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Performance of pigeonpea variety BDN 2013-41 (Godavari) for growth, yield and economics in Solapur District of Maharashtra

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Abstract

An on-farm trial (OFT) was conducted during the Kharif season 2021-2022, 2022-2023 and 2023-2024 to evaluate the performance of the improved Pigeonpea variety BDN 2013-41 (Godavari) under farmers' field conditions. The trial was carried out in selected villages with the participation of progressive farmers to compare the improved variety with the locally cultivated variety. Observations on growth, yield attributes, grain yield and economics were recorded. The results revealed that BDN 2013-41 produced higher grain yield and better yield attributes than the local check. The pigeon pea variety BDN 2013-41 recorded higher average grain yield (20.01qha^{-1}) as compared to average yield obtained from farmer's practice (15.50qha^{-1}) which computed to increase in yield by 30.22 per cent during the years under observation. The variety also fetched higher average net returns (73531₹ ha^{-1}) and benefit-cost ratio (2.22), indicating its suitability for adoption under limited irrigation conditions. The OFT demonstrated the superiority and farmer acceptability of BDN 2013-41 for sustainable Pigeonpea production.

Keywords: Pigeonpea, assessment, variety, on-farm trial, yield, economics

Introduction

Pigeon pea (*Cajanus cajan* (L.) Millsp.) is one of the most important pulse crops of India and plays a major role in ensuring nutritional security due to its high protein content (20-22%). It is widely grown under rainfed conditions and is well adapted to semi-arid and drought-prone regions. Despite being the largest producer of pigeon pea, India's productivity remains low due to cultivation under marginal environments, use of local varieties, moisture stress, and pest and disease incidence. Pulses are one of the important food crops globally due to their higher protein content. Pulses are an important group of crops in India, which is also responsible for yielding large financial gains by amounting to a large part of the exports. Pulses are the major sources of protein in the diet. Of all categories of people, pulses form an integral part of the Indian diet, providing much-needed protein to the carbohydrate-rich diet. India is the largest producer of pulses in the world. Pulses are 20 to 25 percent protein by weight which is double the protein content of wheat and three times that of rice. Major pulses are grown Chickpeas, Pigeonpea, Greengram, Blackgram, lentil, Peas and various kinds of beans. According to Upag, total production of pulses of India in financial year 2024 was 244.93lakh tonnes. The major regions of pulse cultivation are Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, Karnataka, West Bengal delta region, Tamil Nadu, Kerala and some parts of Maharashtra. The country has exported 626,653.80 MT pulses to the world during the year 2023-24. (Source: DGCIS).

India continues to be the world's largest producer of pigeon pea (*Cajanus cajan*), with the crop cultivated on an estimated 5.05 million hectares, yielding around 4.34 million tonnes and an average productivity of about 859 kg ha^{-1} as per the Fourth Advanced Estimates of the Ministry of Agriculture & Farmers Welfare (DES, 2022) indicating its dominant contribution to the global pigeon pea pool. Despite this leading production status, domestic output often falls short of the country's substantial demand, resulting in large imports to bridge the gap; India accounted for over 92% of global pigeon pea imports in 2021 with import volumes of approximately 674 million kg, highlighting its net importer position in the international trade landscape. Productivity remains constrained under predominantly rain-fed systems and climatic variability, necessitating improved varieties and agronomic practices. Export data compiled by APEDA (Agricultural & Processed Food Products Export Development Authority) show that overall pulses exports (including pigeon pea among other pulses) contributed to 626,654 MT worth USD 686.90 million in FY 2023-24,

with major destinations such as Bangladesh, China, UAE, USA and Sri Lanka, although pigeon pea's share is relatively modest compared to aggregate pulse exports. This scenario underscores the need for enhanced productivity and value chain interventions to reduce import dependence and strengthen India's role in global pulses trade.

Development and dissemination of improved Pigeon pea varieties with higher yield potential and stress tolerance is essential for enhancing productivity. Pigeon pea variety Godavari (BDN 2013-41) developed by Agricultural Research Station (ARS), Badnapur under VNMKV, Parbhani in the year 2018. The variety recommended for irrigated land and heavy soil in drought area. The yield ranges between 19.5-24.5 qha^{-1}. The identified character of Godavari (BDN 2013-41) is light yellow color of flower and color of mature seeds is white. The pigeon pea variety Godavari (BDN 2013-41) is resistant to wilt, sterility mosaic disease (SMD) and has high protein content. Variety BDN 2013-41 (Godavari) is a medium-duration(160-165days) variety developed with the objective of higher yield, better adaptability and tolerance to major diseases. On-farm trials (OFTs) are an important extension tool to test newly released varieties under actual farmers' field conditions and to generate location-specific recommendations. Therefore, the present study was undertaken to evaluate the performance of Pigeonpea variety BDN 2013-41 under farmers' field conditions through OFT approach.

Materials and Methods

Location and season

The on-farm trial was conducted during the Kharif season 2021-2022,2022-2023 and 2023-2024 at selected farmers' fields in the operational area of the Krishi Vigyan Kendra Mohol Dist. Solapur (KVK, Solapur II). The soil of the experimental fields ranged from medium to deep black with good fertility. The crop was grown under supplemental irrigation conditions.

Experimental design and treatments

The on-farm trial (OFT) on pigeon pea variety BDN 2013-41 (Godavari) was conducted using a paired-plot experimental design on farmers' fields to ensure realistic comparison under actual field conditions. Each participating farmer maintained two adjacent plots under identical management practices. The treatment plot (T_1) was sown with the improved pigeon pea variety BDN 2013-41 (Godavari), while the control plot (T_2) consisted of the locally cultivated check variety. Both plots were managed by the same farmer following prevailing farmers' practices, enabling a valid assessment of the varietal performance of BDN 2013-41 in comparison with the local check under similar agro-management conditions.

Crop management

Sowing was done with the onset of monsoon at recommended spacing, recommended seed rate and seed treatment with fungicide and Rhizobium culture were followed in T_1. Soil test based fertilizer dose of 25:50:00 NPK kg ha^{-1} was applied. For maintaining per hectare required plat population thinning and gap filling practices has adopted. Nipping technology followed in demonstration plot of Pigeonpea. Nipping refers to the manual removal of the 5 cm terminal apical bud at 45 days after sowing to regulate apical dominance. Need-based plant protection measures were undertaken.

Observations recorded

During the on-farm trials conducted to evaluate the performance of pigeon pea variety BDN 2013-41, systematic observations were recorded on key yield and economic parameters. Yield attributes were assessed in terms of the number of pods per plant, while productivity was evaluated by recording grain yield expressed in quintals per hectare (q ha^{-1}). Economic analysis included the estimation of cost of cultivation on a per hectare basis (₹ ha^{-1}). Further, the profitability of the variety was assessed by computing gross returns and net returns (₹ ha^{-1}). The overall economic viability of the on-farm trials was determined through the calculation of the benefit-cost (B:C) ratio.

Statistical analysis

The data recorded from different farmers' fields were pooled and analyzed using standard statistical procedures. Mean yield and economics were compared between treatments to assess performance. The average yield of each demonstrations and farmers practice, cost of cultivation, gross return, net return and benefit cost (B: C) ratio was taken for interpretation of the results. Economic parameters such as cost of cultivation, gross returns, net returns and benefit-cost ratio were computed using prevailing market prices. The extension gap, technology gap and technology index were calculated using the following formula as suggested by Samui *et al*. (2000) [5].

$$\text{Percent increase in yield} = \frac{\text{Demonstration yield} - \text{farmers practice yield}}{\text{farmers practice yield}} \times 100$$

$$\text{Technology gap} = \text{Potential yield} - \text{Demonstration yield}$$

$$\text{Extension gap} = \text{Demonstration yield} - \text{farmers practice plot yield}$$

$$\text{Technology index (\%)} = \frac{\text{Technology gap}}{\text{potential yield}} \times 100$$

Results and Discussion

Growth and yield attributes and Grain yield

The improved variety BDN 2013-41 showed better growth and yield attributes compared to the local check. It recorded higher plant height, more branches per plant, greater number of pods per plant (135.66 pods per plant) and higher 100-seed weight. These improved traits resulted in superior yield performance. The higher pod number and bold seeds of the improved variety may be attributed to its better genetic potential and adaptability under field conditions. Similar findings have also been observed by Kanik Kumar Bansal *et al*. (2024) [15].

The findings of a three year assessment revealed that the on farm trials of improved pigeon pea variety BDN 2013-41(Godavari) recorded 30.22% higher yield as compared to existing farmers practice. BDN 2013-41 recorded significantly higher mean grain yield 20.01qha^{-1}as compared to the local farmers' variety 15.50 qha^{-1} (Table 2). The higher yield under improved practice may be

attributed to the use of quality seed, better yield attributing characters, reduced pest and disease incidence, balanced fertilization and improved crop management. Similar yield advantages of improved Pigeonpea varieties under on farm trial conditions have also been reported earlier by Sanjay Kumar *et al*. (2022) [8].

Table 1: Yield performance of On farm trial Pigeon pea var. BDN 2013-41 (Godavari) during 2021-2022, 2022-2023 and 2023-24

Treatment	Seed yield (qha⁻¹)				Pods/Plant			
	2021-22	2022-23	2023-24	Pooled	2021-22	2022-23	2023-24	Pooled
T₁: Improved variety BDN 2013-41 (Godavari)	18.63	20.16	21.25	20.01	124	137	146	135.66
T₂: Farmers Practice	14.50	15.10	16.90	15.50	98	103	115	105.33

Table 2: Yield performance of On farm trials of Pigeonpea var.BDN 2013-41 (Godavari) during 2021-22, 2022-23 and 2023-24

Year	Potential Yield (qha⁻¹)	Average grain yield (qha⁻¹)		Percent increase
		T₁: Improved variety BDN 2013-41 (Godavari)	T₂: Farmers Practice	
2021-22	22.00	18.63	14.50	28.48
2022-23	22.00	20.16	15.10	33.50
2023-24	22.00	21.25	16.90	28.69
Mean	22.00	20.01	15.50	30.22

Technology Gap and Extension Gap

The technology gap, extension gap and technology index were calculated to assess the feasibility of the demonstrated technology at the farmers' level. Table 3 further revealed that the highest technological gap was calculated during 2020-2021 i.e. 3.37 qha⁻¹, and the lowest 0.75 qha⁻¹, during 2023-2024, whereas the mean technological gap was 1.99 qha⁻¹. Technological gaps may be due to variations in soil fertility, lack of insect-pest disease management, changes in weather conditions, skills of farmers, and agronomical practices. The extension gap refers to the differences between demonstration yields to existing farmer practice yields. The highest (5.06 qha⁻¹) during 2022-2023 and the lowest (4.13 qha⁻¹) extension gap was received during 2021-2022 with a mean 4.51 qha⁻¹extension gap observed during three years of observation. Similar results were also found by Meshram *et al*. (2022) [12] and AK Mauriya *et al*. (2024) [4] in pigeon pea. The observed extension gap suggests a strong need for strengthening extension activities to enhance adoption of improved varieties like BDN 2013-41.

Technology Index

The technology index shows the feasibility of the evolved technology at the farmers' fields. The lower the value of technology index shows the feasibility of the technology. Further, the data presented in Table 3 revealed that the highest (15.31%) technological index noticed during 2021-2022 and the lowest(3.40%) during 2023-2024 and 9.02% mean of three years technological index. This finding is in corroboration with the findings of Kumar *et al*. (2023) [11] and Mauriya *et al*. (2023) [13].

Table 3: Technology gap, extension gap and technology index in on farm trial during2021-22, 2022-23 and 2023-24

Year	Technology gap (qha⁻¹)	Extension gap (qha⁻¹)	Technology index (%)
2021-2022	3.37	4.13	15.31
2022-2023	1.84	5.06	8.36
2023-2024	0.75	4.35	3.40
Mean	1.99	4.51	9.02

Economic performance

Economic analysis revealed that cultivation of BDN 2013-41 resulted in higher gross and net returns compared to the local variety. Data presented in table 4 revealed that the highest gross return (133058₹ ha⁻¹), net return (73531₹ ha⁻¹) and benefit cost ratio (2.22) was calculated from on farm trial of pigeon pea variety BDN 2013-41 with involvement of improved production technology as compared to existing common farmer practices The higher cost benefit ratio in demonstrated plot is because of higher yield obtained under improved technologies compared to farmers practices during the experimental years. The higher benefit-cost ratio obtained with the improved variety indicated its economic feasibility and profitability for farmers. Similar results were corroborated with Kumar *et al*. (2018) [10], Keshavareddy *et al*. (2018) [9], and Dhuware *et al*. (2023) [7].

Table 4: Economic impact of On farm trial Pigeonpea var. BDN 2013-41 (Godavari) during 2021-22, 2022-23 and 2023-24

Year	No. of Demo	Area (ha)	Gross income (₹ ha⁻¹)		Net income (₹ ha⁻¹)		B: C Ratio	
			Demo	Farmers Practice	Demo	Farmers Practice	Demo	Farmers Practice
2021-22	15	6.0	117369	91350	61569	34150	2.10	1.59
2022-23	15	6.0	133056	99660	74476	40160	2.27	1.67
2023-24	15	6.0	148750	118300	84550	52200	2.31	1.68
Mean	45	18.0	133058	103103	73531	42170	2.22	1.64

Farmer feedback and acceptability

Farmers expressed positive feedback regarding BDN 2013-41 with respect to pod load, bold seed size, uniform maturity and market preference. The variety was also found suitable for intercropping systems. High farmer satisfaction indicated strong potential for large-scale adoption.

Conclusion

The on-farm trial results clearly indicated that pigeon pea variety BDN 2013-41 (Godavari) performed better than the local farmers' variety in terms of growth, yield attributes, grain yield and economic returns under farmers' field conditions. The variety was well accepted by farmers due to

its higher productivity and profitability. Therefore, BDN 2013-41 is recommended for wider dissemination and adoption in the region for enhancing pigeon pea productivity and farmers' income.

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