Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2019; 7(2): 1363-1370

Received: 11-01-2019
Accepted: 14-02-2019

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Impact of sowing periods on incidence of insect pest complex in Pigeon pea

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Abstract
A field experiment was conducted during the *kharif* seasons of the year 2014, 2015 and 2016 at Pulse Research Station, Anand Agricultural University, Model Farm, Vadodara, Gujarat in sandy loam soil to evaluate the effect of five period of sowing *i.e.*, D_1-15th June, 24th SMW (11-17 June), D_2- 1st July- 26th SMW (25 June -1 July), D_3-15th July, 28th SMW (9-15 July), D_4- 30th July, 31st SMW (30 July - 5 August) and D_5- 14th August, 33rd SMW (13-19 August) and three varieties (BDN-2, AGT-2 and Vaishali) on the incidence of insect pest complex in Pigeon pea. The result revealed that sowing periods have the influence on the larval population, pod damage, grain weight loss and grain yield. Early sown crop suffers higher due to *Helicoverpa armigera* Hubner whereas pod fly, *Melanagromyza obtusa* Malloch damage found comparatively lower which ultimately resulted in highest grain yield. Second date of sowing (1st July, 26th SMW) found more suitable in minimizing insect pests population and thereby increase in grain yield. Among the varieties, AGT-2 remained superior than Vaishali and BDN- 2 in respect of lower larval population of *H. armigera*, pod damage and grain weight loss which resulted in higher grain yield.

Keywords: Pigeon pea, date of sowing, varieties, *Helicoverpa armigera* Hubner, *Melanagromyza obtusa* Malloch

1. Introduction
Pigeon pea [*Cajanus cajan* (L.) Millsp.] is an important pulse crop belongs to family Leguminosae. It is a multipurpose grain legume crop grown in Gujarat. The green pods of pigeon pea are used as vegetables, grains used as split grain as dal and it is rich in protein, averaging a protein digestibility of 70% when cooked [9] and forms a major constituent of our daily vegetarian diet. It also enriches the soil through biological nitrogen fixation, fit in various cropping system without disturbing the main cereal and oilseed crops, while the other plant parts are used as a valuable fodder. Among the *Kharif* pulses, pigeon pea rank first and it has great significance in Indian agriculture because of its multiple use (food, feed, fodder and fuel and its role in sustaining agricultural productivity). It is a drought resistant crop and suitable for dry land farming besides being used as an intercrop. It is cultivated in about 53.37 lakh ha with a production of 48.73 lakh tonne with a productivity of 913 kg ha^{-1} in India. In Gujarat [1], it is cultivated in 3.47 lakh ha with a production of 4.01 lakh tonne and a productivity of 1156 kg ha^{-1} [1]. Many factors are responsible for low production of pigeon pea, amongst insect pest is one of the major constraint in reducing crop production.
Insect pests which not only exert quantitative loss but also caused qualitative loss to the crop. Pigeon pea is tasty, not only to people, but also to insect pests. Nearly 300 species of insects are known which infest on pigeon pea crop at its various growth stages in India [5]. The most economical pests those attack at flowering and podding stage of the crop are pigeon pea pod borer, *Helicoverpa armigera* (Hubner); blue butterflies, *Lampides boeticus* Linn. and *Catochrysops Strabo* (Fabricius); plume moth, *Exelastis atomosa* (Walsingham) and pod fly, *Melanagromyza obtusa* Malloch [9].
The information on suitable sowing periods and variety for *kharif* pigeon pea for middle Gujarat agro-climatic zone is lacking. Keeping this in view, the present experiment was conducted to fulfill the lacuna.

2. Materials and Methods
A field experiment was conducted during the *kharif* seasons of the year 2014, 2015 and 2016 at Pulse Research Station, Anand Agricultural University, Model Farm, Vadodara, Gujarat in sandy loam soil with pH 7.35.

It was very deep and fairly moisture retentive, low in organic carbon (0.275) and high in available phosphorus (75.43) and potash (301.85). The experiment was laid out in split plot design with three replications wherein five sowing date {D_1- 15th June, 24th SMW (11-17 June), D_2- 1st July- 26th SMW (25 June -1 July), D_3-15th July, 28th SMW (9-15 July), D_4- 30th July, 31st SMW (30 July - 5 August) and D_5- 14th August, 33rd SMW (13-19 August)} were tried as main plot treatments and three varieties *viz*., BDN-2, AGT-2 and Vaishali were evaluated in sub plot treatments. Recommended dose of fertilizer (25 kg N + 50 kg P_2O_5/ha) was applied in the form of Urea and SSP at the time of sowing. For recording the observations, 5 plants selected and tagged randomly from each plot. Weekly observations taken up 15 days after germination. Pod borer- *Helicoverpa armigera* (Hub.) larva (e) recorded on randomly selected and tagged 5 plants from each plot at weekly inetrval. In order to record the pod damage at green pod stage and at harvesting stage, 100 pods selected randomly from each plot, plucked, separated in healthy and damaged pods to derive per cent pod damage by *H. armigera* and *Melanagromyza obusta*. Grain weight loss derived from 100 gm seed from each plot. Grain yield recorded. The data on larval population, per cent pod and grain damage and grain yield subjected to ANOVA to draw the conclusion.

3. Results and Discussion

3.1 Effect of sowing periods on *H. armigera*

3.1.1 Larval population

It can be revealed from the data presented in Table 1 that the trend of the larval population in the different dates of sowing remained the same over the years.

First year 2014-15: All the sowing periods of pigeon pea were found differ significantly in larval population. The fifth sowing period recorded significantly the least (2.24 larvae per plant) larval population whereas the highest (3.93 larvae per plant) larval population was recorded in first sowing period which remained at par with second sowing period.

Second year 2015-16: All the sowing periods of pigeon pea were found differ significantly from each other in respect of the larval population. The fifth sowing period recorded significantly the least (1.62 larvae per plant) larval population whereas the highest (3.84 larvae per plant) in the first sowing period.

Third year 2016-17: All the sowing period of pigeon pea were found differ significantly in larval population. The fifth sowing period recorded significantly the least (1.72 larvae per plant) larval population whereas the highest (3.93 larvae per plant) larval population was recorded in first sowing period which remained at par with second sowing period.

Based on three year pooled data, the trend of larval population in different sowing period remained same over the years. All the sowing periods of pigeon pea were found differ significantly from each other in respect of larval population. Fifth sowing period recorded the least (1.86 larvae per plant) larval population whereas it was the highest (3.88 larvae per plant) in first sowing period.

Early sown crop recorded relatively higher larval population of *H. armigera* than the late sown pigeon pea.

3.1.2 Green pod damage (%)

Impact of sowing periods was found significant (Table- 2) in respect of pod damage caused by *H. armigera* to pigeon pea pods.

First year 2014-15: The pod damage at green pod stage was found significant. The least (15.67 %) and highest (21.67 %) pod damage was recorded in fifth and first sowing period, respectively. The pod damage in fifth sowing period was remain significantly superior on rest of the sowing periods in having lower pod damage, whereas first sowing period suffered significantly more damage than rest of the sowing periods (D2, D3 and D4).

Second year 2015-16: The pod damage at green pod stage was found significant. The least (14.56 %) and highest (20.44 %) pod damage was recorded for fifth and first sowing period, respectively. The pod damage in fifth sowing period was remained at par with the other sowing period except first sowing period.

Third year 2016-17: The pod damage at green pod stage was found significant. The least (14.56 %) and highest (18.67 %) pod damage was recorded for fifth and first sowing period, respectively. The pod damage in fifth sowing period remained at par with the second and fourth sowing period. First sowing period remained at par with third and fourth sowing period.

Based on Pooled data, pod damage differed significantly in sowing periods. Significantly least (14.93 %) and highest (20.26 %) pod damage was recorded for fifth and first sowing period, respectively. Fourth (16.52 %) sowing period has also recorded the least pod damage than first sowing period but remained at par with second (17.41 %) sowing period.

The present studies were in conformity with other researchers who also noted the minimum pod borer damage in early sowing [3, 4].

3.1.3 Pod damage (%) at harvest

The impact of pigeon pea sowing periods on pod damage by *H. armigera* was found significant (Table- 3) over the years.

First year 2014-15: At crop maturity, the crop sown late *i.e.* fifth sowing period had significantly least (18.33 %) pod damage. First sowing period recorded the highest pod damage (31.0 %).

Second year 2015-16: Same trend for pod borer damage was also observed in *khraif* -2015. The pod damage in different sowing periods was found significant. First sowing period had significantly the highest (31.44 %) pod damage except fifth and fourth sowing period. The least (19.56 %) pod damage was recorded in fifth sowing period but remain at par with fourth (22.33 %) sowing period.

Third year 2016-17: All the sowing periods had significant differences in pod damage. Fifth sowing period had the least (20.22 %) pod damage than rest of the sowing periods except fourth sowing period (23.44 %). The highest (30.11 %) pod damage recorded in the first sowing period but found at par with second (27.33 %) and third (26.56 %) sowing period.

Based on pooled data, the impact of pigeon pea sowing period on pod damage by *H. armigera* was found significant over the years. First sowing period recorded significantly the highest (30.85 %) pod damage whereas it was the lowest (19.37 %) in fifth sowing period. Second (28.15 %) and third (27.37 %) sowing period found superior than first sowing period.

3.2 Effect of sowing periods on *M. obtusa*

3.2.1 Green pod damage (%)

Impact of sowing periods was found significant (Table- 4) in respect of pod damage caused by *M. obtusa* to pigeon pea pods.

First year 2014-15: In the different sowing period, early sown pigeon pea crop suffer less pod fly damage but the difference

was found non-significant.

Second year 2015-16: The first (11.44 %) and second (12.78 %) sowing period recorded significantly the least pod fly damage than third (15.66 %), fourth (16.56 %) and fifth (16.67 %) sowing period.

Third year 2016-17: The first sowing period recorded significantly lowest (11.22 %) pod damage than third (14.33 %), fourth (16.11 %) and fifth (16.67 %) sowing period but remained at par with second (12.89 %) sowing period.

Based on pooled data, the trend of pod fly damage to the pods remained the same. The first (11.81 %) and second (13.07 %) sowing period recorded significantly the least pod fly damage than third (14.78 %), fourth (16.11 %) and fifth (16.44 %) sowing period. Fourth and fifth sowing period found at par with each other.

The late sowing caused lower incidence of pod fly, *M. obtusa.* It was evident that late sowing of pigeon pea crop lowers the pod fly infestation [3, 8].

3.2.2 Pod damage (%) at harvest

The impact of pigeon pea sowing periods on pod damage by *M. obtusa* was found significant (Table- 5) over the years.

First year 2014-15: At crop maturity, the crop sown late *i.e.* fifth sowing period had significantly the highest (27.33 %) pod damage except first sowing period. First sowing period had significantly the lowest (22.67 %) pod fly damage.

Second year 2015-16: The first (20.78 %) and second (22.67 %) sowing period recorded significantly the least pod fly damage than third (26.11 %), fourth (26.67 %) and fifth (27.67 %) sowing period.

Third year 2016-17: The first (19.89 %) and second (21.56 %) sowing period recorded significantly the least pod fly damage than third (24.89 %), fourth (26.78 %) and fifth (28.22 %) sowing period.

Based on pooled data, first (21.11 %) and second (23.37 %) sowing period recorded significantly the least pod fly damage than third (26.04 %), fourth (27.22 %) and fifth (27.44 %) sowing period. First and second sowing period also differed significantly in pod fly damage. The least (21.11 %) damage was recorded in the first sowing period.

3.2.3 Grain wt. loss (%)

The impact of pigeon pea sowing periods on grain wt. loss by *M. obtusa* was found significant (Table- 6) over the years.

First year 2014-15: Grain damage due to insect pests resulted in grain weight loss at maturity recorded significantly the lowest (10.56 %) in third sowing period compared to first (18.22 %) and fourth (22.00 %) sowing period but found at par with second (11.89 %) and fifth (15.11 %) sowing period.

Second year 2015-16: The fourth sowing period recorded significantly the highest (18.89 %) grain weight loss than rest of the sowing periods except third (16.78 %) sowing period. The least (14.89 %) grain weight loss recorded for first sowing period which remained at par with second (15.56 %) and fifth (15.89 %) sowing period.

Third year 2016-17: Second sowing period recorded significantly lowest (12.22 %) grain weight loss than the highest (18.67 %) observed in fourth sowing period but found at par with third (12.67 %), first (14.22 %) and fifth (14.89 %) sowing period.

Pooled over year data indicated a significant difference in tested varieties in respect of grain weight loss. Second sowing period recorded significantly lowest (13.22 %) grain weight loss than the highest (19.85 %) observed in fourth sowing period but found at par with third (13.33 %), fifth (15.30 %) and first (15.78 %) sowing period. Late sown pigeon pea crop suffered more damage of pod fly as compared to early sown crop.

3.3 Effect of varieties on *H. armigera*

3.3.1 Larval population

The impact of different varieties of pigeon pea on larval population of *H. armigera* was found significant (Table- 1) over the years.

First year 2014-15: Among the three tested varieties, AGT-2 recorded significantly the least (2.69 larvae per plant) larval population whereas the highest (3.28 larvae per plant) in Vaishali which remained at par with BDN-2 (3.20 larvae per plant).

Second year 2015-16: All the varieties tested found differ significantly from each other in larval population. AGT-2 variety recorded significantly the least (2.31 larvae per plant) larval population whereas it was highest (3.12 larvae per plant) in BDN-2.

Third year 2016-17: All the varieties tested found differ significantly from each other in larval population. The trend in respect of larval population remained the same as observed in 2015. AGT-2 variety recorded the least (2.42 larvae per plant) larval population whereas it was highest (3.20 larvae per plant) in BDN-2.

Based on three year pooled data, the trend of larval population in tested varieties remained same over the years. Among the three tested varieties, AGT-2 recorded significantly the least (2.46 larvae per plant) larval population whereas it was the highest (3.16 larvae per plant) in BDN-2 which remained at par with Vaishali (2.46 larvae per plant).

3.3.2 Green pod damage (%)

Impact of varieties were found significant (Table- 2) in respect of pod damage caused by *H. armigera* to pigeon pea pods

The ascending order of pod damage observed as AGT-2 (16.47, 14.60 and 14.07 %), Vaishali (19.73, 17.87 and 17.27 %) and BDN-2(19.80, 19.27 and 18.53 %) over the years. AGT-2 variety has recorded significantly the least pod damage than rest of the two varieties which were found at par with each other in all three year.

Based on the pooled over year data, AGT-2 had significantly the least (15.04 %) pod damage than rest the two varieties. Vaishali (18.29 %) and BDN-2 (19.20 %) remained at par with each other.

3.3.3 Pod damage (%) at harvest

Almost the same trend (Table- 3) observed at maturity as recorded at green pod stage for the pod damage in tested varieties.

First year 2014-15: AGT-2 (21.93 %) found significantly superior than rest of the two varieties found at par with each other.

Second year 2015-16: AGT-2 variety had significantly the least (24.00 %) pod damage than BDN-2 (28.73 %) but remained at par with Vaishali (25.13 %).

Third year 2016-17: AGT-2 variety had significantly the least (23.07 %) pod damage than BDN-2 (27.80 %) but observed at par with Vaishali (25.73 %).

Based on the pooled over year data, all the varieties were found significantly differed to each other in having pod damage at harvest. AGT-2 had significantly the least (23.00

%) pod damage than Vaishali (26.22 %) and BDN-2 (28.20 %). Vaishali found superior over BDN-2.

3.4 Effect of varieties on *M. obtusa*

3.4.1 Green pod damage (%)

Impact of varieties were found significant (Table- 4) in respect of pod damage caused by *M. obtusa* to pigeon pea pods

AGT-2 variety recorded significantly the least (13.00, 12.73 and 12.53 %) pod damage than Vaishali (14.93, 14.93 and 14.53%) and BDN-2 (15.53, 16.13 and 15.67 %) which were at par with each other in 2014, 2015 and 2016, respectively.

Based on pooled over year data, the variety AGT-2 recorded significantly lowest (12.76 %) pod fly damage at green pod stage. The varieties Vaishali (14.80 %) and BDN-2 (15.78 %) remained at par with each other.

3.4.2 Pod damage (%) at harvest

Almost the same trend (Table- 5) was observed at maturity for pod fly damage to the different varieties as recorded at green pod stage over the years.

AGT-2 variety recorded significantly the lowest (22.73, 21.00 and 21.13 %) pod damage than Vaishali (27.53, 25.33 and 24.67 %) and BDN-2 (27.87, 28.07 and 27.00 %) which were found at par with each other in 2014, 2015 and 2016, respectively.

Based on pooled data, the difference in pod damage due to pod fly found significant. AGT-2 variety recorded significantly the lowest (21.62 %) pod fly damage than the Vaishali (25.84 %) and BDN-2 (27.64 %) which were also found significantly differed to each other.

3.4.3 wt. loss (%)

The impact of different varieties pigeon pea on grain wt. loss by *M. obtusa* was found significant (Table- 6) over the years.

First year 2014-15: The impact of variety on the grain weight loss due to pod fly found non-significant.

Second and Third year 2015-16 and 2016-17 AGT-2 variety recorded significantly lowest (13.20 & 11.40 %) pod fly damage to the grains. Vaishali (17.67 and 15.40 %) and BDN-2(18.33 and 16.80 %) found at par with each other.

Based on pooled over year data, the trend of grain weight loss due to pod fly in different varieties found significant. AGT-2 recorded significantly the lowest (13.07 %) grain damage than Vaishali (16.64 %) and BDN-2 (16.78 %).

3.5 Effect of sowing periods on Grain yield of Pigeon pea

Grain yield of pigeon pea was found significant due to different date sowings period (Table- 7).

First year 2014-15: Significantly the highest (1473 kg/ha) grain yield was recorded in first sowing period as compared to third, fourth and fifth sowing period which recorded 1136, 947 and 715 kg/ha grain yield, respectively but found at par with second (1389 kg/ha) sowing period.

Second year 2015-16: Significantly the highest (2125 kg/ha) grain yield was recorded in first sowing period as compared to third, fourth and fifth sowing period which recorded 1754, 1157 and 897 kg/ha grain yield, respectively but found at par with second (2093 kg/ha) sowing period.

Third year 2016-17: Significantly the highest (1877 kg/ha) grain yield was recorded in first sowing period but remained at par with second (1843 kg/ha) sowing period whereas third, fourth and fifth sowing period recorded 1467, 1324 and 1098 kg/ha grain yield, respectively. Third and fourth sowing period found at par with each other. Fifth sowing period recorded significantly the lowest grain yield.

Based on pooled over year data, the difference in grain yield was found significant. First and second sowing period yielded significantly the higher (1825 and 1775 kg/ha, respectively) grain yield than third (1453 kg/ha), fourth (1143 kg/ha) and fifth (904 kg/ha) sowing period. Fourth and fifth date of sowing found at par with each other.

Researchers also reported sharp decline in the grain yield of pigeon pea with delay in sowing time [6, 7, 2].

3.6 Effect of varieties on Grain yield of Pigeon pea

Grain yield of pigeon pea was found significant due to different varieties (Table- 7).

First year 2014-15: AGT-2 yielded higher grain yield, through differences among the varieties in terms of grain yield found non-significant.

Second year 2015-16: AGT-2 yielded significantly the highest (1740 kg/ha) grain yield than BDN-2 (1465 kg/ha) but found at par with Vaishali (1612 kg/ha).

Third year 2016-17: AGT-2 yielded significantly the highest (1645 kg/ha) grain yield than Vaishali (1500 kg/ha) and BDN-2 (1422 kg/ha) which were found at par with each other.

Based on pooled over year data, AGT-2 and Vaishali yielded significantly higher grain yield than BDN-2. AGT-2 variety recorded significantly highest (1537 kg/ha) grain yield than Vaishali and BDN-2.

Table 1: Mean larval population in different sowing periods & varieties of Pigeon pea

S. No.	Character	Larval Population - *H. armigera*			
1 Sowing dates		**2014**	**2015**	**2016**	**Pooled**
1	D1	2.22c	2.2e	***2.22***d	***2.21***e
		(3.93)	(3.84)	(3.93)	(3.88)
2	D2	2.14c	2.07d	2.15d	2.12d
		(3.58)	(3.28)	(3.62)	(3.49)
3	D3	1.98b	1.97c	1.95c	1.97c
		(2.92)	(2.88)	(2.80)	(2.88)
4	D4	1.92b	1.76b	1.81b	1.83b
		(2.69)	(2.10)	(2.28)	(2.35)
5	D5	1.8a	1.62a	1.65a	1.69a
		(2.24)	(1.62)	(1.72	(1.86)
	S.Em. ±	0.03	0.02	0.02	0.03
	CD at 0.05	0.09	0.06	0.08	0.08
	CV%	16.00	12.00	15.00	14.00
2 Varieties					
1	BDN-2	2.05b	2.03c	2.05c	2.04b

		(3.20)	(3.12)	(3.20)	(3.16)
2	AGT-2	1.92a	1.82a	1.85a	1.86a
		(2.69)	(2.31)	(2.42)	(2.46)
3	Vaishali	2.07b	1.92b	1.97b	1.99b
		(3.28)	(2.69)	(2.88)	(2.96)
	S.Em. ±	0.02	0.02	0.02	0.02
	CD at 0.05	0.06	0.05	0.05	0.07
	CV%	17.00	13.00	13.00	14.00
Interaction					
D x Y	S.Em. ±				0.02
	CD at 0.05				0.07
V x Y	S.Em. ±				0.02
	CD at 0.05				0.05
D x V x Y	S.Em. ±				0.04
	CD at 0.05				NS

Means √x+1 transformed values
Figures in parenthesis are retransformed values
Common letter indicates non-significant difference

Table 2: Mean pod damage caused by *H. armigera* in different sowing periods & varieties of Pigeon pea

S. No.	Character	Green pod stage (%)			
1 Sowing dates		**2014**	**2015**	***2016***	**Pooled**
1	D1	21.67 d	20.44 b	18.67 c	20.26 d
2	D2	18.44 bc	17.78 ab	16.00 ab	17.41 bc
3	D3	19.78 c	17.78 ab	17.78 bc	18.44 c
4	D4	17.78 b	15.67 a	16.11 abc	16.52 b
5	D5	15.67 a	14.56 a	14.56 a	14.93 a
	S.Em. ±	0.47	1.05	0.79	0.47
	CD at 0.05	1.54	3.44	2.59	1.36
	CV%	8.00	18.00	14.00	14.00
2 Varieties					
1	BDN-2	19.80 b	19.27 b	18.53 b	19.20 b
2	AGT-2	16.47 a	14.60 a	14.07 a	15.04 a
3	Vaishali	19.73 b	17.87 b	17.27 b	18.29 b
	S.Em. ±	0.63	0.94	0.61	0.43
	CD at 0.05	1.85	2.76	1.79	1.21
	CV%	13.00	21.00	14.00	16.00
Interaction					
D x Y	S.Em. ±				0.81
	CD at 0.05				NS
V x Y	S. Em. ±				0.74
	CD at 0.05				NS
D x V x Y	S. Em. ±				1.65
	CD at 0.05				NS

Table 3: Mean pod damage caused by *H. armigera* in different sowing periods & varieties of Pigeon pea

S. No.	Character	Harvest (%)			
1 Sowing dates		**2014**	**2015**	***2016***	**Pooled**
1	D1	31.00 d	31.44 b	30.11 c	30.85 d
2	D2	29.00 cd	28.11 b	27.33 bc	28.15 c
3	D3	27.22 bc	28.33 b	26.56 bc	27.37 c
4	D4	24.11 b	22.33 a	23.44 ab	23.30 b
5	D5	18.33 a	19.56 a	20.22 a	19.37 a
	S.Em. ±	1.02	0.98	1.42	0.67
	CD at 0.05	3.31	3.21	4.63	1.95
	CV%	12.00	11.00	17.00	13.00
2 Varieties					
1	BDN-2	28.07 b	28.73 b	27.80 b	28.20 c
2	AGT-2	21.93 a	24.00 a	23.07 a	23.00 a
3	Vaishali	27.80 b	25.13 a	25.73 ab	26.22 b
	S.Em. ±	0.83	1.00	1.26	0.60
	CD at 0.05	2.45	2.96	3.70	1.70
	CV%	12.00	15.00	19.00	16.00
Interaction					

D x Y	S. Em. ±	1.16
	CD at 0.05	NS
V x Y	S. Em. ±	1.04
	CD at 0.05	NS
D x V x Y	S. Em. ±	2.33
	CD at 0.05	NS

Table 4: Mean pod damage caused by *M. obtusa* in different sowing periods & varieties of Pigeon pea

S. No.	Character	Green pod stage (%)			
1 Sowing dates		**2014**	**2015**	***2016***	**Pooled**
1	D1	12.78	11.44 a	11.22 a	11.81 a
2	D2	13.56	12.78 a	12.89 ab	13.07 a
3	D3	14.44	15.56 b	14.33 bc	14.78 b
4	D4	15.67	16.56 b	16.11 c	16.11 c
5	D5	16.00	16.67 b	16.67 c	16.44 c
	S.Em. ±	0.79	0.63	0.83	0.44
	CD at 0.05	NS	2.06	2.67	1.27
	CV%	16.00	13.00	17.00	16.00
2 Varieties					
1	BDN-2	15.53 b	16.13 b	15.67 b	15.78 b
2	AGT-2	13.00 a	12.73 a	12.53 a	12.76 a
3	Vaishali	14.93 b	14.93 b	14.53 b	14.80 b
	S.Em. ±	0.64	0.60	0.67	0.37
	CD at 0.05	1.88	1.76	1.99	1.04
	CV%	17.00	16.00	18.00	17.00
Interaction					
D x Y	S.Em. ±				0.75
	CD at 0.05				NS
V x Y	S.Em. ±				0.64
	CD at 0.05				NS
D x V x Y	S.Em. ±				1.42
	CD at 0.05				NS

Table 5: Mean pod damage caused by *M. obtusa* in different sowing periods & varieties of Pigeon pea

S. No.	Character	Harvest (%)			
1 Sowing dates		**2014**	**2015**	***2016***	**Pooled**
1	D1	22.67 a	20.78 a	19.89 a	21.11 a
2	D2	25.89 b	22.67 a	21.56 a	23.37 b
3	D3	27.11 b	26.11 b	24.89 b	26.04 c
4	D4	27.22 b	27.67 b	26.78 bc	27.22 c
5	D5	27.33 b	26.67 b	28.22 c	27.44 c
	S.Em. ±	0.97	0.90	0.84	0.52
	CD at 0.05	3.16	2.94	2.74	1.53
	CV%	11.00	11.00	10.00	11.00
2 Varieties					
1	BDN-2	27.87 b	28.07 b	27.00 b	27.64 c
2	AGT-2	22.73 a	21.00 a	21.13 a	21.62 a
3	Vaishali	27.53 b	25.33 b	24.67 b	25.84 b
	S.Em. ±	1.20	0.86	1.14	0.62
	CD at 0.05	3.54	2.53	3.37	1.76
	CV%	18.00	14.00	18.00	17.00
Interaction:					
D x Y	S.Em. ±				0.91
	CD at 0.05				NS
V x Y	S.Em. ±				1.08
	CD at 0.05				NS
D x V x Y	S.Em. ±				2.41
	CD at 0.05				NS

Table 6: Mean grain wt. loss in different sowing periods & varieties of Pigeon pea

S. No.	Character	Grain wt. loss (%)			
1 Sowing dates		**2014**	**2015**	***2016***	**Pooled**
1	D1	18.22 bc	14.89 a	14.22 a	15.78 a
2	D2	11.89 a	15.56 a	12.22 a	13.22 a
3	D3	10.56 a	16.78 ab	12.67 a	13.33 a
4	D4	22.00 c	18.89 b	18.67 b	19.85 b

5	D5	15.11 ab	15.89 a	14.89 a	15.30 a
	S.Em. ±	1.46	0.77	0.84	1.23
	CD at 0.05	4.55	2.51	2.74	4.00
	CV%	28.00	14.00	17.00	21.00
2 Varieties					
1	BDN-2	15.20	18.33 b	16.80 b	16.78 b
2	AGT-2	14.60	13.20 a	11.40 a	13.07 a
3	Vaishali	16.87	17.67 b	15.40 b	16.64 b
	S.Em. ±	1.06	0.81	0.67	0.79
	CD at 0.05	NS	2.38	1.97	3.10
	CV%	26.00	19.00	18.00	21.00
Interaction					
D x Y	S.Em. ±				1.07
	CD at 0.05				3.12
V x Y	S.Em. ±				0.86
	CD at 0.05				2.43
D x V x Y	S.Em. ±				1.92
	CD at 0.05				NS

Table 7: Grain yield in different sowing periods & varieties of Pigeon pea

S. No.	Character	Yield (Kg/ha)			
1 Sowing dates		**2014**	**2015**	***2016***	**Pooled**
1	D1	1473 d	2125 d	1877 c	1825 c
2	D2	1389 d	2093 d	1843 c	1775 c
3	D3	1136 c	1754 c	1467 b	1453 b
4	D4	947 b	1157 b	1324 b	1143 a
5	D5	715 a	897 a	1098 a	904 a
	S.Em. ±	28	50	60	84
	CD at 0.05	90	163	195	274
	CV%	7.00	9.00	12.00	10.00
2 Varieties					
1	BDN-2	1048	1465 a	1422 a	1312 a
2	AGT-2	1225	1740 b	1645 b	1537 c
3	Vaishali	1124	1612 ab	1500 a	1412 b
	S.Em. ±	74.28	56	44	34
	CD at 0.05	NS	167	128	97
	CV%	25.00	14.00	11.00	16.00
Interaction					
D x Y	S.Em. ±				48
	CD at 0.05				140
V x Y	S.Em. ±				59
	CD at 0.05				NS
D x V x Y	S.Em. ±				132
	CD at 0.05				NS

4. Conclusion

It can be concluded that sow pigeon pea variety Anand Gujarat Tur 2 (AGT 2) from 25th June to 1st July (26th SMW, onset of monsoon) to minimize the incidence of pod borers and thereby increase the seed yield (narrow spacing).

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