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Boosting Summer Mung (*Vigna radiata* L.) Production through Frontline Demonstration in Tarn Taran District of Punjab

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present study was conducted to boost summer mung crop area during summer season of 2017 and 2018 with 130 front line demonstration (FLD's) covering an area of 50 hectare (ha) in Tarn Taran district of Punjab to aware the farmers about improved agricultural technology in real farm situations. The results were compared between FLD and control plots. Latest crop production and protection technologies with improved summer mung varieties (SML 668 and SML 832 during 2017 and 2018, respectively) resulted in an average increase of 23% in the yield of summer mung. Technology gaps, extension gaps and technology indices were calculated to analyze the performance of these FLDs at farmers' fields. The average extension gap and technology gap recorded were 2.05 q ha^{-1} and 1.4 q ha^{-1}, respectively. Between both varieties of summer mung, lower technology index of 6.92 per cent in SML 668 in 2017 indicates the feasibility of this variety in existing farming situation in the district over SML 832. This proved that variety SML 668 performed better than SML 832. Sowing of high yielding varieties along with improved package of practices resulted in higher benefit-cost ratio (1.61) over farmers' practice (1.35) during both years of study.

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1. INTRODUCTION

Mung bean (*Vigna radiata* L.), also known as green gram, has been grown in India since ancient times. In addition to be grown as *kharif* crop, green gram is also cultivated as summer crop and is a good fit in Rice-Potato/Pea/ Mustard-Summer Mung crop rotation because of its short duration of 55-60 days. Although large area covers cereal crops but shortage of pulses, oilseed and vegetable is the main reason of low returns from the pulses and other crops [1,2]. The nutritional dimension is said to be integral to concept of food security, therefore, it is required to increase the production and productivity of pulse crops in the current scenario. The current per capita availability of pulses is 41.7 g/capita/day which are much below the recommendations of ICMR of 51 g/capita/day. Seeing the diminishing quality of soil and crop diversification and increased import of pulses, a project "Cluster Frontline Demonstrations on Pulses," under National Food Security Mission (NFSM) of Department of Agriculture, Cooperation and Farmers Welfare (DAC&FW), Government of India was started in the year 2015-16 to accomplish the target of 32 million tones of pulses by the year 2030, an average annual growth of 4.2% is required [3].

In Tarn Taran district of Punjab, large area is under rice-wheat cropping system and vegetables, hence, it is required to incorporate summer mung where vegetables such as potato and peas are grown by the farmers and after wheat harvesting to get additional income as well as to enrich the soil with leguminous crop accompanied with organic biomass and nitrogen, off course after wheat harvest there is reduction in the yield of mung due to delayed planting of the crop, however, there are benefits such as enriching soil with N after mung harvest. Summer mung is one of the conventional pulse crops among grain legumes [4]. Several biotic and abiotic constrains in the region are prevailing that restrict the full yield potential of crop to be achieved which needs to be addressed with implementation of recommended practices at farmers' field [5]. Frontline demonstration (FLD) is a unique approach in which there is a direct interface between researcher and farmers for monitoring and evaluating the technologies and getting direct feedback from the farmers' field. The main objective of FLD is to demonstrate newly released crop production and protection technologies and its management practices in the farmer field under different agro-climatic regions and farming situations [6]. Keeping this view in fact, the frontline demonstration on summer mung was conducted in the district by Krishi Vigyan Kendra (KVK), Tarn Taran at different locations at farmers' field to aware the farmers about adoption of improved production technology.

2. MATERIALS AND METHODS

The frontline demonstrations were conducted in district Tarn Taran of Punjab during the year of 2017 and 2018 to demonstrate the impact of improved production technology on summer mung according to recommended package of practices. It lies between 31° 7′ and 32° 3′ North latitude and 74° 29′ and 75° 23′ in the East longitude. The net sown area in the district is about 2.17 lakh ha, which is almost 100 % double cropped. However, in some areas of the district, farmers' takes more than two crops in a year involving summer mung in cropping system. Tube wells are the main source of irrigation. Total 130 front line demonstration (FLD's) on 50 ha area were conducted by KVK during the study period. The Package of Practices followed under the demonstrations and farmer practice is presented in Table 1. The SML 668 and SML 832 varieties of summer mung were sown with seed rate of 37.5 and 30 kg ha^{-1}, respectively during the month of March and April in rows 22.5 cm apart with plant-to-plant distance about 7 cm and 4 to 6 cm deep during study years. On heavy soils, the crop was sown on beds 67.5 cm apart with two rows of the crop. Farmers also prefer to grow the crop on the ridge having distance 30 cm apart. All N, P and K as per university recommendation were applied according to soil test basis and as per previous crop (potato/pea/wheat) taken in the field. Seed was treated with fungicide before sowing and biofertiliser (*Rhizobium* sp LSMR-1 and *Rhizobacterium* RB 3). Recommended weed control measure was adopted and irrigation was given according to the requirement of the crop. The demonstration fields were regularly visited by KVK scientists to supervise and to collect feedback from farmers. Different extension activities such as trainings, field days and group meetings were organized at the demonstration sites to show the benefits of demonstrated technology to the other farmers. Demonstrated plot yield was obtained from front line demonstrations conducted at the farmer's field in

Summer mung crop under frontline demonstration with improved agronomic practices

Summer mung crop with higher weed incidence and stunted crop growth under farmer's practice

different locations of the district. Farmers usually follow unscientific method of crop production such as local varieties, no use of bio-fertilizer inoculums, suboptimal sowing time, imbalanced fertilization and other faulty practices for raising the crop. The traditional practices were practiced by farmers in case of local checks for comparative study. The data were collected from both demo plots as well as check plots (farmers' practices) from different locations to achieve the final result of the demonstrated technology.

Gross returns were estimated based on the prevailing market prices and the yield obtained by the farmers during both the years. For obtaining input cost, the sum of expenditure on land preparation, planting method, fertilizer, fungicide, insecticide, herbicide, irrigation, labour and harvesting cost, etc. were calculated from each plot. Benefit:Cost was calculated as ratio of net return over cost of cultivation. The extension yield gap, technology yield gap and technology index were calculated [7,8]. Extension gap refers to the difference between demonstrated plot yield and farmers practice plot yield, whereas, technology gap is the difference between potential yield and demonstrated plot yield. The technology index shows the feasibility of evolved technology at the farmers' fields:

Percent yield increase = (Demonstration yield (q ha^{-1}) - farmers practice yield (q ha^{-1}) × 100) / Farmers practice yield (q ha^{-1})

Technology gap (q ha^{-1}) = Potential yield (q ha^{-1}) - Demonstration yield (q ha^{-1})

Extension gap (q ha^{-1}) = Demonstration yield (q ha^{-1}) - Farmers practice yield (q ha^{-1})

Technology Index = (Potential yield (q ha^{-1}) - Demonstration yield (q ha^{-1}) × 100) / Potential yield (q ha^{-1})

3. RESULTS AND DISCUSSION

Comparative analyses of the recommended package of practices and farmers practices have been presented in Table 1. It was reported that in the frontline demonstrations with recommended production technology such as improved variety of summer mung, seed treatment with fungicides and inoculation with biofertilizer, recommended seed rate, balanced nutrient application and insect pest management was followed by the farmers which led to the overall better performance of the crop. In comparison to demonstration plots, farmers usually delayed the sowing and used broadcast method of sowing under check plots. They did not prefer to treat the seeds with biofertilizer and used imbalanced fertilizer application and its dose. In addition to this, farmers were not willing to adopt the recommended use of herbicides and pesticides for controlling the weeds and insect pest in the planted crop.

Grain Yield: Data furnished in Table 2 and Fig. 1 indicated that yield of summer mung was found to be substantially higher in demonstration plot than that of farmers practice during 2017and 2018. During year 2017, variety of summer mung SML 668 yielded 12.1 q ha^{-1} as compared to yield of farmers' practice (9.2 q ha^{-1}). There was an additional increment of 31.5% for the seed yield under demonstration plots than local check. Similarly, during year 2018, summer mung variety SML 832 recorded 9.6 q ha^{-1} yield under demonstration in comparison to local check (8.4

q ha^{-1}). The increase in yield was to the tune of 14.3 % in demonstration plots during second year of study. It was due to use of high yielding improved varieties, improved agronomic practices, timely weed management, balanced application of fertilizer and timely control of pest and diseases at economic threshold level. Singh et al. [9] also observed that improved package of practices of summer mung varieties resulted in average increase in yield of 15.7 per cent over the check plots in Moga district of Punjab. Similar findings have also been supported by Suryavanshi et al. [10] and Bhargav et al. [11] in summer mung who reported that the yield of demonstration plots exceeds that of farmer's plots in all demonstrated plots in real farm situation. The yield enhancement is probably due to adoption of improved varieties and agronomic practices [12,13].

Technology and Extension Gap: Technology gap was found to be 0.9 q ha^{-1} and 1.9 q ha^{-1} during the study years of 2017 and 2018, respectively (Table 3). The average value of technology gap during both years was recorded as 1.4 q ha^{-1}. The benefits of improved practices are quite visible from the extension gap that was to the tune of 2.9 q ha^{-1} in the year 2017 and 1.2 q ha^{-1}in 2018. The average extension gap was 2.05 q ha^{-1} in district Tarn Taran. Technology Index shows the feasibility of improved technology at farmer's field. Technology index indicated wide variation from 6.92% in 2017 to 16.5% in year 2018 that might be due to difference in soil nutrient status, prevailing weather conditions and disease and pest attack on the crop. The average technology index was found to be 11.71% during both years of study that proclaims the possibility of new technology adoption in district. The results are concordant with the findings of Kaur and Kumar [14].

Economics of Frontline Demonstration: The economic analysis of front line demonstrations on summer mung is presented in Table 4. The data revealed that during 2017, cost of cultivation of summer mung SML 668 was Rs. 30573/- (Rs. ha^{-1}) over 38180/- (Rs. ha^{-1}) in case of local check (farmers' practice). Gross return was recorded of Rs. 50215/- (Rs. ha^{-1}) from the demonstration plots under variety SML 668 over Rs. 38180/- (Rs. ha^{-1}) under local check during 2017. The highest gross returns were during second year of study under summer mung variety SML 832. The value was 50880/- (Rs. ha^{-1}) from the demonstration plots under variety SML 832 as compared to 44520/- (Rs. ha^{-1}) of local check during 2018.

Table 1. Package of practices followed under demonstration and farmers practices in summer mung crop in Tarn Taran district of Punjab

S. No.	Particulars	Demonstration	Farmers Practice
1.	Farming situation	Irrigated	Irrigated
2.	Variety	Recommended variety of PAU (SML-668, SML 832)	Local varieties
3.	Time of sowing	20 March to 10 April	2nd fortnight of April
4.	Seed rate	37.5 kg ha^{-1} for SML-668 and 30 kg ha^{-1} for SML 832	20-30 kg ha^{-1}
5.	Method of sowing	Line sowing	Broadcasting
6.	Seed treatment	Recommended fungicide	No seed treatment
7.	Use of Bio-fertilizer	(Rhizobium sp LSMR-1 and Rhizobacterium RB 3)	No biofertilizer treatment
8.	Fertilizer dose	Urea @ 27.5 kg ha^{-1} and SSP @ 250 kg ha^{-1}	Irrational use of nitrogenous fertilizer and no application of SSP
9.	Weeding	Stomp 30 EC @ 2.5 lit /ha	Not used
10.	Plant protection measures	Need based spray of insecticides and fungicides	No application or with unrecommended insecticides/fungicides

Table 2. Grain yield of summer mung under demonstration and farmer practice conducted during 2017 and 2018

Season	Variety	No. of trials conducted	Total area (ha)	Average yield under Demonstration plots (q ha^{-1})	Average yield under Local check plots (q ha^{-1})	Per cent increase (%)
2017	SML 668	100	40	12.1	9.2	31.5
2018	SML 832	30	10	9.6	8.4	14.3

Table 3. Yield, technology gap, extension gap and technology Index of summer mung demonstrations in district Tarn Taran

Year	Variety	Yield (q ha^{-1})			Technology gap (q ha^{-1})	Extension gap (q ha^{-1})	Technology index (%)
		Potential	Demonstration	Check			
2017	SML 668	13.00	12.1	9.2	0.9	2.9	6.92
2018	SML 832	11.50	9.6	8.4	1.9	1.2	16.5
Average		-	10.85	8.8	1.4	2.05	11.71

Table 4. Economics of summer mung front line demonstrations and local check in district Tarn Taran

Year	Variety	Demonstration Plot				Local check Plots				Additional returns (Rs. ha^{-1})
		Cost of cultivation (Rs. ha^{-1})	Gross Returns (Rs. ha^{-1})	Net Returns (Rs. ha^{-1})	B:C ratio	Cost of cultivation (Rs. ha^{-1})	Gross Return (Rs. ha^{-1})	Net Returns (Rs. ha^{-1})	B:C ratio	
2017	SML 668	30573	50215	19642	1.64	29058	38180	9122	1.31	10520
2018	SML 832	32282	50880	18598	1.58	32125	44520	12395	1.39	6203
Average	-	31428	50548	19120	1.61	30592	41350	10759	1.35	8361

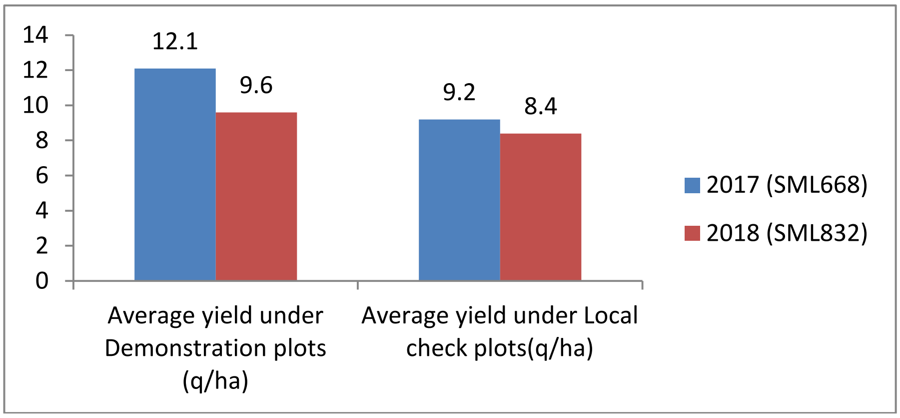

Fig. 1. Comparison in average yield of summer mung between demonstration and local check plots during 2017 and 2018 in Tarn Taran district of Punjab

It is clear from the Table 4 that with improved technology, summer mung variety SML 668 gave highest net returns of Rs. 19642/- per ha with benefit cost ratio of 1.64 as compared to local check (Rs. 9122/- per ha with benefit cost ratio of 1.31). Due to improved production and protection techniques, higher additional return was obtained (Rs. 10520/-) during year 2017 as compared to year 2018 (Rs.6203/-). The additional return is calculated as the difference between net returns of demonstration and local check plots. The cost of cultivation, gross returns as well as benefit-cost ratio (B:C ratio) were calculated during both years of study. It was on higher side in demonstration plots *i.e.* 1.64 and 1.58 as compared to 1.31 and 1.39 in local check during the year 2017 and 2018, respectively. The average additional returns during both years were reported Rs. 8361/- per ha. These results are in agreement with the finding of Matharu and Tanwar [15] and Singh et al. [16].

4. CONCLUSION

It is concluded from this study that summer mung variety SML 668 gave higher grain yield than SML 832 in district Tarn Taran of Punjab. Whereas, performance of both varieties were better under demonstration plots over local check (farmers' practice). On an average 22.9% higher grain yield of summer mung was achieved under the demonstration plots than the farmer practice leading to additional benefit of Rs. 8361/- per ha to the cultivators. It was also noted that the yield gaps between demonstration and farmers plots are due to technology and extension gaps and farmers could achieve benefits of approved techniques with decrease in extension gap with the support of extension scientists. This loophole can be filled with collaboration of farmers, extension workers, KVK team and agriculture department to reap the full benefits of new innovations and technologies. The results of the frontline demonstration clearly indicated the positive effects of improved production technology on grain yield and benefit cost ratio over traditional farmers practice. Farmers can get additional net income and summer mung crop can be a good fit as short duration variety after harvesting of vegetables such as potato, peas and also in wheat-rice crop rotation which certainly will improve the soil quality as well.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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