Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(2): 1431-1433
Received: 08-01-2019
Accepted: 11-02-2019

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Impact of frontline demonstrations on yield of chickpea (*Cicer arietinum* L.) in Amreli district of Gujarat state

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Abstract
Front Line demonstrations (FLDs) is a unique approach to provide an direct interface between researcher and farmers as the scientists are directly involved in planning, execution and monitoring of the demonstrations. The present study was conducted to assess the impact of frontline demonstrations of chickpea crop in the Amreli district of Gujarat state. Chickpea (*Cicer arietinum* L.) is a highly nutritious grain legume crop and is widely appreciated as health food as well as high return crop. Front line demonstrations were conducted at 90 farmers' fields under 25.5 ha, to demonstrate production potential and economic benefits of improved technologies. Study revealed that improved cultivation practices comprised under FLDs viz., recommended varieties, seed rate, timely sowing and plant protection technology resulted in increase in yield in gram crop over the check plots. The improved technologies gave higher yields and recorded a mean yield of 19.72, 20.90 and 21.11 q/ha chickpea yield during 2015-16, 2016-17 and 2017-18, respectively which was 28.7, 19.8, and 21.7 percent higher compared to prevailing farmers practice.

Keywords: Frontline demonstration, chickpea, technology gap, extension gap, technology index

Introduction
Chickpea (*Cicer arietinum* L.) is the largest produced food legume in South Asia and the third largest produced food legume globally, after common bean (*Phaseolus vulgaris* L.) and field pea (*Pisum sativum* L.). Chickpea is grown in more than 50 countries (89.7% area in Asia, 4.3% in Africa, 2.6% in Oceania, 2.9% in Americas and 0.4% in Europe). In India, the area under chickpea was 8.39 million hectares with a production of 7.81million tons and productivity of 931kg/ha during rabi2016-17 (FAOSTAT, 2017) [2]. In Gujarat, area under chickpea was 0.295million hectares with a total production of 0.364million tonnes and productivity of 1235 kg/ha during 2017-18 (Anon., 2017) [1]. Chickpea also improves soil fertility by fixing atmospheric nitrogen, meeting up to 80% of its nitrogen (N) requirement from symbiotic nitrogen fixation. Chickpea returns a significant amount of residual nitrogen to the soil and adds organic matter, improving soil health and fertility. It has been estimated that chickpea has the capacity to fix 140 kg N ha-1 in a growing season. Chickpea is the most important pulse crop of rabi season cultivated mainly in semiarid and warm temperate regions of the world. It produces 126 kg protein from one hectare and is probably the highest protein yielding grain legume except, groundnut and soybean. A 100 g of chickpea seeds provide 360 calories more energy than any other legume except ground nut and lucerne. The high nutritional value makes chickpea an important food particularly in famine prone areas of the world. Overall chickpea crop is best for health and income generation but the production of chickpea is decreasing day by day because farmers unaware of new technology. For which, Krishi Vigyan Kendra organized frontline demonstrations successfully by the with an objective to demonstrate and popularize the improved agro-technology on farmers' field under varied existing farming situations and also to enhance the pulse productivity and farm gains through pulses intensification and diversification for sustaining the production systems.

Materials and Methods
Krishi Vigyan Kendra, Amreli of Gujarat state conducted frontline demonstrations on chickpea at farmers' field to assess its performance during Rabi seasons of the year 2015-16, 2016-17 and 2017-18 in different villages of Amreli district. During these three years, 25.5 hectares under chickpea were demonstrated with improved management practices using improved variety GJG-3.

In general, the soil of the area under study was medium black with low to medium fertility status. Each demonstration was of 1.0 acre area and the components of demonstration comprised of improved varieties, proper tillage, proper seed rate, line sowing using seed cum fertilizer drill, proper fertilization, seed treatment with chemical fungicide, dual inoculation of Rhizobium + PSB, soil application of Trichoderma, proper irrigation, weed management and protection measures. In the demonstration one control plot was also kept in which the farmers practices were carried out. The sowing was done during Mid November under irrigated conditions and harvested during last fortnight of March. The demonstrations on farmers' fields were regularly monitored by scientists of Krishi Vigyan Kendra, Amreli right from sowing to harvesting. The yield data were collected from both the demonstration and farmers practice using random crop cutting method and analysed. The technology gap, extension gap and technological index (Samui *et al.* 2000) [7] were calculated by using following formula (Eq. 1 to 4) as given below-

$$\text{(Eq.1) Percent increase yield} = \frac{\text{Demonstration yield - Farmers yield}}{\text{Farmers yield}} \times 100$$

(Eq.2) Technology gap = Potential yield – Demonstration yield

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$$\text{(Eq.4) Technology index} = \frac{\text{Potential yield–Demonstration yield}}{\text{Potential yield}} \times 100$$

Table 1: Differences between Technological intervention and farmers practices under FLD on chickpea

Particulars	Technological Intervention	Farmers Practice
Variety	GJG-3	Local
Sowing Method	Line Sowing (45x10 cm)	Line Sowing (45-60x10-20 cm)
Seed treatment	Vitavax powder (Carboxin 37.5% + Thiram 37.5%) @ 2g/kg seed	No use of fungicide
Seed inoculation	Rhizobium and PSB culture (10 ml/kg seed)	No use of cultures
Fertilizer dose	20:40:0 kg N:P:K ha^{-1} + Sulphur @ 20 kg/ha	Use only DAP
Weed management	Pre-emergence application of Pendimethalin (0-3 DAS) followed 2 hand weedings at 25 DAS and 55 DAS	No weeding
Irrigation	One at branching, flowering, pod development stage and grain filling stage	One irrigation
Pest Management (pod borer)	HaNPV 2 x 10 POBs/ml (5 ml/10 lit. water) and chlorantraniliprole 18.5 SC 0.004 % (2 ml/10 lit. water)	Mix different pesticide to control pest
Disease Management (Wilt)	*Trichoderma* 1% WP @ 4.0 kg/ha at the time of sowing	No use of bio agent

Table 2: Productivity, Extension gap, Technology gap and Technology Index of Chickpea as grown under FLD and existing package of practices

Year	No. of Demo.	Area	Yield (q/ha)		(%) Increase over FP	Technology Gap (q/ha)	Extension Gap (q/ha)	Technology Index (%)
			Demo.	Farmers Practice				
2015-16	20	8	19.72	15.32	28.7	6.53	4.40	24.9
2016-17	20	5	20.90	17.45	19.8	5.35	3.45	20.4
2017-18	50	12.5	21.11	17.35	21.7	5.14	3.76	19.6

Results and discussion
Yield
The data (Table 2) indicated that the front line demonstration has given a good impact over the farming community of Amreli district as they were motivated by the new agricultural technologies applied in the demonstrations. Results of 90 frontline demonstrations indicated that the cultivation practices comprised under FLD viz., use of improved variety (GJG-3), balanced application of fertilizers (N: P: K @ 20:40:0:20 kg NPKS ha^{-1}, line sowing, timely weed management and control wilt and chickpea Pod borer through fungicide and insecticide, produced on an average 19.72, 20.90 and 21.11 q/ha chickpea yield during 2015-16, 2016-17 and 2017-18, respectively which was 28.7, 19.8, and 21.7 percent higher compared to prevailing farmers practice (Table 2). The results indicated that the front line demonstrations have given a good impact over the farming community of Amreli district as they were motivated by the new agricultural technologies applied in the FLD plots (Table 1). This finding is in corroboration with the findings of Poonia and Pithia (2011) [5] and Raj *et al.* (2013) [6].

Technology gap
The technology gap in the demonstration ranged from 5.14 to 6.53 q/ha yields over potential yield (Table 2). The technology gap observed may be attributed to the dissimilarity in soil fertility, salinity and erratic rainfall and other vagaries of weather conditions in the area. Hence, variety wise location specific recommendation appears to be necessary to minimize the technology gap for yield level in different situations.

Extension gap
The extension gaps ranged from 3.45 to 4.40 q/ha during the period of demonstration emphasized the need to educate the farmers through various means for the adoption of improved agricultural production technologies to reverse this trend of wide extension gap. More and more use of latest production technologies with high yielding variety will subsequently change this alarming trend of galloping extension gap. The new technologies will eventually lead to the farmers to discontinue the old technology and to adopt new technology (Table 1). This finding is in corroboration with the findings of Hiremath and Nagaraju, (2010) [3].

Technology Index

The technology index shows the feasibility of the evolved technology at the farmer's fields and the lower the value of technology index more is the feasibility of the technology (Jeengar *et al.* 2006) [4]. The average technology index was 21.6 %, while 24.9 % maximum technology index was during 2015-16 but lowest 19.6 % was during 2017-18 (Table 2).

Conclusion

The productivity enhancement under front line demonstration over traditional method of *rabi* chickpea cultivation created greater awareness and motivated the other farmers to adopted appropriate production technology of chickpea in district. The selection of specific technology like improve variety, seed treatment, seed inoculation with bio fertilizers i.e. Rhizobium and PSB, recommended dose of Phosphorus, Pre-emergence weed management and plant protection measure were undertaken in a proper way. Frontline demonstration was effective in changing attitude of farmers towards pulse cultivation. Cultivation of demonstrated plots of *rabi* chickpea with improved technologies has increased the skill and knowledge of the farmers. Front line demonstration also helped in replacement of local varieties with improved recommended varieties. This also improved the relationship between farmers and scientist and built confidence between them.

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