

Multi-Correlation Analysis Between Some Vital Aspects of Zizyphus Fruit Fly *Carpomyia incompleta* Becker, (Diptera: Tephritidae) and Soil Characteristics

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Abstract

Trials were carried out at three locations with three different types of soil throughout the period from April to May 2011. From surface of the soil (5-10 cm.) under zizyphus trees, soil samples were collected from each location, sent to the Central Laboratory of Soil and Water Department for analysis. The fallen zizyphus fruits under the same trees were collected, transferred to the laboratory, and zizyphus fly larvae were isolated. Data of soil characteristics and the vital aspects of the zizyphus fruit fly were subjected to one way analysis of variance and multi-correlation analysis programs. The analysis of variance of the data indicates that each type of soil showed a different effect on the percentage of infestation and on the vital aspects of pupal stage of zizyphus fruit flies. The obtained data revealed that the effect of sandy, sand loamy and loamy soil types on the percentage of pupation were 32.2, 35, and 41%, respectively. The percentage of emerged adults was

varied according to the soil type on which the fruits were fallen. It was 25.5, 33.2, and 65.8% related to sandy, sand loamy and loamy soil types, respectively. Pupal periods lasted for 16.4, 14.8, and 11.4 days for sandy, sand loamy, and loamy soil types, respectively.

Simple and multiple correlations indicated that the percentage of sand, total soluble salts (TSS), and saturation capacity, are the key factors in the above-mentioned variations; although, the simple correlation between these variables were (not significant). In contrast, some factors with highly significant simple correlations; have the less coefficient of determination. These reversed evidences, show that the simple correlation between a dependent factor and an independent one, is not enough to determine the relative efficiency of the independent factor where it has an auto-correlation with other independent factors.

Key words: Zizyphus Fruit Fly, *Carpomyia incompleta* Becker, Soil Characteristics, Multi-Correlation Analysis.

Introduction

The Egyptian jujube *Zizyphus spina-christi* (L.) Desf., is an ancient prehistoric fruit, that usually known as sidr and its edible fruit as Nabq. It is a common fruit grown in the warm subtropical regions, belongs to the genus *Zizyphus* of family Ghamnaceae. The economic importance of nabq in Assiut region comes after citrus, dates and pomegranate, (Morsy, 1971 and Abdel-Galil and Darwish, 1987). This crop is highly sensitive to the infestation with *Zizyphus* fruit fly *Carpomyia incompleta* Becker, (Farghal, *et al.*, 1981). It is well known that *C. incompleta* as most of fruit flies, deposits eggs singly in the fruit, the larvae emerge within individual nabq fruit, feeding on the fruit where they develop through three developmental stages. The third-stage larvae exit the fruit, drop or crawl to the soil where they burrow below the surface, and pupate. So, this pest spends a part of its life cycle (pupal stage) inside the soil. Morsy, *et al.* (1981) reported that a proportion of *C. incompleta* pupae enter diapause by the end of April. Thus, the characteristics of the soil under nabq trees play a very important role in the vital aspect of the pupae, subsequently; the degree of infestation by *C. incompleta* to nabq fruit was also affected. On an investigation by Ibrahim, *et al.* (2010), they found that the soil characteristics affected the weight of the earthworm drastically. The pupae in the soil lie under the stress of biotic and abiotic agents; they

don't affected by these factors individually (simple correlation), but in fact, they correlate with all these factors together.

However, the present work was conducted to provide a demonstration about the multi correlation between a dependent variable (vital aspects) reacting with many of independent variables (soil characteristics) of the pupal stage to determine basic facts which can be used for developing an integrated pest management program for controlling fruit flies in general.

Materials and Methods

The present study was carried out at three locations, with three different soil types (Abnub, Elfath, and Walidia Island), Assiut Governorate, Egypt, throughout the period from 18 April to 12 May 2011.

Sampling:

From the surface of the soil (5-10 cm.) under *Zizyphus* trees, five soil samples, (1 kg. each), were collected from every location, dried in open air, grinded, screened through 2mm mesh size, and sent to the Central Laboratory of Soil and Water Department, Faculty of Agriculture, Assiut University for analysis. The fallen *Zizyphus* fruits under the same trees were collected in mesh bags and transferred to the laboratory for examination. To determine the percentage of infestation, 400 fruits were weighed and visually observed. A fruit with a high point or brown decayed area on its skin was considered as infested one.

Abdel-Kawi separator (Abdel-Galil, 2007 and Amro and Abdel-Galil, 2008) was used to isolate zizyphus fly larvae. Twenty of these larvae were placed in 0.5 kg glass jars packed to its half with the soil, covered with a thin layer of the same soil type, and kept under laboratory conditions. Jars were examined daily and the vital aspects (the percentage of developed pupae, emerged adults, and pupal period) were recorded.

Statistical analysis:

The obtained data of soil characteristics and the vital aspects of the pest were subjected to one way analysis of variance, simple and multi-correlation analysis programs by mean of the Advanced Statistical Analysis Package (ASAP)® (Rizk, 2012) to determine the effect of soil type and the co-efficient of determination of

the soil components together, and relative efficiency of each component.

Results and Discussions

Soil characteristics:

Analysis of variance of data obtained from soil physical analysis of the three locations (Walidia Island, Elfath, and Abnub) indicated that the soil types of these locations have different characteristics (Table 1). The statistical analysis of data showed a highly significant difference between the three locations in each variable (p values less than 0.01). The previous results indicated that soil type of Walidia Island, Elfath, and Abnub were found to be sandy, sand loamy, and loamy, respectively.

Table 1: Soil characteristics of the experiment areas (Walidia Island, Elfath, and Abnub), Assiut.

Location	Soil type	Soil Texture %			Saturation Capacity	EC mms 1:2.5	Total soluble salts TSS	Ece Calc.
		Clay	Silt	Sand				
Walidia Island	Sandy	0.94	16	83	42.18	0.29	464	1.72
Elfath	Sand loamy	12.8	32	54.2	48.03	0.25	382	1.08
Abnub	Loamy	25	39	36	56.25	1.99	3161	10.4
Significance		**	**	**	**	**	**	**

** means which the p. values are less than 0.01

Zizyphus fruit fly vital aspects:

Analysis of variance of data (Table 2) indicated that each of soil type had a different effect on the percentage of infestation and on the vital aspects of pupal stage of zizyphus fruit flies.

The effect of soil type on the infestation of fallen fruits proved that the sandy soil showed the less percentage, followed by sand loamy, (76% and 81.4%); loamy soil had the largest percentage (96.8%).

Also, data obtained showed that the effect of sandy, sand loamy and loamy soil types on the percentage of developed pupae were shown to be 32.2, 35, and 41%, respectively.

The percentage of emerged adults was varied according to the soil type on which the fruits were fallen. It was 25.5, 33.2, and 65.8% related to sandy, sand loamy and loamy soil types, respectively.

Green, *et al.* (1995) suggested that loamy soil is intermediate between sandy and clay, usually with superior mature and nutrient capacity, and a porous crumb structure.

Pupal periods for the three soil types were found to be 16.4, 14.8, and 11.4 days for sandy, sand loamy, and loamy soil types, respectively.

Table 2: Soil type effects on some vital aspects of zizyphus fruit fly.

Pupal vital Factor	Soil type	Mean	SD	F- value	Sig.
Infestation %	Sandy	76	1.58	375.8	**
	Sand loamy	81.4	0.89		
	Loamy	96.8	1.64		
developed pupa %	Sandy	32.2	0.84	21.43	**
	Sand loamy	35	0.71		
	Loamy	41	1		
Emerged adults %	Sandy	25.5	2.77	129.58	**
	Sand loamy	33.2	2.88		
	Loamy	65.8	4.49		
Pupal period day	Sandy	16.4	1.14	27.55	**
	Sand loamy	14.8	0.84		
	Loamy	11.4	1.52		
** means which the p. values are less than 0.01					

Multi-correlation between soil characteristics and pupal vital aspects:

Data in Table 3 showed the simple and multiple correlations between

soil characteristics and some of vital aspects of pupal stage of zizyphus fruit flies.

Table 3: Simple and multiple correlations between some soil characteristics (independent variables), and some vital aspects of zizyphus fruit fly pupae (dependent variables)

Soil characteristics	% Developed Pupae	% Emerged adults	Pupal period (days)
Clay	-0.273	0.946 **	-0.865 **
Silt	-0.071	0.870 **	-0.802 **
Sand	0.149	-0.909 **	0.833 **
Saturation Capacity	0.659 **	0.196	-0.245
EC mms	-0.678 **	0.936 **	-0.836 **
Total Soluble Salts TSS	-0.679 **	0.936 **	-0.839 **
Multiple Correlation R	0.9118	0.9221	0.9434
Co-efficient of determination R ²	0.83138	0.85027	0.890004

Multi-correlation between soil characteristics and developed pupae%:

The co-efficient of determination was found to be 0.8314 (Table 3), this figure means that 83.14 % of the variability of the percentage of

developed pupae is due to soil characteristics together. The relative efficiency of characteristics is ranged from 0.85 for EC mms to 34.04 for proportion of sand in the soil (Table 4).

Table 4: Relative efficiency of some soil characteristics on some vital aspects of the zizyphus fruit fly pupal stage.

Soil characteristics (dependent)	Relative efficiency %					
	% Dev. Pupae		% Emerged adults		Pupal period (days)	
	Efficiency %	Rank	Efficiency %	Rank	Efficiency %	Rank
Clay	6.66	3	15.20	3	2.05	6
Silt	2.07	5	2.37	6	6.81	5
Sand	34.04	1	3.44	5	26.18	2
Saturation Capacity	16.81	2	7.88	4	32.62	1
EC mms	0.85	6	22.21	2	7.96	4
Total Soluble Salts TSS	5.91	4	25.62	1	12.62	3
Total efficiency	83.14		85.03		89.00	

Multi-correlation between soil characteristics and adult emergence%:

Co-efficient of determination of soil characteristics together was found to be 0.8503; this figure indicates that 99.6 % of the variability of adult emergence is due to soil characteristics. Statistical analysis showed that the relative efficiency values of these characteristics were ranged between 25.62 for the total soluble salts (TSS), and 2.37 for amount of silt in the soil (Table 4).

Multi-correlation between soil characteristics and pupal period:

Statistical analysis of data shows that 89 % of the variability in pupal period was attributed to soil characteristics (Table 3). The relative efficiency was ranged from 2.05 for clay to 32.62 for saturation capacity of the soil and pupal period (Table 4).

These figures indicate that the percentage of saturation capacity is the most important factor; although, the simple correlation between this variable and pupal period was - 0.245 (not significant, Table 3). In contrast, clay has a highly simple correlation value (-0.865**); it has the less co-efficient of determination. These reversed

evidences, show that the simple correlation is not enough to determine the potency of a dependent factor as it has an auto-correlation with other independent factors. Thus, multi-correlation coefficient analysis is highly recommended in such cases.

References

- Abdel-Galil, F.A. (2007):** Study on biological means for controlling the Mediterranean fruit fly *Ceratitis capitata* (Wiedemann) in new valley governorate. The final report (July 2007), Academy of Scientific Research and Technology (ARST): 1-176.
- Abdel-Galil, F.A. and Y.A. Darwish. (1987):** Soil fauna of Zizyphus fruit trees in Assiut area. Assiut J. Agric. Sci., 18 (2): 61-72.
- Amro, M.A. and F.A Abdel-Galil. (2008):** Infestation redistribution and relative susceptibility of certain edible fruit crops to the native and invading fruit flies (Diptera: Tephritidae) in the new valley oases, Egypt. Ass. Univ. Bull Environ. Res., 11(1): 89-98.
- Farghal, A.I., M.A.A. Morsy and F.A. Abdel-Galil: (1981).** Effect of soil treated with certain insecticides Jha's and chitin inhibitor on the zizyphus fruit fly and its parasite. 1st Inter. Cong. Soil Poll. Part II: 135-146.
- Green, N. P. O., G.W. Stout, D. J. Taylor, and R. Soper, (1995):** Biological Science. Cambridge University Press Cambridge: 387 – 390.
- Ibrahim, B. U., J. Auta, and D. A. Adebote (2010):** Effect of soil types and enhanced nutrient levels on the productivity of earthworm (*Eudrilus eugeniae*, Kinberg). Bajopas, 3 (1): 59 – 62.
- Morsy, M.A. (1971):** Studies on certain fruit pests in Upper Egypt. M.Sc. Thesis, Fac.. of Agric. Assiut Univ. Egypt.
- Morsy, M.A.A., F.A. Abdel-Galil and S.A. Temerak (1981):** Thermal regulation of pupal diapause in zizyphus fruit fly *Carpomyia incompleta* Becker (Diptera:Trypetidae). 4th Arab Pesticide Conf. Tanta Univ., III A: 179-186.
- Rizk, M. M. A. (2012):** Advanced Statistical Analysis Package (ASAP) ®. Un published data.

الملخص العربي
تحليل الارتباط المتعدد بين بعض السمات الحيوية لذبابة ثمار النبق
Carpomyia incompleta Becker (Diptera: Tephritidae)
وخصائص التربة

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أجرى هذا العمل في ثلاث مناطق تختلف عن بعضها في نوع التربة وذلك خلال الفترة من أبريل حتى مايو ٢٠١١م. تم جمع عينات التربة في كل منطقة من سطح التربة (عمق ٥-١٠ سم) أسفل أشجار النبق، وأرسلت هذه العينات إلى المعمل المركزي بقسم الأراضي والمياه لتحليلها. كذلك تم جمع ثمار النبق الساقطة أسفل نفس الأشجار ونقلت إلى المعمل حيث عزلت منها يرقات ذبابة النبق.

تم تعريض البيانات المتعلقة بخصائص التربة والسمات الحيوية لذبابة ثمار النبق لتحليل التباين ذات الاتجاه الواحد وكذا لبرامج الارتباط المتعدد. وأشار تحليل التباين للبيانات أن كل نوع من التربة قد أظهر تأثيراً مختلفاً على نسبة الإصابة وعلى السمات الحيوية لعذارى ذبابة ثمار النبق.

كما أظهرت البيانات المتحصل عليها أن تأثير أنواع التربة الرملية والرملية الممزوجة بالطفل والتربة الطفلية على نسبة التعذر قد بلغ ٣٢.٢، ٣٥، ٤١% على التوالي. كما اختلفت نسبة خروج الحشرات الكاملة (الانباتق) طبقاً لنوع التربة التي سقطت عليها الثمار، حيث كانت نسبة (الانباتق) ٢٥.٥، ٣٣.٢، ٦٥.٨% بالنسبة للتربة الرملية والرملية الطفلية والطفلية على التوالي. كذلك استغرقت فترة التعذر في التربة الرملية والرملية الطفلية والطفلية ١٦.٤، ١٤.٨، ١١.٤ يوماً على التوالي.

وقد أثبتت نتائج تحليل التلازم البسيط والمتعدد أن نسبة الرمل والأملاح الكلية الذائبة (TSS) وقدرة التشبع Saturation capacity هي عوامل رئيسية محددة للاختلافات التي أوردناها آنفاً رغم أن الارتباط البسيط بين هذه العوامل لم يكن معنوياً. وعلى العكس من ذلك فإن بعض العوامل ذات الارتباط البسيط عالي المعنوية قد حققت أدنى معامل تحديد Co-efficient of determination.

هذه الدلائل العكسية توضح أن الارتباط البسيط بين احد العوامل المستقلة وعامل تابع، ليس وحده كافياً لتحديد الكفاءة النسبية لهذا العامل المستقل حيث يوجد ارتباط تلقائي مع عوامل أخرى تعمل على نفس العامل التابع.