J. Plant Prot. and Path., Mansoura Univ., Vol. 1 (12): 1099 - 1107, 2010

EFFECT OF DIFFERENT PH VALUES OF SPRAY SOLUTION ON THE EFFICIENCYOF MALATHION, *Beauveria bassiana* AND EXTRATONE ON *Aphiscraccivora*

Hashem, H. H. A. [**]; I. F. Shokry [*]; K. T. Hussein [*] and Rehab M. El-Gendy[**]

*** Fac. Sci., Zagazig Univ., Egypt.**

**** Plant Protection Res. Institute, Agric. Res. Center, Giza, Egypt.**

ABSTRACT

The toxicity of chemical insecticide; malathion, bioinsecticide; *Beauveria bassiana* and a plant growth regulator (PGR); Extratone at different pH values of spray solution and its effects on some biological parameters of adult *Aphis craccivora* under laboratory conditions were studied. Data showed that malathion at LC_{50} revealed more effective in acidic water, also revealed that, the ideal pH for water used for spraying fungi is alkaline (pH 8-10). Data indicated that the toxicity increased as a period after treatment, Malathion gave the maximum toxicity at pH 4 followed by pH 5 while Biovar gave the maximum toxicity at pH 10 & 8 but Extratone gave the maximum toxicity at pH values 4 followed by pH 5. Malathion at LC_{50} in acidic water decreased longevity, pre-parturition, parturition and post-parturition periods and mean numbers of nymphs of adult per female. Biovar decreased longevity, pre-parturition, parturition and post-parturition periods and mean numbers of nymphs of adult per female at pH values 10 & 8. Extratone decreased longevity, parturition periods and mean numbers of nymphs of adult per female but increased pre-parturition and post-parturition periods pH value 5.

Keywords: *Aphis craccivora,* malathion, *Beauveria bassiana*, plant growth regulator (PGR), Extratone, pH values.

INTRODUCTION

The cowpea aphid, *Aphis craccivora* is one of the major insect pest attacking leguminous crops in Egypt. Malathion is the most effective and posses a highly toxic effect against *A. craccivora* (Nasser *et al*., 2000). Entomopathogenic fungi are currently being used for the control of several insect pests as alternatives or supplements to chemical insecticides. Improvements in virulence and speed of kill can be achieved by understanding the mechanisms of fungal pathogenesis and genetically modifying targeted genes, thus improving the commercial efficacy of these biocontrol agents. Entomopathogenic fungi are considered as the best candidate for biological control of aphid (Latgé and Papierok, 1988; Van *et al*, 2007). Plant growth regulators proved to be diversely affect against *A. craccivora.* The goal when applying any pesticides is to optimize its effects on the target pest by applying the proper rate at the proper time with calibrated equipment. The quality of the water carrier can be another important factor that should be considered to optimize pest control. Minerals and the effect of pH in spray water can diminish the effectiveness of many herbicides and some insecticides. The aim of the present work is determining the effect of

different pH values of spray solution on the efficiency of some pesticides on cowpea aphid.

MATERIALS AND METHODS

Tested compounds:

Chemical insecticide:

- Trade name: Malathion57% (EC).

-Chemical name: o,o-dimethyl-s-(1,2(di-carbethoxy ethyl phosphoro dithioate)).

-Recommended rate: 1.250 L/Feddan.

Entomopathogenic fungus:

- Trade name: Biovar.

-Scientific name: *Beauveria bassiana.*

- Recommended rate: 200g/100L at concentration of $2.3x10^7$ spores per gm.

Plant growth regulator:

- Trade name: Extratone.

-Chemical compistion: It consists of

Napthylacetic acid……2.5%

Moisture……5.0%

Inert……..92.5%

-Recommended rate: 60cm/100L.

Rearing technique of *A. craccivora:*

A. craccivora were reared on faba bean plants under laboratory conditions at 20-25c^o, 70± 5% R.H. and under a photoperiod of 16:18 hours according to (El-Arnaouty, 1991).

Biochemical assays:

Toxicity of tested materials against aphid:

Leaf dipping technique:

Serial degrees of pH values of water were prepared at [10, 9, 8, 7.5, 7, 6, 5 and 4 degree of pH-values and mixed with malathion at LC_{50} (0.73ppm) after determination it, *B. bassiana* at (200ppm) and also with Extratone at recommended concentration. Leaves of faba bean were dipped in the insecticides solutions for 10 seconds then left to dry at room temperature. Treated leaves were put separately in five Petri dishes for each concentration and untreated leaves were put in five Petri dishes as control then 20 individuals of *A. craccivora* were put in each replicate alive and dead individuals were counted and then percent mortalities were calculated after 24, 48, 72 hr. post treatments under laboratory conditions (25-28^{o}C and 70-75R.H%.) (Ghatwary, 2000) and followed them daily to study the effect of tested materials on biological aspects.

Citrate phosphate buffer system (Malic and Singh, 1980):

Citrate phosphate buffer was used for the adjustment of hydrogen ion concentration (pH) in the present work. It is consisted of solution (A) and solution (B) solution (A) is formed of 19.21 gram of citric acid per 1000 ml distilled water and solution (B) consisted of 53.65 of di sodium basic phosphate (Na2 HPO4. 7H2O) or 71.7 gram of (Na2 HPO4. 12H2O) in 1000

ml distilled water. Xml of solution (A) and Y ml of solution (B) were diluted to 100 ml with distilled water to give a known-pH-value as described in Table (1).pH meter CG710,NR SS81,V110/220,VA,Schett Gerate Gmbh D6 238 Hotheim a-T-S. Germany) used for adjustment of the above pH values.

Table (1): Amount of acid (0.1 M citric acid) and base (0.2 M Na2 HPO4. 7H2O) added as a buffer and completed to 100 ml with distilled water to give the corresponding pH value.

pH-value	Solution (A) X ml	Solution (B) Y ml
2	49.0	1.0
3	39.58	10.42
4	30.82	19.18
5	24.95	25.05
6	18.43	31.57
7	9.07	40.93
8	1.38	48.62

RESULTS AND DISCUSSION

Effect of different pH values of spray solution on the toxicity of malathion, *Beauveria bassiana* and Extratone on *Aphis craccivora*:

Results of the toxicity of the tested materials at different pH values of water used for dilution against *A. craccivora* are cited in Tables (2, 3 & 4) which indicated that the toxicity increased as a period after treatment till reached its maximum effect after 72 hrs. of treatment. Results also indicated that the toxicity of the tested materials were depend on the pH value of dilution water, malathion gave the maximum toxicity at pH 4 followed by pH 5 while Biovar gave the maximum toxicity at pH 10 & 8 but Extratone gave the maximum toxicity at pH value 4 followed by pH 5.

The results obtained are in harmony with those mentioned by (Peck, 1985) who discussed the degradation of pesticides in alkaline water in spray tanks, data being provided on the degradation rates of captan, chlorpyrifos, Guthion [azinphos-methyl], Imidan [phosmet], carbaryl, malathion, diazinon and Benlate [benomyl. (Sangita *et al.*, 1995) demonstrated that, the persistence of malathion is increased by soil matter content and degradation is dependent on pH, large CaCO3 content and moderate soil water content. (Ravi *et al.*, 1997) reported that organic matter content and pH affected the rate of decay carbaryl, carbendazim, carbofuran, dimethoate, malathion and methyl parathion [parathion-methyl] in water. (Harris *et al.*,1999) showed rapid degradation of malathion in well and pond water pH levels. **(**Nabi *et al.*, 1999) observed that the movement of most organophosphorus pesticides was enhanced with an increase in the degree of ionization of the acids (pKa) studied as background electrolytes. Movement also increased with an increase in the pH of acids.

In general, the ideal water pH used for spraying fungi is alkaline (pH 8-10). Many workers came with the same results (Shimazu *et al.*, 1996) who investigated growth of *B. bassiana* at various pH at 25°C and the fungus was

found to be able to grow well at high pH of more than 10. The fungus was also resistant to copper chloride and to low sugar content. (Zhang *et al.*,2001) tested three isolates of *B. bassiana*, Bb 02, Bb 03 & Bb 07 which were shown to have quite strong pathogenicity against peach aphid, *Myzus persicae*. The optimum temperature for their growth appeared in the range of 25-30°C, and Bb 02 & Bb 07 grew well at pH 4.0-6.0.

Table (2): Effect of different pH values of spray solution on toxicity of malathion , *Beauveria bassiana* and Extratone against adult stages of *Aphis craccivora* after 24hr

pH value / Treatments	pH. Value					
	10	9	8	6	5	4
	Observed Mortality %	Observed Mortality %	Observed Mortality %	Observed Mortality %	Observed Mortality %	Observed Mortality %
Malathion 57%	30	18	18	27	10	40
Beauvaria bassiana	10	0	50	0	0	10
PGR Extratone	0	0	0	0	20	9

Table (3): Effect of different pH values of spray solution on toxicity of malathion , *Beauveria bassiana* and Extratone against adult stages of *Aphis craccivora* after 48hr.

pH value / Treatments	pH. Value					
	10	9	8	6	5	4
	Observed Mortality %	Observed Mortality %	Observed Mortality %	Observed Mortality %	Observed Mortality %	Observed Mortality %
Malathion	60	27	36	46	50	80
Beauvaria bassiana	30	8	60	10	0	30
PGR Extratone	13	20	10	7	20	18

Table (4): Effect of Malathion57%, *Beauvaria bassiana* and PGR/pH value mixtures against adult stage of *Aphis craccivora* Koch after 72hr.

pH value / Treatments	pH. Value					
	10	9	8	6	5	4
	Observed Mortality %	Observed Mortality %	Observed Mortality %	Observed Mortality %	Observed Mortality %	Observed Mortality %
Malathion	80	45	36	64	80	90
Beauvaria bassiana	60	16	60	30	10	40
PGR Extratone	25	30	10	27	40	45

Effect of malathion diluted with water at different pH values on the biological aspects of adult stages of *Aphis craccivora*:

The data presented in (Table 5) show that malathion at LC_{50} was more effective in more acidic water. Malathion at acidic water gave more potentiation than in alkaline and neutral water (control) but at pH (6, 8, 9, &

10) the longevity of adult varied between 4.00±0.00 and 9.14±0.83 days while at pH, 7 the longevity of adult of *A.craccivora* was 5.88±0.69 days. The highest effect of longevity at pH value4 followed by pH 5 while the lowest effect at pH 8.

The pre-parturition period varied between 1.80±0.37 to 3.5±0.29 days at different pH values. While, it was 1.00±0.00 day at pH, 7. The highest effect of pre-parturition period at pH value4 followed by pH 5 while the lowest effect at pH 9.

The parturition periods were varied between 1.00+0.00 to 6.43+1.09 days while at pH, 7 was 4.25±0.49 days at different pH values. The highest effect of parturition period at pH value4 followed by pH 5 while the lowest effect at pH 8 and 9.

Post-parturition of adult of *A. craccivora* at pH, 6, 8, 9, &10 ranged between zero to 0.60±0.40 days and it was 0.63±0.26 day at pH,7. The highest effect of post-parturition period at pH value4 followed by pH 5 &6 while the lowest effect at pH 9.

The mean number of nymphs per female ranged between 1.00±0.00 to 17.71±2.29 nymphs after treated with malathion at pH (10, 9, 8 & 6) and the mean number of nymphs per female was 13.38+1.63 nymphs at pH,7. The highest effect of mean number of nymphs per female at pH value4 followed by pH 5 while the lowest effect at pH 8.

Table (5): Effect of malathion diluted with water at different pH values on the biological aspects of adult stage of *A. craccivora* under laboratory conditions.

pH value	Longevity/day Period Mean±S.E. (Ranges)	Pre-parturition Period /day Mean±S.E. (Ranges)	Parturition Period/day Mean±S.E. (Ranges)	Post-Parturition Period/day Mean±S.E. (Ranges)	No. of nymphs/female Mean±S.E. (Ranges)
10	4.00±0.00 (4-4)	2.00±0.00 (2-2)	1.00±0.00 (1-1)	1.00±0.00 (1-1)	1.00±0.00 (1-1)
9	7.00±1.53 (4-13)	1.80±0.37 (1-3)	5.40±1.29 (3-10)	0.60±0.40 (0-2)	9.80±3.12 (2-2)
8	9.14±0.83 (6-11)	2.57±0.43 (1-4)	6.43±1.09 (2-10)	0.14±0.14 (0-1)	17.71±2.29 (8-23)
6	8.25±0.25 (8-9)	3.50±0.29 (3-4)	4.75±0.48 (4-6)	0.00±0.00 (0-0)	15.25±5.11 (7-29)
5	0.00±0.00 (0-0)	0.00±0.00 (0-0)	0.00±0.00 (0-0)	0.00±0.00 (0-0)	0.00±0.00 (0-0)
4	0.00±0.00 (0-0)	0.00±0.00 (0-0)	0.00±0.00 (0-0)	0.00±0.00 (0-0)	0.00±0.00 (0-0)
7	5.88±0.69 (4-9)	1.00±0.00 (1-1)	4.25±0.49 (3-7)	0.63±0.26 (0-2)	13.38±1.63 (4-20)

Effect of *Beauveria bassiana* diluted with water at different pH values on the biological aspects of adult stage of *Aphis craccivora*:

B. bassiana is an entomopathogenic fungus used as a bioinsecticide in crop pest management. It exists saprophytically in the soil. The pH of the soil and the insect cuticle and its haemocoel may influence fungal survival and infection potential. The obtained data in (Table 6) showed the effect of *B. bassiana* on longevity of adult of *A. craccivora* and number of nymphs per female at different pH-values. The longevity of adult of *A. craccivora* after treatment with *B. bassiana* at pH from 10 to 4 ranged from 6.25±0.50 to 9.86±1.18 days and at pH, 7 the longevity was 8.33±0.66 days. The highest effect of longevity at pH value10 followed by pH 8 while the lowest effect at pH 4 &5.

The pre-parturition period ranged from 1.50±0.28 to 4.5±0.34 days and pre-parturition period was 1.00±0.00 day at pH, 7. The pre-parturition period increased at all pH values than at pH 7.

The parturition periods ranged from 3.75±0.75 to 7.40±0.62 days at pH from 10 to 4 but at pH,7 the parturition period was 6.57±0.49 day. The highest effect of parturition period at pH value 8 while the lowest effect at pH 4 and 5.

The post-parturition periods ranged from 0.17±0.17 to 1.00±0.32 days and at pH, 7 the post-parturition period was 0.76+0.28 days. The lowest effect of post-parturition period at pH value 5.

The number of nymphs per female at pH from 10 to 4 ranged from 7.25±2.56 to 16.20±1.26 and the number of nymphs per female was27.43±1.62 nymphs at pH 7. The highest effect of mean number of nymphs per female at pH value 10 followed by pH 8 while the lowest effect at pH 4.

Table (6): Effect of *B. bassiana* diluted with water at different pH values on the biological aspects of adult stage of *A. craccivora* under laboratory conditions.

pH value	Longevity/day Period Mean±S.E. (Ranges)	Pre-parturition Period/day Mean±S.E. (Ranges)	Parturition Period/day Mean±S.E. (Ranges)	Post-Parturition Period/day Mean±S.E. (Ranges)	No. of nymphs/female Mean±S.E. (Ranges)
10	6.25±0.50 (5-8)	1.50±0.28 (1-2)	4.00±0.74 (3-6)	0.75±0.25 (0-1)	7.50±1.32 (4-10)
9	9.70±0.79 (6-15)	1.80±0.13 (1-2)	7.40±0.62 (4-8)	0.50±0.31 (0-3)	16.20±1.26 (10-24)
8	7.00±1.41 (5-11)	2.5±0.29 (2-3	3.75±0.75 (2-5)	0.75±0.50 (0-3)	7.25±2.56 (2-14)
6	8.67±1.48 (6-15)	4.5±0.34 (4-6)	4.00±1.09 (2-9)	0.17±0.17 (0-1)	8.50±1.59 (5-15)
5	9.86±1.18 (6-15)	4.29±0.29 (3-5)	5.28±1.36 (1-12)	0.29±0.29 (0-2)	8.86±1.97 (2-19)
4	9.20±1.36 (4-11)	2.00±0.00 (2-2)	6.20±1.32 (1-8)	1.00±0.32 (0-2)	12.80±3.25 (1-20)
7	8.33±0.66 (4-15)	1.00±0.00 (1-1)	6.57±0.49 (1-10)	0.76±0.28 (0-4)	27.43±1.62 (14-39)

Effect of Extratone diluted with water at different pH values on the biological aspects of adult stage of *Aphis craccivora*:

Results in (Table 7) show the effect of Extratone on the longevity, periods of parturition and number of nymphs per female of adult of *A. craccivora* at different pH-values.

The longevity of adult from pH, 4 to 10 ranged from 8.18±1.10 to 5.17±0.40 days while at PH, 7 was 7.13±0.67 days. These results show that, there weren't differences between the treatments and control so there was antagonism action.

The pre-parturition period ranged from 1.36±0.24 to 3.20±0.20 day at pH from 10 to 4 and was 1.25±0.16 days at PH, 7. These results show that, the pre-parturition period increased at all pH values than at pH 7

The parturition period ranged from 2.20±0.37 to 6.55±1.32 days at pH from 10 to 4 and was 5.88±0.72 days at PH, 7. These results show that. The parturition period decreased at all pH values than at pH 7 except at pH 6.

The post-parturition periods ranged from 0.20±0.20 to 0.50±0.22 days and at pH, 7 the post-parturition period was zero days. These data also indicated that, there was increased in number of the post-parturition period at all pH values than at pH 7.

The mean number of nymphs per female ranged from 4.60±1.81 nymphs to 12.27±2.57 nymphs at pH from 10 to 4 and was12.50±2.05 nymphs at pH, 7. The highest effect of mean number of nymphs per female at pH value 10 while the lowest effect at pH 6.

Table (7): Effect of Extratone diluted with water at different pH values on biological aspects of adult stages of *A. craccivora* under laboratory conditions.

pH value	Longevity/day Period Mean±S.E. (Ranges)	Pre-parturition Period /day Mean±S.E. (Ranges)	Parturition Period/day Mean±S.E. (Ranges)	Post-Parturition Period/day Mean±S.E. (Ranges)	No. of nymphs/female Mean±S.E. (Ranges)
10	5.60±0.40 (5-7)	3.20±0.20 (3-4)	2.20±0.37 (1-3)	0.20±0.20 (0-1)	4.60±1.81 (1-9)
9	6.43±0.75 (4-9)	2.57±0.30 (1-3)	3.57±0.48 (2-5)	0.29±0.18 (0-1)	8.57±1.57 (2-14)
8	7.22±0.64 (5-11)	2.11±0.31 (2-4)	4.67±0.58 (1-7)	0.44±0.18 (0-1)	8.78±1.31 (2-13)
6	8.18±1.10 (4-14)	1.36±0.24 (1-3)	6.55±1.32 (1-13)	0.27±0.19 (0-2)	12.27±2.57 (2-27)
5	5.17±0.40 (4-6)	2.33±0.21 (2-3)	2.33±0.42 (1-3)	0.50±0.22 (0-1)	5.83±1.83 (1-13)
4	6.67±0.88 (4-9)	2.50±0.34 (1-3)	3.83±0.95 (1-6)	0.33±0.21 (0-1)	10.00±2.92 (1-17)
7	7.13±0.67 (5-18)	1.25±0.16 (1-2)	5.88±0.72 (3-9)	0.00±0.00 (0-0)	12.50±2.05 (5-21)

REFERENCES

El-Arnaouty, S.A. (1991): Studies on the biology and manipulation of *Chrysoperla carnea* (Stephens) and *Chrysoperla sinica* (Tjeder) (Neuroptera: Chrysopedae) for controlling the green peach aphids *Myzus persicae* (Sulzer) (Homoptera: Aphididae) in greenhouses Ph. D. Thesis, Faculty of Agric., Cairo Univer.

Ghatwary, W. G. T. (2000): Integrated management of certain piercing sucking insects infesting some vegetables crops. PH. D. Thesie Fac. Agric Zagazig. Univers. 1-227 pp.

Harris, F. A.; D. J. Wise; R. L. Ingram; E.G. Alley; J. E. Mulrooney; E. H. Robinson and C. E. Watson (1999): Malathion fate in water and catfish. Technical Bulletin Mississippi Agricultural and Forestry Experiment Station, (225) 10 pp.

Latgé, J.P. and B. Papierok (1988): Aphid pathogens, pp.323-336. In: Minks,A.K. and Harrewijin , P. (Eds.), Aphids. Their biology, natural enemies and control, Vol. 2B. Elservier Science, Amesterdam.

Malic, C. P. and M. B. Singh (1980): Extraction and estimation of amino acids and keto acids. In; Plant Enzymology and Histoenzymology, New Delhi. Lud Hana, 257, India.

Mansour, N. A.; M. E. EL-Defrawi; A. Tappozoda and M. Zeid (1966): Toxicological studies on the Egyption cotton leafworm *Pordenia litura*. VI- potentiation and antagonism of organo phosphorus and carbamate insecticides. J. Econ. Entomol., 59(2): 307-311.

Nabi, S. A.; G. Ajay and A. Gupta (1999): Paper electrophoretic separations of some common pesticides: determination of monocrotophos, Rogor and malathion in soil samples. J. of Environ. Sci. and Health. Part B, Pesticides, Food Contaminants, and Agric. Wastes, 34(2): 239-254.

Nasser, M. A. K; A. M. EL-Ghareeb; A. M. K. EL-Sayed and G. A. Mohamed (2000): Toxicological effects of some insecticides against susceptible and field population of the cowpea aphid, *Aphis craccivora* (Koch). Assiut. J. Agric. Sci. 31(1)217-230.

Peck, K. (1985): Pesticide degradation in relation to spray water pH. Transactions of the Illinois State Horticultural Soci., 119: 37-43.

Ravi, B.; T. Sangita; R. P. Mathur; R. Bhushan and S. Thapar (1997): Accumulation pattern of pesticides in tropical fresh waters. Biomedical-Chromatography, 11(3): 143-150.

Sangita, T.; B. Ravi and R. P. Mathur (1995): Degradation of organophosphorus and carbamate pesticides in soils- HPLC determination. Biomedical Chromatography, 9(1): 18-22.

Shimazu, M.; H. Sato; K. H. Veen and P. Ferron (1996): Media for selective isolation of an entomogenous fungus, *Beauveria bassiana* (Deuteromycotina: Hyphomycetes. Appl. Entomol. Zoolo., 31(2):291-298.

Van, H. V.; S. Hong and K. Kim (2007): Selection of entomopathogenic fungi for aphid control.J. of Biosci. and Bioengineering,104(6): 498-505.

Zhang, Y. J.; Z. K. Wang; Y. P. Yin and Y. Pei (2001): Biological characteristics of *Beauveria bassiana* and its virulence against wheat aphids. J. of Southwest Agric. Univ., 23(2):144-146.

تأثير درجات الـ pH المختلفة لمحلول الرش علي كفاءة الملاثيون وفطر البوفاريا باسيانا والإكستراتون علي حشرة من اللوبيا

حليم حسن أحمد هاشم [2]، إبراهيم فتحي شكري[1] ، كرم طلب حسين [1] و ريحاب محمود الجندي [2]

1- كلية العلوم - جامعة الزقازيق – مصر.

2- معهد بحوث وقاية النباتات – مركز البحوث الزراعية - الدقي – جيزة – مصر.

تم دراسة تأثير قيم درجة حموضة الوسط المختلفة لمحلول الرش علي كفاءة وسمية الملاثيون 57 % والبوفاريا والإكستراتون . و قد أوضحت النتائج أن سمية المواد المختبرة تزداد بزيادة الفترة بعد المعاملة وأنها أعطت أعلي سمية لها عند pH 4 يلية 5 في حالة الملاثيون 'pH 10و 8 في حالة البيوفار' بينما كانت pH 4 و5 في حالة منظم النمو النباتي الإكستراتون. تم دراسة تأثير الملاثيون في درجات الـ pH المختلفة علي المظاهر البيولوجية للطور البالغ لحشرة *أفيس كراسيفورا* . و أوضحت النتائج أن الملاثيون عند التركيز نصف مميت أكثر فاعلية في الماء الأكثر حموضة وقلل طول عمر الطور البالغ وفترات التوالد وعدد الخلفات لكل أنثي و خفض عدد الخلفات لكل أنثي علي طول فترة عمرها يوميا. و أيضا فطر البوفاريا عند تركيز 200 جزء في المليون وقلل طول عمر الطور البالغ وفترات التوالد وعدد الخلفات لكل أنثي و خفض عدد الخلفات لكل أنثي علي طول فترة عمرها يوميا عند درجة pH 8 و 10 . منظم النمو النباتي الإكستراتون عند التركيز الموصي به أثر علي حشرة من اللوبيا بزيادة فترة ما قبل التوالد وتخفيض فترة التوالد وما بعد التوالد وطول عمرها و متوسط عدد الخلفات لكل حشرة كاملة عند درجة pH 5.

قام بتحكيم البحث

أ.د / على على عبد الهادى — كلية الزراعة – جامعة المنصورة

أ.د / حسن السيد سالم — مركز البحوث الزراعية