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Bioefficacy of newer insecticides against pigeonpea (*Cajanus cajan* L. Millsp.) pod borers

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Abstract
Among various insecticides under study, rynaxypyr 18.5 SP @ 30 g a.i./ha was most effective insecticide in minimizing the larval population of pigeonpea pod borers *viz*., gram pod borer, plume moth and pod fly. The treatment application of rynaxypyr 18.5 SP @ 30 g a.i. per ha shown the lowest pod damage (5.59 per cent) due to pigeonpea pod borers and recorded highest gain yield of pigeonpea (7.60 q per ha). The treatment application of profenofos + DDVP @ 2ml + 0.5 ml per lit and rynaxypyr 18.5 SP @ 30 g a.i. per ha recorded highest increase in yield over control *i.e.* 3.62 and 3.63 q per ha as well as maximum cost benefit ratio of 1:1.75 and 1:1.72. The results indicated that rynaxypyr 18.5 SP was more effective against pigeonpea pod borers and reducing the pod damage with its novel properties which ultimately leads to increase in yield and highest cost benefit ratio.

Keywords: Newer insecticides, Pigeonpea, Plume moth, Pod borers, Pod borer and Pod fly

1. Introduction

Pigeonpea [*Cajanus cajan* (L.) Millspaugh], also known as red gram or tur or arhar is the second most important grain legume of India after chickpea. The seeds and other parts of plant are fed upon by many insects, with over 200 insect species have been recorded on pigeonpea crop [1]. Among the pod borer complex, gram pod borer (*Helicoverpa armigera* Hubner), plume moth (*Exelastis atomosa* Walsingham) and pod fly (*Melanagromyza obtusa* Malloch) causes heavy damage to pigeonpea pods and grains resulting in huge loss in the grain yield. Pod borers caused 60 to 90 per cent loss in the grain yield under favourable conditions [2]. *Helicoverpa armigera* and *Melanagromyza obtusa* cause huge economic damage leading to very low yield levels as against the potential yield. Economic losses due to biotic factors have been estimated to be US $ 8.48 billion [3]. The pod fly, *Melanagromyza obtusa* alone causes a yield loss of 60 to 80 per cent [4] and the losses have been estimated at US $ 256 million annually [5]. Farmers are using chemical pesticides indiscriminately, which leads to increased cost of plant protection resulting in lower profitability. Considering above facts, newer insecticides were evaluated to find out economically feasible insecticide having novel mode of action for management of pigeonpea pod borers.

2. Material and Methods

The field experiment was conducted at Research Farm, Agricultural Entomology Unit, Agricultural Research Station, Badnapur (VNMKV, Parbhani) during *Kharif* season of 2014-15. The experiment was carried out in randomized block design (RBD) using pigeonpea Cv. BSMR-736, with seven treatments and three replications in a plot size of 6.0 m x 4.5 m. Row to row and plant to plant spacing was maintained at 60 cm x 30 cm. The treatments T_1 = Acephate 75 SP @ 750 g a.i./ha, T_2 = Acetamiprid 20 SP @ 20 g a.i./ha, T_3 = Indoxacarb 15.8 EC @ 73 g a.i./ha, T_4 = Rynaxypyr (=chlorantriniliprole or E2Y45) 18.5 SP @ 30 g a.i./ha, T_5 = Profenofos + DDVP @ 2 + 0.5 ml/lit, T_6 = Dimethoate 30 EC @ 600 g a.i./ha in comparison with T_7 = Control (untreated) were evaluated for their efficacy against pigeonpea pod borer complex. Crop was raised with recommended agronomic practices. The first spray was applied at 50 per cent flowering stage and second spray was administered at pod development stage through high volume hand operated knapsack sprayer. The sprays were applied at evening hours to minimize the toxicity for relative pollinators and support their conservation. The pre-treatment count was made a day before, while, post treatment counts were made on one, three, seven and fifteen days after each spray, respectively [6, 7]. The population count of pigeonpea pod borers *viz*., for *H. armigera*, *E. atomosa* and *M. obtusa* was taken on randomly selected five tagged plants. Pod damage due to pigeonpea pod borers was calculated at harvest. About five plants were kept without plucking pods throughout the season for recording of actual yields and converted to q per ha. The data, thus, obtained were subjected to RBD analysis using AGRES package [8] for drawing meaningful conclusion. Cost Benefit Ratio was worked out on the realized net profits, considering cost of plant protection, which exhibits the economic viability through the viewpoint of management of pod borers infesting pigeonpea. Per cent pod damage was calculated by using following formula [9].

$$\text{Per cent pod damage} = \frac{\text{Number of damaged pods}}{\text{Total number of pods}} \times 100$$

3. Results and Discussion

The data on larval population of gram pod borer, *H. armigera* on pigeonpea is presented in Table 1. The data indicates that the larval population of *H. armigera* was non-significant on one day before spray (DBS) in all the treatments indicating uniform distribution of pest larvae. The treatment application of rynaxypyr 18.5 SP @ 30 g a.i./ha found as the best treatment which recorded minimum larval population of *H. armigera* on one, three, seven and fifteen day after spray (DAS) *i.e.* 1.13, 0.47, 0.20 and 0.27 larvae per plant, respectively. This was followed by all other remaining treatments *i.e.* dimethoate 30 EC @ 600 g a.i./ha, profenofos + DDVP @ 2ml + 0.5 ml/lit, indoxacarb 15.8 EC @ 73 g a.i./ha, acetamiprid 20 SP @ 20 g a.i./ha and acephate 75 SP @ 750 g a.i./ha except control having at par effect with each other, respectively; while maximum larval population was observed in untreated control *i.e.* 1.87, 1.60, 1.67 and 1.93 larvae per plant on one, three, seven and fifteen days after spray, respectively. The results in relation to larval population of *H. armigera* are in accordance with the earlier reports of [6] who reported that chlorantraniliprole @ 30 g a.i./ha was the most effective insecticide against pod borer complex and was followed by chlorantraniliprole + lambda cyhalothrin @ 37.5 g a.i./ha, chlorantraniliprole + lambda cyhalothrin @ 30 g a.i./ha and indoxacarb @ 75 g a.i./ha, respectively. Similarly, [10, 11, 12, 13] reported that rynaxypyr 20 SC @ 30 g a.i. /ha as superior molecule in recording less larval population.

Table 1: Effect of newer insecticides against gram pod borer on pigeonpea.

S. No.	Name of treatment	Pod borer larvae per plant				
		1 DBS	**1 DAS**	**3 DAS**	**7 DAS**	**15 DAS**
1	Acephate 75 SP @ 750 g a.i./ha	2.60 (1.72)	1.67 (1.47)	0.67 (1.08)	0.33 (0.90)	0.40 (0.94)
2	Acetamiprid 20 SP @ 20 g a. i./ha	2.53 (1.70)	1.53 (1.42)	0.93 (1.20)	0.33 (0.91)	0.53 (1.02)
3	Indoxacarb 15.8 EC @ 73 g a. i./ha	2.40 (1.69)	1.27 (1.32)	1.00 (1.22)	0.27 (0.87)	0.40 (0.94)
4	Rynaxypyr 18.5 SP @ 30 g a. i./ha	2.00 (1.58)	1.13 (1.28)	0.47 (0.98)	0.20 (0.84)	0.27 (0.87)
5	Profenofos + DDVP @ 2ml + 0.5 ml/lit	1.60 (1.45)	1.40 (1.38)	0.80 (1.14)	0.20 (0.84)	0.33 (0.91)
6	Dimethoate 30 EC @ 600 g a.i./ha	1.73 (1.49)	1.20 (1.30)	0.60 (1.04)	0.27 (0.87)	0.87 (1.17)
7	Control	3.00 (1.86)	1.87 (1.54)	1.60 (1.45)	1.67 (1.47)	1.93 (1.56)
	SE± (m)	0.104	0.042	0.045	0.044	0.029
	CD at 5%	N.S.	0.128	0.140	0.137	0.088

Figures in parenthesis are √x+0.5 transformed values.

The data on larval population of plume moth, *E. atomosa* on pigeonpea is presented in Table 2. The data indicates that the larval population of *E. atomosa* was non-significant on one day before spray in all the treatments indicating uniform distribution of pest larvae. The treatment application of rynaxypyr 18.5 SP @ 30 g a.i./ha found as the best treatment which recorded minimum larval population of *E. atomosa* on one, three, seven and fifteen day after spray *i.e.* 0.13, 0.13, 0.07 and 0.07 larvae per plant, respectively. This was followed by all other remaining treatment *i.e.* acetamiprid 20 SP @ 20 g a.i./ha, acephate 75 SP @ 750 g a.i./ha, dimethoate 30 EC @ 600 g a.i./ha, profenofos + DDVP @ 2ml + 0.5 ml/lit and indoxacarb 15.8 EC @ 73 g a.i./ha except control having at par effect with each other, respectively; while maximum larval population was observed in untreated control *i.e.* 0.33, 0.33, 0.27 and 0.33 larvae per plant on one, three, seven and fifteen days after spray, respectively. The results in relation to larval population of *E. atomosa* are in accordance with [6] who reported that chlorantraniliprole @ 30 g a.i./ha was the most effective insecticide against pod borer complex and was followed by chlorantraniliprole + lambda cyhalothrin @ 37.5 g a.i./ha, chlorantraniliprole + lambda cyhalothrin @ 30 g a.i./ha and indoxacarb @ 75 g a.i./ha, respectively. Similarly, the treatment application of rynaxypyr 20 SC @ 30 g a.i. /ha was superior molecule in recording less larval population [10, 11, 12, 13].

Table 2: Effect of newer insecticides against plume moth on pigeonpea.

S. No.	Name of treatment	Plume moth larvae per plant				
		1 DBS	**1 DAS**	**3 DAS**	**7 DAS**	**15 DAS**
1	Acephate 75 SP @ 750 g a.i./ha	0.53 (1.01)	0.27 (0.87)	0.13 (0.79)	0.07 (0.75)	0.27 (0.87)
2	Acetamiprid 20 SP @ 20 g a.i./ha	0.53 (1.01)	0.20 (0.83)	0.13 (0.79)	0.07 (0.75)	0.27 (0.87)
3	Indoxacarb 15.8 EC @ 73 g a.i./ha	0.27 (0.87)	0.33 (0.91)	0.27 (0.87)	0.07 (0.75)	0.13 (0.79)
4	Rynaxypyr 18.5 SP 30 g a.i./ha	0.33 (0.91)	0.13 (0.79)	0.13 (0.79)	0.07 (0.75)	0.07 (0.75)
5	Profenofos + DDVP @ 2ml + 0.5 ml/lit	0.33 (0.91)	0.20 (0.83)	0.27 (0.87)	0.13 (0.79)	0.20 (0.83)
6	Dimethoate 30 EC @ 600 g a.i./ha	0.40 (0.94)	0.27 (0.87)	0.13 (0.79)	0.07 (0.75)	0.20 (0.83)
7	Control	0.40 (0.94)	0.33 (0.91)	0.33 (0.91)	0.27 (0.87)	0.33 (0.91)
	SE± (m)	0.038	0.025	0.027	0.016	0.025
	CD at 5%	N.S.	0.076	0.083	0.050	0.077

Figures in parenthesis are √x+0.5 transformed values.

The data on larval population of pod fly, *M. obtusa* on pigeonpea is presented in Table 3. The data indicates that the larval population of *M. obtusa* was non-significant on one day before spray in all the treatments indicating uniform distribution of pest. The treatment application of rynaxypyr 18.5 SP @ 30 g a.i./ha found as the best treatment which recorded minimum larval population of *M. obtusa* on one, three, seven and fifteen day after spray *i.e.* 0.47, 0.13, 0.13 and 0.20 larvae per plant, respectively. This was followed by all other remaining treatments *i.e.* profenofos + DDVP @ 2ml + 0.5 ml/lit, acephate 75 SP @ 750 g a.i./ha, dimethoate 30 EC @ 600 g a.i./ha, acetamiprid 20 SP @ 20 g a.i./ha and indoxacarb 15.8 EC @ 73 g a.i./ha except control having at par effect with each other, respectively; while maximum larval population was observed in untreated control *i.e.* 0.93, 0.87, 1.13 and 0.93 larvae per plant on one, three, seven and fifteen days after spray, respectively. The results in relation to larval population of *M. obtusa* are in accordance with [6] who reported that chlorantraniliprole @ 30 g a.i./ha was the most effective insecticide against pod borer complex and was followed by chlorantraniliprole + lambda cyhalothrin @ 37.5 g a.i./ha, chlorantraniliprole + lambda cyhalothrin @ 30 g a.i./ha and indoxacarb @ 75 g a.i./ha, respectively. Similarly, [10, 11, 12, 13] reported that rynaxypyr 20 SC @ 30 g a.i. /ha as superior molecule in recording less larval population.

Table 3: Effect of newer insecticides against pod fly on pigeonpea.

S. No.	Name of treatment	Pod fly larvae per plant				
		1 DBS	1 DAS	3 DAS	7 DAS	15 DAS
1	Acephate 75 SP @ 750 g a.i./ha	1.33 (1.35)	0.53 (1.02)	0.27 (0.87)	0.27 (0.87)	0.40 (0.95)
2	Acetamiprid 20 SP @ 20 g a.i./ha	0.80 (1.14)	0.80 (1.13)	0.27 (0.87)	0.40 (0.94)	0.47 (0.98)
3	Indoxacarb 15.8 EC @ 73 g a.i./ha	1.33 (1.35)	0.87 (1.16)	0.60 (1.05)	0.27 (0.87)	0.40 (0.94)
4	Rynaxypyr 18.5 SP @ 30 g a.i./ha	1.07 (1.24)	0.47 (0.98)	0.13 (0.79)	0.13 (0.79)	0.20 (0.84)
5	Profenofos + DDVP @ 2ml + 0.5 ml/lit	1.20 (1.30)	0.73 (1.10)	0.20 (0.83)	0.13 (0.79)	0.33 (0.91)
6	Dimethoate 30 EC @ 600 g a.i./ha	0.67 (1.07)	0.67 (1.07)	0.60 (1.05)	0.27 (0.87)	0.20 (0.84)
7	Control	1.00 (1.22)	0.93 (1.18)	0.87 (1.16)	1.13 (1.27)	0.93 (1.19)
	SE± (m)	0.061	0.041	0.055	0.045	0.033
	CD at 5%	N.S.	0.126	0.169	0.137	0.100

Figures in parenthesis are $\sqrt{x+0.5}$ transformed values.

The data on pod damage due to pigeonpea pod borers and pigeonpea grain yield is presented in Table 4. The treatment application of rynaxypyr 18.5 SP @ 30 g a.i./ha found as the best treatment which recorded lowest pod damage *i.e.* 5.59 per cent and this was followed by all other remaining treatments *i.e.* profenofos + DDVP @ 2ml + 0.5 ml/lit (5.92 per cent), acetamiprid 20 SP @ 20 g a.i./ha (6.56 per cent), acephate 75 SP @ 750 g a.i./ha (6.59 per cent), indoxacarb 15.8 EC @ 73 g a.i./ha (7.58 per cent) and dimethoate 30 EC @ 600 g a.i./ha (7.69 per cent) having at par effect with each other, respectively; while maximum pod damage was observed in untreated control *i.e.* 10.40 per cent. Effectiveness of different newer molecules to minimize the pod borers' infestation was reflected by grain yield. The highest yield (7.60 q per ha) was obtained from the plot receiving treatment sprays of rynaxypyr 18.5 SP @ 30 g a.i./ha and was followed by profenofos + DDVP @ 2 ml + 0.5 ml/lit (7.59 q per ha), acetamiprid 20 SP @ 20 g a.i./ha (7.07 q per ha), dimethoate 30 EC (4.90 q per ha), acephate 75 SP @ 750 g a.i./ha (4.80 q per ha) and indoxacarb 15.8 EC @ 73 g a.i./ha (4.02 q per ha) having at par effect with each other, respectively; whereas lowest yield (3.97 q per ha) was recorded from control. The results in relation to percent pod damage due to pigeonpea pod borers and the grain yield of pigeonpea are in accordance with the earlier reports of [11, 12, 13] who reported that rynaxypyr 20 SC @ 30 g a.i. /ha as superior molecule in recording lower pod damage. Similarly, [14] reported that the spraying of indoxacarb along with halt (*Bacillus thuringiensis*) against *H. armigera* and *E. atomosa* was most effective treatment in reducing pod damage (9.00 per cent) in pigeonpea crop. Highest grain yield realized due to the treatment application of rynaxypyr 20 SC @ 40g a.i./ha (17.52 q per ha) as against 8.02 q per ha in untreated control [13]. Similarly, highest pigeonpea grain yield of 13.71 q per ha was recorded from rynaxypyr @ 30 g a.i./ha against 8.38 q per ha in untreated control [11]. [15] recorded maximum grain yield with emamectin benzoate @ 11 g a.i./ha (1761 kg per ha) and was followed by spinosad @ 73 g a.i./ ha (1717 kg per ha), indoxacarb @ 50 g a.i./ha (1598 kg per ha) which supports the findings on efficacy of newer insecticides and its translation into higher yield.

Table 4: Effect of newer insecticides against pod damage due to pod borers and grain yield of pigeonpea.

S. No.	Name of treatment	Per cent pod damage*	Yield (q per ha)
1	Acephate 75 SP 750 g a.i./ha	6.59 (14.86)	4.80
2	Acetamiprid 20 SP 20 g a.i./ha	6.56 (14.82)	7.07
3	Indoxacarb 15.8 EC 73 g a.i./ha	7.58 (15.94)	4.02
4	Rynaxypyr 18.5 SP 30 g a.i./ha	5.59 (13.66)	7.60
5	Profenofos + DDVP 2ml + 0.5 ml/lit	5.92 (14.02)	7.59
6	Dimethoate 30 EC 600 g a.i./ha	7.69 (16.08)	4.90
7	Control	10.40 (18.80)	3.97
	SE± (m)	0.265	0.879
	CD at 5%	0.817	2.708

*Figures in parenthesis are angular transformed values.

The data on economics of chemical management against pigeonpea pod borers is presented in Table 5. The results revealed that rynaxypyr 18.5 SP @ 30 g a.i./ha recorded highest increase in yield over control *i.e.* 3.63 q per ha followed by profenofos + DDVP @ 2ml + 0.5 ml/lit (3.62 q per ha), acetamiprid 20 SP @ 20 g a. i./ha (3.10 q per ha), dimethoate 30 EC @ 600 g a.i./ha (0.93 q per ha) and acephate 75 SP @ 750 g a.i./ha (0.83 q per ha), respectively, while indoxocarb 15.8 EC @ 73 g a.i./ha recorded least increase in yield over control. Cost benefit ratio based on the obtained yield and pigeonpea support price gave realization over untreated was worked out and the results showed that the cost benefit ratio reward was highest from profenofos + DDVP @ 2ml + 0.5 ml/lit (1: 1.75) and rynaxypyr 18.5 SP @ 30 g a.i./ha (1: 1.72) followed by acetamiprid 20 SP @ 20 g a. i./ha (1: 1.71), dimethoate 30 EC @ 600 g a.i./ha (1: 1.14) and acephate 75 SP @ 750 g a.i./ha (1: 1.12), respectively whereas no benefit was observed from the treatment indoxacarb 15.8 EC @ 73 g a.i./ha with cost benefit ratio *i.e.* 1: 0.85. Usually all the treatments except indoxocarb 15.8 EC were lucrative as compared to control. This may be due to treatments effectiveness for reducing the grain infestation and sustaining the yield. The results obtained in the present investigation in relation to cost benefit ratio are in accordance with the earlier workers of [16] where in highest cost benefit ratio reward (1: 4.24) was obtained from chlorantraniliprole. Similarly, [17] reported that the chemical-based IPM was more effective for pod fly (*Melanagromyza obtusa*) management, wherein, chemical-based IPM gave the highest pigeonpea equivalent yield with a cost benefit ratio of 1: 2.66.

Table 5: Economics of chemical management against pigeonpea pod borers.

S. No.	Treatment and Dosage (a.i./ha)	Cost (Rs./Lit)	Yield (q/ha)	Increased yield over control	Monitory return (Rs/ha)	Cost of treatment	Net profit (Rs)	Cost: benefit ratio
1	Acephate 75 SP @ 750 g a.i./ha	640	4.80	0.83	4150	1840	2310	1: 1.12
2	Acetamiprid 20 SP @ 20 g a. i./ha	1650	7.07	3.10	15500	1365	14135	1: 1.71
3	Indoxacarb 15.8 EC @ 73 g a.i./ha	4000	4.02	0.05	250	3200	-2950	1: 0.85
4	Rynaxypyr 18.5 SP @ 30 g a.i./ha	17500	7.60	3.63	18150	3825	14325	1: 1.72
5	Profenofos + DDVP @ 2ml + 0.5 ml/lit	760+600	7.59	3.62	18100	3310	14790	1: 1.75
6	Dimethoate 30 EC @ 600 g a.i./ha	290	4.90	0.93	4650	1780	2870	1: 1.14
7	Untreated Control	-	3.97	0	0	0	0	0

Cost of pigeonpea seed: Rs. 5000/q., Cost of one spray: Three labour @ Rs.600/day/spray.

Conclusion

From present study, it may be concluded that the treatment application of rynaxypyr 18.5 SP @ 30 g a.i./ha was found effective for suppression of pod borers population and extenuate yield. The cost benefit ratio reward was highest from profenofos + DDVP @ 2ml + 0.5 ml/lit and rynaxypyr 18.5 SP @ 30 g a.i./ha resulted in superior at par yield due to their systemic action against pigeonpea pod borers. The safer chemical control methods reduce the pest population, pod and grain damage with higher yield; therefore, chemical management popularizes as an effective, practical alternative and makes lucrative cultivation of pigeonpea.

References

1. Lateef SS, Reed W. Insect pests of Pigeonpea. In “Insect pests of tropical food legumes. (Ed. Singh SR). John Wiley and Sons, New York, USA, 1990; 193-242.
2. Lal C, Sharma SK, Chahota RK. Oviposition response of pod fly (*Melanagromyza obtusa*) on resistant pigeonpea (*Cajanus cajan*) selections. Indian Journal of Agricultural Science. 1992; 64:658-660.
3. Sarika, Arora V, Iquebal MA, Rai A, Kumar D. PIPEMicroDB: microsatellite database and primer generation tool for pigeonpea genome. Database, 2013 Article ID bas054, doi:10.1093/database/bas054. (http://database. oxfordj ournals. org)
4. Durairaj C. Evaluation of certain neem formulations and insecticides against pigeonpea pod fly. Indian Journal of Pulses Research. 2006; 19(2):269-270.
5. Sharma OP, Bhosle BB, Kamble KR, Bhede BV, Seeras NR. Management of pigeonpea pod borers with special reference to pod fly (*Melanagromyza obtusa*). Indian Journal of Agricultural Sciences. 2011; 81(6):539-543.
6. Patel SA, Patel RK. Bio-efficacy of newer insecticides against pod borer complex of pigeonpea [*Cajanus cajan* (L.) Millspaugh]. AGRES - An International e-Journal. 2013; 2(3):398-404.
7. Dhaka SS, Singh G, Ali N, Mittal V, Singh DV. Efficacy of novel insecticides against pod borer, *Etiella zinckenella* (Treitschke) in vegetable pea. Crop Research. 2011; 42(1, 2, 3):331-335.
8. Gomez KA, Gomez AA. Statistical procedures for agricultural research. Joh Wiley and sons, New York. 1984, 207-215.
9. Naresh JS, Singh J. Population dynamics and damage of insect pests in flowering pigeonpea (*Cajanus cajan* (L.) Millsp.). Indian Journal of Entomology. 1984; 46(4):412-420.
10. Bhosale BB, Nishantha KMDWP, Patange NR, Kadam DR. Comparative efficacy of microbial insecticides with new insecticide molecule E2Y45 against pod borer complex of pigeonpea. Pestology. 2009; 33(9):38-42.
11. Nishantha KMDWP, Bhosle BB, Patange NR, Bhute NK. Rynaxypyr, a new insecticide for managing pod borer complex in pigeonpea. Indian Journal of Entomology. 2009; 71(2):179-183.
12. Chowdary LR, Bheemanna M, Kumar LR. Bioefficacy of rynaxypyr (Coragen) 20 SC against fruit borer *Helicoverpa armigera* (Hubner) in okra. International Journal of Plant Protection. 2010; 3(2):379-381.
13. Satpute NS, Barkhade UP. Evaluation of rynaxypyr 20 SC against pigeonpea pod borer complex. Journal of Food Legumes. 2012; 25(2):162-163.
14. Singh SS, Yadav SK. Bioefficacy of modern insecticides, biopesticides and their combination against pod borers in pigeonpea. Indian Journal of Entomology. 2005; 67(2):133-136.
15. Dodia DA, Prajapati BG, Acharya S. Efficacy of insecticides against gram pod borer, *Helicoverpa armigera* Hardwick, infesting pigeonpea. Journal of Food Legumes. 2009; 22(2):144-145.
16. Singh AK. Evaluation of new molecule of insecticides against pod fly (*Melanagromyza obtusa*) of pigeonpea. SAARC Journal of Agriculture. 2014; 12(1):89-95.
17. Chaudhary RG, Saxena H, Dhar V, Prajapati RK. Evaluation and validation of IPM modules against wilt, *Phytophthora* blight, pod borer and pod fly in pigeonpea. Journal of Food Legumes. 2008; 21(1):58-60.