leaves number:**

The data in Table (5) showed that the plant density had a significant effect on the number of leaves for stock plant; the highest number was obtained in the first plant density (74.21 leaves) which significantly differed from the second plan density (43.10 leaves). Planting in the peat moss medium gave the highest number (95.13 leaves) as compared with the rest of the used media. The interaction between the first plant density and the peat moss medium had recorded a significant highest number (128.67 leaves).

**5- Number of flowers / plant:**

It can be noticed from Table (6) that planting density had a significant effect on the number of flowers. The first density gave the highest number of flowers (8.53). Culture media revealed a significant differences in the number of flowers; the highest number was recorded for the peat moss medium (10.10 flowers) which didn't differ significantly as compared with the animal manure medium. The interaction between the first densities in peat moss and animal manure media gave the significant highest number of flowers as compared with other interactions except between the first density in loam medium.

**Table (5):** Effect of plant density and culture media and their interactions on leaves number of stock (*Mathiola incana*) plants.

| Culture media / Plant Density | Sand | Loam | Peat moss | Animal manure | Density Means |
|---|---|---|---|---|---|
| 2 plants \ pot | 19.33 f | 39.67 d | 128.67 a | 109.17 B | 74.21 a |
| 4 plants \ pot | 17.83 f | 26.92 e | 61.58 c | 66.08 C | 43.10 b |
| Media Means | 18.58 d | 33.29 c | 95.13 a | 87.63 B | |

***** Numbers carrying the same letter has no significant differences according to Duncan test under probability level of 5%.

**Table (6):** Effect of plant density and culture media and their interactions on number of flowers of stock (*Mathiola incana*) plants.

| Culture media / Plant Density | Sand | Loam | Peat moss | Animal manure | Density Means |
|---|---|---|---|---|---|
| 2 plants \ pot | 2.50 d | 10.27 ab | 10.72 a | 10.62 a | 8.53 a |
| 4 plants \ pot | 1.16 e | 6.03 c | 9.47 b | 9.38 b | 6.51 b |
| Media Means | 1.83 c | 8.15 b | 10.10 a | 10.00 a | |

***** Numbers carrying the same letter has no significant differences according to Duncan test under probability level of 5%.

**6. Spike flowers length:**

Table (7) showed a significant effect of planting density on the spick flower length; the longest spick flower was recorded for the first density (3.14 cm) which differ from the second density. The longest spick flower had been obtained from the planting in the peat moss medium (4.72 cm) while the lowest length was founded in plants which planted in sand. A significant difference for the interaction between plant density and culture media; the first density with peat moss medium gave 5.30 cm which differed significantly as compared with the other interaction.

**7. Root length:**

From the data in Table (8), it is cleared that plant density had a significant effect on root length for stock plant; the longer roots was recorded for the first density (43.07 cm), while the minimum length of roots was obtained from the second density (39.53 cm). The highest length of roots had been obtained from the planting in the second animal manure medium (49.15 cm). For the interaction; the first density in the animal manure medium gave the highest length 50.63 cm which didn't differ significantly as compared with the interaction of the second density and the animal manure and loam medium, respectively. The minimum length was recorded for the planting at the second density and the sand medium (25.93 cm).

**Table (7):** Effect of plant density and culture media and their interactions on spick flower lengths (cm) of stock (*Mathiola incana*) plants.

| Culture media / Plant Density | Sand | Loam | Peat moss | Animal manure | Density Means |
|---|---|---|---|---|---|
| *2 plants \ pot* | 0.42 e | 3.31 c | 5.30 a | 3.52 Bc | 3.14 a |
| 4 plants \ pot | 0.43 e | 2.40 d | 4.14 b | 1.78 D | 2.19 b |
| Media Means | 0.42 c | 2.85 b | 4.72 a | 2.65 B | |

* Numbers carrying the same letter has no significant differences according to Duncan test under probability level of 5%.

**Table (8):** Effect of plant density and culture media and their interactions on roots length (cm) of stock (*Mathiola incana*) plants.

| Culture media / Plant Density | Sand | Loam | Peat moss | Animal manure | Density Means |
|---|---|---|---|---|---|
| 2 plants \ pot | 43.70 b | 44.23 b | 33.70 c | 50.63 A | 43.07 a |
| 4 plants \ pot | 25.93 d | 46.87 ab | 37.67 c | 47.67 ab | 39.53 b |
| Media Means | 34.82 c | 45.55 b | 35.68 c | 49.15 A | |

* Numbers carrying the same letter has no significant differences according to Duncan test under probability level of 5%.

**8- Dry weight of vegetative growth(g):**

Table (9) showed that plant density significantly affect on vegetative dry weight of stock plants vegetative growth; the first density gave the highest weight (46.95 g) which significantly differed from the second density (40.42 g). The planting in the animal manure gave a significant highest weight of vegetative growth (73.69 g). The interaction between the second density and animal manure media gave the highest weight of vegetative growth (74.07 g) which didn't differ significantly as compared with the interaction between the second density in animal manure or first density in peat moss medium (73.35 and 73.30 g), respectively.

**Table (9):** Effect of culture media and plant density and their interactions on vegetative growth dry weight (g.) of stock (*Mathiola incana*) plants.

| Culture media / Plant density | Sand | Loam | Peat moss | Animal manure | Density Means |
|---|---|---|---|---|---|
| 2 plants \ pot | 6.95 de | 47.02 c | 60.51 b | 73.30 A | 46.95 a |
| 4 plants \ pot | 4.21 e | 10.05 d | 73.35 a | 74.07 A | 40.42 b |
| Media Means | 5.58 d | 28.53 c | 66.93 b | 73.69 A | |

***** Numbers carrying the same letter has no significant differences according to Duncan test under probability level of 5%.

**9- Dry weight of Root (g):**

The data in Table (10) showed that the plant density had a significant effects on the dry weight of roots for stock plant; the highest weight was obtained in the second plant density (15.83 g) which significantly differed from the first plant density (14.64 g). Planting in the animal manure medium gave the significant highest weight (20.28 g) as compared with the rest of the used media. The interaction between the second plant density and the animal manure medium had recorded the highest dry weight of roots (20.45 g).

**Table (10):** Effect of culture media and plant density and their interactions on roots dry weight (g) of stock (*Mathiola incana*) plants.

| Culture media / Plant density | Sand | Loam | Peat moss | Animal manure | Density Means |
|---|---|---|---|---|---|
| 2 plants \ pot | 7.96 e | 16.35 cd | 14.15 d | 20.10 ab | 14.64 b |
| 4 plants \ pot | 6.22 e | 17.67 bc | 18.99 ab | 20.45 A | 15.83 a |
| Media Means | 7.09 c | 17.01 b | 16.57 b | 20.28 A | |

* Numbers carrying the same letter has no significant differences according to Duncan test under probability level of 5%.

**10- Total chlorophyll in leaves (%):**

It can be noticed from Table (11) that planting density had a significant effect in the increasing total of chlorophyll percentage in leaves and the highest amount was obtained in first density (47.78 %) which significantly differed from the second density. Planting in the animal manure medium gave the significant highest chlorophyll percentage (58.68 %) which significantly differed as compared with the rest of the used media. The interaction between the first plant density and the animal manure medium has recorded significantly the best total chlorophyll percentage (62.63 %).

**Table (11):** Effect of culture media and plant density and their interactions on total chlorophyll amount (%) in leaves of Stock (*Mathiola incana*) plants.

| Culture media / Plant density | Sand | Loam | Peat moss | Animal manure | Density Means |
|---|---|---|---|---|---|
| 2 plants \ pot | 28.23 e | 54.57 b | 45.67 c | 62.63 A | 47.78 a |
| 4 plants \ pot | 36.80 d | 37.20 d | 42.33 c | 54.73 B | 42.77 b |
| Media Means | 32.52 c | 45.88 b | 44.00 b | 58.68 A | |

* Numbers carrying the same letter has no significant differences according to Duncan test under probability level of 5%.

## DISCUSSION

It had been observed from the results in (Table 2) except (table 10) that plants had grown in low densities (2 plants / pot) gave a higher rates of the vegetative growth characteristics (plant height, number of lateral branches / plant, stems diameter, number of leaves and dry weight of shoot), flower characteristics of (number of flowers / spick and the length of spick flower), root length and total chlorophyll percentage in the leaves compared with those planted in high densities (4 plants / pot). These results were in consistent with the findings of Noraldeen (2002) on Zinnia and Antirrhinum plants. Perhaps it might be due to the competition for nutrients and water at high densities and the lack of this competition for light which caused an increase in plant height because Some varieties of stock plant need to low density of light for successful cultivation in half shady places (Al-Ba·aly, 1967).

The superiority of cultured plants in low densities might explicated according to lack of competition among these plants on nutrients, water and light resulting oxidation of auxin in terminal buds of plants and therefore caused reduction of apical dominance activity and stimulate the formation of lateral buds and grow it to the lateral branches and know the plants which formed lateral branches in primary stages in their growth (self-branching plants) and this property desirable commercially in ornamental plants (Tawajin, 1987). Or may have been due to that planting in low densities leads to distribution the plant roots in a wider area allowing them a wider space for growth and formation of a greater number of lateral branches compared with plants grown in high densities and thus the number of branches and the dry weight of shoots and roots increased (Donald, 1963). Or due to competition between plants on water in high densities lead to retard plant growth (Mohammad, 1985).

As for the number of flowers and the spick flower length as shown in (Tables 6 and 7) that the culture of plants in low densities had led to obtain the largest number of flowers on spick flower and an increase in the spick flower lengths of compared to high densities. The reason return to the abundance of food materials at low densities and the physiological maturity degree for plant leading to an increase in vegetative growth thereby increasing the manufactured materials by photosynthesis process which led to an increase in the number of flowers and spike lengths and this characteristic is commercially important especially for export, cut and vases flowers (Juma, et al, 1962).

It had been observed from the results in (Tables 2) that using of different growth media can affect to improving plant growth and its ability to keep water, air and nutrients rather than thermal balance and pH which effects either positively or negatively on seed germination and growth and development of different plant organs subsequently in the whole plant life cycle (Rowell, 1994; Al-Shoura and Hosni, 1996; El-Sallami and Mahros, 1997).

The peat moss and animal manure media had led to obtain the highest value for all studied features. And they agreed with Al-Mukhtar, 2003 and Abdulrahman, 2006. The improvement of plant growth and as a result increasing flower production may be due to many probable reasons which have been mentioned by many authors like the medium porosity which leads to a good ventilation which prevent $CO_2$ accumulation in the roots resulted and microorganisms respiration in the medium and the analysis of its components which deceased respiration and as a resulted growth of plant (Al-Anny, 1982; Sutcliffe and Baker, 1981; Nelson, 1991).

The use of animal manure and peat moss as compared with sand and loam media cause an improvement in all studied features that can be due to the high fertility which leads to increasing nutrients absorption especially nitrogen which has a great role in activating many enzymes and plant growth hormones that can be attractive centers for nutrient materials, this interacts in many biological processes and as a result promoting photosynthesis and improvement flower production rather than increasing chlorophyll and green plastids formation. The organic fertilizers especially animal fertilizers may contain Mg and Fe which have an effective role in chlorophyll synthesis which can leads to increase its presence in plant tissue cells (Al-Ba'aly, 1967; Abdulqader *et.al*, 1982; Sharaqy *et.al.*, 1983; Mohammed *et.al.*, 1985 and Al-Sahaff, 1989).

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# كارتێكـــرنا چراتیا رووەكا وياڤێت چانـــدنێ ل سەر هندەك ساخلەتێن شینبوونا رووەكـــــی شەبـــوێ.*Mathiola incana* R. Br


## كورتی

ئەڤ ڤەكولینە هاتە ئەنجامدان ل خانێی شویشەی سەرب پشكا بیستانكاری ڤە ل كولیژا چاندنێ/زانكویا دهوك دوەرزی (2009–2010) یێ دا . دوو ئاستێن چراتیا چاندنێ ( 2 رووەك / گولدان و 4 رووەك / گولدان ) وێ چوار بەیاڤێت چاندنێ (خیزێ ئاڤاهیا ، خیزێ باغچا ، پیتموس و زبلێ گیانەوەری یێ گەڤن) هاتنە تاقیكرن بـو دیاركرنـا كارتێكرنا وان ل سەر هندەك ساخلەتێن شینبوونا رووەكی شەبوێ . ئەنجاما دیاركر كو چـراتیا ئێكـی ( 2 رووەك / گولدان) یاباشترین ژ چراتیا دووێ وساخلەتێن دریژاهیا رووەكی وژمارا چقا وستێراتیا قەدی وژمارا بەلگا وكێشەیا هشك یاشینكاتیێ وریژەیا سەدەیی یا كلوروفیلێ هەمیشەیێ دناڤ بەلگا دا وژمارا گولیلكا ودیژاهیا گولا ودیژاهیا رەها. لێ چراتیا چاندنێ یا دووێ یا سەركەفتی بوو بتنێ دگەل ساخلەتا كێشەیا هشك یا رەها. دیسـان هـەردوو بەیاڤێ چاندنێ زبلێ گیانەوەرا و پیتموس دسەركەفتی بوون ل سەر بیاڤێ خیزێ ئاڤاهیا و باغچا دهەمێ سـاخلەتێن هاتینە تاقیكرن. ئوژلایەكێ دی ڤە دیار بو كو هەڤپشكی دناڤبەرا چراتی یا چاندنی یا ئێكی هەردوو بەیاڤێن چاندنێ زبلێ گیانەوەرا و پیتموس كارتێكرنا بەرجاڤ هەبوو لسەر هەمی ساخلەتێن هاتینە وەرگرتن بونە ئەگەرێ بدەسـتڤە ئینانا بلندترین ئەنجام ددەمێ بەراوەردكرنێ دگەل لێكدانێن دیتر .

## تأثير الكثافة النباتية وأوساط الزراعة في بعض خصائص النمو لنبات الشبوي (المنثور) *Mathiola incana* R. Br.

### الخلاصة

أجريت الدراسة في البيت الزجاجي التابع لقسم البستنة في كلية الزراعة / جامعة دهوك للموسم 2009-2010. وتضمنت دراسة تأثير كثافتي الزراعة هي ( نباتين / سندانة و4 نباتات / سندانة ) وأربعة أوساط زراعية وهي (الرمل ، التربة المزيجية ، البيتموس و السماد الحيواني المتحلل) في بعض خصائص النمو لنبات الشبوي (المنثور) ***Mathiola incana*** **R. Br.** ، أظهرت الكثافة الأولى (نباتين / سندانة) تفوقا معنويا على الكثافة الثانية (4 نباتات / سندانة) في ارتفاع النبات وعدد الأفرع وقطر الساق وعدد الأوراق والوزن الجاف للمجموع الخضري والنسبة المئوية للكلوروفيل الكلي في الأوراق وعدد الأزهار وطول الشمراخ الزهري وطول الجذور بينما تفوق الكثافة الثانية في صفة الوزن الجاف للجذور عند المقارنة بينهما، كما أظهر الوسطين السماد الحيواني المتحلل والبيت موس تفوقا معنويا على الرمل والتربة المزيجية وفي جميع الصفات المدروسة، وكان للتداخل بين الكثافات والأوساط تأثير معنوي على تلك الصفات وأعطى التداخل بين الكثافة الأولى والوسطين السماد الحيواني والبيتموس أعلى النتائج مقارنة بالتداخلات الأخرى.

# STUDIES ON THE ATTAINMENT OF PUBERTY IN KARADI EWE LAMBS 1. EFFECT OF LEVEL OF PROTEIN ON AGE AND WEIGHT AT PUBERTY*

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## ABSTRACT

**Thirty Karadi ewe lambs ,6 months old were divided randomly into two groups and allocated into two dietary protein levels namely 12% (n=15;initial weight =25.40±1.01kg) and 16 %(n=13;initial weight =26.54±1.65kg). Two rams equipped with marking crayons were introduced for each group to facilitate estrus detection .Animals were weighed at weekly intervals. Also, blood samples were collected at the onset of estrus for progesterone determination. Two ewe lambs from second group was died during the trail .Results revealed that: age and body weight at puberty averaged 235.78±7.40 days and 35.46± 1.16 kg, respectively. Both traits were not affected significantly by protein level being used, whereas month of lambing had a significant effect on age at puberty, but not on body weight .Yet ewe lambs born in March were younger than those born in December, January and February. All the correlations between each of age and body weight at puberty and each of gain from birth –puberty, weaning –puberty and six month weight –puberty are positive and significant and ranged between 0.510 and 0.990. Also, from regression analysis it seems that ewe lambs which grew faster during post –weaning tended to reach puberty at an earlier age and at heavier weight**.

***KEY WORDS:*** Puberty ,Ewe Lambs, Karadi, Protein Level

## INTRODUCTION

Age at which ewes can first be mated is of considerable practical importance from the view point of increasing life time performance and the probable benefit from early sexual activity. This generally results in higher levels of reproductive efficiency in the adult ewe, a shorter generation interval and hence speeding up genetic improvement (Dyrmundsson, 1987). A number of investigators have indicated considerable variability in the incidence of first estrus within a particular breed (Dyrmundsson, 1972; Quirke et al., 1985; Jawad et al., 1986). Also, numerous studies have demonstrated a close association between body growth, nutritional status and the timing of puberty onset. Foster et al. (1985) and Foster *et al.* (1989) found that energy deficiency retards growth and delays the onset of puberty in sheep. Moreover, dietary energy and protein restriction influenced age at puberty in ewe lambs with energy restriction having a greater influence on delaying onset of puberty than protein restriction (Boulanouar et al., 1995).

Since very limited work has been conducted on the attainment of puberty in Karadi ewe lambs therefore the aim of the present work were to determine age and body weight of this breed together with effect of level of protein on these traits.

*Part of Ph.D. thesis submitted by the first author.

## MATERIAL AND METHODES

This work was conducted at the Animal farm, Animal Production Department College of Agriculture, University of Duhok ,where a total of 30 Karadi ewe lambs, six months old born during December through March were divided randomly into two groups and assigned into two dietary protein levels namely 12%(n=15) or 16% (n=13) crude protein. Their initial body weights were 25.40± 1.01 and 26.54 ± 1.65 kg, respectively. Two ewe lambs from second group was died during the trail. Each group was housed in a separate pen during the experimental period. Concentrate was offered ad libitum and the quantity was divided into two halves and fed at 8.00 a.m. and 4.00 p.m. Clean water and mineral blocks were available at all times. The composition of concentrate mixture with the chemical composition is shown in Table (1) All animals were weighed at the beginning of the experiment and at weekly intervals thereafter just prior to morning feeding.

At 6 month of age, ewe lambs were kept with two rams equipped with marking crayons, to assist in estrus detection .Date of exhibiting first estrus, defined as date of first observed standing estrus, was determined by checking ewes for crayon marks twice daily, confirmed by subsequent observation within 20 day. Moreover, detection of estrus was further

confirmed by progesterone concentration above 1ng/ml (Kridli et al., 2006). A 1ng/ml progesterone concentration is indicative of luteal function (Chagas de Silva et al., 2003). Body weight and age were recorded at first standing estrus and considered as body weight and age at puberty. Blood samples (10 ml) were collected via veinpuncter in vaccum- collecting tubes at the onset of puberty .Plasma was harvested from samples and stored at ─ 20 C° until further analysis. Blood samples were run in a single assay to measure progesterone level using Elcysys and Cobase immunoassay kit (Cobas,USA). General Linear Model (GLM) within the statistical program SAS(2005) was used to analyze the factors affecting age and weight at puberty, assuming the following model:

$Y_{ijk} = \mu + P_i + M_j + b_{(wwt)} + b_{(smwt)} + e_{ijk}$

Where,

$Y_{ijk}$ : measurements on $k^{th}$ observation ;

$\mu$ : overall mean;

$P_i$ : effect of $i^{th}$ protein level ( i=12 , 16) ;

$M_j$ : effect of $j^{th}$ month (j=12, 1, 2, 3);

$b_{(wwt)}$ : the regression of studied traits on weaning weight,

$b_{(smwt)}$ : the regression of studied traits on six month weight, and

$e_{ijk}$ : random error NID (0 , $I\sigma^2e$).

Duncan Multiple Range Test (Duncan, 1955) also used to test the significant differences between the levels of each factor affecting the studied traits. Correlation coefficients among traits associated with puberty were also calculated.

**Table (1):** The formulation and chemical composition of the diets.

| Ingredient | Group | |
|---|---|---|
| | 16% protein | 12% protein |
| Barley | 51 | 48 |
| Wheat bran | 35 | 31 |
| Soya bean meal | 4 | 12 |
| Straw | 9 | 7.5 |
| Salt | 0.5 | 0.5 |
| Vitamins | 0.5 | 0.5 |
| Urea | - | 0.4 |
| Crude protein (%)* | 12.18 | 16.03 |
| ME ( M cal/kg)* | 2.428 | 2.458 |

* Khawaja et al. (1978)

## RESULTS AND DISCUSSION

**Age and body weight at puberty;**

The overall mean of age at puberty , defined as the age of first behavioral estrus and confirmed with progesterone concentration(>1 ng/ml) was 235.78±7.40 days (Table 2) .The age at puberty of Karadi ewe lambs observed in the present study was younger to that of 286.2 days observed by Al-Hassan(1985) for the same breed as well as 273.9 days (Younis et al.,1978), 327 days (Al-Wahab and Khudayer ,1981),318.9 days (Jawad et al.,1986) and 278.9 days (Alkass et al.,1994) which have been reported for Awassi breed in Iraq. However, such differences could be due to breed as well as individual variation within breed (Dyrmundsson, 1973), feeding level ( Bichard et al., 1974) and month of lambing( Jawad et al., 1986).

Average body weight at puberty was 35.46±1.16 kg (Table 2). Also, Al-Hassan (1985) reported that body weight at puberty of Karadi ewe lambs averaged 35.3kg. However, a higher body weight of 39.5 , 40.0 and 37.0 kg were noticed ,respectively, by Younis et al(1978), Al-Wahab and Khudayer (1981) and Jawad et al(1986) for Awassi ewe lambs in Iraq.On the other hand , Alkass et al(1994) observed a lighter body weight (30.0 kg) for Awassi ewe lambs. The differences might be due to breed (Dyrmundsson, 1987), feeding level (Younis et al. 1978) and to the introduction of ram at various ages (Dyrmundsson and Lees, 1972a).

**Effect of protein level.**

Average body weight was similar across the two groups at initiation of the experiment ($p>0.05$). Ewe lambs fed 16% protein gained weight at a greater rate and were 3.58kg heavier at puberty than ewe lambs fed 12% protein ($P>0.05$) (Table 3). Although age at puberty was not influenced significantly by protein level in this study, however, ewe lambs fed 16%protein achieved puberty 16.4 days earlier than those fed 12% protein (Table 2). The cumulative proportion of ewe lambs of both groups that attained puberty are given in Figure (1). It seems that 26.7, 86.7 and 100% of ewe lambs fed 12% protein attained puberty at an age of ≤200, 260 and ≤ 310 days, whereas30.1 and 92.3% of ewe lambs fed 16% protein attained puberty at an age of ≤200 and 260 days respectively .Only one animal (7.7%) was achieved puberty at 290 days. Thus, rapidly growing animals achieved puberty earlier and at heavier weight than animals

growing at slower rate (Table 3). This is consistent with previous findings (Keane, 1975; Quirke, 1979; Boulanouar et al 1995). The non significant effect of level of protein on both body weight and age at puberty may be due to sample size used in this experiment or lambs fed 12% protein diet may have maintained a body composition more nearly like lambs fed the 16% protein diet (Boulanouar et al, 1995).

**Table (2):** Effect of protein level and month of lambing on age and body weight at puberty of Karadi ewe lambs **($\bar{X}$±s.e.)**.

| Effect | No. | Weight at puberty (kg) | Age at puberty (days) |
|---|---|---|---|
| Overall mean | 28 | 35.46±1.16 | 235.78±7.40 |
| Protein | | | |
| 12% | 15 | 33.80±0.85 a | 243.40±9.32 a |
| 16% | 13 | 37.38±2.24 a | 227.00±11.68 a |
| Month of lambing | | | |
| December | 10 | 36.45±1.19 a | 260.70±21.43 a |
| January | 7 | 36.78±3.72 a | 232.14±19.99 ab |
| February | 6 | 34.75±1.89 a | 229.66±12.14 ab |
| March | 5 | 32.50±2.67 a | 198.40±11.30 b |
| *Regression on* | | | |
| *Weaning wt.* | 1 | 1.379±0.598 | 4.944±4.076 |
| *Six month wt.* | 1 | -0.236±0.440 | -1.662±3.002 |

Means with different letters within each column differ significantly ($P<0.05$).

It's recognized that the effect of nutrition on attainment of puberty is mediated through diminished luteinizing hormone (LH) release (Day et al., 1984; Foster et al., 1986; Kinder et al., 1987). Low dietary energy intake prepuperty prolonged the negative effect of estradiol on release of LH, and response to negative feedback regulation of LH release declined after initiation of feeding a high energy diet (Foster et al., 1986). Inadequate nutrition inhibits reproduction by actions exerted on hypothalamic neurons responsible for release of LHRH (Ebling et al., 1990; I´Anson et al., 1990). Moreover, there is general agreement that plane of nutrition induced restrictions in the onset of puberty in animals that have achieved their threshold age for the attainment of puberty (Prunier et al.,1987) are caused by an inhibition in the pulsatile release of GnRH from the hypothalamus and consequently of LH from the pituitary (Foster and Olster,1985; Kinder et al.1987).This inhibition of the GnRH pulse generator occurs in the presence of ample supplies of both hypothalamic GnRH and the pituitary gonadotropins.

**Table (3):** Initial body weight and body weight gain (kg) of Karadi ewe lambs fed the two diets.

| Trait | 12% protein | | 16% protein | |
|---|---|---|---|---|
| | No. animals | $\bar{X}$±s.e | No. animals | $\bar{X}$±s.e |
| Initial weight (kg) (6 month old) | 15 | 25.40±1.01 | 13 | 26.54±1.65 |
| Gain birth_ puberty(kg) | 15 | 28.81±0.94 a | 13 | 32.22±2.15 a |
| Gain weaning _puberty(kg) | 15 | 14.27±1.33 a | 13 | 17.17±1.22 a |
| *Gain six month old _puberty(kg)* | 15 | 8.39±1.50 a | 13 | 10.83±1.22 a |

Means with different letters within each row differ significantly.

Moreover, it was reported that the suppression of LH secretion (Foster, 1988) and FSH (Padmanabhan et al., 1989) in undernourished lambs was reversed by a high plane of nutrition, the reversal occurring in some individuals within 2 days of changing their feeding level. Similarly ,AL- Hayali (2005) indicated that Awassi ewe lambs fed 12,15 and 18% crude protein and Numan et al(2000) observed that protein level (10.0,14.4 and 16.9) had no significant effect on age at puberty in both experiments . Furthermore, Boulanouar et al (1995) indicated that dietary energy and protein restriction influenced age at puberty in ewe lambs with energy having a greater influence on delaying onset of puberty than protein restriction.

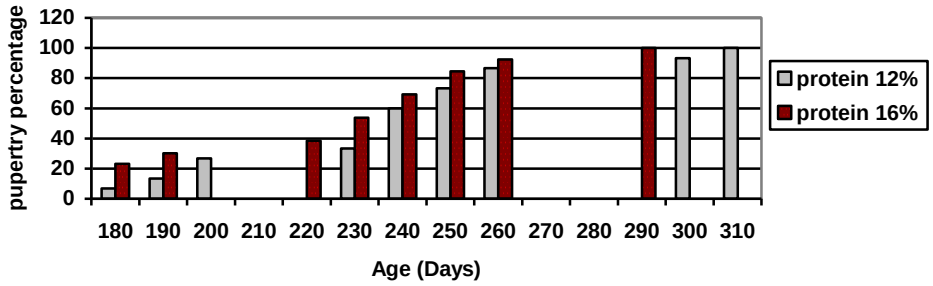


**Fig. (1):** Cumulative percentage of ewe lambs attaining puberty when fed two levels of protein.

**Correlations among traits associated with puberty**

The significant correlation (P<0.01) (0.556) between age and body weight at puberty indicated that ewe lambs that were older at puberty tended to be heavier at puberty. Similarly, Bathaei and Leroy (1997) found a correlation of 0.58 between age and body weight at puberty in Iranian fat-tailed ewe lambs. Little association between birth weight and each of age and body weight at puberty was found as indicated by the low correlation of -0.161 and 0.201, respectively (Table 4). Similar finding was reported by Fuentes et al (1987), Nuryadi et al (1986), Michailidis et al (1988) and Bathaei and Leroy (1997). The significant correlations between age at puberty and each of gain from birth –puberty, weaning –puberty and six month weight –puberty were 0.589, 0.619 and 0.510, respectively and between body weight at puberty and gain from birth –puberty, weaning –puberty and six month weight at puberty were 0.990., 0.799 and 0.641, respectively (P<0.01). These results indicate that ewe lambs that grow most rapidly during post weaning tended to be heavier and younger at puberty (Table 2). These observations are similar to those of Fuentes et al (1987) and Bathaei and Leroy (1997). The correlation between weight at puberty and each of weaning weight and 6 month weights were significant (0.594 and 0.567 , respectively), and a non-significant correlation was found between age at puberty and each of weaning weight, (0.096) and 6 month weight (0.150).

The regression coefficients reveal that an increase in 1 kg at weaning and 6 month weight resulted in an increase of 1.37 kg and a decrease of 0.236 kg of body weight at puberty, respectively (Table 2). Also the regression coefficients indicate that an increase in 1 kg at each of weaning and 6 month weights resulted in an increase of 4.94 and a decrease of 1.66 day in age at puberty, respectively (Table 2). Also, Jawad et al (1986) reported that an increase of 1 kg of body weight is responsible for an increase of 6.5 days at age of puberty; while an increase of 1 gm in daily gain resulted in a decrease of 0.29 day at age of puberty. From the phenotypic correlations between age at puberty and each of weaning weight (-0.10) and growth rate (-0.27) , Alkass et al. (1994) indicated that good management ,feed and other environmental conditions tend to enhance growth and increase body weight and shorten the time to reach puberty. Therefore ewe lambs which grew faster during post –weaning tended to reach puberty at an earlier age and at heavier body weight. This

result agrees with those of Younis et al. (1978) and Bathaei and Leroy (1997).

**Effect of month of lambing**

In the current investigation, month of lambing had a significant effect (P<0.05) on age at puberty, but not on body weight .It appears from Table (2) that ewe lambs born in March were younger (198.40 ±11.30 days) at puberty than those born either in December (260.70 days), January (232.14 days) of February (229.66 days). The mean body weight of March born lambs at puberty was 32.50 kg, whereas body weight of ewe lambs born in December, January and February were 36.45, 36.78 and 34.75 kg, respectively, (Table 2) and body weights indicated that the lambs in these groups grew at the same rate thereafter, thus ewe lambs born in March had grown at a faster rate, and reached puberty at an earlier age and lighter body weight. It is well documented that the attainment of puberty in ewe lambs is usually heralded by a brief elevation in serum progesterone concentrations lasting 4-7 days. This transient ovarian luteal activity (Berardinelli et al., 1980) apparently results from an LH surge (Foster and Ryan, 1979) and is associated with increases in serum estradiol concentration (Fitzgerald and Butler, 1982). The higher mean age for puberty in December through February lambs represents a delay of this phenomen on which apparently due to seasonal factors. Effect of season on mean age at puberty in lambs born from January through May have been noted (Mallampati et al, 1971, Dyrmundsson and Lees, 1972 b, Fitzgerald and Butler, 1982). Similarly, Bathaei and Leory (1997) observed that date of birth within the year had a significant effect on age and body weight at puberty of Mehraban fat-tailed ewe lambs. Ewe lambs born late in the lambing season were lighter and younger at puberty.

**Table (4):** Correlation coefficients among traits associated with puberty in Karadi ewe lambs. (n=28).

| Traits | Age at puberty | Weight at puberty |
|---|---|---|
| Age at puberty | _ | 0.556** |
| Birth weight (BT) | -0.161 N.S | 0.201 N.S |
| Weaning weight(WT) | -0.096 N.S. | 0.594** |
| Six month weight(6WT) | 0.150 N.S. | 0.567** |
| Gain from birth to puberty | 0.589** | 0.990** |
| Gain from weaning to puberty | 0.619** | 0.799** |
| *Gain from 6 month weight to puberty* | 0.510** | 0.641** |

N.S. Not significant ** P<0.01

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**بوختە**

**28 بەرخێت مێ ل ژیێ 6 هەیڤا هاتنە دابەشکرن بو دوو گروپا : گروپا ئێکێ ئالیکا 12٪ پروتین ( ژمارا گیانەوەرا + 15 و کێشا دەستپێکێ 25.40±1.01 کغم کگم ) و یا دووێ ئالیکا 16٪ بروتین (13 گیانەوەری و کێشا دەستپێکێ 26.54±1.65 کگم).**

**2 بەرانێت دیارکەر بو هەر گروپەکێ بو دیارکرنا هاتنا بەرانی . گیانەوەر هەفتیی جارەکی دهاتنە کێشان هەروەسا سامپلیت خوینێ هاتنە وەرگرتن ودوو کیانە وەر مرین زی کروبا دووی.**

**تێکرایێ ژی وکێش ل پێگەیشتنا توخمی 235.78±7.40 روژ و 35.46±1.26 کگم لدیف ئێك و هەردوو سەخلەت ب ریژاپروتینی کارتێکرنا بەرچاڤ نەبوو. هەیڤا بوونێ کارتێکرنا بەرچاڤ ل ژی ل پێگەیشتنا توخمی هەبوو نە کێشێ ل پێگەیشتنا توخمی . و بەرخێت ل هەیڤا ئادارێ بوین گەهشتنە پێگەیشتنا توخمی بژیەکێ بچویکتر بەرامبەر وان یێ ل هەیڤا کانینا ئێکێ و کانینا دووێ و شواتێ بوین . فاکتەرێت هەڤبەندی دناڤبەرا کێشێ و ژی ل پێگەیشتنا توخمی و زێدە بونا کێشێ ل بوونێ , پێگەیشتن و شیرڤەکرن و ژیێ 6 هەیڤا – پێگەیشتن یا پوزەتیڤ و بەرچاڤ بو ونافبەرا 0.589و0.990 وەکی دیار ژ ( تحلیل الانحدار )کو گەشەکرنا ( نمو )بەرخێت مێ یا بلندتر دەمێ پشتی شیرڤەکرنێ دبیتە ئەگەرێ گەهاندنا پێگەیشتنا توخمی دژیەکێ بچویکتر و کێشا گرانتر .**

**الخلاصه**

**تم توزيع 30 حملا انثويا وبعمر 6 اشهر عشوائيا الى مجموعتين لتتغذى احداهما على عليقه تحوي 12 % بروتين ( عدد الحيوانات15 ووزن ابتدائي 25.40±1.01 كغم) والثانيه على عليقه تحوي 16% بروتين (عدد الحيوانات 13 وبوزن ابتدائي 26.54±1.65 كغم).تم ادخال 2 كبش كشاف لكل مجموعه للكشف عن الشبق .كان يتم وزن الحيوانات مره واحده اسبوعيا .كما اخذت عينات من الدم , هلك حيوانين من المجموعه الثانيه.**

**بلغ معدل العمر والوزن عند البلوغ الجنسي 235.78±7.40 يوم و 35.46±1.26 كغم على التوالي .ولم تتاثر كلا الصفتين معنويا بمستوى البروتين.كان لشهر الولاده تاثيرا معنويا في العمر عند البلوغ الجنسي وليس الوزن عن البلوغ الجنسي. حيث وصلت الحملان الانثويه المولوده في شهر اذار البلوغ الجنسي بعمر اصغر مقارنه بتلك المولوده في شهر كانون الاول وكانون الثاني وشباط.**

**كانت معاملات الارتباط بين كل من الوزن والعمر عند البلوغ الجنسي وكل من الزياده الوزنيه من الميلاد _البلوغ و الفطام_البلوغ وبعمر 6 اشهر _البلوغ موجبه ومعنويه اذ تراوحت القيم بين 0.510 و0.990 كما يتضح من تحليل الانحدار بان نمو الحملان الانثويه الاعلى خلال مده ما بعد الفطام يؤدي الى وصولها البلوغ الجنسي بعمر اصغر ووزن اخف.**

# THE EFFECT OF ORGANIC LINERS AND TIME OF INCUBATION ON THE HYDRAULIC CONDUCTIVITY OF THREE DIFRENT TEXTURED SOILS

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## ABSTRACT

**A factorial experiment was conducted to evaluate and to compare the sealing performance of five types of organic liner from different sources on seepage rate reduction for three textured soils that have a wide range of clay content from Dohuk governorate , the results showed that a 10 fold reduction in HC was observed under sugar beet treatment after two months from incubation in the bioplastic experiment. Upon prolonging the incubation period for extra two month the seepage rate under the above mentioned treatments was reduced to zero. Further, it was found that the percentage of reduction under the other treatments like morus, chick pea, chard , broad bean and barley leaves were less than 100%.**

## INTRODUCTION

Seepage is the percolation of a liquid through the soil or another medium (Krauss,2008).The hydrologists defined seepage as the movement of water between groundwater aquifer and surface sources(Wisler and Brater, 1959). The unit seepage or the specific discharge is the seepage rate for a unit cross sectional area of a pond and has the unit of velocity, $m.s^{-1}$ (AWMFH,1997).

The loss of water from the bottom and sides of earthen ponds is a main reason why the ponds often get dry just at the time when water is most needed to keep crops and livestock alive. This forces the people to migrate out the rural areas, causing vast dislocations to themselves and to the country (Ahmad,1993) .

Seepage not only constitutes loss of pond water but also leaches nutrients( Coddingto- and Peralta ,1989). Muendo et al. (2005) have shown that the mean nitrogen, phosphorus and potassium concentrations in seepage water were significantly higher than in the pond water during different sampling times. While water lost by seepage reduces the water available for agricultural production. Also, groundwater accessions from seepage losses contribute to rise water tables and the associated problems of water logging and salinization.The objective of the present experimental study was to compare the sealing performance of five different types of organic liner from different sources on seepage reduction for three different soil texture.

## MATERIALS AND METHODS

Bulk soil samples were taken from the surface layer ( 0.00 - 0.50 m), from three different textured soils namely, Qerwola sandy loam LOAM, Behrawa sandy clay loam and Sumail silty clay soils, upon bringing the samples were brought to the laboratory, they were air dried, grounded to pass through a 4-mm sieve and kept in plastic containers until the analysis time.

The physical and chemical properties of investigated soils(Table 1 ) were determined according to the standard methods as following; particle size distribution was performed by using hydrometer method as out lined by (Klute et al.,1986), the percent of colloids was determined according to(Bowles,1970), the soil bulk density was measured by core method as described by (Blake and –Hardage,1986). The pH of saturation extract was measured according to (Jackson,1958), electrical conductivity of the saturation soil extract(Ece) as described by Hesse(1972),the total organic matter was determined by the modified method of Wakley-Black(Allison,1965).the calcimeter method was followed for determining the calcium carbonate equivalent as out lined by (Loeppert and Saurez,1996) and the gypsum was determined by the analytical Dep method as described by (Black et al.,1982).

Soil columns were prepared by packing predetermined quantities of each soil into plastic cylinders with a supporting screen on the bottom.

The cylinder dimensions were: length : 50 cm ; internal diameter 10 cm and wall thickness 0.64 cm ,at the bottom of cylinder, a 20 mm support base of fine gravel was established with a filter paper over the upper surface to prevent the flashing of fine particles.

Before packing the prepared soils were moistened to their optimum moisture content as determined from standard Proctor test ( ASTM - D698 -1986) . The packing was done in form of three layers with a special device manufactured for this purpose to obtain the insitu bulk densities of 1.3,1.4 and 1.5 $Mg.m^{-3}$ for the three soils, respectively. The soil surface of each compacted layer was scarified with wire brush such that flow properties of the compacted soil would not be influenced by discontinuities within the soil columns.

Representative leave samples of barley, broad bean, chard , chick pea and morus were taken at the flowering stage of the grown crops along with sugar beet tubers. They were chopped into small pieces with a sharp knife and 100 gm of glucose was added to each sample as a substrate to promote microbial growth.

Upon preparation of the soil columns, the upper five cm of each column was removed and a layer of organic matter 30 mm in thickness was placed over the exposed surface to construct an organic liner. The excavated soil was backfilled maintaining the same bulk density. A filter paper was placed over the soil surface to minimize disturbance during leaching with tap water (Figure. 1.1).

After installing the liner, the soil water content was raised to 75% of field capacity and set up in a temperature controlled roam at 32 $\pm$ 4 $^{o}C$ for a period of two months. The soil moisture was brought to the same level whenever depletion occurred

A factorial experiment was conducted in completely randomized design. The first factor was soil type with three levels:

S1 = Qerwola sandy loam
S2 = Behrawa sandy clay loam
S3 = Sumail silty clay

The second factor included type of organic liner with six levels:

To = Control ( without liner )
T1 = Barley leaves
T2 = Sugar beet roots
T3= Broad bean leaves
T4 = Chard leaves
T5 = Chick pea leaves
T6 = Morus leaves.

Assay were done in duplicates. Accordingly, the number of experimental units becomes 3 soils x 6 treatments x 2 replicates = 36.

At the end of two months, the saturated hydraulic conductivity was determined by leaching the columns with a constant head device (inverted volumetric flask).

The columns were leached from the top with tap water with a constant head of 180 mm. Leaching was continued until no considerable change in leachate volume was noticed in at least five consecutive containers.

**Table (1.1):** Some physical and chemical properties of investigated soils.

| Soil properties | | Type of soil | | |
|---|---|---|---|---|
| | | Qerwola | Behrawa | Sumail |
| Particle size distribution $g.Kg^{-1}$ | Colloid | 81 | 24.3 | 238.0 |
| | Clay | 102.3 | 273.1 | 448.2 |
| | Silt | 132.2 | 238.3 | 513.3 |
| | sand | 765.5 | 488.6 | 38.4 |
| Textural class | | sandy Loam | Sandy clay loam | Silty clay |
| Bulk density $Mg.m^{-3}$ | | 1.24 | 1.40 | 1.29 |
| PH | | 7.11 | 7.40 | 7.24 |
| EC $ds.m^{-1}$ | | 1.86 | 0.23 | 1.70 |
| O.M | $g.Kg^{-1}$ | 32.7 | 24.2 | 27.0 |
| Total carbonate | | 190.0 | 212.4 | 160.8 |
| *Gypsum* | | 14.64 | 14.04 | 14.58 |


**Figure. (1.1):** Laboratory measurement of saturated hydraulic conductivity by constant head method as affected by different bioplastic treatments of three different textured soils.

The hydraulic conductivity of the columns were monitored by measuring the volume leached collected at intervals over the experimental period. The hydraulic

The hydraulic conductivity of the columns were monitored by measuring the volume leached collected at intervals over the experimental period the hydraulic conductivity was calculated as:

$$K = \frac{V}{A\ \Delta t\ I} \quad (1.1)$$

Where:
K = Hydraulic conductivity ( cm $s^{-1}$ )
V = Volume of leachate ( $cm^3$ )
A= Cross-sectional area of the cylinder ( $cm^2$ )
$\Delta$ t = Time during which V was collected ( s)
I = Hydraulic gradient ( dimensionless).

It is commendable to mention that the hydraulic conductivity measurement was repeated after four months since the date of incubation.

## RESULTS AND DISCUSSION:

The bioplastic experiment was designed to evaluate the sealing performance of some selected materials of plant origin after sufficient period of incubation on seepage reduction from three soils with a wide range of particle size distribution. [Figure.(1.2) to (1.4)] illustrate the effect of different bioplastic treatments on HC that has been measured during two consecutive days. Prior to seepage rate measurement the soil columns were incubated for a period of two months. It is evident from these figures that the sugar beet gave the best sealing performance compared to the other treatment in all study soils during the first day of seepage measurement.

Under this treatment a 10 fold reduction in HC was observed in Qerwola sandy loam and Behrawa sandy clay loam soils, whilst it diminished to zero in the Sumail silty clay soil. Also Seki et al.(2002) have noticed for a given biomass per unit volume caused a larger HC decrease in fine textured soils than in coarse textured materials. The degree of pore occlusion may be greater in fine textured soils compared to coarse textured soils. Additionally Seki et al.(1996) found that 14% of gas filled pores was occluded by methane and gave rise to HC reduction.

On the other hand, the percentage of reduction under the other treatments was less than 100% in most cases. In contrast, under some treatments such as morus leaves, there was a slight increase in HC. The low sealing efficiency of such materials along with the fact that HC is highly affected by particle segregation may be the reason for a slight increase in HC. It seams that morus leaves provided poor condition of gleization.

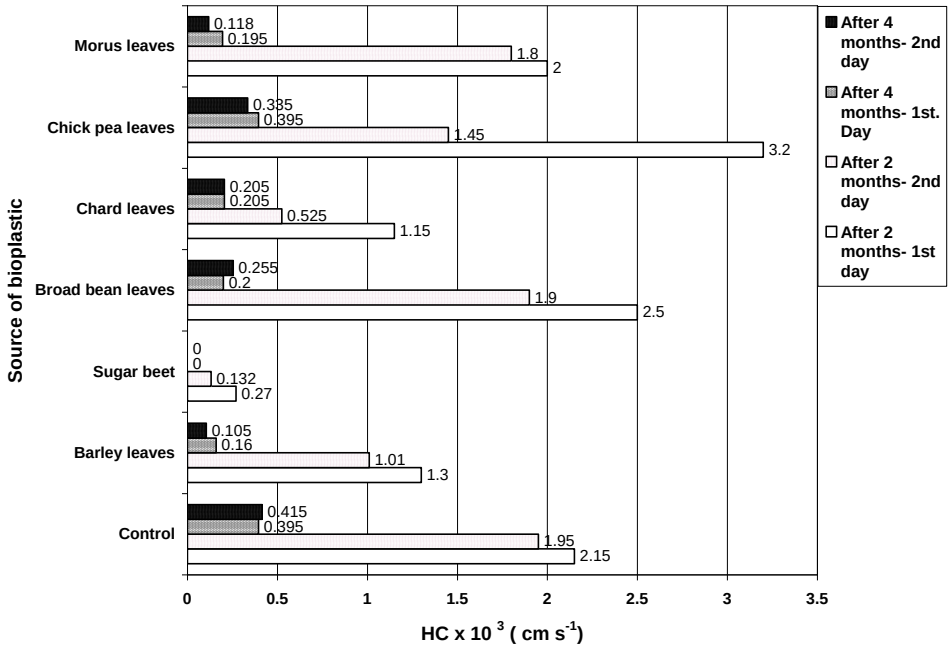


**Figure (1.2):** hydraulic conductivity of Qerwola sandy loam a and aa affected by aource of bioplaatic period of incubation and time of meaaurement.

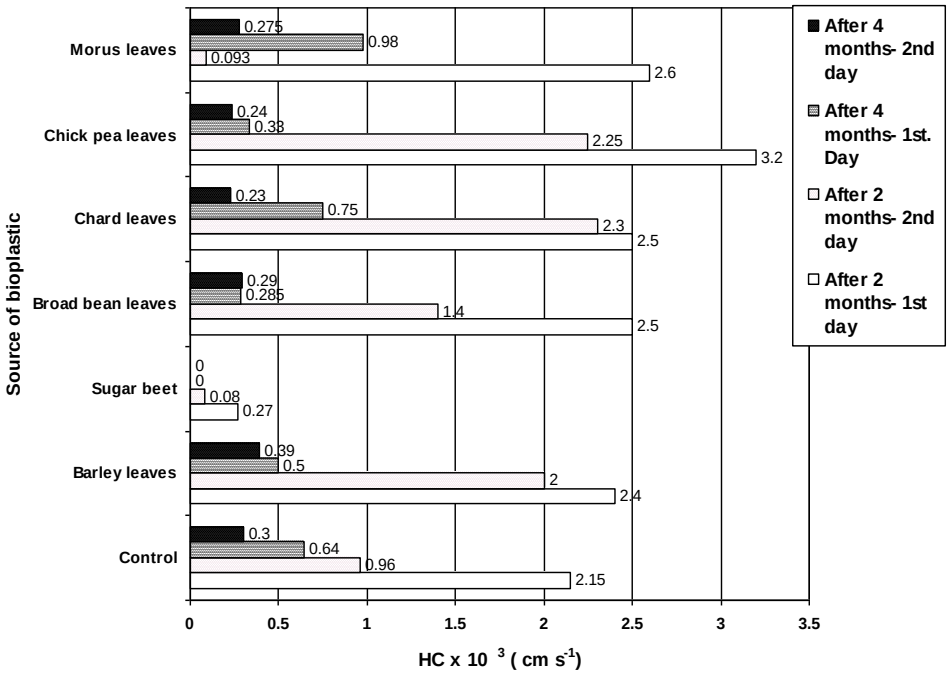


**Figure (1.3):** hydraulic conductivity of Behrawa sandy clay loam aa affected by aource of bioplaatic period of incubation and time of meaaurement.

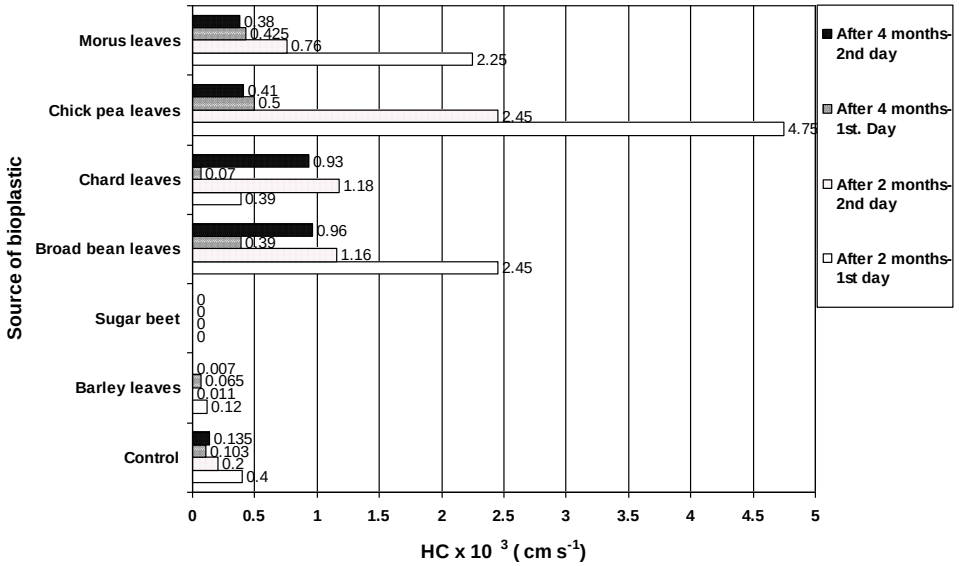


**Fig (1.4):** hydraulic conductivity of Sumial silty clay aa affected by aource of bioplaatic, period of incubation and time of meaaurement.

overall, a slight reduction in HC was observed during the second day of seepage measurement and the percentage of reduction is less than 100%.

To show the effect of further incubation period on seepage losses, the HC measurement was repeated for extra two days, but after four months since date of incubation [Fig. (1.2) to (1.4) or Table (1.2 )]. The most outstanding conclusion that can be drawn from these figures is that sugar beet provided the best condition of gleization and limiting seepage to zero in all the study soils. Complete sealing was due to the combined effects of biological clogging, particle dispersion and soil swelling. Fattah (2004) attributed a great portion of HC reduction under effective bioplastic treatments to greater growth of microbial cells, microbial synthesized products and occlusion of pore spaces by gases produced by bacteria under anaerobic conditions. Additionally, Further examination of [Fig.(1.2)to(1.4)] indicates that there is considerable seepage loss under broad been leaves after both periods of incubation. This is in contrasts with the study by Fattah (2004), who found that the seepage rate under broad bean leaves was suppressed completely. This may be due to differences in preparation procedure and type of soil used.

It is praiseworthy to note that further reduction in seepage losses can be obtained upon compacting the study soils to maximum dry density. In this study, the soils were repacked to insitu bulk densities which were far below the maximum dry density.

**Table:(1.2):** Effect of different bioplastic treatments on saturated hydr- aulic conductivity For different textured soils
**First duration after two months of incubation**
**a. During first day .**

| Soil type | Treatment | Measured saturated hydraulic conductivity ( cm $s^{-1}$ *$10^{3}$) | | |
|---|---|---|---|---|
| | | Rep.I | Rep.II | Average |
| Qerwola Loamy Sand | Control | 1.9 | 2.4 | 2.15 |
| | Barley leaves | 1.6 | 1.0 | 1.3 |
| | Sugar beet | 0.35 | 0.2 | 0.27 |
| | Broad bean leaves | 2.6 | 2.4 | 2.5 |
| | Chard leaves | 0.9 | 1.4 | 1.15 |
| | Chick pea leaves | 3.2 | 3.2 | 3.2 |
| | Morus leaves | 1.1 | 1.9 | 2.0 |
| Behrawa Silty clay Loam | Control | 2 | 2.3 | 2.15 |
| | Barley leaves | 2.3 | 2.5 | 2.4 |
| | Sugar beet | 0.54 | Nil | 0.27 |
| | Broad bean leaves | 2.3 | 2.7 | 2.5 |
| | Chard leaves | 2.4 | 2.6 | 2.5 |
| | Chick pea leaves | 5.2 | 5.4 | 5.3 |
| | Morus leaves | 2.3 | 2.9 | 2.6 |
| Sumail Silty Clay | Control | 0.47 | 0.34 | 0.4 |
| | Barley leaves | 0.15 | 0.09 | 0.12 |
| | Sugar beet | Nil | Nil | Nil |
| | Broad bean leaves | 2.9 | 2 | 2.45 |
| | Chard leaves | 0.32 | 0.46 | 0.39 |
| | Chick pea leaves | 4.4 | 5.1 | 4.75 |
| | Morus leaves | 2.6 | 1.9 | *2.25* |

**b. During second day .**

| Soil type | Treatment | Measured saturated hydraulic conductivity (cm $s^{-1}$*$10^{3}$) | | |
|---|---|---|---|---|
| | | Rep.I | Rep.II | Average |
| Qerwola Sandy Loam | Control | 1.7 | 2.2 | 1.95 |
| | Barley leaves | 1.2 | 0.81 | 1.005 |
| | Sugar beet | 0.2 | 0.065 | 0.132 |
| | Broad bean leaves | 2 | 1.8 | 1.9 |
| | Chard leaves | 0.41 | 0.64 | 0.525 |
| | Chick pea leaves | 1.7 | 1.2 | 1.45 |
| | Morus leaves | 2.1 | 1.5 | 1.8 |
| Behrawa Sandy clay Loam | Control | 0.87 | 1.05 | 0.96 |
| | Barley leaves | 2.2 | 1.8 | 2.0 |
| | Sugar beet | 0.16 | Nil | 0.08 |
| | Broad bean leaves | 1.2 | 1.6 | 1.4 |
| | Chard leaves | 2 | 2.6 | 2.3 |
| | Chick pea leaves | 2.6 | 1.9 | 2.25 |
| | Morus leaves | 0.087 | 0.10 | 0.093 |
| Sumail Sandy Clay | Control | 0.25 | 0.15 | 0.20 |
| | Barley leaves | 0.015 | 0.0072 | 0.011 |
| | Sugar beet | Nil | Nil | Nil |
| | Broad bean leaves | 1.4 | 0.92 | 1.16 |
| | Chard leaves | 0.95 | 1.4 | 1.175 |
| | Chick pea leaves | 2.8 | 2.1 | 2.45 |
| | Morus leaves | 0.89 | 0.62 | *0.755* |

**Second duration after four months of incubation .**

**a. During first day .**

| Soil type | Treatment | Measured saturated hydraulic conductivity ($cm\ s^{-1} *10^{3}$) | | |
|---|---|---|---|---|
| | | Rep.I | Rep.II | Average |
| Qerwola Sandy Loam | Control | 0.33 | 0.46 | 0.395 |
| | Barley leaves | 0.21 | 0.11 | 0.16 |
| | Sugar beet | Nil | Nil | Nil |
| | Broad bean leaves | 0.29 | 0.11 | 0.20 |
| | Chard leaves | 0.19 | 0.22 | 0.205 |
| | Chick pea leaves | 0.27 | 0.52 | 0.40 |
| | Morus leaves | 0.27 | 0.12 | 0.195 |
| Behrawa Sandy clay Loam | Control | 0.78 | 0.50 | 0.64 |
| | Barley leaves | 0.59 | 0.42 | 0.50 |
| | Sugar beet | 0.21 | Nil | 0.105 |
| | Broad bean leaves | 0.21 | 0.36 | 0.285 |
| | Chard leaves | 0.63 | 0.87 | 0.75 |
| | Chick pea leaves | 0.43 | 0.23 | 0.33 |
| | Morus leaves | 1.18 | 0.78 | 0.98 |
| Sumail Silty Clay | Control | 0.12 | 0.087 | 0.103 |
| | Barley leaves | 0.13 | Nil | 0.065 |
| | Sugar beet | Nil | Nil | Nil |
| | Broad bean leaves | 0.35 | 0.43 | 0.39 |
| | Chard leaves | 0.048 | 0.091 | 0.0695 |
| | Chick pea leaves | 0.45 | 0.55 | 0.50 |
| | Morus leaves | 0.52 | 0.33 | *0.425* |

**b. During second day .**

| Soil type | Treatment | Measured saturated hydraulic conductivity ($cm\ s^{-1} *10^{3}$) | | |
|---|---|---|---|---|
| | | Rep.I | Rep.II | Average |
| Qerwola Sandy Loam | Control | 0.36 | 0.47 | 0.415 |
| | Barley leaves | 0.14 | 0.07 | 0.105 |
| | Sugar beet | Nil | Nil | Nil |
| | Broad bean leaves | 0.23 | 0.28 | 0.255 |
| | Chard leaves | 0.16 | 0.25 | 0.205 |
| | Chick pea leaves | 0.26 | 0.46 | 0.36 |
| | Morus leaves | 0.087 | 0.15 | 0.118 |
| Behrawa Sandy clay Loam | Control | 0.39 | 0.21 | 0.30 |
| | Barley leaves | 0.39 | 0.40 | 0.39 |
| | Sugar beet | Nil | Nil | Nil |
| | Broad bean leaves | 0.26 | 0.32 | 0.29 |
| | Chard leaves | 0.25 | 0.21 | 0.23 |
| | Chick pea leaves | 0.26 | 0.21 | 0.24 |
| | Morus leaves | 0.37 | 0.18 | 0.275 |
| Sumail Silty Clay | Control | 0.16 | 0.11 | 0.135 |
| | Barley leaves | 0.013 | Nil | 0.0065 |
| | Sugar beet | Nil | Nil | Nil |
| | Broad bean leaves | 1.2 | 0.72 | 0.96 |
| | Chard leaves | 0.69 | 1.17 | 0.93 |
| | Chick pea leaves | 0.43 | 0.39 | 0.41 |
| | Morus leaves | 0.46 | 0.30 | *0.38* |

In the long term effect, sugar beet heads can be considered as a promising liner or the likeliest candidate to reduce seepage rate to acceptable limits. On the other hand, the results of[ Fig.(4.24) to (4.26)] revealed that on the whole the study soils exhibited similar trends during the bioplastic experiment

## CONCLUSIONS AND RECOMMENDATIONS:

**1.** Among the bioplastic materials sugar beet was the most effective materials in reducing the seepage.
**2.** Apply bioplastic materials like sugar beet in the early spring to allow their proper fermentation under the soil mild temperature during the spring season.
**3.** Take benefits from the by-product of the existing factories in Iraq such as sugar beet as source of liner materials.

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# كارتيكرنا كەرستين هوونين اوركانيك وماوى گەمارئ لسهر ر ئاڤ دا چوون ل سئ جورين ئاخى ييت جودا

**پوختە**

**تاقيكرنەكا فاكتری هاته ئەنجامدان ژ بو هەلسنگاندن وهەڤبەركرنا چوستی ڤەگرتنی ييت پينج كەرستين هوونين اورگانيك ييت لسەر كيمكرنا ئاڤ دزين ل سی جورين جودا ييت ئاخی.**

**ئاڤ دا چوون دەھ جاركی كيم بووی وەك كەرستی بەنجرسكری هاتيی يە بكارئينان بتايبەت پشتی دوو مەهين گەماری ل تاقيكرنا بايوپلاستيكێدا. وپشتی ماوی گەماری هاتی يە زيدەكرن پتر ژ دوو مەها ريژا ئاڤ دا چوونی ووسان كيم بوو نيزيكی سفری لی هات سەرەرابی ڤی چەندی ريژا سەديا كيم بوونی بوو هەمی كەرستين دی وەك ( بەلگين تورويا – نووكا – بەقلی – بەقلك وبەلگين جەهی ) كيم بوون ژ ريژا 100٪ كيم تر بو.**

تاثير المواد العضوية المبطنة وزمن التحضين على التوصيل الهيدروليكي لثلاثة ترب مختلفة النسجة

**الخلاصة**

نفذت تجربة عاملية لتقييم و مقارنة الاداء الانسدادي لخمسة مواد عضوية مختلفة ومتنوعة المصادرفي انخفاض معدل التسرب من ثلاثة ترب ذات نسجات مختلفة ولها مدى واسع من محتوى الطين من محافظة دهوك. اظهرت النتائج ان 10 مرات انخفاض في التوصيل الهيدروليكي تم ملاحظتها في معاملة البنجر السكري بعد شهرين من فترة التحضين في التجربة البايوبلاستيكية , وبعد مرور فترة اكثر من شهرين اصبح معدل التسرب صفرا تحت المعاملة المذكورة اعلاه. بالاضافة الى ذلك وجد ان نسبة الانخفاض في التوصيل الهيدروليكي تحت بقية المعاملات مثل ( اوراق التوث, الحمص ,السلق , الباقلاء واوراق الشعيركانت اقل من 100%.

# A SURVEY STUDY OF SHEEP AND GOATS RAISED UNDER FARM CONDITIONS

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## ABSTRACT

**Data for the present observation was collected on 4112 karadi ewes and 750 black does raised on 17 farm located in Duhok province.**

**Its seems from this observation that almost 25 and 70 % of total females in the flock are 2 and 3-5 years old, and the main reason of culling is the age of animals, because of their lower productivity. Fertility, conception, lambing rates and litter size averaged, respectively 84.5, 90.2, 86.5% and 1.02 for ewes, and 81.7, 92.4, 94.0 and 1.15 in the same order for does. The average lambs and kids survival rate are 96.0 and 90.4% respectively. It can be concluded from the current investigation that the performance of ewes and does is comparable if not better than those raised on station conditions.**

***KEYWORD:*** commercial flocks, sheep, goat, reproduction traits

## INTRODUCTION

Native sheep and goats of Iraq are raised under different climatic, topographic and management conditions, adapted well to the harsh environment of the region, and considerable differentiation due to natural selection has taken place. Although these breeds are characterized by low productivity in general, nevertheless, their importance is further enhanced because they are the most suitable farm animal to the extensive area of arid and semi-arid lands of the country, as well as, the major source of livelihood for the rural inhabitants of these areas. Furthermore, small ruminant production in Iraq will continue to maintain its importance in the future due to the increasing human population, and the increasing demand for meat and milk production (Juma and Alkass, 2000).Moreover, small ruminants production systems generally lag behind crop production ones in term of development, standards of management and husbandry and mechanization. Feeding generally depends on natural pastures (range land) and crop residues ( Majid et. al. 2003).

Indeed cumulative works on small ruminants have been carried out on experimental state farms in the country. Yet very limited works have been taken place under farm conditions. Therefore, the aim of this observation was to shed some light on some aspects of management practices, as well as some reproductive and productive traits.

## MATERIAL AND METHOD

Data for the present survey was collected by regular visits to 17 sheep and goat farms located in Duhok province, Kurdistan region involving 4112 karadi ewes and 750 black does, during the period March to September 2010.

**Mating season:**

Mating season on the majority of sheep farms (61.5 %) commence in June, while in other farms started either on July (30.7%) or during August (7.8%) (Figure 1), and extended for a period ranged between 1.5 to 3 months in few flocks. Accordingly, lambing season started during October up to December. Also, it is worth to note that the majority of farmers (84.6%) used their own rams for mating. In goat farms, mating season started during September and extended for about 2 months. Therefore, kidding commenced in January till the end of March (Figure 2).

**Feeding practices:**

Sheep and goat generally depends on grazing range lands that are communally owned, and the availability of crop residues during the entire year (Figures 1 and 2). Supplementation in form of concentrate (barely or wheat bran), straw or hay are used during winter (Figures 1 and 2).

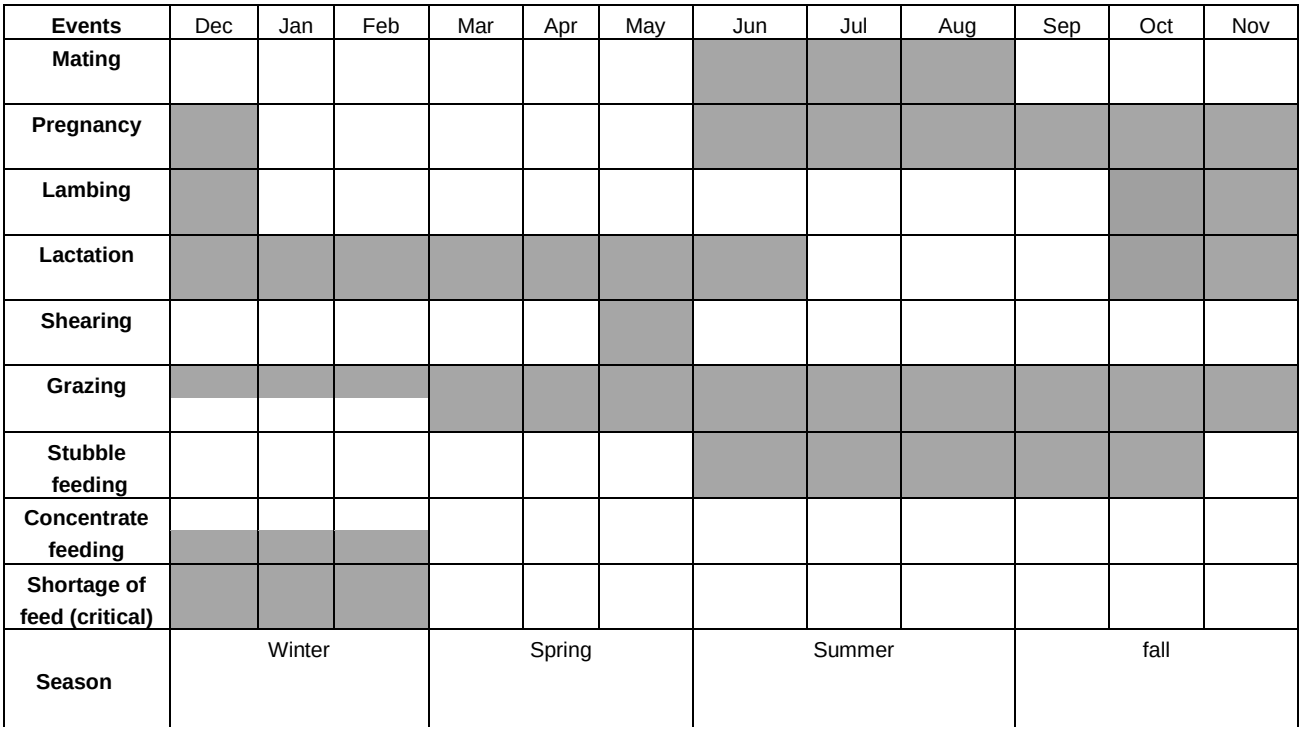


**Figure. (1):** Main features of the yearly management of sheep.

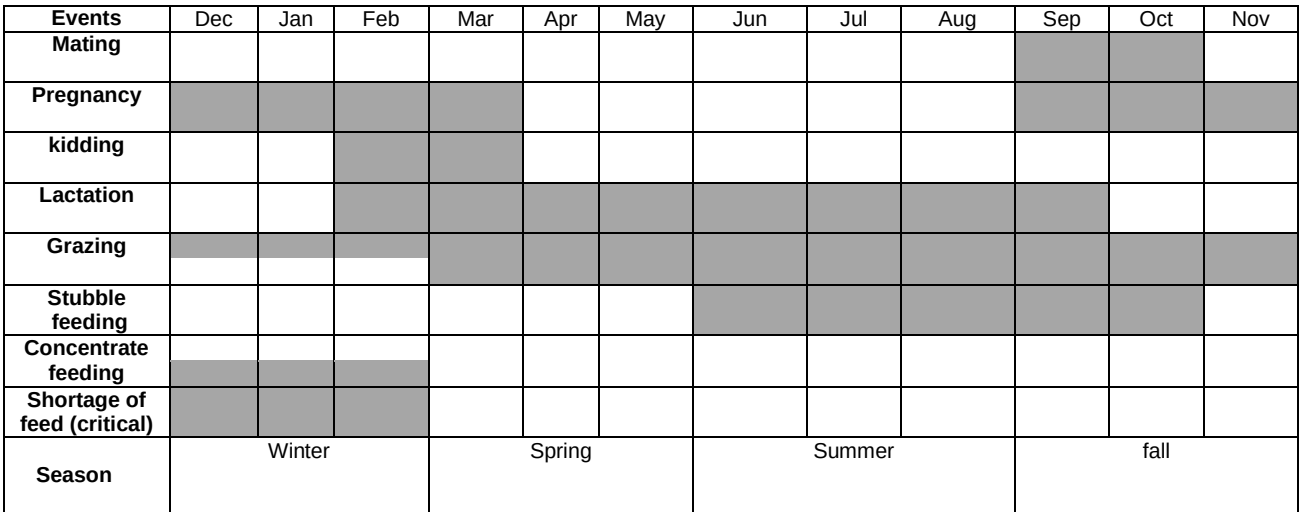


**Figure. (2):** Main features of the yearly management of goat.

**Milk production:**

Milk is usually left for the suckling lamb or kids over the first 1-2 months of its age. This period may be extended depending on the weight and general condition of the lamb/ or kids. Thereafter, and until weaning (3-4 months) lambs or kids and their dams are separated overnight and the latter are hand milked in the following morning before going out with their lambs or kids to pasture. Also, ewes and does are milked post-weaning till they dry off. The averages daily milk yield ranged between 250-600 grams for ewes and 500-750 gram for goats.

**Shearing:**

Sheep are shorn during May and shearing is still carried out by hand shears. First shearing is performed either at 9 or 18 months of age and thereafter once every year.

Data of the reproductive performance was analyzed by chi-squre according to SAS (2004).

## RESULTS AND DISCUSSION

**Flock structure:**

Since both age and breeding status or sex influence production, consideration has to be given to determining the flock structure for age

which will give the maximal return (Turner and young, 1969). In the current observation, the rough estimate of flock structure for ewes and does is presented in Table (1).

It seems from the above table that approximately one fourth of the both ewes and does are almost 2 years old, the majority of animals (70 %) is between 3-5 years old, and about (5-6 %) are older than 5 years. Thus age is among the main reasons of culling ewes and does because of their lower productivity. Diseases is ranked the second cause of culling and finally the unavailability of pasture due to drought or to high prices in the market due to more demand for meat could contribute for culling animals.

**Table (1):** Flock structure according to age of ewes and does

| Age (year) | Ewes % | Does % |
|---|---|---|
| 2 | 24.2 | 25.3 |
| 3 | 27.7. | 30.6 |
| 4 | 27.6 | 22.0 |
| 5 | 15.0 | 15.5 |
| >5 | 5.5 | 6.6 |

**Reproductive traits:**

In the current observation, fertility, conception and lambing rates of ewes averaged 84.5, 90.2 and 86.5 %, respectively, and litter size at birth averaged 1.02 (Table 2). Statistical analyses revealed a significant effect of flock on studied traits except of litter size. The minimum fertility rate recorded herein (75%) is comparable to those of Awassi ewes raised under state farm conditions obtained by Kazzal and Hamdoon (1986) (75.6%) Abdul-Rahman (1996) ( 76.2%) and Al-Ameri (1999) ( 73.9%). However, the average of fertility for all flocks ( 84.5%) which is comparable to those reported by Koster, et.al. (1970) for Awassi ewes raised under state farm conditions and Alkass et.al (1999) for Awassi ewes raised on commercial flock. Thus it seems in general that ewes performed better under on farm condition compared to those on station farms.

Conception rate ranged between 80.2-97 % which is comparable to the value (95.1 %) recorded by Alkass et.al (1999) for Awassi ewes raised under on farm conditions. However, a difference of 5.70% was observed between fertility and conception rates. The main cause for such reduction in fertility was attributed to the losses caused by abortion, as a result of infected ewes with B. abortus (Brucellosis), therefore, better health control is needed to avoid such losses. Lambing percentage in all studied flocks ewes ranged between 70.0 -95.8%. Previously, lambing percentage of Awassi ewes averaged 82.9 % (Al-Ameri, 1999), 93.2 % (Koster et.al., 1970) and 100.0 % (Alkass et.al., 1999).

Litter size at birth ranged between 0.96 to1.10 the differences among flocks were not significant (Table 2), while such values are in accordance with those reported earlier by Askar and El-Khalisi(1964) for Awassi and Arabi ewes raised on farm condition, on the other hand, it is lower than values (1.08 – 1.12) recorded for Awassi kept on state conditions (Koster et.al., 1970 ; Abdul-Rahman, 1996). It is generally agreed that flushing ewes prior to mating is responsible for higher ovulation rate and consequently an increase in lambing rate. However, flushing is not practiced by the farmer, and the genetic potential of our native sheep could be responsible for such lower lambing rate and litter size at birth.

**Table (2):** Reproductive performance of ewes and does raised under on farm conditions

| Trait | sheep | | | Goat | | |
|---|---|---|---|---|---|---|
| | No. | Mean | range | No. | Mean | range |
| No. female exposed to male | 4112 | | | 750 | | |
| No. of female lambed or kidded | 3477 | | | 613 | | |
| Fertility rate% (1) | | 84.5* | 75-94 | | 81.7** | 60-93.2 |
| No. female aborted | 231 | | | 80 | | |
| Conception rate % (2) | | 90.2** | 80.2-97 | | 92.4** | 80-97.5 |
| No. of lamb/kids born | 3559 | | | 705 | | |
| Lambing /kidding rate % (3) | | 86.5** | 70-95.8 | | 94.0** | 70-108 |
| Litter size at birth (4) | | 1.02 | 0.96-1.1 | | 1.15 | 1.11-1.18 |
| No. lambs/kids died till weaning | 141 | | | 68 | | |
| Survival rate % (5) | | 96.0* | 71.5-99.5 | | 90.4 % | 73.1-97.0 |

1. No. female lambing or kidding / No. of female exposed) X 100
2. No. female lambing or kidding + aborted / No. female exposed X 100.
3. No. lambs or kids born / No. of females exposed X 100
4. No. lambs or kids / No. of females lambed or kidded
5. No. lambs or kids alive till weaning / No. of lambs or kids born

Lamb wastage is considered one of the main problems facing sheep producers. In the present investigation, lamb survival averaged 96.0 %. However, higher mortality rate were recorded in commercial flocks (12.1%) by Asker and El-Khalisi (1964) and the value (12.1.-17.6%) being recoreded by Alkass et. al. (1989) and Kazzal and Hamdoon (1986). Although, a significant difference among flock exit for this trait, in general, it is a good indicator of adaptation of Karadi breed to the prevailing conditions in the region as well as to good management practices followed during lambing in most studied flock.

In the present investigation, fertility, conception and kidding rates of does averaged 81.73, 92.4 and 94.0 % respectively (Table 2) and were affected significantly by flock. The fertility rate observed herein was higher than those reported earlier on local Iraqi goat raised on station condition (67.6 – 78.3 %. (Sultan, 1999; Juma et.al., 2001) or under farm conditions (77.23 %) (Alkass et.al. ,2009). Similarly, in semi- arid of Ethiopia, fertility rate of Adel local goats and their crosses with Saanen were 78 and 80 %, respectively (Kassahun et. al., 1989). Also, under extensive system of management, fertility rate are affected by range condition. For indigenous goats kept under semi-arid or arid ranges of Pakistan, conception and kidding rates were 88 and 75 %, 75 and 58 %, respectively( Rafiq et al., 1990). It may stated that a part from breed differences, concentrate supplementation, better range condition and rain fall through its indirect effect on herbage growth improve body condition of does and thus resulting in improved fertility rates.

Although the conception rate was relatively high (92.4 %), the reduction in the rate of fertility (81.7%) was due to mainly to the losses caused by abortion (10.7%). As in case of ewes the main reason of abortion was the infected does with B. abortus. Therefore, better health control is required to avoid such losses.

Litter size is a combination of ovulation rate and embryo survival. In the present observation. litter size averaged 1.15 and the differences among flocks were not significant (Table 2). This value is slightly lower than the values 1.33 and 1.24 reported earlier by Juma et.al (2001) and Alkass et.al. (2009). Moreover, as Shelton (1978) stated that with the exception of a few of more highly fertile breed of sheep like the Finnish Landrace and black belly Barbados, the goat ranks highest in prolificacy among domestic ruminant species. Since litter size is greatly influenced by environmental factors particularly nutrition, it would be possible to design a program aimed to improve this trait independent of any genetic improvement.

Survival rate of kids up to weaning averaged 90.4 % and the range was 73.1-97.0% (Table 2). Therefore, with the exception of one flock, the survival rate in general is good and indicates the adaptability of this breed to the prevailing conditions in the region as well as to the good management practices followed by the farmers during kidding season.

**Income of raising sheep and goat:**

The main income of raising sheep is coming from selling lambs, and aged ewes and rams, which contribute about 73%. The contribution of milk and wool is approximately 22 and 5%, respectively. Similarly, the main contribution of income in goat is coming from selling kids and aged does and bucks (81 %) and milk formed about 19 % of the total income.

## CONCLUSION

From the present investigation, it can be concluded that the reproductive performance of both ewes and does raised on farm conditions is comparable if not better than those raised on station conditions.

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**كورتى**

**ڤەكولينەكا ميدانى ل سەر 17 كەرێت پەزى ييّت خودان كرن ژلايێ جوتيارا كو ژمارا ميها 4112 ميە و 750 بزن بون لبارێزگەها دهوكێ.**

**لدويف ڤێ ڤەكولينێ رێژا ميە و بزنێت دوو سالى 25 % و ێت بژيێ 3- 5 سالى 70 % و ئەگەرێ سەرەكى بو دوير ێخستنا گيانەوەرا ژ كەرێت پەزى ژيێ مەزن بو ژبەر كێم بونا بەرهەمێ وان.**

**تێكرا رێژا خصوبێ و اخصابێ وكاڤرا و هژمارا كاڤرا د ئێك زك دا د ميە دا 84.5 و90.2 و 86.5 % و 1.02 دويفكدا و لدبزنا دا 81.7 و 92.4 و 94.0 % و 1.15 ديف ئێك دا . و ديسا رێژا مانا ساخ تا شيرڤەكرنێ 96.0 و 90.4 % د هەر ئێك ژ كاڤرو كيسكا دا دويف ئيك دا. و لدويف ڤێ ڤەكولينێ بو مە ديار دبيت كو ئەو پەزێ بزنێن ژلايێ خەلكى دهێتە خودان كرن باشترە ژوى پەزى بزنێن ئەوێ ل پروزژێت كشتى دهێتە بخودان كرن .**

**الخلاصة**

**دراسة ميدانية لقطعان الاغنام و الماعز التجارية شملت بيانات هذه الدراسة الميدانية ما مجموعه 4112 نعجة و 750 معزة مرباة في 17 قطيع في محافظة دهوك.**

**تبين في هذه الدراسة بان نسبة الاناث بعمر سنتين قد بلغت 25 % في حين بلغت 70% منها بعمر 3–5 سنة , وكان السبب الرئيسي للاستبعاد هو التقدم بالعمر نتيجة انخفاض الانتاجية.**

**بلغ معدل كل من نسب الخصوبة و الاخصاب و الولادات و المواليد من البطن الواحدة في النعاج 84.5 و 90.2 و 86.5 % و 1.02 على التوالي. وفي حين بلغت في الماعز 81.7 و 92.4 و 94.0 % و 1.15 و نفس الترتيب السابق. كما بلغت نسبة البقاء لحين الفطام 96.0 و 90.4 % لكل من الحملان و الجداء على التوالي. و على ضوء ما تقدم يمكن الاستنتاج بان اداء الاغنام و الماعز المرباة في القطعان التجارية مقارب اذا لم يكن احسن من نظيراتها المرباة في المحطات الرسمية.**