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Efficacy of High Volume (HV) vs Ultra Low Volume (ULV) Spraying of Talstar 10EC (bifenthrin), Mustang 380 EC (zetacypermethrin + ethion) and Novastar 56EC (abamectin + bifenthrin) Against Different Larval Stages of *Helicoverpa armigera* (Hub).

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ABSTRACT

A comparative study, (high volume, HV vs. ultra low volume, ULV), to find out the efficacy of Talstar 10EC (bifenthrin), Mustang 380EC (ethion +zetacypermethrin) and Novastar 56EC (abamectin + bifenthrin) @ 250mL, 700mL, 500mL acre^{-1}, respectively against various larval instars of *Helicoverpa armigera* on FH-901 cotton, was carried out. The experiment was conducted at 189/92, Harrapa (Sahiwal, Punjab, Pakistan) with seven treatments including a control replicated thrice following Randomized Complete Block Design. On numerical basis, Novastar was found to be the most effective through ULV against I, II, and III larval instars of *H. armigera* and was followed by Novastar (HV), Mustang (HV), Talstar (HV), Mustang (ULV) and Talstar (ULV). The relationship of spray volume and insect control has been discussed.

Key Words: Spray; *Helicoverpa armigera;* Cotton; Larval instars; Pesticides

INTRODUCTION

The increase in per hectare yield from 166 to 624 kg of cotton is attributed to the use of improved varieties, quality seed, better agronomic practices and adequate plant protection measures (Anonymous, 2000). Plant protection measures, though mainly revolving around use of insecticides and their application techniques, have played a major role in achieving cotton production targets. Lack of proper education and training of cotton growers in the timely use of plant protection measures has led to injudicious and overuse of pesticides resulting in many side effect including environmental pollution and development of resistance in insect pests e.g. whitefly and American bollworm. The latter has proved a serious pest in certain years of cotton season and reports of its resistance to many insecticides are on the record (Cock *et al.,* 1991; Ahmad *et al.,* 1992; Ahmad *et al.,* 1999). Different techniques of insecticide application are being used to keep the population of harmful insect pest especially *Helicoverpa armigera* (Hub.) below the economic injury level. Out of these, high volume sprays are the most prevalent among the farming communities in the cotton growing areas of the Punjab, Pakistan and elsewhere (Bacheler & Moh, 1995; Silva *et al.,* 1997; Dunbar *et al.,* 1998; Mitchell *et al.,* 1999; Ma *et al.,* 2000).

There are inherent problems associated with high volume sprays. These problems include difficulty in uniform distribution, penetration in crop canopy and less effectiveness of the spray materials. The solutions of these problems were sought in the application of U.L.V. (Ultra Low Volume) formulations of insecticides, which in certain cases have proved more effective than EC (Emulsifiable Concentration) formulations (Caprioli & Ventura, 1997; Javaid *et al.,* 1998; Hindy *et al.,* 1999; Javaid *et al.,* 2000).

Since *H. armigera* lays most of the eggs on the upper canopy of the plant, therefore, the insecticide sprays for the larval stages should especially be directed at the top portion of the cotton plant. Kirk *et al.* (2000) found that ULV malathion delivered more dye tracer to top-canopy cotton leaves and fipronil in ULV oil had lower spray deposits when comparison was made among electrostatic fipronil, fipronil in ULV and ULV malathion.

Keeping in view, the importance of cotton crop, vulnerability of *H. armigera* (Hub.) to spray deposits, no attempt has been put forward to investigate the role of application techniques in management of *H. armigera.* Present studies were, therefore, conducted to compare the two application techniques (high volume vs. ultra low volume spray) of Talstar 10EC, Mustang 380EC and Novastar 56EC for the effective control of *H. armigera.*

MATERIALS AND METHODS

The cotton variety “FH 901”was sown in Randomized Complete Block Design at 189/9L Harrapa, Sahiwal. There were 7 treatments including a control and each treatment was replicated three times. Plot size measured 3.78m x

15.15m (57.27 m^2). The plant to plant distance was 45cm and row to row distance was 75cm.

There were three spays and larval population was estimated before and after each spray. The description of insecticides in treatments is as follows:
1. Talstar 10 EC (bifenthrin) @ 250 mL $acre^{-1}$ (HV), 2. Talstar 10 EC (bifenthrin) @ 250 mL $acre^{-1}$ (ULV), 3. Mustang 380 EC (zetacypermethrin + ethion) @ 700 mL $acre^{-1}$ (HV) 4. Mustang 380 EC zetacypermethrin + ethion @ 700 mL $acre^{-1}$ (ULV.), 5. Novastar 56 EC (abamectin + bifenthrin) @ 500 mL $acre^{-1}$ (HV), 6. Novastar 56 EC (abamectin + bifenthrin) @ 500 mL $acre^{-1}$ (ULV.), and 7. Control.

Regular pest scouting was done twice a week, after the germination of the crop, for the assessment of economic threshold level of *H. armigera.* The pest attained the economic threshold level in the month of August and then the four spay of each insecticide with two variables, High volume spray and low volume spray were done.

The population of *H. armigera* was recorded per meter row of cotton plants selected randomly before and after each insecticide application. The population of the pest was recorded in terms of live larval populations per meter row cotton plants per plot. The data was recorded 24 h pre-insecticide application, and then 48 and 72 h and 7 days post application interval. The data thus collected was analyzed statistically by applying Analysis of Variance Technique (Steel & Torrie, 1980). The means were compared by Duncan's Multiple Range Test at 5 % level of probability.

RESULTS

Comparison of High Volume vs Ultra Low Volume spraying of Talstar 10EC (bifenthrin), Mustang 380 EC (zetacypermethrin + ethion) and Novastar 56EC (abamectin + bifenthrin) on 1st, 2nd and 3rd larval stages of *H. armigera* (Hub). The data given in Table I show the number of *H. armigera* larvae (Ist, 2nd, and 3rd instar) 24 h pre- spray and then after 48, 72 h and 7 days post spray intervals of I, II and III sprays. The number of larvae in the plots treated with Talstar 10EC, Mustang 380 EC and Novastar 56EC either as HV or ULV had non-significant difference among themselves at all post-spray intervals of the first application the insecticides. The larval population at 48 h post spray was in the order of Mustang (U.L.V.) < Novastar (U.L.V.) < Mustang (HV) < Talstar (HV). Minimum larval population was observed in plots treated with Talstar (HV) followed by Mustang (HV), Talstar (U.L.V.), Novastar (HV) and Novastar (U.L.V.) at 72 h post-spray interval of first application. However, lowest numbers of larvae were in the plots treated with Novastar (HV) at 7th day of spray.

It was in the second application that the treatments were found to be significantly different among themselves at 48 h post-spray interval but all the treatment had non-significant difference at 72 h and 7th day post-spray interval. The plots treated with Talstar (HV) and Mustang (HV) showed greater larval population than from corresponding plots treated with ULV formulations at 48 h post-spray.

All the treatments were found to be highly non-significant among themselves at 48 h post spray interval of 3rd spray while larval population at 72 h post-spray was found to be significantly different among the treatments. Mustang showed non-significant difference between two application techniques, i.e., HV and ULV, and had lowest number of the larvae at 7th day of the post- spray interval.

The mean number of larvae (Ist, 2nd, and 3rd instar**)** of three sprays of each insecticide with HV and ULV treatment showed non-significant difference among themselves.

Comparison of High Volume vs Ultra Low Volume spraying of Talstar 10EC (bifenthrin), Mustang 380 EC (zetacypermethrin + ethion) and Novastar 56EC (abamectin + bifenthrin) on 4th and 5th instar larvae of *H. armigera* (Hub). The data given in Table II show the number of *H. armigera* larvae (4th and 5th instar)at 24 h pre spray and then after 48 h, 72 h and 7 days post spray

Table I. Comparison of High Volume vs Ultra Low Volume spraying of Talstar 10EC, Mustang 380 EC and Novastar 56EC on Ist, 2nd, and 3rd larval instars of *H. armigera* (Hub)

	Larval population												
	Pre-spray			Post-spray									
	24 h			48 h			72 h			7th day			
Spray Treatment	I	II	III	I	II	III	I	II	III	I	II	III	Over all
				n.s.			n.s.			n.s.			
Talstar (HV)	3.33	2.00	1.66	3.16	2.16ab	2.16b	1.33	1.16b	2.50b	2.00	1.66b	1.00bc	2.46b
Talstar (ULV)	4.50	3.66	1.00	2.50	1.66b	2.16b	2.00	0.50b	2.83b	3.66	1.00b	0.50bc	2.63b
Mustang (HV)	4.00	2.50	1.83	2.50	2.00ab	1.33b	1.83	1.16b	2.83b	2.50	1.83b	0.33c	2.46b
Mustang (ULV)	4.16	1.83	1.83	2.33	1.50b	1.66b	3.16	2.00b	2.16b	1.83	1.83b	0.33c	2.56b
Novastar (HV)	3.83	1.33	2.00	2.83	1.00b	1.50b	2.33	1.83b	0.83c	1.33	2.00b	1.50bc	2.23b
Novastar (ULV)	4.16	2.16	1.00	2.50	0.66b	0.50b	2.66	0.66b	0.83c	2.16	1.00b	0.17c	1.90b
Control	3.66	4.16	6.50	3.50	4.33a	6.33a	3.66	4.66a	6.66a	4.16	6.50a	3.00a	5.33a

Values are mean number of larvae m^{-1} row of cotton plants. Overall number of larvae in the post spray column is combined number of all four sprays at all the post spray intervals. n.s. stands for non-significant. Means sharing same letter in a column are not different among themselves at 5% level of probability.

Table II. Table I. Comparison of High Volume vs Ultra Low Volume spraying of Talstar 10EC, Mustang 380 EC and Novastar 56EC on 4th and 5th instar larvae of *H. armigera* (Hub)

	Larval population												
	Pre-spray			Post-spray									
	24 h pre spray			48 h post spray			72 h post spray			7th day post spray			
Spray Treatments	I	II	III	I	II	III	I	II	III	I	II	III	Over all
				n.s.	n.s.		n.s.			n.s.			
Talstar (HV)	3.33	2.16	0.16	2.16	0.50	1.16ab	3.16	0.00b	1.66b	2.16	0.16b	1.00b	1.56b
Talstar (ULV)	1.83	1.00	0.16	1.66	0.33	0.33b	1.33	0.66b	1.16bc	1.00	0.16b	0.50b	1.03c
Mustang (HV)	3.16	1.50	0.16	1.66	1.83	0.83b	1.16	0.83b	1.00bc	1.50	0.16b	0.33b	1.20c
Mustang (ULV)	1.83	2.50	0.33	1.66	0.50	0.83b	3.16	0.33b	0.66bc	2.50	0.33b	0.33b	1.26bc
Novastar (HV)	2.16	1.00	0.00	2.00	0.50	0.83b	1.83	0.50b	0.33c	1.00	0.00b	1.00b	0.93c
Novastar (ULV)	2.83	0.66	0.00	1.50	1.00	0.33b	1.50	0.66b	1.16bc	1.16	0.00b	0.16b	0.90c
Control	1.66	5.00	2.50	2.50	2.17	2.33a	2.83	2.66a	5.00a	5.00	2.50a	3.00a	3.10a

Values are mean number of larvae m^{-1} row of cotton plants. Overall number of larvae in the post spray column is combined number of all four sprays at all the post spray intervals. n.s. stands for non-significant. Means sharing same letter in a column are not different among themselves at 5% level of probability

intervals of I, II and III sprays. The number of larvae in the plots treated with Talstar 10EC, Mustang 380 EC and Novastar 56EC either as HV or ULV had non-significant difference among themselves at all post-spray intervals of the first application. The range of number of 4th and 5th instar larvae was from 1.50-2.16, 1.50-3.16, and 1.00-2.50 at 48 h, 72 h and 7th day post-spray intervals with corresponding values in the control were 2.50, 2.83, and 5.00 larvae, respectively.

At 48 h post-spray interval of second application, there were non-significant difference among the treatments including control. Talstar (ULV) registered the lowest number (0.33 larvae). At 72 h and 7th day post-spray interval, all the treatments though non-significantly different among them selves, had significant difference from control treatment.

Talstar (HV) had non-significant difference with control while all other treatments had significant difference at 48 h post-spray interval. Talstar (HV) and Novastar (HV) were significantly different from each other at 72 h post-spray interval, however, all the treatments had non-significant difference among themselves sat 7th day post-spray time point.

The mean number of larvae (4th and 5th instar) of three sprays of each insecticide with HV and ULV treatment showed non-significant difference among themselves.

DISCUSSION

The project under study was carried out to compare the efficacy of Talstar 10EC, Mustang 380 EC and Novastar 56 EC based on amount of carrier (water versus oil) used for application of these insecticides. Talstar (bifenthrin), Mustang (zetacypermethrin + ethion) and Novastar (abamectin + bifenthrin) have been successfully used in high volume sprays against *H. armigera* (Bacheler & Moh, 1995; Silva *et al.*, 1997; Dunbar *et al.*, 1998; Mitchell *et al.*, 1999; Ma *et al.*, 2000).

The lowest larval population observed in plots treated with Novastar through U.L.V. sprayer. These findings are similar to that of Dunbar *et al.* (1998) and Silva *et al.* (1997) who reported that emamectin (Novastar) was very effective in controlling tobacco budworm and cotton budworm (*H. armigera*) at low rates (0.0075-0.015 lb a.i acre^{-1}). It was also revealed that the U.L.V.-CDA sprayer had an average density of 28.90 droplets.cm^2 as compared to 93.91 in case of traditional high volume sprayer.

Talstar U.L.V. treated plots had high larval population as compared to other treatments, which may suggest a possibility of the development of resistance to Talstar (bifenthrin). This possibility is in agreement with same reported by Ahmad *et al.* (1997) who monitored of resistance of *H. armigera* to a range of pyrethriods, viz., cypermethrin, alphacyermethrin, deltamethrin, cyfluthrin, bifenthrin and lamda cyhalothrin.

It is concluded from above discussion that *H. armigera* might have been resistant to conventional insecticides, so there should be new insecticides, which can kill the pest in more efficient and economic manner. It can be said that Novastar (abamectin + bifenthrin) is a good substitute of conventional insecticides for providing rapid control against *H. armigera* on cotton.

It is interesting to mention here that Novastar was used for the first time in our experiments through U.L.V. application technique. It gave better control of *H. armigera* than the conventional insecticides. The conventional insecticides with similar modes of action when used through ULV application technique also proved inefficient in controlling the said pest. It provided an edge in the control of *H. armigera* with Novastar (U.L.V.) over other insecticides.

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