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Original Research Article

Assessment of Relative Grain Yield Losses and Economics of Different Insecticidal Treatment against Pod Borer Complex

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Keywords

Insecticidal treatment, pod borer complex, *kharif*

A B S T R A C T

An investigation was conducted during *kharif* season 2016-17 at the experimental field of Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh. Among the insecticidal treatments against pod borer complex viz *Maruca vitrata*, *Helicoverpa armigera*, *Exelastis atomosa* and *Melanagromyza obtusa* in pigeonpea, the highest grain yield 1302.08 Kg /ha was recorded in Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha which was at par with Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Indoxacarb 15.8 EC @ 73g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha (1192.01 Kg/ha), in the untreated control the yield obtain was 856.42 kg /ha which was lowest of all the insecticidal treatments. The highest cost benefit ratio (1:4.81) calculated was also with Acetamiprid 20 SP @ 20g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha followed by Dimethoate 30 EC @ 600g a.i./ha > Dimethoate 30 EC @ 600g a.i./ha > Dimethoate 30 EC @ 600g a.i./ha (1:2.89).

Introduction

Pigeonpea [*Cajanus cajan* (L.) Millsp.] belongs to the genus *Cajanus* and family Fabaceae. India is the largest producer and also the largest consumer of pulses in the world. It accounts for 33 percent of the world areas and 25 percent share in global production (Srivastava *et al.*, 2010). The yield levels of this crop are not very encouraging. Among the factors responsible for low yield, the damage caused by insect pests is one of the major factors in pigeonpea. There are several numbers of insect pests were reported to attack this crop among these only few are economically important as pests *viz*., Tur plume moth, *Exelastis atomosa* (Walsh), Tur pod borer, *Helicoverpa armigera* (Hubner) and Tur Pod fly, *Melanagromyza obtusa* (Mall) collectively referred as "Pod borer complex" (Lal, 1998; Patil *et al.*, 1990). This pod borer complex recorded economic damage at various places ranging 30 to 100 percent, as a result we had to import pulses from other countries by investing a huge amount. Sahoo and Senapati (2001) reported that the pod borers together damaged 54.09 percent pods and 30.90 percent seeds incurring the yield losses of 21.01 percent in medium cultivars in pigeonpea.

Materials and Methods

Experiment on assessment of relative yield losses and economics due to pod borer

complex in pigeonpea was conducted in *kharif* season 2016- 17, at the experimental area of Research cum Instructional Farm, IGKV, Raipur, (C.G.). For the estimation of numbers of healthy and damaged pods and grains were recorded at the time of harvest to calculating yield loss. Seed weight in 100 damage pods due to pod borer complex comparison with seed weight in 100 healthy pods, the yield losses per cent were recorded with following formula

$$\text{Per cent grain yield losses} = \frac{\text{seed weight in 100 healthy pods}}{\text{seed weight in 100 damage pods}} \times 100$$

Where,

T = the yield obtained from full protected plot.

C = the yield obtained from the unprotected plot.

The weight of grains were recorded from each plot and converted in to kg / ha with the help of following formula

$$\text{Grain Yield (kg/ha)} = \frac{\text{Weight of grains in kg/plot}}{\text{Plot area in m2}} \times 10000$$

Economics of different insecticides were worked out as per the market price of the commodities and wages prevailing during the course of studies. For economic analysis, the factors considered were cost of different insecticides and other additional cost involved. Gross and net returns and benefit cost ratio were work out. Value of increased yield over untreated control was calculated by multiplying the increased yield over control by prevailing market price of pigeonpea (Rs 3000 per quintal). The net profit over untreated control was worked out by deducting cost of insecticides and labour charges from price of increased yield over control. The cost: benefit ratio were also be calculated by dividing net profit over control by the total cost (insecticides and labour charges).

$$\text{Benefit cost ratio} = \frac{\text{Net returns}}{\text{Total cost (insecticides+labour charges}}$$

Results and Discussion

The highest grain yield 1302.08 Kg /ha was recorded in Treatment 5: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha followed by Treatment 6: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Indoxacarb 15.8 EC @ 73g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha (1192.01 Kg/ha), Treatment 8: Dimethoate 30 EC @ 600g a.i./ha > Dimethoate 30 EC @ 600g a.i./ha > Dimethoate 30 EC @ 600g a.i./ha (1135.42 Kg/ha), Treatment 4: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Acephate 75 SP @ 750g a.i./ha (1107.12 Kg/ha), Treatment 7: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Flubendiamide 480 SC @ 30g a.i./ha > Dimethoate 30 EC @ 600g a.i./ha (1062.85 Kg/ha), Treatment 2: Acephate 75 SP @ 750g a.i./ha > Acephate 75 SP @ 750g a.i./ha > Acephate 75 SP @ 750g a.i./ha (1058.51 Kg/ha) while the lowest grain yield of 1056.08 Kg /ha was recorded in Treatment 3: Acetamiprid 20 SP @ 20g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha treated plots, and the untreated control resulted least (856.42 kg /ha) grain yield in comparison to newer insecticides treated plots. The results of the present findings states that all the treatments showed best in yield over control. The highest yield over control was obtained under treatment, Treatment 5: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Chlorantraniliprole 18.5 SC @

30g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha followed by Treatment 6: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Indoxacarb 15.8 EC @ 73g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha (1192.01 Kg/ha). Price of increased yield over control was calculated and highest price was with Treatment 5: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha. lowest was with Treatment 3: Acetamiprid 20 SP @ 20g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha. Thus application of Treatment 5: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha proved to be the best regarding management of pod borers and grain yield of Pigeonpea. The percent pod and grain damage against yield in each plot treated with insecticides was represented under fig 1.

Seed weight in 100 damage pods due to pod borer complex comparison with seed weight in 100 healthy pods, the yield losses per cent was recorded which ranged from 42.15 % to 54.36%. The highest yield loss was obtained under untreated control (54.36%). In treated plot, The highest yield loss was obtained under Treatment 2: Acephate 75 SP @ 750g a.i./ha > Acephate 75 SP @ 750g a.i./ha > Acephate 75 SP @ 750g a.i./ha (48.13%) followed by Treatment 3: Acetamiprid 20 SP @ 20g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha (48.05%). The lowest yield loss was obtained under Treatment 5: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha (36.47%). The details of the relative grain yield losses are presented in the table no.3. Among different newer insecticides tested, the highest net return was found in Treatment 5: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha (Rs.15511.83) followed by Treatment 6: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Indoxacarb 15.8 EC @ 73g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha (Rs.11303.30), Treatment 8: Dimethoate 30 EC @ 600g a.i./ha > Dimethoate 30 EC @ 600g a.i./ha > Dimethoate 30 EC @ 600g a.i./ha (Rs.10465.50), Treatment 3: Acetamiprid 20 SP @ 20g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha (Rs.8348.83), Treatment 2: Acephate 75 SP @ 750g a.i./ha > Acephate 75 SP @ 750g a.i./ha > Acephate 75 SP @ 750g a.i./ha (Rs.7091.55), and Treatment 7: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Flubendiamide 480 SC @ 30g a.i./ha > Dimethoate 30 EC @ 600g a.i./ha (Rs.5360.72) while the lowest net return was with Treatment 4: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Acephate 75 SP @ 750g a.i./ha (Rs.5206.35). The economic analysis of plant protection is based on the prevailing market rates of insecticides, labour wages and pigeonpea grain cost.

The cost benefit ratio was worked out to know the economics of insecticidal treated plots. The highest cost-benefit ratio was with Treatment 3: Acetamiprid 20 SP @ 20g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha (4.81) followed by Treatment 8: Dimethoate 30 EC @ 600g a.i./ha > Dimethoate 30 EC @ 600g a.i./ha > Dimethoate 30 EC @ 600g a.i./ha (2.89), Treatment 2: Acephate 75 SP @ 750g a.i./ha > Acephate 75 SP @ 750g a.i./ha > Acephate 75 SP @ 750g a.i./ha (2.28), Treatment 5: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha (2.22),

Table.1 Per cent pod damage by pod borer complex and grain yield in different treatments of pigeonpea

Notation	Treatments	Doses (a.i./ha)	Percent pod damage by pod borer complex	Percent pod damage due to				Grain Yield (Kg/ha)
				H. armigera	*M. vitrata*	*E. atomosa*	*M. obtusa*	
T1	Control		34.32 (35.84)*	9.15 (17.58)	8.64 (17.09)	8.61 (17.05)	7.91 (16.3)	856.42
T2	Acephate 75SP > Acephate 75SP > Acephate 75SP	750g > 750g > 750g	22.46 (28.26)	5.99 (14.11)	5.9 (14.00)	5.48 (13.50)	5.09 (12.94)	1058.51
T3	Acetamiprid 20SP > Acetamiprid 20SP > Acetamiprid 20SP	20g > 20g > 20g	18.36 (25.28)	4.73 (12.45)	4.72 (12.55)	4.56 (12.14)	4.34 (11.97)	1056.08
T4	Chlorantraniliprole 18.5 SC > Chlorantraniliprole 18.5SC > Acephate 75SP	30g > 30g > 750g	21.71 (27.74)	5.54 (13.58)	4.62 (12.39)	6.3 (14.46)	5.24 (13.12)	1107.12
T5	Chlorantraniliprole 18.5 SC > Chlorantraniliprole 18.5SC > Acetamiprid 20SP	30g > 30g > 20g	15.58 (23.22)	3.98 (11.50)	3.59 (10.89)	4.27 (11.81)	3.74 (11.12)	1302.08
T6	Chlorantraniliprole 18.5 SC > Indoxacarb 15.8 EC >Acetamiprid 20SP	30g > 73g > 20g	18.23 (25.26)	4.77 (12.60)	4.64 (12.37)	4.37 (11.96)	4.46 (12.13)	1192.01
T7	Chlorantraniliprole 18.5 SC > Flubendiamide 480 SC > Dimethoate 30EC	30g > 30g > 600g	19.48 (26.17)	5.52 (13.56)	3.89 (11.29)	4.65 (12.38)	5.42 (13.42)	1062.85
T8	Dimethoate 30EC > Dimethoate 30EC > Dimethoate 30EC	600g > 600g > 600g	22.6 (28.36)	6.29 (14.50)	5.75 (13.86)	6.26 (14.47)	4.31 (11.91)	1135.42
SE(m)±			**0.91**	**0.67**	**0.69**	**1.04**	**0.94**	**162.55**
C.D. (5%)			**2.80**	**2.06**	**2.12**	**3.19**	**2.89**	**53.08**

*Figures in Parentheses are angular transformed values

Table.2 Percent grain damage by pod borer complex and grain yield in different treatments of pigeonpea

Notation	Treatments	Doses (a.i./ha)	Percent grain damage by pod borer complex	Percent grain damage due to				Grain Yield (Kg/ha)
				H. armigera	*M. vitrata*	*E. atomosa*	*M. obtusa*	
T1	Control		18.21 (25.23)	4.94 (12.78)	3.38 (10.58)	4.87 (12.73)	5.01 (12.92)	856.42
T2	Acephate 75SP > Acephate 75SP > Acephate 75SP	750g > 750g > 750g	10.95 (19.32)	2.85 (9.70)	1.58 (7.22)	3.21 (10.31)	3.37 (10.57)	1058.51
T3	Acetamiprid 20SP > Acetamiprid 20SP > Acetamiprid 20SP	20g > 20g > 20g	9.33 (17.77)	2.37 (8.82)	1.27 (6.45)	3.03 (10.02)	2.66 (9.37)	1056.08
T4	Chlorantraniliprole 18.5 SC > Chlorantraniliprole 18.5SC > Acephate 75SP	30g > 30g > 750g	7.14 (15.50)	1.95 (7.99)	1.21 (6.26)	1.72 (7.51)	2.27 (8.56)	1107.12
T5	Chlorantraniliprole 18.5 SC > Chlorantraniliprole 18.5SC > Acetamiprid 20SP	30g > 30g > 20g	6.41 (14.62)	1.84 (7.70)	0.99 (5.69)	1.59 (7.13)	1.99 (8.10)	1302.08
T6	Chlorantraniliprole 18.5 SC > Indoxacarb 15.8 EC >Acetamiprid 20SP	30g > 73g > 20g	7.21 (15.47)	2.28 (8.63)	1.03 (5.75)	1.66 (7.22)	2.25 (8.56)	1192.01
T7	Chlorantraniliprole 18.5 SC > Flubendiamide 480 SC > Dimethoate 30EC	30g > 30g > 600g	8.23 (16.66)	2.25 (8.53)	1.69 (7.44)	1.99 (7.94)	2.3 (8.71)	1062.85
T8	Dimethoate 30EC > Dimethoate 30EC > Dimethoate 30EC	600g > 600g > 600g	9.32 (17.70)	2.96 (9.68)	2.06 (8.23)	2.23 (8.49)	2.07 (8.24)	1135.42
SE(m)±			**0.81**	**0.87**	**0.43**	**0.76**	**0.57**	**162.55**
C.D. (5%)			**2.47**	**2.67**	**1.33**	**2.33**	**1.74**	**53.08**

Figures in Parentheses are angular transformed values

Table.3 Relative grain yield losses by pod borer complex in different treatments

Treatment	Grain yield (g/100 healthy pods/Treatment)	Yield losses by pod borer complex in 100 damage pods (%)	Yield losses by *M. Vitrata* (%)	Yield losses by *H. armigera* (%)	Yield losses by *M. obtusa* (%)	Yield losses by *E. atomosa* (%)
T1	54.36	54.36	39.27	52.24	61.94	64.01
T2	48.13	48.13	24.40	45.83	65.08	57.20
T3	48.05	48.05	25.42	49.13	60.53	57.14
T4	44.30	44.3	31.56	49.18	55.77	40.68
T5	36.47	36.47	29.97	38.56	46.26	31.07
T6	43.25	43.25	26.83	50.96	53.45	41.74
T7	42.15	42.15	41.49	41.15	42.81	43.17
T8	43.29	43.29	37.67	48.55	49.49	37.44

T1: Untreated control; T2: Acephate 75 SP @ 750g a.i./ha > Acephate 75 SP @ 750g a.i./ha > Acephate 75 SP @ 750g a.i./ha
T3: Acetamiprid 20 SP @ 20g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha
T4: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Acephate 75 SP @ 750g a.i./ha
T5: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha
T6: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Indoxacarb 15.8 EC @ 73g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha
T7: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Flubendiamide 480 SC @ 30g a.i./ha > Dimethoate 30 EC @ 600g a.i./ha
T8: Dimethoate 30 EC @ 600g a.i./ha > Dimethoate 30 EC @ 600g a.i./ha > Dimethoate 30 EC @ 600g a.i./ha

Table.4 Cost economics of different insecticides against pod borer complex in pigeonpea

Treatment	Yield (Kg/ha)	Increased yield over control (Kg/ha)	Price of Increased yield over control (Rs./ha)	Cost of chemicals & labour (Rs./ha)	Net profit over control	Benefit:cost ratio
T1	856.42					
T2	1058.51	202.09	10205.55	3114.00	7091.55	2.28
T3	1056.08	199.66	10082.83	1734.00	8348.83	4.81
T4	1107.12	250.70	12660.35	7454.00	5206.35	0.70
T5	1302.08	445.66	22505.83	6994.00	15511.83	2.22
T6	1192.01	335.59	16947.30	5644.00	11303.30	2.00
T7	1062.85	206.43	10424.72	5064.00	5360.72	1.06
T8	1135.42	279.00	14089.50	3624.00	10465.5	2.89

Cost of chemicals: Acephate (75SP) 1 Kg- Rs 590, Acetamiprid (20SP) 1 Kg- Rs 891, Chlorantraniliprole (18.5 SC) 30 ml- Rs 460, Indoxacarb (15.8SC) 1 Lit- Rs 2650, Flubendiamide (480 SC) 100 mi- Rs 1650, Dimethoate (30EC) 1 Ltr- Rs 380
Labour cost = 2 Labour day /ha @ Rs 224.00per day
Total labour cost / ha (Three sprays) = Rs. 1344
Price of Pigeonpea = Rs 5,050 per quintal.

Treatments detail:

T1: Untreated control ; T2: Acephate 75 SP @ 750g a.i./ha > Acephate 75 SP @ 750g a.i./ha > Acephate 75 SP @ 750g a.i./ha
T3: Acetamiprid 20 SP @ 20g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha
T4: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Acephate 75 SP @ 750g a.i./ha
T5: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha
T6: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Indoxacarb 15.8 EC @ 73g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha
T7: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Flubendiamide 480 SC @ 30g a.i./ha > Dimethoate 30 EC @ 600g a.i./ha
T8: Dimethoate 30 EC @ 600g a.i./ha > Dimethoate 30 EC @ 600g a.i./ha > Dimethoate 30 EC @ 600g a.i./ha

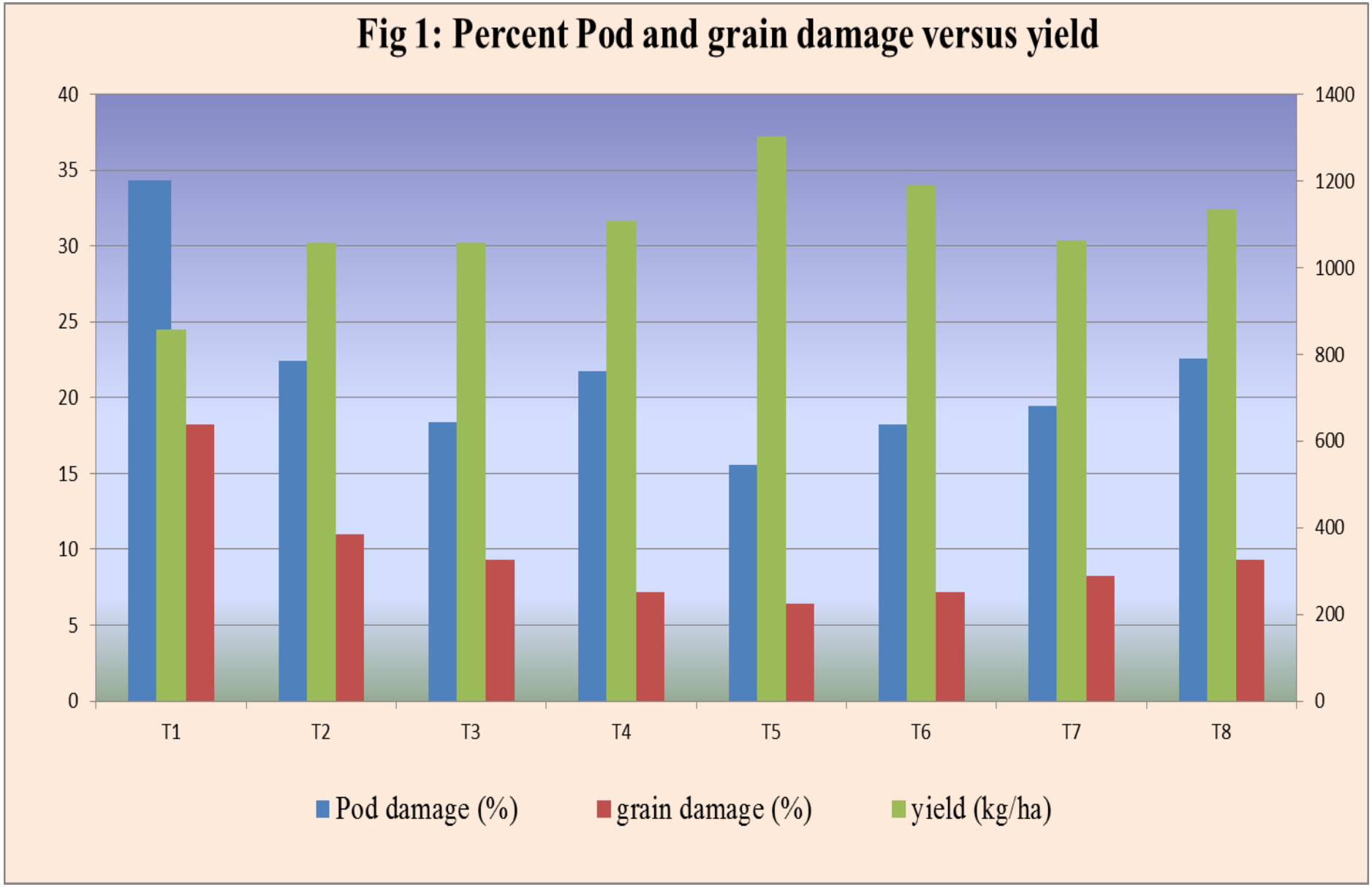
Fig 1: Percent Pod and grain damage versus yield
40
35
30
25
20
15
10
5
0
1400
1200
1000
800
600
400
200
0
T1
T2
T3
T4
T5
T6
T7
T8
Pod damage (%)
grain damage (%)
yield (kg/ha)

Treatment 6: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Indoxacarb 15.8 EC @ 73g a.i./ha > Acetamiprid 20 SP @ 20g a.i./ha (2.00), and Treatment 7: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Flubendiamide 480 SC @ 30g a.i./ha > Dimethoate 30 EC @ 600g a.i./ha (1.06) while the lowest cost-benefit ratio was with Treatment 4: Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Chlorantraniliprole 18.5 SC @ 30g a.i./ha > Acephate 75 SP @ 750g a.i./ha (0.70). The economic analysis of plant protection is based on the prevailing market rates of insecticides, labour wages and pigeonpea grain cost. The details of the cost: benefit estimates ate presented in the table no.4. The present finding are in accordance also with Khamoriya *et al.,* (2017) who reported that sequential application of Chlorantraniliprole 18.5 SC @ 30g a.i/ha - Indoxacarb 15.8 EC @ 73g a.i./ha - Acetamiprid 20 SP @ 20g a.i/ha and Module 3 with sequential application of Chlorantraniliprole 18.5 SC @ 30g a.i/ha -Acephate 75 SP @ 750g a.i/ha - Acephate 75 SP @ 750g a.i/ha provided better control of *M. obtusa, C. gibbosa* and *H. armigera* on pigeonpea in terms of lower pod and grain damage and higher grain yield.

References

Khamoriya, J. Keval, R.., Chakravarty, S., and Mishra, V. 2017. Evaluation of sequential application of insecticides against major insect pests on long duration pigeonpea [*Cajanus cajan* (L.) Millsp.]. Journal of Entomology and Zoology Studies 2017; 5(3): 1891-1894.

Lal, S.S. and Katti, G. 1998. IPM of pod borer complex infesting pigeonpea (In) IPM system in Agriculture, Vol IV. Aditya books Pvt. Ltd., New Delhi, pp. 79-128.

Patil, C.S., Khaire, V.M. and Mole, U.N. 1990. Comparative performance of different insecticides against pigeonpea pod borer complex on short duration pigeonpea. Journal of Maharashtra Agril. Uni. 15(30):337-339.

Sahoo, B. K. and Senapati, B. 2001. Efficacy and economics of synthetic insecticides and plant products for the control of pod borers incidence in pigeonpea. Indian Journal of Entomology. 62 (4): 346-352.

Srivastava, S. K., Sivaramane, N. and Mathur, V. C. 2010. Diagnosis of pulses performance of India. Agricultural Economics Research Review. 23: 137-148.