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AGRONOMY

Determination of Optimum Sowing Time of Grass Pea Based on Yield Variation as Affected by Varied Dates of Sowing in New Alluvial Zone of West Bengal

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ABSTRACT

To investigate the optimum sowing time of grass pea (*Lathyrus sativus* L.) in New Alluvial Zone of West Bengal, field experiment was conducted with grass pea (cv.: Prateek), sown on nine different dates from 26th October to 21st December at weekly interval during the winter season of 2016-17 at the Instructional Farm (22°58′ N, 88°31′ E), Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India. Grain yield and different yield attributes viz. numbers of pods per plant (PP), numbers of grains per pod (GP) and test weight of grains (TW) were observed and statistically analyzed. It was observed that sowing time greatly altered grain yield and yield attributes. Highest mean grain yield (994.4 kg/ha) was obtained from the crops sown on 16th November. TW showed highest correlation with grain yield ($r = 0.88^{**}$). Test weight of grains seemed to be the most important yield attribute in terms of adjusted R^2 values (0.752^{**}), obtained from the regression analysis between grain yield and different yield attributes individually and in combination. It was clear that grass pea should be sown after 2nd November and not beyond 16th November to obtain the potential productivity in the New Alluvial Zone of West Bengal.

Highlights

- Grain yield of grass pea was influenced by the time of sowing to a greater extent.
- Among all yield attributes, contribution of test weight of grains (TW) to final grain yield (GY) was the maximum.
- To get potential production of grass pea, the crop should be sown during the first two weeks of November in the New Alluvial Zone of West Bengal.

Keywords: Grass pea, grain yield, optimum sowing time, yield attributes

Grass pea (*Lathyrus sativus* L., 2n=14) is a food, feed and fodder crop belonging to the family Leguminosae or Fabaceae, subfamily Papilionoideae and tribe Vicieae. This is a temperate crop. In general, it also grows well under the high temperature conditions of the subtropics as a winter crop. Grass pea has a high yield potentiality under low fertilization level (Campbell *et al*. 1994; Vaz Patto *et al*. 2006). It can be cultivated under a wide range of soils (Campbell *et al*. 1994). It is cultivated in the cold winter months (*rabi* season) in the Indian sub-continent. The crop, under these conditions, is generally sown in October or November and harvested in March (Sarwar *et al*. 1995). Sowing time determines the yield of crops to a great extent. Delay in sowing after the optimum sowing time can have adverse effect on crop yield (Darwinkel Ten Hag and Kuizenga 1977; Fielder 1988). The objective of this research was to investigate the optimum sowing time based on the variation in yield under different sowing time.

MATERIALS AND METHODS

One field experiment was conducted during the winter season of 2016-2017 at the Instructional

Farm (22°58′ N latitude, 88°31′ E longitude and at an altitude of 9.75 m above the mean sea level), Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India. The crop was grown in sandy loam soil having pH of 6.75, 0.54% organic carbon, 0.053% total nitrogen, 15.00 kg/ha available P_2O_5 and 253.57 kg/ha available K_2O. Average annual rainfall of the experimental site is 1457 mm, 85 per cent of which is received from June to September and mean monthly temperature ranges from 10°C - 37°C.

Grass pea was sown on nine different dates at weekly interval starting from 26th October to 21st December. Plot size was 4.5 m × 3.3 m and Randomized Complete Block Design (RCBD) was followed with three numbers of replications. Name of the variety was 'Prateek'. Seed rate was 40 kg/ha and row to row spacing of 30 cm was maintained. 10: 20: 20 kg N, P_2O_5 and K_2O /ha was applied to the crop as basal. Two live saving irrigations were provided at 30 and 60 days after sowing. One hand weeding was done at 30 days after sowing and no herbicide was applied to control weeds. The crop was harvested leaving 0.5 m border from all sides of each plot when almost all of the pods were fully matured.

After threshing, the grains were dried and dry weights were recorded. Yield attributes viz. numbers of pods per plant, numbers of grain per pod and test weight of grain or 1000-grain weight were recorded and statistically analyzed in OP-STAT software. Simple correlation study was conducted between yield attributes and mean grain yield (Gomez and Gomez 1984). In order to investigate the contribution of different yield attributes to grain yield, grain yield was regressed against yield attributes.

RESULTS AND DISCUSSIONS

Grain Yield

Mean grain yield (GY) of grass pea as affected by varied dates of sowing has been presented in Table 1. The results revealed that grain yield varied from 620.9kg/ha in 21st December sown crop to 994.4kg/ha in 16th November sown crop. Due to variation in the sowing dates, there were significant differences in grain yield of grass pea. The highest grain yield (994.3kg/ha) of grass pea was observed in the crop sown on 16th November which was statistically at par with the grain yields obtained from the crops sown on 2nd November, 9th November, 23rd November and 30th November. Furthermore, there was significant reduction in grain yield in crops sown before 2nd November and sown after 30th November. Thus it is observed that crop sown during the period from 26th October to 30th November gave rise to grain yield to the tune of above 800kg/ha, while the crops sown in December (7th, 14th and 21st December) produced grain yield ranging from 620.9kg/ha to 793.7kg/ha. The results further revealed that for every seven days delay in sowing beyond 16th November, there were reductions in grain yield by 2.6%, 12.2%, 20.2%, 31.4% and 37.6% in crops sown on 23rd November, 30th November, 7th December, 14th December and 21st December, respectively. Reduction in grain yield due to delay in sowing has been reported in wheat (McDonald *et al.* 1983). It has been demonstrated that yield of barley decreased when it was sown beyond the optimum sowing time (Kirby 1969).

Number of pods per plant

The number of pods per plant (PP) is one of the most important yield components in grass pea. Average number of pods per plant of grass pea varied from 20 in 21st December sown crop to 48 in 16th November sown crop. The crop sown on 16th November had the highest number of pods per plant (48) which was statistically at par with the number of pods per plant produced from the crops sown on 2nd November and 9th November. Numbers of pods per plant significantly decreased in crops sown after 16th November. It was demonstrated in wheat that with delayed sowing dates, the number of ears per plant at any plant density was reduced (Spink *et al.* 2000).

Number of grains per pod

Number of grains per pod (GP) is an important yield component. Number of grains per pod of Grass pea was recorded at the time of harvest and presented in Table 1. It was found that there was no significant variation in the number of grains per pod among different dates of sowing. Thus, it can be concluded that the number of grains per pods was very less or not affected by the sowing times.

Test weight of grain

Mean test weight of grain (TW) or 1000-grain weight

Table 1: Effect of sowing date on grain yield and yield attributes

Dates of sowing	Grain yield (kg/ha)	Numbers of pods per plant	Numbers of grains per pod	Test weight of grain (g)
26th October	806.7	37	3.3	39.7
2nd November	840.0	39	3.0	42.9
9th November	865.3	40	3.3	43.1
16th November	994.4	48	3.3	44.4
23rd November	968.9	34	3.0	43.4
30th November	873.2	25	3.0	40.7
7th December	793.7	25	3.0	40.4
14th December	682.6	23	3.0	39.2
21st December	620.9	20	3.0	38.7
C.D. (5%)	162.343	10.105	NS	3.315
S.E.m. (±)	53.688	3.342	0.192	1.096
C.V. (%)	11.2	17.9	10.7	4.6

of Grass pea varied from 38.7g in 21st December sown crop to 44.4g in 16th November sown crop. Due to variation in the sowing dates, there were significant differences in the test weight of Grass pea. The highest test weight (44.4g) of Grass pea was observed in crop sown on 16th November which was statistically at par with the test weight of grains produced from the crops sown on 2nd November, 9th November and 23rd November. For every seven days delay in sowing beyond 16th November there were reductions in test weight by 2.5%, 8.3%, 9.0%, 11.7% and 12.8% in crops sown on 23rd November, 30th November, 7th December, 14th December and 21st December, respectively. Test weight is affected by the size of grains and from the results it is clear that the size of grains decreased with the advancement of the sowing dates. Reduction in the test weight of grain due to delay in sowing was reported earlier in rice (Jagtap *et al.* 2016). In wheat it was reported that test weight of grain decreased in late sown crop (Tomar *et al.* 2014).

Contribution of yield attributes to grain yield

Values of correlation coefficients so obtained have been shown in Table 2 which revealed that the yield attributes exhibited positive correlation with grain yield. Regression equations, coefficient of determination (R^2) and percentage contribution of each components of yield in yield variation have been shown in Table 3, from which it is evident that test weight of grains alone contributed to or explained 75.2 per cent of total yield variation, followed by the number of pods per plant which was able to account for 51.2 per cent of the total variation in grain yield.

Table 2: Correlation coefficients between grain yield and yield attributes

Yield attributes	Correlation coefficient (r)
Number of pods per plant at harvest	0.75**
Number of grains per pod at harvest	0.38
Test weight of grain	0.88**

**Significance of r at 5% level of significance (r ≥ 0.67); **Significance of r at 1% level of significance (r ≥ 0.80).*

Table 3: Regression equations involving grain yield and individual yield attribute

Yield attributes	Regression equations	Adjusted R^2	Contribution to the total variation in grain yield (%)
PP	Y = 515.656 + 9.638 PP	0.512*	51.20
GP	Y = -125.95 + 307.5 GP	0.024	2.40
TW	Y = -1299.261 + 51.380 TW	0.752**	75.20

**Significant at 5% level of significance; **Significant at 1% level of significance; Y = Grain yield, PP = Numbers of pods per plant, GP = Numbers of grains per pod, TW = Test weight of grain.*

Table 4 indicated the contribution of various combinations of yield attributes to the final grain yield in terms of adjusted R^2. Model 2 which

Table 4: Regression equations involving grain yield and various combinations of yield attributes

Model No.	Yield attributes	Regression equations	Adjusted R^2	Contribution to the total variation in grain yield (%)
1	PP-GP	Y = 1366.131 + 13.282 PP - 312.356 GP	0.522*	52.2%
2	GP-TW	Y = -1410.09 + 55.056 GP + 49.934 TW	0.716**	71.6%
3	PP-TW	Y = -1201.57 + 0.781 PP + 48.409 TW	0.713**	71.3%
4	PP-GP-TW	Y = - 1712.81 – 1.604 PP + 105.82 GP + 54.7 TW	0.662*	66.2%

**Significant at 5% level of significance; **Significant at 1% level of significance; Y = Grain yield, PP = Numbers of pods per plant, GP = Numbers of grains per pod, TW = Test weight of grain.*

involved TW and GP showed highest values of adjusted R^2 (0.716**) closely followed by model 3 involving TW and PP with R^2 value of 0.713**. Thus, model 2 and 3 could be able to predict 71.6% and 71.3% respectively, of the total variability in grain yield. 66.2% of the total variability in the grain yield could be predicted by model 4 (R^2 = 0.662*) which included TW, PP and GP. In each of these above mentioned models, one predictor variable was common i.e. TW. Model 1(R^2 = 0.522*) involving GP as the predictor variable showed the least ability to predict grain yield. Thus it was clear that test weight of grain (TW) was the most important among all other yield attributes. It was evident that grain yields were found to be reduced mainly because of the lower test weight on grains in the late sown crops. Same results was reported in wheat (Subhan *et al.* 2004).

CONCLUSION

It is evident from the research that yields of Grass pea varied depending on the sowing times. The crops sown in October and beyond November were vulnerable to produce significantly lesser grain yield. The variation in grain yields over different dates of sowing may be caused mainly by the reduction in test weight of grains. It can be concluded that for potential productivity evaluation in Grass pea the crop needs to be sown after 2nd November and not beyond 16th November i.e. roughly during the first fortnight of November.

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