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INFLUENCE OF SOME ORGANIC AND CHEMICAL FERTILIZERS ON THE INCIDENCE OF COWPEA APHID, APHIS CRACCIVORA KOCH.

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ABSTRACT

Seven treatments of organic (peanut residue) incubated and non-incubated and chemical fertilizers (urea and potassium sulphate) were evaluated on the fertility of wingless females of *Aphis craccivora* Koch. Bean plants cultivated in loamy soil was treated with different fertilizers and the fecundity of *A. craccivora* was estimated 7 and 10 days after treatment. Obtained results indicate that the organic fertilizers when incubated became more effective than the non-incubated ones, led to increase the pest population on bean plants. While by using organic and chemical fertilizers separately, the fecundity of the pest decreased, while their mixture increased the aphid infestation significantly.

INTRODUCTION

Aphids have been long established in Egypt as one of the most economic pests infesting agronomic horticultural and ornamental plants. The intensive use of insecticides to control aphids has fallen into disrepute with both farmers and consumers in view of residue and insect resistance problems. To overcome this problem, research efforts were directed to the integrated pest management. One of this items is the agricultural practises including fertilization. Havlickova and Smetankova (1998) studied the effect of 5 fertilizers, (K) and (Mg) and combinations (NPK), (NPMg), (NPKMg) in the soil on the attractivity and reproduction of the bird cherry oat-aphid, *Rhopalosiphum padi* L., the plants cultivated in soil rich in (K) or treated with (NPK) showed lower attractivity to the pest, while Godfrey *et al.* (1999 & 2000), Oudhia *et al.* (1999) stated that the high levels of nitrogen as culture control measure increased aphid (*Aphis gossypii* Glov.) populations and gall midge (*Orseola oryzae*). Fragoyiannis *et al.* (2000 & 2001) and Yardim and Edwards (2003) studied the effect of nitrogen fertilizer or sheep manure on the aphids (*Myzus persicae* Sulz.) on two potato cultivars and tomatoes. The source of available nitrogen to potato plants did not affect foliar glycoalkaloid (GA) synthesis, and as a sequence did not affect its endogenous chemical defence against insect herbivory, while the organic fertilizers might have the potential to reduce pest attacks in the long-term. In comparative studies between different levels of nitrogen fertilizers and ammonium nitrate on aphid susceptibility of some apple cultivars, it was found that lowest aphid infestation was in urea plots compared with the ammonium nitrate plots (Haltrich *et al.*, 2000). Avinash *et al.* (2000) and Jaworska and Gospodarek (2004) tested the effect of some phosphorus (P) and magnesium (Mg) fertilizer levels on incidence of pests infesting *Vigna nungo* and *Vicia faba* and observed that increasing the level of (P) and (Mg) fertilizers decreased pest infestation and the females revealed their shorter life span and

decreased fertility. Morales *et al.* (2001) studied the effect of fertilization on corn aphids population clarified that maize in fields treated with organic fertilizer hosted fewer aphids (*Rhopalosiphum maidis* F.) than the maize treated with chemical fertilizer, this was attributed to high concentration and total content of foliar nitrogen in maize.

The aim of the present work is to study the influence of organic and chemical fertilizer applications on the population dynamics such as growth and reproduction of the cowpea aphid, *Aphis craccivora*.

MATERIALS AND METHODS

Rearing Pest

A stock culture of *A. craccivora* was maintained on broad bean plants (*Vicia faba*) in open-air conditions. In all experiments, fresh 7-day old bean plants, cultivated in each pot (6cm in diameter and 5.5cm in high) and artificially infested with single aphid/each branch. The whole plant with the aphids was covered with chimney cage, covered with muslin and fixed in place with rubber bands to prevent the insect escaping.

In this study, a series of experiments were conducted to evaluate the effects of different treatments on the incidence of the cowpea aphid, *A. craccivora*.

1- Effect of different soil types on the fecundity of *A. craccivora*

Three different soil types were used (loamy, sandy and mixture of both). Newly born apterous adults were individually transferred to one branch of the broad bean seedlings previously planted in pots. Five pots from each soil (1Kg) were conducted. The number of nymphs deposited/ each adult female aphid on the broad bean seedlings planted in different soils was counted daily for 7 days to differentiate among the three soil types and to evaluate the incidence of *A. craccivora* on the broad bean planted in each soil.

(A) Soil treatment

(1)- Effect of incubated and non-incubated peanut residue (humic acid extract) on reproductivity of *A. craccivora*

In another experiment, the three soil types were tested again using incubated and non-incubated humic acid extracted from peanut residue. Five pots from each soil were treated with 50cm from incubated humic acid (the peels of peanut was left in the soil for 30 days for fermentation and to become compost, extracted with potassium hydroxide 0.3%) and another 5 were also treated with non-incubated humic acid (peanut peels + water without any treatment). An equal number of pots containing untreated soil was used as control.

Fecundity of the adult and weight of the plant (one branch broad been seedling) before and after 7 days from experiment in treated and untreated soil were calculated.

The percentage of reduction with respect to control (untreated)

$= ((c-t)/c)*100$

where c= number of nymphs in the control soil.

t= number of nymphs in the treated soil.

(2)- Effect of soil treated with incubated humic acid and chemical fertilizers (urea and potassium sulphate) on reproductivity of *A. craccivora*

Thirty-five pots, for seven treatments, each contained 1Kg of loamy soil, 5 pots for each treatment and 50cm (5% concentration) from incubated humic acid, urea, potassium sulphate, urea+ potassium sulphate, humic acid+urea, humic acid+ potassium sulphate and humic acid+urea+ potassium sulphate (25+12.5+12.5 cm/Kg) were tested. Five pots were left without any treatment as check (control). The number of nymphs produced after 7 and 10 days was counted.

B- Plant treatment

Effect of sprayed plants with incubated peanut residue and chemical fertilizers on fecundity of *A. craccivora*

In this experiment, the same number of broad bean pots (35) were used and sprayed with the humic acid residue and chemical fertilizers as mentioned before. The number of nymphs produced after 7 and 10 days was counted. Number of nymphs deposited on the plants in the soil treated with the organic and chemical fertilizers compared with those deposited on the sprayed plant was recorded.

Statistical analysis using Analysis of Variance (F-test) was calculated according to Hayslett (1970).

RESULTS AND DISCUSSION

I- Effect of different soil types on the fecundity of *A. craccivora*

The effect of the different soil types (loamy, sandy and mixture of both) on the broad bean plant, *V. faba* and the fecundity of *A. craccivora* was evaluated. Data obtained in table (1) show that the loamy soil was avourable for the growth of the broad bean plant and consequently had a significant effect on the fecundity of *A. craccivora* in comparison to the soil mixture of sandy and loamy. The number of nymphs laid on the bean plants cultivated in loamy soil was 54.0±3.9 nymphs/one branch of bean through 7 days, whereas in case of the soil mixture, it was 25.2±2.9 nymphs. The sandy soil was nearly the same as the loamy soil and there was no significant differences between them (Table 1).

Table (1): Effect of different soil types on the fecundity of Aphis craccivora

Type of soils	Number of nymphs/one branch after 7 days Mean ± S.E.
Loamy	54.00±3.90 a
Sandy	48.60±3.20 a
Mixture (loamy + sandy)	25.20±2.90 b
F-value	230.700**
L.S.D. at 5%	9.80

Means in column followed with the same letter are not significantly different at 0.5% level of probability.

II- Soil treatment

A- Effect of incubated and non-incubated humic acid of peanut residue on fecundity of *A. craccivora*

Results presented in table (2) indicate that there was no significant differences between fecundity of the adults of *A. craccivora* on the plant cultivated in the different 3 tested soil types either with incubated or non-incubated humic acid extract (50cm/Kg soil). The minimum number of nymphs was found on the broad bean grown in sandy soil treated with non-incubated humic acid, being 20.2 nymphs/one branch of plant. The organic fertilizer caused 33.7% reduction in number of nymphs compared to the control, when incubated humic acid was used. Percentage of reduction became 23.9% while the maximum number of nymphs/female was 31.4 on the plants grown in loamy soil treated with incubated humic acid. On the other hand, the fecundity of the aphids species was not affected when the soil mixture treated with incubated and non-incubated humic acid, it was 25.0 and 27.8 nymphs/female, respectively.

It can be concluded from the results that the sandy soil was not suitable for the growth of the bean plant which was preferable by *A. craccivora*.

Table (2): Effect of organic fertilizer (humic acid incubated and non-incubated) on the fecundity of *Aphis craccivora* at 5% (50cm/Kg soil)

Treated soil	Number of nymphs/plant after 7 days	% Reduction	Weight of plant	
			Before experiment	After experiment
Sandy (untreated)	27.0±0.7		2.5±0.01	2.6±0.05
Non-incubated	20.2±4.3	33.7	2.7±0.01	3.3±0.15
Incubated	21.8±1.5	23.9	2.2±0.19	2.3±0.20
Loamy (untreated)	30.6±3.1		2.5±0.05	2.8±0.23
Non-incubated	24.4±4.7	25.4	2.5±0.12	2.7±0.50
Incubated	31.4±2.9	- 2.6	2.5±0.70	3.2±0.36
Sandy and loamy (untreated)	26.6±1.1		2.7±0.01	2.9±0.20
Non-incubated	25.0±2.5	6.4	2.5±0.13	3.3±0.13
Incubated	27.8±1.6	- 4.3	2.6±0.16	2.7±0.22
F-value	1.340 ^{NS}		1.735 ^{NS}	

% Reduction = ((c-t)/c) * 100

The weight of the bean plant was not affected before and after infestation, these findings are in agreement with those of Riedell and Hesler (2000) who clarified that there were no significant interactions between nutrient solutions (organic fertlizer) and aphid treatments for shoot fresh weight. Generally, humic acid when incubated became more effective on soil than non-incubated, leading to the increase of pest populations on bean. The results obtained are in agreement with Sudhakar *et al.* (1998) and Sohail *et al.* (2003) who observed that the application of various organic fertilizers (farmyard manure and chemical fertilizer, N, K and P) did not show any significant reduction of the aphids and the incidence was insignificant. While Yardims and Edwards (2003) mentioned that the application of either organic

or chemical fertilizers increased *M. persicae* on tomatoes. Organic fertilizers might have the potential to reduce pest attacks in the long-term.

B- Effect of organic and chemical fertilizer for the loamy soil and plant on reproductivity of *A. craccivora*

Data obtained in table (3) show the effect of 7 treatments used in loamy soil namely: humic acid, urea, potassium sulphate, urea with potassium sulphate, humic acid + urea, humic acid + potassium sulphate, and humic acid + urea + potassium sulphate. The obtained results revealed that the different treatments significantly affected the reproductivity of *A. craccivora* after 7 and 10 days, especially in the soil treated with mixture of organic and chemical fertilizers, i.e., humic acid with urea + potassium sulphate at 5% concentration (50cm/Kg) for each fertilizer. The fecundity was increased significantly to 48.4, 48.5 and 46.8 nymphs/female, respectively comparing to the control (25.4 nymphs after 10 days). On the other hand, the effect of organic and chemical fertilizer, separately reduced the fecundity of the insect being 29.2, 29.4 and 26.0 nymphs/ female on the bean plants cultivated in the soil treated with humic acid, urea and potassium sulphate, respectively. They are nearly the same as the control (24.4 nymphs/female). The same results occurred with regard to the efficiency of the organic and chemical fertilizers after 7 days. The efficiency of the fertilizers on the aphid during 7 days is arranged descendingly as follows, potassium sulphate, urea, potassium sulphate + urea, humic acid + urea + potassium sulphate and humic acid + urea (Table 3).

It appears from the above results that the potassium sulphate had obvious effect on feeding and oviposition of the aphid as the fecundity was significantly decreased. These results are in agreement with the work of Havlickova and Smotankova (1998) who mentioned that the soil rich in (K) had low attractivity to the aphid *R. padi*. While (K) and (Mg) mixture are not likely to yield favourable responses (Toit *et al.*, 1999). Godfrey *et al.* (1999 & 2000) observed that the high levels of nitrogen fertilization appeared to promote cotton aphid, *A. gossypii* reproduction and build up of the aphid populations. Data in table (3) indicate that urea, when mixed with any fertilizer either humic acid or potassium sulphate, increased the attractivity of aphids and aphid reproduction, however, the damage caused by the pest was reduced. These data are in agreement with Fragoyiennis *et al.* (2001) who concluded that the source of available nitrogen did not affect foliar glycoalkaloid (GA) synthesis in potatoes as consequence did not affect its endogenous chemical defence against aphid. While Bado *et al.* (2002) indicated that mixed urea and vermicompost resulted to highest number of aphids. On the other hand, Chau *et al.* (2002) observed a insignificant effect of nitrogen (urea) on *A. gossypii* abundance, possibly due to delay reaction of the host plant to changes in nitrogen levels.

When the plants were sprayed with the different 7 treatments as shown in table (3), there was no significant differences between fecundity on the plants sprayed with different fertilizers and the control after 7 and 10 days. Significant differences was only observed between fecundity on sprayed plants with humic acid + urea + potassium sulphate comparing with the control after 10 days, they were 20.4 and 33.6, respectively (Table 3).

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Table (3): Effect of organic and chemical fertilizers on reproductivity of *Aphis craccivora* at 5% (50cm/Kg soil) (treated soils and plants)

Number of nymphs during	Treatment	Number of nymphs/one branch of plant									
		Mean ± S.E.									
		H	U	P	P + U	H + U	H + P	H+ U + P	Control	F-value	L.S.D. at 5%
7 days	Soil	24.6±2.4c	21.8±1.8c	20.4±1.5c	22.2±1.2c	45.4±3.5a	37.6±4.7ab	34.0±1.5b	23.2±3.0c	11.80**	7.9
	Plant	22.6±4.5a	19.0±1.1a	20.6±5.7a	32.2±3.8a	23.2±6.6a	23.0±4.2a	17.0±2.9a	28.8±3.5a	1.30 NS	---
10 days	Soil	29.2±4.6b	29.4±3.8b	25.0±2.3b	23.6±2.8a	48.4±3.8a	48.4±6.4a	46.8±2.9a	25.4±3.0b	8.90**	10.9
	Plant	24.2±2.0a	23.8±3.8a	21.0±6.1a	39.6±5.1a	27.4±7.5a	24.4±4.7a	20.4±3.9a	33.6±2.8a	1.70 NS	---

Means in rows followed with the same letter are not significantly different at 0.5% level of probability.

H= Humic acid U= Urea P = Potassium sulphate

In comparison between the fecundity of aphids on the plant sprayed with 7 treatments of fertilizers and soil treated with the same treatments for 7 and 10 days. Data obtained indicate that the difference among the fecundity of the aphid on the plants treated in the soil with humic acid + urea, humic acid + potassium sulphate and humic acid + urea + potassium sulphate were highly significant. They were (27.4, 48.4), (24.4, 48.4) and (20.4, 46.8), respectively after 10 days (Table 3).

These data may indicate that, when the organic and chemical fertilizers mixed with each other and used in the soil, thus induced the plant to be more powerful and resistant against the attack of the aphids although the fecundity of the pest increased and its damage reduced (Godase and Patel, 2001 and Riedell and Hesler, 2000).

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تأثير بعض الأسمدة العضوية والكيميائية على انتشار من الفول *Aphis craccivora*

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قسم آفات ووقاية النبات – المركز القومى للبحوث – الدقى – القاهرة – مصر

اشتملت هذه الدراسة على سبعة معاملات من السماد العضوى المستخلص من الفول السودانى المحضن وغير المحضن وبعض الأسمدة الكيميائية مثل اليوريا وسلفات البوتاسيوم، لمعرفة مدى تأثيرها على خصوبة انثى الطور اليافع لحشرة المن. حيث تمت زراعة الفول فى التربة الطفلية والتى تمت معاملتها بالأسمدة العضوية والكيميائية لمدة ٧ و ١٠ أيام.

وقد أظهرت النتائج أن الأسمدة العضوية عندما تكون محضنة تصبح أكثر تأثيرا على خصوبة الحشرة بالمقارنة بغير المحضنة، وعندما يستعمل كل من السماد العضوى والكيميائى كل على انفراد يصبح أقل تأثيرا بينما الخليط منهما يزيد من انتشار الحشرة