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RESEARCH ARTICLE :

Influence of different spraying dates on pod borer complex of pigeonpea

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SUMMARY : A experiment was conducted at Experimental Research Farm Department of Agril. Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, during the *Kharif* 2016 to study effect of different spraying dates on management of pod borer complex of pigeonpea in three different cultivars in split plot design. Two consecutive sprays of emamectin benzoate 5% SG @ 4.4 gm/10 lit. water followed by flubendiamide 39.3% SC @ 3.9 ml/10 lit. water at 15 days interval were taken at various crop growth stages. Three cultivars of pigeonpea *viz.,* BDN-711 (early), BSMR-716 (mid late), BSMR-736 (late) were observed under field condition for their response to pod borer complex. The results revealed that in BDN-711 spraying at 50% bud initiation stage was superior treatment whereas in BSMR-716 crop sprayed at 10% flowering stage recorded minimum pest incidence and produced higher yield. In the cultivar BSMR-736, crop sprayed at flower initiation stage recorded minimum incidence of *H. armigera* and maximum yield. In above three cultivars, the incidence of *E. atomosa* was minimum, when the crop was sprayed at pod formation stage.

KEY WORDS :
Spraying dates, Pod borer complex, *Helicoverpa armigera*, *Erias atomosa*

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BACKGROUND AND OBJECTIVES

The pigeonpea is cultivated in more than 25 countries of the world and grown on areas of about 4.59 million hectares in world with the production of 3.28 million tons annually. Dominant producers of this crop are the countries in the India subcontinent, Africa and Central America. The leading producer is India, producing about 90% of world's total production, sharing 36 and 28 per cent of the area and production of this crop. In India pigeonpea is cultivated on 3.853 lakh ha area while production is 7.36 lakh tonnes with the national productivity of 729 kg per hectareduring 2014. Out of total per cent of pulse production pigeonpea contributes 22 per cent of production (Anonymous, 2015). In India it is extensively grown in Maharashtra, Uttar Pradesh, Madhya Pradesh, Bihar, West Bengal, Karnataka, Andhra Pradesh, Gujarat and Tamil Nadu. In Maharashtra, during 2014, it was grown on an area of 1.21 lakh hectares, productivity obtained was 600 kg per hectare with total production of 7.36 lakh tons. In Marathwada, the area under pigeonpea was 3.99 lakh hectares with production and productivity to the tune of 1.01 lakh tonnes and 247 kg/ ha (Anonymous, 2015).

The yield of pigeonpea in India is not satisfactory when compared to other countries. Among the various reasons responsible for low grain yield, attack of insect pests is a major cause. Over 250 species of insect pests belonging to 8 orders and 61 families have been reported by several workers (Davis and Lateef, 1977**;** Sekar e*t al.*, 1991 and Khokhar and Singh, 1984). The important pests of this crop are Gram pod borer, *Helicoverpa armigera* Hubner, Plume moth, *Exelastis atomosa* Walshigham, Pod fly, *Melanagromyza obtusa* Malloch, Leaf webber, *Eucosa critica* Meyer, Pod bug, *Clavigrala gibbosa* Spinola, Pod weevil, *Apion* spp. and spotted pod borer *Maruca vitrata.* Out of these *Helicoverpa armigera*, *Exelastis atomosa* and *Melanagromyza obtusa* is important feeder of pigeonpea which are collectively referred to as the "Pod Borer Complex" known to cause an average 39.8 per cent grain

Pod borer complex is serious constraint to the production and productivity in India. They contribute a major cause for low yields such as, 77.04 per cent pod damage and 68.70 per cent grain damage (Awasthi and Bhatnager, 1983). According to Yadav and Chaudhary (1993) around 14 and 10 per cent pigeonpea pods were damaged by *H. armigera* and *M. obtusa*. Pigeonpea pod damage due to different insect pests including *H. armigera* and *E. atomosa* varied from 7.6 + 31.0 per cent (Lal *et al*., 1997). *H. armigera* caused 27 per cent damage to pigeonpea pod during 2001-02. The crop suffered heavy field losses due to pod borers (Bhuvaneshwari and Balangurunathan, 2002).

Continuous applications of same insecticides have increased the chances of resistance and resurgence of insect pest. *H. armigera* is known to infest different stages of crop growth but the incidence of *E. atomosa* and *M. Obtusa* is depending on growth stage of plant. For management of these pests spraying with insecticides at specific growth stage is most economical. Therefore present study was designed with a objective that to study the effect of different dates of spraying on management of pod borer complex. Similarly, safety stages where maximum population of natural enemies was also studied.

RESOURCES AND METHODS

The field experiment was conducted during *Kharif* 2016-17 at the experimental farm of the Department of Agril. Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra). The experiment was laid on uniform, heavy black cotton soil having good fertility and drainage with cultivars as BDN- 711, BSMR-716, BSMR-736 laid in split plot design with three replication plot 54 of size of 4.8 m x 4.2 m and spacing of 120 cm x 30 cm.

Treatment details:

Main plot treatment: Variety

V_1- BDN-711 (Early)

V_2 - BSMR-716 (Mid late)

V_3 - BSMR-736 (Late)

Sub plot treatment:

1st Spraying of Emamectin benzoate 5% SG @ 0.0022 *i.e.*4.4 g/10 lit. of water.

2nd Spraying of Flubendiamide 39.3% SC @ 0.0078 *i.e.*3.9 ml /10 lit. of water.

T_1 : 1st spraying at bud initiation stage followed by 2nd spraying after 15 days

T_2 : 1st spraying at 50% bud formation stage followed by 2nd spraying after 15 days

T_3 : 1st spraying at flower initiation stage followed by 2nd spraying after 15 days

T_4 : 1st spraying at 10% flowering stage followed by 2nd spraying after 15 days

T_5 : 1st spraying at 50% flowering stage followed by 2nd spraying after 15 days

T_6 :1st spraying at pod formation stage followed by 2nd spraying after 15 days

Method of recording observations :

Effect of different spraying dates on management of pod borer complex of pigeonpea:

Larval population of *H. armigera :*

Larval population of *H. armigera* was recorded at one day before and 1, 3, 7 and 14 days after each application of insecticides from on five randomly selected plants from each treatment.

Larval population of *E. atmosa :*

Larval population of *E. atmosa* was recorded at one day before and 1, 3, 7 and 14 days after each application of insecticides on five randomly selected plants from each treatment.

Grains damaged by *M. obtusa* :

At the time of harvesting, hundred pods from five randomly selected plants were collected from each plot, threshed and weighed separately to study the extent of pod damage, grain damage and weight loss due to *M. obtusa* in different treatments.

$$\text{\% infestation of pods} = \frac{\text{Number of grains damaged}}{\text{Total number of grains (health + damaged)}} \times 100$$

Effect of different spraying dates on natural enemies of pod borer complex of pigeonpea :

The observations on population of natural enemies like lady bird beetles, Chrysopa and predatory spiders, *etc*. per plant were recorded on randomly selected five plants from each quadrant at the time of recording observation of pod borer complex on respective dates of spraying administered on different crop stages.

The data obtained in insect numbers were subjected to poison formula $\sqrt{X + 0.5}$ before further analysis. The analysis of pooled data was carried out to ascertain effect of different spraying dates on management of pod borer complex of pigeonpea and their effect on natural enemies of pod borer complex. Appropriate statistical methods were employed to work out standard error (SE) and critical difference (CD) to know the significance of treatments (Gomez and Gomez, 1984).

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads and Table 1 to 8 :

Effect of main treatment (Variety) :

The pooled data on incidence of *Helicoverpa armigera* (No. of larvae/plant) revealed that the before Ist spray treatments *H. armigera* counts was in the range of 1.48 to 1.59 larvae/plant and before IInd spray it ranged from 1.91 to 2.15 larvae/ plant. The minimum *H. armigera* population was observed in treatment V_1 (BDN-711) followed by V_2 (BSMR-716) and V_3 (BSMR-736) after 1st and 2nd spray.

The data on *Exelastis atomosa* (No. of larvae/plant) revealed that before 1st spray larval count was 0.50 to 0.51 larvae/plant and before 2nd spray 2.57 to 2.62 larvae/ plant. The minimum *E. atomosa* population was observed

Table 1 : Effect of different varieties and spray schedules against *Helicoverpa armigera* after Ist spray

Treatments	Pre count	Days after first spray (No. of larvae/plant)			
		1	3	7	14
Main treatment: Variety					
V_1-BDN-711	1.48 (1.41)	0.62 (1.06)	0.85 (1.16)	1.03 (1.24)	1.23 (1.32)
V_2-BSMR-716	1.54 (1.43)	0.86 (1.17)	1.01 (1.23)	1.24 (1.32)	1.47 (1.40)
V_3-BSMR-736	1.59 (1.45)	0.94 (1.20)	1.12 (1.27)	1.34 (1.36)	1.55 (1.43)
S.E. ±	0.05	0.01	0.02	0.03	0.05
C.D. (P=0.05)	NS	0.04	0.07	0.09	NS
Sub treatment: Spray schedule					
T_1- Bud initiation stage	1.48 (1.41)	0.52 (1.01)	0.66 (1.08)	0.79 (1.14)	1.00 (1.22)
T_2- 50% bud formation stage	1.47 (1.40)	0.44 (0.97)	0.59 (1.04)	0.70 (1.10)	0.72 (1.10)
T_3- Flower initiation stage	1.56 (1.44)	0.34 (0.92)	0.53 (1.01)	0.63 (1.06)	0.73 (1.11)
T_4- 10% flowering stage	1.57 (1.44)	0.38 (0.94)	0.53 (1.01)	0.70 (1.10)	0.80 (1.14)
T_5- 50% flowering stage	1.54 (1.43)	2.5 (1.73)	2.87 (1.84)	3.42 (1.98)	4.12 (2.15)
T_6- Pod formation stage	1.59 (1.45)	0.60 (1.05)	0.78 (1.13)	1.00 (1.22)	1.14 (1.28)
S.E. ±	0.05	0.02	0.03	0.06	0.05
C.D. (P=0.05)	NS	0.07	0.08	0.18	0.16
Interaction (V xT)					
S.E. ±	0.96	0.04	0.05	0.91	0.10
C.D. (P=0.05)	NS	0.12	0.15	NS	NS
GM	1.54	0.81	0.99	1.20	1.42

*Figures in parentheses are $\sqrt{X + 0.5}$ transformed values NS=Non-significant

in the treatment V_1 (BDN-711) followed by V_2 (BSMR-716) and V_3 (BSMR-736) after Ist and IInd spray.

The data on *Melanagromyza obtusa* (% grain damaged) revealed that the treatment V_1 (BDN-711) has minimum damaged grains 18.97 % followed by V_2 -BSMR-716 (19.07%) and V_3-BSMR-736 (19.99%).

Effect of sub plot treatment (Different crop growth stages) :

Pooled data on effect of sub plot treatments for *H. armigera* revealed that the population was increased from 1.54 to 4.12 (larvae/plant) over a span of 14 days in untreated plots in 1st spray and 4.06 to 4.41 (larvae/plant) 2nd spray. The count of *H. armigera* in different growth stage treatments was significantly lower indicating that all evaluated treatments were significantly effective against *H. armigera*. The minimum *H. armigera* population was observed in plants treated at flower initiation stage followed by 10% flowering stage, 50% bud formation stage, bud formation stage and pod formation stage.

The data on *E. atmosa* revealed that the population of larvae increased from 0.0 to 1.34/plant over a span of 14 days in untreated plots in 1st spray and 2.65 to 3.21

Table 2 : Interaction effect of variety and spray schedules on incidence of *H. armigera* after 1st spray

V x T	No. larvae/plant one day after first spray						No. larvae/plant third day after first spray					
	T_1	T_2	T_3	T_4	T_5	T_6	T_1	T_2	T_3	T_4	T_5	T_6
V_1-BDN-711	0.35 (0.92)	0.18 (0.82)	0.21 (0.84)	0.28 (0.88)	2.34 (1.68)	0.38 (0.94)	0.58 (1.03)	0.26 (0.87)	0.38 (0.94)	0.45 (0.97)	2.83 (1.82)	0.59 (1.04)
V_2-BSMR-716	0.59 (1.04)	0.55 (1.02)	0.27 (0.88)	0.39 (0.94)	2.68 (1.78)	0.71 (1.1)	0.66 (1.07)	0.73 (1.11)	0.43 (0.96)	0.53 (1.01)	2.85 (1.83)	0.87 (1.17)
V_3-BSMR-736	0.62 (1.06)	0.59 (1.04)	0.53 (1.01)	0.46 (0.98)	2.71 (1.79)	0.71 (1.1)	0.73 (1.11)	0.79 (1.14)	0.77 (1.12)	0.61 (1.05)	2.93 (1.85)	0.87 (1.17)
S.E. ±			0.04						0.05			
C.D. (P=0.05)			0.12						0.15			

* T_1- Bud initiation stage, T_2-50% bud formation stage, T_3-Flower initiation stage, T_4-10% flowering stage, T_5-50% flowering stage and T_6- Pod formation stage

Table 3 : Effect of different varieties and spray schedules against *Helicoverpa armigera* after 2nd spray

Treatments	Pre count	Days after second spray (No. of larvae/plant)			
		1	3	7	14
Main treatment: Variety					
V_1-BDN-711	1.91 (1.55)	1.07 (1.25)	1.20 (1.30)	1.36 (1.36)	1.45 (1.40)
V_2-BSMR-716	2.05 (1.60)	1.31 (1.35)	1.48 (1.41)	1.50 (1.41)	1.66 (1.47)
V_3-BSMR-736	2.15 (1.63)	1.33 (1.35)	1.44 (1.39)	1.54 (1.43)	1.65 (1.47)
S.E. ±	0.06	0.02	0.02	0.01	0.01
C.D. (P=0.05)	NS	0.06	0.08	0.05	0.04
Sub treatment: Spray schedule					
T_1-Bud initiation stage	1.50 (1.41)	0.77 (1.13)	0.89 (1.19)	1.00 (1.22)	1.11 (1.27)
T_2- 50% bud formation stage	1.52 (1.42)	0.61 (1.05)	0.73 (1.11)	0.90 (1.18)	0.97 (1.21)
T_3- Flower initiation stage	1.62 (1.46)	0.50 (1.00)	0.65 (1.07)	0.76 (1.12)	0.88 (1.17)
T_4- 10% flowering stage	1.66 (1.47)	0.56 (1.03)	0.74 (1.11)	0.87 (1.17)	0.99 (1.22)
T_5- 50% flowering stage	4.41 (2.22)	4.17 (2.16)	4.24 (2.18)	4.06 (2.14)	4.22 (2.17)
T_6- Pod formation stage	1.52 (1.42)	0.80 (1.14)	1.01 (1.23)	1.21 (1.31)	1.35 (1.36)
S.E. ±	0.06	0.03	0.03	0.03	0.03
C.D. (P=0.05)	0.17	0.09	0.11	0.09	0.09
Interaction (V x T)					
S.E. ±	0.08	0.05	0.06	0.05	0.05
C.D. (P=0.05)	NS	0.15	0.19	0.16	0.16
GM	2.04	1.24	1.38	1.47	1.59

*Figures in parentheses are $\sqrt{X + 0.5}$ transformed values NS=Non-significant

larvae/plant in 2nd spray. The minimum *E. atomosa* population was observed in plants treated at pod formation stage followed by 10% flowering stage, flower initiation stage, 50 % bud initiation stage and bud formation stage.

The pooled data for *M. Obtusa* revealed significantly minimum per cent grain damage was observed in plants treated at pod formation stage followed by 10% flowering stage, flower initiation stage, 50 % bud initiation stage

Table 4 : Interaction effect of variety and spray schedules on incidence of *H. armigera* after 2nd spray

V x T	No. larvae/plant one day after second spray						No. larvae/plant three day after second spray					
	T_1	T_2	T_3	T_4	T_5	T_6	T_1	T_2	T_3	T_4	T_5	T_6
V_1-BDN-711	0.62	0.31	0.42	0.50	3.90	0.67	0.69	0.42	0.59	0.62	4.00	0.92
	(1.06)	(0.90)	(0.96)	(1.00)	(2.10)	(1.08)	(1.10)	(0.96)	(1.04)	(1.06)	(2.12)	(1.19)
V_2-BSMR-716	0.85	0.77	0.42	0.72	4.26	0.86	0.98	0.86	0.59	0.93	4.52	1.01
	(1.16)	(1.13)	(0.96)	(1.10)	(2.18)	(1.17)	(1.21)	(1.17)	(1.09)	(1.19)	(2.24)	(1.23)
V_3-BSMR-736	0.86	0.77	0.66	0.48	4.36	0.88	1.00	0.93	0.77	0.66	4.19	1.11
	(1.17)	(1.13)	(1.07)	(0.99)	(2.20)	(1.17)	(1.22)	(1.19)	(1.12)	(1.16)	(2.16)	(1.27)
S.E. ±	0.05						0.06					
C.D. (P=0.05)	0.15						0.19					
V x T	No. larvae/plant seven day after second spray						No. larvae/plant forteen day after second spray					
	T_1	T_2	T_3	T_4	T_5	T_6	T_1	T_2	T_3	T_4	T_5	T_6
V_1-BDN-711	0.77	0.51	0.67	0.84	4.14	1.24	0.89	0.58	0.77	0.91	4.22	1.35
	(1.12)	(1.00)	(1.08)	(1.16)	(2.15)	(1.32)	(1.18)	(1.04)	(1.12)	(1.19)	(2.17)	(1.36)
V_2-BSMR-716	1.00	0.99	0.73	1.04	4.14	1.12	1.12	1.06	0.89	1.18	4.37	1.35
	(1.22)	(1.22)	(1.11)	(1.24)	(2.15)	(1.27)	(1.27)	(1.25)	(1.18)	(1.30)	(2.21)	(1.36)
V_3-BSMR-736	1.24	1.21	0.89	0.73	3.90	1.29	1.32	1.26	0.99	0.87	4.08	1.37
	(1.32)	(1.31)	(1.18)	(1.11)	(2.10)	(1.34)	(1.35)	(1.33)	(1.22)	(1.17)	(2.14)	(1.37)
S.E. ±	0.05						0.05					
C.D. (P=0.05)	0.16						0.16					

* T_1- Bud initiation stage, T_2-50% bud formation stage, T_3-Flower initiation stage, T_4-10% flowering stage, T_5-50% flowering stage and T_6- Pod formation stage

Table 5 : Effect of different varieties and spray schedules against *Exelastis atomosa* after 1st spray

Treatments	Pre count	Days after first spray (No. larvae/plant)			
		1	3	7	14
Main treatment: Variety					
V_1-BDN-711	0.51 (1.00)	0.06 (0.75)	0.27 (0.88)	0.37 (0.93)	0.89 (1.18)
V_2-BSMR-716	0.50 (1.00)	0.07 (0.75)	0.28 (0.88)	0.43 (0.96)	0.96 (1.21)
V_3-BSMR-736	0.51 (1.00)	0.06 (0.75)	0.30 (0.89)	0.50 (1.00)	0.98 (1.22)
S.E. ±	0.02	0.003	0.042	0.01	0.01
C.D. (P=0.05)	NS	NS	0.016	0.03	0.03
Sub treatment: Spray schedule					
T_2- 50% bud formation stage	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	0.94 (1.20)
T_3- Flower initiation stage	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	0.82 (1.15)
T_4- 10% flowering stage	0 (0.71)	0 (0.71)	0 (0.71)	0.54 (1.02)	0.82 (1.15)
T_5- 50% flowering stage	0 (0.71)	0 (0.71)	0.76 (1.12)	1.02 (1.23)	1.34 (1.36)
T_6- Pod formation stage	2.56 (1.75)	0.33 (0.91)	0.65 (1.07)	0.62 (1.06)	0.80 (1.14)
S.E. ±	0.02	0.008	0.01	0.02	0.01
C.D. (P=0.05)	0.07	0.02	0.03	0.05	0.04
Interaction (V x T)					
S.E. ±	0.05	0.01	0.02	0.03	0.02
C.D. (P=0.05)	NS	0.04	0.05	0.08	0.07
GM	0.51	0.06	0.29	0.44	0.84

*Figures in parentheses are $\sqrt{X+0.5}$ transformed values NS=Non-significant and bud formation stage.

Interaction :

The interaction effect between variety and spraying at different growth stages treatment for *H. armigera* was found significant, except at pre count after 1st spray and it was found significant in all treatment after 2nd spray. In V_1 (BDN-711), spraying at 50% bud formation stage

Table 6 : Interaction effect of variety and spray schedules on incidence of *E. atomosa* after 1st spray

V x T	No. larvae/plant one day after first spray						No. larvae/plant three day after first spray					
	T_1	T_2	T_3	T_4	T_5	T_6	T_1	T_2	T_3	T_4	T_5	T_6
V_1-BDN-711	0.0 (0.70)	0.0 (0.70)	0.0 (0.70)	0.0 (0.70)	0.30 (0.89)	0.0 (0.70)	--	0.0 (0.70)	0.0 (0.70)	0.46 (0.99)	0.91 (1.19)	0.46 (0.99)
V_2-BSMR-716	0.0 (0.70)	0.0 (0.70)	0.0 (0.70)	0.0 (0.70)	0.36 (0.93)	0.0 (0.70)	--	0.0 (0.70)	0.0 (0.70)	0.53 (1.01)	1.00 (1.22)	0.62 (1.05)
V_3-BSMR-736	0.0 (0.70)	0.0 (0.70)	0.0 (0.70)	0.0 (0.70)	0.34 (0.91)	0.0 (0.70)	--	0.0 (0.70)	0.0 (0.70)	0.62 (1.06)	1.13 (1.28)	0.76 (1.12)
S.E. ±	0.01						0.02					
C.D. (P=0.05)	0.04						0.05					
V x T	No. larvae/plant seven day after first spray						No. larvae/plant fourteen day after first spray					
	T_1	T_2	T_3	T_4	T_5	T_6	T_1	T_2	T_3	T_4	T_5	T_6
V_1-BDN-711	--	0.0 (0.70)	0.0 (0.70)	0.46 (0.99)	0.91 (1.19)	0.46 (0.99)	--	0.92 (1.19)	0.79 (1.13)	0.75 (1.12)	1.25 (1.32)	0.77 (1.13)
V_2-BSMR-716	--	0.0 (0.70)	0.0 (0.70)	0.53 (1.01)	1.00 (1.22)	0.62 (1.05)	--	0.97 (1.21)	0.84 (1.16)	0.81 (1.14)	1.37 (1.37)	0.79 (1.13)
V_3-BSMR-736	--	0.0 (0.70)	0.0 (0.70)	0.62 (1.06)	1.13 (1.28)	0.76 (1.12)	--	0.92 (1.19)	0.83 (1.15)	0.89 (1.18)	1.40 (1.38)	0.84 (1.16)
S.E. ±	0.03						0.02					
C.D. (P=0.05)	0.08						0.07					

* T_1- Bud initiation stage, T_2-50% bud formation stage, T_3-Flower initiation stage, T_4-10% flowering stage, T_5-50% flowering stage and T_6- Pod formation stage

Table 7 : Effect of different varieties and spray schedules on incidence of *E. atomosa* after 2nd spray

Treatments	Pre count	Days after second spray (No. larvae/plant)			
		1	3	7	14
Main treatment: Variety					
V_1-BDN-711	2.57 (1.75)	1.89 (1.55)	2.01 (1.58)	2.14 (1.62)	2.24 (1.66)
V_2-BSMR-716	2.62 (1.77)	1.84 (1.53)	2.05 (1.60)	2.20 (1.64)	2.28 (1.67)
V_3-BSMR-736	2.59 (1.76)	1.92 (1.56)	2.01 (1.58)	2.19 (1.64)	2.24 (1.66)
S.E. ±	0.03	0.01	0.03	0.01	0.02
C.D. (P=0.05)	NS	0.03	NS	NS	NS
Sub treatment: Spray schedule					
T_2- 50% bud formation stage	2.58 (1.75)	1.93 (1.56)	2.04 (1.59)	2.18 (1.64)	2.19 (1.64)
T_3- Flower initiation stage	2.56 (1.75)	1.80 (1.52)	1.91 (1.53)	2.01 (1.58)	2.12 (1.62)
T_4- 10% flowering stage	2.54 (1.74)	1.62 (1.46)	1.71 (1.49)	1.84 (1.53)	1.99 (1.58)
T_5- 50% flowering stage	2.65 (1.77)	2.56 (1.75)	2.93 (1.85)	3.14 (1.91)	3.21 (1.93)
T_6- Pod formation stage	2.65 (1.77)	1.49 (1.41)	1.61 (1.45)	1.73 (1.49)	1.75 (1.50)
S.E. ±	0.05	0.03	0.03	0.01	0.02
C.D. (P=0.05)	NS	0.09	0.10	0.04	0.08
Interaction (V x T)					
S.E. ±	0.08	0.05	0.03	0.02	0.04
C.D. (P=0.05)	NS	0.14	0.10	0.06	0.12
GM	2.60	1.88	2.03	2.18	2.26

*Figures in parentheses are $\sqrt{X + 0.5}$ transformed values NS=Non-significant

recorded minimum number of larvae/plant followed by spraying at flower initiation stage, 10% flowering stage, bud formation stage and pod formation stage. These treatments were found to be significant in controlling *H. armigera* and were at par with each other. In V_2 (BSMR-716) and V_3 (BSMR-736) spraying at flower initiation stage recorded minimum number of larvae/plant followed by spraying at 10 % flowering stage, 50 % bud formation stage, bud formation stage and pod formation stage.

The interaction effect in *E. atomosa* was found to significant in all treatments after 1st and 2nd spray. In all varieties minimum number of larvae/plant were recorded at pod formation stage followed by 10% flowering stage, flower initiation stage, 50% bud formation stage. These treatments were found most significant in controlling *E. atomosa*.

The interaction effect of *Melanagromyza obtusa* was found to be non-significant.

The reviews regarding effect of spraying dates applied at various crop growth stages and there interaction are quite meagre since this is a new affect to study in entomological research. The work done and reviews reported by earlier worker regarding parallel issues are being presented here.

Raut *et al*. (2016) reported that the application of insecticides at bud initiation stage followed by 50% flowering stage 15 days after 50% flowering were proved better, recording minimum 3.74 and 3.73 per cent damage by lepidopteran pest on green pod.

Effect of different dates of spraying on natural enemies population :

Effect of main treatment (Variety) :

The effect of variety was found to be non-significant in case of lady bird beetle and spider count after both 1st and 2nd spray.

Effect of sub plot treatment (Different crop growth stages) :

It was observed that number of lady bird beetles and spiders were significantly higher in untreated plot stage 50 % flowering stage followed by 10 % flowering stage, flower initiation stage, 50% bud formation stage, bud initiation stage and pod formation stage after 1st and 2nd spray.

Interaction :

The interaction effect was found to be non-significant in respect of varieties and spraying at different growth stages.

Conclusion :

The precise conclusion from above study can be made in such a way that varieties having different duration

Table 8 : Interaction effect of variety and spray schedules on incidence of *E. atomosa* after Ist spray

V x T	No. larvae/plant one day after second spray						No. larvae/plant three day after second spray					
	T_1	T_2	T_3	T_4	T_5	T_6	T_1	T_2	T_3	T_4	T_5	T_6
V_1-BDN-711	--	1.83	1.74	1.65	2.76	1.47	--	1.92	1.83	1.72	3.02	1.53
		(1.53)	(1.49)	(1.46)	(1.80)	(1.40)		(1.55)	(1.52)	(1.49)	(1.87)	(1.42)
V_2-BSMR-716	--	1.92	1.86	1.62	2.30	1.48	--	2.09	2.00	1.70	2.84	1.64
		(1.55)	(1.53)	(1.45)	(1.67)	(1.41)		(1.61)	(1.58)	(1.48)	(2.83)	(1.46)
V_3-BSMR-736	--	2.02	1.80	1.58	2.63	1.53	--	2.12	1.68	1.71	2.91	1.64
		(1.59)	(1.51)	(1.44)	(1.77)	(1.42)		(1.62)	(1.47)	(1.48)	(1.84)	(1.46)
S.E. ±			0.05						0.03			
C.D. (P=0.05)			0.14						0.10			
V x T	No. larvae/plant seven day after second spray						No. larvae/plant fourteen day after second spray					
	T_1	T_2	T_3	T_4	T_5	T_6	T_1	T_2	T_3	T_4	T_5	T_6
V_1-BDN-711	--	2.07	1.96	1.89	3.17	1.65	--	2.13	2.12	1.98	3.26	1.74
		(1.60)	(1.57)	(1.54)	(1.91)	(1.46)		(1.62)	(1.62)	(1.57)	(1.93)	(1.49)
V_2-BSMR-716	--	2.16	2.17	1.80	3.13	1.73	--	2.19	2.14	2.05	3.22	1.77
		(1.63)	(1.63)	(1.51)	(1.90)	(1.49)		(1.64)	(1.62)	(1.59)	(1.92)	(1.50)
V_3-BSMR-736	--	2.30	1.88	1.83	3.10	1.80	--	2.27	2.08	1.96	3.15	1.73
		(1.66)	(1.54)	(1.52)	(1.89)	(1.51)		(1.66)	(1.60)	(1.57)	(1.91)	(1.49)
S.E. ±			0.02						0.04			
C.D. (P=0.05)			0.06						0.12			

* T_1- Bud initiation stage, T_2-50% bud formation stage, T_3-Flower initiation stage, T_4-10% flowering stage, T_5-50% flowering stage and T_6- Pod formation stage

have to be protected at different crop growth stages. Today most of the farmers are following the spray schedule of first spray at 50% flowering followed by second spray at 15 days interval, to manage pod borer complex of pigeonpea. In the present investigation it was clearly observed that this recommendation does not satisfy the pest management strategies for all cultivars and more studies in this aspect are to be conducted in future.

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