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# Cluster Frontline Demonstration: An Effective Technology Dissemination Approach for Enhancing Productivity and Profitability of Summer Mung (*Vigna radiata* L.)

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## ABSTRACT

**Background:** Summer mung (*Vigna radiata* L.) is a viable option for strengthening of soil health, highly remunerative to the farmers, short duration works as a good catch crop and better fits in paddy-wheat cropping pattern in the irrigated agro-ecosystems of Northern India.

**Methods:** A total number of 175 cluster front line demonstrations (CFLD) were conducted on summer mung covering 70 ha land using improved variety MH-421 during summer 2022 and 2023 by Krishi Vigyan Kendra (KVK), Fatehabad in its adopted villages at farmer's field. In present study production, productivity and economic returns of summer mung in demonstrations and farmers' practice were compared and different yield gaps were analysed.

**Result**: Adoption of improved technology resulted in increased average yield of demonstration plots by 30.13 and 15.37 percent in summer 2022 and 2023, respectively. The extension gap was 1.57 and 0.83 q/ha while technology gap was 5.22 and 5.77 q/ha in 2022 and 2023, respectively. The technology index varied from 43.50 48.53% during summer 2022 and 2023, respectively. The additional economic returns for farmers ranged from Rs. 9722 to Rs. 5453/ha as a results of these CFLD. Hence, adoption of latest and improved summer mung cultivation practices reflects the enhancement of yield and higher economic returns.

**Key words:** Cluster Front line demonstration (CFLD), Economics, Improved technology, Summer mung, Variety MH-421.

## INTRODUCTION

Pulses are the climate resilient crops as they promote sustainable agriculture, provide nutritional security, fix atmospheric nitrogen, improve soil fertility and use less water compared to other crops. Among pulses, Green gram [*Vigna radiata* (L.) Wilczek] is one of the important short duration summer pulse crop of India, which is quite popular amongst the resource-challenged farmers due to its low input requirement and quick growing habit (Patil and Tiwari, 2021, Paul *et al.,* 2023). India ranks first in both area and production of green gram in world with an area of 5.79 million production of 2.50 million tonnes in 2019-20 with the average productivity of 957 kg $ha^{-1}$ (Indiastat, 2022). In Haryana, green gram was grown in an area of 20.17 thousand hectare producing 12.00 thousand tonnes with an average productivity of 595 kg $ha^{-1}$ during 2019-20 (Indiastat, 2022).

In Northern India, climatic conditions are favourable for the production of pulses but as available irrigation facilities improved, pulses were replaced with paddy, wheat, sugarcane and subsequently central and southern India gained the area under pulses, which are usually cultivated on dry and rainfed area in these regions (Singh *et al.,* 2017). Monoculture of rice-wheat cropping system over four decades in irrigated agro-ecosystem in indo gagnatic plain and including in Haryana resulted in many agro-ecological problems namely exploitation of underground water, depleting status of soil health and herbicide resistance *etc.* Fatehabad is a prominent rice-wheat producing district of Haryana. Therefore, there is immense scope to utilize fields vacated after harvesting of wheat and before transplanting of rice by introducing summer mung. Summer mung (*Vigna radiata* L.) being a short duration crop (60-65 days) can be easily accommodated in irrigated rice-wheat production system. Diversification of cereal-based cropping systems with the inclusion of legumes crop in summer fallows is one of the long-term sustainable options of horizontal expansion for improvement of soil organic matter through biological nitrogen fixation, root exudates, leaf shedding and higher below-ground biomass (Sravan and Murthy, 2018). Choudhary *et al.* (2018) reported that conservation agriculture-based opportunistic diversification (as rice-wheat-mung bean) and strategic

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diversification (as maize-wheat-mung) increased soil organic carbon by 83 and 72%, respectively as compared to rice-wheat (4.6 g $kg^{-1}$). Singh *et al.* (2021) and Garg and Singh (2023) conducted Front line demonstrations on summer mung in clusters in different district of Haryana (India) under irrigated farming situation after harvesting of wheat and prior to paddy transplanting to show case improved production technologies on farmers' field specifically under paddy-wheat rotation. They compare farmers' practices in local checks with suggested technologies in demonstrations, a gap analysis was carried out and data on various technical and economic factors were recorded. Similarly, Kumar *et al.* (2023) organized frontline demonstrations on farmer's field to demonstrate the integrated crop management technology on black gram.

Addressing this concern of significance, Cluster Frontline Demonstration (CFLD) programme on pulses had initiated by the Ministry of Agriculture and Farmers Welfare, Govt. of India under National Food Security Mission-Pulses from 2015. The ICAR through its Krishi Vigyan Kendras (KVKs) across the country has been implementing this CFLD programme on different pulse crops to boost the production and productivity of pulses by improved technologies, *i.e.,* seed, micro-nutrients, soil amendments, weed management, integrated pest management, farm machinery, implements and micro irrigation devices along with capacity building of farmers. CFLD is an important method of speedy dissemination of the latest package of practices in totality to farmers. Hence, KVK Fatehabad is also conducting CFLD on summer mung. During demonstration, the scientists study the different factors contributing to higher crop production, field constraints, generate production data and feed-back information (Meena and Dudi, 2018). Therefore, a study was carried out with an objective to find out the impact of summer mung CFLD on its production, productivity and profitability conducted at farmers' fields in Fatehabad district of Haryana.

## MATERIALS AND METHODS

This study was carried out by Krishi Vigyan Kendra, Fatehabad, Harayan in adopted villages where CFLD on summer mung were conducted during summer 2022 and 2023, respectively under irrigated conditions. A total number of 175 front line demonstrations were organized on summer mung in area of 70 hectares using improved variety MH-421 along with full-fledged package of practices (Table 1). The farmers' fields for conduct of CFLD were selected from all the seven blocks of the district with the prior consent of willing farmers. Selected farmers were trained to follow the improved package and practices of summer mung cultivation recommended for northern Haryana by 'on campus training' before organization of CFLD. During training all the agronomic practices *viz.,* seed rate and treatment, nutrient management, weed management and plant protection measures were taken into account. Under demonstration, 0.4 ha area was used by individual farmer and adjacent 0.4 ha was considered local check (farmers' practice). Sowing of CFLD in all plots was completed before 20$^{th}$ April in both the years. Most of the farmers not inoculate seed with bio fertilizers before sowing of the crop. Thus, farmers were advised for dual inoculation of Rhizobium and PSB to obtain higher yield during both year. The line sowing method was demonstrated for cultivation. The spacing between row and plant was kept 30×10 cm for the cluster demonstration. However, application of Pendimethalin 30EC@3.3 $lha^{-1}$ (pre emergence) and one hand weeding was demonstrated to raise weed free crop. Twenty-five kilogram seed per hectare of mung with other inputs were provided to farmers for conducting each CFLD. IPM Practices like spray of copper oxychloride 75WP 1.5 $kgha^{-1}$ and dimethoate 30EC @ 1.25 L $ha^{-1}$ as were adopted for proper management of insect-pest. Two irrigation were applied in case of demonstration. Besides providing training to participating farmers, special educational events of mung gyan divas, crop harvest days, farmer field days and group meetings on CFLD plots were organized in both years.

The data on various technical and economic indicators like yield, cost and market price was recorded in both years and was analyzed in the framework of standard indices for such case studies. The yield of 12 q $ha^{-1}$ was applied as the potential yield of mung variety MH 421 for this study. Yield data were obtained from individual participating farmers and average yield was calculated. The percent yield increase over farmers' practice is the difference of average yield of CFLD plots and farmers' practice. Cost of cultivation was calculated for both practices *viz.*, CFLD and farmers' practice which include cost of inputs namely seed, fertilizers, herbicides and pesticides as well as hired labour except family members, field preparation and sowing cost, harvesting and transportation cost. Average gross and net returns were calculated on the basis of sale price of grain in local market. Benefit-Cost-Ratio was also calculated as a ratio of total return with corresponding total cost of cultivation (Kumari *et al.,* 2007). The extension gap, technology gap and technology index were worked out as per the formula given by Samui *et al*. (2000):-

a. Extension gap=

Demonstration yield - Farmers' practice yield

b. Technology gap=

Potential yield - Demonstration yield

c. Additional return=

Demonstration return - Farmers' practice return

**Table 1:** Front line demonstrations implemented.

| Season | Numbers of FLDs | Area (ha) |
|---|---|---|
| Summer 2022 | 50 | 20 |
| Summer 2023 | 125 | 50 |
| Total | 175 | 70 |

FLDs- Front line demonstrations.

d. Technology index=

$$\frac{\text{Potential yield- Demonstration yield}}{\text{potential yield}} \times 100$$

## RESULTS AND DISCUSSION

### Comparison of production technologies

The improved package and practices with technological intervention is more important for productivity and profitability of summer mung. The perusal of the data (Table 2) clearly showed that farmers generally did not use improved and recommended technologies approved by CCSHAU, Hisar. A wide gap in use of improved varieties seed, seed treatment (chemical and bio-fertilizer), time of sowing, use of chemical fertilizers and use of herbicides for weed management, which led to low production and productivity of summer mung. Generally, farmers used local seed available in local market with shopkeepers. The mung variety MH-421developed by CCSHAU, Hisar was selected for varietal replacement. MH-421 grown under CFLD is non-shattering, YMV resistant, short duration and fits in between paddy-wheat cropping pattern. The data presented in Table 2 indicated that 25-30 kg $ha^{-1}$ 0 of seed used for sowing in demonstration plots as compared to farmers practice of 15-20 $kgha^{-1}$, crop sown before 20$^{th}$ April to avoid pre-monsoon rainfall and increased humidity at harvest stage that lead to more insect pest attack, seed was treated with fungicides and bio fertilizers that was totally ignored in farmers' practice. In case of demonstration crop was sown in lines, while broadcasting method of sowing were followed in farmer's practice which makes the intercultural operations difficult and obstacle in optimum plant population achievement. However, recommended dose of fertilizer was applied in demonstrated plots while farmers were applying irrational fertilizer doses. Further, pre-emergence herbicide was sprayed followed by one hand hoeing in demonstration as compared to no weed management practices in farmers's plot. It seems that farmers were not aware of the potential of summer mung.

Similar trend were reported by Yadav *et al*. (2007) and Dhillon (2016). Kumar and Boparai (2020) also observed considerable gaps in crop cultivation *viz.,* source of purchase of quality seed, seed rate, seed treatment, method of sowing and plant protection measures.

### Analysis of grain yield gap

The results depicted that short duration yellow vein mosaic resistant variety (MH-421) was found better than the local check (SML-668) in particular farming situation *i.e.* wheat-paddy with summer mung. The yield obtained during summer 2022 and 2023 under CFLD and farmers' practices are presented in Table 3. The average yield of demonstration plots was recored 6.78 and 6.22 q $ha^{-1}$ during summer 2022 and 2023, respectively against the potential yield of variety 12.0 $qha^{-1}$. On the other hand, average yield under farmers' practice was 5.21 and 5.4 q $ha^{-1}$ in summer 2022 and 2023, respectively. Average yield under demonstration plots was recorded significantly higher than farmer's practices by 30.13 and 15.37 per cent in summer 2022 and 2023, respectively. Singh *et al.* (2023) also reported yield enhancement of 22.6% over farmers' practice while conducting CFLD. Higher yield of demonstration plot compared to farmers's practices may be due to adoption of improved technologies *ie.* optimum sowing time, proper seed treatment, line sowing, integrated weed and plant protection measures. The similar results of yield enhancement in mung crop in front line demonstration have been documented by Suryavanshi *et al.* (2020); Patel *et al.* (2022); Singh *et al.* (2023). The inoculation of seeds with Rhizobium and PSB enhanced the nodule formation along with yield than farmer's practice of non-inoculated seeds.

**Table 2:** Comparison of technology packages under front line demonstration and farmers' practice.

| Technology components | Demonstration package | Farmer's practice |
|---|---|---|
| Variety | MH-421 | SML-668 and local seed |
| Seed rate | 25-30 $kgha^{-1}$ | 15-20 kg $ha^{-1}$ |
| Sowing time | Last week of April | 1$^{st}$ week of May |
| Seed treatment | Carbendazim 50 WP @ 2 gm $kg^{-1}$ seed | No seed treatment |
| Bio fertilizer used | Rhizotica (125 ml $ha^{-1}$ seed)PSB (125 ml $ha^{-1}$ seed) | No inoculation |
| Weed management | Pendimethalin 30EC @ 3.3L $ha^{-1}$ (pre-emergence) + two hand hoeing | No application |
| Insect management | Dimethoate 30EC @ 1.25 L $ha^{-1}$ | No application |
| Disease management | Copper oxychloride 75WP 1.5 kg $ha^{-1}$ | No application |

**Table 3:** Yield, extension gap and technology gap analysis of FLDs and Farmer' practice of summer mung.

| Season | Yield (q/ha) | | | Increase over farmer's practice (%) | Extension gap (q/ha) | Technological gap (q/ha) | Technology index (%) |
|---|---|---|---|---|---|---|---|
| | Potential | FLD's | Farmer practice | | | | |
| Summer 2022 | 12 | 6.78 | 5.21 | 30.13 | 1.57 | 5.22 | 43.5 |
| Summer 2023 | 12 | 6.23 | 5.40 | 15.37 | 0.83 | 5.77 | 48.83 |

**Table 4:** Economic analysis of FLD's and farmer's practices of summer mung.

| Season | Average cost of cultivation (Rs.ha$^{-1}$) | | Average gross return (Rs.ha$^{-1}$) | | Average net return (Rs.ha$^{-1}$) | | Additional return (Rs.ha$^{-1}$) | BC ratio | |
|---|---|---|---|---|---|---|---|---|---|
| | FLD's | Farmer practice | FLD's | Farmer practice | FLD's | Farmer practice | | FLD's | Farmer practice |
| Summer 2022 | 21500 | 20000 | 49324 | 37902 | 27824 | 17902 | 9722 | 2.30 | 1.89 |
| Summer 2023 | 21000 | 20000 | 48438 | 41985 | 27438 | 21985 | 5453 | 2.30 | 1.99 |

Sale price 2022 and 2023 (Rs. 7275 and 7775 qtl$^{-1}$).

The improved packages and practices had been observed better than traditional one as farmers' practice.

**Analysis of extension gap**

The extension gap ranged from 1.57 to 0.83 qha$^{-1}$ during summer 2022 and 2023, respectively (Table3). The extension gap may be attributed to gaps in the adoption of recommended technology as revealed in the gap analysis presented in Table 3. This wide extension gap may be reduced through the collective interface between researchers, extension workers and farmers (Meena *et al.,* 2020).

**Analysis of technology gap**

Difference between demonstration and potential yield is called technology gap and it was found 5.22 and 5.77 qha$^{-1}$ in summer 2022 and 2023, respectively (Table 3). This gap may be existed due to prevailing farming situation *i.e.* variation in soil fertility, weather conditions at maturity of crop, crop management practices *etc.* Therefore, there is an urgent need to recommend location specific crop management practices to pass over the potential demonstration yield. These findings were similar to the findings of (Kalita *et al.,* 2019 and Gaur *et al.,* 2020).

**Technology index**

Technology index showed the feasibility of the evolved technology in the particular farming situations at farmer fields (Kumari *et al.,* 2007). Hence, lower the index, higher is the practicability and *vice-versa*. The data presented in Table 3 indicated that technology index varied from 43.50 to 48.53 percent during summer 2022 and 2023. It indicates that there exists a gap between the generated technology in mung cultivation at the research institution and its dissemination to the farmers. The results of the present study are similar with the findings of Lalit *et al.* (2015).

**Economic analysis**

The economic analysis of the data presented in Table 4 clearly revealed that during both the years of study, the gross return, net returns and benefit: cost ratio were higher in cluster frontline demonstrations, where recommended practices were followed compared to farmers' practice. Economics evaluation of the demonstrated package revealed that its adoption involved an additional cost of Rs 1000-1500 ha$^{-1}$ over farmer's practice. The average gross return of Rs. 49324 ha$^{-1}$ was obtained during summer 2022 and Rs. 48438 ha$^{-1}$ in summer 2023. The average net return ranges from Rs. 27824 to Rs. 27438 ha$^{-1}$ during the study period. Further, it was also found that additional return of demonstration were Rs. 9722 and Rs. 5453 ha$^{-1}$ during summer 2022 and 2023, respectively. The improved technologies of summer mung gave higher net return in both the years.

It has been found that adoption of improved technology of summer mung not only gives the opportunity of higher yield, but also provides higher benefit cost ratio *i.e.* 2.30 and 2.30 as compared to 1.89 and 1.99 in the farmer's practices in 2022 and 2023, respectively (Table 4). This may be due to higher yield obtained under recommended package of practices compared to farmer's practices. Similarly result has earlier being reported on mung by Dhakad *et al.* (2020). The summer mung provides income to farmers as an additional crop and not by replacing any crop. These results are in agreement with the findings of Meena *et al.* (2021).

## CONCLUSION

The cluster frontline demonstrations on summer mung conducted at Fatehabad district of Haryana during 2022 and 2023 at the farmers' field portrayed that adoption of improved technologies had positive effect towards increase yield of summer mung and also net returns to farmers. Such a large profit by rice-wheat-summer mung cropping system within 65 days provided additional returns to farmers in comparison to a rice-wheat system with the added benefit of green manuring. But there is wide gap in potential yield, demonstration yield and farmers' practice due to existing technological gap.

Horizontal spread of improved technologies may be achieved by the successful implementation of front line demonstration and various extensions activities like training programme, field day, exposure visit organized in CFLDs programmes in the farmers' fields.

**Conflict of interest**

All authors declare that they have no conflicts of interest.

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