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Improved technological intervention- A boon in enhancing fenugreek yield in Western Rajasthan

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Abstract

Fenugreek is an important crop of western arid region of Rajasthan being cultivated over 67.6 thousand hectare with productivity of 1418 kg ha^{-1} during 2017-18. To popularize the improved practices of fenugreek cultivation in western Rajasthan, 80 Front Line Demonstrations (FLDs) for fenugreek were conducted for two consecutive years *i.e.,* 2016-17 and 2017-18 during *rabi* season in Nagaur and Jodhpur districts. The cultivation package included improved variety (RMt-305), seed treatment with Carbendazim (@ 2g kg^{-1}seed) and plant protection measures (Monocrotophos-36% SL @ 500 ml ha^{-1}, Mancozeb -75%WP @1.0 kg ha^{-1}, Sulphur dust @ 20 kg ha^{-1}). These technological interventions increased the overall yield by 17.46 per cent as compared to prevailing farmer's practice *i.e.* broadcasting seeds without seed treatment and plant protection measures. Further, the extension gap, technology gap and technology index in fenugreek cultivation for the test locations was found to be 227, 472 and 23.60, respectively. The highest additional return of ₹ 7502 and maximum effective gain of ₹ 5840 with incremental benefit cost ratio of 4.5 were attained during the year 2017-18.

Key words : Fenugreek, front line demonstrations, farmer's practice, technology intervention.

Introduction

Fenugreek (*Trigonella foenum-graecum* L.) is a popular seed spice of leguminous family. Fenugreek is an annual self-pollinated herbaceous plant, commonly known as 'methi' and grown predominantly for leaves, shoots and seeds during *rabi* season in north-western India. It has high medicinal value and is an important multiuse crop as every part of it is consumed in various forms. The pods and leaves are rich source of iron, calcium, protein and vitamins. Grains are also being used as animal feed. Fenugreek seed has enormous pharmaceutical uses. The extract of fenugreek is a potential source of alternative medicine with high free radical scavenging ability that can be used for therapeutic purposes (Choudhary *et al.*, 2017). Fenugreek seeds are highly nutritive as it contains 26-29% proteins, 10% fat, crude-fibre, carbohydrates, micro-nutrients and vitamins (¯uk-Go³aszewska and Wierzbowska, 2017). Important constituents of fenugreek seeds are natural gum (23.06%), mucilages (28%), trigonellines (0.13-30%), saponines (1.7%) with calorific values of 370 calories per 100 gm seed (Boori *et al.,* 2017). Fenugreek is being cultivated over 67.6 thousand hectare area with the production of 96.0 thousand tonnes in Rajasthan state, contributing around 80% of the national production. In Rajasthan, it is mainly grown in districts of Churu, Bikaner, Sikar, Nagaur, Pratapgarh and Jodhpur. Productivity of fenugreek in Rajasthan has been increased from 1212 kg ha^{-1} to 1418 kg ha^{-1}during the period of demonstrations (Anonymous, 2019). Being a legume crop with high profitability and adaptability in the arid regions makes it an integral crop of the existing cropping system. Looking to the yield potential of improved varieties, cultural practices and plant protection measures, there is immense scope to significantly increase the productivity in the major fenugreek growing area of Rajasthan, especially in Nagaur and Jodhpur districts, where, most of the farmers cultivate fenugreek by broadcasting using local cultivar's seeds without seed treatment, improper fertilizer and plant protection measures. Most of farmers follows non judicious use of pesticides with higher doses, also leads to incur losses in grain quality and net benefits. Hence, to enhance the existing yield levels, it's necessary to popularize the complete package of fenugreek cultivation, which includes improved variety, seed treatment and plant protection measures in the region. Considering these facts, improved technological interventions of fenugreek cultivation were provided with the objectives to increase the fenugreek productivity and net returns.

Materials and methods

The 80 front line demonstrations (FLDs) conducted under Centrally Sponsored Scheme – Mission for Integrated

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Development of Horticulture (MIDH) programme of Directorate of Arecanut and Spices Development, Calicut at Agricultural Research Station, Mandor in nine villages of two districts, *viz.,* Nagaur (Khundala, Kurchi, Nagdi, Narwa and Isarnawda) and Jodhpur (Nevra road, Padasala, Chadi and Raimalwada) during *rabi* seasons of 2016-17 and 2017-18.

Randomly selected farmers were allotted these FLD's to make aware about scientific interventions being developed for yield maximization (Table 1). Critical resources like improved cultivar seed (RMt-305) with seed treatment (Carbendazim @ 2g kg^{-1} seed), recommended fertilizers (40:40:0 kg ha^{-1} N:P:K) and agrochemicals (Monocrotophos-36% SL @ 500 ml ha^{-1}, Mancozeb - 75%WP @1.0 kg ha^{-1}, Sulphur dust @ 20 kg ha^{-1}) were given in the demonstration plot. Other necessary interventions like line sowing, mechanical weeding and scheduled irrigation were also advised timely to show the impact of improved cultivation methods on crop yield. The crop was sown during first fortnight of November and harvested in the last week of March during both the years. Locally grown or available variety seeds along with cultural and management practices followed by villagers such as broadcasting of seeds without seed treatment and plant protection measures was taken as the check for comparing the result of improved management practices demonstrated under all FLD's. Observations were recorded with the help of scheduled personal interview and field performance in each FLD and marked field of local check practices. The data were statistically analysed using tools such as frequency and percentage. The potential yield for RMt 305 was estimated based on mean performance of the best treatment of various agronomical trails conducted previously. Extension gap, technology gap and technology index were calculated using formulae as suggested by Yadav *et al.* (2004).

Extension gap = FLD Yield - Check Yield

Technology gap = Potential Yield - FLD Yield

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

Other observations like additional cost, additional return, effective gain, net return and incremental benefit: cost (B:C) ratios were calculated by formulae suggested by Lal *et al.*(2014).

Additional Cost = FLD Cost–Check Cost

Additional Return = FLD Return - Check Return

Effective Gain = Additional Return - Additional Cost

Net returns = Gross Returns–Production Cost

$$\text{Incremental B : C Ratio} = \frac{\text{Additional Return}}{\text{Additional Cost}}$$

Results and discussion

The field performance of improved variety of fenugreek RMt-305 was analysed statistically for yield performance at farmer field in FLD plot and farmer's practices (Table 2). It was observed that there is an increase in the seed yield of fenugreek with introduction of improved intervention in demonstration as compared to farmer's practice. High seed yield (1549 and 1506 kg ha^{-1} respectively, in 2016-17 and 2017-18) was recorded in FLD's *i.e.,*15.77 and 19.15 per cent higher than farmer's practice. Overall, average seed yield produced in demonstration was 17.45 per cent higher as compared to farmer's practice.

An extension gap of 211-242 kg ha^{-1} was observed between farmer's practice and improved interventions followed under FLD's (Table 2). The extension gap (242

Table 1. Comparative tabulation of farmer's practices followed in the selected sites and improved intervention demonstrated under FLD's.

S. No.	Intervention	Farmer's Practices followed	Improved interventions demonstrated under FLD's
1.	Cultivar	Local Variety available (Lack of awareness for improved cultivar)	Variety RMt-305 developed by SKNAU, Jobner, Rajasthan
2.	Sowing	Prefer Broadcasting (following ancestors practice)	Line sowing using fertilizer cum seed drill
3.	Seed-treatment	Not preferred (low awareness)	Seed treatment with Carbendazim @ 2gm kg^{-1}
4.	Nutrition	No application of NPK or low application than recommended	Application of NPK@ 40:40:0 kg ha^{-1} at the time sowing
5.	Plant protection measures	Only prefer Sulphur dust @ 20 kg ha^{-1}.	Monocrotophos-36% SL @ 500 ml ha^{-1}, Mancozeb -75%WP @1.0 kg ha^{-1}, Sulphur dust @ 20 kg ha^{-1}
6.	Inter-culture	Manually done	Tractor mounted to reduce labour and increase efficiency

Table 2. Performance of fenugreek FLDs on farmer's field.

Year	Area (ha)	No. of FLDs	Potential Yield (kg ha^{-1})	Demo Yield	Farmer practice yield	Yield increase over FP	Extension gap	Technology gap	Technology index (%)
2016-17	20	40	2000	1549	1338	15.77	211	451	22.55
2017-18	20	40	2000	1506	1264	19.15	242	494	24.70
Overall average	20	40	2000	1528	1301	17.45	227	472	23.60

kg ha^{-1}) observed during second year was higher than the first year (211 kg ha^{-1}), which may be the impact of improved intervention promoted under FLD's. The results further depicted a wide technological gap during both the years. The highest technology gap (494 kgha^{-1}) was observed during 2017-18, which again supported the impact of improved variety *vis-a-vis* improved interventions. Technology index of 22.55 and 24.70 were observed during first and second year, respectively showing impact of the FLD's over year (Table 2). These findings suggest that, technology demonstration play a crucial role in increasing the yield in fenugreek. Previous studies also suggested that significant impact of FLD's was observed by demonstrating packages containing variables like improved cultivar, herbicides, fertilizer, plant protection chemicals in cumin (Mehriya and Ramesh, 2018; Lal *et al.,* 2015; Meena and Singh, 2011) and mustard (Dayanand *et al*., 2012).

Data presented in Table 3 revealed that the average cost of cultivation with improved practices in FLD was ₹ 24,470 ha^{-1}and in farmer's practice was only ₹ 21,703 ha^{-1} for two years. The additional cost of cultivation for two consecutive years was ₹ 2766 ha^{-1} higher FLDs compared to farmers practice (Table 4). Total return is a product of seed yield of fenugreek and sale price of seed/grain, hence, average gross returns over the year was ₹ 46,578 and ₹ 39,662 ha^{-1} under improved practices and farmer's practices, respectively. Additional returns of ₹ 6,330 and ₹ 7,502 ha^{-1} were recorded, respectively, for the year 2016-17 and 2017-18 with an average additional return of ₹ 6,916 ha^{-1}. Increase in the return over year is expected to happen due to increased production as a result of improved interventions being followed (Table 4). The incremental benefit: cost ratio for both the years was 1.74 and 1.60, respectively, with an average of 1.67. Impact

Table 3. Cost of cultivation (Rs.ha^{-1}) for fenugreek cultivation in Rajasthan (Average for 2016-17 and 2017-18)

S. No.	Operation/Item	Improved practices	Farmer's practices
1.	Field preparation and sowing of seeds	6,527	6,300
2.	Irrigation	3,000	3,000
3.	Plant nutrition and protection measures	3,968	1,178
4.	Harvesting, threshing, packaging and labour	10,975	9,225
Total		**24,470**	**19,703**

Note- Market price of fenugreek grains was Rs. 30 kg^{-1} during 2016-17 and Rs. 31 kg^{-1} during 2017-18.

Table 4. Benefit-cost analysis of fenugreek FLDs conducted at farmer's field.

Year	Total cost (Rsha^{-1})		Additional cost in demo (₹ha^{-1})	Sale price of seed (₹ q^{-1})	Total return (₹ ha^{-1})		Additional return in demo (₹ ha^{-1})	Effective gain	INBC ratio (IBCR)
	Demo	Farmers practice			Demo	Farmers practice			
2016-17	24280	21577	2703	3000	46470	40140	6330	3627	1.74
2017-18	24660	21830	2830	3100	46686	39184	7502	4672	1.60
Overall average	24470	21703	2766	3050	46578	39662	6916	4150	1.67

of FLD's was significant in delivering high crop yield which in-turn increased additional return. The present findings are supported by Mehriya and Ramesh (2018) and Lal *et al.* (2015) in cumin.

Conclusions

The FLD's showed that use of improved interventions significantly increase the productivity and net return. Seed yield increment of 17.46 % was observed in FLDs as compared to farmers' practices with additional return of ₹ 6,916 ha^{-1}. These FLDs clearly suggested that existing farmers practices needs to be replaced for enhancing the productivity of the region. Impact of all the interventions including cultivar, seed treatment, sowing method, inter-culturing operation, nutrient application and plant protection measures contributed significantly. Cultivar selection is the most important intervention, hence, variety RMt-305 should be promoted in the region for getting higher returns.

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