

Impact of Cluster Front Line Demonstrations in Diversification of Chickpea with Safflower Variety ISF-764 in Rainfed Black Soils of Kurnool District of Andhra Pradesh

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Authors' contributions

This work was carried out in collaboration among all authors. Author MJ designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors GPB and BHC managed the analyses of the study. Author MM managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The productivity of chickpea has declined considerably during the last three years in rainfed black soils of western part of Kurnool district due to the aberrations in the rainfall pattern, high cost of cultivation, pest & disease incidence and wild deer problem. To overcome these production constraints Cluster Frontline Demonstrations in safflower played major role with introduction of new safflower variety ISF-764. Cluster Frontline Demonstrations were conducted in safflower in 30ha area in 2017-18 and 40 ha in 2018-19 by Krishi Vigyan Kendra Banavasi. ISF-764 (T3 demonstration) performed better even in dry spell conditions compared to chickpea. Cost of cultivation in both ISF -764 (demonstration) and PBNS-12 (T2check) was low (18,300 Rs/ha) compared to chick pea (35,500 Rs/ha) variety JG-11(T3farmers Practice). Chickpea equivalent

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yields of safflower was 1339 and 803 (kg/ha) in demonstration and check and 720 kg/ha in farmers practice with 86 and 11.6 % improvement in yield. Extension gap for ISF 764 and PBNS-12 were 619 & 83 kg/ha respectively. The technology index was lowest in ISF-764 (21.8) as compared to PBNS-12 (57.12) and JG -11 (58 .8) which indicates the highest feasibility of the demonstrated technology. The net returns (37,950 Rs/ha) and benefit cost ratio (3.07) were highest in ISF -764. Hence Safflower variety, ISF 764 is highly suitable for rainfed black soils of Kurnool district of Andhra Pradesh.

Keywords: Cluster front line demonstrations; safflower; extension gap; technology gap; technology index; ISF-764.

1. INTRODUCTION

Chickpea (*Cicer arietinum* L.) is an important leguminous food grain crop. The area covered under chickpea cultivation in India is around 10 million ha with an annual production of 7.5 million tonnes. India is the largest producer of chickpea with about 63% of world’s production [1]. Andhra Pradesh is categorized among the states which show high growth rate of chickpea production in India. Kurnool district is representing an important region in Rayalaseema with an average rainfall of < 700mm per annum and around 72 to 77% of the cropped area in the district is rainfed. Chickpea is a major crop grown on residual soil moisture during rabi season in Kurnool district of Andhra Pradesh state. Generally, farmers grow local chickpea variety

JG11, which is susceptible to wilt and drought. The crop choice for the dryland farmer is limited and subjected to uncertainties of prolonged dry spells and moisture stress during critical stages of crop growth. Onset of monsoons is another crucial factor influencing selection of crop. Under delayed onset of monsoon situation, farmers change the crop options Suhasini *et.al* .[2]. The cropping pattern in Kurnool district is predominantly single cropped and hence the yield levels of the crop have direct bearing on the livelihood of the farming community. The productivity of chickpea has declined considerably during the last three years due to the aberrations in the rainfall and forced maturity is a perpetual problem in the area and most of chickpea cultivated area in western parts of Kurnool district is damaged by wild deers.

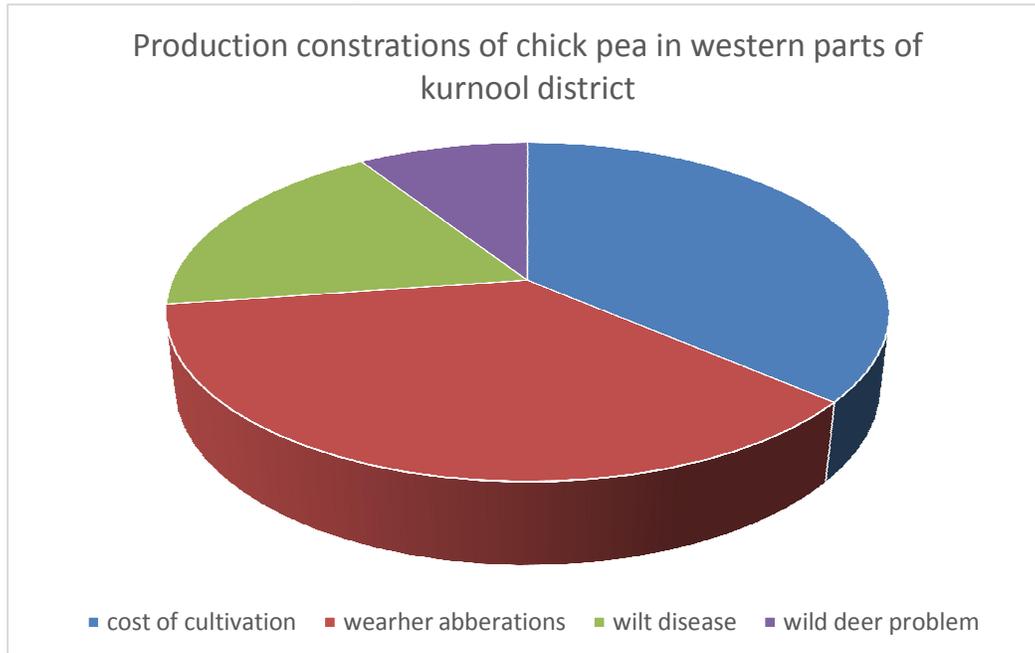


Fig. 1. Production constractions of chick pea in western parts of Kurnool district

The Paid-out cost component is very high primarily due to seed cost, plant protection chemicals and fertilizer application besides harvesting and threshing for marketing the produce. With all the drudgery involved in the cultivation of chick pea, the farmers were able to reap on an average 900-1000 kg ha⁻¹ which is uneconomical due to high cost of production. Yield levels of chick pea were stagnant at 900-1000 kg ha⁻¹ and farmers were not able to achieve even the breakeven output and hence a losing proposition to the farming community. Rao [3]. In some districts of Andhra Pradesh where black cotton soils are predominant, the

government is promoting crop diversification with low risk crops such as safflower. Considering all these production constraints (Fig.1) in chickpea Krishi Vigyan Kendra Banavasi introduced improved safflower variety through cluster Frontline Demonstrations in western parts of Kurnool district. Gopalappa [4] revealed that there was scope to increase income through crop diversification in Andhra Pradesh. On-Farm Testing conducted in Prakasam district of Andhra Pradesh stated that safflower is an alternate crop to chick pea in rainfed black soils. Sahajadeva et.al. [5].



Picture 1. ISF-764 at Guduru Mandal



Picture 2. Conducting field day for ISF-764 at Kowthalam Mandal

Cluster front line demonstrations (CFLDs) is a novel approach to provide direct interface between researcher and farmer for the transfer of technologies developed by them and to get direct feedback from farming community. CFLDs on Oilseed project was initiated by the Department of Ministry of Agriculture cooperation and Farmer's Welfare (DAC&FW) with cooperation of Division of Extension Education. ICAR, New Delhi under NMOOP during 2015 and it continued in 2016-17. The scheme implemented in a mission mode through a farmer centric approach, The scheme aims to target the select districts by making available the improved technologies like promotion of Integrated Nutrient Management (INM) Integrated Pest Management (IPM), promotion of micronutrients/gypsum/bio-fertilizers, promotion of sprinkler irrigation, and Extension, training and mass media campaign. These demonstrations were conducted under the close supervision of scientists of Krishi Vigyan Kendras, SAUs and their Regional Research Stations.

2. MATERIALS AND METHODS

Cluster frontline demonstrations on safflower crop were conducted by KVK,Banavsi during rabi in 2017-18 and 2018-19. With Participatory

Rural Appraisal (PRA) technique a group of cooperative farmers were identified based on their participation and feedback received during the preliminary survey and interactive meeting. The demonstrations were conducted in Kowtalam and Guduru blocks of Western part of Kurnool region where traditional chick pea crop was affected with wild deers. Preseason trainings were conducted to create awareness among farmers for selection of suitable technology with low cost of cultivation to get profitable net returns. .Krishi Vigyan Kendra Banavasi has succeeded in convincing traditional chickpea growing farmers for crop diversification with safflower. Farmers were provided with ISF-764 (8 kg each farmer for 0.8ha) as critical input for conducting demonstrations.ISF-764 which yields 16 q/ha in rain fed conditions and is also tolerant to drought. The crop can be grown with residual soil moisture in rainfed black soils which motivated farmers to diversify to safflower as an alternative to chick pea. Safflower variety PBNS-12 was grown as check where all the beneficiary farmers were grown adjacent to the demonstration field to evaluate the performance of varieties. Aphid infestation was observed in the safflower demonstration fields and pest incidences were recorded in both safflower varieties. During 2017-18, 45 demonstrations on 18 ha area and 50

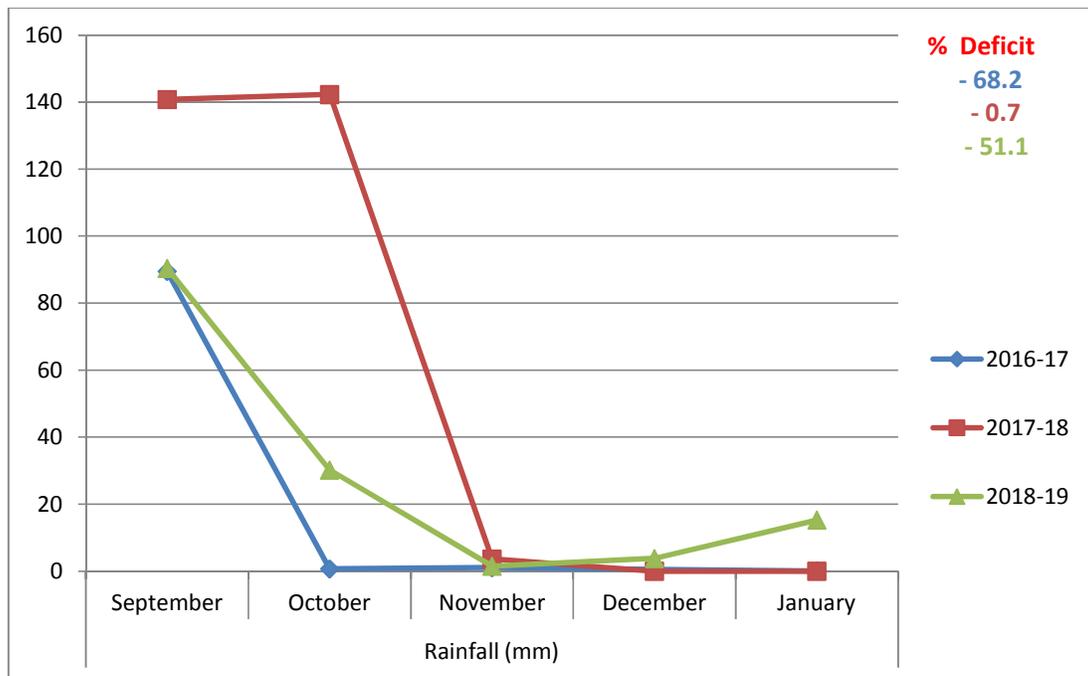


Fig. 2. Rainfall during three years at Guduru Mandal

demonstrations on 20 ha with area during 2018-19 (Picture:1) were conducted with active participation of farmers. Critical inputs such as quality seed of improved high yielding variety, recommended chemicals and literature were provided to farmers after the trainings. Regular field visits for monitoring pest and diseases and advisory services for

management of crop were provided by the KVK scientists .Finally field day was organized (Picture;2) involving demonstration farmers, other farmers in the village, Scientists from University and ATARI, officials from department of Agriculture and local extension functionaries to show the superiority of the technology.

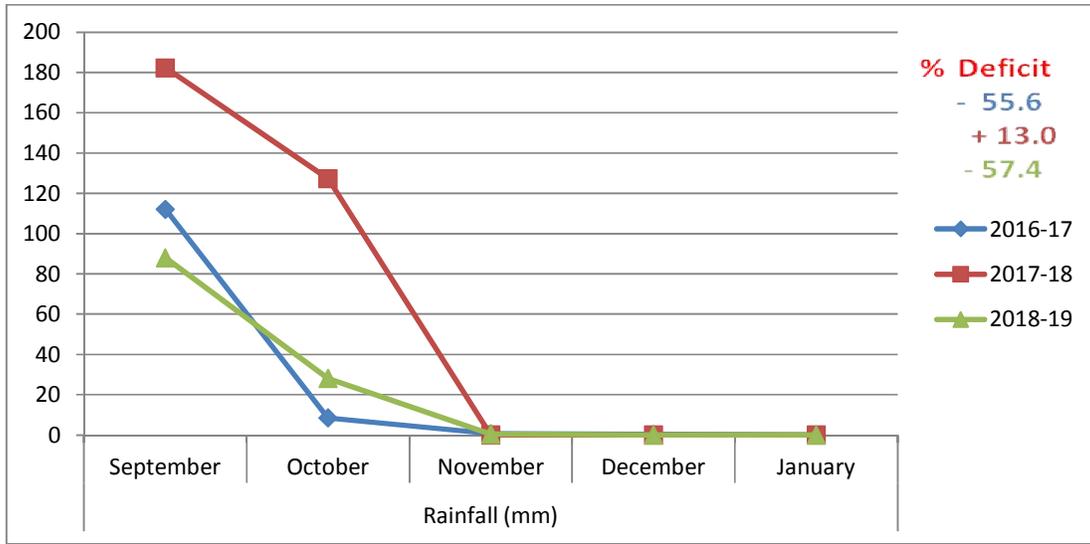


Fig. 3. Rainfall during three years at Kowthalam Mandal

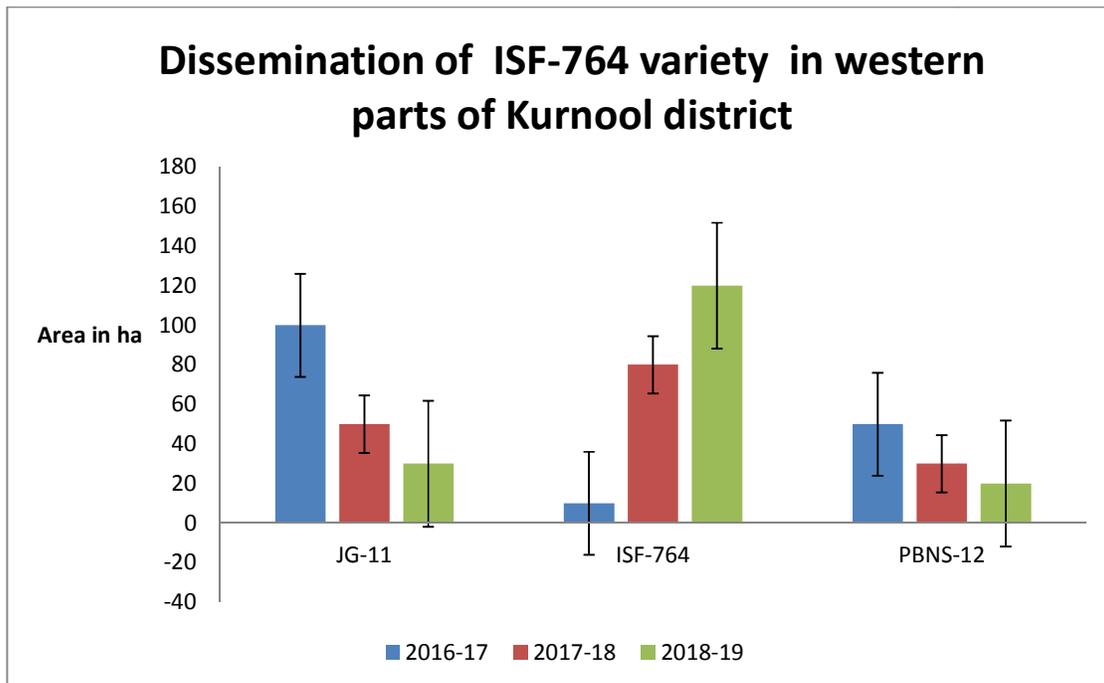


Fig. 4. Dissemination of ISF-764 variety in western parts of Kurnool district

In Gudur mandal (Fig. 2) total rainfall received during the *Rabi* in 2016-17, 2017-18 and 2018-19 were 91.9 mm, 286.7 mm, 141.2 mm with percent deficit of 68.2, 0.7, 51.1 respectively and in Kowthalam mandal(Fig. 3) the total rainfall received was 121.5mm ,309.6mm&116.5 mm and percent deficit was 55.6 and 57.4 in 2016-17 and 2018-19 respectively, in 2017-18, 13 percent more rainfall was received compared to normal. Soil type was black in both the mandals. Guduru is located at 15.46°N latitude and 77.47°E longitude. Kowthalam is located at 15.460 N latitude and 77.0840E longitude. The treatments were chick pea JG-11 variety was considered as T₁ (Farmers Practice), Safflower variety PBNS-12 as T₂ (Check) and ISF-764 as T₃ (demonstration) in both the years (2017-18 & 2018-19). During the crop period growth parameters like plant height (cm) and number of branches/plant, yield parameters viz number of capitula/plant, number of seeds/capitula, 100 seed weight (5 plants in each demonstration) and yield were recorded from the demonstration and control plots. The basic information were recorded from farmer's field and analyzed to compare performance of improved technology and farmer's practice. While conducting field day crop cutting experiment was done to show the performance of technology to the neighbour farmers and yield data were collected from all demonstrations and farmers practice in both years. The average yield was calculated and pooled. The yield analyzed by using simple statistical tools. The technology gap and technological index Yadav *et. al.*, [6] were calculated by using following formula as given below:

Extension gap = Demonstrated yield- farmer's practice yield

Technology gap= Potential yield-Demonstration yield

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

$$\text{Technology Index} = \frac{\text{Potential yield} - \text{Demonstration yield}}{\text{Potential Yield}} \times 100$$

Chickpea equivalent yield of safflower (kg ha⁻¹) :

$$\frac{\text{Safflower prevailing market price (Rs ha}^{-1})}{\text{Chickpea prevailing market price (Rs ha}^{-1})} \times \text{Safflower yield Kg/ha}$$

2.1 Economic Parameters

Cost of cultivation (Rs ha⁻¹) was estimated by considering the prevailing charges of agricultural operations and market price of inputs involved. Over the course of studies, gross returns were obtained by converting the yield into monetary terms at the prevailing market rate. Net returns were obtained by deducting cost of cultivation from gross return. The benefit cost ratio was calculated by dividing gross returns by cost of cultivation Gross returns (Rs/ha)

$$\text{Gross return (Rs ha}^{-1}) = (\text{Seed yield} \times \text{price})$$

$$\text{Net returns (Rs ha}^{-1}) = \text{Gross return (Rs ha}^{-1}) - \text{Cost of cultivation (Rs ha}^{-1})$$

$$\text{Benefit: Cost ratio} = \frac{\text{Gross returns (Rs ha}^{-1})}{\text{Cost of Cultivation (Rs ha}^{-1})}$$

3. RESULTS AND DISCUSSION

3.1 Yield and Yield Attributes

Plant height, number of branches /plant, number of capitula /pod per plant and number of seed per pod/ capitula and 100 seed weight was recorded highest in demonstration plot (ISF-764) as compared to check (PBNS-12) and farmers practice (JG-11). Chickpea equivalent yield of safflower variety ISF-764 was 1339 kg ha⁻¹ which was highest as compared to check variety PBNS 12 (803 kg/ha) and farmers practice JG-11 (720 kg ha⁻¹). Increase in seed yield over control is 86% & 11.6 % in ISF-764 and PBNS -12 respectively (Table:2). This findings were also supported by sahadadeva *et al* [5].

Table 1. Characteristics of Safflower and Chick pea varieties

Variety	Duration	Yield q/ha	Characteristics of variety
ISF-764 (Safflower)	125-130	16 in rainfed and 23 in irrigated conditions	Suitable for both rainfed and irrigated conditions. Contains 31% oil
PBNS-12 (Safflower)	130-135	17.5	Suitable for irrigated conditions. Contains 30 % oil
JG-11 (Chick pea)	90-95	17.5-20	Tolerant to Fusarium wilt.

Table 2. Growth, Yield parameters and Yield of Safflower varieties and local Chick pea variety (pooled data of two years)

Particulars	ISF-764	PBNS-12	JG-11
Plant height cm	68.9	85.1	35.2
No of branches/plant	16.9	18.5	14.5
No. of capitula/plant (or) pods/plant	28	26	32.5
Seeds/capitula (or) seed per pod	36.5	35	1.0
100 seed weight (g)	37.8	36.5	24.5
Yield (kg/ha)	1250	750	720
Chickpea equivalent yield (kg/ha)	1339	803	--
Per cent increase in yield over control	86.0	11.6	---

Prevailing market price of safflower: 4500Rs/ha and Chickpea 4200Rs/ha

Table 3. Yield gap quantification of Safflower varieties and local Chick pea variety (pooled data of two years)

Particulars	ISF-764	PBNS-12	JG-11
Technology gap Kg/ha	350	1000	1380
Extension gap Kg/ha	619	83	----
Technology Index	21.8	57.12	58.8

Table 4. Economics analysis of Technology (pooled data of two years)

Variety	Cost of cultivation Rs/ha	Cost on plant protection chemicals	Gross returns Rs/ha	Net Returns Rs/ha	B:C Ratio
ISF-764	18300	3100	56250	37950	3.07
PBNS-12	18300	3100	33750	15450	1.84
JG-11	35500	6250	30240	-5260	0.85

Table 5. Safflower aphid incidences in two safflower varieties

Month	Average Aphid population per 5 cm apical twig	
	ISF-764	PBNS-12
October	14.4	14.9
November	25.6	28.8
December	36.2	39.1
January	58.2	65.7
February	77.3	91.8
March	102.1	132.6
MeanAphid population	52.3	62.2

3.2 Plant Protection Aspects

The wilt incidence and pod borer infestation was observed more in farmers practice (JJ-11). Hence the cost of cultivation towards plant protection chemicals was increased. Since wilt is a soil born disease it is difficult to manage on standing crop. The cost on plant protection is high in farmers practice (6250 Rs ha⁻¹) than demonstration practice (3100 Rs ha⁻¹) Tabel 3. Based on the above study it could be ascertained that safflower is a suitable alternate crop for chickpea crop in order to decrease the cost of cultivation. When two safflower varieties were compared

with pest data, the population of aphid, leaf eating caterpillar and capsule borer was observed in two safflower varieties. It was noticed that the population of leaf eating caterpillar and capsule borer was below ETLs or negligible during crop period. It was found that the aphid population was increasing with plant age. The safflower aphid infestation was found active from January to 1st week of March (Tabel-5). The observed mean aphid population was minimum in ISF-764 variety (52.3/5 cm twig) than PBNS-12 variety (62.2/5 cm of twig). Safflower aphid is the major pest as it causes huge yield losses in safflower about 24.2 - 72% Dobrin et

al., and Nivedita et al., [7,8]. Hence, ISF-764 is most suitable safflower variety for western part of Kurnool.

3.3 Gap Analysis

In Table 3 the technology gap was recorded 350, 1000 and 1380 kg ha⁻¹ for demonstration, check and farmers practice respectively. The lowest technology gap (350 kg ha⁻¹) was observed in demonstration plot followed by check and farmer's fields. The lowest technology gap in ISF-764 was due to higher yield obtained with demonstration. Highest extension gap (619 kg ha⁻¹) in ISF-764 indicates that there is need to decrease this wider extension gap through implementation of latest techniques. Technology index was lowest in ISF 764 (21.8%) followed by PBNS-12(57.12%) and JG-11(58.8%). The technology index shows the feasibility of new technology at the farmer's fields and the lower the value of technology index more is the feasibility of the technology. Similar findings were reported by Sandhu et al. [9] in Rape seed in Punjab.

3.4 Economic Analysis

Data of economic analysis (Table:4) reveals that the cost of cultivation in safflower was lowest (18,300 Rs. ha⁻¹) due seed cost and less incidence of pest and diseases as compared to chickpea (35500 Rs. ha⁻¹). Gross returns, net returns and benefit cost ratio were highest in safflower as compared to chick pea. These findings were in accordance with demonstrations conducted at prakasam district of Andhra Pradesh [5]. In our demonstrations, we observed that farmers got negative net returns due to failure of north east monsoon in both the years of demonstration period.

3.5 Dissemination of Safflower Variety ISF-764:

Due to Farmers demand, KVK have indented for ISF-764 seed for 25 ha in 2017-18 and 40 ha in 2018-19 (other than demonstrations) and supplied to the farmers as the farmers got positive feedback from neighbour farmers on this technology. (Fig. 4).

4. CONCLUSION

Hence it could be concluded that due to weather aberrations and higher cost of cultivation chickpea growing farmers were interested to shift

to safflower which could perform better in adverse climatic conditions too. The variety ISF-764 played major role in this diversification with its characteristics (single or no irrigation requirement) which were highly suitable for rainfed black soil agro eco systems in western parts of Kurnool district of Andhra Pradesh.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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