COMPARING THE EFFECTIVENESS OF A BIOPESTICIDE WITH THREE SYNTHETIC PESTICIDES FOR APHID CONTROL IN WHEAT

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ABSTRACT

An experiment was conducted on two wheat varieties, Inqilab-91 and Saleem 2000, at Malakandher Research Farm, NWFP Agricultural University Peshawar during 2004-05 to compare the effectiveness of a biopesticide (BtA @ 1g lit^{-1}) with different synthetic pesticides (chlorpyriphos @ 5ml, trend @ 4ml and megamos @ 1.25ml lit^{-1}) against wheat aphids. Three aphid species namely *Rhopalosiphum padi*, *Schizaphis graminum* and *Sitobion fragariae* were collected from the host and identified in the Entomology Department of NWFP Agricultural University Peshawar. Aphid density on Saleem-2000 was significantly lower in chlorpyriphos treatment with 0.67, 0.76, 2.16 and 8.55 aphids $leaf^{-1}$ while significantly higher in the trend treatment with 1.87, 2.17, 3.60 and 11.55 aphids $leaf^{-1}$ after 1, 2, 3, and 7 days of chemical treatment, respectively. Mean aphids density $leaf^{-1}$ over the entire two weeks period was significantly lower in chlorpyriphos and higher in trend treatments. Mean aphid density in control during this period increased from 21.3 to 31.2 $leaf^{-1}$ (9.2 to 38.2%). Aphid density on Inqilab-91 was significantly lower in chlorpyriphos treatment with 1.31, 2.66, 1.75 and 3.89 aphids $leaf^{-1}$ while higher in trend with 3.33, 2.10, 3.90 and 6.36 aphids $leaf^{-1}$ after 1, 2, 3, and 7 days of chemical treatment. Mean aphid density $leaf^{-1}$ over entire two weeks was significantly lower in chlorpyriphos and higher in trend treatment. Mean aphid density in control during this period increased from 26.2 to 36.4 $leaf^{-1}$ (33.8 to 52.3%). Mean yield (kg ac^{-1}) of Saleem-2000 was significantly higher in chlorpyriphos (734), megamos (716) and BtA (713) while lower in trend (676) as well as control (675). On the other hand, mean yield (kg ac^{-1}) of Inqilab-91 was significantly higher in chlorpyriphos (644), megamos (622) and BtA (616) while lower in trend (615) and control (585 kg).

Key words: wheat, aphids, biopesticide, synthetic insecticides, density, yield.

INTRODUCTION

Wheat (*Triticum aestivum* L.) ranks first as staple food in Pakistan. It is a vital source of carbohydrate and contains important substance "gluten" which increases its demand for backing products. It provides about 20% of the world's food calories and is a food for nearly 40% of world's population (Wiese, 1987).

Among the sap sucking arthropods, aphids are the most widely distributed group. Aphids pierce and suck sap from leaves, stems and less frequently the developing kernels of wheat. Aphids inject toxic substances during feeding on plants that destroy plant tissue. They also serve as vectors of viruses. The diseases caused by these viruses cause widespread losses, exceeding those attributed to the direct feeding damage.

Aphids species commonly found on wheat throughout the world include: *Rhopalosiphum padi* (Bird cherry-oat aphid), *Schizaphis graminum* (greenbug), *R. maidis* (corn leaf aphid), *Metopolisphum dirhodum* (rose grass aphid) and *Diuraphis noxia* (Russian wheat aphid). These species when feeding in sufficient numbers can cause significant damage to host plants. In addition, these species may act as vectors of a very important wheat disease barley yellow dwarf virus (Gair *et al*., 1983).
Yield losses in wheat and other small grains caused by the feeding of cereal aphids are well documented during the early stages of plant growth e.g. 30 aphids/tiller feeding for 10 days cause about 20% yield loss at harvest, but there is uncertainty about losses incurred during the time when and after grain heads form. *R. padi* and *S. graminum* are (most likely to occur in the field on maturing grain) caused yield losses of 19% and 31% at boot stage and 15% and 20% at flowering stage, respectively (Voss Todd *et al*., 1996).

Several methods have been practiced for the control of aphids. These include cultural, physical, mechanical, biological, chemical and host plant resistance. Combinations of the non-chemical control method keep aphids population normally below economic injury level. But, in cases of aphid's population build ups chemicals have to be used for control and yield assessment (Avila, 1992; El-Hag and Zaitoon, 2000a; Hatchett and Webster, 1987; Khaliq *et al*., 1995; Storck, 1989 and Zheng and Tang, 1989).

The present approach of aphids control is the use of Integrated Pest Management (IPM) program. In this approach non-chemical as well as chemical control practices are unitedly used against the wheat aphids.
Keeping in mind the importance of wheat crop and wheat aphids, an experiment was conducted to achieve the objectives to identify the aphid species that attack wheat, to compare the performance of two

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wheat varieties against aphids and to compare effectiveness of a biopesticide with synthetic chemicals against aphids on wheat.

MATERIALS AND METHODS

The present experiment on comparison of a biopesticide with different synthetic pesticides against aphids of wheat crop were carried out in Malakandher Research Farm, NWFP Agricultural University Peshawar during 2004-2005. Two wheat varieties Inqilab-91 and Saleem-2000 were sown during November, 2004. There were five treatments replicated four times in a randomized complete block design. The treatment size was kept 6 x 4 m with row-to-row distance maintained at 30 cm in each treatment. All the treatments were given standard agronomic practices.

Fifteen plants were randomly selected from each row of each treatment for data recording. Density of aphids plant^{-1} was recorded. Data were recorded 24 hours before chemical application and then 24, 48, and 72 hrs and at weekly intervals after chemical treatment. Three synthetic and one biopesticide were applied after the pests reached their economic threshold levels.

Pesticides applied against aphids on wheat during 2004-2005.

Trade Name	Common Name	Concentration
Larsban	Chlorpyriphos	5ml/L
Actamaprid	Trend	4 ml/L
Methamadophos	Megamos	1.25 ml/L
BtA	Biopesticide	1gm/L

The three different aphid samples were collected and examined under electric microscope and then were matched with the keys and photographs mentioned in the book "Aphids on the World's Trees, An Identification and Information Guide" by R.L Blackman and V.F. Eastop (1974). For chemical control, the above insecticides were sprayed above the plants surface with the given concentrations. The calculation of percentage reduction was made with the help of the formula:

$$\% \text{ Reduction} = \frac{\text{Pre treatment - Post treatment}}{\text{Pre treatment}} \text{ X } 100$$

For yield assessment, the treatments were individually harvested, threshed and grain yield was taken with the help of electronic digital balance and then converted to kg ac^{-1}.

Statistical Analysis

The data were analyzed using MSTATC computer software (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The results of the experiments on wheat aphid species identification, chemical control as well as yield of wheat species are discussed as;

WHEAT APHIDS SPECIES IDENTIFICATION

The wheat aphids collected during the experimental period were brought to the Entomology laboratory for identification. The following wheat aphid species were identified:

1. *Rhopalosiphum padi* (Bird cherry-oat aphid)
2. *Schizaphis graminum* (Green-bug)
3. *Sitobion fragariae*

CHEMICAL CONTROL

Wheat variety Saleem-2000

The results of this experiment showed that different chemicals had significant differences in controlling wheat aphids (Table I).

Twenty-four hours after chemical treatment, mean aphid density leaf^{-1} was significantly lower with 0.67 (95.5% reduction) in chlorpyriphos treatment, while it was significantly higher with 1.87 (89.5% reduction) in trend as compared to control where aphid density was 21.27 (9.2% reduction). Khaliq *et al*. (1995), investigated resistance to *R. padi* in 43 wheat varieties. Some insecticides were tested which gave 98% aphid control after 24 hours, compared with 66-78% mortality in neem oil-treated plots and 35% mortality in the controls.

Forty eight hours after chemical treatment, mean aphid density leaf^{-1} recorded was the lowest with 0.76 aphids leaf^{-1} (94.9% reduction) in chlorpyriphos, while the highest with 2.17 (87.8% reduction) in trend. In control density of aphids was 24.25 (20.4% reductions).

Seventy-two hours after chemical treatment, density of the pest leaf^{-1} recorded was significantly lowest with 2.16 aphids (85.5% reduction) in chlorpyriphos, while it was significantly highest with 3.66 (79.5% reduction) in trend. Density of the pest in control was 27.51 (29.8% reduction). Khaliq *et al*. (1995) tested some insecticides which gave 100% aphid mortality three days (72 hrs) after treatment as compared to 84% in the neem oil-treated plots and 47% in the controls.

One week after chemical treatment, pest density was the lowest (8.55 aphids, 55.2% reduction) in chlorpyriphos treatment and the highest (11.55, 35.3% reduction) in plots sprayed with trend. In control, aphid density was 29.44 (34.4% reduction).
The results of the experiments showed that two weeks after chemical treatment, pest density was non-significantly different among the various chemicals but pest density was significantly higher in the control with 31.25 aphids leaf^{-1} (38.24% reduction). Zheng and Tang (1989), reported that several aphid species, including *S. graminum,* and *R. padi* were found to be hosts of parasites in wheat field.

During the two weeks post-chemical period, pest density was lower (4.38 aphids leaf^{-1}, 70.6% reduction) in chlorpyriphos treatment, while it was higher (6.92, 61.2%) in trend. In the control pest density during this period increased from 21.27 to 31.25 aphids/leaf (9.2 to 38.2% increase). Storck (1989) studied the use of reduced dosages of some insecticides in wheat especially for *Rhopalosiphum padi*. He reported killing more than 90% of the aphids even with reduced insecticide doses.

Wheat Variety Inqilab-91

The results of this experiment showed that different pesticides had significant differences in controlling aphid's population (Table II).
Twenty four hours after chemical treatment, mean aphid density leaf^{-1} recorded was significantly lower (1.31 aphids, 92.6% reduction) in chlorpyriphos treatment, while it was significantly higher with 3.33 (82.7% reduction) in trend treatment. In control, density of aphids was 26.24 (33.8% reduction). Khaliq *et al*. (1995) investigated resistance to *R. padi* in 43 wheat varieties. Some insecticides were tested which gave 98% aphid control after 24 hours, compared with 66-78% mortality in neem oil-treated plots and 35% mortality in the controls.
Forty eight hours after chemical treatment, pest density was significantly lower with 2.66 aphids/leaf (84.9% reduction) in chlorpyriphos treatment, while it was significantly higher with 2.10 (89.1% reduction) in trend treatment. In control density of aphids was 28.04 (38.0% reductions).
Seventy-two hours after chemical treatment, pest density leaf^{-1} recorded was the lowest (1.75 aphids, 90.2% reduction) in chlorpyriphos treatment, while it was significantly higher with 3.90 (79.81% reduction) in trend treatment. Density of the pest in control was 30.26 (42.6% reductions). Khaliq *et al*. (1995) tested some insecticides which gave 100% aphid mortality three days (72 hrs) after treatment as compared to 84% in the neem oil-treated plots and 47% in the controls.
One week after chemical treatment, pest density was significantly lower with 3.89 aphids/leaf (77.9% reduction) in chlorpyriphos treatment, while it was significantly higher with 6.36 (67.1% reduction) in plots sprayed with trend. In control density of aphids was 31.70 (45.3% reductions). Avila (1992), tested the effectiveness of chlorpyrifos @ 95 g and 125 g a.i./ha 10 days after its application against *S. graminum* on wheat. chlorpyrifos gave 92% control at all dosages and dates.
The results of the experiments showed that two weeks after chemical treatment, pest density was significantly lower with 14.94 aphids/leaf (15.1% reduction) in chlorpyriphos, while it was significantly higher with 21.43 (9.8% reduction) in plots sprayed with trend. In control density of aphids was 36.38 (52.3% reductions).

During the two weeks post-chemical period pest density was lower in chlorpyriphos treatment with a mean of 4.55 (74.2% reduction), while it was higher in trend with 7.42 (61.6% reduction). In the control pest density during this period increased from 26.24 to 36.38 aphids/leaf (from 33.8 to 52.3% increase).

3. WHEAT YIELD

Wheat Variety Saleem-2000

The results of this experiment showed significant differences among the different treatments (Fig 1). Wheat yield (kg ac^{-1}) was maximum (734.0) in chlorpyriphos followed by 716.0 in megamos and 712.6 in the BtA treatment. Wheat yield was non-significantly different in the trend and control treatments. El-Hag and Zaitoon (2000a) reported significant grain yield increase using a biopesticide with insecticide. The results thus suggest a synergistic effect between the chemical and biological components.

Wheat Variety Inqilab-91

The results showed significant differences among the different treatments (Fig 2). The maximum yield of 643.6 kg/acre was recorded in chlorpyriphos treatment and 621.8 kg/acre in megamos. While minimum yield of 584.6 kg/acre was recorded in control. El-Hag and Zaitoon (2000b) reported significant grain yield increase per m^2 in the biological and biochemical treatments. The results thus suggest a synergistic effect between the chemical and biological components.

CONCLUSION

Among the chemicals, Chlorpyriphos proved highly effective against aphids on wheat crop as compared to the rest of the pesticides. Furthermore, yield of wheat was also higher in chlorpyriphos treatments. Among the wheat varieties, Saleem-2000 proved to be high yielding as compared to Inqilab-91.

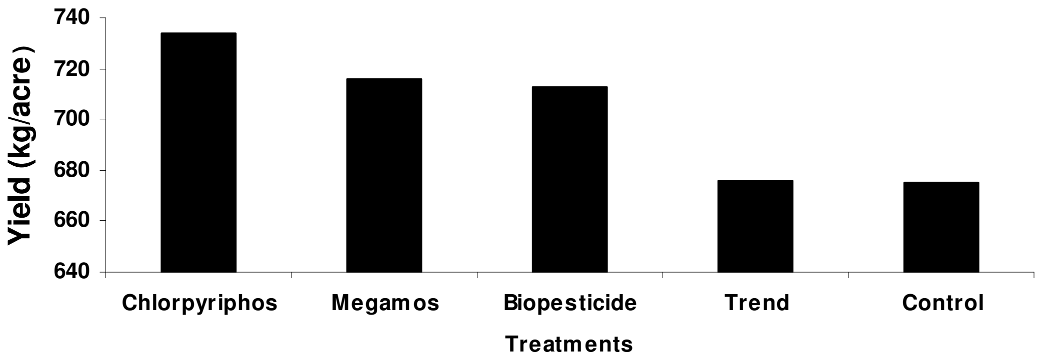

Fig 1: Mean yield (kg ac^{-1}) of wheat variety Saleem-2000 after chemical treatment against wheat aphids

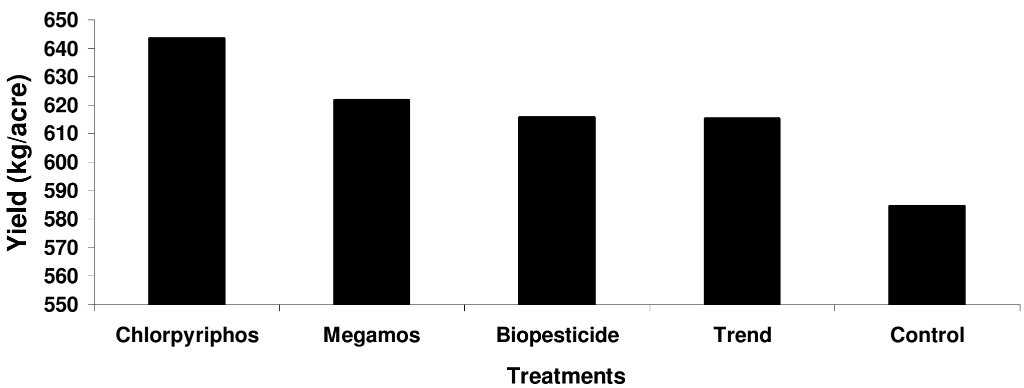

Fig 2: Mean yield (kg/acre) of wheat variety Inqilab-91 after chemical treatment against wheat aphids

Table 1. ***Mean aphids density leaf^{1} of wheat variety Saleem-2000 after chemical treatment***

		Mean aphids density leaf^{1} of wheat plant					
		Post-treatment					
Treatment	*Pre – treatment*	*24h (% Reduction)*	*48h (% Reduction)*	*72h (% Reduction)*	*1 week (% Reduction)*	*2 weeks (% Reduction)*	*Mean total (% Red.)*
Chlorpyriphos	14.91c	0.67c (95.5)	0.76d (94.9)	2.16b (85.5)	8.55c (55.2)	9.7b (42.6)	4.38d (70.6)
Megamos	16.25bc	0.98bc (93.9)	1.02d (93.7)	2.5b (84.6)	9.77bc (39.9)	11.67b (28.2)	5.19cd (61.7)
BtA	16.42bc	1.54bc (90.7)	1.44c (91.3)	2.94b (82.1)	10.65b (35.1)	12.88b (21.5)	5.86c (68.4)
Trend	17.85ab	1.87b (89.5)	2.17b (87.8)	3.66b (79.5)	11.55b (35.3)	15.27b (14.4)	6.92b (61.2)
Control	19.30a	21.27a (9.2)	24.25a (20.4)	27.51a (29.8)	29.44a (34.4)	31.25a (38.2)	27.72a (30.4)
LSD Value	2.770	0.9584	0.4076	4.098	1.970	5.58	0.9075

Means followed by similar letters within a column are not significantly different at 5% level of significance (LSD-test).

Table 2. ***Mean density of aphids/leaf on wheat variety Inqilab-91 after chemical treatment***

		Mean aphid density leaf^{1} of wheat plant					
		Post treatment					
Treatment	*Pre- treatment*	*24h (% Reduction)*	*48h (% Reduction)*	*72h (% Reduction)*	*1 week (% Reduction)*	*2 weeks (% Reduction)*	*Mean total (% Red.)*
Chlorpyriphos	17.63	1.31d (92.6)	2.66b (84.9)	1.75c (90.2)	3.89b (77.9)	14.96d (15.1)	4.55c (74.2)
Megamos	17.95	1.91cd (89.4)	1.52b (91.5)	2.35bc (86.9)	5.17b (71.2)	18.46c (2.8)	5.88bc (65.2)
BtA	16.91	2.52c (85.1)	2.57b (84.8)	2.58bc (84.6)	5.67b (66.5)	19.74bc (14.3)	6.62bc (63.1)
Trend	19.32	3.33b (82.7)	2.10b (89.1)	3.90b (79.8)	6.36b (67.1)	21.43b (9.8)	7.42b (61.6)
Control	17.36	26.24a (33.8)	28.04a (38.0)	30.26a (42.6)	31.70a (45.2)	36.38a (52.3)	26.21a (33.8)
LSD Value	N.S	0.6182	2.653	1.628	2.770	2.630	2.447

Means followed by similar letters within a column are not significantly different at 5% level of significance (LSD-test).

REFERENCES

Avila, C.J. 1992. Chemical control of *Schizaphis graminum* (Rondani, 1852) (Hemiptera: Aphididae) in wheat. Anais da Sociedade Entomol. do Brasil, 21(3): 267-272.

Blackman, R.L. and V.F. Eastop. 1994. Aphids on the World's Trees: an Identification and Information Guide. Publishers CAB International in Association with Natural History museum, UK: 1003 pp.

El-Hag, E.A. and A.A. Zaitoon. 2000a. Studies on the integrated control of cereal aphids in the Gassim area, Saudi Arabia. The BCPC Conference: Pests and diseases proceedings. Entomol. Exper. *et* Appl. 64(7): 254-261.

El-Hag, E.A. and A.A. Zaitoon. 2000b. Use of *Coccinella undecimpunctata* L. and pirimicarb as biochemical control agents for *Schizaphis graminum* (Rondani) in Gassim, Saudi Arabia. Alexandria J. Agric. Res., 45(1): 167-177.

Gair, R., E.E. Tenkins and E. Lister. 1983. Wheat Pests. Cereal Pests and Diseases. Farming Press Ltd. UK. 34(4): 54-80.

Hatchett, A.H. and J.A. Webster. 1987. Insect and mite pests of wheat. In E.G. Heyne (ed). Wheat and wheat improvement. Madison Wisconsin, USA: 625-668.

Khaliq, A., T.H. Raza and L. Khan. 1995. Screening of varietal resistance and insecticides efficacy for control of aphids in wheat. Pak. J. Sci. and Indust. Res. 38(9-10): 365-367.

Steel, R.G.D. and J.H. Torrie. 1980. Principles and procedures of statistics. A biometrical approach. 2^{nd} Editon. McGraw Hill, Inc. USA: pp 481.

Storck, W.S. 1989. The application of reduced dosages of insecticides- a contribution to the integrated control of cereal aphids. Gesunde Pflanzen. 41(8): 285-289.

Voss Todd, S., J.M. Murdick, W.F. Bitty and A.B. Avid. 1996. Yield losses in maturing spring wheat caused by cereal aphids under laboratory conditions. US Deptt. of Agric. Res. Serv. 51(1): 33-37.

Wiese. 1987. Compendium of wheat diseases. The Amer. Phytopathol. Soc. USA. pp. 21-91.

Zheng, Y.S. and B.S. Tang. 1989. Field releases and recovery of an introduced aphid parasitoid, *Lysiphlebus testaceipes* (Hymenoptera: Braconidae) in Shaanxi. Chin. J. Bio. Con. 5(2): 68-70.