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Joint Action of Cypermethrin Insecticide and Some Natural Control Agents Against Cereals Aphids and Their predators.

By

A.A.M. Thabet
Plant Protection Department, Faculty of Agriculture.
Sana'a University, Republic of Yemen
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ABSTRACT

Maize and Sorghum aphid , *Rhopalosiphum padi* (L.) and the Russian Wheat aphid, *Diuraphis noxia* (K.). are serious pest for several grain cereals in Yemen . The natural enemies of the Coccinellidae, *Coccinella septrmpunctata* (L.) and *Coccinella undecimpunctata* (H.) , are insect predators that can play an important role in the dynamics of aphids populations. The toxicity of the chemical insecticide Cypermethrin ; Neem Azal , T.S. 5% (*Azadirachtin indica*), and *Bacillus thuringiensis* (H-14) were evaluated separately against the adult aphids and their predators. The results indicated that cypermethrin was the most effective insecticide tested against the adult of *D. noxia* (K.) aphid followed by Neem Azal T.S. 5% and *B. thuringiensis, B. t* (H-14). The LC50 values were 1.10, 69.20 and 208.82 ppm, respectively. While the adult of *R padi* (L.) was more toloarant, where the LC50 values were11.61 , 250.10 and 286.31 ppm, respectively. Cypermethrin was the most toxic insecticide tested against the adult stage of *C. undecimpunctata* and *C. septermpunctata* predators. The LC50 values of the three insecticides were 30.00, 442.32 , and 780.11ppm,respectively against *C. undecimpunctata*, while it was 35.12, 523.86 and 614.33 ppm, respectively against the adult of *C. septermpunctata predator*. The results indicated that the combinations of the *B. t.* (H-4) at LC25 with the LC20 , LC30 of the cypermethrin resulted in potentiation or additive

effects when , were tested against the adult stage of *D. noxia* (k.) and *R. padi* (L.).

In conclusion , with cypermethrin combinations , the insecticide concentration can be reduced to a level which would minimize the environmental pollution and spare predators. Integration of biological and chemical insecticides, thus achieved in the present work, is one way of minimizing the environmental hazards of chemical pesticides while maintaining the efficient control of the insects pest , and pastoponing the onest of pest resistance due to the decreased chemical pressure.

INTRODUCTION

Wheat, *Triticum aestivum* (L.) is on of the extensively cultivated cereal crops in Yemen. Several aphid species attack the plants in the field , particularly the Russian aphid *Diuraphis noxia* (K.) and Maize and Sorghum aphid, *Rhopalosiphus padi* (L.) . They cause substantial losses in the yeild due to the direct effects of its feeding and as vector of several plant virus diseases (Tantawi , 1985). The honeydew arrests both pollen and dust, then reduces photosynthesis in the host plant that may result in lower yeild and poor grain quality (Du Toit , 1990).

The Coccinellidae are insect predators found in many crops of economic importance such as maize (Wright and Laing, 1980; Coderre and Tourneur, 1988) , Cereals (Shade, *et.al*. 1970) . The presence of predators and insects pathogens can play a large role in the dynamics of aphid populations. Hopper *et. al.* (1995) showed that complex of natural enemies has pronounced impact on limitation of *D. noxia* in wheat fields. However, use of some chemical pesticides has resulted in environmental contamination ,Frank, *et. al.* 1990), negative effects on non-target organisms (Mulla and Mian , 1981, Gary and Mussen 1984) and the development of resistance (Brattsten *et. al*. 1986 and Tabashnik *et . al* 1987. Consequently , interest in alternatives to synthetic pesticides has greatly increased in recent years. Natural pesticides, particularly plant derived chemicals, have received considerable attention one of the most promising plant in Yemen is Neem trees, *Azadirachta indica*. Neem extract exhibits extremely low acute mammalian toxicity (Larson , 1987), yet, it is very effective as control agent for many insect pests (Schmutterer , 1990).

Aphids are economically important pests that are difficult to control because of their mobility, to many synthetic pesticides (Van Lenteren 1990). Previous studies have indicated that Neem – based insecticide can be effective in controlling aphids (Patel and Srivastava, 1989). The use of microbial agents in combination with chemical insecticides has recently agreat deal of attention (Sutter *et. al*. 1971; Thabet , 1990, 1998 a , b).

MATERIALS AND METHODS

A- Maintenance of Aphids and Predators .

The Russian wheat aphid *D. noxia* (K.) and The Maize and Sorghum aphid *R. padi* (K.) were collected from the wheat and Maize in the Research Farm , Faculty of Agriculture, Sana'a University and used at the same day of collection without rearing in the laboratory .

Adults of two coccinellid species includng *Coccinella undecimpunctata* and *Coccinella septempunctata* collected from the same Farm and reared on Russian wheat aphid and kept under laboratory conditions.

B- Insecticids Tested :

1- Cypermethrin insecticide (Fenom 20% E .C) was purchased from (Shell. Co., England.) .
2- The bacteria , *Bacillus thuringiensis B.t* (H-14) was kindly obtained as an experimental materals (100% a.i) from Prof. Dr. R. Saleh Department of Entomology , Faculty of Agriculture University of Tanta, Egypt,.
3- Neem Azal , T.S. 5%- (Azadirachtin) , India.

C- Preparation , infestation and spraying of wheat plants :

Wheat was sowed in plastic pots (12cm bottom diameter, 18cm top diameter, and 17cm deep) at the rate of 15 seeds par pot. After initial growing 10 plants were kept per pot. When the wheat plants reached a height of about 10 cm , they were infested with ten adults of , *D. noxia*, and *R. padi*. Infested plants were sprayed with 10 ml of an aqueous suspension of tested compounds. A series of five concentrations and four replicates for each treatment were used and then each pot covered by a cage consisting of an iron framework 60 cm high suporting a fabric sleeve of 0.2cm mesh. Mortalily was assessed after 72 h. of treatment. The toxicity of tested compounds against the adult stage of *C. undecimpunctata* and *C. septemppunctata* were made. Ten predators were, used for each concentration, reared on wheat plants infested with the, adult stage of *D noxia*, which were used as food supply for the predators . Mortalily of predators was assessed after 72 h. of treatment . The estimation of mortality was corrected according to Abbott's (1925) formula. The slope of log concentration probit regression lines and LC50 values for tested compounds were calculated according to Finney (1952).

In order to evaluate the joint effect of both insect pathogens,*B.t.* (H-14) with cypermethrin insecticide, twenty four pots of wheat plants were each submitted to one of the following treatments. Twelve pots were spread with 10 ml of an aqueous suspension of *B.t.*(H-14) . The combination of the concentrations were used at the level of the LC50 , LC30 and LC20 of the cypermethrin insecticide and combined with the LC25 of the insect pathogens. A fine , moistened squirrel's hair brush was used to transfer ten *D. noxia* and / or *R. padi* to each treated pot . Four wheat pots were treated with 10 ml water and serve as control . Toxicity tests were carried out under laboratory conditions (22-24C° and 55-65 % R.H. with a photoperiod of 16 : 8 (L.: D.).

The joint effect was expressed as the coeffective factor (C.F.) and was estimated according to the equation given by Mansour *et. al* (1966). This coeffective factor was used to differentiate results into these categories. A positive factor of 20 or more is considered potentiation , a negative factor of 20 or more means antagonism and intermediate values between 20 and –20 indicate only additive effect.

RESULTS AND DISCUSSION

The data of the susceptibility of the adult stage of *D noxia* and *R padi* aphids to cypermethrin insecticide, Neem Azal (Azadirachtin) , *B.t.* (H-14) are recorded in Table (1) It was clear from this table that cypermethrin insecticide was at the top of the effective compounds against the adult of the Russian wheat Aphid and maize *D. noxia* (K.) and sorghum Aphid *R. padi* (L) . The LC50 values were 1.10 and 11.61 ppm , respectively The data show that almost all compounds tested were more toxic to the pest than to the *C. undecimpunctata* and *C. spetempunctata* predators . This agrees with the findings of Plapp and Bull (1978) who concluded that pyrethroids may be least toxic of available insecticides for both predators. The use of insecticides that are selectively more toxic to the pest than to the predator has been advocated by Coats *et. al* .(1976) . This differential insecticide susceptibilitiy may result from biochemical differences between the predator and its prey. In the case of the pyrethroids compound, these are metabolized by microsomal oxidase and esterases in insects (Shono *et al* 1979).

Effective concentrations of azadirachtin resulting in 50% mortalily of *D. noxia* and *R. padi* aphids LC50 values were 69.20 and 250.10 ppm , respectively . Lowery , (1992) found that the effective concentrations of azadirachtin resulting in 50% inhibition of aphid reproduction ranged from as low as 14.4 ppm for *N. ribisnigri* , to 616.4 ppm for *R. padi* , but interspecific differences appear to segregate partly on the basis of host plant . These concentrations are of approximately the same magnitude as those resulting in 50% mortality of 2^{nd} instar aphids (Lowery and Isman , 1995). The LC50 values of azadirachtin were (442.32 and 523.86 ppm) when used against the *C undecimpunctata* and *C. seplempunctata* , respectively. From the data in Table (1) , it appears that *B.t.* (H-14) the bacterial pathogen was more toxic against tested aphids than their predators. The LC50 values were 208.82 and 286.34 ppm for *D. noxia* and *R. padi* aphids, respectively .While the LC50 values for the predators, *C. undecimpunctata* and *C. septempunctata* were 780.11 and 614.33 ppm, respectively. The LC50 valuees for the

Table (1) : LC50 values, Confidence Limits and Slope for the Trsted Compounds Against Sorghum Aphid and Predaator.

Treatment	Tested			Aphid		
	D.noixia			*R.padi*		
	LC50 Ppm	LC50 Conf. Limit	Slope	LC50 ppm	LC50 Conf. Limit	Slope
Cypermethrin (Fenom)	**1.10**	**0.09 – 2.14**	**2.56**	**11.61**	**7.00 - 26.12**	**2.7**
Azadirachta indica Neem Azal, TS 5%	**69.20**	**46.2 - 136.1**	**2.3**	**250.10**	**180.36 - 386.4**	**2.68**
Bacillus thuringiensis (B.t. H.14	**208.82**	**170.42 -288.9**	**1.68**	**286.34**	**80.14 - 304.19**	**1.88**

Treatment	Tested			Predator		
	C. undeciumpunctata			*C. septempuncata*		
	LC50 ppm	LC50 Conf. Limit	Slope	LC50 Ppm	LC50 Conf. Limit	Slope
Cypermethrin (Fenom)	**30.0**	**0.09 – 2.14**	**2.00**	**35.12**	**26.00 - 56.66**	**2.12**
Azadirachta indica Neem Azal, TS 5%	**442.32**	**46.2 - 136.1**	**1.98**	**523.86**	**360.11 - 600.14**	**2.80**
Bacillus thuringiensis (B.t. H.14	**780.11**	**588.1 - 480.41**	**2.14**	**614.33**	**412.00 - 1112.12**	**1.25**

Neem Azal were 69.20 and 250.10 ppm for *D. noxia* and *R. padi*, respectively,.

In a laboratory experiment adult of the *C. septempunctata*, kept on No- treated (Neem oil) glassplates, did not show increased mortality or reduction of fecundity when compared with untreated control, but the melamorphosis of the larvae was interrupted (Schmutterer *et al*, 1981). The rate of emergence of 1^{st} – instar larvae from treated eggs was not affected by the Neem products. In contrast, spraying of two coccinellied species *including C. septempanctata* in field cages did not result in obvious side- effects. In laboratory studies of Lowery and Isman (1995) topical treatment of early 2^{nd} instar larvae *of C. undecimpunctata*, using 1% NO(Neem Oil) did not result in reduced pupation emergence of a dults as compared with control . Neem products are broad – spectrum pesticides . Schmutterer and Singh (1995) listed 413 insect pest species as sensitive to Neem.

Conventional insecticides are aften more toxic to predator and parasitoid than to pest insects Morse and Bellows, (1986) and Rosenheim and Hoy, (1988). however, previous work has indicated that Neem seed kernel extracts are generally less harmful to beneficial insects than to pest insects (Saxena et. al 1984).

The results in Table (2) indicated that the coimbination of the *Bacillus thuringiensis* H-14 at LC25 with the LC20, LC30 and LC50 of cypermethrin insecticides, which were tested against the adult stage of the Russian Wheat Aphid *D. noxia* and Maize and Sorghum Aphid *R. padi* resuted in potentiation or additive effects with the (*B.t.*) combination according to the level of the concentrations combined. However, it has been suggested that *B.t.* (H- 14)may have weakened the adult of tested aphids sufficient to make them less tolerant to the tested cypermethrin insecticide.

These results are in full agreement with the results of Salama *et. al* (1984) who found that all pyrethroids and most of the organophosphorous insecticides tested potentiated the activity of *B. thuringiensis* Varieties. The use of low doses of chemical insecticides such as pyrethroids and some orgnophosphorous compounds with low

Table (2): The joint effect of *Bacillus thuringiensis* & cypermethrin insecticide against the adult stage of *D. naxia* and *R. padi*

	Diuraphis noxia				
Treatment	**Pathogen + Insecticide Conc.ppm**	**% EM**	**% OM**	**Coeffective Factor (CF)*****	**Type of Interaction**
LC25(B)* + LC20 (C) **	92.15 + 0.62	45	59	31.11	Potentiation
LC25 (B) + LC30 (C)	92.15 + 0.84	55	77	40.00	Potentiation
LC25(B) + LC50 (C)	92.5 + 1.10	75	83	10.67	Additve
	Rhopalosiphus padi				
Treatment	**Pathogen+ Insecticide Conc.ppm**	**% EM**	**% OM**	**Coeffective Factor (CF)*****	**Type of Interaction**
LC25(B) + LC20 (C) **	144.84 + 6.10	45	58	28.89	Potentiation
LC25 (B) + LC30 (C)	144.84 + 7.00	55	68	23.64	Potentiation
LC25(B) + LC50 (C)	144.84 + 11.61	75	86	14.67	Additive

B*. LC25 value of *Bacillus thuringiensis* – H-14 (Bacteria)

C**. Cypermethrin Insecticide (Fenom 20% EC).

$$\text{CF***. Coeffective factor} = \frac{\%\ OM - \%\ EM}{\%\ EM} \times 100$$

OM = Observed Mortality, EM = Expected Mortality.

dosages of *B. thuringiensis* formulations appears suitable as a means to the control of Aphids. The pyrethroids affect the peripheral and central nervous system and thus result in paralysis of the insect pest.

With these chemical insecticide pathogen combinations, the insecticide dosage can be reduced to levels which would minimize the environmental pollution and spare parasites, predators , and biotic control agents. The reduced levels of *B. thuringiensis* insecticide combinations, would also reduce the cost of pests control which is one of the main targets of IPM programes.

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الملخص العربى

التأثير المشترك للمبيدالحشري السيبرمثرين وبعض عناصر المكافحة الطبيعية ضد الحشرات الكاملة لمن محاصيل الحبوب وأعدائها الطبيعية .

د. عبد الرحمن علي محمد ثابت
جامعة صنعاء ، كلية الزراعة ، قسم وقاية النبات ، الجمهورية اليمنية .

تعتبر أفة من الذرة (*Rhopalosiphum padi* (L.)) وكذلك من القمح الروسي (*Diurphis noxia (K.)*) من أخطر الافات التي تصيب عديد من محاصيل الحبوب في اليمن . تلعب الاعداء الطبيعية لتلك الافات دور كبير وهام في خفض تعداد افة المن. وتشمل الدراسة الحالية دراسة سمية مبيد السيبرمثرين وكذلك مستخلص النيم وبالاضافة إلى اختبار فعالية الممرض الحشري *B..t H-14)* ضد الحشرة الكاملة للمن وكذلك المفترسات ابو العيد احدى عشر نقطة وابو العيد سبع نقط. أوضحت النتائج المتحصل عليها أن المبيد الحشري سيبرمثرين كان اكثر فعالية في مكافحة من القمح الروسي وكذلك من الذرة حيث كانت قيم التركيزات المسبب لموت ٥٠% من الحشرات المعاملة كالتالي ١,١٠ ، ١١,٦١ جزء في المليون على التوالي وأوضحت النتائج أن مستخلص النيم كان اكثر فعالية من الممرض البكتيري على الحشرتين السابقتين حيث كانت قيمة التركيزات المسببة لموت ٥٠% من الحشرات المعاملة ٦٩,٢٠ ، ٢٥٠,١٠ جزء في المليون على التوالي. بينما كانت قيمة التركيز المسبب ٥٠% من الحشرات المعاملة في حالة الممرض البكتيري ٢٠٨,٨٢ ، ٢٨٦,٣٤ جزء في المليون على التاولي اوضحت النتائج أن مبيد السيبر مثرين كان اكثر المركبات سمية على المفترس أبو العيد احد عشر نقطة وكذلك ابو العيد سبع نقط حيث كانت قيمة التركيز المسبب لموت ٥٠% من المفترس ابو العيد احدى عشر نقطة (٣٠,٠٠) جزء في المليون ، بينما كان (٣٥,١٢) جزء في المليون ضد المفترس ابو العيد سبع نقط يليه في السمية حسب الترتيب مستخلص النيم ثم الممرض البكتيري وقد أوضحت نتائج التأثير المشترك للممرض البكتيري عند إستخدام التركيز المسبب لموت ٢٥% من الحشرات المعاملة مخلوطا مع التركيزات المسبب لموت ٢٠% ، ٣٠% ، ٥٠% من مبيد السيرمثرين وحسب

قيم معامل التأثير المشترك (C.F) كان هناك مستويات مختلفة من التقويةوالأضافةوذلك طبقا لمستويات التركيزات المستخدمة من المبيد وبذلك يمكن تقليل تلوث البيئة بمتبقيات المبيدات حيث يؤدي ذلك إلى حماية الاعداء الطبيعية لافات المن خاصة المفترسات .

ونتائج هذه الدراسة تؤكد أن المكافحة المتكاملة للافات هي الطريق الوحيد والامثل للحد من مخاطر المبيدات الكيمائية على البيئة وبذلك يمكن التغلب على مقاومة الافات للمبيدات الكيميائية وكذلك التخفيض في تركيز المبيدات سوف يؤدي إلى تخفيض تكاليف مكافحة الافات بالاضافة إلى حماية البيئة والإنسان من التلوث بمتبقيات المبيدات الكيميائية المصنعة.