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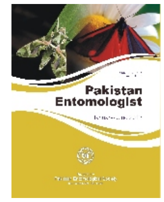

COMPARATIVE EFFICACY OF INSECTICIDES AS SEED TREATMENT AGAINST WHEAT APHID AND ITS COCCINELLID PREDATOR

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ABSTRACT

Aphid (*Sitobion avenae* F.) is the serious insect pest of wheat and has attained the status of regular insect pest over the last couple of years. The efficacy of four insecticides as seed treatment against wheat aphids and its coccinellid predator (*Coccinella septempunctata* L.) was evaluated at their recommended field doses under field conditions. The insecticides were Hombre® (Imidachloprid + Tebuconazole), Actara® (Thiamethoxam), Dividend Star® (Cyproconazole + Difenoconazole) and Actara® + Dividend Star® at their recommended field doses i.e. 4.0gm/kg, 0.6gm/kg, 1.0 gm/kg and 0.72 + 1.0 gm/kg per acre respectively. Aphid population was the lowest after application of Hombre® and Actara® insecticide whereas highest aphid densities were found after application of Dividend Star® and in untreated control. The higher population of ladybird beetle was recorded after seed treatment with Dividend Star® as compared to other treatments. Application of Hombre® resulted significant increase in 1000 grain weight and wheat crop yield as compared to all other treatments. It can be concluded that Hombre® and Actara® as seed treatment could be efficiently utilized for controlling wheat aphids.

Keywords: Coccinellid beetle, Insecticides, wheat aphid

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the main cereal crop of Pakistan that plays a major role in improving the economic stability of the country (Anwar *et al.,* 2009; Anonymous, 2010). Wheat crop is under threat of sucking pests especially aphids (Homoptera: Aphididae) that ultimately affect the wheat yield and attained the status of regular pest in Pakistan (Abdulkhairova, 1979; Girma *et al*., 1993). Wheat is under severe threat to number of aphids species but *Sitobion avenae* (F.) (Aphididae: Homoptera) is the potential aphid species that causes huge losses in grain yield of wheat crop (Hashmi *et al.,* 1983; Singh, 1986; Kieckhefer and Gellner 1992; Grima *et al.,* 1993; Aheer *et al.,* 1994).
Aphid sucks the cell sap from the leaves and reduces the vigor of the plant (Kauffman and Laroche, 1994). The affected leaves turn pale yellow, wilt and show silky appearance (Ashfaq *et al.,* 2007). Aphids also exude honey dews which encourages sooty mould growth on the greenish part of the plant. Photosynthesis is adversely affected in sooty mould attacked plants (Mahmood, 1981; Kindler *et al.,* 1995). The abundance of aphids adversely affects the nitrogen and protein contents, number and weight of grains per ear (Ciepiela, 1993) and result in reduction of carbon assimilation rate, transpiration, total chlorophyll and plant biomass (Ryan *et al*., 1987; Holmes *et al.,* 1991). The population of aphid is mostly related with suitable environmental conditions (Metcalf *et al.*, 1951; Amjad and Ali, 1999). Therefore, a usual and regular monitoring of wheat crop is very important during the prevailing ecological conditions.
Besides other insect controlling strategies, the biocontrol agents provide an environmentally safe and effective control of insect pests including aphids (Quisenberry and Schotzko, 1994). The natural enemies may help to reduce the aphid population from reaching the economic injury level. Coccinellid beetle (*Coccinella septempunctata* L.) is amongst the most common predator of immature and adult aphids (Krotova, 1994; Pell and Vandenberg, 2002; Iqbal *et al.,* 2008). It has high reproductive potential and long oviposition period (Iperti, 1999; Hodek and Honek, 1996; Dixon, 2000). However, their protection and conservation in agro ecosystems is narrow due to extensive and indiscriminate use

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of insecticides. Coccinellid predators are likely to be exposed to an immense number of insecticides while foraging in the crop field. They are exposed to chemicals directly through insecticide application or indirectly by consuming insecticides contaminated preys. Therefore, careful selection and doses of insecticides can be helpful to preserve the natural biocontrol agents of aphid (Croft, 1990; Unal and Jepson, 1991; Alford *et al.,* 1995; Oakley *et al.,* 1996; Head *et al.,* 2000). The most appropriate insecticides are those with high toxicity to pests and least lethal effects on natural enemies (Plapp and Bull, 1978). Insecticides are effectively used in the field to control the wheat aphid (Ahmed *et al*., 2001; Wains *et al.,* 2010). Therefore, the impact of insecticides on natural enemies along with its required effects on target insect pests of wheat should be the complete component of the essential management process.

The present project was designed to investigate the comparative efficacy of different insecticides as seed treatment against wheat aphid population and the response of coccinellid predator, *C. septempunctata* population against these insecticides under field conditions. Moreover, the effect of these seed treatment insecticides on 1000 grain weight and wheat crop yield was also analyzed.

MATERIALS AND METHODS

The research trial was conducted under Randomized Complete Block Design (RCBD) with three replications and five treatments under two blocks (broadcast and drill sowing methods). The wheat variety WATAN 91 was sown for the experiment at Syngenta Farm, Multan. The plot size for each replication was 80 x 30 meter and the treatment size was 16 ft x 15 ft. Following five treatments were used in the experiment at their recommended doses against wheat aphid.

T1: Control (Untreated)
T2: Hombre® 186.25FS (Imidacloprid+Tebuconazole) @4.0ml/kg
T3: Actara® 25 WG (Thiamethoxam) @ 0.6gm/kg
T4: Actara® 25 WG+Dividend Star® 36FS@7.2gm+1ml/kg
T5: Dividend Star® 36FS (Cyproconazole+Difenoconazole) @ 1ml/kg

The aphid population was recorded 70, 80, 90 and 100 days after sowing. Counting of aphids was done from three randomly selected areas having 20 stems in each treatment under each block. The population of coccinellids was recorded by counting them on spikes of wheat after counting the number of tillers from three randomly selected areas of one square meter in each treatment under each block. Data regarding 1000 grains weight was recorded at harvesting with three randomly selected areas in each treatment under each block. Data relative to quality of grains was recorded by separating healthy and shriveled (wrinkled) grains in 1000 grains. Yield of each plot per treatment and whole yield was recorded. Analysis of variance (ANOVA) was used to analyze the data of aphid and coccinellids beetle population and then the means were separated by Duncan's multiple range test (Duncan, 1955) at $p < 0.05$.

RESULTS AND DISCUSSION

Effect of seed treatments on aphid population

Analysis of variance (ANOVA) revealed significant differences for all the treatments regarding the aphid population. However methods of sowing (broadcast and drill) did not affect the population significantly after 70, 80, 90 and 100 days of sowing (Table 1).

Regarding the mean aphid population after 70 & 80 days sowing of crop showed that Hombre® and Actara® showed lowest aphid population as compared to all other treatments and were significantly different from other treatments (Fig. 1a & 1b). Our results are in accordance with the findings of Macharia *et al.* (1999) who reported significant efficacy of seed treatment of insecticides for the control of *D. anoxia.* After 90 days of sowing, Actara® showed maximum aphid population followed by Hombre®. The minimum aphid population was recorded after Actara®+Dividend Star® application (Fig. 1c). After 100 days of sowing, Dividend Star® showed maximum aphid population almost parallel with control. While Hombre® and Actara® were almost equal with minimum aphid population (Fig. 1d). Ahmed *et al*. (2001) also reported the effective impact of pesticide seed dressing for the management of aphid. Similarly, Royer *et al.* (2005) and Patil *et al.* (2003) found that seed dressing with Imidacloprid decreased the population of sucking insect pests like cereal aphids and leaf hoppers that are partially supporting our results.

Effect of seed treatment with insecticides on lady bird beetle population

Analysis of variance (ANOVA) revealed the significant differences for all the treatments regarding the lady bird beetle population under both methods. It was also concluded that lady bird beetle numbers were also different between methods after 90 days of sowing but remains non significant between interactions (Table 2).

The data regarding the mean population of lady bird beetle after 90 days sowing of crop revealed that control and Actara®+Dividend Star® showed significantly highest population of lady bird beetles as compared to all other treatments. The minimum lady bird beetle population was recorded in Actara®, Hombre® and Dividend Star® respectively (Fig. 2a). After 100 days of sowing, control and Dividend Star® showed highest ladybird beetle population under both methods and were significantly different from all other treatments. All other treatments Hombre®, Actara® and Actara®+Dividend Star® were nearly similar having low population of lady bird beetle and were significantly different from other treatments (Fig. 2b). Theiling and Croft (1988) reported the considerably different susceptibility of coccinellids to insecticides. Our results are in accordance with the findings of Katole and Patil (2000) who reported biosafety of seed dressing against predators including lady bird beetle. Previous study conducted by Khan *et al*. (2011) reported the effect of wheat cultivar on aphids and predators rather than using the seed treatment pesticides.

Table 1
ANOVA parameters for aphid population under different seed treatments of insecticides, sowing methods and their intraction in field conditions.

Source of variation	Degrees of freedom	Mean squares 70 days	Mean squares 80 days	Mean squares 90 days	Mean squares 100 days
Replication	2	0.11273	1.311	11.436	0.03804
Method	1	0.00370^{ns}	0.057^{ns}	0.096^{ns}	0.01556^{ns}
Treatment	4	0.20234^{*}	1.312^{**}	3.391^{*}	0.04538^{*}
Method x Treatment	4	0.01577^{ns}	0.054^{ns}	0.051^{ns}	0.01429^{ns}
Error	18	0.06021	0.125	0.791	0.01022
Total	29				

Observation of aphid population under different seed treatments of insecticides in field conditions. Analysis of variance of aphid population after 70, 80, 90 and 100 days of sowing. The data showed the significant differences for all the treatments regarding aphid population. The significance and non significance has been shown by letters viz., ns = non-significant (P>0.05); * = significant (P<0.05); ** = highly significant (P<0.01).

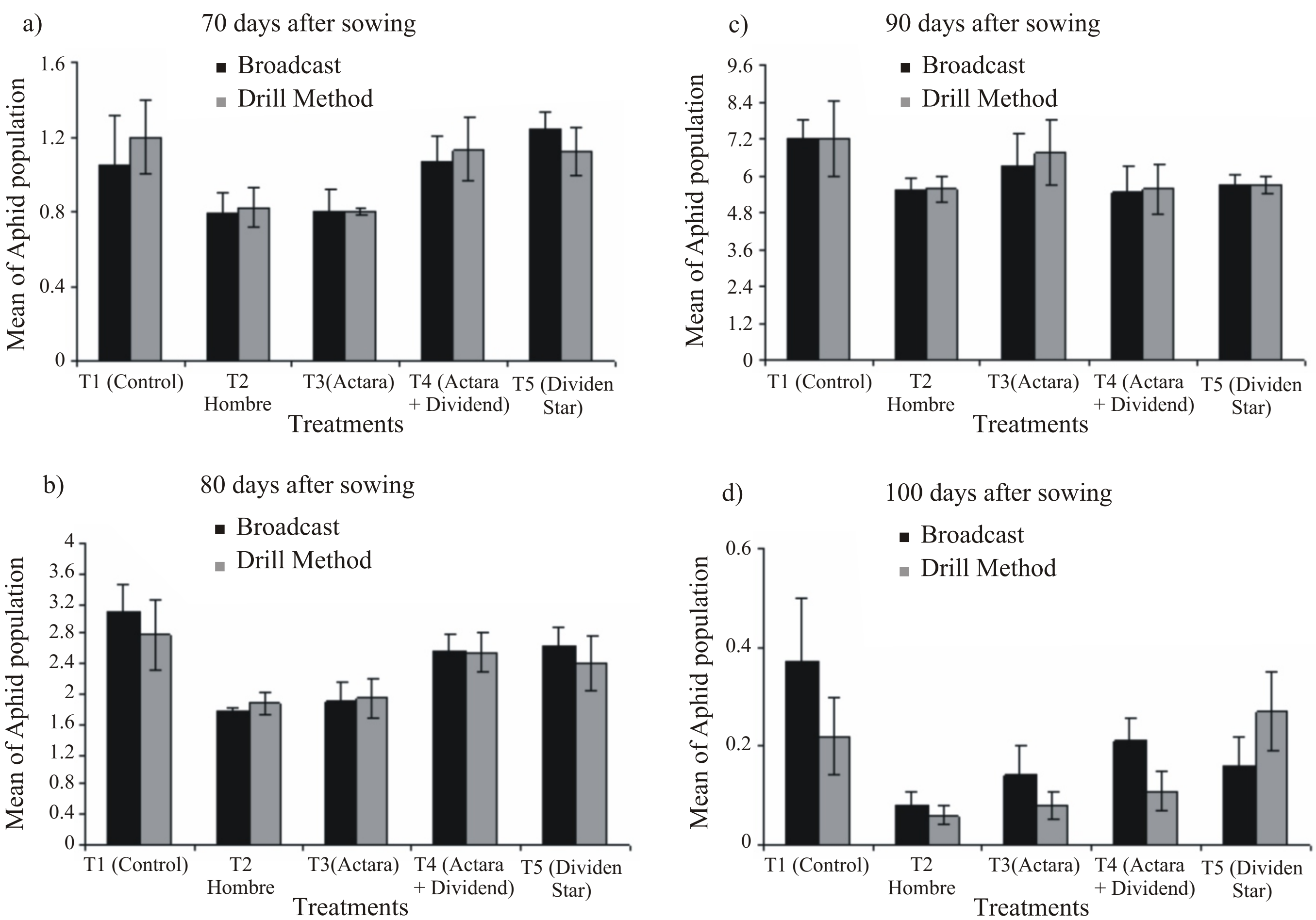

Fig. 1
Observation for mean population of Aphid after 70 (1a), 80 (1b), 90 (1c) and 100 (1d) days of sowing. The error bars indicates the standard error of mean.

Table 2
ANOVA parameters of lady bird beetle population under different seed treatments of insecticides, sowing methods and their interaction in field conditions.

Source of variation	Degrees of freedom	Mean squares 90 days	Mean squares 100 days
Replication	2	0.001709	0.059
Method	1	0.047460*	0.048 ^{ns}
Treatment	4	0.059448**	2.821**
Method x Treatment	4	0.003075 ^{ns}	0.058 ^{ns}
Error	18	0.009540	0.072
Total	29		

Observation of Lady bird beetle population under different seed treatments of insecticides in field conditions. Analysis of variance of ladybird beetle population after 70, 80, 90 and 100 days of sowing. The data showed the significant differences for all the treatments regarding ladybird beetle population. The significance and non significance has been shown by letters viz., ns = non-significant (P>0.05); * = significant (P<0.05); ** = highly significant (P<0.01).

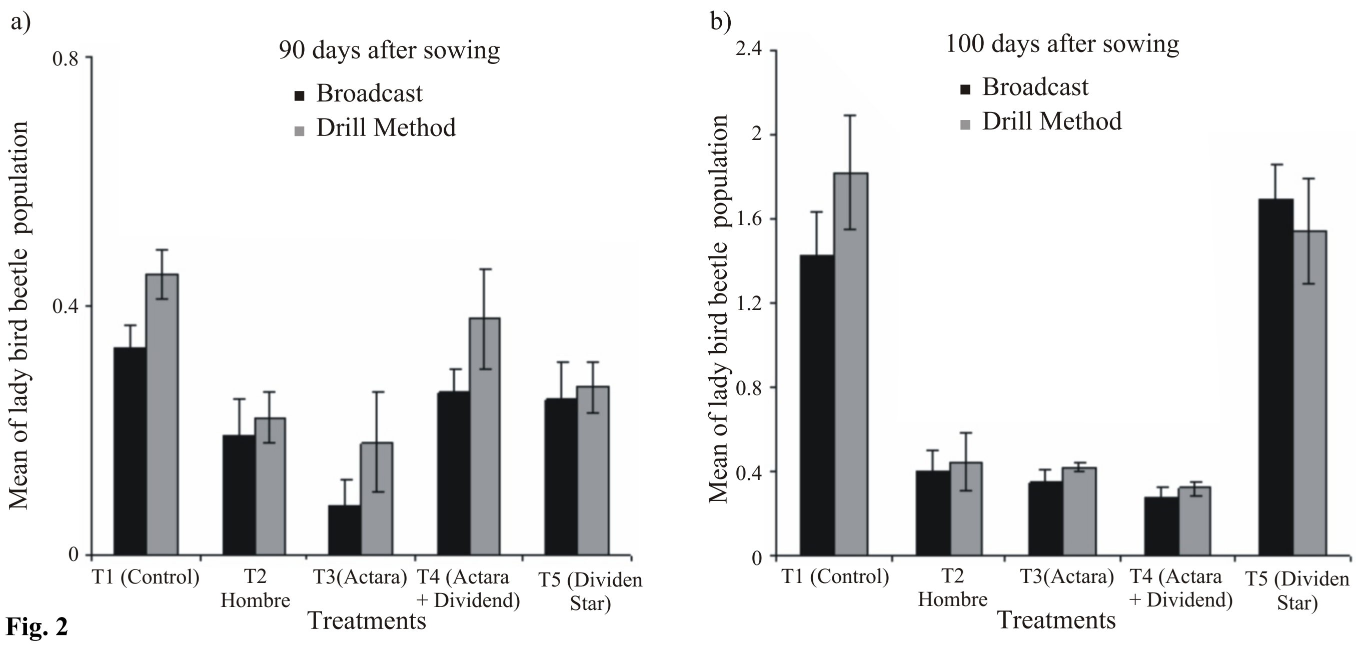

Fig. 2
Observation for mean population of lady bird beetle after 90 and 100 days of sowing. The error bars indicates the standard error of mean. a) Lady bird beetle population 90 days after sowing: Control & Actara®+Dividend Star® showed highest lady bird beetle population and significantly different from all other treatments. b) Lady bird beetle population 100 days after sowing: Control & Dividend Star® showed highest lady bird beetle population and significantly different from all other treatments.

Effect of seed treatment with insecticides on 1000-Grain weight and yield of the wheat crop

Analysis of variance showed that treatments were significantly different among each other regarding 1000 grain weight and yield of the wheat crop. Results also showed the significant differences between both sowing methods and non significant differences between interactions regarding 1000 grain weight and yield of the wheat crop (Table 3).

All the treatments were same regarding 1000 grain weight in broad cast method but significant difference among all the treatments was found in drill method. Results showed that Hombre® (36.48±0.94a) yielded highest grain weight and was significantly different from all other treatments under broad cast method (Table 4). Regarding the effect of insecticide on crop yield, the data indicated that Actara® (81.34±4.04a) and Hombre® (84.78±0.78a) exhibited the highest yield and were statistically different from all other treatments in drill and board cast method respectively (Table 4).

CONCLUSION

It is concluded that aphid population was lowest on Hombre® and Actara® treatments whereas highest aphid densities were found on Dividend Star® and untreated control. The highest number of lady bird beetle populations was found on Dividend Star® whereas lowest populations were found on Actara®. Hombre® gave the highest 1000 grain weight and wheat crop yield as compared to all other treatments.

Table 3
ANOVA parameters of 1000 grain weight and yield of wheat crop under different seed treatments of insecticides, sowing methods and their interactions.

Source of variation	Degrees of freedom	Mean squares 1000 grain weight	Mean squares Yield
Replication	2	26.134	40.372
Method	1	9.263*	35.816*
Treatment	4	12.662**	108.504**
Method x Treatment	4	0.748 ns	1.948 ns
Error	18	1.976	5.388
Total	29		

Observation of 1000 grain weight and yield of wheat crop under different seed treatments of insecticides. Analysis of variance regarding 1000-grain weight and crop yield. The data showed treatments were significantly different among each other regarding 1000 grain weight and yield of the wheat crop. The significance and non significance has been shown by letters viz., ns = non-significant (P>0.05); * = significant (P<0.05); ** = highly significant (P<0.01).

Table 4
Observation for **c**omparison of 1000-grain weight and crop yield.

Treatments	1000 grain weight		Crop yield	
	Broadcast	Drill	Broadcast	Drill
Control	34.50±1.48a	32.39±1.21c	72.00±4.16b	74.16±1.7b
Hombre®	37.21±1.33a	36.48±0.94a	80.66±1.86a	84.78±0.78a
Actara®	35.82±1.31a	34.58±1.14b	81.34±4.04a	83.1±1.74a
Actara®+ Dividend Star®	34.06±1.60a	32.80±1.15c	74.66±4.04b	76.44±1.24b
Dividend Star®	34.10±0.78a	33.89±0.92bc	76.00±3.24a	77.1±1.74b

Observation for comparison of means showing 1000-grain weight and crop yield. The data showed the significant differences for all the treatments regarding 1000 grain weight and wheat crop yield. No difference in treatments under drill method whereas Hombre® (36.48±0.94a) gave highest 1000 grain weight under broad cast method. Regarding crop yield, Actara® (81.34±4.04a) and Hombre® (84.78±0.78a) showed comparatively highest crop yield under drill and board cast method respectively. Standard error of mean is also written with each figure in the table. Means sharing similar letter in a column are statistically non-significant (P>0.05).

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