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Effect of sowing date and variety on phenology and yield of lentil during *rabi* season

S. SEN, M. GHOSH, [1]D. MAZUMDAR, B. SAHA AND [2]S. DOLUI

Department of Agronomy, [1]Department of Agricultural Statistics

[2]Department of Agricultural Biochemistry

Bidhan Chandra Krishi Viswavidyalaya, Mohanpur 741252, Nadia, West Bengal

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ABSTRACT

A field experiment was conducted at BCKV during rabi, 2012-13 to study the effect of three sowing dates (November 1, November 15 and November 30) on phenology, growth and yield of four varieties (HUL 57, Moitree, KLS 218 and Ranjan) of lentil. Delay in sowing of four lentil varieties from November 1 to 30 reduced the duration by 11.1 days (114.7 vs. 103.6 days). Mean cultivar days of lentil from sowing to emergence, flower initiation, pod initiation and maturity were 10.4, 54.2, 73.1 and 108.7 days, respectively. Lentil sown on November 15 produced the highest seed yield (908.6 kg ha^{-1}), which was 2.72 and 16.09% higher over earlier (1 November) and later sowing (30 November) dates, respectively. Among four varieties, HUL 57 recorded the highest plant height (41.3 cm), number of nodules plant^{-1}, dry matter yield, number of pods plant^{-1} (105.7) and seed yield (887.8 kg ha^{-1}). Thus, a 15-day period (first fortnight of November) could be recommended as optimum sowing time for lentil, but sowing of HUL 57 during early November appeared as promising for better seed yield in New Alluvial Zone of West Bengal.

***Keywords*:** Growth attributes, lentil, phenology, seed yield

Lentil (*Lens culinaris*, Medik) is an important *rabi* pulse crop in India mainly occupying the states of Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Jharkhand, Bihar and West Bengal. It is cultivated in about 1.51 million ha. in the country with a production of 1.13 million tonnes during 2012-13. Like other pulses, it has remained as a neglected crop due to low input-use and other production constraints. Among cultivation practices, sowing time is an important parameter which affects the growth, development and yield of lentil to a great extent. In West Bengal, lentil is largely grown on alluvial soil in the districts of Murshidabad, Nadia, Dakshin Dinajpur, North 24 Parganas, South 24 Parganas, etc. The survey-based study indicates that the replacement of age-old lentil varieties along with adjustment of sowing time in the crop sequence may help to improve the yield level as well as to expand the areas in potential regions. Thus, the present day research on lentil focuses on the evaluation-cum-selection of promising varieties along with optimization of sowing time in different agro-climatic zones of the state.

The field experiment was conducted during *rabi* season (November – March) of 2012-2013 on a medium land at Instructional Farm (22°93'N, 88°53'E and 9.75 m.s.l.) of Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India. The experiment was laid in a split-plot design with three sowing dates (November 1, 15 and 30) in main plots and four varieties (HUL 57, Moitree, KLS 218 and Ranjan) in sub-plots replicated thrice. The varietal descriptions are as follows: HUL 57 (Mutant of HUL 11) and Moitree (ILL 7723 × BLX 84176) are small seeded and resistant to rust, KLS 218 (KLS 133 × LG 362) is small seeded and Ranjan (Mutant of B 77) is spreading type, small seeded and with white flowers.

Seeds of four lentil varieties were sown at 30 cm row spacing in experimental plots (4 × 3 m) as per sowing time of various main plot treatments. The standard crop management practices like uniform fertilizer dose of 20:40:40 kg ha^{-1} of N:P_2O_5:K_2O, two hand weedings at 25-30 and 55-60 days after sowing (DAS) and one irrigation was given at 30-32 DAS because lentil was mainly grown on residual soil moisture along with little precipitation during *rabi* season.

The phenophases (*viz.* emergence, flower initiation, pod initiation and maturity) of lentil varieties sown at different dates were noted by regular field inspection method. The number of nodules plant^{-1} was counted from the root samples and total dry matter (g m^{-2}) were noted at 40, 60, 80 and 100 DAS. The plant height, yield components, seed and stover yield of lentil were recorded at crop maturity stage and protein content in grain was determined following Sadasivam and Manickam (1996). The data collected as described earlier in the investigation were subjected to the analysis of variance method suitable for split-split-plot design (Gomez and Gomez, 1984) by Statistical software SPSS 10.

Phenology

The duration of lentil crop was successively reduced with delay in sowing from November 1 to

Short Communication

Email: mghoshbckv@rediffmail.com

November 30 (Table 1). Lentil sown on 1 November took 114.7 days from sowing to maturity, which was decreased by 6.8 days on 15 November and 11.1 days on 30 November sowings in the study. Singh *et al.* (2005) reported similar reduction in time to 50% flowering and maturity for delay in sowing of lentil (*cv*. LG 308) from 10 November to 10 December at Gurdaspur, Punjab. Although the variations in length of phenophases among three sowing dates were complex, but the trends during emergence to flower initiation (E - FI) and pod initiation to maturity (PI – M) noted in the study probably influenced the life cycle of lentil crop.

The emergence of seedlings of four lentil varieties was relatively faster (8.00 days) in November 1 sown plots compared to two later sowing dates *viz.* November 15 (12.3 days) and November 30 (10.8 days), which might be due to better residual soil moisture during post-rainy period along with four consecutive rainy days from November 3-6 (2.1, 3.4, 0.3 and 25.6 cm) just after sowing.

Mean cultivar days of lentil crop from sowing to emergence (E), flower initiation (FI), pod initiation (PI) and maturity (M) were 10.4, 54.2, 73.1 and 108.7, respectively. Among four varieties, HUL 57 took greater number days to attain each phenophases compared to other three varieties (*viz*. Moitree, KLS 218, and Ranjan) tested in the study. Based on the length of life cycle, four lentil varieties could be arranged as: HUL 57 (113) days > Moitree (108.6) days e" KLS 218 (108.4) days > Ranjan (104.9) days.

Nodulation

The nodulation on roots of lentil plant increased steadily from 40 to 80 DAS, which declined thereafter due to withering or drying of nodules towards maturity (Table 2). Although there was no definite trend of variation in nodulation among sowing dates during the period from 40 to 100 DAS, but late sown (November 30) lentil usually produced greater number of nodules plant^{-1} during mid and mid-late phase compared to earlier two sowings (1 and 15 November). On the contrary, Sinha (1986) reported a decreasing trend of nodulation with delay in sowing from November 15 to December 30 at Kalyani, West Bengal. Among four varieties, HUL 57 generally recorded the highest number of nodules plant^{-1} at all stages of observation during the cropping period.

Plant height and dry matter accumulation

Delay in sowing from November 1 to 30 reduced the plant height by 4.5 cm (45.3 *vs.* 38.8 cm) (Table 2). Besides, the varieties differed in plant height between 35.3 cm (Ranjan) and 45.2 cm (KLS 218). Dry matter (DM) accumulation showed an upward trend with the advancement of crop age upto 100 DAS. Sowing time exerted significant influence on dry matter yield of lentil crop at 80 and 100 DAS in the investigation, excluding 40 and 60 DAS. Lentil sown on November 30 produced the highest dry matter at 80 DAS (137.6 g m^{-2}) and 100 DAS (195.5 g m^{-2}) probably due to rapid development of pods and seeds within shorter period than earlier two sowings on 1 and 15 November. The findings were in contrast to the trends of variation among sowing dates between 15 October and 30 November for lentil (cv. LL 699) at Gurdaspur, Punjab (Gill *et al*., 2012). Variation in DM accumulation among four lentil varieties might be due to their respective nature of branching and podding characteristics. The cultivar HUL 57 recorded the highest dry matter compared to other three varieties in the study.

Yield components and seed yield

Sowing time had significant influence on number of pods plant^{-1}, seed and stover yield of lentil varieties tested in the study (Table 3). Lentil sown on 15 November produced the highest number of pods plant^{-1} (97.4) compared to early (93.3) and late (86.6) sowings during *rabi* season of 2012-13. 100-seed yield, being a genetical character, remained unaffected due to variation in sowing time adopted in the investigation. Among four varieties, Ranjan had the highest 100- seed weight (2.08 g), being on par with KLS 218 (2.04 g); while Moitree recorded lowest 100-seed weight (1.90 g).

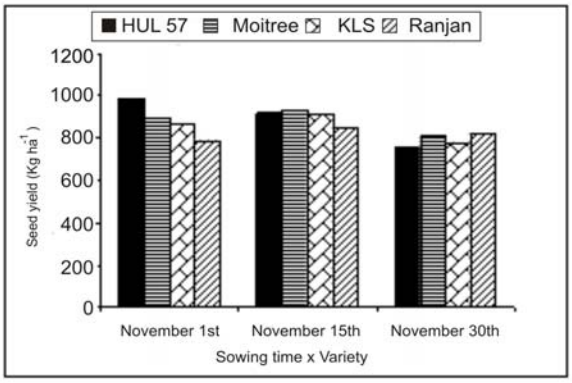

Fig. 1: Interaction effect of sowing time and variety on seed yield of lentil during *rabi* season

Lentil sown on November 15 produced the highest seed yield (908.6 kg ha-1), which was 2.72 and 16.09 per cent higher over earlier (November 1) and later sowing (November 30) dates, respectively. Considering the yield performance, the first fortnight of November might be the optimum for sowing of lentil crop in New Alluvial Zone of West Bengal, which was in conformity with the findings of Roy *et al*. (2009). Seed yield, differed significantly among four lentil varieties in the study. Based on seed yield, four varieties could be arranged as: HUL 57 (892.5 kg ha^{-1}) e" Moitree

(875.4 kg ha^{-1}) > KLS 218 (851.7 kg ha^{-1}) > Ranjan (816.5 kg ha^{-1}). Although HUL 57 recorded the highest seed yield (987.6 kg ha^{-1}) at November 1 sowing, which was successively decreased thereafter; but other three varieties (*viz*. Moitree, KLS 218, and Ranjan) performed best at mid sowing (15 November) compared to early (1 November) and late sowing (30 November) (Fig. 1). Thus, HUL 57 could be recommended as a promising variety with it's sowing during early November for better seed yield from lentil crop in the region. The highest stover yield (1708.5 kg ha^{-1}) of lentil was obtained when sown on November 15 compared to earlier (1584.4 kg ha^{-1}) or later (1497.1 kg ha^{-1}) sowings during *rabi* season. Two varieties (*viz*. Moitree and Ranjan) recorded the highest harvest index (0.36), while HUL 57 had the lowest value (0.33). Protein content in lentil grain remained unaffected due to variation in sowing time and four varieties did not differ among themselves with regard to protein content (22.3 - 22.6 per cent) in the experiment.

Delay in sowing of four lentil varieties from 1 November to 30 November reduced the duration by 11.1 days (114.7 *vs.* 103.6 days), plant height by 4.5 cm (43.3 *vs.* 38.8 cm) and seed yield by 93.4 kg ha^{-1} (883.6 *vs.* 790.2 kg ha^{-1}). Mean cultivar days of lentil from sowing to emergence, flower initiation, pod initiation and

Table 1: Effect of sowing time and variety on phenological development of lentil during *rabi* season

Treatment	Phenological stage (days)				Life cycle (days)
	Sowing to emergence (S-E)	Emergence to flower initiation (E-FI)	Flower initiation to pod initiation (FI-PI)	Pod initiation to maturity (PI-M)	Sowing to Maturity (S-M)
Sowing time					
1st November	8.0	49.1	14.6	43.0	114.7
15th November	12.3	40.5	21.1	34.0	107.9
30th November	10.8	41.8	21.1	29.9	103.6
SEm (±)	**0.24**	**0.28**	**0.13**	**0.21**	**0.37**
LSD (0.05)	**0.94**	**1.10**	**0.52**	**0.82**	**1.44**
Variety					
HUL 57	11.2	45.8	19.7	36.3	113.0
Moitree	10.0	44.2	18.7	35.7	108.6
KLS 218	10.1	45.6	18.4	34.3	108.4
Ranjan	10.1	39.7	18.9	36.2	104.9
SEm (±)	**0.27**	**0.29**	**0.33**	**0.28**	**0.25**
LSD (0.05)	**0.80**	**0.85**	**NS**	**0.83**	**0.74**

NS = Not significant

Table 2: Effect of sowing time and variety on nodulation of lentil during *rabi* season

Treatment	Number of nodules plant^{-1}				Dry matter accumulation (g m^{-2})				Plant height (cm)
	DAS								
	40	60	80	100	40	60	80	100	
Sowing time									
1st November	16.7	22.2	31.7	24.9	20.0	64.2	110.5	175.5	43.3
15th November	14.5	22.0	34.0	30.0	19.1	65.2	120.0	189.1	41.1
30th November	12.8	23.2	36.6	29.9	18.6	66.4	137.6	195.5	38.8
SEm (±)	**0.51**	**0.32**	**0.80**	**0.69**	**0.36**	**1.10**	**1.92**	**0.45**	**0.29**
LSD (0.05)	**2.00**	**NS**	**3.14**	**2.73**	**NS**	**NS**	**7.52**	**1.78**	**1.15**
Variety									
HUL 57	16.6	23.6	36.7	29.4	20.4	72.6	137.0	202.3	41.3
Moitree	13.5	21.6	36.7	29.6	19.5	66.7	120.4	184.1	42.4
KLS 218	14.8	23.2	31.5	26.5	21.0	63.8	119.3	184.8	45.2
Ranjan	13.7	21.5	31.5	27.6	16.1	58.0	114.1	175.5	35.3
SEm (±)	**0.55**	**0.65**	**0.96**	**1.00**	**0.31**	**1.42**	**2.03**	**2.28**	**0.70**
LSD (0.05)	**1.62**	**NS**	**2.84**	**NS**	**0.92**	**4.23**	**6.04**	**6.76**	**2.09**

Note: DAS = Days after sowing

maturity were 10.4, 54.2, 73.1 and 108.7 days, respectively. Among four varieties, HUL 57 recorded the highest final plant height (41.3 cm), number of nodules plant^{-1} during 40-80 DAS, dry matter yield during 60-100 DAS, number of pods plant^{-1} (105.7) and seed yield (887.8 kg ha^{-1}) in the study. Thus, a 15-day period (first fortnight of November) could be recommended as optimum sowing time for lentil, but sowing of HUL 57 during early November appeared as promising for better seed yield in New Alluvial Zone of West Bengal.

Table 3: Effect of sowing time and variety on yield attributes and yield of lentil during *rabi* season

Treatment	No. of pods plant^{-1}	100 seed weight (g)	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index	Protein content (%)
Sowing time						
1st November	93.3	2.00	883.6	1584.4	0.36	22.3
15th November	97.4	2.03	902.0	1708.5	0.35	22.6
30th November	86.6	1.96	790.2	1497.1	0.35	22.5
SEm (±)	**1.90**	**0.02**	**8.79**	**16.21**	**0.003**	**0.10**
LSD (0.05)	**7.47**	**NS**	**34.52**	**63.63**	**NS**	**NS**
Variety						
HUL 57	105.7	1.96	887.8	1803.6	0.33	22.3
Moitree	94.6	1.90	877.1	1547.9	0.36	22.5
KLS 218	98.2	2.04	851.7	1559.4	0.35	22.6
Ranjan	71.2	2.08	818.2	1475.8	0.36	22.5
SEm (±)	**2.14**	**0.02**	**9.80**	**23.13**	**0.004**	**0.11**
LSD (0.05)	**6.36**	**0.06**	**29.10**	**68.73**	**0.011**	**NS**

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