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**Research Communication**

# Effect of crop-establishment methods on growth, yield, and economics of lathyrus (*Lathyrus sativus*) varieties in Vindhya Alluvial region of West Bengal

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## ABSTRACT

A field experiment was conducted at Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, during the winter (*rabi*) season of 2020–21, to study the performance of 3 lathyrus varieties ('Nirmal', 'Prateek' and 'Ratan') under 3 establishment methods (broadcasting, line sowing and dibbling). Broadcast-sown lathyrus emerged early (4.9 days) with the highest emergence rate (96.5%) and recorded the maximum plant population (30.2/$m^2$) compared to line sowing and dibbling method. Lathyrus variety 'Ratan' recorded the highest aerial dry-matter (94.5 g/$m^2$) at 80 days after sowing (DAS) and crop-growth rate (CGR) 1.74 g/$m^2$/day at 60–80 DAS, but 'Nirmal' produced the tallest plants (110.9 cm) and maximum branches/plant (8.5) at harvesting. Lathyrus raised in line-sown plots yielded the highest (1,757 kg/ha), being 6.7 and 27.3% greater than dibbling and broadcasting methods, respectively. Among the 3 varieties, 'Ratan' gave the highest grain yield (1,672 kg/ha) mainly owing to greater number of pods/plant (59.4), maximum net income (₹34,989/ha) and benefit: cost ratio (2.06) compared to 'Prateek' (1,605 kg/ha) and 'Nirmal' (1,507 kg/ha).

***Key words:*** Economics, Establishment method, Growth, Lathyrus, Variety, Yield

In India, lathyrus (*Lathyrus sativus* L.) is known as *khesari*, *lakhori*, *lakhodi*, grass pea and chickling pea. Lathyrus serves different purposes including food, feed and fodder, but it contains a neurotoxin ODAP [β-N-oxalyl-amino-L-alanine (BOAA)] whose consumption for a prolonged period leads to the neurological disorder lathyrism in humans and domestic animals. Although a few improved varieties containing low amount of toxin have been developed in the country, but farmers are shifting their cultivation towards high-value crops. As a result, the national acreage under lathyrus has gradually fallen from 1.67 million ha to 0.58 million ha over 4 decades, and production from 0.84 million to 0.43 million tonnes (https://agricoop.nic.in/). *Lathyrus* is grown predominantly on marginal and sub-marginal land under rainfed conditions. Apart from various agro-ecological constraints, the crop also encounters some biotic and abiotic stresses, which reduce the yield potential by 15–25%.

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In the Eastern Indo-Gangetic plains including West Bengal, a sizeable area is monocropped due to lack of irrigation water and delay in vacating the long-duration rice (*Oryza sativa* L.) field. The top soil layer generally dries out at the time of rice harvesting and thus planting a post-rainy season crop is not feasible. In such a situation, inclusion of short-duration low-water requiring legumes offer excellent opportunity to utilize carry-over residual moisture in rice fallow (Rahmianna *et al*., 2000), where lathyrus is a good option. In West Bengal, 'Nirmal' (>2% ODAP content) has been cultivating for more than 3 decades as *paira* crop, but 'Prateek' and 'Ratan' having high yield potentiality (1.5 t/ha) with low ODAP content (<0.1%) need to be tested in the winter (*rabi*) season. Thus, the present study was undertaken to find out appropriate crop-establishment method for better growth, yield, quality and economics of lathyrus varieties during the winter season in Vindhya Alluvial Zone of West Bengal.

A field experiment was conducted at Teaching Farm (23°14' N, 87°51' E and 30 m above msl), College of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, during the winter (*rabi*) season of 2020–21. The experimental soil was sandy, well-drained and neutral in reaction (*p*H 7.0), medium in organic carbon (0.59%), available N (270.0 kg/ha), P (26.9 kg/ha) and K (132.8 kg/ha). The experiment was laid out in a split-plot design with

3 replications, consisting of 3 crop-establishment methods (broadcasting, line-sowing, dibbling) in main plots and 3 lathyrus varieties ('Nirmal', 'Prateek', 'Ratan') in subplots. The field experiment was conducted in no-tilled condition i.e. without land preparation before sowing. Soaked seeds of 3 different lathyrus varieties were mixed separately with *Rhizobium* culture (*Rhizobium leguminosarum*), and then they were sown in 19 November 2020 following treatment schedule for seed rate (80 kg/ha for broadcasting, 60 kg/ha for line sowing, 40 kg/ha for dibbling) and spacing (30 cm × 10 cm for line sowing and dibbling). A uniform fertilizer dose of 20 kg N + 40 kg $P_2O_5$ + 40 kg $K_2O$/ha was applied basal in each experimental unit. Thinning was done at 15 days after sowing (DAS) in all the plots of no-tilled field, but no weed-control method was adopted. There was no or scanty rainfall during the cropping period, so need-based irrigations were given to save the crop from moisture-stress situation. The observations on leaf-area index, dry-matter production were recorded at 60 and 80 DAS whereas plant height and branches/plant, yield attributes and yield were recorded at harvesting. The economics of cultivation was calculated as per local rates. The data obtained in the study were analysed using Analysis of Variance technique (ANOVA) following standard statistical procedures using online OPSTAT software.

The seeds sown on surface of the soil in broadcasting method facilitated early emergence (4.9 days) and the maximum emergence rate (96.5%); while the seeds placed in line sowing and dibbling technique required more time (6.2 and 6.3 days) to emerge above the ground along with less emergence rate (89.9% and 85.2%).The greater moisture content in soil at 20 DAS was noted in broadcast-sown plots (22.5%) because of non-disturbance of soil compared to furrow opening by tyne in line sowing and scooping of soil in dibbling method in no-tilled condition.

Broadcast-sown crop matured early (111.7 days) compared to line sowing and dibbling method (Table 1). Among 3 varieties, 'Ratan' required slightly greater days to maturity (114.2 days), while the other 2 varieties ('Nirmal' and 'Prateek') had similar durations (≈112 days) in the field. The crop raised in dibbling-sown (111.4 cm) and line-sown (102.8 cm) plots had greater plant height probably because of optimum plant spacing compared to broadcast-sown plots. 'Nirmal' variety produced the tallest plants (110.9 cm) and the maximum number of branches (8.5/plant) at harvesting compared with the other 2 varieties. However, 'Ratan' gave the highest aerial dry-matter (94.5 g/$m^2$) at 80 DAS and crop-growth rate (CGR 1.74 g/$m^2$/day) at 60–80 DAS. Dibbling-sown lathyrus crop had the maximum leaf-area index (LAI 2.74) at 60 DAS, dry-matter accumulation (95.8 g) at 80 DAS and branching habit (8.9/plant) at harvesting because of uniform growth of plants. Kar and Kumar (2009) found that, reduced tillage resulted in the maximum dry-matter accumulation of lathyrus (cv. 'Ratan') compared to conventional tillage and relay cropping in rice fallow system at Bhubaneshwar, Odisha.

The non-uniform distribution of seeds during broadcast sowing with higher seed rate (80 kg/ha) resulted in greater plant population (30.2/$m^2$) than line sowing and dibbling (Table 2). The maximum number of plant/$m^2$ was noted with 'Ratan' (28.2), being at par with 'Prateek' (27.9), but the lowest population density was observed with 'Nirmal'. The evenly-spaced plants in line-sown and dibbling-sown plots had better growth habit that led to the production of more number of pods/plant (61.6 and 59.2) compared to broadcasting method (43.4/plant). With regard to number of pods/plant, 'Ratan' produced maximum (59.4), followed

**Table 1.** Effect of establishment method and variety on growth attributes of lathyrus during the winter (*rabi*) season

| Treatment | Days to emergence (days) | Emergence (%) | Moisture at 20 DAS content (%) | Duration (days) | Plant height at harvest (cm) | Branches/ plant at harvest | LAI at 60 DAS | DM production (g/$m^2$) | | CGR at 60–80 DAS (g/$m^2$/day) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 60 DAS | 80 DAS | |
| *Establishment method* | | | | | | | | | | |
| Broadcasting | 4.9 | 96.5 | 22.5 | 111.7 | 97.9 | 7.6 | 2.60 | 60.4 | 82.8 | 1.12 |
| Line sowing | 6.2 | 89.9 | 19.8 | 112.2 | 102.8 | 8.1 | 2.70 | 59.5 | 94.7 | 1.76 |
| Dibbling | 6.3 | 85.2 | 21.2 | 115.6 | 111.4 | 8.9 | 2.74 | 57.8 | 95.8 | 1.90 |
| SEm± | 0.30 | 2.04 | 0.28 | 0.44 | 2.36 | 0.20 | 0.03 | 0.15 | 1.72 | 0.09 |
| CD (P=0.05) | 1.18 | 8.01 | 1.09 | 1.74 | 9.26 | 0.79 | NS | 0.58 | 6.75 | 0.36 |
| *Variety* | | | | | | | | | | |
| 'Nirmal' | 5.8 | 91.0 | 21.4 | 112.3 | 110.9 | 8.5 | 2.74 | 58.7 | 85.2 | 1.33 |
| 'Prateek' | 6.0 | 89.7 | 20.7 | 112.9 | 96.9 | 7.8 | 2.54 | 59.3 | 93.5 | 1.71 |
| 'Ratan' | 5.7 | 90.9 | 21.4 | 114.2 | 104.2 | 8.3 | 2.76 | 59.7 | 94.5 | 1.74 |
| SEm± | 0.29 | 1.93 | 0.24 | 0.39 | 3.09 | 0.13 | 0.02 | 0.24 | 1.58 | 0.09 |
| CD (P=0.05) | NS | NS | NS | 1.19 | 9.53 | 0.40 | 0.08 | 0.75 | 4.87 | 0.26 |

*DAS, Days after sowing; DM, Dry-matter; CGR, crop-growth rate

**Table 2.** Effect of establishment method and variety on yield and economics of lathyrus during winter *(rabi)* season

| Treatment | Plant population (No./m²) | Pods/ plant | Seeds/ pod | 1,000-seed weight (g) | Grain yield (kg/ha) | Cost of cultivation (₹/ha) | Gross returns (₹/ha) | Net income (₹/ha) | Benefit: cost ratio |
|---|---|---|---|---|---|---|---|---|---|
| *Establishment method* | | | | | | | | | |
| Broadcasting | 30.2 | 43.4 | 4.07 | 53.6 | 1381 | 32,107 | 56,133 | 24,026 | 1.75 |
| Line sowing | 26.9 | 59.2 | 4.04 | 55.7 | 1757 | 33,531 | 71,410 | 37,879 | 2.13 |
| Dibbling | 25.1 | 61.6 | 4.07 | 54.6 | 1646 | 33,315 | 66,871 | 33,556 | 2.01 |
| SEm± | 0.43 | 0.21 | 0.15 | 0.16 | 28.9 | | 1,157 | 1,157 | 0.03 |
| CD (P=0.05) | 1.68 | 0.84 | NS | 0.63 | 113.5 | | 4,542 | 4,542 | 0.14 |
| *Variety* | | | | | | | | | |
| 'Nirmal' | 26.1 | 56.0 | 4.03 | 57.4 | 1507 | 32,984 | 61,234 | 28,250 | 1.85 |
| 'Prateek' | 27.9 | 48.8 | 4.04 | 53.9 | 1605 | 32,984 | 65,206 | 32,221 | 1.97 |
| 'Ratan' | 28.2 | 59.4 | 4.12 | 52.6 | 1672 | 32,984 | 67,973 | 34,989 | 2.06 |
| SEm± | 0.39 | 0.37 | 0.09 | 0.23 | 26.0 | | 1,043.17 | 1,043.17 | 0.03 |
| CD (P=0.05) | 1.21 | 1.14 | NS | 0.69 | 80.0 | | 3,214.33 | 3,214.33 | 0.10 |

Cost of grain, ₹40 kg/ha; cost of stalk, ₹0.5 kg/ha

by 'Nirmal' and 'Prateek'. Line-sown crop recorded the higher test weight (55.7 g) probably owing to optimum growth and proper seed filling than dibbling and broadcasting method. Among the 3 varieties, 'Nirmal' had maximum 1,000-seed weight (57.4 g) and it was significantly higher than 'Prateek' and 'Ratan'.

Line-sown crop recorded the maximum grain yield (1,757 kg/ha), being at par with dibbling-sown crop, (1,646 kg/ha), but significantly greater over broadcast-sown one (1381 kg/ha) in Vindhya Alluvial soil of West Bengal (Table 2). Our finding indicated that, line-sowing resulted in 6.7 and 27.3% greater grain yield over dibbling and broadcasting of lathyrus during winter season. Among 3 lathyrus varieties, 'Ratan' gave the highest grain yield (1,672 kg/ha), mainly owing to greater number of pods/ plant compared to 'Prateek' (1,605 kg/ha), and 'Nirmal' (1,507 kg/ha). It could be mentioned that, the grain yield of 3 lathyrus varieties (1,507–1,672 kg/ha) grown in Vindhya Alluvial region was somewhat higher than the grain yield of 6 varieties (1,016–1,494 kg/ha) grown in coastal zone of West Bengal (Gupta and Bhowmick, 2005) and lathyrus as *utera* crop (1,063–1,120 kg/ha) in Burdwan, West Bengal (Mondal *et al.*, 2004).

Although common cost of cultivation was same (₹25,995/ha) for all 3 crop-establishment methods, but the total cost of cultivation varied as ₹32,107/ha for broadcasting, ₹33,531/ha for line sowing and ₹33,315/ha for dibbling method due to seed rate and man units required for sowing under different crop-establishment methods: (broadcasting, 4-man units/ha; line sowing, 12-man units/ ha; dibbling, 15-man units/ha). Among 3 establishment methods, gross return was least (₹56,133/ha) for the crop raised with broadcasting compared to line sowing and dibbling method. The line-sown crop recorded the highest net income (₹37,879/ha), being ₹4,323/ha and ₹13,853/ha over dibbling and broadcasting method respectively. Both line sowing and dibbling methods recorded benefit: cost ratio more than 2.0, while that was 1.75 for broadcasting. However, Sorokhaibam *et al.*, (2016) reported that, no-tillage required less cost of cultivation compared to conventional tillage and resulted in higher net returns and benefit: cost ratio in rice–lathyrus cropping system at Imphal, Manipur.

It could be concluded that 'Ratan' variety of lathyrus could be adopted under line-sown condition in Vindhya Alluvial soil of West Bengal during the winter season for greater yield and profitable cultivation.

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