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Cultivation

of summer mungbean in rice-wheat cropping system

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This article describes the impact of summer mungbean demonstrations conducted by KVK Delhi under cluster frontline demonstrations (CFLD) in rice-wheat cropping system in different villages of NCT Delhi. A gain of 22.6% in productivity of mungbean was achieved through the improved packages of practices under CFLD over the farmers' practices.

Keywords: CFLD, KVK, Mungbean, Productivity, Leguminous

RICE-WHEAT cropping system is a major cropping system of North-West region of India. This cropping system is dominant in Indian states, such as Punjab, Haryana, Bihar, Uttar Pradesh and Madhya Pradesh, and contributes 75% of the national food grain production. Even with balanced or integrated nutrient management practices, the productivity of rice and wheat in rice-wheat cropping systems has stagnated or declined recently due to the overuse of natural resources, which has resulted in soil fertility loss, multiple nutrient deficiencies, a decline in factor productivity, and a decrease in crop productivity in high productivity areas. In rice–wheat cropping cycle, inclusion of legumes crop is sustainable practice to sustain productivity, increase input use efficiency and to restore soil fertility under intensive cropping system. Legumes may be introduced in rice-wheat cropping systems with benefits beyond biological nitrogen fixation, such as nutrient recycling from deeper soil layers, reduced soil compaction, increased soil organic matter, the breakdown of weed and pest cycles, and reduced detrimental allelopathic effects. Summer mungbean crop incorporation in rice-wheat cropping systems is now more feasible because of the development of short-duration and uniformly maturing varieties in recent years. Taking into account the negative impacts of a continued rice-wheat cropping system on the productivity and health of the soil, 75 demonstrations of summer mungbean were conducted by KVK Delhi under cluster frontline demonstrations (CFLD) in rice-wheat cropping system in different villages of NCT Delhi region with the objectives to increase sustainability, diversification and food security of this cropping system. The CFLD is an important tool for transferring latest package of practices to farmers and the main objectives of this programme are to demonstrate newly released improved varieties, crop production and protection technologies and management practices on farmers' fields in real farming situations. Through this method, it is possible to promote innovative technology that has a better potential for production under a particular farming system while simultaneously collecting feedback from farmers on the technology that has been demonstrated.

In summer season, the improved packages of practices under CFLD programme enhanced productivity of mungbean by 22.6% over the farmers' practices.

Highest seed yield (11.00 q/ha) of summer mungbean crop was obtained under demonstrated fields as compared to farmer's practice. The average seed yield across the demonstrations was 9.20 q/ha, much higher than the famers' practices (7.5 q/ha). A higher net income of ₹29405.00/ha and a benefit-cost ratio of 2.2 were also recorded with improved packages of practices for summer mungbean (var. MH-421). The mungbean productivity at national level could be improved by bridging the yield gaps. This indicates the presence of

Table 1. Yield and economics of mungbean crop cultivated in summer 2019

Situation	Yield (q/ha)			% Increase in yield	Cost of cultivation (₹/ha)	Gross returns (₹/ha)	Net return (₹/ha)	B:C ratio
	Lowest	Highest	Average					
Demonstrations (MH-421)	7.00	11.00	9.20	22.60	23955.00	53360.00	29405.00	2.2
Local Check (Pusa Vishal)	7.50				22200.00	43500.00	21300.00	1.93

significant yield reservoir which can be exploited through dissemination of appropriate technology among the farmers. Therefore, there is an urgent need for effective transfer of improved mungbean production technologies to convince them to adopt such technologies so that yield gaps can be bridged and mungbean production in the country can be scaled up.

Improved packages of practices for summer mungbean

Climatic requirements: Mungbean crop is mostly cultivated during spring, summer and *kharif*, and it could tolerate high temperature up to 40^{0}C. A well distributed 60-75 cm rainfall is suitable for better growth and development of crop, but rainfall during flowering are detrimental as it affects pollination and fertilization.

Soil type: Fertile sandy loam soils with adequate internal drainage and a pH between 6.3 and 7.2 are ideal for mungbean crop cultivation. It cannot tolerate salinity and can show severe iron chlorosis symptoms and certain micronutrient deficiencies.

Improved varieties: Mungbean varieties mature in about 55 to 65 days, which is suitable for the summer season. Short-duration cultivars are cultivated in the summer to enable timely harvesting and timely sowing of the succeeding crop as well as to protect the crop from harm caused by early summer monsoon showers that could degrade seed quality.

Sowing time: Summer mungbean crop should be sown immediately after the harvest of wheat/mustard crops. The second fortnight of March month is most suitable for sowing of summer mung while sowing should be avoided after 10 April in Delhi, Haryana and Uttar Pradesh as this may lead to the flowering time coinciding with very high temperatures and hot air leading to heat stress resulting in decrease in yields. Moreover, maturity of late sown mungbean crop may coincide with early monsoon rains leading to deterioration in grain quality and reduction in seed yield.

Field preparation: Pre-sowing irrigation before tillage should be ensured for summer cultivation after the harvest of preceding crops followed by 2–3 ploughings and 1 planking are required to make the

Table 2. Recommended varieties of mungbean crop for different states of India

State	Recommended varieties
Delhi	MH-421, IPM 02-3, Pusa Vishal, HUM-1, IPM 205-7 (VIRAT), PDM-11
Haryana	MH-421, SML 668, Pusa Vishal, Samrat, IPM 02-3
Punjab	SML 668, Pusa Vishal, Samrat, IPM 02-3, MH-421
Uttar Pradesh	IPM 02-3, IPM 2-14, HUM 2, HUM 12, HUM 16, Pant M 5
Bihar	Pusa Vishal, HUM 16, HUM 2, Pant M 5, TMB 37, HUM 2, Samrat
Madhya Pradesh	Pusa Vishal, Samrat, HUM 2, HUM 12, Pusa 9531

Table 3. Important features of different varieties of mungbean crop

Variety	Important features
MH-421	Suitable for *kharif*, spring and summer seasons and resistant to Mungbean yellow mosaic virus (MYMV). Yield potential 10-12 q/ha, matures in 60-65 days in summer and non-shattering of pods.
IPM 205-7 (Virat)	Suitable for summer season and resistant to mungbean yellow mosaic disease and powdery mildew, and moderately resistant to Cercospora leaf spot. Yield potential 10-12 quintals per hectare and matures within 52-55 days.
MH-318	Suitable for *kharif*/spring/summer seasons and resistant to MYMV, yield potential 10-14 quintals per hectare.
HUM-2	Suitable for *Zaid* season (Spring/summer), seeds are green and medium bold. Yield potential 12-15 quintals per hectare and matures within 65 days.
IPM 02-3	Released for North-West plains zone, suitable for *kharif* and spring season and resistant to yellow mosaic virus. Yield potential is 12-15 quintals per hectare.
PDM-139 (Samrat)	Suitable for summer season and resistant to mungbean yellow mosaic virus. Yield potential 10-12 quintals per hectare and matures within 55-60 days.
HUM-6	Suitable for *Zaid* season (Spring/summer). Moderately resistant to MYMV. Yield potential 12-14 quintals per hectare and matures within 60-65 days.
HUM-16	Suitable for NEPZ in summer season and resistant to MYMV. Yield potential 14-15 quintals per hectare and matures within 55-60 days.
SML-134	Suitable for summer/spring season, yield 10-12 quintals per hectare and matures within 60-70 days.
SML-668	Suitable for spring/summer season and tolerant to mungbean yellow mosaic virus. Yield potential 11-12 quintals per hectare and matures within 60-65 days.
Pusa Vishal	Suitable for spring/summer season and mungbean yellow mosaic virus. It matures in 65-70 days in spring, 60-65 days in summer season and synchronous in maturity. Yield 12 q/ha.
HUM-1	Suitable for summer season and resistant to resistant to mungbean yellow mosaic virus, cercospora leaf spot and powdery mildew.Yield potential 15 quintals per hectare and matures within 65-70 days.
IPM 02-14	Suitable for spring/summer season and resistant to mungbean yellow mosaic virus and leaf crinkle virus. Yield potential 10-12 quintals per hectare.

Mungbean fields under cluster frontline demonstrations in NCT Delhi

seedbed free from clods and weeds. Summer mung can also be grown without any preparatory tillage with the help of zero-till drill after the harvest of wheat crop if there is no wheat straw in the field. In case of combine-harvested wheat crop, summer mungbean can be sown by Happy Seeder even with remnant wheat straw.

Crop geometry and seed rate: Seeds should be sown in lines 4-5 cm deep in a well-prepared seedbed in good moisture regime. The crop should be sown at row spacing of 30 cm with 10 cm plant-to-plant distance. The seed rate of 25 kg/ha is recommended in summer season to achieve an optimum plant population of mung crop.

Seed treatment with fungicide/ insecticides: Seed treatment with fungicides like carbendazim @ 2 g/kg seed of mung crop before sowing to effectively control fungi and reduces the incidence of both seed and soil borne diseases. Further seed treatment with the insecticide imidaclorprid @ 3 ml per kg seed reduces the infestation of YMV disease, termites and cutworms.

***Rhizobium* inoculation:** *Rhizobium* culture is more important for the summer mung as the number of natural microbes decrease in soil during this season due to higher temperature. The amount of *rhizobium* culture required to treat 10 kg of mung crop seeds is 250 g. About 200 g of jaggery, a half-liter of water, and 250 g of *rhizobium* culture should be mixed to treat the seeds of the mungbean crop. The treated seed should be dried in shade for 4-5 hours before sowing.

Nutrient management: Nitrogen fertilizers are usually not required at higher amount in mungbean crop as this crop fixes a good amount of nitrogen through atmospheric nitrogen. Phosphate fertilizers are usually requires in higher amount in irrigated conditions or on severely P-deficient soils. Mung crop requires 15-20 kg nitrogen, 30 kg phosphorus and 25 kg sulphur per hectare which should be applied at the time of sowing.

Irrigation management: Summer mungbean is grown under assured irrigation condition only. The most critical time for irrigation in mungbean crop is during flowering and early pod fill stages. It is essential to manage irrigation carefully so as to provide sufficient moisture in root zone at the time of pod filling. One pre-sowing irrigation for land preparation and 3–4 irrigations at the time of crop growth are required for the summer crop, depending upon the weather conditions of particular region and soil type.

Weed management: Weed management in the field of mungbean crop is essential, so that competition between mung crop and weeds could reduce especially at early growth stage (20-25 DAS) which is critical period of crop-weed competition. The summer mung field is mainly infested with weeds like *Cyperus rotundus*, *Amaranthus viridis*, *Trianthema monogyna*, *Digitaria sanguinalis* and *Ageratum conyzoides*. An efficient way to manage weeds is to apply the pre-emergence herbicide Pendimentalin @ 1 kg/ha, followed by one-hand weeding at 20–25 days after sowing. If weed infestation is seen during the crop's early growth stage, a post-emergence herbicide called Imazethapyr should be sprayed @ 60 ml per hectare 20 to 25 days after planting.

Pest management in mungbean crop

Yellow mosaic disease: This disease is caused by mung yellow mosaic virus (MYMV) and it is transmitted by the whitefly (*Bemisia tabaci*). The tender leaves show yellow mosaic spots, which increase with time leading to complete yellowing. Yellowing leads to reduced flowering and pod development. Early infection often leads to necrosis and death of plants.

***Control measures*:** Diseased plants should be rouged out to prevent further spread of the disease. In order to prevent whitefly (*Bemisia spp.)*, spray imidacloprid 17.8 SL @ 125 ml per hectare. Grow tolerant/resistant varieties of mung like MH 421, Pant Mung 3, PDM 139 (Samrat), PDM 11, MUM 2 etc.

Leaf curl: The symptoms of leaf curling are visible first in third leaf after three to four weeks of sowing. These are characterized by enlargement of leaves followed by their crinkling. Later the leaves become thicker and leathery.

***Control measures*:** Treat the seeds with imidacloprid (17.8 SL) 3 ml/kg seed. Foliar spray of insecticide (dimethoate 30 EC @ 1.7 ml/ha) at 30 days after sowing. Rogue out the infected plants and field sanitation.

Anthracnose: The fungus *Colletotrichum* spp. is the causal organism affecting aerial plant parts, however, the leaves and pods are more vulnerable. The characteristic symptoms of this disease are circular brown sunken spots with dark centers and bright red orange margins on leaves and pods. Infection just after germination causes seedling blight.

***Control measures*:** Seed treatment with carbendazim 50 WP @ 2 g/kg of seed helps in eliminating the seed borne infection. Spray of carbendazim @ 2 g/liter of water with first appearance of symptoms on the crop and repeat after 15 days (if necessary).

Whitefly: Whitefly (*Bemisia tabaci*) nymphs and adults suck sap from leaves and make the plants very weak. Whitefly is a vector of number of viral diseases especially mungbean yellow mosaic virus (MYMV). Showing downward cupping of the leaves giving a sickly look and the plant may die eventually due to severe attack of the pest. The insect secretes honey dew on which growth of sooty mould takes place resulting in blackening of leaves, drastically reducing photosynthetic rate and drying of leaves leading to total failure of the crop.

***Control measures*:** Spray of imidacloprid 17.8 SL @ 125 ml per hectare at 15 days intervals is effective in reducing the incidence of whitefly as well as MYMV disease.

Pod borer: This pest has become a limiting factor in the cultivation of summer mungbean. The incidence of pod borer found at the time of grain filling stage and the immature larvae of the borer feed on leaves, flowers, pods and seeds in pods. Pod borer defoliation is characterized by

rounded chew marks and angular holes.

Control measures: Spray of Indoxacarb 14.5 SC @ 65g a.i./ha at the appearance of larvae in the field. Spray of emmamectin benzoate 5 WG @ 0.2 g/L water effectively manages the larval population.

Seed yield

Farmers can get good yields of mungbean crop by implementing the improved packages and management practices of summer mungbean cultivation. Seed yield of summer mungbean generally ranges from 8 to 12 q/ha depending upon type of variety, soil and climatic condition and production technology.

Farmer perceptions

The farmers, who cultivated improved variety of mungbean (var. MH 421) along with improved agronomic management expressed their happiness as they got additional good yield as compared to yield level of past years in summer season in rice-wheat system. Mungbean is now being cultivated by farmers as a crop as it provides an additional source of income in the rice-wheat cropping system and also enhances soil health through crop diversification.

SUMMARY

The yield potential and production of summer mungbean can be increased to a great extent by conducting frontline demonstrations of proven technologies at farmers' fields. The increasing popularity of the summer mungbean cultivation in rice–wheat system is due to new adoptable technology like recommended improved varieties of mungbean which have the ability to mature between 55 to 60 days by which the farmers can plan for mungbean cultivation in rice-wheat system in summer season. This will substantially increase the income as well as the livelihood of the farming community.

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