JUVENILE HORMONE MIMIC AND PLANT-DERIVED OILS AS CONTROL AGENTS AGAINST WHITEFLY, *BEMISIA TABACI* (GENN.), ON COTTON

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Abstract

Two field experiments were conducted during 1996 and 1997 cotton seasons to evaluate the initial and bio-residual eficacy of a number of chemicals including: pyripoxyfen (a juvenil hormone mimic), primbet (a mixture of fenpropathrin / pyriproxyfan) and four plant - derived oils (cotton seed oil, sunflower oil, corn oil and linseed oil) against the adult and immature stages of whitefly *Bemisia tabaci* (Genn.). Among the more effective compounds, primbet was the only one that induced over 70% reduction in population of whitefly during a period of two weeks. All the tested compounds had moderate to low effect as the individuals of the pest after spray were capable to renew the infestation rapidly and caused serious damage to cotton plants.

INTRODUCTION

The whitefly, *Bemisia tabaci* (Genn.) has been a pest of increasing importance on cotton. Damage to cotton resulting in significant losses may occur from feeding and contamination of lint with honeydew that reduces cotton lint grade.

The plant - derived oils and juvenile hormone minic (JHM) are considered to be new promising approaches for suppressing the population of certain pests. Investigations have continuously been done to control whitefly using conventional insecticides, insect growth regulators or plant-derived oils (Broza et al., 1988; Butler et al., 1988., Butler et al., 1989; Butler et al., 1991; Akey et al., 1992; Salem and Khalafalla, 1992; Watson, 1992; Ishaaya et al., 1993; El-Kabbany, 1994; El-Khawalka et al., 1997).

Hence, this work was conducted to investigate the effect of plant-derived oils and JHM on the population of whitefly in cotton fields.

MATERIALS AND METHODS

The experiments were conducted at Sakha Agricultural Research Station to

evaluate the effect of certain insecticides and commercial plant-derived oils on reducing the population of whitefly in cotton fields during 1996 and 1997 seasons. The fields were cultivated with Giza 77 cotton variety and arranged in complete randomized blocks with four replicates for each treatment. Each replicate was 1/48 of a feddan.

The chemicals used and their rates of application were as follows:

1. Insecticides

1.1. Primbet, EC: a mixture of fenpropathrin 15% and pyripoxyfen 5% at 300 ml/fed.

Fenpropathrin (Meothrin) = (RS)-α-cyano-3-phenoxybenzyl 2,2,3,3,-tetramethyl cyclopropanecarboxylate.

Pyriproxyfen (Admiral): a juvenile hormone mimic (JHM) = 4-phenoxyphenyl (RS)-2-(2-pyridyloxy) propyl ether.

1.2. Pyriproxyfen, EC, 10% at 300 ml/fed.

2. Plant -derived oils

The following commercial plant-derived oils were used at rate of 50 ml/L:

2.1. Oleic-linoleic oils: namely, cottonseed oil, sunflower oil and corn oil.

2.2. Linolenic acid oils: namely, linseed oil.

These chemicals were sprayed once; on August 8, 1996 and August 17, 1997. A knapsack sprayer with one nozzle (model CP3) was used to spray the chemical dilutions. The volume of spray solution was 200 liter/feddan. Triton X - 100 (an emulsifying agent) was used at concentration of 0.075% in the case of oil treatments to insure the uniform distribution of the dilution on the treated surface.

Samples of 25 cotton leaves were collected at random from the inner rows of each plot to estimate the population counts of whitefly. The leaves were collected early in the morning (2, 1 and 2 leaves/plant from upper, middle and lower level of the plant, respectively). The upper and lower surfaces of the leaf were inspected immediately in the field and the number of whitefly (adults) were recorded. The same samples were taken to the laboratory to count the number of alive immature

stages of whitefly using binocular microscope.

Sampling and counting were made just before treatment, then after 2, 5.8, 11 and 14 days of spraying. Percent reduction in infestation was estimated, using Henderson and Tilton (1955) equation, to determine the initial effect (after 2 days of spraying) and the residual effect (after the next dates) of the tested compounds. Also, the toxicity index was calculated according to the method of Sun (1950), to compare the relative toxicity of the tested compounds.

RESULTS AND DISCUSSION

Data presented in Table 1 show the population density of the adult and immature stages of whitefly, *B.tabaci*, infesting cotton before spraying with certain toxicants belong to different chemical groups during 1996 and 1997 seasons. The mean number of adults/25 leaves before treatment ranged between 89 and 156.5 individuals during 1996 season, and 373 and 614.75 during 1997 season. The corresponding ranges of immature stages were 134.5 to 184.75 and 592.75 to 743.25.

The initial activity (during the first two days after spraying) and the residual effect (during the next 12 days post treatment) of the tested chemicals against adult and immature stages are also given in Table 1. The results of the first season (1996) indicated that tested toxicants induced different levels of reduction in the population of adult and immature stages of whitefly. Concerning the initial activity on adult stage, cottonseed oil was the most effective toxicant giving 82.7% reduction in infestation. The other toxicants induced 73.3 to 8.5% reduction and could be arranged descendingly according to their initial effect as follows: primbet (73.3%), sunflower oil (70.2%), linseed oil (57.9%), corn oil (54.5%) and pyriproxfen (8.5%). The residual activity of primbet surpassed all the tested chemicals representing 85.4% reduction in adult population. The other chemicals caused 60.5 to 19.0% reduction and could be arranged descendingly according to their residual effect as follows: pyriproxfen (60.5%), cottonseed oil (37.4%), corn oil (29.5%), sunflower oil (27.7%) and linseed oil (19.0%).

Also, data in Table 1 show the initial and residual effect of the tested chemicals on the population density of immature stages in 1996 season. Corn oil proved to be the most efficient chemical recording 53.1% initial reduction, while pyriproxfen displayed the least efficient one (28.5% reduction). The descending order of the initial activity of the rest toxicants was primbet (52.3%), cottonseed oil (49.9%),

linseed oil (46.4%) and sunflower oil (40.8%). Concerning the residual activity of the aforementioned toxicants, pyriproxfen and primbet showed the longest residual effect recording 72.9% and 64.3% reduction in immature stages population, while the oil chemicals recorded 36.3 to 20.9% reduction.

Considering the initial activity of the tested toxicants during 1997 season, cottonseed oil proved to be the superior compound against adult stage of whitefly, while primbet recorded the highest residual effect. The corresponding values were 79.5% and 90.8% reduction in population. Such toxicants could be arranged descendingly according to the initial activity against the adult stage as follows: cottonseed oil (79.5%), primbet (76.0%), sunflower oil (75.7%), corn oil (71.2%), linseed oil (70.3%) and pyriproxfen (26.4%). The descending order of residual activity against adult was: primbet (90.8%), pyriproxfen (74.7%), cottonseed oil (41.1%), sunflower oil (39.8%), linseed oil (30.5%) and corn oil (26.8%).

Regarding the efficacy against immature stages during 1997 season, corn oil recorded the highest initial reduction (67.0%) followed descendingly by primbet (58.4%), cottonseed oil (56.5%), linseed oil (35.4%), sunflower oil (32.4%) and pyriproxfen (25.1% reduction). Meanwhile, pyriproxfen recorded the highest residual activity (79.5% reduction) followed descendingly by primbet (65.9%), corn oil (40.1%), cottonseed oil (39.8%), linseed oil (21.2%) and sunflower oil (20.2%).

Data presented in Table 1 show also the combined initial and bioresidual activity of the tested chemicals against adult and immature stages of whiteffly in 1996 and 1997 seasons. The tested chemicals could be arranged descendingly according to the combined effect as follows: primbet (70.8%), cottonseed oil (52.9%), pyriproxfen (47.0%), corn oil (46.6%), sunflower oil (41.2%) and linseed oil (37.7% reduction). Among all the tested chemicals, primbet was the only one that induced over 70% reduction in population of adult and immature stages during a period of two weeks and could be recommended to reduce the population of whitefly in cotton fields.

The values of the toxicity index presented in Table 2 indicate that cottonseed oil induced the highest initial effect against the adult stage followed closely by primbet (92.11% as toxic as cottonseed oil). On the other hand, primbet recorded the highest residual effect against the adult stage and occupied the second class of initial effect against immature stages after corn oil, recording 92.18% as toxic as corn oil. Also, primbet occupied the second class of residual effect against immature

Table. 1. Percent reduction in the population of the whitefly, *B.tabaci* infesting cotton plants during 1996 and 1997 seasons.

Treatments	Adult stage								Immature stages								Combined effect
	Pretreatment population		Percent reduction						Pretreatment population		* Percent reduction						
			Initial effect			Residual effect					Initial effect			Residual effect			
	1996	1997	1996	1997	Mean	1996	1997	Mean	1996	1997	1996	1997	Mean	1996	1997	Mean	
1. Primbet	106	602	73.3 b	76.0 b	74.7	85.4 a	90.8 a	88.1	134.50	714	52.3 a	58.4 b	55.4	64.3 b	65.9 b	65.1	70.8
2. Pyriproxfen	94.50	614.75	8.5 d	26.4 d	17.5	60.5 b	74.7 b	67.6	144	685.50	28.5 c	25.1 e	26.8	72.9 a	79.5 a	76.2	47.0
3. Cottonseed oil	131.25	453.50	82.7 a	79.5 a	81.1	37.4 c	41.1 c	39.3	156.25	743.25	49.9 a	56.5 b	53.2	36.3 c	39.8 c	38.1	52.9
4. Sunflower oil	120.50	373	70.2 bc	75.7 b	73.0	27.7 cd	39.8 c	33.8	184.75	624	40.8 b	32.4 d	36.6	22.2 d	20.2 d	21.2	41.2
5. Corn oil	89	380.25	54.5 c	71.2 c	62.9	29.5 cd	26.8 d	28.2	161.50	717.50	53.1 a	67.0 a	60.1	30.4 c	40.1 c	35.3	46.6
6. Linseed oil	125.75	408	57.9 c	70.3 c	64.1	19.0 d	30.5 d	24.8	173	592.75	46.4 ab	35.4 c	40.9	20.9 d	21.2 d	21.1	37.7
7. Control	156.50	605.50	-	-	-	-	-	-	179.75	723.50	-	-	-	-	-	-	-

By Duncan's multiple range test, means followed by the same letter are not significantly different at 5% level.

* Average of 4 sampling dates.

stages following pyriproxfen recording 85.43% as toxic as pyriproxfen. Considering the combined effect, primbet induced the highest toxicity index. Such results are in agreement with those of Table 1 and indicated the superiority of primbet in reducing the population of whitefly.

In general, it should be mentioned that all the tested compounds have moderate to low effect on whitefly population as the survived individuals of the pest are capable to renew the infestation rapidly and cause serious damage to cotton plants.

Table. 2. The toxicity index of the tested chemicals against *B.tabaci.*

Compounds	Toxicity index*				
	Adult stage		Immature stages		
	Initial effect	Residual effect	Initial effect	Residual effect	Combined effect
1. Primbet	92.11	100.00	92.18	85.43	100.00
2. Pyriproxfen	21.58	76.73	44.59	100.00	66.38
3. Cottonseed oil	100.00	44.61	88.52	50.00	74.72
4. Sunflower oil	90.01	38.37	60.90	27.82	58.19
5. Corn oil	77.56	32.01	100.00	46.33	65.82
6. Linseed oil	79.04	28.15	68.05	27.69	53.25

* Based on the average of the two seasons.

REFERENCES

1 . Akey D.H., C.C. Chu and T.J. Henneberry. 1992. Efficacy of the insect growth regulator, buprofezin and the insecticide, amitraz against the sweetpotato whitefly on cotton at Maricopa, AZ, 1991. Cotton, A University of arizona Report. p-91 : 165-170.

2 . Broza, M., G.D. Butler, Jr. and T.J. Henneberry. 1988. Cottonseed oil for control of *Bemisia tabaci* on cotton. Proc. Beltwide Cotton Prod. Res. Conf. : 301.

3 . Butler, G.D., Jr., D.L. Coudriet and T.J. Henneberry. 1988. Toxicity and repellency of soybean and cottonseed oils to the sweetpotato whitefly and the cotton aphid on cotton in greenhouse studies. Southwest. Entomol. 13 (2): 81-86.

4 . Butler, G.D., Jr., D.L. Coudriet and T.J. Henneberry. 1989. Sweetpotato whitefly: host plant preference and repellent effect of plant-derived oils on cotton, squash, lettuce and cantaloupe. Southwest, Entomol. 14 (1): 9-16.

5 . Butler, G.D., Jr., S.N. Puri and T.J. Henneberry. 1991. Plant-derived oil and detergent solutions as control agents for *Bemisia tabaci* and *Aphis gossypii* on cotton. Southwest. Entomol. 16 (4): 331-337.

6 . El-Kabbany, S.M. 1994. Comparative studies on the efficacy of some insecticides on cotton whitefly, *Bemisia tabaci* (Genn.), and their side effects on non-target soil microorganisms. J. Agric. Sci. Mansoura Univ. 19 (4): 1569-1577.

7. El-Khawalka, M.H.M., M.A. El-Bessomy, H.M. El-Maghraby and H.I.H. Omar. 1997. Effect of the insect growth regulator Admiral on the different stages of the whitefly infesting tomato plants. Egypt. J. Agric. Res., 75 (2): 377-382.

8. Henderson, C.F. and E.W. Tilton. 1955. Tests with acaricides against the brown wheat mite. J. Econ. Entomol. 48:157-161.

9. Ishaaya, I., Z. Mendelson and A.R. Horowitz. 1993. Toxicity and growth suppression exerted by diafenthiuron in the sweetpotato whitefly, *Bemisia tabaci*. Phytoparasitica, 21 (3): 199-204. [C.F. Entomol. Abstracts, 25 (4): 3427].

10. Salem, R.M. and E.M.E. Khalafalla. 1992. Initial and residual activity of certain pesticides against the whitefly. *Bemisia tabaci* (Genn.) infesting cotton. Egypt. J. Appl. Sci. 7 (7): 702-711.

11. Sun, Y.P. 1950. Toxicity index-an improved method of comparing the relative toxicity of insecticides. J. Econ. Entomol. 43: 45-53.

12. Watson, T.F. 1992. Insecticidal control of the sweetpotato whitefly in cotton. Cotton, A University of Arizona Report. p-91: 146-154.

مشابهات هرمون الحداثة والزيوت النباتية كوسائل لمكافحة ذبابة القطن البيضاء

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أجريت تجربتان حقليتان خلال موسمي ١٩٩٦ ، ١٩٩٧ في المزرعة البحثية لمحطة البحوث الزراعية بسخا لدراسة فعالية عدد من المركبات الكيمائية من حيث تأثيرها علي الأطوار الكاملة و غير الكاملة للذبابة البيضاء في حقول القطن. أشتملت مجموعة المركبات المختبرة علي مركب بيريبروكسفين (أحد مشابهات هرمون الحداثة) ومركب برمبيت (مخلوط من مشابه الهرمون مع فنبروباثرين) علاوة علي اربع من الزيوت النباتية وهي زيت بذرة القطن وزيت عباد الشمس وزيت الذرة وزيت بذرة الكتان.

أوضحت النتائج التفوق النسبي لمركب برمبيت علي باقي المواد المختبرة حيث كان المركب الوحيد الذي اعطي نسبة خفض في تعداد الحشرة تزيد قليلا عن ٧٠٪ خلال فترة اسبوعين من الرش. وقد اظهرت النتائج ان جميع المواد المختبرة لم تعط سوي تأثير متوسط أو منخفض حيث كان لافراد الحشرة القدرة علي إصابة نباتات القطن مرة أخري وبسرعة مسببة اضرارا بليغة.