Egypt. J. Agric. Res., 77 (1), 1999

EFFECT OF PLANTING DATE AND CERTAIN WEATHER FACTORS ON THE POPULATION FLUCTUATIONS OF THREE INSECT PESTS INFESTING KIDNEY BEANS IN QUALYOBIA GOVERNORATE

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(Manuscript received 17 February 1997)

Abstract

Two field experiments were carried out in Qualyobia governorate during 1995 and 1996 seasons. Each experiment was planted in one feddan divided into four equal parts and cultivated by kindney beans in four different planting dates; during March, April, May and June. The number of eggs and nymphs of *Bemisia tabaci* (Hemiptera: Aleyrodidae), nymphs of *Aphis craccivora* (Hemiptera: Aphididae) and larvae of *Melanagromyza phaseoli* (Diptera: Melanagromyzidae) were recorded.

The population of the immature stages of *Bemisia tabaci* was lower on March planting, while on May planting of *Aphis craccivora* and *Melanagromyza phaseoli* populations recorded the lowest levels.

The effect of three weather factors; day maximum temperature, night minimum temperature and daily mean relative humidity on the population fluctuations of the three pests was studied. Minimum night temperature had a highly significant effect on the number of immature stages of *B.tabaci*. Minimum night temperature and maximum day temperature had a significant effect on *A.craccivora*. The three tested weather factors had insignificant effect on *M.phaseoli* population.

The combined effect of the three tested weather factors was low effect on *B.tabaci* eggs (1.7-11.8 % explained variance), little bit high and slightly higher on nymphs (5.83-23.7%).

The effect of the three tested weather factors was rather stronger on *A.craccivora* nymphs (44.83, 83.1, 44.85%) explained variance.

INTRODUCTION

Kidney bean, *Phaseolus vulgaris* (Fam. Leguminosae) is attacked by several destructive insect pests that cause great damage. Among these pests, dominate the whitefly *Bemisia tabaci* (Hemiptera: Aleyrodidae), the phaseolus fly *Melanagromyza phaseoli* (Diptera: Melanagromyzidae) and the legume aphid *Aphis craccivora* (Hemiptera: Aphididae) (Arx et al., 1983; Hamad et al., 1983 & 1984; Helaly et al., 1983; Megahed et al., 1983; Attia and El-Hamad, 1985; Butler et al., 1986; Baum-

gartner and Severinin, 1987; Baumgartner et al., 1986; Vianen et al., 1988; Metwally, 1993).

Therefore, it is important to find out appropriate methods for the management of the populations of these pests based on avoiding, as much as possible, using chemical pesticides and utilizing instead predictions on the relationship between population changes and weather conditions.

MATERIALS AND METHODS

Field experiments were carried out at El-Kanater El-Khayria, Qualyobia Governorate, during 1995 and 1996 seasons. For each season, an area of about one feddan was seeded with kindney beans and divided into 4 plots, each devoted for one planting date. In 1995, the planting dates were March 20, April 20, May 20, and June 20, while in 1996, planting dates were March 14, April 14, May 14, and June 14. Normal agricultural practices were practiced and no insecticides were applied. Weekly samples of 20 leaves were randomly picked-up from every plantation and examined for infestation with *Bemisia tabaci* (no. of eggs and nymphs), *Aphis craccivora* (no. of nymphs) and *Melanagromyza phaseoli* (no. of larvae). Population date was statistically analyzed by applying F-test.

The relationship between the population fluctuations of the three considered insects and certain weather factors, [day maximum temperature (D. max. T.), night minimum temperature (N.min. T.) and daily mean relative humidity (D.m. R.H.)] was calculated by applying the simple correlation and partial regression formula.

RESULTS AND DISCUSSION

I. Effect of Planting date, Table 1

1. I. *Bemisia tabaci*

In 1995, the number of *B.tabaci* eggs on March plantation ranged 61-434/20 leaves, with a mean of 188.1 eggs. This number increased gradually to a peak of 434 individuals/20 leaves by May 29, then tended to decrease thereafter. On April plantation, the number of eggs was comparatively higher and ranged 149-588, with a mean of 294.09 eggs/20 leaves. Egg population recorded a peak of 588/20 leaves by June 19. As for May and June plantations, the number of eggs was comparatively higher, with respective ranges of 118-369 and 261-694 and means of 287.7 and

Table 1. Mean numbers of *B.tabaci* eggs and nymphs, *Aphis craccivora* (nymphs) and *Melanagromyza phaseoli* (larvae)/20 leaves for 4 planting dates in 1995 and 1996

1995					1996				
Planting date	*B.tabaci*		*A.craccivora*	*M. phaseoli*	Planting date	*B.tabaci*		*A.craccivora*	*M. phaseoli*
	Eggs	Nymphs				Eggs	Nymphs		
March 20	188.10a	181.20a	258.20a	242.30a	March 14	101.23a	86.07a	204.23d	273.69c
April 20	294.09b	422.81b	26.45b	96.18b	April 14	156.45b	162.81b	37.54c	102.70b
May 20	287.70b	620.70d	1.90b	62.90b	May 14	327.80c	387.50c	2.40a	63.80a
June 20	448.45c	605.54c	19.56b	215.27a	June 14	458.77d	371.44c	12.77b	229.55d
F	8.35**	7.24**	44.56**	31.71**	F	32.11**	28.76**	9.99**	27.6**
$F_{0.05}$	2.85				$F_{0.05}$	2.85			
LSD 0.05	73.72	148.07	35.34	30.53	LSD 0.05	40.56	40.50	45.02	13.23

* Means followed by the same letter are insignificantly different from each other at 0.05 level of probability.

448.45/20 leaves. In 1996, population trend of *B.tabaci* was nearly similar to that of 1995. On March plantation, the number of eggs ranged 48-208/20 leaves with a mean of 101.23 eggs. Egg population increased gradually to a peak of 208 eggs/20 leaves by June 11. For April plantation, egg population ranged 60-392 eggs/20 leaves, with a mean of 156.45 eggs and a peak of 392 eggs/20 leaves reached by June 25. On May plantation, the number of eggs/20 leaves ranged 207-390, with a mean of 327.8 eggs/20 leaves and a peak of 390 eggs/20 leaves reached by July 8. The range of egg population on June plantation was 268-631 eggs/20 leaves, with a mean of 458.77 eggs and a peak of 631 eggs by July 15. Previous results indicate that in 1995 the period of maximum egg abundance fell between late May and about mid-August, whereas in 1996 this period occurred between mid-June and mid-July.

In 1995, the number of *B.tabaci* nymphs on March plantation ranged 61-442/ 20 leaves, with a mean of 181.2 nymphs giving a peak of 442 on May 29. This number increased gradually to a peak of 901 individual/20 leaves by June 12. On April plantation, the number of individuals/20 leaves ranged 163 to 901, with a mean of 422.81. The number of nymphs was comparatively higher on May plantation (329-1182, with a mean of 620.7 individuals/20 leaves), while on June plantation the number of nymphs ranged 143-1047, with a mean of 605.54 individuals/20 leaves and recorded a peak of 1047 individuals/20 leaves by August 28. In 1996, the population level of *B.tabaci* was relatively low. On March plantation, the number of nymphs ranged 35-162/20 leaves, with a mean of 86.07 individuals. It increased gradually to a peak of 271 nymphs/20 leaves by June 11. On April plantation, population ranged 44-271, with a mean of 162.81 individuals/20 leaves. For May plantation, nymphal population ranged 241-542/20 leaves, with a mean of 387.5 nymphs and a peak of 542 nymphs/20 leaves was reached by July 8. On June plantation, the number of nymphs/20 leaves ranged 208-639, with a mean of 371.44 and a peak of 369 nymphs/20 leaves was recorded by August 20. Previous results indicate that during both seasons of this investigation the period of maximum nymph abundance of *B.tabaci* fell between May 20 and June 20.

Statistical analysis revealed that planting date of kidney bean significantly affected *B.tabaci* egg and nymphal populations in both 1995 and 1996. Late May and late June plantations received the highest population of eggs and nymphs, while late March and late April plantations were subject to comparatively lower populations. Such results suggest that it is recommended to sow kidney bean throughout the second half of March to avoid high whitefly infestation. Plantations sown during May and June are expected to suffer high whitefly attacks.

I.2. *Aphis craccivora*

In 1995, March 20 plantation received a mean number of 258.6 individuals of *A.craccivora*/20 leaves. This number increased gradually to a peak of 388 individuals/20 leaves by May 1, then the population tended to decrease thereafter. On April plantation, the number of individuals deceased sharply and ranged 0-121, with a mean of 26.45 individuals/20 leaves. As for May 20 plantation, kidney beans were almost free of *A.craccivora* infestation giving a mean of 1.9 individuals/20 leaves. On June plantation, population increased to 0-91, with a mean of 19.56 individuals/20 leaves. In 1996, population trend was nearly similar to that of 1995. On March plantation, the number of individuals/20 leaves was 204.23, with a range of 15-509. Population decreased on April plantation (0-16 individuals/20 leaves, with a mean of 37.54). On May and June plantations, the numbers of *A.craccivora* were relatively low, with means of 2.40 and 12.77 individuals/20 leaves, respectively. Previous results indicate that, in 1995, the period of maximum population abundance of *A.craccivora* fell between March 20 and May 20, whereas in 1996 this period occurred between March 14 and May 14.

Statistical analysis revealed highly significant differences in *A.craccivora* population on the four tested plantations during both years of investigation. Results emphasized that planting date of kidney beans significantly affected the rate of infestation with *A.craccivora* during both seasons. March plantations received the highest aphid population, while those sown during May and June were subject to the lowest rates of infestation. The above mentioned data lead to the conclusion that planting kidney beans to avoid as much as possible *A.craccivora* attacks should take place during May.

I.3. *Melanagromyza phaseoli*

In 1995, the number of larvae of *Melanagromyza phaseoli* on March *plantation* ranged 124-342/20 leaves, with a mean of 243.3 larvae. This number increased gradually to a peak of 342 larvae/20 leaves by June 5, then tended to decrease thereafter. On April plantation, the number of larvae was comparatively low and ranged 32 to 139, with a mean of 96.18 larvae/20 leaves. The number of larvae recorded its lowest level on May plantation (a mean of 62.0/20 leaves and a range of 31-112 larvae/20 leaves), while it was comparatively high (120-297larvae/20 leaves, with a mean of 215.27 larvae/20 leaves) on June plantation. In 1966, the trend of infestation was nearly similar to that of 1995. On March plantation, the

number of larvae was relatively high ranging 161 to 363/20 leaves, with a mean of 273.69 larvae, and a peak of 363 larvae on May 13.This number decreased during April plantation (8-162 larvae/20 leaves, with a mean of 102.70 larvae). On May plantation the number of larvae/20 leaves ranged 31-111, with a mean of 63-80 larvae, and a peak of 111 larvae/20 leaves reached by June 18. The number of larvae on June plantation ranged 119-449 larvae/20 leaves, with a mean of 229.55 larvae and a peak of 449 larvae on September 4. Statistical analysis revealed highly significant differences between the number of larvae on the four tested plantations. The period of maximum larval abundance of *M.phaseoli* on kindney beans fell between late March and late June. April and May plantations received relatively low larval populations.

II. Effect of three main weather factors on population fluctuation

II.I. The immature stages of *Bemisia tabaci*

Table 2 and 3 give the simple correlation and partial regression values for the effect of the 3 considered weather factors on the egg and nymphal populations of *B.tabaci* on kidney beans during 1995 and 1996.

Table 2. Simple correlation and partial regression coefficient for the effect of three weather factors on the population fluctuation of *Bemisia tabaci* eggs on kidney beans during 1995 and 1996 seasons.

Season	Factor	r	b	t	EV%	F
1995	N.min.T.	0.633	26.32	1161.6	11.70%	1.31
	D.max.T.	0.504	6.97	52640		
	D.m.R.H.	0.313	5.84	9733.3		
1996	N.min.T.	0.601*	-10.36	-9961.5	16.17%	0.92
	D.max.T.	0.811*	29.47	35939.02		
	D.m.R.H.	0.413	6.14	32315.7		

In 1995, the effect of the three weather factors on egg population was insignificant. In 1996, N.min. T. and D.max. T. expressed a significant positive effect on egg population, whereas that of D.m.R.H. was insignificant. The simultaneous effect of the three factors on changes of egg population was generally insignificant and approximately 12-16% of the variance was attributed to them. As for nymphal popu-

lation, the effect of the N.min. T. was positive and significant in both 1995 and 1996. The effect of D.max.T. on nymphal population was irregular, being insignificant in 1995 significantly positive in 1996. As in the case of egg population, the effect of D.m.R.H. on nymphs was insignificantly positive during both years of investigation. Nevertheless, the effect of the three factors simultaneously on the population fluctuation of nymphs was generally insignificant, but rather stronger than it on egg population. The variance explained by the three factors on changes of nymphal population was 24-26%.

Table 3. Simple correlation and partial regression coefficient for the effect of three weather factors on the population fluctuation of *Bemisia tabaci* nymphs on kidney beans during 1995 and 1996.

Season	Factor	r	b	t	EV%	F
1995	N.min.T.	0.640*	36.45	85238	23.70%	3.11
	D.max.T.	0.475	35.80	98513.5		
	D.m.R.H.	0.483	23.46	55857.1		
1996	N.min.T.	0.628*	7.81	8135.4	25.63%	0.92
	D.max.T.	0.788*	16.80	24000		
	D.m.R.H.	0.341	-7.9	-46470.5		

II.2. The nymphs of *Aphis craccivora*

Table 4 gives the simple correlation and partial regression values for the effect of three weather factors on the nymphal population of *A.craccivora* on four kidney bean plantations during 1995 and 1996. In 1995, the effect of the three weather factors was significant. The D.max.T. expressed a significant negative effect. N.min.T. and D.m.R.H. were of insignificant effect. In 1996, the D.max.T. and N.min.T. expressed a significant negative effect, while the effect of D.m.R.H. was insignificant. The simultaneous effect of the three factors on changes of *A.craccivora* population was generally significant and 44.83%-61.70% of the variance in population was attributed to the influence of the three above mentioned factors.

II.3. The larvae of *Melanagromyza phaseoli*

Table 5 gives the simple correlation and partial regression values for the ef-

fect of the 3 tested weather factors on the larval population of *M.phaseoli* during 1995 and 1996. For both years of investigation, N.min.T.and D.m.R.H. were of insignificant effect. The effect of D.max.T.was significant in 1995 but insignificant in 1996. The percentage of variance explained by the three tested factors were slight and insignificant (5.22% and 7.14% in 1995 and 1996, respectively). This refers that these three factors were almost around the optimum for M.*phaseoli* larvae.

CONCLUSION

Results suggest that planting kidney bean during the second half of March may lead to avoiding high infestations with the immature stages of the whitefly *Bemisia tabaci*, while May and June plantations are subject to high populations of that pest. Meanwhile, April, May and June kidney bean plantations are subject to low infestation with aphids *Aphis craccivora* and phaseolus fly, *Melanagromyza phaseoli*. March plantations suffer high attacks by both pests. Day maximum temperature, night minimum temperature and daily mean relative humidity expressed a low effect on the changes of *B.tabaci* populations on kidney bean plantations (explained variance of 11.7-16.17% and 23.7-25.13% for egg and nymphal populations). 44.83-83.61% of the changes in the *A.craccivora* nymphal population were attributed to the fluctuation of the three considered weather factors. The same factors expressed a slight insignificant effect on the population fluctuations of *Melanagromyza phaseoli* larvae (5.22%, 7.14%).

Table 4. Simple correlation and partial regression coefficient for the effect of three weather factors on the population fluctuation of *Aphis craccivora* on kidney beans during 1995 and 1996 seasons.

Season	Factor	r	b	t	EV%	F
1995	N.min.T.	-0.954	-49.33	972.4	61.70 %	51.02
	D.max.T.	-0.861*	2.82	18973		
	D.m.R.H.	-0.060	2.07	713.7		
1996	N.min.T.	-0.904*	22.62	13305.8	44.83 %	8.12
	D.max.T.	-0.942*	-49.11	-35078.5		
	D.m.R.H.	0.128	8.33	2776.6		

Table 5. Simple correlation and partial regression coefficient for the effect of three weather factors on the population fluctuation of *M.phaseoli* on kidney beans during 1995 and 1996 seasons.

Season	Factor	r	b	t	EV%	F
1995	N.min.T.	-0.574	-16.54	5320	5.22 %	0.55
	D.max.T.	-0.535*	5.32	-16540		
	D.m.R.H.	0.086	2.31	2310		
1996	N.min.T.	-0.187	52.95	44125	7.14 %	0.76
	D.max.T.	-0.394	-47.85	-47850		
	D.m.R.H.	0.197	5.81	2526.08		

REFERENCES

1 . Arx, R.Von, J. Baumgartner and V. Delucchi. 1983. A model to simulate the population dynamics of *Bemisia tabaci* (Gennadius) (Diptera, Aleyrodidae) on cotton in the Sudan Gezira. Z.ang. Ent., 96:341-361.

2 . Attia, A.A. and M.A. El-Hamaky. 1985. A survey of the different species of aphids attacking some cucurbit vegetables. Bull. Soc. ent. Egypt, 65:373-381.

3 . Baumgartner, J. and M.Severini. 1987. Microclimate and arthropod phenologies. The leafminer *Phyllonorycter blancardella* F. (Lep.) as an example in agrometerology. International Conference on Agrometeorology, Cesena, 1987.

4 . Baumgartner, J., V.A.R.Von Delucchi and D.Rubli. 1986. Whitefly (*Bemisia tabaci*) Genn., (Diptera, Aleyrodidae) infestation patterns as influenced by cotton weather: Hypothesis testing by using simulation models. Agric., Ecosys, & Environ., 17:49-59 .

5 . Butler, G.D., T.J. Henneberry, and W.D.Hutchison. 1986. Biology, sampling and population dynamics of *Bemisia tabaci.* In Agricultural Zoology Reviews, Vol. 1, Intercept, Winborne, England, 387 pp.

6 . Hamad, N.E.F. M.H. Hilmy and Attia M.M.El-Sheikh. 1983. Time of flight of certain pyralid species in relation to weather factors as measured by a flight trap at Quena. Bull. Soc. Ent. Egypt, 64:61-69.

7. Hamad, N.E.F. M.H. Hilmy and Attia M.M.El-Sheikh. 1984. Studies on the effect of weather conditions on the activity of certain pyralid species. Bull. Soc. Ent. Egypt, 65:1-12.

8. Helaly, M.M., A.E. Ibrahim and M.R.A. Saleh. 1983. Fluctuations of population densities of *Empoasca* sp., *Aphis craccivora* Koch and *Tetranychus arabicus* Attiah attacking cowpea plants at Zagazig, Egypt. Bull. Soc. Ent. Egypt. 64:35-43.

9. Megahed, M.M., S. El-Nagar and M.A.K. El-Sheikh. 1983. Seasonal abundance of aphids on cruciferous crops in Giza, Egypt. Bull. Soc. ent. Egypt. 64:29-34.

10. Metwally, S.A.G. 1993. The effect of planting date and certain climatic factors on the fluctuation of *Etiella zinckenella* Treit. infesting cowpea in Qualyobia Governorate. Bull. Soc. ent. Egypt. 72:230-234.

11. Vianen, A.Van, R.M. Xu and J.C. Van. Lentern. 1988. The influence of whitefly densities and temperature on the horizontal dispersal of whiteflies. J. Appl. Entomol., 105:436-449.

تأثير ميعاد الزراعة وبعض العوامل الجوية على تذبذبات تعداد ثلاثة آفات حشرية تصيب نباتات الفاصوليا بمحافظة القليوبية

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أجريت تجربتان حقليتان بمحافظة القليوبية خلال موسمى ١٩٩٥ ، ١٩٩٦ وغطت كل منها مساحة قدرها فدان، قسم إلى ٤ أجزاء متساوية زرعت بالفاصوليا فى ٤ مواعيد خلال أشهر مارس وإبريل ومايو ويونيو من كل عام، وأخذت عينات عشوائية أسبوعيا من النباتات وسجل تعداد ماعليها من بيض وحوريات الذبابة البيضاء *Bemisia tabaci* وحوريات المن *Aphs craccivora* ويرقات ذبابة الفاصوليا *Melanagromyza phaseoli* وبينت النتائج أن تعداد الأطوار غير الكاملة للذبابة البيضاء كان أقل مايمكن على العروة المنزرعة خلال شهر مارس، فى حين كان أقل تعداد لحوريات المن وذبابة الفاصوليا على العروات المختلفة خلال شهر مايو.

كما درس تأثير ثلاثة عوامل جوية هى درجة الحرارة القصوى للنهار، درجة الحرارة الدنيا لليل والمتوسط اليومى للرطوبة النسبية على تعداد الأفات الثلاثة. وجد أن لدرجة الحرارة الدنيا والقصوى تأثير معنوى على تعداد حوريات من البقوليات. كما وجد أن تأثير العوامل الجوية الثلاثة المختبرة على تعداد يرقات ذبابة الفاصوليا غير معنوى، مما يحتمل معه وقوع هذه المتوسطات داخل المدى المثالى لنشاط الآفة فى تلك المنطقة. وكان التأثير المشترك للعوامل الجوية الثلاثة بسيطا على تعداد بيض الذبابة البيضاء (١,٧ – ١١,٨٪) وأكبر نسبيا على تعداد حورياتها (٥,٨٣٪ ٢٣,٧٪)، بينما كان للعوامل نفسها تأثير كبير على تعداد حوريات من البقوليات (٤٤,٨٣ و ٨٣,١ و ٤٤,٨٥٪).