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Yield losses due to sucking pests in summer cowpea

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Abstract
Considering the yield and economics of insecticides, highest grain yield of cowpea 853 kg/ ha was recorded from the treatment of dinotefuran 0.006 per cent which was statistically at par with acetamiprid 0.004 per cent (816 kg/ha), spiromesifen 0.08 per cent (795 kg/ha), dimethoate 0.03 per cent (790 kg/ha) and flonicamid 0.02 per cent (752 kg/ha).The economics of different insecticidal treatments revealed that application acetamiprid 0.004 per cent proved to be the most economically viable treatment with maximum CBR (1:21.8). While, dimethoate 0.03 per cent emerged as second treatment with CBR (1:21.2). The other treatments, spiromesifen 0.08 per cent (1:9.8), dinetofuran 0.006 per cent (1:9.4), chlorfenapyr 0.0075 per cent (1:5.8), clothianidin 0.003 per cent (1:5.5) and flonicamid 0.02 per cent (1:4.8) appeared next in order.

Keywords: Aphis craccivora, Empoasca Kerri and Bemisia tabaci major sucking pests of cowpea

Introduction
Pulse crop recognized as a major source of dietary proteins for majority of the population in India and also in the world. It also helps in the improve soil fertility by fixing the atmospheric nitrogen in to soil through symbiotic bacterium called as Rhizobia. Cowpea is one among the major pulse crops in our country which serves the dietary requirement of the most of the vegetarian population on daily basis.

Cowpea [*Vigna unguiculata* (L.) Waip] belongs to family Leguminosae and sub family Faboidae. It is one of the most important principle pulse crop of tropics and commonly known as crowdel pea, *chala*, *chola or choli*, *chavli*, *lobia*, southern pea and black eyed bean. Importance of this crop is used as a fodder, as a vegetable, as a grain legume and as a green manure. It is consumed as dry grains, green pods and green seed. Cowpea play important role in human nutrition in a predominantly vegetarian country like India because it is also called as vegetable meat due to very rich amount of proteins. Cowpea seed contains around 60% carbohydrates, 22 to 28% proteins and 11.8% fat, it is also rich source of calcium and iron (Sharma, 2000) [7].

Cowpea originated in the west and central African Savannah region (Colby and Steele, 1976). In India it is grown mainly in both *kharif* and summer season as a sole crop. It is also grown either as an intercrop or mixed crop along with cereals such as sorghum, maize, millet or sometimes cotton. It is grown mainly in the states of Gujarat, Uttar Pradesh, Tamil Nadu, Andhra Pradesh, Haryana, Punjab, Kerala, West Bengal and Punjab

In India, with an annual production of 0.5 million tons and an average productivity of 608 kg/ha, cowpea is grown in about 1.5 million hectares (Swaminathan 2007) [8]. In Gujarat, cowpea (grain legume) is grown on an area of approximately 30470 ha with an annual production of 322084 tones and an average productivity of 845 kg / ha, while cowpea for vegetable purposes occupies an area of 760 ha with annual output of 6460 mt/ha and average productivity of 8.50 mt/ha (Anonymous, 2014) [1].

Even though the scientists have made every effort to increase output, the higher yield potential of different pulses, including cowpea, could not be achieved. Among the constraints that are responsible for the low yield of such an important pulses crop, the losses due to insect-pests are considered important. It is an unfortunate fact that every year about 15 to 20 per cent losses in pulses is due to the ravages of pest infestation (Lai and Sachan, 1997) [4]. The avoidable yield losses due to insect pests were recorded in the range 66-100 per cent in cowpea

(Pandey *et al.* 1991) [5]. In summer and *kharif* season as many as 21 insect pests of different groups were observed on cowpea. Among this, only a few are considered as a major pest of cowpea. Sucking pests such as aphid, jassid, and whitefly are important pests that restrict productive cowpea cultivation not only through direct sap sucking but also through transmission of viruses.

Materials and Methods

An experiment with the following information was performed with a view to estimating the losses incurred by the cowpea sucking pest complex.

Treatment Details

Both the treated and untreated plots were divided into 15 quadrates of size 1.0 m × 1.0 m. Two strips (treatments) each of 20.0 m × 10.0 m were prepared.

Unprotected plot (a): The field was kept free of insecticides and subject to the normal occurrence of the cowpea sucking pests.

Protected plot (b): The crop was protected from the damaged sucking pests by applying effective insecticides.

Observations Recorded

1. Yield of treated plot @ kg/quadrate (1.0 m×1.0 m)
2. Yield of untreated plot @ kg/quadrate (1.0 m×1.0 m)

Cowpea yields from protected and unprotected plots were recorded at harvest from each quadrate, and then statistically analyzed. The yield increased in protected plot over the unprotected plot (control) and avoidable loss was worked out from cowpea final yield using the formula given below by Pradhan (1969) [6]

$$\text{Yield increased (\%)} = 100 \times \frac{T-C}{C}$$

$$\text{Avoidable yield loss (\%)} = 100 \times \frac{T-C}{T}$$

Where,

T = Yield from treated (protected) plots (kg/ha)

C = Yield from untreated (control) plots (kg/ha)

Economics of all treatments were worked out by taking into the price of products, the cost of insecticides and the lobour fees. To compare different insecticidal treatments, the cost benefit ratio (CBR) was worked out.

$$\text{Cost Benefit Ratio} = \frac{\text{Net realization (Rs / ha)}}{\text{Total cost of insecticides (Rs /ha}}$$

Results

Treatment wise data on cowpea grain yield are given in Table -1 and shown in Figure. 1 It was found that the maximum grain yield of 853 kg / ha was obtained from the treatment of dinetofuran 0.006% which was statistically at par with acetamiprid 0.004%, spiromesifen 0.08%, dimethoate 0.03%and flonicamid 0.02%in which 816, 795, 790 and 752 kg/ ha yield was recorded, respectively. The insecticidal treatments of chlorfenapyr 0.0075 per cent, cyantraniliprole 0.02 per cent, clothianidin 0.003 per cent and spinosad 0.009 per cent were the next in the order giving yields of 700, 652, 624 and 614 kg/ ha, respectively and they did not differ significantly from the control (525 kg/ ha).

As far as the increase in yield is concerned, the maximum% increase (62.47 per cent) was recorded from the treatment of dinetofuran 0.006 per cent. The treatments which gave higher percentage of yield include acetamiprid 0.004%, spiromesifen 0.08%, dimethoate 0.03% and flonicamid 0.02%recording 55.42, 51.42, 50.47 and 43.23% increase over control. The other treatments gave less than 50% increase in yield.

Economics of Different Insecticidal Treatments

The economies of different treatments were estimated on the basis of the current market price of cowpea yield and management costs, which include the price of insecticides and labor costs, and finally the CBR values for each treatment were estimated and summarized in Table 2.

From the data provided in Table-2, it is evident that the net realization of different treatments with insecticides ranged from 8010 to 29520 Rs / ha. The treatments of dinetofuran 0.006% recorded maximum net realization i.e. 29520 Rs/ha, followed by acetamiprid 0.004% (26190 Rs./ha), whereas, minimum net realization was observed in the treatment of spinosad 0.009% (8010 Rs./ha).

Worked out the CBR of various insecticides (Table -2). Cost-benefit ratio is a very important parameter which indicates the wide-scale adoption recommendation's effectiveness and suitability.

The economy of different insecticide treatments showed that the highest cost-benefit ratio (1: 21.8) was obtained from the treatment of acetamiprid 0.004% followed by dimethoate 0.03% (1:21.2), spiromesifen 0.08% (1:9.8), dinetofuran 0.006% (1:9.4), chlorfenapyr 0.0075% (1:5.8), clothianidin 0.003% (1:5.5) and flonicamid 0.02% (1:4.8). The other treatments such as spinosad 0.009% (1:1.9) and cyantraniliprole 0.02% (1:0.4) registered low cost benefit ratios.

Among the different insecticides, dinetofuran 0.006% (29520 Rs/ ha) and spiromesifen 0.08% (24320 Rs/ha) recorded the maximum net return but the cost befit ratio of dinetofuran 0.006% (1:9.4) and spiromesifen 0.08% (1:9.8) were found low as compare to acetamiprid 0.004% (1:21.8) and dimethoate 0.03% (1:21.2) which may be due to high cost of insecticides so it can be concluded that the treatments of acetamiprid 0.004% and dimethoate 0.03% were found the most effective and economical against the sucking pest when compared with other treatments.

Table 1: Cowpea yield obtained in different insecticidal treatments

Sl. No.	Treatment	Concentration (per cent)	Yield kg/ha	Percentage increase in yield over control
1	Flonicamid 50 WG	0.02	752	43.23
2	Dinetofuran 20 SG	0.006	853	62.47
3	Cyantraniliprole 10 OD	0.02	652	24.19
4	Clothianidin 50 WDG	0.003	624	18.85
5	Chlorfenapyr 10 EC	0.0075	700	33.33
6	Spinosad 45 SC	0.009	614	16.95
7	Acetamiprid 20 SP	0.004	816	55.42
8	Spiromesifen 48 EC	0.08	795	51.42

9	Dimethoate 30 EC	0.03	790	50.47
10	Control	-	525	-
		S. Em.±	73.6	
		C. D. at 5%	176.43	
		C. V.%	10.56	

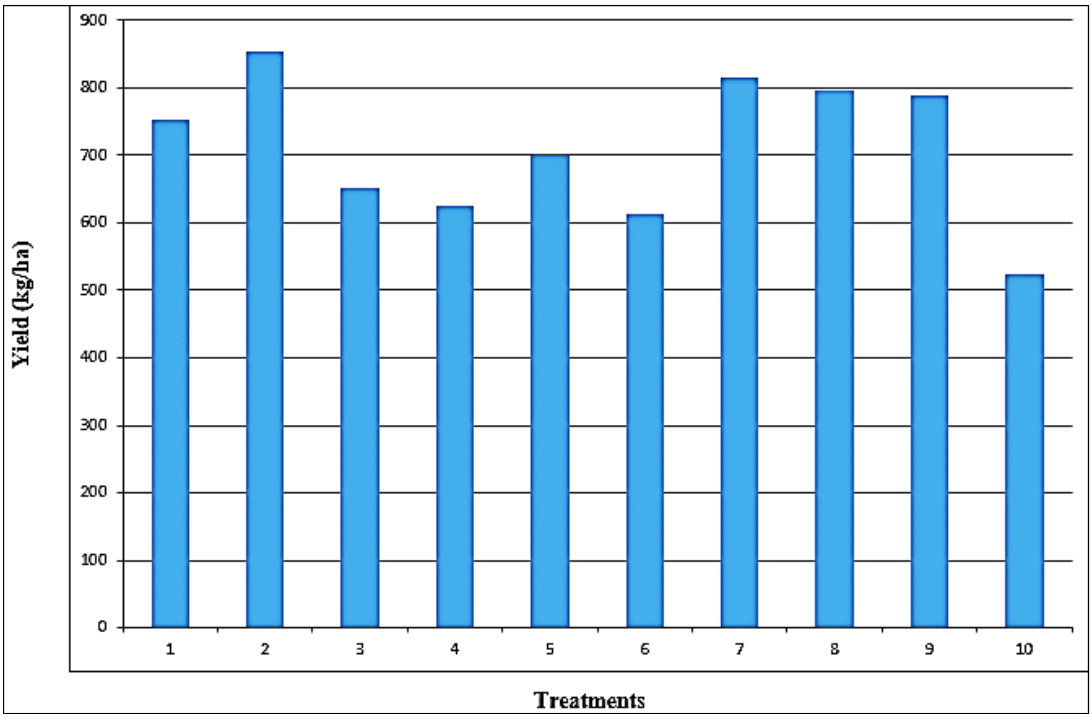

Fig 1: Cowpea yield obtained in different insecticidal treatments

Table 2: Yield and economics of different insecticidal treatments applied for the control of insect pests of summer cowpea during 2016

Sl. No.	Treatments	Quantity of insecticides for two sprays (lit/ha or kg/ha)	No. of sprays	Price of insecticides (Rs. /lit or kg)	Cost of insecticides for two sprays (Rs. / ha)	Total Cost of control measure (Rs./ha)	Yield (kg/ha)	Gross realization (Rs. / ha)	Net realization (Rs. / ha)	CBR
1.	Flonicamid 50 WG	0.4 kg	2	8666	3466	4186	752	67680	20430	1:4.8
2.	Dinetofuran 20 SG	0.3 kg	2	8000	2400	3120	853	76770	29520	1:9.4
3.	Cyantraniliprole 10 OD	2.0 lit	2	13000	26000	26720	652	58560	11310	1:0.4
4.	Clothianidin 50 WDG	0.06 kg	2	13500	810	1530	624	56160	8910	1:5.8
5.	Chlorfenapyr 10 EC	0.75 lit	2	2800	2100	2820	700	63000	15750	1:5.5
6.	Spinosad 45 SC	0.2 lit	2	17000	3400	4120	614	55260	8010	1:1.9
7.	Acetamiprid 20 SP	0.2 kg	2	2400	480	1200	816	73440	26190	1:21.8
8.	Spiromesifen 48 EC	1.6 lit	2	4100	6560	7280	795	71550	24300	1:9.8
9.	Dimethoate 30 EC	1.0 lit	2	400	400	1120	790	71100	23850	1:21.2
10.	Control	-	-	-	-	-	525	47250		

Labour charge has been calculated @ Rs. 360/ ha/ spray
Market value of cowpea has been calculated @ Rs. 90/ kg

Discussion

So far as yield of cowpea in various insecticides in concerned, the highest grain yield of 853 kg/ ha was obtained from the treatment of dinetofuran 0.006%, followed by acetamiprid 0.004%, spiromesifen 0.08%, dimethoate 0.03% and flonicamid 0.02% in which 816, 795, 790 and 752 kg/ ha yield was recorded, respectively. While, chlorfenapyr 0.0075% (700 kg/ ha), cyantraniliprole 0.02% (652 kg/ha), clothianidin 0.003% (624 kg/ha) and spinosad 0.009% (614 kg/ha) recorded moderate yield.

Among the different insecticides, the highest cost benefit ratio (1: 21.8) was obtained from the treatment of acetamiprid 0.004% followed by dimethoate 0.03% (1:21.2), spiromesifen 0.08% (1:9.8), dinetofuran 0.006% (1:9.4), chlorfenapyr 0.0075% (1:5.8), clothianidin 0.003% (1:5.5) and flonicamid 0.02% (1:4.8). The remaining treatments, spinosad 0.009% (1:1.9) and cyantraniliprole 0.02% (1:0.4) registered low cost benefit ratios.

Considering the effectiveness yield and economics of insecticides, acetamiprid 0.004% and dimethoate 0.03% were found most effective and economical treatments for the control of sucking pests in cowpea. The treatments of dinetofuran 0.006% and spiromesifen 0.08% were found comparatively less economical against the sucking pests of cowpea ecosystem.

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