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Assessment of Doable Technologies for enhancing the yield potentials in Sunflower (*Helianthus annuus* L.) under Rainfed Conditions

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ABSTRACT

Cluster FLDs were organized by AICRP on sunflower scheme, Regional Agricultural Research Station, Nandyal during three consecutive years of 2018-19, 2019-20 and 2020-21 in an area of 50 ha at 66 locations. At every demonstration site improved management practices viz improved sunflower hybrid with high oil content (Prabhath), thinning at 10 days after sowing boron spray @0.2% at ray floret stage and need based plant protection measures were demonstrated against *viz.,* farmer's practice of sunflower cultivation. The sunflower yields under demonstration practice higher than farmer practice in all the three years. The percentage increase over farmers practice was lowest 13.3% during 2020-21 and highest 25.6 during 2018-19 with an average increase of 20.7 per cent observed in demonstration practice. The average gross returns of three years were Rs. 92477/- per hectare in demo practice which is 19.7 per cent higher than the farmers practice (Rs. 72262/- per ha.). The net returns of Rs.65393/- per hectare was recorded under demonstration practice and it was 26.9 per cent higher than the farmer practice (Rs. 51528/- per ha.). The mean benefit cost ratio of three years of demonstration practice higher (1:3.2) than farmer practice (1:2.96).

Key words: *B: C ratio, Cluster, Front Line Demonstrations, Net returns, Sunflower yields*

Introduction

Sunflower (*Helianthus annuus* L.) known as "Golden Girl of American Agriculture". The name has its origin in Greek "Helios" means "Sun" and "Anthois" means flower. It is native to southern parts of USA and Mexico. In the Asian continent, after China, India is the second largest sunflower growing country. In India, edible oilseeds are cultivated over an area of 19 million hectares with 17 million tonnes production. Peanut, rapeseed mustard, sunflower, sesame and safflower are the major edible oilseed crops. However, about 75 per cent of the total oilseed production is contributed by peanut and rapeseed mustard. The Oilseeds are the second largest agricultural commodities in India after cereals accounting for about 14 per cent of the cropped area, contributing 5 per cent to the gross national product and 10 per

cent of the value to all agricultural products (Anon., 2007). In recent years sunflower has emerged as a potential oilseed crop in both rainfed and irrigated farming. It is a major source of vegetable oil in the world. In India it has gained popularity due to the national priority of vegetable oil production. India is one of the largest producers of oilseed crop in the world. Oilseeds occupy an important position in the Indian agricultural economy. Sunflower oil is considered as premium when compared to other vegetable oils. Sunflower oil has a high nutritional value and good taste. It is composed mainly of unsaturated fatty acids like linoleic (50-65%) oleic (25-40%). In India, sunflower is being grown over an area of 2.13 million hectares with a production of 1.12 million tones and contributing considerably for edible oil sector of the nation. Karnataka is one of the major sunflower growing state and leading in the country by contributing 53 and 35 per cent of total area and production, respectively. It is the second important oilseed crop after groundnut in the state having an area of 1.43 million hectares with production of 0.42 million tones.

However, productivity (372 kg ha^{-1}) is lesser than the national average of 566 kg ha^{-1} (Anon., 2007). Thus, there is a thrust for improving the productivity of oilseeds through exploitation of commercial untapped yield reservoir through effective hybridization programmes by identifying superior and better lines and further their purity maintenance. The improved hybrids/varieties are to be exhibited through Frontline demonstrations on the farmer's field by the scientists.

The major objective of organizing cluster front line demonstrations on sunflower is to demonstrate the production potential and profitability of improved production technologies via versa farmer practice in real farming situation. While demonstrating the technologies in the farmers' fields, the scientists are required to study the factors contributing higher crop production, field constraints of production and thereby generate production data and feedback information. Frontline demonstrations are conducted in a block of two to four hectares land in order to have better impact of the demonstrated technologies on the farmers and field level extension functionaries. Front line demonstration is one of the most powerful tools of extension because farmers in general, are driven by the perception that "seeing is believing". Keeping in view the importance of FLDs, the Agriculture Extension Education centre, Hadagali conducted demonstrations on sunflower at farmers' field under rainfed and irrigated situations from 2015-2020. With this objectives of the study was formulated, to know the impact of sunflower Frontline Demonstrations (FLDs) on farmers field, to study the cost of cultivation and yield level of sunflower. Finally compared the yield of local check (farmers' field) and FLD fields.

Materials and Methods

Cluster front line demonstrations in sunflower organized by AICRP on sunflower scheme, Regional Agricultural Research Station, Nandyal with financial support from ICAR- IIOR, Hyderabad, during *rabi*, 2018-19, 2019-20 and *rabi*, 2020-21 in Jupadu banglow, Nandikotkur, Chippagiri and Owk mandals of Kurnool district of Andhra Pradesh in an extent of 50 ha and 66 farm holdings with average size of 0.5 ha at every demonstration site. The study area falls under semi arid type of climate with average annual rainfall of 690 mm. The south west monsoon (June-Sep), north east monsoon (Oct-Dec) contributes 56.6% 33.6% of annual average rainfall and remaining 9.8% received in rest of months in a year. The temperature ranged between 12.0^{o} C to 47.8^{o} C and the cropping intensity is about 120%, since the maximum area of black soils under mono-cropping of *rabi* sunflower. The front line demonstrations incharge scientist conducted preliminary survey in operational area through Participatory Rural Appraisal (PRA) techniques and identified the production constraints for *rabi* sunflower cultivation during summer season (March-June). The majority of the farmers in operational area are cultivating private hybrids which is having very low yield potential and susceptible to necrosis disease. The farmers have habit of sowing higher seed rate and allowing more plant population. farmers were not adopting spraying of boron nutrient at ray florate stage to improve pollination and seed setting. The selection of participatory farmer's for conducting cluster demonstrations including demo site selection, farmers selection, layout of demonstration, farmers participation etc. were followed (Choudhary, 1999). The soil samples were collected at 0-15 cm depth from each demonstration site by random sampling and the samples were processed and confine the sample weight to 500 g by quartering method. The soil samples were analysed for fertility status at Agricultural Research Station, Utukur with duly following

the standard procedures. The soils are slightly alkaline in reaction (pH range - 7.9- 8.9), slightly saline (0.25-0.75 d Sm^{-1}), organic carbon low to medium (0.32-0.48%), with available nitrogen, phosphorous and potassium ranged between low (60-130 kg ha^{-1}), low to medium (16-50 kg ha^{-1}) and medium to high (140-380 kg ha^{-1}) respectively. At demonstration site implemented the Best Management Practices (BMP's) *viz.,* 1. Variety with high yield potential and high oil yielder (Prabhath), 2. thinning at 10 days after sowing, 3. Boron spray at 0.2% at ray florate stage,4. Integrated Pest Management (IPM) strategies for management ofnecrosis and alternaria leaf spot disease: The above mentioned demonstration and farmer's practice of sunflower cultivation were compared for three consecutive years (2018-19, 2019-20 and 2020-21). The crop sown during first F.N of October in all the three years and came to the maturity during second F.N of January and harvested by manual picking followed by mechanical threshing. The field days at harvest were conducted with neighbouring farmers and extension officials for horizontal spread of the technology to other areas at large scale. The yield data, cost of cultivation, gross returns, net returns and B:C ratio of demonstration and farmer's practice were recorded at each location, tabulated and analyzed the data year wise. Further, from the yield obtained from demonstration and farmers method in the study area extension and technology gap were a workout for the study area using following formulae (Samui *et al.,* 2000).

Technology gap = Potential yield - demonstration yield

Extension gap = Demonstration yield - farmer's yield

$$\text{Technology index} = \frac{\text{(Potential yield-demonstration yield)}}{\text{Potential yield}} \times 100$$

$$\text{\% Yield increase} = \frac{\text{(Demonstration yield-Farmers practice yield)}}{\text{Farmers practice yield}} \times 100$$

Results and Discussion

Sunflower yield

AICRP on sunflower, Regional Agricultural Research Station, Nandyal, conducted cluster FLDs in *rabi* sunflower to demonstrate the production potential of new released varieties/technologies during 2018-19, 2019-20 and 2020-21 against farmers practice under rainfed black soil farming system. The yield and economics of both demonstration practice and farmer practice presented in Table 1 and 2. The results indicated that the average gram yield was 2275 kg ha^{-1} (1810 kg ha^{-1} to 2700 kg ha^{-1}) and 1811 kg ha^{-1} (1350 kg ha^{-1} to 1987 kg ha^{-1}) during *rabi* 2018-19, 2395 kg ha^{-1} (1862 kg ha^{-1} to 2550 kg ha^{-1}) and 1944 kg ha^{-1} (1250 kg ha^{-1} to 2132 kg ha^{-1}) during *rabi* 2019-20 and 1802 kg ha^{-1} (1175 kg ha^{-1} to 1948 kg ha^{-1}) and 1590 kg ha^{-1} (1089 kg ha^{-1} to 1650 kg ha^{-1}) in 2020-20 respectively under demonstration practice and farmers practice. The per cent increase in yield under demonstration practice is lowest (13.3 per cent) during 2020-21 and highest (25.6 per cent) during 2018-9 with an average of 20.7 per cent yield increase observed in demonstration practice over farmers practice. These results are in similarity with results reported by Madaka Madhan Mohan *et al.,* 2019 in Cluster FLDs in sunflower (Table 1).

Table 1. Yield, extension gap, technology gap and technology index in sunflower under FLDs and farmers practice in Kurnool district, Andhra Pradesh.

	2018-19		2019-20		2020-21	
	Demo practice	Farmer practice	Demo practice	Farmer practice	Demo practice	Farmer practice
Area (ha)	10	20	20			
No. of demonstrations	12	25	29			
Mean yield (kg/ha)	2275	1811	2395	1944	1802	1590
SEm	42.3	36.5	52.4	49.6	37.9	42.1
CV%	13.2	18.7	22.3	18.6	20.2	18.9
% increase over farmers practice	25.6	23.2	13.3			
Potential yield (kg/ha)	2500	2500	2500			
Extension gap (kg/ha)	689	556	910			
Technology gap(kg/ha)	225	105	698			
Technology index	**9**	**4.2**	**27.9**			

The yield data of three consecutive years clearly indicated the positive impact of cluster FLDs over farmers practice towards productivity enhancement of *rabi* sunflower under rainfed balcksoil farming situation of kurnool district and similar results also reported by Poonia and Pithia, (2011) in cluster FLDs in bengalgram. The higher yields in demonstrations over farmer's method is mainly due to effective control of necrosis and alternaria leaf spot disease by IPM practices which is main responsible for yield reduction in bengalgram, optimum plant stand and boron foliar spray at ray florate stage, contributed towards yield increase in demonstrations compared with farmer's practice. The extension gaps ranged between 556 kg ha^{-1} to 910 kg ha-1 during cluster FLDs in sunflower which emphasized the enhancement of knowledge level of the farmers on improved varieties/agricultural technology innovations to bridge the existing gap through field days, capacity buildings and exposure visits among the neiboring farmers having similar farming situation. The demonstration yield of the three years compared with potential yield of sunflower and calculated the technology gap and technology index separately. The technology gap ranged between 105 kg ha^{-1} to 698 kg ha^{-1} which further indicates that there is greater scope of productivity enhancement in subsequent years through transfer of best management practices from research station to farmers fields (Katare *et al.,* 2011). Whereas the technology index indicates the extent of feasibility of improved technology at farmer level under existing local situations. The technology index of the demonstrations ranged from lowest (4.2 per cent) during 2019-20 to highest (27.9 per cent) during 2020-21 with average technology index of 13.7 per cent. The variations might be attributed to variations optimum plant stad and less intra and row competition, incidence of necrosis and alternaria disease management strategies in the study area (Table 1).

Economics of cluster FLDs

The cost incurred during cultivation of sunflower including land preparation, procurement of critical inputs *viz.* seeds, fertilizers, pesticides *etc.* harvesting and threshing and seed selling price prevailed in that year were considered for computing the cost of cultivation, gross income, net income and benefit cost ratio for demonstration practice and farmers practice separately and presented in Table 2. From the three years data, the cost to be incurred during cultivation was higher side in demonstration practice against farmers practice in all the three years. All the three years higher gross returns and net returns recorded in demonstration practice rather than farmers practice which mainly attributed to higher yields with reduced cost of cultivation, which was realized by adoption of best management practices on cluster's approach and similar results also reported by Dubey *et al.* 2016. The average gross returns of three years is Rs. 92477 ha^{-1} in demo practice, which is 19.7 per cent higher than the farmer's practice (Rs.77262 per ha). The net returns of Rs.65393 ha-1 was recorded under demonstration practice and it was 29.6 per cent higher than the farmer's practice (Rs.51528 ha^{-1}). The mean benefit cost ratio of three years of demonstration package is higher (3.2) than farmers practice (2.97). Hence it is clearly indicated that the cultivation with adoption of best management practices and demonstrations with best management practices gave higher productivity and profitability compared with traditional farmer's practice.

Conclusion

Cluster front line demonstrations in sunflower with improved hybrid seed, maintaining optimum plant population, foliar spray of boron nutrition at ray florate stage and integrated pest and disease man-

Table 2. Economics of demonstration practice vs farmers practices of sunflower cultivation

Year	Cost of cultivation (Rs/ha)		Gross returns (Rs/ha)		Net returns (Rs/ha)		B:C ratio cost		Additional incurred in demo practice (Rs/ha)	Additional net returns (Rs/ha)
	Demo practice	Farmers practice	Demo practice	Farmers practice	Demo practice	Farmers practice	Demo practice	Farmers practice		
2018-19	26345	24100	81900	65196	55555	41096	1:3.1	1:2.7	(+) 2245	(+) 14459
2019-20	27206	26284	83825	68040	56619	41756	1:2.5	1:2.5	(+) 922	(+) 14863
2020-21	27700	26819	111707	98552	84007	71733	1:4.0	1:3.7	(+) 881	(+) 12274
Mean	27083	25734	92477	77262	65393	51528	1:3.2	1:2.96	(+) 1349	(+) 13865

agement practices were very much helpful in increased net returns to the farmers. From the three years of demonstrations, it is concluded that the mean additional net returns of Rs.13865 ha^{-1}. to the sunflower growing farmers under rainfed *vertisols* farming situation of Kurnool district. Further, these best management practices should be popularized in other areas having similar farming situation through exposure visits, capacity building programmes, print and electronic media and other innovative extension methodologies to harness sustainable production and to ensure our nation to become a surplus oilseed production country.

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