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Demonstration of Drought mitigation techniques in Chickpea crop in Bidar District, Karnataka, India

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Abstract

With an objective of improving productivity of chickpea, Integrated Crop Management (ICM) for drought mitigation techniques for dryland conditions were conducted in 10 farmer's fields in Belkuni village of Aurad taluk of Bidar district in Karnataka state during Rabi season of 2024-25 and 2025-26. The study findings revealed that ICM practices for drought mitigation techniques recorded a mean average yield of 11.20 kg/ha which is 10.88 per cent higher than obtained with farmer's practice (10.60 q/ha). The average extension gap, technology gap and technology index were 0.60 q/ha, 3.80 kg/ha and 25.37 per cent, respectively. The improved production technologies gave higher benefit cost ratio (1.67) compared to local check (1.45) being grown by farmers under locality. The productivity of chickpea per unit area could be increased by adopting feasible scientific and sustainable management practices with a suitable variety. Considering the above facts, ICM for drought mitigation techniques were carried out in a systematic and scientific manner on farmer's field to show the worth of improved practices and convincing farming community about potentialities of improved production management technologies of chickpea for further adoption by the farming community.

Keywords: Chickpea, FLD, drought mitigation, yield, extension gap, technology gap

Introduction

Chickpea (*Cicer Arietinum* L) is grown in many tropical, sub-tropical and temperate regions of the world and one of the most important pulse crop of India due to its multiple functions in the traditional farming system. Besides helping in the management of soil fertility, particularly in the dryland, it is an important source of human food and animal feed. In India, it is cultivated on about 1372000 ha with a production of 7169000 tonnes. However, its average productivity has remained strikingly low at about 859 kg/ha. In Karnataka, it is grown over an area of 1372000 ha with a production of 897000 tonnes and productivity of 321 kg/ha¹. There are several biophysical, technical and socioeconomic constraints, which limit the productivity of chickpea in India. In order to mitigate these limitations, it is essential to assess the production potential of the environment in relation to achievable and current levels of production as well as the availability of the natural resources (Goudappa *et al.*, 2019) ^[3]. Since chickpea is mostly cultivated under rainfed conditions and unpredictable rain fall under such environments results in terminal drought reducing crop growth and productivity. Globally, drought stress is considered to reduce chickpea production by 33% (Kashiwagi *et al.*, 2015) ^[4] and terminal drought can significantly increase crop yield loss up to 70% (Devasirvatham & Tan, 2018) ^[2]. Even severe water deficit may result in 100% yield loss in susceptible genotypes (Sachdeva *et al.*, 2022) ^[5]. Thus, evaluation of genotypes using some morpho-physiological criteria can be promising to reduce the drastic effects of terminal drought. Therefore, it is very essential to conduct investigation on drought mitigation techniques demonstrations on chickpea to assess their effectiveness and efficiency towards enhancement in yield and economics. Hence a research study was planned and conducted with the aim to analyze and assess the impact drought mitigation techniques in Chickpea crop in Aurad taluk of Bidar district. Krishi Vigyan Kendra or Farm centre is an innovative, science-based institution designed to bridge the gap between agricultural research and farmers. Its primary objective is to reduce the time lag in transferring technology from research institutions to farmers, there by increasing

agricultural productivity and income sustainably. KVKs are grassroots organizations tasked with assessing, refining, and demonstrating proven technologies under diverse micro-farming conditions in each district (Das, 2007)^[1]. Frontline demonstrations (FLDs) are systematic educational initiatives conducted in farmers' fields to showcase the effectiveness of new practices and technologies. Despite advancements in agricultural research, many farmers in India continue to rely on traditional knowledge passed down through generations. This often results in unscientific agronomic, nutrient, and pest management practices, limiting the potential yield of crops and new varieties. The potential yield of crops is influenced by factors such as solar radiation, temperature, photoperiod, atmospheric carbon dioxide levels, and genetic characteristics, assuming no limitations from water, nutrients, pests, or diseases. In rainfed farming systems, where water supply is beyond the farmer's control, water-limited potential yield becomes a critical benchmark for yield gap analysis. Seasonal variations, particularly in rainfall, further affect this potential yield (Singh *et al.*, 2001)^[6]. Although significant strides have been made in agricultural productivity since the mid-1960s, continued efforts are essential to meet the demands of a growing population. Demonstrating recommended improved technologies through FLDs on farmers' fields remains one of the most effective approaches. This study aims to analyze input costs and monetary returns, identify yield gaps, assess technology adoption, and explore reasons for the non-adoption of proven technologies.

Materials and Methods

The study was conducted in the operational area of Krishi Vigyan Kendra (KVK), Bidar, Karnataka. The region receives an annual precipitation of 850 mm, primarily between June and the end of September. The maximum temperature in Bidar district reaches 40°C, while the minimum temperature drops to 8°C. Five frontline demonstrations (FLDs) on Chickpea were conducted during the *Rabi* season from 2024-25 and 2025-26 across adopted villages in the operational area namely Belkuni and each demonstration covered an area of 0.4 ha. The soils in the study area were slightly alkaline, with low to medium organic carbon, medium available phosphorus, and very high available potassium. The treatment involved the recommended practice of applying 04:10:0 NPK kg/ha along with seed hardening with CaCl₂ @ 2 % for 30 minutes and shade drying for 7 hours followed by Trichoderma @ 5g/kg, Rhizobium and PSB 200 g each per 20 kg seeds and foliar spray of Chickpea magic 7.5 g/lit @ 50 % flowering and Potassium Nitrate spray @ 0.5% at flowering and pod filling stage compared to the existing farmer practice of no seed treatment and no micronutrient foliar application. Farmer practices often involved imbalanced nutrient management (50 kg DAP/ha), simultaneous sowing without seed treatment, and lack of proper agronomic practices. To address these challenges, FLDs aimed to demonstrate the productivity and profitability of improved Chickpea production technologies under real farm conditions, even in variable weather.

Key diagnostic issues identified during the PRA survey included:

1. Improper nutrient management and lack of soil testing.
2. Low nutrient availability and minimal use of organic manures and biofertilizers.
3. Limited application of secondary and micronutrients.

4. Faulty methods and improper timing of fertilizer application.
5. Inadequate plant protection measures.
6. Lack of intercultural operations, with reliance on chemical weed control.
7. Uncertain market prices, particularly during harvest.
8. Lack of crop rotation practices.

Data Analysis

Participating farmers were trained in onion production technologies, including fertilizer dosage calculations, soil sampling, seed treatments, and recommended agronomic practices. Primary data were collected using interviews and analysed for yield improvement percentages.

The primary data were collected from the selected farmers with the help of interview schedule and interpreted and presented regarding percentage increased yield. The observation on yield and economic performance of front line demonstration, the data on output were collected from FLDs (demonstration) as well as local check plots from all selected farmers and finally the grain yield, cost of cultivation, yield, net returns of different farmers were analyzed by the formula.

$$\text{Average} = (F1+F2+F3+\dots\dots\dots Fn)/N$$

F1= Farmer

N= No. of Farmers

Gap Analysis

Technology gap, extension gap, and technology index were calculated using the following formulas (Goudappa *et al.*, 2019)^[3].

1. **Technology gap:** Potential yield - Demonstration yield
2. **Extension gap:** Demonstration yield – Farmer's yield
3. **Technology Index%:** (Potential yield-Demonstration yield)/Potential yield *100

Results and Discussion

Growth parameters

The data on growth parameters as influenced by drought mitigation techniques from frontline demonstrations (FLDs) in Chickpea crop conducted during *Rabi* 2024-25 and 2025-26 are presented in Table 1. The average plant height (43.35 cm), number of branches per plant (7.30), number of plant in 5X5 sq area (56.50) and number of pods per plant (66.60) was recorded more in the demonstration plot during the *Rabi* season of 2024-25 and 2025-26, compared to days to average plant height (40.60 cm), number of branches per plant (6.85), number of plant in 5X5 sq area (50.50) and number of pods per plant (61.40) in the farmer's practice plot.

Yield parameters

The data on growth and yield parameters in Chickpea crop from frontline demonstrations (FLDs) conducted during *Rabi* 2024-25 and 2025-26 are presented in Table 2 & Table 3. The average crop duration to harvest (95.50 days), 100 seed weight (22.30 g), seed yield per plant (15.25 g), number of seeds per pod (1.23) and seed yield (11.75 q/ha) in the demonstration plot was recorded higher during the *Rabi* 2024-25 and 2025-26 when compared to average crop duration to harvest (95.80 days), 100 seed weight (22.05 g), seed yield per plant (14.65 g), number of seeds per pod (1.21) and seed yield (10.60 q/ha) in the farmer's practice plot in the local check representing a 12.06 % increase in

yield due to the following of drought mitigation techniques under dryland conditions. The increase in yield and yield attributes can be attributed to the higher number of branches, which provide more sites for flower and pod formation, resulting in a greater number of pods per plant. Enhanced nutrient availability from Chickpea magic and potassium nitrate foliar spray which supports better seed development and increased seed weight per plant, as seen in the work of Thejaswini *et al.* (2025)^[7].

Technology Gap

A wide technology gap was observed across the years, with the lowest gap (3.65 q/ha) recorded in 2025–26 and the highest (3.96 q/ha) in 2024–25. The mean technology gap for all 10 demonstrations was 3.80 q/ha. These differences are attributed to varying feasibility levels of the recommended technologies across years, influenced by factors such as soil fertility and erratic rainfall. The gap between potential yield and demonstration yield highlights the need for location specific recommendations to minimize the technology gap.

Extension Gap

The extension gap, representing the difference between FLD and farmer's practice yields, ranged from 0.54 to 0.65 q/ha.

The lowest gap (0.54 q/ha) was recorded during *rabi* 2024–25, while the highest (0.65 q/ha) was observed in 2025–26 (Table 3). The higher extension gap underscores the need to educate farmers on adopting improved practices, particularly balanced nutrient management for higher yields.

Technology Index

The technology index, which indicates the feasibility of technology at farmers' fields, was recorded at 25.37 % (Table 3), indicating a high suitability of the recommended technology for the Bidar district. These findings are consistent with those of Goudappa *et al.* (2019)^[3] for wheat production technology in the same region.

Economics

The economic analysis (Table 4) revealed that adopting improved Chickpea cultivation technology resulted in higher profitability. The average additional net return from demonstration fields was ₹29475/ha, compared to ₹20625/ha from farmer's practices. The mean benefit-cost (B:C) ratio was 1.67 for demonstration plots and 1.45 for farmer's practices. These results highlight the substantial potential of improved technology to enhance farmer's income and livelihoods in the Bidar district of Karnataka state.

Table 1: Growth parameters of Chickpea as influenced by drought mitigation techniques under Front Line Demonstrations on Farmer's fields (average of ten farmers)

Year	Plant height (cm)		No. of branches per plant		No. of plants (5X5 sq area)		No. of pods per plant	
	RP	FP	RP	FP	RP	FP	RP	FP
2024-25	42.5	40.2	7.2	6.8	55	49	66.2	61.2
2025-26	44.2	41	7.4	6.9	58	52	67	61.6
Mean	43.35	40.60	7.30	6.85	56.50	50.50	66.60	61.40

RP- Recommended practice FP-Farmers practice

Table 2: Yield parameters of Chickpea as influenced by drought mitigation techniques under Front Line Demonstrations on Farmer's fields (average of ten farmers)

Year	Crop duration (days)		100 seed weight (gm)		Seed yield per plant		No. of seeds per pod		Yield (q/ha)		% Increase over FP
	RP	FP	RP	FP	RP	FP	RP	FP	RP	FP	
2024-25	95.2	95.5	22.1	21.8	15.1	14.5	1.21	1.2	11.6	10.5	12.9
2025-26	95.8	96.1	22.5	22.3	15.4	14.8	1.24	12.1	11.9	10.7	11.21
Mean	95.50	95.80	22.30	22.05	15.25	14.65	1.23	6.65	11.75	10.60	12.06

Table 3: Productivity, technology gap, extension gap and technology index of Chickpea as influenced by drought mitigation techniques under Front Line Demonstrations on Farmer's fields (average of ten farmers)

Year	Seed yield (q/ha)				Farmers practice (FP)	Percent increase over FP	Technology gap (q/ha)	Extension gap (q/ha)	Technology index
	Recommended practice								
	Potential yield	Highest	Lowest	Average	Average				
2024-25	15	12.28	9.8	11.04	10.5	7.93	3.96	0.54	26.40
2025-26	15	12.4	10.3	11.35	10.7	13.83	3.65	0.65	24.33
Mean	15	12.34	10.05	11.20	10.60	10.88	3.80	0.60	25.37

Table 4: Cost economics of Chickpea as influenced by drought mitigation techniques under Front Line Demonstrations on Farmer's fields (average of ten farmers)

Year	Gross cost (Rs)		Gross Returns (Rs)		Net Returns (Rs)		Additional net returns (Rs/ha)	B:C Ratio	
	RP	FP	RP	FP	RP	FP		RP	FP
2024-25	45000	46300	69600	63000	24600	16700	7900	1.54	1.36
2025-26	43000	45000	77350	69550	34350	24550	9800	1.79	1.54
Mean	44000	45650	73475	66275	29475	20625	8850	1.67	1.45

Chickpea Price per quintal: 2024-25: 6000 & 2024-25: 6500

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