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Relative Efficacy of Selective Insecticides and Screening of Germ Plasm against Gram Pod Borer in Cow Pea (*Vignа unguiculata* L.)

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A B S T R A C T

An experiment was conducted on the efficacy of selective insecticides and screening of germ plasm against gram pod borer of cow pea (*Vigna unguiculata* L.) under randomized block design at student farm, university of Agricultural sciences, Bengaluru during rabi, 2016-17. The objective of this study was to investigate the most effective insecticide and germ plasm against the pod borer population. Different groups of chemicals were selected and the treatments were imposed as foliar sprays by using a hand compression knapsack sprayer of about 500 lit ha^{-1} spray fluid against major insect pests. A field study was conducted to evaluate the efficacy of six insecticides *viz.*, (Buprofezin 25 SC @ 250 g a.i./ha, Profenophos 50 EC @ 500 g a.i./ha, Azardirachtin 300 ppm @ 0.03% Imidacloprid 17.8 SL @ 25 g a.i./ha, Quinalphos 25 EC @ 250 g a.i./ha, Chlorpyrifos 20 EC @ 200 g a.i./ha.) against gram pod borer (*Helicoverpa armigera* H.) on Cowpea (*Vigna unguiculata* L.) variety KM - 5. The highest mortality of gram pod borer was recorded in plots treated with Quinolphos (85%, 90% and 94%) and profenofos (85%, 90% and 92%) at 3, 5 and 7 days after treatment (DAT), respectively. No plant mortality was recorded in untreated plots from 3 to 7 DAT. Thus, these insecticides proved highly effective for the management of gram pod borer on cowpea under field conditions and different genotypes against pod borer screened, in that PGCP – 3 have shown highly resistant to pod borer.

Introduction

Cowpea (*vigna unguiculata* L.) is an important legume crop that belongs to family Fabaceae. Asia contributes 90% of chickpea production in the world (Ahmed and Awan, 2013). Cowpea seed is also important for its high nutritive value and enriched with vegetable protein, carbohydrate, cholesterol lowering fiber, oil, ash, calcium and phosphorus (Pittaway *et al.*, 2006; Muehlbauer and Rajesh, 2008). Cowpea plant is under threat of many insect pests that attack on its roots, foliage and pods (Rao and Shanower, 1999).

Gram Pod borer (*Helicoverpa armigera* H.) is one of the major insect pests of cowpea and has great economic importance (Ahmed and Awan, 2013). It is highly polyphagous insect feeding on many other crops such as cotton, tobacco, safflower, tomato, maize, cabbage, peanuts and pulses (Patankar *et al.*, 2001; Javed *et al.*, 2013). Leguminous crops such as cowpea are its major host resulted in substantial yield loss (37-50%) and in severe cases up to 90% pod damage (Lal, 1996; Yadava and Lal, 1997; Sarwar *et al.*, 2009). Single larva can damage 40 pods and selectively feeds upon growing points and reproductive parts of the host plant. It feeds on floral buds, flowers and young pods of the growing crop (Khan *et al.,* 2009).

The wider host range, multiple generation, migratory behaviour and high fecundity of gram pod borer made it difficult to manage. The chemical control is still considered as the last resort for its management due to their quick known effect (Sreekanth, 2014). However, wise use of insecticide is the need of the time to avoid their drastic side effects on environment and natural biocontrol agents (Suhail *et al.,* 2013). Thus, exploring new insecticides with high efficacy and unique mode of action has become imperative. In recent years, newer compounds with novel modes of action are being concentrated to check the infestation of gram pod borer. Keeping in view the severe attack of gram pod borer, the present study aimed to evaluate the efficacy of selected insecticides against major pests of cowpea crop under field conditions. Nowadays usage of excessive insecticides leading to several environmental problems and it is difficult to incorporate eco-friendly techniques which can be fitted in IPM modules. Identification of pest resistant line is one of such tools with no recurrent cost, safe and easy to adopt. With the increasing importance of cowpea and keeping view in the lacunae in knowledge on pod borer complex of cowpea present investigation carried

Materials and Methods

The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications at University of Agricultural sciences, Bengaluru. six selective insecticides (Buprofezin 25 SC @ 250 g a.i./ha, Profenophos 50 EC @ 500 g a.i./ha, Azardirachtin 300 ppm @ 0.03% Imidacloprid 17.8 SL @ 25 g a.i./ha, Quinalphos 25 EC @ 250 g a.i./ha, Chlorpyrifos 20 EC @ 200 g a.i./ha.) along with a control were tested in the experiment for their relative toxicity against different pests on a cowpea variety KM - 5. These insecticides are abundantly available in the market and used against variety of insect pests of different crops. The chickpea seeds were sown at 45 × 10 cm distance between the plants. Whole agronomic practices were applied uniformly in the field throughout the cropping season. The insecticides were sprayed at their recommended doses with knapsack sprayer (20 mL capacity) at economic threshold level (ETL) of different pests. The data was recorded at 1 day before treatment (pre-treatment) and 3, 5 and 7 days after treatment (post-treatment). The percentage mortality of different pests was calculated with the following formula (Razaq *et al*., 2005).

Mortality (%) = A –B/C × 100

Where,

A = Mean population in control
B = Mean population in treatment
C = Mean population in control

Statistical analysis

For statistical analysis of data SPSS software and WASP softwares were used and for average data, square root transformation, for percentage data arc sine transformation were used.

Insecticides were applied twice, one at pre flowering (45DAS) and another at pod formation stage (70DAS). High volume sprayer was used to apply the insecticides. The efficacy of different insecticides in protecting the crop from different pests in a treated crop was assessed based on the population of different pests, pod damage and seed damage and with ten genotypes KM-5, KBC-2, KBC-8, KBC-9, C-152, PGCP-13, PGCP-5 and PGCP-6 which are screened under pod borer damage.

Screening of cowpea genotypes for resistance to pod borers

The resistance or susceptibility of cowpea genotypes was studied based on the percentage of flowers, pods and seeds damaged by the pod borers. The percentage of flowers damaged by the pod borers was estimated by counting the number of flowers damaged out of total number of flowers from randomly selected five plants during flowering period.

At the time of harvesting, all the pods of five randomly selected plants from each of the genotypes were examined and the percentage of pods and seeds damaged and also hundred grain weight were estimated.

The criteria used in the identification of resistant lines were based on percent pod damage as described below. Entries with 0-20 percent pods bored were regarded as highly resistant; 21-40 percent as moderately resistant; 41-60 percent pods as intermediate; 61-80 percent as susceptible; 81-100 percent as highly susceptible (Jackai,1981).

Results and Discussion

Results showed that all the insecticides significantly reduced the pod borer larval population. At 3 DAT, maximum mortality was recorded in plots treated with Profenofos (85%) and quinolphos (85%) that a statistically at par followed by azadiractin (80%), buprofezin (75%) chlorpyrifos (65%) and Imidacloprid. Likewise, both Profenophos and quinalphos also gave significant highest mortality (90%) as compared to other tested insecticides such as azadiractin (87%), buprofezin (80%) and chloripyiphos (65%) and Imidacloprid. Maximum mortality of gram pod borer was recorded in plots treated with quinolphos (94%) followed by Profenofos (92%), azadiractin (90%), Buprofezin (85%) and chloripyriphos (80%) and Imidacloprid at 7 DAT. No mortality was observed in the untreated plots at 3, 5 and 7 DAT. Thus, it is revealed that Quinolphos and Profenofos were the most effective insecticides to give high mortality of gram pod borer on cowpea under field conditions. It was also observed that the efficacy of all insecticides was gradually increased with the passage of time (Table 2).

Screening of selected cowpea genotypes against pod borers

Flower damage

A total of 10 cowpea entries were screened for the irresistance to podborers under field conditions during *kharif*, 2016 (Table 2). During the investigations, mainly two species of podborers were found damaging the flowers and pods of cowpea. The least percent flower damage was noticed PGCP-13(8.47%) which was significantly superior over other genotypes. This was followed by PGCP-5 (11.53%), PGCP-3(12.13%) and KM-5(14.35%). The damage was significantly highest in the KBC-8 (21.22%).

The least percent pod damage, seed damage, was noticed in PGCP-13 (8.99%) which was significantly superior over other genotypes (Table 2). This was followed by PGCP-3 (13.33%), KBC-9 (13.33%) and PGCP-5 (14.44%). The pod damage was significantly highest in the C-152 (22.22%) and KBC-2 (22.22%).

The least percent seed damage was observed in PGCP-13 (7.67%) which was significantly superior over other genotypes (Table 2).

General view of experimental plot

Damaged pods

Screening of cowpea genotypes for resistance to pod borers

Percent pods damaged	Resist sancerating
0- 20%	Highly resistant
21 -40%	Moderately resistant
4 1 -60%	Intermediately resistant
6 1-80%	Susceptible
8 0-100%	Highly susceptible

Table.1 Insecticides and their doses used in the experiment

Treatments	**Dosage**
T1Buprofezin25SC@250g*a.i.*/ha	1ml/l
T2Azardirachtin300ppm@0.03%	5ml/l
T3Profenophos50EC@500g *a.i.*/ha	2ml/l
T4Imidacloprid17.8SL@25g*a.i.*/ha	0.3ml/l
T5Quinalphos25EC@250g *a.i.*/ha	2ml/l
T6Chlorpyrifos20EC@200g *a.i.*/ha	2ml/l
T7Control	-

Table.2 Mean comparison of mortality of gram pod borer on cow pea at 3, 5 and 7 days after treatment (DAT)

Sl.No	**Treatments**	**Mortality (%)**		
		3DAT	**5DAT**	**7DAT**
1	Buprofezin25SC @1ml/l	75± 3.5	80± 5.75	85± 5.5
2	Azardirachtin300ppm @5 ml/l	80±2.5	87±1.51	90± 5.02
3	Profenophos50EC @2ml/l	85±1.14	90±2.77	91±3.12
4	Imidacloprid17.8SL@0.3ml/l	65±1.51	75±5.40	80±2.56
5	Quinalphos25EC @2ml/l	85±0.55	90±0.5	93±1.14
6	Chlorpyrifos20EC @2ml/l	70±2.23	78±5.01	79±4.56
7	Control	0	0	0
LSD P<0.05		2.12	2.12	2.12 -

Table.3 Flower and pod damage due to pod borers indifferent genotypes of cowpea (Kharif 2016)

Sl.No	Genotypes	Flowerdamage (%)	Poddamage (%)	Seeddamage (%)	100Grainweight (g)
1	KM-5	14.35^{abc}(22.25)	17.78^{ab}(24.85)	11.67^{abc}(19.93)	11.10^{e}
2	KBC-2	16.22^{ab}(23.73)	22.22^{a}(28.07)	15.67^{a}(23.13)	11.20^{e}
3	KBC-8	21.22^{a}(27.36)	17.78^{ab}(24.85)	10.67^{bc}(18.95)	11.77^{de}
4	KBC-9	15.37^{abc}(22.85)	13.33^{bc}(20.98)	9.00^{bc}(17.39)	10.83^{e}
5	C-152	20.74^{a}(27.01)	22.22^{a}(28.07)	15.67^{a}(23.31)	10.53^{e}
6	PGCP-3	12.13^{bc}(20.13)	13.33^{bc}(20.98)	8.00^{c}(16.27)	13.85^{cd}
7	PGCP-5	11.53^{bc}(19.76)	14.44^{bc}(22.14)	8.67^{bc}(17.10)	19.30^{a}
8	PGCP-6	18.06^{ab}(24.75)	17.78^{ab}(24.85)	11.33^{abc}(19.65)	8.30^{f}
9	PGCP-13	8.47^{c}(16.85)	8.99^{c}(17.20)	7.67^{c}(16.02)	16.11^{b}
10	IT-38965-1	18.36^{ab}(25.30)	17.78^{ab}(24.85)	13.00^{ab}(21.03)	14.07^{bc}
Ftest		2.47*	3.37*	3.54*	19.35*
S.Em.±		2.06	1.84	1.40	0.73
C.D.(0.05)		6.01	5.47	4.16	2.15
CV (%)		15.23	13.47	12.60	9.88

Note: Figures in the parentheses are √x+0.5 transformed values. In vertical columns, means followed by similar alphabets are not different statistically (0.05) as per DMRT

Table.4 Screening of cowpea germ plasm resistance against pod borers

Sl.No	Level of infestation (%)	Germplasm	Category	Grade	Score
1	0-20%	KM-5,KBC-8,KBC-9,PGCP-3,PGCP-5,PGCP-6,PGCP-13,IT-38956-1	Highly Resistance	HR	1
2	21-40%	KBC-2,C-152	Moderately Resistance	MR	2
3	41-60%	None	Intermediate	I	3
4	61-80%	None	Susceptible	S	4
5	81-100%	None	Highly Susceptible	HS	5

The next best genotypes was PGCP-3 (8.00%) which were also significantly superior over other genotypes followed by PGCP-5 (8.67%), KBC-9 (9.00%) and KBC-8 (10.67%) which were on par with each other. In C-152 and KBC2 highest percent (15.67%) of seed damage was noticed.

Hundred grain weight

The highest 100 grain weight (Table 2) was observed in PGCP-5 (19.30g), followed by PGCP-13 (16.11g). The 100 seed weight was very less in PGCP-6 (8.33g).

Plant characters of genotypes in relation to susceptibility or resistance

Variation in the infestation due to pod borers among the genotypes tested necessitated the studies on the difference in the morphological characters among them, to find out the relationship between these characters among them to find out the relationship between these characters and susceptibility or resistance. The data on five morphological characters with quantified value for each morphological character and there action of entries to pod borers attack is presented in Table 3.

The flower color (0.672*, 0.689*) and Pod colour (-0.720*, 0.636*) which showed significantly positive and negative correlation with the flower and pod damage respectively. Whereas other morphological characters like days taken to 50 percent flowering (0.159, 0.472) and days taken to maturity (0.157, 0.507) exhibited positive correlation with the flower and pod damage, respectively. The correlation between pod shape and flower or pod damage was negative but not significant (Table 3). During investigation it was noticed that among the germ plasm, eight germ plasm were showed highly resistance against spotted pod borer of cowpea KM-5, KBC-8, KBC-9, PGCP-3, PGCP-5, PGCP-6, PGCP-13, IT-38956-1 whereas, two germ plasm i.e., KBC-2, C-152 were recorded moderately resistance (Table 4).

The present findings clearly indicated that all insecticides were effective against gram pod borer, up to seven days after treatment. However, Profenofos and quinolphos gave maximum mortality of targeted insect pest at 3, 5 and 7 DAT. Hence, it is suggested that these effective insecticides may be suggested to the growers for management of the borer population below economic threshold level under field conditions. However, thorough investigations are necessary to test their specificity, environmental compatibility and insect pest resistance.

There exist significant variations in the different cowpea genotype studied with respect to agronomic and pest damage traits. Selection based on the rank summation index calculated identified top-ranking lines KM-5, KBC-8, KBC-9, PGCP-3, PGCP-5, PGCP-6, PGCP-13, IT-38956-1 with level of infestation 0 and 20 % respectively. Recommended for testing on farmer's field since they could be used to overcome the challenges faced by cowpea farmers in the zone

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