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Impact of Front Line Demonstration Programme on Yield and Economics of Isabgol (Plantago ovata) in Arid Kachchh of Gujarat

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ABSTRACT

Front frontline demonstrations (FLDs) on Isabgol were organized by ICAR-CAZRI, Krishi Vigyan Kendra, Kukma, Bhuj in different villages of Anjar, Bhuj and Nakhatrana Talukas of Kachchh from 2018-19 to 2020-21. The high yielding variety Gujarat Isabgol-4 (resistant to shattering) was evaluate at farmers field under front line demonstration programme (FLDs). A total 50 demonstrations were conducted in 20 ha area at farmers field against farmers practice in arid Kachchh of Gujarat. The average grain yield under improved practice was 1061.67 kg ha^{-1} compared to the farmers practice (950 kg ha^{-1}) and increased significantly by 11.75% an average over farmers practice output. The average extension gap, technology gap and technology index were 111.67 kg ha^{-1}, 238.33 kg ha^{-1} and 18.33%, respectively. Through adoption of improved practice, farmers get additional average returns of Rs.11943.33 ha^{-1} and B: C ratio 3.04. During this period extension activities like farmers training, distribution of literature, diagnostic visits etc. were taken up, to provide instant benefit to the farmers. Frontline demonstrations programme created greater awareness, attitude and skill to adopt improved practices of Isabgol and therefore, increased their production and economics.

Introduction

Isabgol (*Plantago ovata* Forsk.) is one of the most important medicinal crop belongs to family Plantaginaceae and mainly grown for its husk (epicarp of seed) which is used for the treatment of stomach disorders, tridosa, burning sensation, habitual constipation, gastritis, chronic diarrhea, dysentery and colonalgia. It also being used in modern food industries for preparation of ice cream, candy etc. Isabgol is a short-stemmed annual herb that grows up to a height 30 to 40 cm and highly cross pollinated crop. The word isabgol was originated from the Persian words "isap" and "ghol" that mean horse ear, which is descriptive of the shape of the seed. Isabgol is also called as *Psyllium*, originated from a Greek word for a flea, referring to the size, shape, and whitish colour of the seed, which is the commercially important part of this plant.

India ranks first in isabgol production (98%) and the sole supplier of seeds and husk in the international market. India is also largest exporter of Isabgol which has huge market in the the US, China, Japan and Australia. Seeds

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and husks of Isabgol are also used widely in pharmacology as laxatives. The husk, which is about 25 to 30% of seed, has the property of absorbing and retaining water (40-90%) and hence, it works as an anti-diarrheal drug. The husk also used in calico printing, dyeing, agar-agar media preparation, gum and jelly making, as binder in tablets, as thickner and a fixative in ice-cream, confectionary and in cosmetics industries (Dhar et al., 2011). Isabgol seeds consist of 6.85% ash, 23.5% crude fibre, 8.7% protein and 50.65% carbohydrates (Pendse et al., 1976). The mucilage content in isabgol seeds cultivated in India is high (Dalal and Sriram, 1995). The mucilage of Isabgol is colloidal in nature which is composition of xylose, arabinose, galacturonic acid, rhamnose and galactose (Salyers et al., 1978). Isabgol contains a significant amount of proteins and husk yields colloidal mucilage which are valued for medicinal application and used in aryuvedic, unani and allopathic systems of medicines.

The left over material of seed after husk removal is used as animal feed, birds and poultry feed. Isabgol has been grown in a wide range of agro-climatic conditions, but it thrives well in warm temperate region and requires cool and dry weather during its crop season hence generally it is sown during winter months. The high rainfall areas are not suitable for its cultivation. It requires 20^0 C temperatures for better seed germination. It can be grown well in saline soils with poor quality water in arid Kachchh of Gujarat. The water requirement is low as compared to traditional crop thus, making it suitable for such areas. Kachchh is the main producer of Isabgol in Gujarat state and grows Isabgol in 6965 hectares and produces about 5098 M.T. with a productivity of about 731.95 kg/ha (Anonymous, 2019).

The varieties and INM influence the productivity of Isabgol and could be increased by adopting recommended scientific and sustainable management production practices (Pagariya and Kantwa, 2014 and Salimath, *et al.*, 2019). The main objective of FLDs is to demonstrate newly released crop production and protection technologies and their management in the farmers' field under different agro-climatic regions (Singh and Varshney, 2010 and Verma, et al., 2010). Frontline demonstration (FLD) is one of these programmes, which focuses on increasing productivity by providing vital inputs as well as improved packages of practices that have been tested by scientists from ICAR Institutes and State Agricultural Universities (SAUs). The yields are higher when high yielding variety seed, recommended seed rate, seed treatment, planting time, appropriate fertiliser dose, weed control, and integrated pest and disease management are used, as opposed to farmer's practices. Other key aspects of this initiative include promoting the farming of improved varieties, receiving feedback from farmers concerning barriers to adoption of recommended improved technologies for further research, and maximising the technology diffusion process among farmers (*Nagarajan et al.*, 2001).

Keeping in mind of these considerations, KVK conducted FLDs in farmers' fields to encourage the adoption of the high-yielding and non-shattering variety Gujarat Isabgol-4 as well as an improved package of practices in the arid Kachchh, with the goal of increasing productivity and increasing net profit from this crop. The current study seeks to investigate the Yield Gap, Technological Gap, Extension Gap, Technology Index, and Yield Gap between FLD plots and farmers' practices, as well as the level of technology adoption and economics of the technology.

Methodology

The current study was conducted by the ICAR-CAZRI, Krishi Vigyan Kendra, Bhuj-Kutch (Gujarat) during the rabi, 2018-19 to 2020-21 at farmer's fields. A total of 50 frontline demonstrations were held throughout 20.0 ha area in various villages of Anjar, Bhuj and Nakhatrana Talukas of the Kutch district. Table-1 lists the practices adopted for the current study comprising high yielding variety with improved package of practices, where existing farming techniques were viewed as a local check or farmers practice (FP). The soils in the study area were primarily saline and alkaline in nature with pH value 8.5 to 9.2 and EC ranging from 0.9 to 2.6 dSm^{-1}, sandy to sandy loam texture and low in organic carbon. The FLDs were used to look at the differences in potential yield and demonstration yield, as well as the extension gap and technology index. In this impact study, yield data was obtained from FLD plots along with local farming practices widely used by farmers in this region, for comparative analysis.

Results and Discussion

Seed yield performance

The study revealed from the Table-1 that demo plots produced an average seed yield of 1061.67 kg ha^{-1} in comparison to local check (950 kg ha^{-1}) over three years, where the potential yield of Isabgol (Gujarat Isabgol-4) was 1300 kg ha^{-1}. It was recorded that the additional average yield over local check was 111.67 kg ha^{-1}, with a percent increase yield over local check of 11.75 per cent. It was evident from the yield levels recorded in demonstrations that the improved package of practices can boost the yield significantly. The results clearly indicated that the higher average seed yields in demonstration plots compared to farmer's practice were achieved due to knowledge and adoption of the improved package of practices, including high yielding variety seed, sowing time, seed rate, seed treatment, sowing method, spacing, weed management, irrigation management, and need-based plant protection measures. *Jain* (2014), *Jain* (2018), *Pagaria and Kantwa* (2014) all found similar yield enhancement in Isabgol crop by implementing frontline demonstrations on improved coriander cultivation technology.

Table 1. Particulars showing the difference between farmers practice and improved demonstrated technology of Isabgol.

S. No.	Operation	Farmer's practice	Improved demonstrated technology
1.	Seed & seed rate	Local seed @ 8-10 kg/ha in broadcasting method	Gujarat Isabgol-4 (Improved variety from SDAU, Dantiwada) @ 4-5 kg/ha line sowing
2.	Seed treatment	None	Trichoderma 10g/kg seed, PSB + Azotobacter 500 g each/ha.
	Sowing time	15-30th November	1st week of November
3.	Sowing method	Broadcasting	Line sowing: 30 x 5 cm (R x P)
4.	Manure & Fertilizer application	FYM: None 50 :25: 0 (Kg. N: P: K/ha)	FYM: 5-6 t/ha 40:20:00 (Kg N: P: K/ha)
5.	Irrigation	6-7 irrigation	6-7 irrigations
6.	Weeding	Generally, one hand weeding at 30-35 DAS	Soil application of isoproturon @500 g/ha as pre-emergence followed by one hand weeding at 35 DAS.
7.	Integrated pest management	No use of insecticides	Application of Neem oil 2% as precautionary measure followed by two foliar sprays of flonicamid 50WG @ 3g/10 litre water at 15 days interval to manage the aphid population.

During the off-campus trainings and field trips, KVK scientists assisted the demonstration farmers by demonstrating methods such as seeding in rows, spraying, weeding, and harvesting. Table-1 shows the cultivation practices used in FLD plots and farmers' practice. Statistical tools such as frequency and percentage were used to collect, tabulate, and analyse the data. The extension gap, technology gap, and technology index were calculated using the *Samui et al.* (2000) equations.

Technology gap = Potential yield - Demonstration yield

Extension gap = Demonstration yield - Farmers practice yield

Additional return = Demonstration return- Farmers practice return

Technology index = [(Potential yield - Demonstration yield)/Potential yield] x 100

$$\text{Benefit cost ratio (BCR)} = \frac{\text{Gross return } (Rs\ ha^{-1})}{\text{Total cost of cultivation } (Rs\ ha^{-1})}$$

Table 2. Year wise details and yield performance of frontline demonstrations (Average of three years)

Year	No. of Demo	Area (ha)	Yield (kg ha-1)			Increased yield over local check (%)
			Potential Yield (PY)	Demo Yield (IP)*	Check Yield (FP)	
2018-19	10	4.0	1300	1075	960	11.98
2019-20	20	8.0	1300	1050	940	11.70
2020-21	20	8.0	1300	1060	950	11.58
Average			**1300**	**1061.67**	**950**	**11.75**

*IP=Improved Practice; FP= Farmers Practice

Table 3. Extension gap, technology gap and technology index

Year	Extension Gap (Kg ha-1)	Technology Gap (Kg ha-1)	Technology Index (%)
2018-19	115	225	17.31
2019-20	110	250	19.23
2020-21	110	240	18.46
Average	**111.67**	**238.33**	**18.33**

Yield gap analysis

Technology gap is of great significance than other cultivation parameters as it indicates the constraints in implementation and drawbacks in our package of practices with respect to environmental or varietal change. Prior to the study period, it was discovered that the majority of farmers did not use high yielding variety seeds and optimised packages of practices for Isabgol cultivation, resulting in an extension gap between demonstrated technology and farmers' exercise, resulting in lower yields than the district average yield. To bridge that gap, KVK demonstrated improved Isabgol cultivation technology on various farmers' fields as FLDs, which resulted in increased seed yield over the farmers practice. An extension gap of 115 and 110 kg ha^{-1} was found between FLD and farmers practice during the different time lines (Table-3). Such gap might be attributed to adoption of improved technology in demonstrations which resulted in higher seed yield than that of the farmers practice.

The findings of the present study are in line with the findings of previous workers in the coriander Bhoraniya et al. (2017), Lal et al. (2013), and Singh et al. (2011). The technology gap was also investigated in order to determine the difference between the demonstration and the potential yield (Kanwat et.al., 2017). Other factors such as variability in soil fertility, quality of irrigation water, surrounding microclimate, insect-pests and disease risk, level of crop management by farmer, and others are responsible for the changes in this gap. Throughout the study period, the technology gap ranged between 225 kg ha^{-1} to 250 kg ha^{-1} and on average 238.33 kg ha^{-1} (Table 3). As a result, location-specific enhanced technologies must be developed to overcome such gaps in Isabgol cultivation in order to increase production. The acceptability and practicality of a technology are always inversely proportional to the technology index; the higher the acceptability of the demonstrated technology, the lower the technology index value (Sagar and Chandra, 2004). According to the data collected the lowest technology at 17.31 percent in 2018-19 and at highest 19.23 percent in 2019-20. The average technology index was 18.33 percent. During the study period, the lowest technology index in 2018-19 may be due to better monitoring of the growers field as the number of FLDs are lesser. In addition to this, soil and climatic conditions are also responsible factors in that year. The technology index showed that the intervened technology was widely accepted and viable by the farmers. The findings of Mishra et al. (2009); Singh et al (2011); Dayanand et al. (2012); Raj et al. (2013); Kumbhare et al (2014; Choudhary et al. (2018), and Chauhan et al. (2020) on the impact of FLDs in different crops are in agreement with the current studies. Kanwat et.al. (2017) also revealed that he realization of that problem might be due to the fact that still the farmers have not much knowledge and awareness about the regulated markets or mandies where they can sell their produce on better price. Usually, they prefer to sell their produce directly to the middleman (bepari and hawker/ canvasor).

Economic Analysis

To assess their profit above existing technology, it is essential to comprehend the economic viability of any technique exhibited on farmers' fields. The net return varies from year to year due to changes in input cost, labour charges and sale price rate of the produce. The cost of inputs and output statistics for isabgol production under frontline demonstrations were gathered and analysed to determine gross return, net return, additional income, and the benefit cost (B:C) ratio. The outcomes of the economic analysis (Table-4) of isabgol cultivation revealed that an average gross return and net return of Rs. 99036.67 and Rs. 67816.67 ha^{-1} compared to farmers practice of Rs. 86880 and Rs. 55873.33. Furthermore, the demonstration plots produced an average additional return of Rs. 11943.33 ha^{-1} and a higher average benefit cost ratio of 3.04. The higher additional returns under demonstrations could be due to improved technology, timely operations of crop cultivation and scientific monitoring of the crop.

Table 4. Economic analysis of front-line demonstrations on Isabgol

Year	Cost of cultivation (Rs/ha)		Gross Return (Rs/ha)		Net Return (Rs/ha)		Additional Return (Rs/ha)	B:C Ratio	
	IP*	FP	IP	FP	IP	FP		IP	FP
2018-19	25160	25000	101960	85840	76800	60840	15960	3.42	3.07
2019-20	34000	33760	99750	89300	65750	55540	10210	2.93	2.65
2020-21	34500	34260	95400	85500	60900	51240	9660	2.77	2.50
Average	**31220.00**	**31006.67**	**99036.67**	**86880.00**	**67816.67**	**55873.33**	**11943.33**	**3.04**	**2.74**

*IP=Improved Practice; FP= Farmers Practice

The results of the economic study point to the shown technology's increased profitability and economic feasibility. Jain (2018) and Rathore and Mathur (2020) in isabgol, Choudhary et al. (2018) in fennel and Singh et al. (2011) in seed spices found similar results. Bhargav et al. (2015) and Dhaka et al. (2010) all reported similar findings in chickpea and maize.

Conclusions

The production enhancement and quality improvement under frontline demonstrations can be beneficial in improving growers' attitudes, skill, knowledge, and competence. This also led to improve the relationship between farmers and scientists. The beneficiary farmers always play an important role as source of information and dissemination of the high yielding variety of Isabgol for other nearby farmers. This will help in the removal of the cross sectional barriers among farming community FLDs serve a critical role in pushing farmers to adopt modern agricultural technology, resulting in increased output and income. Farmers can attain a higher additional return with a lower additional input cost by using this technology. Furthermore, it is recommended that strong ties be established with line departments and other agencies in order to organise FLDs and large-scale capacity development programmes to overcome the extension gap for better coriander productivity by transferring improved technology to the growers. Conducting the FLDs on farmers field also help to identify the constraints and potential of the crop in specific area to ensure the crop security.

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