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Evaluation of yield gaps and economics in soybean (*Glycine max* L.) through frontline demonstrations at tribal farmer's fields in Dhar district of Madhya Pradesh

GS Gathiye, KS Kirad, SS Chauhan and JS Rajpoot

Abstract
A study was carried out by Krishi Vigyan Kendra, Dhar, Madhya Pradesh to evaluate the impact of frontline demonstrations in soybean (*Glycine max* L.) at tribal farmer's fields of Dhar district for sustainable production and livelihood security in Dhar district of Madhya Pradesh. The maximum yield of soybean in FLDs under rainfed conditions ranged from 1781 and 1936 kg/ha during both the years (2016-17 and 2017-18) of study, respectively whereas the minimum yield (1289 and 1449 kg/ha) was recorded in farmers' practice. The percent increase (ranging from 33.60 to 41.99) in yield with demonstration over farmer's practice was recorded. The technological and extension gap was ranging between 220 to 419 kg/ha and 487 to 556 kg/ha and technological index (10.48 and 23.53 %) was found during both the years of study, respectively. The maximum gross monetary return (Rs. 55332 and Rs. 53430/ha) was recorded in recommended practice while minimum gross monetary return (Rs. 40209 and Rs. 40620/ha) was observed in farmer's practice during both the years, respectively. Moreover, the maximum net monetary returns (Rs. 27513 and Rs. 27312/ha) was recorded in recommended practice and minimum net monetary return observed in farmer's practice (Rs. 14209 and Rs. 16520/ha) during both the years, respectively. Similarly, highest B:C ratio (1.98 and 2.05) was found in recommended practice as compared to farmers existing practice (1.54 and 1.68) during both the years of study, respectively.

Keywords: Extension gap, technology transfer, yield, front line demonstrations, technology index and economics

Introduction

Soybean [*Glycine max* (L.) Merrill] is a prime legume crop having two major quality characters *viz.* protein and oil. Soybean is known as 'miracle bean' rich in protein (40.50 %) and moderate in oil (18-22.5 %) and balanced amino acid and 20-30% extractable substance [2]. It is widely grown in Madhya Pradesh, Maharashtra and Rajasthan and few pocket of Karnataka, Uttar Pradesh, Tamil Nadu and Andhra Pradesh as a sole or intercrop with pigeon pea, maize and cotton. In India, it is grown on an area of about 10.96 million hectares, which is likely to produce more than 13.46 million tonnes with productivity 12.28 q/ha during the year 2018-19 [1]. In order to that, Madhya Pradesh (5.24 million hectare), Maharashtra (3.93 million hectare) and Rajasthan (0.93 million hectare) constitute the major niche for the cultivation of soybean crop. Soybean has become popular because of its wider adoptability for soil, climate and food composition value. Madhya Pradesh is known as "Soya State of India". It has the potential to bridge the gap between the supply and demand of edible oil and protein. The crop has shown enormous growth in area and production in India during recent past and has come out as one of the noteworthy *kharif* season crop in Central India. Soybean is an important *kharif* oilseed crop for livelihood of tribal farmers in Dhar district of Madhya Pradesh. Majority of soybean area *i.e.*2.83 lakh hectares which is about 70 % of the total cultivable area of Dhar district of Madhya Pradesh mostly grown in rainfed conditions but due to non-availability of quality seed, improved variety and poor adoption of improved cultivation practices in the district, productivity (12.0 q/ha) of soybean is far below the potential yield (20.0 q/ha) of improved varieties. Soybean is mostly sown during *Kharif* season in last week of June to first week of July and harvested in October. In this regard, to sustain the production of soybean and consumption system, the Indian Institute of Soybean Research, Indore had sanctioned the project "Augmenting soybean production in tribal district of Madhya Pradesh for sustainable livelihood security from 2016-17'' to Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh. The basic strategy of the Mission is to promote and extend improved technologies with quality seed, balance use of fertilizers, nutrient management, integrated pest management, land configuration along with capacity building of farmers. Project was implemented by Krishi Vigyan Kendra, Dhar, Madhya Pradesh at tribal farmers' fields with main objective to boost the production and productivity of oilseeds through front line demonstrations with implementation of latest and specific technologies.

Materials and Methods

A study was carried out during *kharif* season from 2016-17 to 2017-18 (two consecutive years) by the KVK Dhar, of Madhya Pradesh. The demonstrations were conducted in tribal farmer's field of 5 different tribal villages of Nalcha and Sardarpur blocks of Dhar district in 10th agro climatic zone of Madhya Pradesh. Farmers were got trained to follow the package and practices for soybean cultivation as recommended by the Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.) and need based critical inputs were provided to the beneficiaries by KVK (Table 2). The farmers accompanied the full package of practices (Table-1). In case of local check, the traditional practices were kept by using existing variety (JS 335). An area of 40 and 20 hectare was covered with plot size 0.4 ha under front line demonstration with active participation of 100 and 50 farmers during 2016-17 to 2017-18, respectively. Two varieties namely JS 95-60 (duration 82-88 days) and JS 93-05 (duration 90-95 days) which are high yielding, four seeded pods, bold seeded and Yellow Mosaic Virus (YMV) tolerant varieties depending on the environmental condition were grown in FLDs. Before conducting FLDs, a baseline survey was conducted to know the basic needs of farmers and a list of farmers was prepared from group meeting. As per the needs, specific skill training was imparted to the selected farmers. In demonstration plots, use of quality seeds of improved varieties (JS 95-60 and JS 93-05), line sowing and timely herbicide application, need based application of pesticide as well as balanced fertilizer were applied and comparison has been made with the existing practices. Frequent visit of farmers and the extension functionaries was arranged at demonstration plots to disseminate the message at large scale. The beneficiaries were timely facilitated by KVK scientists to perform field operations during the course of training and visits. The traditional practices were carried out in case of local checks. The yield obtained from demonstrations and potential yield of the crop was compared to estimate the yield gaps which were further categorized into technology index and technology gap. The data were gathered from both FLD plots as well as control plots. Finally the extension gap, technology gap, technology index along with the benefit cost ratio was worked out with the help of formula [5] as described below:

Technology gap= Potential yield - Demonstration yield

Extension gap= Demonstration yield - Farmer's yield

$$\text{Technology index (\%)} = \frac{\text{Potential yield} - \text{Demo.yield}}{\text{Potential yield}} \times 100$$

Table 1: Comparison of practices between demonstration and local control (farmer practice) in Soybean

Particulars	Soybean	
	Demonstration	Farmers Practice
Farming situation	Rainfed	Rainfed
Variety	JS 95-60 and JS 93-05	JS-335
Time of sowing	25 June to 07 July	25 June to 07 July
Method of sowing	Line sowing	Line sowing
Seed rate	80 kg/ha	120 kg/ha
Fertilizer as per STV	NPK 25:60:40:20 kg/ha	NPK 18:46:00 kg/ha
Seed treatment and inoculation	With Carboxin 17.5 + Thiram 17.5 @ 2.5 ml/kg of seed and inoculation with Rhizobium and PSB @ 5 g/kg of seed	Nil
Weed management	Post-emergence herbicide (Imazethapyr 10% SL)	Hand weeding
Plant protection	Need based application of insecticide (Betacyfluthrin+ Imidacloprid, Thiacloprid)	Profenofos+cypermethrin
Time of harvesting	8-15 October	15-25 October

Table 2: Critical inputs and technological packages distributed under front line demonstrations of Soybean

Year	No. of demonstrations	Variety	Technology demonstrated	Need based input distributed
2016-17	66	JS 95-60	Improved variety, seed treatment, inoculation, NM, WM and IPM	Improved seed (20 kg/ha), soil testing, seed treatment with Carboxin 17.5 + Thiram 17.5 @ 2.5 ml/kg of seed and inoculation with Rhizobium and PSB @ 5 g/kg of seed, Imazethapyr 10 % SL @ 1 lit/ha, Betacyfluthrin+ Imidacloprid for white fly and catterpillar, Thiacloprid for girdle beetle, on and off campus trainings, field day and exposure visits
	34	JS 93-05		
2017-18	50	JS 93-05	Improved variety, seed treatment, inoculation, NM, WM and IPM	Improved seed (20 kg/ha), soil testing, seed treatment with Carboxin 17.5 + Thiram 17.5 @ 2.5 ml/kg of seed and inoculation with Rhizobium and PSB @ 5 g/kg of seed, Imazethapyr 10 % SL @ 1 lit/ha, Betacyfluthrin+ Imidacloprid for white fly and catterpillar, Thiacloprid for girdle beetle, on and off campus trainings, field day and exposure visits

Results and Discussion

Results pertaining to the demonstrations indicated that the improved cultivation practices comprised with the use of improved variety (JS 95-60 and JS 93-05), line sowing, balanced application of fertilizers and control of pest at economic threshold level following integrated pest management practices increased the yield and profitability under demonstrations. The maximum number of branches

(3.2 and 3.5) and pods per plant (42 and 48) were recorded in demonstrations as compared to farmer's practice (branches 2.95 and 3.0) and pods (32 and 34) during both the years of study, respectively (Table 5). Yield parameters enhanced with inclusion of improved package of practices under demonstrations over existing farmers practice as shown in Table 3. Results revealed that performance of soybean productivity was comparatively much higher in the demonstrated plots than the farmer's practice. The average increase in yield (1880, 1936 and 1781 kg/ha) was recorded highest in demonstrations plots whereas the lowest average yield (1324, 1449 and 1289 kg/ha) was recorded in local variety during both years, respectively. On two year average data basis, the maximum yield (1866 kg/ha) was recorded in recommended practice while minimum yield (1354 kg/ha) was observed in farmer's practice. The demonstration plot registered on an average of 37.48 % more yield over local practices. In addition, data revealed that the soybean yield fluctuated significantly over the years in demonstration plot due to climatic factors and management practices. The results clearly indicated the positive effects of FLDs over the existing practices toward enhancing the productivity of soybean (Table 3).

The extension gap also appeared an increasing trend. The extension gap ranging between 556, 487 and 492 kg/ha during the period of study also emphasizes that there is need to educate the farmer through various means for adoption of good agricultural practices to reverse the trend of wide extension gap. The trend of technology gap (ranging between 220-419 kg/ha) reflects the farmer's cooperation in carrying out such demonstrations with encouraging results in subsequent years. The performance study of the technology demonstrated was found to be better than the farmers practice under same environment conditions. The farmers were trained and motivated by seeing the results in terms of productivity and income. They are now embracing the soybean varieties *i.e.* JS 95-60 and JS 93-05 by adopting good agricultural practices. The lower value of technology index showed that there is more feasibility of technology. As such fluctuation in technology index (ranging between 10.48-23.53 %) may be attributed to the dissimilarity in soil fertility status, weather conditions, non-availability of water and insect pest attack in the crop during the study period in certain region (Table 3).

The maximum gross monetary return (Rs. 55332 and Rs. 53430/ha) was recorded in recommended practice while minimum gross monetary return (Rs. 40209 and Rs. 40620/ha) was recorded in farmer's practice during both the years, respectively. Moreover, the maximum net monetary returns (Rs. 27513 and Rs. 27312/ha) was recorded in recommended practice whereas minimum net monetary return was observed in farmer's practice (Rs. 14209 and Rs. 16520/ha). The highest B:C ratio (1.98 and 2.05) was noted in recommended practice as compared to farmers existing practice (1.54 and 1.68) during both the years of study, respectively (Table 4). Hence, favorable benefit cost ratio proved the economic viability of the interventions and convinced the farmers on the utility of interventions.

Table 3: Productivity, technology gap, extension gap and technology index under recommended and farmer practices

Year	Variety	Sample No. of farmers	Seed yield (kg/ha)			% increase over control	Tech. gap (kg/ha)	Extension gap (kg/ha)	Technical index (%)
			Potential	FLD	FP				FLD
2016-17	JS 95-60	66	2100	1880	1324	41.99	220	556	10.48
	JS 93-05	34	2200	1936	1449	33.60	264	487	13.64
2017-18	JS 93-05	50	2200	1781	1289	38.18	419	492	23.53
Average	-	-		1866	1354	37.48	167.68	511.66	15.88

Table 4: Comparative study of economics of demonstrations and farmer practices

S. No	Village covered	Block	No. of Farmers	Area (ha)	Cost of Cultivation (Rs./ha)		Gross Monetary Return (Rs./ha)		Net Return (Rs.)		B:C ratio	
					Demo.	FP	Demo.	FP	Demo.	FP	Demo.	FP
1	Sodpur, Ruparel, Undeli, Bodgaon	Nalcha & Sardarpur	100	40	27819	26000	55332	40209	27513	14209	1.98	1.54
2	Moregaon	Sardarpur	50	20	26118	24100	53430	40620	27312	16520	2.05	1.68

* Rate of Soybean in the Mandi of Dhar was Rs 2900/q and Rs 3000/q during 2015-16 and 2016-17 respectively

Table 5: Yield attributing data of crop-

S. No.	Year	Crop	Yield attributing characters					
			Av. no of pods/plant		No of Branches /Plant		Seed weight (100 seed)	
			Demo.	FP	Demo	FP	Demo	FP
1	2016-17	JS 95-60	42	32	3.2	2.95	12.54	11.5
		JS 93-05	48	34	3.5	3.0	12.10	11.20
2	2017-18	JS 93-05	45	34	3.4	3.0	11.90	11.0

Conclusion

On the basis of above findings, It is concluded that the technology gap can be reduced to a considerable extent by adopting of improved soybean varieties *viz.* JS 95-60 and JS 93-05 and scientific methods of cultivation to increase productivity of soybean in the district. It was observed that potential yield can be achieved by imparting scientific knowledge to the farmers, providing the quality need based inputs and their proper utilization. Horizontal expansion of improved technologies may be achieved by organizing such demonstrations and implementation of various extension activities like training programme, field days, exposure visit *etc.* at the farmer's fields. The trend of technology gap reflected the farmer's cooperation in carrying out demonstrations with encouraging results in subsequent years. Moreover, extension institutes like Krishi Vigyan Kendra in the district may play the lead role in providing proper technical support for welfare of the farming community through organizing of different educational and extension activities and also may reduce the extension gap for better oilseed production and productivity in the district.

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Input distribution to tribal farmers


On campus training to the tribal farmers


Demo. Plot of chick pea during 2016-17


Demo. Plot of chick pea during 2017-18

Off campus training to the tribal farmers


Field day under TSP

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