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SUMMER MUNGBEAN INTENSIFICATION



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Indian Council of Agricultural Research
PAU Campus, Ludhiana-141004

SUMMER MUNGBEAN INTENSIFICATION

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Conclusion

The successful conducting of front line demonstrations on summer mungbean at farmers' fields inspired the farmers for cultivation of mungbean during summer under irrigated conditions of Punjab and Haryana. The adoption of the technology in a big way proved an eco-friendly alternative to summer rice in order to conserve the underground water resources. The dual advantage of such technology in terms of enhancing the income of farmers and improvement in soil health helped in its rapid spread. This type of intervention through KVKs will help in augmenting the pulses production and save the precious foreign exchange being spent on import of pulses.

3. In order to have a check on cultivation of summer rice, there are power cuts in Punjab and Haryana, but the sowing of summer mungbean also requires pre-sowing irrigation. Electric power supply may be provided so that the sowing of mungbean can be done as early as possible to harvest the maximum yields.
4. More number of front line demonstrations should be conducted on summer mungbean to gear up its adoption in more area.
5. Sound policy on procurement of produce at Minimum Support Price (MSP) may accelerate the pace of its adoption because price fluctuations in the market sometimes dishearten the farmers.
6. There is scope of introduction of summer mungbean in other regions like Uttarakhand, Uttar Pradesh and Bihar also where rice-wheat cropping system prevails.

Source of Funding

1. The Sir Ratan Tata Trust was established in 1919 and is involved in implementing various agricultural projects, through institutional and individual grant. The Trust operationalised the "Reviving Green Revolution" initiative in Punjab since 2002. The Trust's Chief Partners within the initiative have been many departments of RAU which are involved in the development and demonstration of various innovative concepts to the farmers. Funds have been provided to the Directorate of Extension of Education, RAU for popularization of summer mungbean and gram as alternatives to the popular rice-wheat cropping sequence through field demonstrations covering 17 districts, thereby encouraging crop diversification within the state of Punjab.
2. The Division of Education, ICAR is funding Niche Area of Excellence under plan scheme "Strengthening and Development of Agricultural Education" since 2005. The CCS HAU Hisar is implementing Research and Development on Resource Conservation Technologies as Niche Area of Excellence. Through this project, 12 KVKs have been provided funds for popularization of summer mungbean in districts of Haryana following rice-wheat cropping system.
3. The Division of Agricultural Extension, ICAR has been provided funds through DAC under ISOPOM (Integrated Scheme of Oilseeds, Pulses, Oil palm and Maize) for demonstrations on oilseed and pulses.

डॉ. एस. अय्यप्पन
DR. S. AYYAPPAN



सचिव, कृषि अनुसंधान और शिक्षा विभाग एवं
सहायक, राष्ट्रीय कृषि अनुसंधान परिषद
कृषि मंत्रालय, कृषि भवन, नई दिल्ली 110 114
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Director General
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Foreword

Pulses are important for sustainability of our agricultural production system through biological nitrogen fixation in soil and nutritional security of weaker section of society. India has long been dependent on imports to fulfil its demand and supply gap as the production of pulses has more or less been at the same level. Thus, there is a need to increase the availability of pulses either by enhancing the productivity levels or by increasing the area under pulses.

Production of pulses in cereal based cropping systems such as rice-wheat will add to the sustainability of this system by ensuring both nitrogen economy and improved soil health. Mungbean fits well in this cropping system without any major competition with the main crops and the expansion in area is possible due to availability of short duration varieties of this crop.

Keeping in view this, large number of front line demonstrations on summer mungbean have been conducted by Krishi Vigyan Kendras of Haryana and Punjab. This bulletin portrays the successful experience of summer mungbean cultivation in between rice and wheat.

I appreciate Dr. K. D. Kokate, Deputy Director General (Agricultural Extension) and his team for bringing out this valuable publication on "Summer Mungbean Intensification" which will inspire the farmers of Punjab and Haryana to take the dual advantage of enhancing their income while maintaining the soil fertility.


(S. Ayyappan)

Dated the 6th December, 2010
New Delhi

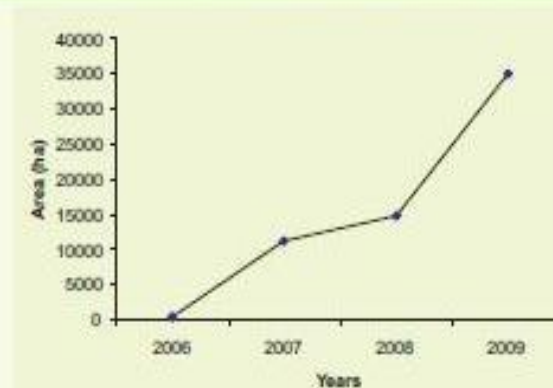


Figure 9: Area expansion under summer mungbean in Haryana



Healthy crop summer mungbean

Future Strategies

1. The farmers are dependent on single variety SML 668 till today. There is need of more concentrated research efforts on evolving more varieties which can mature in 60 or less days to fit in rice-wheat cropping sequence.
2. The seed producing agencies should take up the seed production programmes of summer mungbean to make the seed available in abundance.

- (vii) Pre-monsoon rains damage the crop
- (viii) Bluebull damage
- (ix) Non-availability of bio-fertilizers for easy access to farmers

Area expansion under summer mungbean

The on-farm research involving farmers directly encouraged them for adoption of summer mungbean in larger area in eastern Haryana where rice-wheat cropping system is practiced in about one million ha for the last three decades. The farmers have accepted the technology in a big way for its dual advantage in the form of value addition i.e. third crop of mungbean in lieu of summer rice in irrigated agro-ecosystem and its favorable effect on rice and wheat productivity. Though, there is no official Girdawari for record on area under summer mungbean, yet the data reported by respective district headquarters in Zonal Research Extension Advisory Committee meetings in Haryana has shown that the area under summer mungbean increased manifold from 400 ha (2006) to about 35000 ha (2009) as shown in Table 16. No Girdawari is conducted in Punjab also, therefore district-wise data on summer mungbean is not available. However, the area under summer mungbean is approximately 70,000-80,000 ha and confined to central districts of Punjab.

Table 16: Area under summer mungbean in Haryana

Districts	Area (ha)			
	2006	2007	2008	2009
Karnal	-	750	900	2500
Kurukshetra	100	4200	4500	11500
Kaithal	50	300	1000	3000
Ambala	50	2500	3000	3000
Faridabad	100	2400	4000	10500
Jind	100	600	800	2500
Panipat	-	400	500	1500
Yamuna Nagar	-	-	200	500
Total	400	11150	14900	35000

Acknowledgment

We are extremely grateful to Dr. S. Ayyappan, Secretary (DARE) and Director General (ICAR) for encouraging and motivating us for documentation of this bulletin.

The authors are grateful to the Programme Coordinators and Subject Matter Specialists of the Krishi Vigyan Kendras of Punjab and Haryana for providing the technical reports and information in respect of summer mungbean related to their respective centres.

We also take this opportunity to express our sincere thanks to the progressive farmers for providing the feed back and adoption of this crop at large scale in Punjab and Haryana.

Authors

- **Employment to landless laborers**

Though the variety SML 668 grown during summer season has the characteristics of synchronous maturity (80-90%), the farmers prefer the picking of pods as and when they mature. The picking of pods is generally done by hired labour and consequently employment is provided to landless labour during lean months of summer season.

- **Availability of pulses to resource poor community**

In general, the resource poor community fails to purchase the costly pulses for home consumption and their diet remains nutritionally imbalanced. Majority of the farmers get the picking of mungbean on share basis. The labour engaged in picking of pods get the share in kind and mungbean has become available to their family indirectly and ultimately the poor men's nutrition can be improved.

- **Increase in pulses production**

Bringing more area under summer mungbean would facilitate the production of pulses in the country. The dominance of rice-wheat cropping system in the Indo-Gangetic Plains does not allow any shift from cereals to pulses and intensification of the existing cropping system with summer mungbean would certainly enhance the production of pulses.

- **Saving of foreign exchange**

To meet the shortfall of pulses, import of pulses is done every year and the quantum of import is increasing with the growing demand of pulses. The import of pulses have gone from 3.13 lakh (1991) to 27.91 lakh tones (2007) and huge amount of foreign exchange is being incurred on import. In the year 2008, the foreign exchange amounting 5375 crores was incurred on import of pulses. Probably this foreign exchange can be saved by increasing production of pulses in the country itself through summer mungbean infusion in existing cropping system.

Constraints

- (i) Availability of limited short duration varieties
- (ii) Lack of proper marketing infrastructure
- (iii) Lack of processing industry and value addition
- (iv) Poor dissemination of package technology
- (v) Less availability of irrigation water in summer especially at the time of sowing in the second fortnight of March or first fortnight of April
- (vi) Poor yield of pulses

Advantages of summer mungbean

- **Efficient utilization of vacant fields during summer season**

The most of the fields vacated by wheat remain vacant and very few are occupied by either green manure crop or summer fodder after imposition of ban on summer rice in Punjab and Haryana. The fields could be efficiently utilized by growing summer mungbean during summer season.

- **Conservation of water resources**

Cultivation of rice during summer consumes more water compared to kharif rice and consequently underground water resources are receded. Summer mungbean requires only two irrigations whereas summer rice needs 25-30 irrigations (reports of farmers). Water resources can be conserved by replacing summer rice with summer mungbean in the fertile zone of North India.

- **Value addition to rice-wheat cropping system**

Farmers used to grow summer rice to get maximum output following intensive agriculture to get maximum monetary benefits without considering the importance of water resources. After imposition of ban on summer rice the farmers lost the income otherwise received from summer rice. Inclusion of summer mungbean in the existing rice-wheat cropping sequence can add value to the system which provides additional income to the farmers.

- **Improvement in soil health**

The deteriorated soil health can be restored by interjecting any of the legume crops in between the cereals but not at the cost of main crop. Short duration (60-70 days) varieties of mungbean can be successfully grown during summer. Mungbean added nitrogen to the soil through biological nitrogen fixation and the left over residues of mungbean improved the physical and biological properties of soil.

- **Increase in productivity of rice and wheat**

The beneficial effect of mungbean taken in between the rice and wheat crops has been observed in enhanced productivity of rice and wheat crops. By growing summer mungbean in the niche, the grain yield of basmati rice increased to the tune of 11 % in comparison to rice-wheat crop rotation devoid of summer mungbean. The effect of summer mungbean was noticed in wheat also grown after basmati rice and the wheat productivity increased by 4 % under summer mungbean-basmati rice-wheat cropping sequence.

Preface

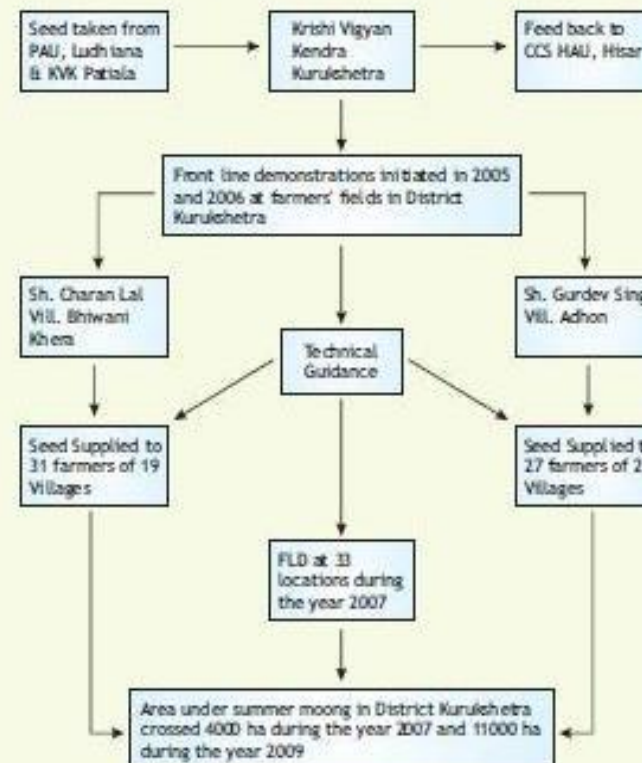
Rice-wheat cropping system is prevalent in the Indo-Gangetic Plains for the last three or more decades. The continuous dominance of rice-wheat cropping sequence in irrigated agro-ecosystem particularly in Punjab and Haryana has resulted in many types of agro-ecological problems viz. depleting status of soil health, herbicide resistance in wheat, excessive use of water resources and over exploitation of underground water. The practice of cultivation of summer rice has further worsened the situation. The burning of combine harvested residues of both rice and wheat has altered the biological properties of soil resulting in decrease of nutrient use efficiency. The all apparent consequences of this cropping system are reflected in either stagnating or decreasing productivity of rice and wheat crops. Under such circumstances, the policy planners, agricultural scientists and farmers are forced to think about the alternatives or ameliorations to correct the rice-wheat cropping system.

On the other hand, neither the scope of diversion from rice and wheat nor elastic spread of soil to accommodate pulses in order to feed the continuous growing population in our country looks remote possibility. Thus, the efforts need to be concentrated on formulating the strategies which can not only maintain the present levels of productivity but enhance the over all production of food grains. The scientific interventions helping to enhance the soil fertility and improve soil productivity while simultaneously conserving the scarce water resources need to be evolved. There is great scope of judicious utilization of fields vacated by wheat before transplanting of rice during summer. The summer mungbean can be easily infused in rice-wheat cropping sequence. The technology providing eco-friendly solutions to summer rice have been demonstrated in the form of summer mungbean at the farmers' fields in Punjab and Haryana through Krishi Vigyan Kendras. The

detailed reports on success of summer mungbean cultivation in between rice and wheat through front line demonstrations are given in this bulletin. Adoption of summer mungbean in irrigated agro-ecosystem will help in enhancing the soil health and consequently improving the profits of the farmers giving value addition to rice-wheat cropping system. By bringing more area under summer mungbean, the nutritional status of resource poor farming community may be improved through augmenting the pulses production in the country. We hope that this bulletin will certainly act as guide to the field functionaries and progressive farmers in further disseminating the technology resulting in horizontal spread of summer mungbean in Indo-Gangetic Plains.

Authors

VERTICAL AND HORIZONTAL SPREAD OF SUMMER MUNGBEAN (An Example in District Kurukshetra)



moisture and restricts the germination of weeds. The comparable grain yield was obtained under zero tillage conditions. This technique of raising summer mungbean reduced the cost of cultivation and in-situ conservation of wheat residues shall improve the soil properties. Furthermore, such practice of resource conservation may help in checking the burning of wheat residues, a resultant of combine harvesting. Though, most of the front line demonstrations were conducted under good till conditions, Krishi Vigyan Kendra Kurukshetra (Haryana) laid out the demonstrations under zero tillage conditions also.



Summer mungbean under zero tillage conditions

Availability of Quality Seed

Most of the seed of variety SML 668 remained available in Punjab during 2006 and 2007 and the farmers of Haryana fetched seed from Punjab. Thereafter, Haryana also took up seed production programme and made available to farmers of Haryana. The certified seed production of summer mungbean varieties should be stepped by the state governments of Punjab and Haryana. Availability of quality seed in abundance can further increase its acreage.

Produce Procurement

The market rates of mungbean produce varied from Rs. 1800 to 5500/- per quintal during the years 2005-2010. If the price risks are overcome, the farmers will certainly make summer mungbean a part of their cropping system irrespective of the weather aberrations. Procurement policy of produce at Minimum Support Price (MSP) like cereals may help the area expansion under summer mungbean in rice-wheat cropping system to enable the farmers for its acceleration. The MSP of Mungbean has been fixed at Rs. 3100/-

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found promising during its testing at KVK Langrova (Punjab) during the year 2009. Krishi Vigyan Kendra Sangrur (Punjab) recorded comparable results on new variety of summer mungbean PAU 911 in front line demonstrations during the year 2008 and 2009. The characteristics of SML668 in the form of short duration, non-shattering of pods, synchronous maturity and high yield have become the first choice of the farmers in Punjab and Haryana for its propagation in a big way.

Sowing Time

Though, the recommended time of sowing of summer mungbean is the month of March in Punjab and Haryana, but the March sowing is feasible only in the fields vacated by sugarcane, toria, potato, pea and other vegetable crops. In case of rice-wheat cropping system, the sowing could be possible after harvest of wheat in the first fortnight of April. Time of sowing was found as most crucial factor because the period utilized for cultivation of summer mungbean is limited (defined) i.e. between harvest of wheat and transplanting of rice. Each day counts in cultivation of summer mungbean. The sowings should be completed as early as possible just after harvesting of wheat and up to third week of April. The crop sown early matures by 3rd week of June and escapes the early monsoon.

Irrigation

The cultivation of summer mungbean is possible under irrigated conditions only. It requires two irrigations i.e. at 20-25 and 40-45 days after sowing irrespective of pre-sowing irrigation. Further irrigations not only prolong the maturity but also lead to non-synchronous maturity of pods and single harvesting is not possible.

Weed Management

Generally the weeds problem is negligible in crops grown during summer season. In summer mungbean, weeds can be easily controlled by mechanical hoeing at about 20 days after sowing. Application of Pendimethalin (30 E.C.) @ 1.0 litre a.i. per ha as pre-emergence keeps the field weed free.

Sowing Method

Though, there exists recommendation for sowing of mungbean in well prepared fields in rows of 20 cm apart at optimum soil moisture, the sowing can be done under no-tillage conditions also. The farmers' participatory research conducted by Krishi Vigyan Kendras revealed that after harvesting of wheat, pre-sowing irrigation would be applied in the un-tilled fields keeping the wheat stubbles intact. After 3-4 days, sowing can be done using seed cum fertilizer drill keeping the seed rate 25-30 kg per ha. The left over biomass (straw) of wheat acts as mulch which conserves soil

- **Publicity of success stories**

The success stories of farmers who grew summer mungbean successfully were highlighted in the Daily News Papers and the response was received through telephonic calls to Krishi Vigyan Kendras. The innovative farmers were assured for raising summer mungbean at their fields in the next season and they did the same as reflected in the area expansion under summer mungbean in Haryana and Punjab.

Productivity Realization of Cropping System

The cultivation of summer mungbean was propagated as an option of third crop to discourage summer rice. But the farmers realized the leguminous effect of summer mungbean on the rice-wheat cropping system as a whole in terms of enhanced productivity of rice and wheat also. The mungbean grown during summer improved the properties of soil reflected in yield enhancement of rice and wheat following mungbean. The farmers harvested 9-12% and 4-6% higher grain yield of rice and wheat, respectively following mungbean during summer (Table 15).

Table 15: Effect of mungbean on productivity of following rice and wheat crops.

Cropping Pattern	Grain Yield (q/ha)			
	2006-07		2007-08	
	Basmati	Wheat	Basmati	Wheat
Wheat-basmati rice	33.1	45.6	35.9	48.9
Wheat-mungbean-basmati rice	37.2	47.5	39.4	51.8

Critical Factors Identified

The successful cultivation of summer mungbean depends upon some critical agronomical practices as observed during front line demonstrations.

Varieties

Selection of varieties for cultivation of mungbean during summer season is crucial factor. Short duration varieties having comparable high yield potential which can mature in 60-70 days are ideal for summer cultivation. The variety SML 668 found best among all for cultivation during summer because this variety matures in 62-68 days with 3-5 days deviation. Research efforts are on to develop new high yielding varieties of summer mungbean by both the universities at Hisar and Ludhiana. A new variety SML 832 has already been released by PAU Ludhiana and varieties MH 318 and MH 421 are in pipeline for release by CCSHAU Hisar. These varieties have given promising results under on farm trials. Varieties MH 318 and MH 421 mature in 58-63 days and the grain yield is also comparable to SML 668. The variety SML 832 also

SUMMER MUNGBEAN INTENSIFICATION

Introduction

Pulses are the next only to cereals in terms of national food and nutritional security and have been considered the best options for diversification and intensification of agriculture for their intrinsic values. Rice-wheat cropping system constituting the domain of Indo-Gangetic Plains remains dominant in north-western part including Punjab and Haryana for the last three decades due to all apparent reasons of assured output with no risk. Secondly, the farmers' preference for rice-wheat cropping system gained impetus due to government support for increasing food grains production to feed the increasing population. Thus, there is need to increase the pulses availability either by enhancing the productivity levels or by increasing the area under pulses. The present food grains situation across the world does not allow the shift from major food grain crops particularly rice in kharif towards pulses. Therefore, the efforts need to be concentrated on multiple land use through increased cropping intensity to harvest maximum per unit land area under cultivation. Keeping in view the above facts, front line demonstrations were conducted by KVKs at farmers' fields to augment the pulses production and to restore the degrading soil health to sustain the productivity of system while conserving the natural resources.

Scenario of pulses in India

India is the major producer and consumer of pulses in the world accounting for about 25 per cent of global production, 27 per cent area, and 34 per cent of food use. The latest estimates indicate that the present production of pulses is 15.1 million tonnes coming from an area of 23.88 million ha in the country. About 85-90 % of the pulses are grown under rain fed conditions and only 10-15 % area under pulses is irrigated. Pulses are mainly grown on marginal and sub-marginal land with low input usage thus, exposing pulses production to weather related yield risks. The average growth rate of pulses was 0.96% during 1998-2008 which is below the required growth rate to meet the domestic requirements. Pulses have shown relatively lower yield gains compared with other crops under better management conditions. This is the main cause of major geographical shift in pulses cultivation from better-endowed region of North India to fragile environment of central and south India. The poor comparative economics of pulses on one hand and rice-wheat cropping system

on the other hand is attracting the farmers to follow cereals based cropping sequences in North India.

The per capita availability of pulses in the country is more or less showing the declining trend since independence. According to World Health Organization Standards, there should be 80 gm pulses per capita per day in the normal human diet but unfortunately, the per capita availability of pulses in our country has come down from 64 gm (1951) to 32 gm (2009). Per capita consumption of pulses which has fallen by over 53 % from 27.3 kg a year in 1958-59 to 12.7 kg a year currently and is anticipated to fall further to 10 kg by 2010 due to decline in their production and continuously rising prices. Thus, there is wide gap in requirement and availability of pulses in the country. At present, there is shortfall of pulses in the country to the tune of 2.5 to 3.0 million tones. India is the top importer of pulses with 19 % share of the world imports and 27.91 lakh tones of pulses were imported in the year 2007. In order to bridge this gap, it necessitates attaining the growth rate of over 2% in pulses production. To make up the shortfall in supply of pulses besides further demand from burgeoning population and feed industry, at least 20 and 24 million tones of pulses are required by 2012 and 2020, respectively. Moreover, the demand of pulses is projected as 19.2 million tones by the end of XI Plan. In order to meet the demand of pulses, the import of pulses is tremendously increasing every year and the magnitude of pulses import has increased from 792 thousand tons worth Rs. 473 crores (1990-91) to 1608 thousand tones costing Rs. 2347 crores (2005-2006). Recently, India has contracted for 3.39 lakh tones of pulses during the current financial year (2010-11) according to a latest update from the ministry of consumer affairs.

Importance of Pulses

Pulses are edible grain legumes, commonly used as split seeds and sometimes the whole grains. In India, commonly used pulses are green gram, bengal gram, lentil, arhar and kidney beans. Pulses are called wonder food as they are low in fat and absorb the flavour of spices and herbs, making them fun and tasty to eat. People have been eating



Whole and split grains

pulses for thousands of years and these foods are the main source of protein in many cultures all over the world. Beans and legumes have all the nutrients that are now recognized as important in preventing heart disease, cancer and obesity. They are



Vice-Chancellor, CCSHAU Hisar along with foreign delegates at the Field Day in village Adhon (Kurukshetra)

cultivation at their farms. This approach proved successful for horizontal expansion of summer mungbean in rice-wheat system. The seed of summer mungbean became available to more farmers during the years 2007 onwards through farmers' to farmers approach.

• Publication of Bulletin in Hindi

Krishi Vigyan Kendra Kurukshetra and Directorate of Extension Education, CCS Haryana Agricultural University Hisar published a bulletin namely "Geinhu-Dhan Phasal Chakra Mein Grishmakalin Moong". This bulletin was circulated to all the deputy directors of agriculture stationed at district head quarters in Haryana for spread of technology particularly in the domain of rice-wheat cropping system.



Release of Bulletin on Summer Mungbean by Hon'ble Chief Minister of Haryana

Table 14: Details of field days on summer mungbean organized in Haryana.

KVK	2006		2007		2008		2009	
	No. of Field Days	Participants	No. of Field Days	Participants	No. of Field Days	Participants	No. of Field Days	Participants
Kurukshetra	1	40	2	1000	1	23	2	120
Panipat	1	18	2	51	2	43	3	94
Ambala	1	35	1	45	1	37	1	35
Kaithal	-	-	1	30	1	20	1	95
Jind	1	18	1	45	2	42	1	35
Total	4	111	7	1171	7	162	8	379

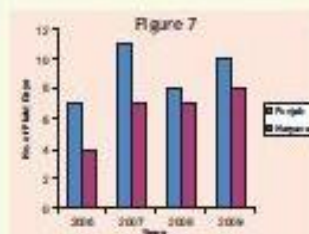


Figure 7a 8 : Details of field days organized on summer mungbean in Punjab and Haryana.



Field Day on summer mungbean at village Bhiwani Khara (Kurukshetra) in Haryana

high in complex carbohydrates, proteins, fibre and extremely low in fat. Pulses are one of the sources of protein in the diet, other than meat and dairy products. For vegetarians, pulses are a vital part of life and for non-vegetarians pulses offer an alternative source of protein without fat with lot of fibre. The old saying "Dai-Roti" is the combination of pulses and cereals providing balanced food in terms of nutrition.

Composition of pulses

Pulses contain protein, carbohydrates, fat, calcium, phosphorus, iron, and are source of energy. Pulses supply the same amount of calories as cereals i.e. 350 kcal per 100 gm of dry weight. The protein content of pulses is 20-25 %, about twice as much as cereals, making them the most economical source of protein. The fat content of pulses is negligible being 1-2 gm per 100 gm. Pulses provide about 60 gm of carbohydrates per 100 gm. Whole pulses are good source of B-complex vitamins. The iron content of pulses is high i.e. 8-10 mg per 100 gm. The calcium content is between 100-200 mg per 100 gm. The pulses are good source of zinc and copper. According to Dr Sunita Bhatti, a dietician at PGI Chandigarh, in her article in "The Tribune", stated that fermentation of pulses to produce idli, dosa, dhokla etc. enhances its contents of vitamins of the B group and decreases the level of phytate, which decreases calcium, iron, and zinc absorption and trypsin inhibitor, which decreases the digestibility of proteins. Some whole pulses are also a good source of magnesium which helps to lower blood pressure.

Mungbean

Mungbean (*Vigna radiata* L.) or green gram which is commonly known as moong is an important pulse crop grown in our country, and accounts 11 % to the total production of pulses. Mungbean is generally short duration crop compared to other pulses and is easily accommodated in most of the crop rotations which provide a small niche between two major crops during summer or kharif. Mungbean

is delicious pulse and is considered as first choice among pulses particularly in northern parts of the country. Green gram is generally recommended by doctors for growing children, old persons and patients due to its easy digestibility. Eating mungbean sprouts is indeed a very important part of healthy eating. Half a cup of



Sprouted mungbeans

Table 1 : Nutritional composition of mungbean.

Nutrients	Contents per 100 gram
Carbohydrates	63g
Dietary fibre	16g
Sugars	7g
Protein	24g
Fat	1g
Saturated fatty acids	0
Cholesterol	0
Vitamin C	4.8mg
Calcium	132 mg
Iron	6.7 mg
Energy	347 kcal

Source: http://www.growmorepulses.com/about/mung_bean.htm

almost any sprouted seed provides vitamin C equivalent to six glasses of orange juice. Therefore, a plateful of sprouted moong chat and salads is a tasty and healthy way of getting daily dose of vitamins. Mungbean is also a good source of protein, thiamin, iron, magnesium, phosphorus, potassium, copper, folate and manganese. The nutritional composition of mungbean is given in Table 1.

Importance of pulses in agriculture

Besides the importance of pulses in food, these are equally important in agriculture stream from soil health point of view. Pulses are leguminous in nature and add atmospheric nitrogen to the soil. Pulses act as natural source of nitrogen through the process of biological nitrogen fixation. Most of the pulse crops fix approximately 50-70 kg nitrogen per ha. The root nodules of pulses are rich source of nitrogen and the root residues left in the field enhances the fertility of the soil. Rice-wheat cropping system especially in Indo-Gangetic Plains became dominant and soil health declined to support the cropping system to harvest the potentials. Intensive agriculture in irrigated agro-ecosystem particularly in Punjab and Haryana has declined the fertility and productivity of soil. A document of Ministry of Agriculture, Govt. of India reveals that soil organic carbon and nitrogen was lower in as much as 62% and medium in 37% of soil samples tested from the 37 districts of Punjab and Haryana in the year 2006-2007. The latest reports from Haryana indicated that 91% and 82% soil samples were found low in organic carbon and phosphorus, respectively. Inclusion of pulses in the cereals based cropping system is of utmost importance to revive the soil health in terms of chemical, physical and biological properties.

• Publication of popular articles

Popular articles on cultivation of summer mungbean were got published in Haryana Kheti and Kheti Dunia for readers (mostly progressive farmers and extension functionaries) of these magazines.

• Field days

The concept of "seeing is believing" is most effective in getting adoption of any technology. Field days at farmer's fields were organized to show the worth of demonstrated technology. A total of 62 field days (36 in Punjab and 26 in Haryana) were organized in different districts during different years; wherein 4749 and 1823 farmers in Punjab and Haryana, respectively saw the crop of summer mungbean grown under front line demonstrations at farmers' fields.

Table 13: Details of field days on summer mungbean organized in Punjab.

KVK	2006		2007		2008		2009	
	No. of Field Days	Participants	No. of Field Days	Participants	No. of Field Days	Participants	No. of Field Days	Participants
Amritsar	1	33	2	60	1	120	1	85
Kapurthala	-	-	-	-	1	56	-	-
Patiala	1	120	-	-	1	148	1	28
Moga	-	-	4	320	1	70	3	255
Jalandhar	-	-	-	-	1	200	-	-
Fridkot	-	-	-	-	1	54	1	44
Ferozepur	1	42	-	-	-	-	1	55
Samrala	-	-	3	346	1	94	3	169
Sangrur	4	1500	2	600	1	40	-	-
Bhatinda	-	-	-	-	-	-	1	113
Total	7	1692	11	1526	8	782	10	749

• Farmers' to farmers approach

In the years 2005 and 2006, the produce of summer mungbean obtained from front line demonstration plots was kept by the farmers and this produce was made available to other farmers of the same village or vicinity for sowing purpose in the next season. The farmers supplied the seed in the form of grains to their relatives for

- **Display of banners**

For spread and adoption of summer mungbean in more area, banners showing photographs of mungbean crop were displayed at farmers' public places like grain markets, rural petrol pumps and roadsides. The telephone number of Krishi Vigyan Kendras were also displayed on the banners resulted in a large number of telephonic calls to KVKs regarding the cultivation of mungbean in summer season.

- **Distribution of pamphlets**

Many Krishi Vigyan Kendras got printed the pamphlets on success of summer mungbean and ill effects of summer rice for distribution among farmers. For creating awareness among farmers pamphlets were also placed at centers like IFPCO, KRIBHCO, Mini Banks (Cooperative Societies), Kisan Clubs and Department of Agriculture.

- **Personnel contact programmes**

The personnel contact programmes were made to adopt summer mungbean and the farmers were convinced about the importance of pulses in agriculture and warned about the depleting water resources. All the farmers visiting Krishi Vigyan Kendras for seeking advice even on other aspects were told about importance of summer mungbean cultivation.

- **Organization of Moong Gyan Diwas**

In months of March and April, special "Moong Gyan Diwas" were organized at villages addressing the farmers to include summer mungbean in their cropping sequence. All the technologies relating to cultivation of summer mungbean were highlighted during these programmes.

- **In-service training**

Trainings to the extension workers (Agriculture Development Officers) of state department of agriculture were imparted for spread of message at large scale.

- **Broadcast of technology capsule**

A technical capsule was prepared by Krishi Vigyan Kendra for daily broadcast at All India Radio Kurukshetra. This capsule was broadcast in the months of March and April so that the message may be sent to all listeners of Krishi Programme through Akashwani (Prashar Bharti).

- **Broadcast of phone-in-programme**

A special broadcast of phone-in-programme was made by All India Radio Kurukshetra. During this broadcast all queries concerning summer mungbean cultivation were addressed by the KVK specialists.

Rice-wheat-rice: An Ecological Curse

Due to confirmed market procurement of produce and convincing economics, the farmers are still inclined to follow the rice-wheat cropping system with no eye on long term consequences on soil and water environment, the baseline for crop production. The situation worsened further when the farmers started taking one more crop of rice during summer before the main crop of kharif rice. Haryana used to be the typical example, where at least on 15% of the one million hectare rice-wheat area, farmers prefer embracing rice-wheat-rice rotation. Under such circumstances, the double crop of rice exhausted underground water resources to an extent that the water table in the Kurukshetra district which was at a depth of 7 meters in 1984 reached at 30.25 meters in 2009. The picture of water under the soil in Punjab also is grim showing over-exploitation of underground water in 103 of the 137 blocks. Keeping in view the concerns over depleting water table, it was felt that unless the farmers of state diversify to other crops, the nation's food security would be threatened in the next decade as over 75 % of the state fields would become rain-fed. According to recent reports, the continued sowing of paddy is resulting in the dropping of water table consistently in Punjab (The Tribune, 05.02.2010). Similar fall in water table happened in eastern Haryana also. All tube wells in Punjab and Haryana dominating rice-wheat cropping sequence have been converted from shallow to deep submersible wells up to a depth of 300-350 feet. Installations of deep submersible wells are beyond the reach of small and marginal farmers. Therefore, rice-wheat-rice system became an ecological curse as the availability of water is expected to decline by almost 40 to 60% in the next three decades.

Furthermore, during the last few years the production as well as productivity of rice-wheat cropping system has become more or less stagnant. This high input farming dependent on chemical fertilizers and indiscriminate use of pesticides has adversely influenced the physico-chemical and biological properties of soil besides the over exploitation of water resources. The scientists analyzed the consequences of this high intensity cereals dominated cropping system, and alarmed by this, the departments of agriculture of both the states issued fervent appeal and launched virulent campaign against summer rice cultivation. The government of Punjab and Haryana have imposed ban on transplanting of rice before second fortnight of June. Such cautions minimized the area under summer rice but the farmers remained dissatisfied due to prospect of losing income, which they were otherwise getting from a third crop.

Eco-friendly Superior Alternative

The ill effects of rice-wheat - rice cropping system on over-exploitation of water

resources and deteriorating soil health cautioned the policy planners, scientists and farmers. The farmers were made aware and massive campaigns were launched to stop cultivation of summer rice and in lieu of summer rice the emphasis was given on green manuring with *Sesbania aculeata* to improve the soil health and to save scarce water resources. The impact of green manuring with *Sesbania aculeata* was not convincing in direct monetary outcomes and the only option left was to have value addition to the existing rice-wheat cropping system to make it more remunerative and sustainable. This type of intervention in the form of summer mungbean as an alternative to summer rice was suggested to farmers but the recommended varieties viz. K 851 and SML32 could not lure the farmers for low productivity. The variety of mungbean SML 668 released by Punjab Agricultural University Ludhiana and has its origin to Asian Vegetable Research and Development Centre Taiwan in the year 2002 and fits in the rice-wheat cropping sequence. The Zonal Project Directorate Zone-I through its Krishi Vigyan Kendras led the farmers' field research through front line demonstrations to provide an eco-friendly superior or farmer's satisfying alternative to utilize the vacant fields during summer with mungbean instead of summer rice. The conductance of front line demonstrations on summer mungbean in the niche available after harvesting of wheat and before transplanting of rice became an alternative to summer rice, improving profits of the system vis-à-vis conserving scarce water resources while improving soil health.



Why Summer Mungbean?

Though, there are eco-friendly superior alternatives to summer rice like *Sesbania* commonly known as dhaincha and summer mungbean as discussed above, yet a comparison is required between these two also to convince the farmers for wisdom. The farmers prefer to grow a crop which is more beneficial and remunerative.

The Table 2 reveals that growing of summer mungbean has an edge over *Sesbania* for all parameters. It is wise to grow summer mungbean instead of *Sesbania* in the larger prospects of resource conservation (water and nutrients), soil health improvement, augmentation of pulses production, employment to landless and enhancement in profits of the farmers. To popularize this technology, large number of demonstrations were conducted by KVKs of Zone I.

Table 11: Details of trainings on cultivation of summer mungbean imparted to extension functionaries in Punjab.

KVK	2006		2007		2008		2009	
	No. of Trainings	Parti-cipants	No. of Trainings	Parti-cipants	No. of Trainings	Parti-cipants	No. of Trainings	Parti-cipants
Amritsar	-	-	1	7	-	-	1	21
Ropar	1	15	1	10	1	7	1	8
Patiala	-	-	-	-	1	31	1	9
Moga	-	-	4	51	-	-	3	32
Faridkot	-	-	-	-	1	13	1	15
Ferozepur	2	44	-	-	-	-	-	-
Samrala	-	-	1	19	-	-	1	10
Sangrur	-	-	1	10	1	40	1	26
Total	3	59	8	97	4	91	9	121

Table 12: Details of trainings on cultivation of summer mungbean imparted to extension functionaries in Haryana.

KVK	2006		2007		2008		2009	
	No. of Trainings	Parti-cipants	No. of Trainings	Parti-cipants	No. of Trainings	Parti-cipants	No. of Trainings	Parti-cipants
Kurukshetra	1	21	1	23	1	21	1	22
Panipat	-	-	1	17	1	19	-	-
Ambala	1	30	-	-	-	-	-	-
Kaithal	-	-	1	30	1	25	1	30
Jind	1	32	2	32	1	35	1	15
Total	3	83	5	102	4	100	3	67

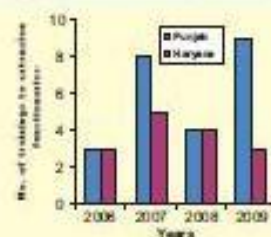


Figure 5

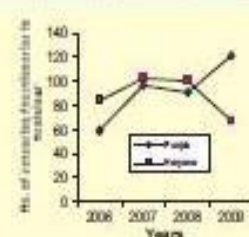


Figure 6

Figure 5&6 : Detail of trainings imparted to extension functionaries on cultivation of summer mungbean in Punjab and Haryana.

Table 10: Details of trainings on cultivation of summer mungbean imparted to farmers in Haryana.

KVK	2006		2007		2008		2009	
	No. of Trainings	Participants	No. of Trainings	Participants	No. of Trainings	Participants	No. of Trainings	Participants
Kurukshetra	3	67	3	73	2	46	4	107
Panipat	2	26	4	155	1	47	4	110
Ambala	1	9	1	9	1	25	1	10
Kaithal	-	-	2	90	2	85	2	95
Jind	4	85	6	162	7	119	3	185
Total	10	187	16	489	13	322	14	507

apprised about the deteriorating soil health, importance of water, ill effects of rice-wheat-rice sequence, significance of including summer mungbean in crop rotation and awareness of shortfall in pulses along with need of increasing pulses production in our country.

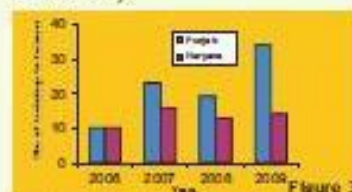


Figure 3B4 : Details of trainings imparted to farmers on cultivation of summer mungbean in Punjab and Haryana.

• Trainings to extension functionaries

The extension functionaries involved in transfer of technology were made acquainted with the latest dividends obtained from summer mungbean in rice-wheat system. A total of 39 trainings were given to 720 extension personnel (Table 11 & 12) in both the states of Punjab and Haryana. The details of trainings have been depicted in Figures 5B6 separately for both the states during the years 2006-2009. The alarming picture on depleting water table and increasing pressure on electric energy concerned with rice-wheat cropping system in Punjab and Haryana was highlighted to the extension functionaries of department of agriculture for ecological security in the zone. They were trained in respect of summer mungbean cultivation right from sowing including latest varieties to harvesting for disseminating the technology to the farmers.

Table 2: Comparison between summer mungbean and Sesbania

Particulars	Sesbania aculeata	Summer mungbean
Purpose of cultivation	Single-green manuring	Dual-grain and green manuring
Field preparation	2-3 tillage operations	Can be grown under zero tillage conditions
Availability of seed in Punjab and Haryana	Imported from other states	Available in Punjab and Haryana
Seed rate (kg/ha)	25	25-30
Ability of biological nitrogen fixation	Nitrogen fixing nodules present	Nitrogen fixing nodules present
Percent nitrogen in green biomass	0.42	0.53
Crop duration	6-8 weeks for green manuring	8-10 weeks for grain and after that used for green manuring
Age at in-situ incorporation	6-8 weeks	8-10 weeks after pods picking
Number of irrigations required	At least four	Only two
Grain yield (q/ha)	Nil	6-15 depending upon varieties
Monetary output (Rs/ha)	Nil	Rs. 10000-30000/-
Incorporation in field	Difficult to incorporate	Easy to incorporate
Infestation of insects at early stage	Heavy infestation of caterpillar	Negligible infestation of caterpillar
Availability of pulses to farmers	Nil	Grains (dal)
Employment to labour	Nil	Pod picking
Availability of pulses to labour	Nil	Grains obtained, if picking on share-basis

Demonstrations on Summer Mungbean

Encouraged by the farmers' participatory approach in 2005, the front line demonstrations were laid out in more area to show the worth of technology in larger prospects. The demonstrations at farmers' fields conducted during the years 2005 to 2009 signified the success of growing mungbean during summer in rice-wheat cropping system. A total of 564 and 567 demonstrations were laid out at farmer's fields in Punjab and Haryana, respectively during the years from 2006 to 2010 (Table 3B4). The short duration variety SML 668 was found promising which fits well

in summer after harvesting of wheat before transplanting of rice. In Punjab and Haryana, the harvesting of wheat takes place between 5th to 20th April and the transplanting of rice starts in second fortnight of June, thereby providing 65 to 70 days during summer and this period can be utilized for cultivation of mungbean. On an average the farmers harvested 6 to 10 quintals/ha of mungbean in demonstrations conducted at farmers fields (Table 586).

Table 3: Front line demonstrations on summer mungbean in Punjab.

KVK	Years				
	2006	2007	2008	2009	2010
Ropar	17	4	4	10	13
Amritsar	2	5	10	5	25
Kapurthala	5	-	2	-	10
Patiala	10	3	14	9	20
Moga	-	2	14	14	20
Jalandhar	-	-	2	3	12
Ludhiana	-	2	12	11	20
Hoshiarpur	-	-	3	-	30
Faridkot	-	-	10	10	20
Ferozepur	-	-	10	20	21
Muktsar	7	-	-	-	20
Sangrur	7	5	12	12	35
Bhatinda	-	-	-	10	20
Fatehgarh Sahib	-	-	-	-	10
Nawanshahr	-	-	-	-	10
Gurdaspur	-	-	-	-	15
Manisa	-	-	-	-	10
Total	48	21	93	104	301

Large number of demonstrations were laid out by all KVKs of Punjab covering 17 districts (Table 3). Initiating in the year 2006, the demonstrations (48) were conducted in 6 districts (Ropar, Amritsar, Kapurthala, Patiala, Muktsar and Sangrur) which expanded to other districts also like Moga and Ludhiana in 2007. The success of the demonstrated technology discussed in zonal workshops on front line demonstrations (oilseed and pulse crops) inspired the scientists of other KVKs also for conducting the demonstrations on summer mungbean in Jalandhar, Ludhiana, Hoshiarpur, Faridkot, Ferozepur and Bhatinda districts during the years 2008 and

Steps Under Lateral Flow Technology Transfer

• Arrangement of seed

Initially (2005) the seed of variety SML 668 was obtained from PAU, Ludhiana for front line demonstrations. The overwhelming results encouraged the farmers as well as scientists for its expansion in ensuing next summer season. The KVKs of Punjab also involves in the seed production of this variety. The state Department of Agriculture also provided subsidy on seed for promotion of this technology among farming community cultivating rice-wheat system in the state of Haryana.



Excellent pod formation in summer mungbean variety SML 668

• Trainings to farmers

Trainings on production as well as protection technology were imparted to the farmers for successful cultivation of summer mungbean. A total of 139 trainings were imparted to 3106 farmers of Punjab and Haryana (Table 9&10). The farmers were

Table 9: Details of trainings on cultivation of summer mungbean imparted to farmers in Punjab.

KVK	2006		2007		2008		2009	
	No. of Trainings	Parti-cipants	No. of Trainings	Parti-cipants	No. of Trainings	Parti-cipants	No. of Trainings	Parti-cipants
Amritsar	1	10	2	25	2	37	2	21
Ropar	2	40	2	27	3	68	1	13
Patiala	-	-	-	-	1	32	1	32
Moga	-	-	9	192	-	-	8	146
Jalandhar	-	-	-	-	2	41	1	13
Faridkot	2	52	1	21	4	83	3	61
Ferozepur	4	44	3	35	3	37	4	47
Samrala	-	-	4	87	2	20	12	183
Sangrur	1	13	2	28	2	30	2	45
Bhatinda	-	-	-	-	-	-	1	118
Total	10	159	23	415	19	348	34	679

Table 7 : Economic analysis of front line demonstrations on summer mungbean in Punjab during the years from 2006 to 2009.

KVK	2006		2007		2008		2009	
	Net Returns (Rs./ha)	B:C Ratio	Net Returns (Rs./ha)	B:C Ratio	Net Returns (Rs./ha)	B:C Ratio	Net Returns (Rs./ha)	B:C Ratio
Amritsar	8500	1.54	11200	2.46	15250	3.24	27888	3.85
Ropar	16770	4.90	21529	2.80	16670	5.90	12725	2.90
Kapurthala	7200	1.36	-	-	-	-	-	-
Patiala	4550	1.97	9666	1.90	8658	1.80	32560	2.40
Moga	-	-	12030	2.10	27390	3.30	32100	3.20
Jalandhar	-	-	30575	5.60	12908	2.06	11921	2.02
Faridkot	-	-	-	-	26955	3.99	32790	4.40
Ferozepur	-	-	-	-	41985	3.50	37561	2.24
Multras	16470	2.69	-	-	-	-	-	-
Bhatinda	-	-	-	-	-	-	27800	3.28

Similar to Punjab, the net returns under front line demonstrations on summer mungbean in Haryana also ranged between Rs. 4380 and 27181 in different years (Table 8). The maximum net returns were received due to higher grain yield and more prices of the produce resulting in highest benefit-cost ratio of 4.32 during the year 2006. The farmers of eastern Haryana where rice-wheat cropping system is dominant for the last three decades accepted the demonstrated technology because of value addition enhancing the profitability of the system.

Table 8 : Economic analysis of front line demonstrations on summer mungbean in Haryana during the years from 2006 to 2009.

KVK	2006		2007		2008		2009	
	Net Returns (Rs./ha)	B:C Ratio	Net Returns (Rs./ha)	B:C Ratio	Net Returns (Rs./ha)	B:C Ratio	Net Returns (Rs./ha)	B:C Ratio
Kurukshetra	24332	3.24	11250	2.35	5780	1.57	21540	3.09
Panipat	27181	4.32	9255	2.10	8342	1.92	12129	2.37
Ambala	13602	1.82	13290	2.98	8557	2.73	24708	4.01
Kaithal	-	-	8680	1.17	11200	2.72	22500	2.89
Jind	27008	3.90	13242	3.40	15235	3.40	12691	4.00
Yamuna Nagar	-	-	-	-	4380	1.41	8130	2.40

2009. The number of demonstrations has also been substantially increased in 2010, keeping in view the adoption of this technology in rice-wheat system.

In Haryana, the district Kurukshetra took lead in conducting the front line demonstrations on summer mungbean in the year 2005 in barely 2 ha area and the promising results registering the grain yield up to 15 q/ha made the event as point of attraction for farmers as well as the scientists of KVKs. Consequently, the front line demonstrations were planned for other districts like Kaithal, Panipat, Ambala, Jind and Yamuna Nagar also following the rice-wheat cropping sequence. The number of demonstrations increased from 3 (2005) to 29, 75, 22 and 187 in the years 2006, 2007, 2008 and 2009, respectively (Table 4). A total of 313 demonstrations have been conducted in Haryana in the following years to spread the summer mungbean horizontally.

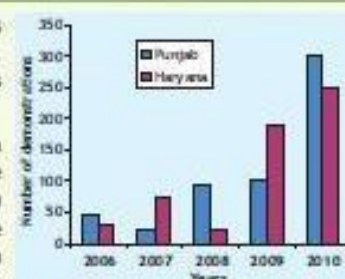


Figure 1. Details of front line demonstrations on summer mungbean in Punjab and Haryana.

Table 4: Front line demonstrations on summer mungbean in Haryana.

KVK	Years				
	2006	2007	2008	2009	2010
Kurukshetra	9	33	3	42	60
Panipat	10	20	3	5	30
Ambala	5	5	2	5	13
Kaithal	-	12	9	8	50
Jind	5	5	3	5	20
Yamuna Nagar	-	-	2	6	10
Rohtak	-	-	-	-	25
Sirsa	-	-	-	-	3
Faridabad	-	-	-	-	10
Hisar	-	-	-	-	10
Sonapat	-	-	-	-	10
Gurgaon	-	-	-	-	10
Total	29	75	22	187	251

Table 5 : Performance of summer mungbean (Grain Yield, q/ha) under front line demonstrations in Punjab.

KVK	Years			
	2006	2007	2008	2009
Ropar	8.5	11.4	9.5	6.7
Amritsar	7.7	8.8	9.1	10.0
Kapurthala	6.8	-	8.3	-
Patiala	10.9	10.9	10.5	10.2
Moga	-	8.5	13.1	10.3
Jalandhar	-	-	9.3	9.1
Ludhiana	-	11.2	11.2	9.3
Hoshiarpur	-	-	11.2	-
Faridkot	-	-	9.6	10.0
Ferozepur	-	-	10.1	10.7
Muktsar	13.1	-	-	-
Sangrur	10.5	10.6	11.4	11.8
Bhatinda	-	-	-	12.5
Average Yield	9.6	10.2	10.2	10.1

The farmers of Punjab harvested the average grain yield of 9.6 to 10.2 q/ha under front line demonstrations on summer mungbean during the years 2006 to 2009 (Table 5). On an average of four years data of demonstrations, the pooled grain yield of 10 q/ha has been registered in Punjab. This quantum of average grain yield lured the farmers for its propagation in Punjab.



Inspection of fields of summer mungbean by experts



Table 6 : Performance of summer mungbean (Grain Yield, q/ha) under front line demonstrations in Haryana.

KVK	Year			
	2006	2007	2008	2009
Kurukshetra	8.8	7.8	8.8	9.1
Panipat	9.0	6.0	9.7	8.4
Ambala	6.3	8.0	5.3	14.9
Kaithal	-	3.1	3.5	7.5
Jind	7.8	5.7	6.5	5.3
Yamuna Nagar	-	-	6.2	7.5
Average Yield	8.0	6.1	6.7	8.8

The average grain yield of summer mungbean in front line demonstrations ranged from 6.1 to 8.8 q/ha in Haryana during the years from 2006-2009 (Table 6). The pooled grain yield has been recorded as 7.4 q/ha in Haryana during the period under report. Though the average grain yield obtained in Haryana was lower than in Punjab, yet it still satisfied the farmers and encouraged them for its adoption.

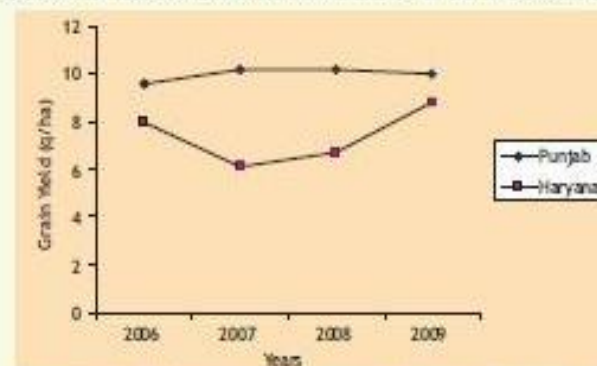


Figure 2. Performance of summer mungbean under front line demonstrations in Punjab and Haryana.

There were wide variations in net returns received by the farmers of Punjab on account of summer mungbean cultivation during the years 2006-2009. The net return varied from Rs. 4550 (2006) to 41985 (2008) depending upon the agro-ecological situations and prevailing weather conditions during summer season in Punjab in the respective years (Table 7). The benefit-cost ratio also varied from 1.36 to 5.9 depending upon the output and market price of pulses during the period under report.