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Chickpea Varietal Comparison of chickpea under Front Line Demonstration of Chickpea in Bundelkhand Region

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ABSTRACT

In the Bundelkhand region during 2018–19, fifteen front-line demonstrations were conducted on a one-hectare plot of chickpea cultivation using RVG-202 and JG–14. Integrated disease and pest management, improved varieties, and balanced fertiliser treatments are examples of improved technologies. On a village-by-village basis, the demonstration yield increased by 36.85% above local varieties. Variety JG-14 of chickpeas outperformed with a yield increase of 36.54%, followed by variety RVG-202. An average extension gap, technology gap, and technology index were 3.96 q/ha, 6.28 q/ha, and 29%, respectively, at the village level. Variety JG-14 had an average extension gap, technology gap, and technology index of 4.30 q/ha, 9 q/ha, and 36%, respectively. Hardua Village and variety JG-14 had maximum average cost benefit ratio returns of 1:2.18 and 1:3.16, respectively, for RVG-202.

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INTRODUCTION

Pulses are cultivated in India during the two seasons of *Kharif* and *Rabi*, with *Rabi* being more abundant in terms of acreage and production than *Kharif*. The acreage and production of pulses have increased during the last ten years. In 2011–12, the total area planted with pulses in *Kharif* and *Rabi* was 11,190 thousand hectares and 13,272 thousand hectares, respectively. However, by 2020–21, these numbers had risen to 13,430 and 15,353 thousand hectares, respectively (Fig. 1).

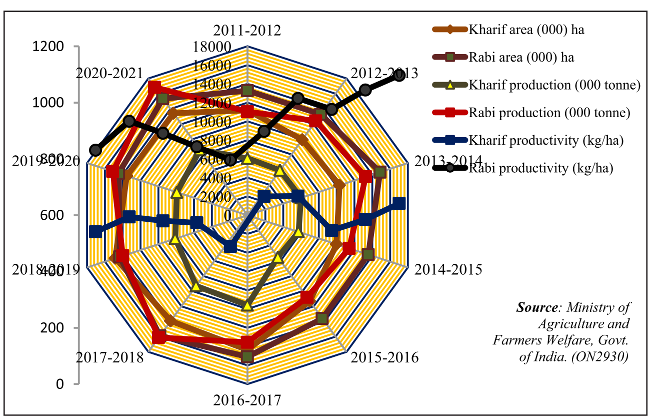
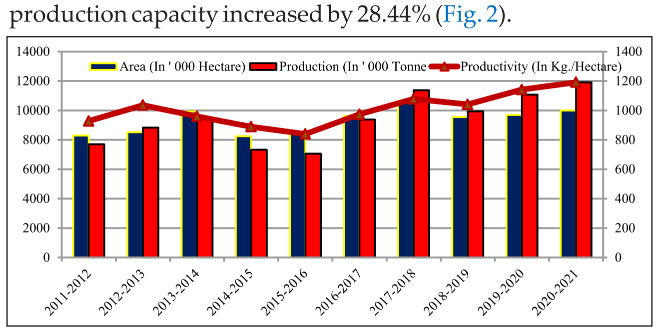


Fig. 1: Season-wise area, production and productivity of total pulses in India

Production grew from 6,058 thousand tonnes (*Kharif*) and 11,031 thousand tonnes (*Rabi*) in 2011–12 to 8,618 thousand tonnes (*Kharif*) and 16,845 thousand tonnes (*Rabi*) in 2020–21, but productivity fell in 2011–12. It was 541 and 831 kg/ha, however in 2020–21 it would be 642 and 1097 kg/ha. In India, the area, output and productivity of the gram crop have increased. It had an area of 8,299 thousand hectares and a production of 7,702 thousand tonnes in 2011–12, but by the 2020–21, it had grown to 9,996 thousand hectares and a production of 11,911 thousand tonnes. Although the production capacity increased by 28.44% (Fig. 2).



Source : MA& FW, Govt. of India.

Fig. 2: Area, Production and Productivity of Gram in India fro 2011-12 to 2020-21

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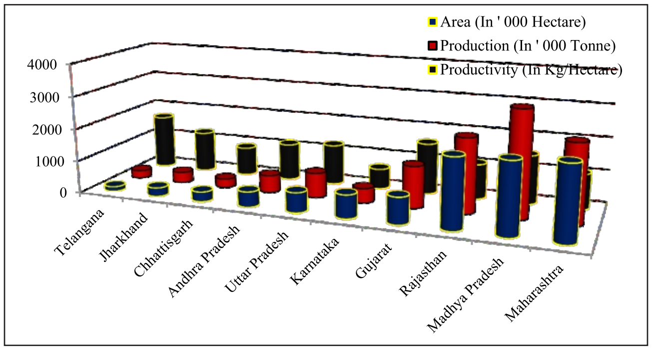
Maharashtra is the top-producing state in India in terms of chickpea produced. In Maharashtra, where 2231 thousand hectares of chickpea are grown, 2396 tones of production are produced. Madhya Pradesh is second in terms of both output and area whereas Uttar Pradesh is sixth in terms of area and fifth in terms of chickpea production (Fig. 3).



Source : MA& FW, Govt. of India.

Fig. 3: State-wise Area, Production and Productivity of Gram in India (2020-2021)

In addition to being one of the biggest consumers, India produces 68% of the world's chickpeas. In the Indian subcontinent, chickpeas are a crucial component of vegetarian diets as a protein alternative. In addition to being a highly rich source of protein, it also preserves soil fertility by biologically fixing nitrogen. The majority of soils used to cultivate chickpeas have low fertility and moisture retention capabilities. Low yields are a result of the plant's perennial and indeterminate growth habit, protracted flowering, flower drop, and pod cracking. Due to a lack of support prices, the crop is mostly grown by marginal and sub-marginal farmers and is grown against their will without proper irrigation or fertilization. In the state of Uttar Pradesh, the Bundelkhand region includes the districts of Jhansi, Jalaun, Lalitpur, Hamirpur, Mahoba, Banda and Chitrakoot, and it encompasses an area of more than 7.1 million hectares of central India's semi-arid plateau. The Bundelkhand region's several districts have quite distinct living conditions. In comparison to the southern part, the northern portion is more developed (Das *et al*., 2021). With temperature ranges between 3 and 47.8^{0}C and an undulating topography, the region enjoys a hot climate. In this area, an annual average rainfall is 867 mm (Jeet *et al*., 2019). The region is ethically different, rural, and backward despite its complexity, rainfed character, danger, underinvestment, vulnerability, and socio-economic variety (Samra, 2008). The main industry in this prone to drought region is agriculture. With a gross irrigated area of 48% of the total sown area, the zone's average irrigation intensity is almost 108%. One of India's most vulnerable regions to climate change is the Bundelkhand region (Bisht and Sheikh, 2015). The livelihoods of farmers in this area have been negatively impacted by temperature and rainfall fluctuation (Singh, 2020). The principal crops in the area are wheat, black gramme, sesame, and chickpea. Therefore, policies should embrace technology and infrastructure to keep balance and keep the interest of both consumers and producers (Kumar *et al*., 2022). In Bundelkhand region, approx. 0.38 lakh hectares cultivable area are under chickpeas cultivation with productivity of 13.1 kg ha^{-1}. The conventional techniques of cultivation, such as the use of subpar seed, the absence of external inputs (fertiliser, weedicide and pesticide), and the spread way of planting crops, may be a major factor in the low production. According to some researchers, chickpea productivity may be increased by employing enhanced pulse production cultivation techniques, such as high yield varieties, seed treatment, line sowing, and integrated pest and weed management (Ali, 1998). The pulse production in the area may be improved by these best management practices under front line demonstration. The chickpea front line demonstration is a tried-and-true technique for spreading knowledge about the technology. Farmers and scientists collaborate together and share ideas in CFLDs (Mitnala *et al*., 2018). The National Food Security Mission sponsored the CFLDs in order to promote pulse. However, cultivars' potential output is typically larger than their actual yield. Although other inputs and the potential yield of the cultivars developed with its adoption are non-limiting, it is very challenging to reach the potential yield because biotic factors are the most limiting. While the actual yield can be defined as the economic crop produced by the farmers with their available resources, the maximum attainable yield can be defined as the economic crop produced under the best management practices. It is important to identify the technological and yield gaps that are to blame for the poor yield. In order to increase the productivity of the chickpea, a study was carried out to identify the technological gap, extension gap and technology index.

MATERIALS AND METHODS

Rani Lakshmi Bai Central Agricultural University in Jhansi, Uttar Pradesh, India, during the Rabi season of 2018–19 conducted fifteen FLDs on chickpea under the AICRP–Chickpea in twelve villages *viz.* Kairokhar, Jakhora, Bhadarwara Bujurg, Bharsunda, Jamrohi, BilatiKarke, Khagsis, Dhikoli, Gora, Hardua, Thanra and Rund Karari. In the villages of Kairokhar, Jakhora, Bhadarwara Bujurg, Bharsunda, Jamrohi, BilatiKarke, Khagsis, Dhikoli, Gora, and JG-14 in Khagsis, Hardua, Thanra, and Rund Karari, two improved chickpea varieties—RVG 202 and JG-14—were displayed. By visiting the indicated villages, meeting the farmers, and touring their farms, our team members selected farmers. The farmers were chosen based on the minimum area requirement of one hectare, irrigation capabilities, and machinery accessibility during the growing season. Selected farmers who qualify for these FLDs are given the money they need to purchase essential inputs including 65 kg of several types of seed, bio-fertilizers, plant protection chemicals, and herbicides for a one-hectare area. Scientists gave farmers a wealth of knowledge about crops during seed distribution. The issues with the farmers' crops and their solutions were also covered. Members of the team visited specific farmers' farms during the agricultural season to evaluate the crop.

Along with this, the members occasionally spoke with the farmers and obtained updates on the crops through their cell phones. Additionally, data on the production from fields and a regional cultivar of the same crops were gathered, along with information on the yield and economic performance of frontline demonstrations. Finally, the grain yield, cultivation costs, and net returns were computed along with the benefit-cost ratio. A well-organized interview schedule was used to gather information from personal contacts. In accordance with the goals of the study, the obtained data was then processed, tabulated, categorized, and assessed in terms of mean percent scores and ranks. Between beneficiaries and non-beneficiaries, there was a sizable disparity of more than 10%. Using Samui et al. (2000) formula given in equation (1), (2) and (3), extension gap, technology gap, and technology index were all determined.

Extension gap (qha-1) = Demonstration yield - Farmer's yield (1)

Technology gap (qha-1) = Potential yield- Demonstration yield (2)

$$\text{Technology index (\%)} = \frac{\text{Potential yield- Demonstration yield}}{\text{Potential yield}} \times 100 \quad (3)$$

Result and Discussion

The study was conducted as part of a front-line demonstration of two varieties of chickpea, RVG-202 and JG-14 were shown in Kairokhar, Jakhora, Bhadarwara Bujurg, Bharsunda, Bharsunda, Jamrohi, Jamrohi, BilatiKarke, Khagsis, Dhikoli, Gora, Khagsis, Hardua, Thanra, and Rund Karari villages of Uttar Pradesh and Madhya Pradesh by comparing them to local or traditional technology. As a result, Table 1 shows that the demonstration plot's field pea varieties produced a higher yield than the local variety. The production of the crops varied according to the village. The chickpea variety used in the front line demonstration produced a higher yield than the indigenous variety there. Hardua village produced 1950 kg per hectare of the enhanced variety, compared to only 600 kg per hectare of the local variety for the maximum production. The output from the enhanced variety from Karokhar village was observed to be 1270 kg per hectare, while the yield from the local variety was 930 kg per hectare (table 1 and Fig. 4).

Based on the total average, the upgraded variety's yield was 35.58 percent higher than the local variety's output. If performance is compared amongst different chickpea varieties, the JG-14 variety produced an average of 1600 kg per hectare, which is 36.54% greater than the native variety, in the demonstration villages of Khagsis, Hardua, Thanra, and Rund Karari. It had been. The yield of the local variety was 35.33% lower than the yield of the chickpea variety RVG-202, which had an average yield of 1470.91 kg per hectare (Table 2).

Table 1: Chickpea production yield performance based on village under FLD

Village	Mean yield (kg /ha)		Yield difference (kg/ha)	YIOFP
	IP	FP		
Bharsunda	1300.0	1005.0	295.0	29.31
Jamrohi	1440.0	1092.5	347.5	31.81
Khagsis	1650.0	1255.0	395.0	31.38
Bhadarwara Bujurg	1350.0	950.0	400.0	42.11
BilatiKarke	1550.0	1110.0	440.0	39.64
Dhikoli	1550.0	1110.0	440.0	39.64
Gora	1850.0	1380.0	470.0	34.06
Hardua	1950.0	1350.0	600.0	44.44
Jakhora	1380.0	980.0	400.0	40.82
Kairokhar	1270.0	930.0	340.0	36.56
RundKarari	1550.0	1150.0	400.0	34.78
Thanra	1350.0	980.0	370.0	37.76
Overall average	**1505**	**1110**	**408.12**	**36.85**

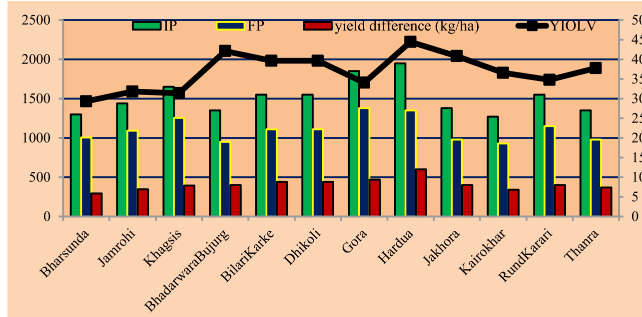


Fig. 4: Fig. 4 Chickpea production yield performance based on village

Table 2: Chickpea varietal yield production performance under fifteen (15) FLDs

Village	Mean yield (kg /ha)		Yield difference (kg/ha)	YIOFP
	IP	FP		
Variety RVG 202				
Kairokhar	1270	930	340	36.56
Jakhora	1380	980	400	40.82
Bhadarwara Bujurg	1350	950	400	42.11
Bharsunda	1250	990	260	26.26
Bharsunda	1350	1020	330	32.35
Jamrohi	1460	1110	350	31.53
Jamrohi	1420	1075	345	32.09
BilatiKarke	1550	1110	440	39.64
Khagsis	1750	1310	440	33.59
Dhikoli	1550	1110	440	39.64
Gora	1850	1380	470	34.06
Average	**1470.91**	**1087.73**	**383.18**	**35.33**
Variety -JG-14				
Khagsis	1550	1200	350	29.17
Hardua	1950	1350	600	44.44
Thanra	1350	980	370	37.76
RundKarari	1550	1150	400	34.78
Average	**1600.00**	**1170.00**	**430.00**	**36.54**

The performance of chickpea variety RVG-202 was half as high (1850 KG/ha) in Gora village while jg-14 variety obtained highest yield from Hardua village. Rajasthani farmers were motivated by Dhaka *et al.* (2015) to adopt agricultural technology rather than traditional techniques and to boost crop production using scientific methods with an appropriate variety of maize. According to front line demonstrations, Lal *et al*., 2016; Meena *et al*., 2016 and Verma *et al*., 2016 all reported similar increases in coriander yield. The pigeonpea variety PRG-176 has an overall yield trend of 12.50 to 13.00 q ha^{-1} and a yield improvement of 11.11 to 11.84% over the yield from local methods, according to Rajashekar *et al.* (2022). Due to great variation in the degree of adoption of suggested technology, the yield levels were noticeably lower under local practices.

Technology assessment

Meanwhile, Table 3 data revealed that the extension gap achieved on a variety basis among farmers was very high, which aided in better understanding the extension and technology gaps. As a result, extension communication systems played only a minor role in farmers' daily lives.

According to the study, the range of agricultural knowledge among farmers is limited to a few people, a few shops, and a few institutions. The Hadua village's farmers practice effective farming techniques and produce crops with a good yield. The highest was obtained from Hardua village and the minimum from Bharsunda village, which were 6.0 quintals/ha and 2.9 quintals/ha, respectively, subject to the extension gap. Based on Table 3, it was determined that Thanra village produced 11.5 quintals/ha, demonstrating the scientific understanding of the local farmer.

Table 3: Technology assessment in chickpea under front line demonstrations based on village

Village	Extension gap (q/ha)	Technology gap (q/ha)	Technology index (%)
Bharsunda	2.95	7.0	35.0
Jamrohi	3.5	5.6	28.0
Khagsis	3.9	6.0	25.2
Bhadarwara Bujurg	4.0	6.5	32.5
BilatiKarke	4.4	4.5	22.5
Dhikoli	4.4	4.5	22.5
Gora	4.7	1.5	7.5
Hardua	6.0	5.5	22.0
Jakhora	4.0	6.2	31.0
Kairokhar	3.4	7.3	36.5
RundKarari	4.0	9.5	38.0
Thanra	3.7	11.5	46.0
Average	3.96	6.28	29.0
SD	0.79	2.61	10.28
SE	0.20	0.68	2.65

The difference between the potential yield and the demonstration yield of the species under the technological gap was calculated. Even his own advice wasn't adequately implemented in his industry. However, throughout the investigation, it was 0.5 quintal per acre in Hardua village, which was the lowest. The local farmers were more knowledgeable and skilled at farming. The Hardua hamlet had the lowest technology score (2.5), whereas Thanra village had the highest (46%) value. When examining the extension gap based on chickpea variety, it was found that variety RVG-202 had an extension gap of 3.83 q/ha, a technology gap of 5.29 q/ha, and a technology index of 26.45%, compared to variety JG-14.4's 26.45% (Table 4 and Fig. 5).

When the two varieties were compared, growers were able to produce more because variety JG-14 performed better than variety RVG-202. The JG-14 variety will succeed in leaving its mark in the Bundelkhand region since it was able to bridge the technical divide. The average extension gap, technology gap, and technology index for pigeonpea were 128.30, 125, and 8.93%, respectively (Rajashekar *et al*., 2022). The extension gap was ranged from 5.10q ha^{-1} to 10.38q ha^{-1} during the study period recorded by Lal *et al.* (2016). This finding corroborates results of Dhaka *et al*., 2015; Meena *et al*., 2016 and Verma *et al*., 2016. Additionally, Singh and Singh (2020) found that by bridging the technology gap, using the latest varieties and improved packages of practices under cluster frontline demonstration significantly increases pulse productivity and

Table 4: Varietal yield gap and technology index in chickpea under front line demonstrations

Village	Extension gap (q/ha)	Technology gap (q/ha)	Technology index (%)
Variety RVG 202			
Kairokhar	3.4	7.3	36.5
Jakhora	4.0	6.2	31.0
BhadarwaraBujurg	4.0	6.5	32.5
Bharsunda	2.6	7.5	37.5
Bharsunda	3.3	6.5	32.5
Jamrohi	3.5	5.4	27.0
Jamrohi	3.5	5.8	29.0
BilatiKarke	4.4	4.5	22.5
Khagsis	4.4	2.5	12.5
Dhikoli	4.4	4.5	22.5
Gora	4.7	1.5	7.5
Average	3.83	5.29	26.45
SD	0.63	1.91	9.53
SE	0.19	0.57	2.87
Variety -JG-14			
Khagsis	3.5	9.5	38.0
Hardua	6.0	5.5	22.0
Thanra	3.7	11.5	46.0
RundKarari	4.0	9.5	38.0
Average	4.30	9.00	36.00
SD	1.15	2.52	10.07
SE	0.58	1.26	5.03

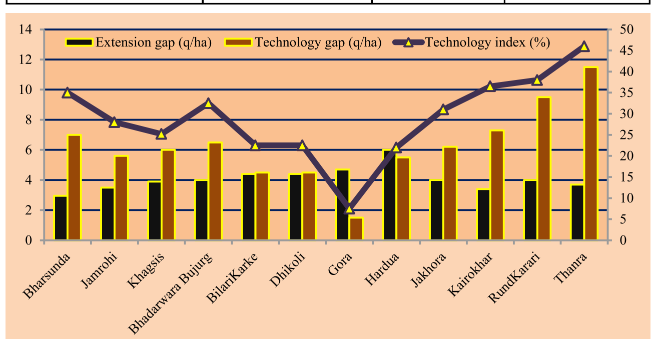


Fig. 5: Technology assessment in chickpea under front line demonstrations based on village

profitability in the field (Dwivedi *et, al*., 2014; Mitnala *et al*., 2018; Saikia *et al*., 2018 and Singh *et. al*., 2020). Lal *et al.* (2016) demonstrated coriander variety AFg-2 Pratapgarh district of Rajasthan in *Rabi* season.

The villages of Hardua and Karokhar yielded the highest and lowest net marginal returns under FLD chickpea, respectively, at Rs. 61540 and 30774 each. Hardua village provided a net marginal return that was Rs. 19647.2 higher than the average yield, whereas Karokhar village's net marginal return was Rs. 111122.08 lower. Hardua village recorded the highest cost-benefit ratio (3.16), while Karokhar village recorded the lowest (2.10). According to a variety-based analysis, the average net marginal return was found to be Rs. 39819.64 for variety RVG-202 and Rs. 45745.0 for variety JG-14, while the cost-benefit ratio was found to be 2.42 for RVG-202 and 2.18 for JG-14. Pigeon pea was found to have a higher benefit-cost ratio on average throughout the experiment, as 2.8. (Rajashekar *et al*., 2022). A coriander field demonstration with a comprehensive set of practises generated higher benefit-cost ratios and additional net returns for farmers (Lal *et al*., 2016). These results agree with those from Mitnala *et al*. (2018), and Dhaka *et al*. (2015). Singh *et al*. (2017) also discovered comparable findings.

CONCLUSION

To grow a successful harvest, the farmer must be knowledgeable about the crop. All of these elements contribute to optimal crop production: what the crop requires at the moment, how much it needs, how and in what shape. In conclusion, the farmer in Kairokhar village failed to adhere to the FLD guidelines and the chickpea crop recommendations in a proper and appropriate manner. Only the enhanced variety and the supplied inputs could account for the apparent difference in crop production between the improved variety RVG-202 and the local variety. Our scientists must interact with the residents of Kairokhar Village, get to know them, and teach crop production techniques to them in order to close the extension gap there. For this, we must intensify our extension work. Farmers in Hardua and Gora villages were more knowledgeable than farmers in other villages because they had successfully used the enhanced variety to produce good yields by correctly implementing crop production suggestions.

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