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Sunitha NH
Assistant Professor (Home Science), Agricultural Extension Education, Centre, Huvinahadagali, Karnataka, India

Hanumanthppa Shrihari
Assistant Professor (Entomology), Agricultural Extension Education, Centre, Huvinahadagali, Karnataka, India

Manjunatha Bhanuvally
Assistant Professor (Soil science & Agriculture chemistry), Agricultural Extension Education, Centre, Huvinahadagali, Karnataka, India

CM Kalibavi
Extension Leader & Agronomist, Agricultural Extension Education, Centre, Huvinahadagali, Karnataka, India

Correspondence
Sunitha NH
Assistant Professor (Home Science), Agricultural Extension Education, Centre, Huvinahadagali, Karnataka, India

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Yield gap analysis in sunflower (*Helianthus annuus* L.) through front line demonstrations in Bellary District of Karnataka

Sunitha NH, Hanumanthppa Shrihari, Manjunatha Bhanuvally and CM Kalibavi

Abstract
The constraints in the production of sunflower crop were identified with a major emphasizes against the pest and diseases in the sunflower. The critical inputs required were identified from the recommended package of practices of Karnataka and their usages were discussed in practicing farmer's trainings at the farmer's field. The average five years data revealed that an average yield of demonstrated plot was obtained 14.99q/ha over local check 13.23 q/ha and the average percentage increase in yield over local check was 12.33 per cent. The average extension gap was found to be 0.95. The hybrid RSFH –1887 and KBSH-53 performed better at front line demonstrated plot as compared to local check. Further, benefit: cost ratio was recorded to be higher under demonstrated plot against local check during the study. Further, average higher benefit- cost ratio (1.77) was recorded under demonstrated plot against check (1.53). The results clearly indicate the positive effects of FLDs over the existing practices towards enhancing the yield of the sunflower hybrids. Findings of the study clearly indicate the positive effects of FLDs over the existing practices towards enhancing the yield of the sunflower hybrids.

Keywords: Extension Gap, Frontline Demonstrations, Yield, Performance, Sunflower

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) [1].

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) [1]. 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.

Frontline Demonstration (FLD)

The main objective of Frontline demonstration is to demonstrate newly released crop production and protection technologies and its management practices in the farmers' fields under different agro-climatic regions and farming situations. 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 Method

The experimental study area, comes under Zone -3, Northern Dry Zone which lies between 14º.28'and 14.39' North latitude and 75º.40'and 77º.11'East longitude. The AEEC has varied climatic, topographic, soil and water resources and cropping systems. The present study was conducted for five years (2015-2020). In total 130 demonstrations were conducted in different villages of Bellari district of Karnataka. The villages were selected based on the participatory Rural Appraisal method and cultivation practices of the Bellari District. The blocks are namely HBHalli, Hadagali, Harapanahalli, in an area of 59 ha at 130 beneficiary fields.

Field days and group meetings were also organized at the demonstration sites to provide opportunities for other farmers to observe and witness the benefits of demonstrated technologies. The critical inputs were duly supplied to the farmers by the AEEC Hadagali. Data were collected from the FLDs farmers and analysed with the suitable statistical tools to compare the yield of farmers' fields and FLD fields. The data output were collected from both FLD plot as well as check plots and finally the extension gap (Kalare *et al*., 2011) [10] along with the benefit cost ratio were worked out (Samui *et al*., 2000).

The sunflower seed was treated with Imidachloprid 6ml/kg of seed to avoid pest and disease. The critical inputs viz., sunflower seed were distributed to the beneficiaries. Farmers were trained to follow the package of practices as per University of Agricultural Sciences, Raichur for sunflower cultivation. The farmers followed the full package of practices like seed treatment, biofertilizer & fertilizer application, irrigation and weed management, insect-pest management etc. In case of local check, the traditional practices were followed in existing varieties by the farmers. The yield parameters were recorded for both check and demonstrated variety of sunflower.

Results and Discussions

In general the soils under study was sandy loam in texture with a pH ranging between 7.1 -7.5. The sowing of the sunflower seeds should be done by August to October in Rabi season and in summer sowing done during December to January. The 5 kg seed were sown per hectare. Ridge sowing were done and the seeds were placed about 6-8 cm below the ridge top. Irrigated to ridge sown crop at 2-3 days after sowing and care was taken that, water level in the ridges well below the seed placement line. The data on average cost of cultivation, average gross return, average net return and benefit: cost ratio were collected from frontline demonstrations plots for working out the economic feasibility of sunflower hybrids. The recommended packages of practices were followed at the farmer's field. The difference between the demonstration package and existing farmers practices are given in Table 2.

The average yield of five years in demonstrated plot was 14.66 q ha against local check (13.23 q/ha). The per cent increase in yield was 12.33 per cent over local check (Table 1). The sunflower yield is increased from 1.5-2.0 t/ha due to adopting improved production technology. Thus, there is a gap of 0.8 to 1.2 t/ha on yield has recorded in between improved agronomic practices and farmers field (Yadav *et.al*., 2009). Among the varieties KBSH-52, RSFH-1887, and RSFH-130 was found superior and yield increase was by 16.33, 15.30 and 15.30 respectively.

Further, average higher benefit- cost ratio (1.77) was recorded under demonstrated plot against check (1.53). The results clearly indicated the positive effects of FLDs over the existing practices towards enhancing the yield of the sunflower hybrids. The reason for the higher yield in FLDs is due to application of recommended dosages of fertilizers and prper pest management practices against the pest and diseases. However, yield of the different hybrids were varied in different years which might be due to the variation in climatic conditions and incidence of disease/ pest attack. The technological gap i.e. the difference between potential yield and yield of demonstration plot were varied between 1.47, 1.88, 2.16, 2.04, 1.88, 6.43, 7.85 & 2.20 during the year 2015-16, 2016-17,2017-18, 2018-19 and 2019-2020 respectively. The average technology gap in all the years was 3.24. Technology gap imply researchable issues for realization of potential yield, while the extension gap imply what can be achieved by the transfer of existing technologies. The technological index revealed the feasibility of the demonstration technology. As such variation in technology index varied between 23.50 to 32.15 during the study period in certain area may be attributed to dissimilarity in the soil fertility condition, pest-diseases attack, non availability and poor quality of irrigation water and weather condition.

The extension gap showed the trend ranged from 0.52 to1.52 q/ha during the period of study (Table 2). The percentage increases in yield over local check were recorded constantly year wise during the period of study.

Table 1: Details of sunflower hybrids growing under existing farmer's practices and improved practices adopted in frontline demonstrations at farmer's field

Sl. No.	Operations	Existing farmers practice	Improved/ Recommended practices adopted in demonstration plot (FLDs)
1	Farming situation	Irrigated	Irrigated
2	Time of sowing	Second fortnight of August	Second fortnight of August
3	Seed treatment	Not done	Treatment with imidachloprid 6ml/kg of seed
4	Method of sowing	Sowing	Ridge sowing/ Dibbling
5	Fertilizers dosage	Non-adoption of recommended package of practices. Usually more emphasizes were done on the higher dosages of urea and application of Muriate of potash (MOP) is omitted due to higher cost.	Urea-50kg/acre Single Superphosphate-75kg/acre Muriate of Potash-20 kg/acre
6	Weed control	hoeing and hand weeding	First hoeing was done 2-3 weeks after the emergence followed by second hoeing three weeks thereafter and application of Stomp 30 EC (Pendimethalin) @ 1litre/acre as pre-emergence within 2-3 days after sowing
7	Plant protection Measures (Pest Incidences)	No adoption of recommended package practices and injudicious use of pesticides and spray.	Imidachloprid 17.8 EC @ 0.25ml/lit Dusting melathion @ 20 kg/ha or Quinolphos 25 EC @ 2 ml/lit for insect pest management. Mancozeb 75 WP @ 2 gm or Hexaconazole 5 EC @1 ml/lit or Difenconazole 25 EC @ 1 ml/lit.

Table 2: Performance of frontline demonstrations on sunflower (*Helianthus annus L.)* hybrids

Year	Variety	Area	No of demos	Yield (Q/acre)		% increase in yield over local check	TG	EG	TI	B:C ratio	
				Demo	Check					Demo	Local check
2015-16	KBSH-53	5	10	16.33	15.04	7.89	1.47	0.52	18.30	1.79	1.50
2016-17	KBSH-53	10	20	15.30	13.50	11.76	1.88	0.72	23.50	1.82	1.53
	KBSH-41	10	20	14.60	13.10	10.27	2.16	0.60	27.00	1.81	1.56
	KBSH-44	10	20	14.90	13.30	10.73	2.04	0.64	25.50	1.91	1.55
2017-18	RFSH-130	4	10	15.30	13.50	11.76	1.88	0.72	23.50	1.95	1.54
2018-19	RSFH-130	4	10	13.57	12.07	11.05	6.43	1.50	32.15	1.59	1.53
	RSFH-1887	09	22	13.67	12.15	11.11	7.85	1.52	31.65	1.67	1.52
2019-20	RSFH-1887	07	18	16.25	13.25	24.14	2.20	1.40	27.50	1.67	1.51
Average				14.99	13.23	12.33	3.24	0.95	26.18	1.77	1.53

N=130,
Extension Gap= Demonstration – Farmers yield
TG=Technology gap
EG=Extension Gap
TI=Technology Index

Conclusion

The findings of the study revealed that, the percent increment in yield of sunflower to the extent of 14.99% in frontline demonstrations over the farmers practice. This has created the greater awareness and motivated the other farmers to adopt the improved package of practices of sunflower. These demonstration trails also enhance the relationship and confidence between farmers and scientists.

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