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StatOS APPIlice Resources and the state of t	Technology Adaptability for Higher Pulses Productivity in Varied Conditions of Uttar Pradesh, India					
KEYWORDS	Mungbean and Urdbean in var pulses	ied conditions, Technology adaptation for harnessing productivity and profitability				
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ABSTRACT The technology demonstration for harnessing pulses productivity programme was implemented in 137 districts of 11 states in India with the participation of Krishi Vigyan Kendras for demonstrating production potentiality of newly developed technologies of pulses at farmers' fields. Under this programme, 376 demonstrations on mungbean and urdbean were laid down in different conditions of 16 districts of Uttar Pradesh in summer season during 2010-2012-13. Technology modules included all the recommended package of practices. Technology performance in respect to productivity and profitability from mungbean and urdbean were observed as important intervention. On an average, 10.94 q/ha (mungbean) and 10.18 q/ha (urdbean) yields were realized on farmers' fields under demonstration which were significantly higher as compared to local check, state and national average yield. More than 10 q/ha yield was provided by Azad Urd-2, PU-31 and PU-35 varieties of urdbean. On an average, net return of Rs. 41526 per ha under urdbean in summer season was harnessed by the farmers which indicated higher income between 99 - 119% as compared to local check. The technology dissemination process adopted for scientific demonstrations of pulses played a great role in enhancing productivity and net return of the farmers along with creating a platform for interface with different stakeholders.

Pulses are very important in Indian agriculture both in terms of enriching soil health and ensuring 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 taken to farmers' fields with their active participation. 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 a 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 vegetarian 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 ricewheat adds sustainability to the system by enhancing nitrogen economy and improving soil health. In the light of 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 three consecutive years (2010-11 to 2012-13). The programme envisaged demonstrating production potential of newly developed technologies and varieties of pulses at farmers' fields through Krishi Vigyna Kendras (KVKs) as to bring in enhanced application of modern technologies to address the issues related to production of pulses in the country.

Mungbean and Urdbean were emphasized as important interventions with demonstrations on an area of 344.50 acre during 2010-2012-2013. This paper discusses performance of technology on mungbean and urdbean under varied agro-climatic situations in summer season in the state of Uttar Pradesh.

Materials and Methods

The programme on mungbean (Vigna radiata) and urdbean (Vigna mungo L) was organized in 16 districts of Bundelkhand zone, Central Plain zone, Eastern Plain and Mid Western Plain zone of Uttar Pradesh during 2010-11 and 2012-13. Technology modules were prepared including all the recommended package of practices based on agro-ecosystems analysis.

Mungbean: The district specific technology modules were prepared on recently released varieties, planting techniques, integrated plant nutrient management, integrated weed management, integrated disease-insect management, etc. The major cropping systems like sorghum-wheat-mungbean; rice-wheat-mungbean; rice-wheat- mungbean; bajra-wheatmungbean; 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. Cultivars PDM-139, IPM 99-125, IPM-02-03 and HUM-16 were included in the demonstrations. Sowing was done during 15th March to 05th April. The fertilizer doses 20 kg N, 40 kg P_2O_5 , 20 kg K₂O, 20 kg S, 15 kg ZnSO₄ as basal application and 5 tonnes farm yard manure were used. First irrigation after 25 days after sowing and subsequent irrigation at 10-12 days interval was applied. Spray of Metasystox 0.03% solution at flower initiation and podding stage to control thrips was done.

Urdbean: The major cropping systems like urdbean-wheat-vegetable/fallow, urdbean-sugarcane, urdbean-wheat/chick-pea/pea/mustard and urdbean-wheat/mustard 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 30 cm x 10 cm was adopted. IPU 94-1, Azad urd-

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2, Shekhar-3, Narendra Urd-1 and Pant Urd-31 varieties were recommended. First irrigation after 25 days after sowing and subsequent irrigation at 10-12 days interval was applied. Sowing was done during 15th March to 05th April.

The sample included 16 districts and 376 farmers of 4 agroclimatic zones of Uttar Pradesh. Critical inputs were provided to the participating farmers. Training of participating farmers and extension workers were orgainized through KVKs. Statistical techniques like percentage, weighted mean, yield gap analysis, technology index were used. The technology gap, extension gap and technology index were estimated using the following formula:

Technology gap = (Potential yield) - (Demo. yield) Extension gap = (Demo. yield) - (Farmer's yield)

Technology index = <u>Pi - Di</u> ×100

where

Pi=Potential yield of ith crop. Di=Demonstration yield of ith crop.

A technology dissemination model evolved by Singh & Singh, 2013 was used for effective delivery of district specific technology modules (Fig. 1). This model indicates representation of networks and deliverables.

Fig. 1: Technology Adaptation Model for Harnessing Productivity



Results and Discussion

Agro-climatic zone wise results on mungbean and urdbean demonstrations are given in this section.

Central Plain Zone

Mungbean: A total of 220 demonstrations were conducted in district Kannauj, Fatehpur, Etawah, Sitapur, Pratapgarh, Faizabad and Unnao with average productivity of 10.81 q/ ha which was about 34.96% higher to local check, 94.77 % to state and 165.60 % to national average. The average net return of Rs. 43247 per ha was realized against Rs. 21695 per ha from local check. In 108 demonstrations, average returns were obtained more than Rs. 45000 per ha. About 99.34% of higher net economic gain was realized as compared to local check. IPM 99-125 cultivar provided highest average yield (12.62 q/ha) in Sitapur district. The additional yield gains (3.0 q/ha) of 39.71 % over farmers' practice and net returns of Rs. 18979/ha was reported by Kokate, et. al. 2013. The encouraging results of crop productivity and net returns are attributed to application of improved varieties and package of technologies.





		S		Yield (q/ha)			Net Return (Rs./ha)			
Varieties	District	No. of Farmer	Area (acre)	Demo	Check	% Increase	Demo.	Local Check	% Increase	
PDM- 139	Kannauj, Fatehpur, Etawah	77	78.50	10.29	7.64	34.69	46140	26884	71.63	
IPM 2-3	Kannauj, Etawah	31	31.00	10.76	7.90	36.2	47941	25561	87.56	
HUM- 16	Sitapur, Pratap- garh	18	20.00	9.85	7.80	26.28	36040	14700	145.17	
IPM 99- 125	Sitapur	40	40.00	12.62	8.78	43.74	44150	17256	155.85	
SML 668	Faizabad	26	15.00	9.98	7.49	33.24	34387	15477	122.18	
Nar- endra Mung- 1	Unnao	20	20.00	11.42	8.9	28.31	38340	16020	139.33	
Sweta	Fatehpur	08	8.00	9.55	7.53	26.83	39050	21330	83.08	
Wt. Mean/Total		220	212.50	10.81	8.01	34.96	43247	21695	99.34	

Urdbean: A total of 37 demonstrations were conducted with average productivity of 11.18 q/ha which was about 62.26% higher to local check, 154.09 % to state and 147.35 % to national average. The average net return of Rs. 40266 per ha was realized against Rs. 23081 per ha from local check. Kokate, et. al. 2013 indicated 10.08 q/ha average yield of urdbean in summer with net profit of Rs. 39141 per ha.

Table 2: Performance	of Summer Urdbean	demonstrations
in Central Plain Zone	(2010-2013)	

		lers		Yield (q/ha)			Net Re	turn (Rs.	/ha)
Varieties	District	No. of Farm	Area (acre)	Demo	Check	% Increase	Demo.	Local Check	% Increase
PU-31	Sitapur, Bara- banki	27	23.00	11.25	7.03	60.03	40456	23598	71.44
PU-35	Bara- banki	10	4.00	10.80	6.10	43.5	39180	20110	94.83
Wt. Me	an/Total	37	27.00	11.18	6.89	62.26	40266	23081	74.46

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Rainfed Condition

Mungbean: Under rainfed situation, 35 demonstrations were conducted (35.0 acre) in 3 districts (Banda, Hamirpur and Etah) of Uttar Pradesh. On an average, 11.76 q/ha yield was realized by the farmers which was 32.58 % higher over local check, 111.89 % over state and 188.94 % over national average with net return of Rs. 31077 per ha which was 100.87% higher over farmer's practice (Table 3 and Fig. 4).





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Table 3: Performance of Summer Mungbean demonstrations in Rainfed condition (2010-2013)

		Ę.	Area (acre)	Yield (q/ha)		e	Net Return (Rs./ha)			
Varieties	District No. of Far	No. of Fa ers		Demo	Check	% Increas	Demo.	Local Check	% In- crease	
PDM- 139	Etah, Banda	25	25.00	12.06	9.02	33.70	31708	15459	105.11	
IPM 99- 125	Hamirpur	10	10.00	11.00	8.50	29.41	29500	15500	90.32	
Wt. M	ean/Total	35	35.00	11.76	8.87	32.58	31077	15471	100.87	

Urdbean: Under rainfed situation, 15 demonstrations were organized (15.0 acre) in 2 districts (Jhansi and Jalaun) of Uttar Pradesh. On an average, 8.90 q/ha yield was realized by the farmers which was 54.25 % higher over local check, 102.27 % over state and 96.9 % over national average with net return of Rs. 23224 per ha which was 72.11% higher over farmer's practice (Table 4 and Fig. 5).



Table 4: Performance of Summer Urdbean demonstrations in Rainfed condition (2010-2013)

Varieties	District	No. of Farmers	Area (acre)	Yield (q/ha)			Net Return (Rs./ha)		
				Demo	Check	% Increase	Demo.	Local Check	% Increase
Azad-2	Jhansi	10	10.00	9.10	6.10	49.18	23685	14414	64.32
Shekhar-3	Jalaun	5	5.00	8.50	5.10	66.67	22300	11650	91.42
Wt. Mean/Tota	I	15	15.00	8.90	5.77	54.25	23224	13494	72.11

Mid-Western Plain Zone

Urdbean: A total of 69 demonstrations were conducted with average productivity of 10.03 q/ha which was about 46.42% higher to local check, 127.95 % to state and 121.90 % to national average. The average net return of Rs. 40377 per ha was realized against Rs. 15244 per ha from local check (Table 5 and Fig. 6). The additional yield gains (2-4 q/ ha) over farmers' practice was realized by the participating farmers. The demonstrations of summer urdbean in western Uttar Pradesh (Muzaffarnagar, Saharanpur and Bijnor) indicated 54.06 % higher yield (13.48 q/ha) as compared to kharif urdbean (8.75 q/ha) as reported by Kokate, et. al. 2013.



Table 5: Performance of Summer Urdbean demonstrations in Mid-Western Plain Zone (2010-2013)

Varieties	District	No. of Farmers	Area (acre)	Yield (q/ha)			Net Return (Rs./ha)		
				Demo	Check	1% Increase	Demo.	Local Check	% Increase
Azad-2	Budaun	36	24.00	10.00	7.93	26.10	39860	15644	154.79
PU-31	Shahjahan- pur	33	31.00	10.05	6.02	66.94	40778	14935	173.04
Wt. Mean/Total		69	55.00	10.03	6.85	46.42	40377	15244	164.87

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Technology Gap

The yield gap of 2.97 q/ha (mungbean) and 3.96 q/ha (urdbean) was observed between demonstrated and local check condition. The technology gap of 2.23 q/ha (mungbean) and 2.11 q/ha (urdbean) was also observed between potential and demonstrated yield. Technology Index (15.36% and 16.44%) was computed for different cultivars of mungbean and urdbean which show a significant difference of technology and extension gap (Fig. 7). There is a great scope for enhancing productivity of summer mungbean and urdbean with reduction in yield gap and technology gap. It may be possible by adoption of district specific technology modules, advance planning, critical monitoring, critical input support, organization of field days, etc. related to demonstrations. By introducing short duration pulses in summer season in different cropping systems, the profitability per unit area may be enhanced





Fig. 7: Technology Index of Mungbean and Urdbean

Conclusion

Technology demonstrations on mungbean and urdbean in summer season included special attention on planning, capacity building, district specific technology modules and regular monitoring. On an average 10.94 g/ha (mungbean) and 10.18 q/ha (urdbean) yield was realized by the farmers under demonstration which was significantly higher as compared to local check, state and national average yield. More than 10 g/ha yield was provided by PDM-139, IPM-2-3, IPM 99-125 and Narendra Mung-1 varieties of mungbean. Similarly, more than 10 g/ha yield was provided by Azad Urd-2, PU-31 and PU-35 varieties of urdbean. On an average, net return of Rs. 41526 per ha under mungbean and Rs. 37695 per ha under urdbean in summer season was obtained by the farmers which was 99-119% higher as compared to local check. The technology dissemination model utilized for scientific demonstrations of pulses played a great role for enhancing productivity and net return along with creating a platform for interface with different stakeholders.

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