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COMPARATIVE EFFICACY OF VARIOUS INSECTICIDES FOR THE CONTROL OF WHITE FLY (BEMISIA TABACI GENN.) ON GUAR (CLUSTER BEAN) CROP UNDER ARID CONDITIONS

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Abstract

The experiments were conducted during the Kharif season 2022 at two different geographic locations i.e. Adaptive Research Farm, Karor, District Layyah, Punjab, Pakistan and at farmer's field (Chak No. 245/TDA, Tehsil Karor, Distt Layyah) using cluster bean variety BR-99 with seed rate of 25 kg ha^{-1}. The objective was to determine the efficacy of different pesticides against white fly on cluster bean under arid conditions. The experiments were designed in Randomized Complete Block Design (RCBD) with five treatments i.e. T1 - Flyban 10% EC (Cholofinapyre) 11.7% w/w @ 1235 ml ha-1, T2 - Decode 36 SC (Chlorofinapyre) @ 556 ml ha-1, T3 - Ulala (Flonicamid 50 % WG) @ 148.26 g ha^{-1} ,T4 - Thiacloprid 240 SC (Calypso) @ 625 ml ha-1 and T5- (Control) with three replications. The insecticides Flyban 10% EC (Pyriproxifin) 11.7% w/w @ 1235 ml ha-1 was found significantly best against white fly of guar, after 24 hours, 72 hours and 7 days after spray. All Pesticides resulted in decreased white fly population over control and a maximum yield of 717.18 kgha^{-1} and 617.85 kg ha-1 was obtained at both locations at Adaptive Research Farm as well as farmer's field, respectively. Thus, it is recommended that Flyban 10% EC (Pyriproxifin) 11.7% w/w may be applied @ 1235 ml ha-1 for effective control of white fly coupled with increased yield and yield contributing traits like number of clusters plant-1, number of podscluster-1, number of pods plant-1, 1000-seed weight of guar (cluster bean).

Keywords: *Arid zone, Cluster bean, Efficacy, Insecticides, Irrigated area, White fly, Yield parameters*

INTRODUCTION

Guar or cluster bean [*Cyamopsis tetragonoloba* (L.) Taub], family Fabaceae is a drought tolerant legume crop grown in arid and semi-arid regions of the country. It has many uses such as human nutrition, animal fodder and industrial purposes (1). It is also used for oil and methane extraction (hydraulic fracturing) (2). The crop posses high value as vegetable as it is rich in protein content and the later as source of gum. The crop is also being used as green manure which improves the physical properties of the soil. The straw is known for better quality fodder (3).

The total world production of guar is about 1.0-1.6 Mt per annum, with considerable fluctuations depending on climate trends such as monsoons, which influence market quotations (4, 18). India produces

approximately 80% of the world guar, followed by Pakistan (15%), while the remaining 5% is produced in USA, Australia and South Africa. In Pakistan guar is grown on area of 0.200 million hectares with annual production of 0.125 million tons (5, 20).This annual field crop is not exigent. It tolerates saline soils and drought as well, which allows its cultivation in southern regions of Punjab and Sindh with good results (6, 19).

Insect pests are major constraints in the productivity of cluster bean. Among them, leaf hopper (*Empoasca motti* Pruthi), White fly [*Bemisia tabaci* (Genn)], *Acaudaleyrodes rachipora* (Singh). Aphid (*Aphiscraccivora* Koch), Pod borer [*Helicoverpa armigera* (Hub.)], Leaf perforator *(Dichomeris inthes* Meyr), *Maruca testulalis* Geyer and *Protaetia terrosa* G & P are important pests infesting cluster bean (7).
White fly, [*Bemisia tabaci* (Genn.)] is an inconspicuous polyphagous insect pest and causes heavy loss to the crop by withdrawing large amount of cell sap. The pale yellow bodied white fly measure 1.0-1.5 mm in length and the body is covered with a white waxy powder. To combat the insect pests of cluster bean, the chemical control has been recommended by some workers (7, 8).

Crops security with chemical is advantageous and unavoidable part of Integrated Pest Management. Even in the technologically advanced countries about 30% of market value of Agriculture crops is spent on poisonous chemical. As there is a lack in studies on guar in Pakistan, the present study was carried out to verify the percentage of infestation on guar plants by whitefly and to assay the effect of successive application of insecticides on infestation rate.

MATERIALS AND METHODS

LOCATION

The experiments were conducted during the years 2022 at Adaptive Research Farm Karor, District Layyah, Punjab, Pakistan and at farmer's field *i.e.* Chak No. 245/TDA, Tehsil Karor, District Layyah using guar variety BR-99 with seed rate of 25 kg ha^{-1},the fertilizer NPK was applied as per recommendation and standard Agronomic practices were given at proper time. The experiments were laid out in Randomized Complete Block Design (RCBD) with three replications.

TREATMENTS

Trials were comprised of five treatments viz T1. Flyban 10% EC (Pyriproxifin) 11.7% w/w @ 1235 ml ha^{-1} T2. Decode 36 SC (Chlorofinapyre) @ 556 ml ha^{-1} T3. Ulala (Flonicamid 50 % WG) @ 148.26 g ha^{-1} T4. Thiacloprid 240 SC (Calypso) @ 625 ml ha^{-1} and T5. Control (Check plot). The treatments were replicated thrice. The treatments were applied after performing the proper pest scouting of whitefly on cluster bean.

PEST SCOUTING AND DATA RECORDING

The observation on white fly was recorded soon after their appearance at ETL. Data were recorded early in the morning by counting number of white fly to through use of magnifying lens on five randomly selected tagged plants in each plot. Three leaves of upper, middle and lower portion from these selected plants were observed. The same leaves were picked from each treatment and placed, gently, in paper bags and transferred to the population densities of immature stages of white fly was recorded. Data were treated as Complete Randomization Design according to Steel *et al*. (9). Multiple comparisons of significance were carried out applying LSD values. The crop was sprayed when the pest attack reached economic threshold level. The insecticides were dissolved in water to prepare insecticides solutions on V/V and W/V basis. Pest scouting at 24 hour, 72 hour and 7 days after spray was done. The crop was sprayed in the morning before 9 a.m. Pre and post spray data on the number of live nymphs-and-adults were recorded on five randomly selected plants per treatment. The mean number of the pests per plant was computed and data generated was statistically analyzed.

PARAMETERS

The growth parameters including plant height (cm) and yield parameters *i.e.* average number of cluster $plant^{-1}$, average number of pods $cluster^{-1}$, average number of pods $plant^{-1}$, 1000-seed weight (g) and yield (kg ha^{-1})were also recorded.

STATISTICAL ANALYSIS

Data were subjected to statistical analysis separately by using analysis of variance technique. The difference among treatment means was compared by using least significant different test at 5% probability level (9).

RESULTS AND DISCUSSION

AVERAGE PEST POPULATION BEFORE 24 HOURS OF SPRAY

The data regarding the number of pests before spray indicated non-significant differences among all the treatments at both locations i.e. Adaptive Research Farm Karor and farmer's field (Table I & II). The comparative study at Adaptive Research Farm, Karor resulted in maximum number of pests (10.50) in T4 where Thiacloprid 240 SC (calypso) @ 625 ml ha^{-1} was applied followed by T1 (10.33), T2 (10.30) and T3 (10.23). Whereas, the least number of pests (10.00) was found in check plot where, no insecticide was applied. Data pertaining to number of pest, before spray at farmer's field i.e. Chak No. 245/TDA, Tehsil Karor, Distt Layyah (Table II) showed similar trend of results as that of Adaptive Research Farm, Karor (Table I).

Table I. Efficacy of Different Insecticides for the control of white fly on Cluster bean crop at AR Farm, Kharif, 2022

Treatments with description	PP before 24 hrs	PP after 24 hrs	PP after 72 hrs	PP after 7 days	PH (cm)	NPP	NCP	NPP	1000 GW	YLD (Kg ha^{-1})
T1. Flyban 10% EC (Cholofinapyre) 11.7 % w/w @ 1235 ml ha^{-1}	10.33 a	1.33 a	1.00 a	0.33 a	49.6 a	4.6 a	13.7 a	49.3 a	30.7 a	717.18 a
T2. Decode 36 SC (Cholofinapyre)@ 556 ml ha^{-1}	10.30 a	2.00 b	1.66 a	1.00 b	49.2 a	4.2 a	11.5 a	46.3 a	30.2 a	639.43 b
T3. Ulala (Flonicamid 50%) WG) @ 148.26 gm ha^{-1}	10.23 a	2.33 b	2.06 b	1.33 b	48.8 a	4.0 a	11.4 a	46.1 a	30. 0 a	619. 65 b
T4. Thaicloprid 240 SC (Clapso) @ 625 ml ha^{-1}	10.50 a	1.66 b	1.33 b	0.66 b	49.3 a	4.3 a	12.0 a	48.5 a	30.5 a	705.75 a
T5. Control	10.00 a	16.33 d	18.66 d	9.33 e	47.6 a	2.9 b	11.1 b	43.3 b	21.8 b	554.97 d

The means in columns bearing same letters do not differ significantly ($p<0.05$)

*PP=Pest population, PH=Plant height, NPP= Number of pods plant^{-1}, GW= Grain weight, T_1-T5=Treatment 1, 2, 3, 4 & 5

AVERAGE POPULATION AFTER 24 HOUR OF SPRAY

The data regarding mean population of whitefly 24 hours after spray are presented in Table I & II which showed that all the treated plots at both locations i.e. Adaptive Research Farm, Karor and farmer's field are equal effective in controlling whitefly as compared to check plot, however, treatment 1significantly proved better as compared to other treatments. The analysis of data pertaining to the mean population of whitefly at Adaptive Research Farm, Karor (Table I) showed that there were no significant differences among the treatments except treatment 1. Minimum decrease in mean population of white fly (1.33) was recorded in T1 where Flyban 10% EC (Pyriproxifin) 11.7% w/w@ 1235 ml ha^{-1} was applied, which is statistical significant to T2 (2.00), T3 (2.33) and T4 (1.66) where Decode 36 SC (chlorofinapyre) @ 556 ml ha^{-1}, Ulala (Flonicamid 50 % WG) @ 148.26 gm ha^{-1} and Thiacloprid 240 SC (calypso) @ 625 ml ha-1 were applied, respectively. The maximum average population of white fly (16.33) was recorded in T5 (control plot) that was due to heavy infestation of white fly because no insecticide was sprayed. The similar trend of result was observed in farmers' field i.e. Chak No. 245/TDA, Tehsil Karor, Distt. Layyah (Table II) as that of AR Farm, Karor (Table I).

Table II. Efficacy of Different Insecticides for the control of white fly on Cluster bean crop at farmers field Chak No. 245 TDA Tehsil Karor Kharif, 2022

Treatments with description	PP before 24 hrs	PP after 24 hrs	PP after 72 hrs	PP after 7 days	PH (cm)	NPP	NCP	NPP	1000 GW	YLD (Kg ha^{-1})
T1. Flyban 10% EC (Cholofinapyre) 11.7 % w/w @ 1235 ml ha^{-1}	14.8 a	1.20 a	1.00 a	0.10 a	47.6 a	4.4 a	13.4 a	47.2 a	28.9 a	617.85 a
T2. Decode 36 SC (Cholofinapyre)@ 556 ml ha^{-1}	14.30 a	2.10 b	1.33 b	0.33 b	47.2 a	4.0 a	11.2 a	44.2 a	28.4 a	529.55 b
T3. Ulala (Flonicamid 50%) WG) @ 148.26 gm ha^{-1}	14.66 a	2.20 b	1.22 b	0.22 b	46.8 a	3.8 a	11.1 a	44.0 a	28.2 a	519.75 b
T4. Thaicloprid 240 SC (Clapso) @ 625 ml ha^{-1}	14.50 a	2.10 b	1.33 b	0.33 b	47.3 a	4.1 a	11.7 a	46.4 a	28.7 a	605.65 a
T5. Control	14.00 a	16.66e	19.33e	11.00 e	45.6 a	2.7 b	10.8 b	41.2 b	20.0 b	454.77d

The means in columns bearing same letters do not differ significantly ($p<0.05$)

*PP=Pest population, PH=Plant height, NPP= Number of pods plant^{-1}, GW= Grain weight, T_1-T5=Treatment 1, 2, 3, 4 & 5

AVERAGE POPULATION AFTER 72 HOURS OF SPRAY

The data concerning mean population of white fly 72 hours after spray as indicated in Table I & II showed that all the treatments at both locations i.e. Adaptive Research Farm, Karor and farmer's field were statistically at par and decrease the white fly population except T1 which significantly proved more better as compared to all treated and check plot. The data regarding the mean population of whitefly afterb72 hours of spray at ARF Karor (Table I) showed non-significant differences among the treatments except T1. Average minimum population of whitefly (1.00) was recorded in T1 where Flyban 10% EC (Pyriproxifin) 11.7% w/w @ 1235 ml ha^{-1} was applied which is significantly different from to T2 (1:66), T3(2.0) and T4 (1.33) where Decode 36 SC (Chlorofinapyre) @ 556 ml ha^{-1}, Ulala (Flonicamid 50% WG) @ 148.26 gha-1 and Thiacloprid 240 SC (Calypso) @ 625 ml ha^{-1} were applied, respectively. The maximum white fly population (18.66) was found in check plot. The similar trend of results was also observed in farmers' field i.e. Chak No. 245/TDA, Tehsil Karor, Distt. Layyah (Table II) as thatof ARF, Karor (Table I).

AVERAGE POPULATION AFTER 7 DAYS OF SPRAY

Data recorded at both locations (Table I & II) showed non-significant differences among the treatments and equi-effective in controlling whitefly after pest scouting of 7 days of spray. However, treatment I significantly proved better as compared to other treated and check plot. The perusal of the data regarding mean population of white fly at Adaptive Research Farm, Karor indicated that there were no significant differences among the treatments except TI (Table I). Minimum mean population of white fly (0.33) was recorded in T1, where Flyban 10% BC (Pyriproxifin) 11.7% w/w @ 1235 ml ha^{-1} was applied which is statistically significant To T2 (1.0) T3 (1:33) and T4 (0.66) where Decode 36 SC (Chlorofinapyre) @ 556 ml ha^{-1}, Ulala (Floricamid 50% WG @ 148.26 g ha^{-1} and Thiacloprid 240 SC (Calypso) @ 625 ml ha^{-1} were applied, respectively. Maximum mean population of white fly (9.33) was recorded in check plot. The similar trend of results was observed at farmers' field i.e. Chak No. 245/TDA, Tehsil Karor, Distt. Layyah (Table II) as that of ARF, Karor (Table I).

AVERAGE PLANT HEIGHT (CM)

Data presented in Table I & II showed no significant differences among the treatments regarding plant height (cm) of cluster bean at both the locations i.e. Adaptive Research Farm, Karor (Table I) as well as farmers' field at Chak no. 245/TDA,Tehsil Karor Distt. Layyah (Table II). Maximum plant height of cluster bean at Adaptive Research Farm, Karor was recorded in T1 (49.6 cm) where Flyban 10% EC (Pyriproxifin)

11.7% w/w @ 1235 ml ha^{-1} was applied which is statistically at par to T2 (49.2),T3 (48.8) and T4 (49.3) where Decode 36 SC (Chlorofinapyre) @ 556 ml ha^{-1}, Ulala (Flonicamid 50 % WG) @ 148.26 g ha^{-1} and Thiacloprid 240 SC (Calypso) @ 625 ml ha^{-1} were applied, respectively. Plant height remained stunted (47.6) in T5 (Control) due to heavy infestation of white fly because no insecticide was sprayed in check plots. The similar trend of results was also observed at farmers' field i.e. Chak No. 245/TDA, Tehsil Karor District Layyah (Table II) as that of ARF, Karor (Table I).

NO OF CLUSTERS PLANT-1

Data presented in Tables I and II showed non-significant differences among all treated plots except the treatment T5 (check plot) regarding average number of clusters per plant in cluster bean at both locations i.e. Adaptive Research Farm, Karor as well as farmer's field at Chak No.245/TDA , Tehsil Karor, Distt. Layyah. Maximum number of clusters plant-1at Adaptive Research Farm, Karor was recorded in T1 (13.7) where Flyban 10% EC (Pyriproxifin) 11.7% w/w @ 1235 ml ha-1 was applied which is statistically similar to T2 (11.5), T3 (11.4) and T4 (12.0) where Decode 36 SC (Chlorofinapyre) @ 556 ml ha^{-1} Ulala (Flonicamid 50 % WG) @ 148.26 gm ha^{-1} and Thiacloprid 240 SC (Calypso) @ 625 ml ha^{-1} were applied respectively. While minimum number of clusters per plant was recorded (11.1) in check plot (T1) where no pesticide was applied.

While data pertaining to average number of clusters plant-1 in farmer's field i.e. Chak no. 245/TDA, Tehsil Karor, District Layyah (Table-II) showed similar trend of result as that of ARF, Karor (Table I).

NUMBER OF PODS CLUSTER-1

A perusal of the data presented in Tables I & II showed non-significant differences among all treated plots except the treatment T1 (check plot) regarding average number of pods cluster-1at both the locations i.e. Adaptive Research Farm, Karor as well as farmer's field at Chak No.245/TDA, Tehsil Karor, Distt. Layyah. Maximum number of pods cluster-1at Adaptive Research Farm, Karor was recorded in T1(4.6) where Flyban 10% EC (Pyriproxifin) 11.7% w/w @ 1235 ml ha-1 was applied which was statistically at par to T2 (4.2), T3 (4.0) and T4 (4.3) where Decode 36 SC (Chlorofinapyre) @ 556 ml ha^{-1} Ulala (Flonicamid 50% WG) @ 148.26 gm ha^{-1} and Thiacloprid 240 SC (calypso) @ 625 ml ha^{-1} were applied respectively. While least number of pods cluster-1(2.9) was recorded in check plot (T5), where no pesticide was applied. While Data pertaining to average number of pods cluster-1 at farmer's field, i.e. Chak No. 245/TDA Tehsil Karor, Distt. Layyah (Table II) showed similar trend of result as that of Adaptive Research Farm, Karor (Table I).

NUMBER OF PODS PLANT-1

Data presented in table I and II showed non-significant differences among all treated plots except treatment T5 (check plot) regarding average number of pods plant^{-1} at both the locations i.e. Adaptive Research Farm Karor as well as farmer's field at Chak No. 245/TDA, Tehsil Karor, Distt. Layyah. Maximum number of pods plant-1 of cluster bean at Adaptive Research Farm Karor was recorded in TI (49.3) where Flyban 10% EC (Pyriproxifin) 11.7% w/w @ 1235 ml ha^{-1} was applied. The number of pods plant-1 in remaining treatments were found tobe T2 (46.3), T3 (46.1) and T4 (48.5), where Decode 36 SC (Chlorofinapyre) @ 556 ml ha^{-1} Ulala (Flonicamid 50% WG) @ 148.26 gm ha-1 and Thiacloprid 240 SC (Calypso) @ 625 ml ha-1 were applied respectively. While minimum number of pods plant-1 was recorded (43.3) in T5 (check plot), where no pesticide was applied.

While data pertaining to average number of pods per plant at farmer's field, i.e. Chak No. 245/TDA, Tehsil Karor, District Layyah (Table II) showed similar trend of result as that of Adaptive Research Farm, Karor (Table I).

1000-SEED WEIGHT (G)

Data presented in Table I and II showed non-significant differences among all treated plots except T5 (check plot) regarding 1000-seed weight of at both the locations i.e. Adaptive Research Farm, Karor as well as farmer's field at Chak No 245/TDA, Tehsil Karor. Maximum 1000-seed weight of cluster bean at Adaptive Research Farm, Karor was recorded in T1 (30.7 gm) where Flyban 10% EC (Pyriproxifin) 11.7%

w/w @1235 ml ha^{-1} was applied, which was statistically at par with to T2 (30.2), T3 (30.0) and T4 (30.5) where Decode 36 SC (chlorofinapyre) @ 556 ml ha^{-1} Ulala (Flonicamid 50 % WG) @ 148.26 gha-1 and Thiacloprid 240 SC (Calypso) @ 625 ml ha-1 were applied, respectively. Minimum 1000-seed weight (21.8 g) was recorded in check plot, where no pesticide was recorded. The similar trend of results was also observed in farmers' field Chak no. 245/TDA, Tehsil Karor District Layyah (Table II) as that of AR Farm Karor (Table I).

SEED YIELD (KG HA-1)

The data pertaining to the cluster bean seed yield at both the locations i.e. Adaptive Research Farm Karor and farmer's field at Chak No. 245/TDA, Tehsil Karor Distt Layyah is presented in Table I & II showed significant differences among the treatments which resulted in increased yield of seed as compared to check plot. The analysis of data concerning the seed yield at Adaptive Research Farm, Karor showed that maximum seed yield (717.18 kg ha^{-1}) was achieved in T1 where Flyban 10% EC (Pyriproxifin) 11.7% w/w @ 1235 ml ha-1 was applied. It was statistically similar with treatment T4where Thiacloprid 240 SC (Calypso) @ 625 ml ha^{-1}was applied with seed yield of 705.75 kg. Treatment T2 decode @ 629.43 kg ha^{-1} was statistically at par with treatment T3 (Ulala (Flonicamid 50 % WG) @ 148.26 g ha-1) with seed yield of 629.43 kg ha^{-1} and 619.65 kg ha^{-1}, respectively. The minimum seed yield of 554.97 kg ha^{-1} was recorded in T5 (check plot), because of high infestation of whitefly. All the insecticides increased the yield and yield parameters of cluster bean but Flyban 10% EC (Pyriproxifin) 11.7% w/w @ 1235 ml ha^{-1} provedto be the most effective pesticide to increase the seed yield of cluster bean. While data pertaining to seed yield at farmer's field, i.e. Chak No. 245/TDA, Tehsil Karor, District Layyah (Table II) showed similar trend of result as that of ARF, Karor (Table I).

Chemical control being the rapid method of pest control is an important practice of Integrated Pest Management to overcome losses caused by insect pest to crop (10, 17, 20). Chemical control is the most popular method for control of insect pest not only in Pakistan (9, 11) but also in the whole world. So, majority of farmers prefer chemical control of insect pest either primary or secondary (12). Our results are in conformity with Brown J.K. (13) who reported that Imidacloprid is most and least toxic to whitefly. However, our results are in contrast to Gresta *et al*. (14) and Khan *et al.* (15). Abdel-Razek *et al*. (16) stated that Imidacloprid controlled whitefly effectively.

CONCLUSION

From the studies of both the locations *i.e.* Adaptive Research Farm, Karor and farmer's field i.e. Chak No. 245/TDA, Tehsil Karor it is concluded that insecticide Flyban 10% EC (Pyriproxifin) 11.7% w/w @ 1235 ml ha^{-1} was found more effective against white fly of cluster bean which resulted in increased grain yield and yield contributing traits such as number of clusters plant^{-1}, number of pods cluster^{-1}, number of pods plant^{-1} and 1000-seed weight (gm) over control plot during the cropping season 2022 in arid zone of Karor.

On the basic of results it may be suggested that the insecticide Flyban 10% EC (Pyriproxifin) 11.7% w/w @ 1235 ml ha^{-1} is most effective for management of white fly.

Conflict of Interest:

Authors have no conflict of interest.

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