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Performance of semi leafless variety of field pea under abiotic stress – A case study

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The productivity of pulse crops in the Bundelkhand region of Madhya Pradesh has been declining due to low adoption of improved varieties and recommended production technologies under limited irrigation conditions. The productivity of field pea at district, state, and national levels was reported as 9.81, 10.49, and 9.40 q/ha, respectively, against the varietal potential yield of 20–22 q/ha. To address this gap, Krishi Vigyan Kendra Chhatarpur introduced the drought-tolerant, semi-leafless dwarf field pea variety IPFD 12-2 under the National Food Security Mission during rabi *2022–23. Farmers were also trained on balanced fertiliser application along with the use of biofertilisers. Adoption of the improved production technology resulted in higher grain yield and net income compared to traditional farming practices.*

Keywords: Horizontal spread, Nodulation, Yield and economics

FIELD pea (*Pisum sativum* L.) is an important pulse crop, utilised for human consumption in both fresh and dry split forms. It is rich in essential amino acids such as lysine and tryptophan and also improves soil fertility through biological nitrogen fixation. During field visits and farmer interactions conducted by Krishi Vigyan Kendra (KVK) Chhatarpur in villages of Rajnagar block, Chhatarpur district, it was observed that the predominant cropping system was Green gram/ Black gram–chickpea. However, this system was severely affected by erratic rainfall during *kharif* season and heavy incidence of wilt disease in chickpea during *rabi* season. Due to recurrent wilt infestation and yield losses in chickpea, farmers preferred growing lathyrus instead of field pea for pulse requirements. The productivity of field pea in Rajnagar block was reported to be low (900 kg/ha) compared to the full crop yield potential. The major constraints identified were lack of awareness regarding improved production technologies, non-availability of suitable semi-leafless varieties, imbalanced fertiliser application, and inadequate plant protection measures. To address these issues, KVK Chhatarpur introduced improved production technologies along with the semi-leafless fieldpea variety IPFD 12-2. The variety is suitable for both early and late sowing under limited irrigation conditions and possesses an average yield potential of 22–24 q/ha. Its semi-leafless dwarf growth habit provides better standability and adaptability under moisture-stress conditions, making it a suitable alternative to chickpea in the Bundelkhand region.

Tendril vs. traditional varieties

When peas are cultivated as a monoculture, they exhibit severe lodging post-flowering. Lodging results in forage and seed yield reduction. It is particularly pronounced in leafed varieties. The main contributing factor to lodging is extensive foliage in leafed varieties, which shades lower plant parts, decreases light penetration, reduces photosynthetic activity in lower leaves, and fosters a moist lower canopy environment conducive to pathogen buildup. While the semi-leafless phenotype results from a recessive mutation replacing leaflets with tendrils, rendering them less susceptible to lodging than conventional leafed varieties.

KVK intervention

Most of the farmers of Richai and Nayagaon villages in Rajnagar block of Chhatarpur district are small and marginal landholders, and agriculture is their primary source of livelihood. Prior to the intervention, farmers had limited knowledge regarding improved production technologies such as the use of semi-leafless varieties, optimum seed rate, line sowing, seed treatment, and appropriate plant protection measures, which resulted in low crop productivity. To enhance farmers' knowledge and income, drought-tolerant field pea cultivation was promoted in the region.

A series of field experiments were conducted for three consecutive year from 2022–23 to 2024–25 at farmers' fields under medium black soil conditions. The experiments were laid out in a randomized block design (RBD) with three replications. The field pea cultivar IPFD 12-2 was used for the study and *Aman* cultivar as check/control. A total of 25 farmers adopted the semi-leafless dwarf field pea variety IPFD 12-2 for split dal production.

Sowing was carried out on third week of November and first week of March during the respective cropping seasons using a seed-cum-fertiliser drill. Seeds were placed at a depth of 4–5 cm with a row spacing of 45 cm and a seed rate of 80 kg/ha. The treatments consisted of the application of 75% of the recommended dose of fertilisers (RDF) at the rate of 20:60:20 NPK kg/ha. Seed treatment with systemic fungicide (Carboxin + thiram @ 2 g/kg seed), inoculation with *Rhizobium leguminosarum* for biological nitrogen fixation, and soil application of phosphate-solubilising bacteria (PSB) and potassium-solubilising bacteria (KSB) @ 5 kg/ha along with 75% RDF were included. All recommended agronomic practices, except the experimental treatments, were uniformly followed throughout the crop growth period. Observations on nodulation were recorded at 45 days after sowing (DAS), while seed yield was recorded at physiological maturity of the crop.

The farmers were supported through the supply of improved seed, training programmes, *Krishak Sangosthi*, and regular field visits for dissemination of improved agricultural practices. The adoption of improved field pea production technologies resulted in enhanced crop productivity, increased income, and improved livelihood status of the participating farmers.

Varietal performance

The field pea variety IPFD 12-2 showed resistance to powdery mildew and pod borer along with moderate drought tolerance. Due to its semi-leafless growth habit with modified tendrils, the variety exhibited reduced evapotranspiration losses and better translocation of assimilates towards flowering and pod development. The tendrils provided inter-plant support by forming a tendril network, which minimised lodging and reduced bird damage to pods. The performance of the variety was evaluated under both rainfed and irrigated conditions.

Flowering stage

Pod development stage

Pod formation stage

Under rainfed conditions, the number of pods/plant ranged from 14–16, while under irrigated conditions, it ranged from 16–18. The variety attained physiological maturity nearly 10 days earlier and performed better under rainfed conditions, indicating its suitability for the Bundelkhand region. Semi-leafless varieties such as IPFD 12-2 can serve as suitable alternatives to traditional leafy field pea cultivars under rainfed situations where lodging and moisture stress are common constraints. Their improved stand ability, drought adaptability, and nitrogen-fixing ability contribute to sustainable crop production. In contrast, conventional leafy cultivars often experience self-shading due to excessive foliage, which may reduce light interception within the canopy and adversely affect pod development and yield.

Table 1. Comparison of yield and yield contributing characters of IPFD 12-2 and control

Parameters	Findings/results	
	IPFD 12-2 variety	Local/ control
Germination (%)	85	80
Plant population (per m^2)	12	12
Nodule number/plant	19	13
Nodule diameter (mm)	5.2	3.5
Plant height (per cm)	66	86
Pods/plant (No.)	15	10
No. of grains/pod	8.5	5
Yield (q/ha)	19.2	9.0

Effect of biofertilisers on nodulation and yield attributes

Seed treatment with *Rhizobium leguminosarum* @ 10 g/kg seed along with soil application of PSB and KSB @ 5 kg/ha each, combined with 75% of the RDF significantly improved nodulation, yield attributes, and grain yield of field pea. The integrated use of inorganic fertilisers and biofertilisers proved beneficial under Bundelkhand conditions, where soil fertility is generally poor due to the imbalanced use of chemical fertilisers. Their combined application improved the physical, chemical, and biological properties of the rhizosphere, resulting in better root growth and enhanced *Rhizobium* activity. Increased nodulation can be attributed to improved symbiotic association between plant roots and nitrogen-fixing bacteria, leading to enhanced nitrogen fixation and photosynthetic efficiency. Adequate nitrogen availability further facilitated nutrient uptake and utilisation of phosphorus and potassium. The application of PSB and KSB enhanced the availability of fixed forms of phosphorus and potassium in soil through processes such as organic acid production, chelation, and ion exchange reactions. This improved nutrient availability and uptake ultimately contributed to higher crop productivity.

Table 2. Economic analysis of the intervention

Used Practice	Yield (q/ha)	Cost of cultivation (₹)	Gross income (₹/ha)	Net income (₹/ha)	B:C ratio
Farmer practices	9.0	22,500	31,500	9,000	1.4
Demonstration	19.2	23,200	68,250	45,050	2.9

In this regard, farmers who adopted the improved production technology of field pea crop received the higher production (19.2 q/ha) as well as net income (₹45,050/ha) as compared to exiting variety (9.0 q/ha and ₹9,000 /ha, respectively) and cultivation practices. Thus, cultivation of field pea crop using improved cultivar (IPFD 12-2) along with appropriate production technology brought out the changes in social and living status of the farmers. Similar growths were also recorded in other crops which also impart improvement in economic condition of the farmers by providing technical assistance by the scientists of KVK at regular interval.

Horizontal spread of the variety

The demonstration conducted at the farmers' field was appreciated by the neighbouring farmers also. They too became interested in following the similar technical intervention in their fields. Improved field pea IPFD 12-2 variety was cultivated only in 25 ha area during *rabi* 2022-23 in village Nayagaong and in the second year, this variety occupied 57 ha area by fellow farmers. During 2024-25, the horizontal spread of the variety IPFD 12-2 increased by 83 per cent (92 ha). Before adoption of this variety, the farmers used to harvest an average production of field pea of 900 kg/ha, and now the same farmers are producing 1,902 kg/ha of field pea. The better performance of field pea variety over others grown at the specified location appears on account of its trait of doing well under either higher or lower rainfall conditions, better germinability, inbuilt moderately tolerant to drought. This makes it possible to optimise productivity of field pea by adoption of semi leafless variety 'IPFD 12-2' in light and medium black soils with limited irrigation situation.

Table 3. Horizontal spread of improved variety

Year	Area under field pea with old variety *Aman* (ha)	Area under field pea with improved variety IPFD 12-2 (ha)	Percent area covered by improved variety
2022-23	110	25	22.7
2023-24	110	57	51.8
2024-25	110	92	83.6

Impact of technology

The adoption of this technology has contributed to an increase in the farmer's income level, resulting in positive socio-economic changes in her life. Farmers have inspired other farming communities, particularly marginal farmers in the village and neighboring villages, to adopt this technology. The horizontal spread of this technology is rapid, with 75 farmers currently purchasing seeds from fellow farmers in the village and neighboring villages. This achievement is primarily attributed to the effective dissemination of the improved variety and production technique of the field pea crop, which has raised awareness among farmers and farm women, as well as the RAEO of the village, through various field-oriented activities, training programmes, and literature related to the package and practices of the field pea crop.

Tendrils with pod formation stage

Field pea at maturity stage

Demonstration of new field pea variety 'IPFD 12-2'

Feedback of field pea growers

The adoption of a given semi-leafless variety typically involved a process that encompasses awareness of the variety, evaluation of the anticipated returns, and the farmer's subsequent decision to cultivate it. The variety demonstrated excellent performance during the evaluation process with the farmers. To gather feedback on the variety, farmers were interviewed through group meetings in the study area. The farmers decided to discontinue the other variety and adopt this improved semi-leafless variety.

SUMMARY

Low productivity of field pea in the study area was mainly due to poor awareness among farmers regarding drought-tolerant improved varieties and recommended production practices. To overcome this constraint, KVK Chhatarpur introduced the semi-leafless, drought-tolerant field pea variety IPFD 12-2 along with improved production technologies. Adoption of the improved variety and recommended practices significantly increased grain yield (19.2 q/ha) and net income (₹ 45,050/ha) compared to traditional practices (9.0 q/ha and ₹ 9,000/ha, respectively). The semi-leafless growth habit reduced lodging and improved crop standability under rainfed conditions. The variety is also suitable for early and late sowing under limited irrigation conditions, and its bold, attractive grains are suitable for both vegetable and split dal purposes, contributing to higher market value and farmer acceptance.

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