Indian Res. J. Ext. Edu. 13 (1), January, 2013

Harnessing Pulses Productivity for Food and Nutritional Security

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ABSTRACT

Pulses are important for existing farm production systems as it adds nitrogen in the soil and provides food and nutritional security to large number of vegetarians and weaker sections of the society who can not afford other sources of protein. A programme on 'Technology Demonstrations for Harnessing Pulses Productivity' *was initiated by Indian Council of Agricultural Research to address the application of selected technologies related to five major pulses crops viz. chickpea, pigeon pea, mungbean, urdbean and lentil in 2010-11. Mungbean was emphasized as an important intervention with demonstrations on an area of 2126.31 acre during 2010-11 to 2011-12. The district specific technology modules were prepared on recently released varieties, planting techniques, integrated nutrient management, integrated weed management, integrated disease-insect management and intercropping. The sample size included 8 states, 59 districts and 2301 farmers. The data were collected by the concerned KVKs and analyzed as per need. Mungbean has shown tremendous adaptability in different crop seasons and agro-ecological environments. The average yield gains of 39.71 % over farmers' practice, average net returns of Rs. 18979//ha and Rs.40848/ ha from summer crop and more importantly being grown commonly in the fields which are kept fallow by the farmers, make this crop extremely valuable. The additional benefits attached with this crop like net returns, soil health enhancement, low competition with other crop, nutritional value, low resource use in its cultivation, etc. indicate potentiality of the crop to further expand area and broaden its domestic and industrial use.*

Key Words: *Harnessing pulses productivity; Technology demonstrations;*

Pulses are very important in Indian agriculture both in terms of enriching soil health and for food and nutritional security of country's ever growing population. Pulses being predominantly rainfed crop grown in constrained and limiting factor environment, the increase in productivity had remained a major challenge for several decades. There has not been remarkable increase in area and productivity of pulses as witnessed in other commodities over the years. There has been number of technological breakthroughs with promise to raise the productivity levels which need to be demonstrated at farmers' fields with their active participation so as to build their confidence in new technologies. India produced 17.21 million tonnes of pulses from an area of 24.78 million hectares (*Directorate of Economics and Statistics Department of Agriculture and Cooperation-2012* and *Nadarajan, 2013*), major contributors being Madhya Pradesh (4.16 million tonnes), Uttar Pradesh (2.43 million tonnes) and Rajasthan (2.36 million tonnes). However, about 2-3 million tonnes of pulses are imported annually to meet the domestic consumption requirement (*Chaturvedi, et al 2010*). There is need to increase production and productivity of pulses in the country by more intensive interventions. Pulses are important for our agricultural production system through biological nitrogen fixation in soil and nutritional security of large number of vegetarians and weaker sections of the society who could not afford other sources of protein. An estimated amount of 30 to 74 kg/ha of nitrogen can be fixed by mungbean (*MULLARP-2011-12*). Introduction of pulses in cereal based cropping systems

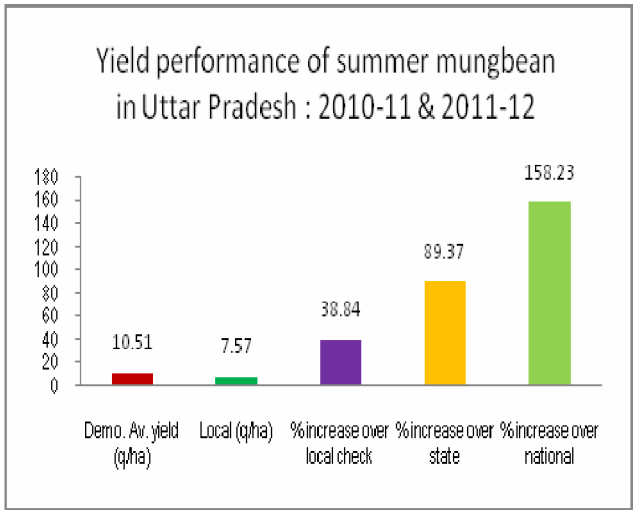
such as rice-wheat adds sustainability to the system by enhancing nitrogen economy and improving soil health. A programme *'Technology Demonstrations for Harnessing Pulses Productivity'* was taken up by Indian Council of Agricultural Research to address the application of selected technologies related to five major pulses crops viz. chickpea, pigeon pea, mungbean, urdbean and lentil. 6000 demonstrations were organized for two consecutive years (2010-11 to 2011-12). The programme envisaged demonstrating production potential of newly developed technologies and varieties of pulses at farmers' fields through KVKs as to bring in enhanced application of modern technologies to address the issues related to production of pulses in the country. Mungbean was emphasized as an important intervention with demonstrations on an area of 2126.31 acre during 2010-2011-12. This paper discusses performance of technology on mungbean in different cropping systems.

METHODOLOGY

The programme on mungbean was launched in 8 states and 59 districts with the participation of Programme Coordinators of concerned KVKs. A comprehensive programme was chalked out which included preparation of district specific technology modules by Indian Institute of Pulses Research, involvement of Agricultural Universities and research centres for technology support, capacity building of concerned KVKs and development departments and farmers, timely conduct and monitoring of the programme. The district specific technology modules were prepared on recently released varieties, planting techniques, IPNM, IWM, integrated disease-insect management, intercropping and micro irrigation system. The major cropping systems like sorghum-wheat-mungbean; rice-wheat-mungbean; rice-wheat-mungbean; bajra-wheat-mungbean; maize-potato-mungbean; maize-wheat-mungbean were found existing. Broadly for one acre, 10 kg seed treated with fungicides like Thirum/Captan/Carbendazim @ 3.0 gram/kg seed and rhizobium culture @ one packet per 10 kg seed with a spacing of 25 cm x 10 cm was adopted. Other technological options were adopted as per location specific requirements. The sample included 8 states, 59 districts and 2301 farmers.

RESULTS AND DISCUSSION

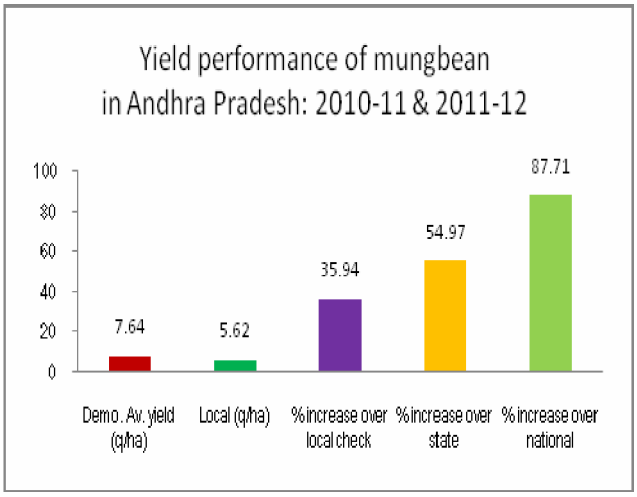
Summer Mungbean - Uttar Pradesh : During 2010-11 and 2011-12, 241 demonstrations were conducted on summer mungbean mainly in central part of UP in 7 districts on an area of 210.13 acre with average productivity of 10.51 q/ha. The yield recorded under these demonstrations was 38.84% higher over local check, 89.37% to state average and 158.23% to national average.



Summer mungbean is an addition of new crop mainly in rice-wheat and maize-potato cropping systems. Short crop duration especially of cultivars Samrat (60 days) and Meha (65 days), low input requirements (two irrigations, one insecticidal spray, etc.) are encouraging features attracting farmers to grow summer mungbean. The crop does not have any competition as the fields in summer are generally kept fallow by the farmers. The introduction of this crop to the existing cropping systems, fetches Rs. 40848 per ha of net income and also adds 30-74 kg/ha of nitrogen to the soil every year. The crop cover during summer also checks soil erosion, besides, its advantage as nutritional value to the malnutrition village population. The area under summer mungbean is showing an increasing trend with coverage of area in Uttar Pradesh and with little support for post harvest and value addition, the farmer's interest can be further aroused to bring more area under summer mungbean.

Mungbean

Andhra Pradesh: Mungbean is an important short duration grain legume grown in rainy and post rainy seasons in Andhra Pradesh. It occupies an area of



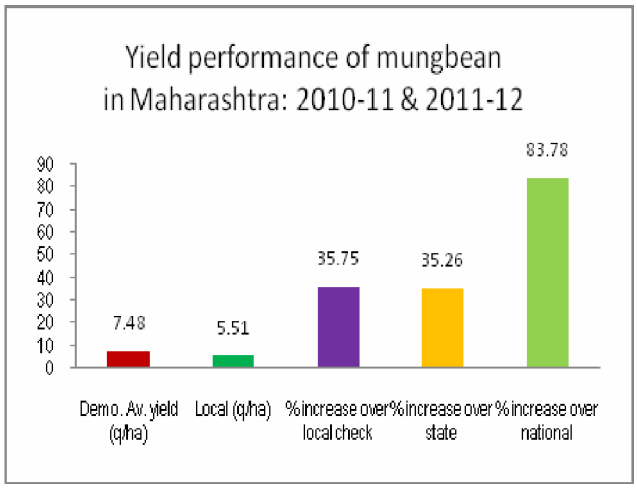
3.78 lakh ha with an average productivity of 439 kg/ha in good rainfall years. To increase the productivity and income of mungbean 217 technology demonstrations were conducted in 277.5 ha with improved varieties LGG-460, MGG-295 and Ekasila (WGG-37). In the demonstrations, an average bean yield of 7.64 q/ha was obtained with improved technologies against local check yield of 5.62 q/ha. The highest average yield of 10.7 q/ha was recorded in Warangal district during 2011-12 under rainfed red soil situation with variety Madhira-295 which is tolerant to drought as well as excess moisture conditions and black spot disease. Due to adoption of improved technology farmers could get additional return of Rs. 5909/ha.

Performance of summer mungbean varieties and technologies - 2010-11 & 2011-12

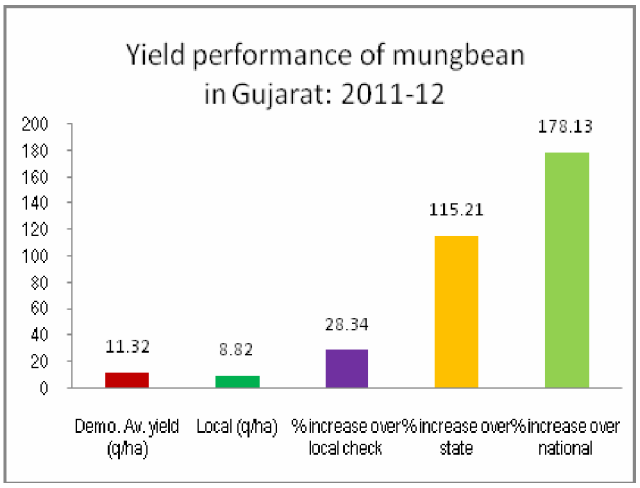
Varieties	District	Area (acre) & No. of Demo.	Yield (q/ha)		Increase (%)	Net Return (Rs./ha)		
			Demo	Check		Demo	Local Check	Net gain (%)
Uttar Padesh								
Samrat	Kannauj, Banda, Etawah, Fatehpur, Etah, Sitapur	94.75 (146)*	11.11	8.06	37.84	39399	26346	49.54
IPM 02-03	Kannauj, Etawah, Fatehpur	40.88 (20)	9.32	6.64	40.36	46836	32341	44.82
Meha	Kannauj, Fatehpur	24.50 (27)	9.92	7.71	28.66	48635	36926	31.71
SML-668	Faizabad	10 (10)	10.67	5.18	105	33244	10102	229.08
Narendra Mung-1	Unnao	20.00 (20)	11.42	9.9	15.35	44550	38340	16.20
HUM-16	Pratapgarh, Sitapur	20.00 (18)	9.85	5.80	69.83	26040	11700	122.56
Wt. Mean		210.13 (241)	10.51	7.57	38.84	40848	27720	59.00
Andhra Pradesh								
LGG-460	Mahboobnagar, Nalgonda, Nizamabad, Prakasam	192.50(132)*	7.68	5.54	38.63	15620	8268	88.92
ML-267	Nalgonda	25.00 (25)	3.80	2.60	46.00	7090	3680	92.66
MGG-295	Warangal	30.00 (30)	10.70	7.40	44.59	20700	18200	13.74
WGG-37	Khammam	30.00 (30)	7.50	6.87	9.17	11400	9260	23.11
Wt. Mean		277.50 (217)	7.64	5.62	35.94	14945	9036	74.00
Maharashtra								
BM-4	Jalna, Nanded	60.00 (60)	5.72	3.75	52.53	10745	4388	144.87
AKM 8802	Amravati (G)	30.00 (30)	7.51	6.5	15.54	11140	8540	30.44
AKM-4	Buldhana	30.00 (30)	6.58	5.7	15.43	7306	5540	31.88
BM-2002-1	Parbhani	30.00 (30)	9.08	6.25	45.28	19013	12138	56.64
Kopargaon	Washim	30.00 (30)	10.27	7.1	44.64	28230	15300	84.51
Wt. Mean		180.00 (180)	7.48	5.51	35.75	14530	8383	82.00
Gujarat								
GM-4	Banaskantha, Kutch, Panchmahal, Sabarkantha	63.00 (63)*	10.36	8.07	28.38	20223	13890	45.59
Pusa Vishal	Tapi	25.00 (20)	13.75	10.7	28.50	45420	33375	36.09
Wt. Mean		88.00 (83)	11.32	8.82	28.34	27379	19425	43.00

* Figure in parentheses indicates no. of demonstrations

Maharashtra : In Maharashtra, the technology demonstrations on mungbean were organized with high yielding varieties viz., AKM-8802, BM-2002-1, AMK-4, etc. The recommended package of technologies gave an additional yield of 1.97q/ha seed over the yield with the existing farmers practice (5.51 q/ha). The additional return obtained by the farmers was Rs. 6147/ha with the application of improved technologies.



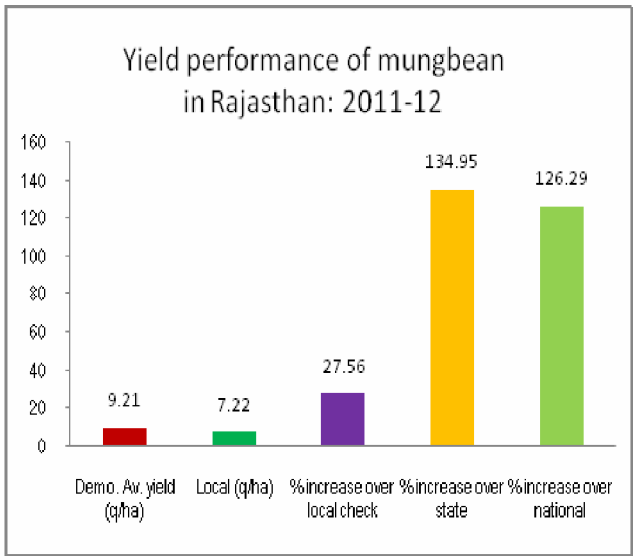
Gujarat : Mungbean, a third important pulse crop after gram and pigeon pea is widely grown in Kutch, Banaskantha, Mehsana, Patan, Sabarkantha, Surendranagar, Gandhinagar, Surat, Amreli, Rajkot, Jamnagar and Panchmahals districts of Gujarat. The acreage fluctuates between 1,70,000 to 1,90,000 ha depending on rainfall pattern and distribution. The rainfall ranging from 200-300 mm in Kutch, 400-500 mm (north and central Gujarat), 700-2200 mm (south Gujarat) is highly erratic and uneven from year to year. The northern and western Gujarat often experienced drought every third year.



It is mainly grown on three types of soils viz., sandy loam to loamy sand (Kutch, Banaskantha, Mehsana, Patan, Sabarkantha and Gandhinagar), medium to heavy black (Surat, Panchmahal, Valsad, Surendranagar, Rajkot and laterite (Tapi and Panchmahal). Mungbean-wheat, mustard-mungbean, castors-mungbean, cotton-mungbean, sorghum-mungbean are the major cropping systems. The demonstrations (83) were conducted in Banaskantha, Kutch, Sabarkantha, Panchmahal and Tapi districts.

The yield and net return from the crop grown on sandy soils was 20.81 and 41.64 per cent higher than the crop grown on medium black soils that recorded 9.60 q/ha grain yield and Rs 20000/ha net return in the state under different demonstration. Although most of the crop is cultivated during kharif season under rainfed conditions, the yield and net returns were recorded slightly higher under irrigated crop grown during summer after harvest of rabi crops. The grain yield of 11.73 q/ha and 10.84 q/ha were recorded with irrigated and rainfed crops respectively in the state. The corresponding net returns under irrigated and rainfed crops were Rs 33085/ha and Rs 20536/ha. Although, increase in grain yield over farmers' practices in both irrigated and rainfed conditions recorded 28 per cent, the increase in net return under irrigated conditions was considerably higher with the crop grown under irrigated conditions in summer. In the state variety GM-4 is most common and recorded grain yield of 10.36 q/ha which was 28.38 per cent higher than the farmers' practice in Banaskantha, Kutch, Panchmahal and Sabarkantha districts . Similarly, the increase in net return was 45.59 per cent over the local check (Rs 13890/ha). Variety Pusa Vishal, a bold seeded variety gave good returns in terms of grain yield (13.75 q/ha) and net returns (Rs 45420/ha) which were 28.50 and 36.09 per cent higher than the grain yield and net return obtained from the local check. The crop grown during kharif season has been infested heavily with sucking insect pests and leaf curl virus. The biotic load of pests and disease is comparatively lower in the crop grown during summer.

Rajasthan : Mungbean is second most important pulse crop of the Rajasthan state. It was cultivated on an area of 1272228 ha during kharif 2011-12. The production of the crop during the corresponding period was 647177 tons and the productivity was 509 kg/ha.



Rajasthan ranked first both in area and production of mungbean in the country and contributed 40 per cent in the total acreage and 30 per cent in total production of crop in India. The major mungbean growing districts of the state include Ajmer, Jaipur, Nagaur, Jodhpur, Jalore, Pali and Tonk in which it is grown as rainfed crop during Kharif season. The rainfall varies from year to year due to climatic variability which often leads two droughts once in 5 years in arid and semi-arid districts of Rajasthan. In western districts especially in Sri Ganganagar it is being cultivated under irrigated conditions on about 23578 ha during Kharif season. It is also grown under irrigated conditions on considerable area in Hanumangarh, Bikaner, Jaisalmer and Jodhpur districts. The total irrigated area of the crop in the state

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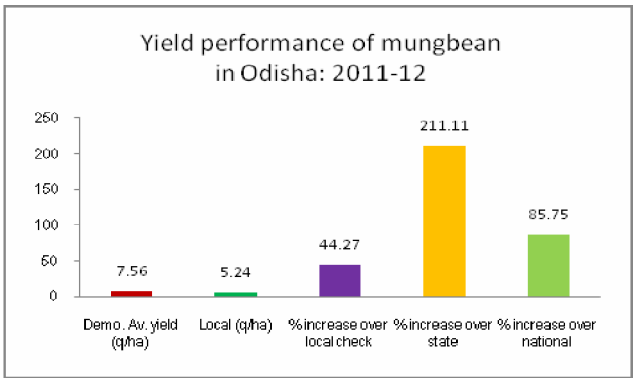
			Demo	Check		Demo	Local Check	Net gain (%)
Rajasthan								
SML-668	Chittorgarh, Churu, Sriganganagar	75.00 (75)*	9.19	7.04	30.54	31968	22974	39.15
RMG-268	Jaipur, Barmer, Jodhpur, Sikar	83.00 (83)	8.81	7.05	24.96	18513	14238	30.03
RMG-492	Ajmer, Jaipur, Jhunjhunu	76.00 (76)	9.98	7.62	30.97	17153	12276	39.73
IPM-02-03	Hanumangarh, Tonk	30.00 (30)	9.03	7.26	24.38	17957	11092	61.89
RMG-62	Jodhpur, Nagaur	45.00 (45)	8.79	6.72	30.80	21912	15473	41.61
Satya	Hanumangarh	10.00 (10)	9.4	9.02	4.44	24452	18912	29.29
Wt. Mean		319.00 (319)	9.21	7.22	27.56	21965	15849	39.00
Odisha								
PDM-139	Bolangir, Klahandi	15.40 (20)*	7.35	5.26	39.73	18996	11372	67.04
TARM-1	Ganjam, Bargarh, Cuttack, Nayagarh	44.03 (43)	7.63	5.23	45.89	20296	11272	80.06
Wt. Mean		59.43 (63)	7.56	5.24	44.27	19959	11298	77.00
Karnataka								
Selection-4	Gadag, Gulbarga, Tumkur	85.00 (83)*	7.09	5.92	19.76	14641	10961	33.57
China Moong	Belgaum, Bellary	32.50 (32)	7.37	5.34	38.01	20931	14148	47.94
BGS-9	Bidar	12.50 (13)	13.12	9.5	38.11	35879	25300	41.81
Local	Chitradurga	30.00 (30)	5.1	4.02	26.87	16650	7490	122.30
Shinymoong	Dharwad	12.50 (12)	11.2	8.9	25.84	31580	24330	29.80
Wt. Mean		172.50 (170)	7.53	5.96	26.34	18942	12965	52.00
Tamil Nadu								
VRM-1	Vellore, Thiruvanamalai	22.50 (15)*	7.42	6.41	15.76	12049	9217	30.73
VBN-2	Tiruvallur, Vellore	22.50 (25)	7.68	6.48	18.52	16052	11885	35.06
VBN3	Virudhanagar	25.00 (25)	7.22	6.22	16.08	17712	13908	27.35
VRM(GG)-2	Thiruvanamalai	5.00 (10)	7.16	6.34	12.9	10044	7756	29.50
Wt. Mean		75.00 (75)	7.41	6.36	16.51	15004	11484	31.00

* Figure in parentheses indicates no. of demonstrations

was 47473 ha during 2011-12. Mungbean-wheat, mungbean-mustard, mungbean-barley and mungbean-castor are the major cropping patterns practiced in the state. Sandy loam, loam and clay loam are the major soil types on which it is grown in the state. The frontline demonstrations on mungbean were conducted in Chittorgarh, Churu, Sriganganagar, Jaipur, Barmer, Jodhpur, Sikar, Jhunjhunu, Ajmer, Hanumangarh, Tonk and Nagaur.

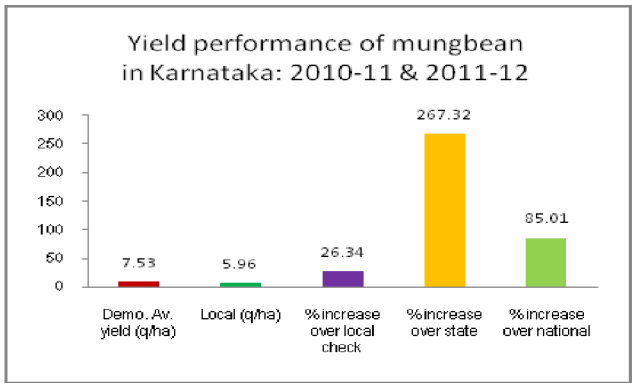
The productivity of mungbean was recorded considerably higher (10.34 q/ha) with the crop grown on loamy soils of Jaipur, Tonk and Ajmer which was 17.5 and 15.89 per cent higher over the crop grown on clay loam (8.80 q/ha) of Chittorgarh and sandy loam soils (8.93 q/ha) of Churu, Hanumangarh, Sri Ganganagar, Jhunjhunu, Sikar, Nagaur, Barmer and Jodhpur districts. The crop grown on clay loam, loam and sandy loam soils recorded 6.70, 7.88 and 7.08 per cent higher grain yield over the farmers' practices in the state. The grain yield of mungbean under rainfed conditions was recorded 13.21 per cent higher over irrigated crop during the year 2011-12 due to good rainfall conditions in the state, although net return per ha was recorded considerably higher (Rs 24378/ha) over the rainfed crop. The grain yield under irrigated and rainfed conditions was recorded 16.16 and 33.80 higher than the local check yield of 7.30 and 7.17 q/ha, respectively. Among the eight technologies demonstrated, integrated crop management (9.91 q/ha) and production technology + varietal improvement (9.81 q/ha) recorded comparatively higher grain yield (average) over integrated nutrient management + plant protection (8.27 q/ha), seed treatment + INM + IPM (8.86 q/ha), and varietal evaluation + biofertilizer (6.50 q/ha). However, per cent increase in grain yield due to demonstrations over local check was recorded highest with demonstrations conducted on varietal evaluation as compared to other technologies. Among the eight varieties tested, variety GM-4 recorded the highest grain yield of 9.98 q/ha followed by variety SML-668 (9.19 q/ha). The grain yield and net return from the demonstrations were 27.56 and 39.00 per cent higher than the grain yield (7.22 q/ha) and net return (Rs 15849/ha) obtained under local check (farmers' practices). The productivity of the crop often suffers terminal moisture stress conditions during the growing period due to failure and uneven distribution of rainfall. Crop during Kharif season also reported to suffer from heavy infestation of aphids and jassids leading to barren crop and poor yield.

Odisha : In Odisha, it is grown in kharif, rabi and summer. It is grown in 8.32 lakh ha with production of 3.41 lakh tonnes and yield of 411 kg/ha. During kharif, Bargarh district occupies the highest position in area (41.56 thousand ha), production (15.67 thousand tonnes) and productivity (377 kg/ha) followed by Kalahandi (Area-41.34 thousand ha, production - 27.08 thousand tonnes and productivit- 655 kg/ha). During rabi, Ganjam district occupies the highest area (150.82thousand ha), production (68.62 thousand tonnes) and productivity (455kg/ha) followed by Nayagarh (52.98 thousand ha, production 14.83 thousand tonnes and productivity (280kg/ha). Out of total greengram area, the share of kharif is 30.0 % and that of rabi is 70 %.



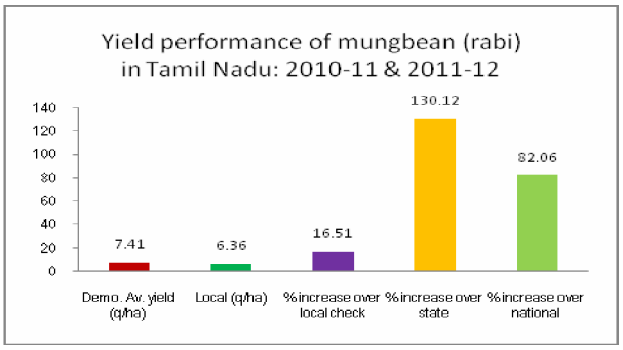
A total of 63 demonstrations were laid out in the six districts in 60 acre area with improved variety and package of practices. Results show that there was 44.27 % yield gain and 77.0 % net return increase due to technological interventions with proper management in the demonstration plots as given in the data. Comparative yield trends, shows that there is yield gain of 211.11 and 85.75 % over the state and national average. Hence, still there is vast scope for the technological interventions for reducing these yield gaps.

Karnataka : Mungbean is one of the important pulse crops of Karnataka state. Karnataka accounts for 15.35% of the country acreage and 7.71% of the country production. It is grown on about 4.04 lakh ha in the State mainly in Bagalkote, Belgaum, Bellary, Bidar, Bijapur, Dharwad, Gadag, Gulberga, Haveri, Koppal, Raichur, Hassan, Chickmagalur, Chitradurga, Chamrajanagar, Mysore, Tumkur and Shimoga districts. The crop is mainly cultivated in red soils during kharif as rainfed and during summer as irrigated crop, besides in paddy fallow under residual moisture in coastal districts of Karnataka.



The state is producing 1.11 lakh tonnes of mungbean with an average productivity of 275 kg/ha. Mungbean is grown mostly during kharif under rainfed condition, however development of short duration and disease resistant varieties led to its cultivation during rabi and summer seasons in most parts of Karnataka. Being a short duration crop, it is ideal for catch cropping, intercropping and relay cropping. In order to increase the production, productivity and farmer's income, 170 demonstrations were conducted during kharif under rainfed situation in various districts of Karnataka state by Krishi Vigyan Kendras during 2010-11 and 2011-12. The results revealed that the yield could be increased by 26.34% over farmers practice by adopting improved varieties such as Selection-4, China Moong, BGS-9 and Shinymoong with improved production technology by recording an average yield of 7.53 q/ha as against 5.96 q/ha under farmers practice. In terms of economic returns also, an overall increase of 52% was recorded over and above the farmers practice.

Tamil Nadu : In Tamil Nadu, the area is around 1.97 lakh ha with a production of 0.72 lakh tonnes which works out to an average productivity of 368 kg/ha. Although this average is slightly above the National average, but is lesser than that recorded in states like Maharashtra (575 kg/ha), Punjab (605 kg/ha), Bihar (561 kg//ha), Andhra Pradesh (447 kg/ha), Uttar Pradesh (428 kg/ha) and West Bengal (390 kg/ha). The crop is mostly cultivated in rabi under rainfed condition and also in paddy fallows utilizing residual moisture during summer season.



The demonstrations conducted in 75 acre area in the State of Tamil Nadu in farmers' fields during rabi , revealed that the yield increased by 16.36% due to adoption of improved varieties namely VRM-1, VBN-2, VBN-3 and VRM-2 combined with improved production technology by recording an average yield of 7.41 q/ha as compared to 6.36 q/ha in farmers practice. This also led to an increase of 31% economic returns under demonstrations over farmers practice.

CONCLUSION

Mungbean has shown tremendous adaptability in different crop seasons and agro-ecological environments. The additional yield gains (3.0 q/ha) of 39.71 % over farmers' practice, average net returns of Rs. 18979/ha and Rs.40848/ ha from summer crop and more importantly being grown commonly in the fields which are kept fallow by the farmers, makes this crop extremely valuable. The additional benefits attached with this crop like net returns, soil health enhancement, no competition with any other crop, nutritional value, low resource use in its cultivation, etc. indicate potentiality of the crop to further expand area and broaden its domestic and industrial use.

Paper received on : December 12, 2012
Accepted on : December 15, 2012

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