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Economics and Impact of FLD on Broccoli Yield at Farmers Filed of Aizawl District Mizoram

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ABSTRACT

The Present study was carried out by Krishi Vigyan Kendra in Aizawl district during Rabi season of 2016-17 and 2017-18. Frontline demonstrations were conducted on broccoli in 16 ha by the active participation of 30 farmers with the objective of expand improved technologies of broccoli. The improved technologies included use of introduction of high yielding variety Solan Green Head, Integrated nutrient with IIHR Arka Special, gravity type rain-port micro sprinkler system, mulching, weed management, integrated pest and disease management. The results of demonstration showed that farmers could increase the broccoli productivity notably by switching over to improved variety and adoption of good agriculture practices. The demonstrated recorded an average yield ranging from 15100– 16300 kg/ha with a mean of 15700 kg/ha. The per cent increase in demonstration yield over the farmers' practice during 2016-17 and 2017-18 was 19.20% and 23.31% respectively. The extension gap was 3200- 3800 kg/ha, whereas the technology gap was 2900- 1700 kg/ha. The technology index was 16.11- 9.44% during the period under study. The demonstrated field gave higher mean gross return (₹ 471000 /ha) and mean net returns (₹ 347500 /ha) with average benefit cost ratio of 2.81 compared to benefit cost ratio of 2.44 under local checks. The results highlighted the fact that yield and economics of broccoli can be enhanced by the adoption of recommended technology.

Keywords: Broccoli, yield, frontline demonstration, INM, net return, technology gap, extension gap

Sprouting broccoli (*Brassica oleracea* var. italica L.) is a native of eastern Mediterranean region, derived from ancient forms of *Brassica oleracea*. Italy is a centre of diversification (Singh and Nath, 2012). Broccoli is an Italian word originated from Latin 'Brachium' meaning an arm or branch (Thamburaj and Singh, 2013). Sprouting broccoli is cherished for its delicious taste, flavour and richest source of protein and vitamin A among cole crops and contains vitamin A 130 and 22 times higher than cauliflowers and cabbage, respectively and also contain thiamine, riboflavin, niacin, vitamin C, minerals (Ca, P, K and Fe) and rich in selenium that acts as an antioxidant. It has a very powerful anticancer compound, glycosinolates (40-80 mg/100 g fresh) which provides protection against bowl cancer. It is also a rich source of sulphoraphane, a compound associated with reducing the risk of cancer (Hazra, Chattopadhyay, Karmakar and Dutta, 2011). The head of broccoli contains following nutrients per 100 g of edible portion; moisture 89.9 g, carbohydrates 5.5g, fat 0.2g, protein 3.3g, vitamin A 3500 IU, thiamine 0.05 mg, riboflavin 0.12 mg, phosphorous 79 mg, calcium 80 mg, iron 17 mg, ascorbic acid 137 mg and calories 37 g (Singh and Nath, 2012).

The cultivation of broccoli is very popular in the developed world and in Mizoram is gaining popularity as a commercial crop because of its remunerative cash crops, highly nutritional and medicinal properties believed that its consumption to decrease the incidence of human cancer. Broccoli is being cultivated in 163 hectares in Aizawl District of Mizoram with production of 1.157 mt. However the average productivity of cauliflower and broccoli in the state is 7.65 mt//ha only which is less than the two time of the national average 17.34 mt/ha (Technical Bulletin No. 51 Vegetable Statistics & Horticulture Statistical, Directorate of Horticulture Govt. of Mizoram 2013) due to lack of technological know-how, non availability of suitable variety (high yielding or hybrid), do-how, interventions, imbalanced and non judicious uses of critical inputs etc. Frontline demonstration (FLD) is the concept of field demonstration evolved by the ICAR with the inception of the Technology Mission on Oilseeds during mid eighties to show the performance of new varieties including recommended production technologies on farmers' fields under real farm situations for increasing productivity and returns. In this context the present frontline demonstration was taken up by Krishi Vigyan Kendra Aizawl at farmers' fields of tough terrain of Aizawl district of Mizoram, India to showcase the high yielding new varieties to farmers and extension functionaries for further wide scale diffusion of the technology.

MATERIALS AND METHODS

The frontline demonstrations were conducted by Krishi Vigyan Kendra, Aizawl in Aizawl district during 2016-17 and 2017-18. Thirty farmers were selected for front line demonstrations on Broccoli variety Solan Big Head. The critical inputs were supplied to farmers and applied as per the package of practices for Broccoli crop recommended by CSK HPKV, Palampur 2013. The information on demonstrated package of practices and farmers practices followed are discussed in Table 1.

Demonstrations at farmer's fields were regularly monitored by scientists of Krishi Vigyan Kendra, Aizawl from sowing to harvesting and marketing. Randomly 10 farmers from each village were selected to making a total sample size of thirty. Basic data of the respondents were collected before and after frontline demonstration by personal interview with the help of well-structured interview schedule. The interview schedule was developed through discussion with experts, scientist and extension officers of horticulture department in the district. Before initiating the demonstration, the beneficiary farmers were given with skill training on various technological interventions to be followed in broccoli cultivation. The yield and economic performance of frontline demonstrations, the data on output were collected from FLDs as well as local plots and finally the head yield, cost of cultivation, net returns with the benefit cost ratio was worked out. Data collected on demonstrated plot yield was obtained using the data from frontline demonstrations conducted in the farmer's field under the close supervision of scientists from Krishi Vigyan Kendra, Aizawl in different locations of the district. Further, information on actual yield obtained by the farmers on their farms under their own management practices was collected. The gathered data were processed, tabulated, classified and analyzed in terms of mean percent score and ranks in the light of objectives of the study. Using these data the differences between potential yield and demonstration plot yield (Yield gap-I), difference between demonstration plot yield and actual yield or yield under existing practice (Yield gap- II) and difference between potential yield and actual yield (Total yield gap) were worked out. The extension gap, technology gap and technology index were calculated using the formula as suggested by Samui *et al*. (2000).

Technological gap (yield gap-I)	= Potential yield – Demonstration plot yield
Extension gap (yield gap-II)	=Demonstration – Actual yield (Farmers plot yield practice)
Total yield gap	= Potential yield – Actual yield.
Technology index (%)	= Technology gap/Potential yield × 100

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized as below:

Growth attributes and yield

A comparison of growth attributes and yield performance between demonstrated practices and

Table 1: Comparison of FLD interventions and farmers' practices

Package of practice	Frontline Demonstration (Demonstrated Package)	Farmers Practice (Local Check)
Variety	Solan Green Head	Local (non-descriptive)
Seed treatment	Seed treated with fungicides/ trichoderma	Not followed
Raising the seedling nursery	The nursery-bed was prepared in side polyhouse by addition of well rotten FYM or vermicompost @ 4-5 kg/ m^2. The width of the nursery bed maintain 100 cm and length 3 m. Drenched the nursery-bed with dithane M-45 @ 2 g/ l water (0.2 %) for reduce the incidence of damping-off disease. Sowed the seeds in rows 6-8 cm apart at a rate of approximately 800-850 seeds/ m^2. Followed by Covered the bed surface with a thin layer of mixture of sand, soil and FYM/ vermicompost.	The nursery-bed was protected from heavy rains by cladding overhead polythene sheet. The seed are sowed broadcasting methods at a rate of approximately 1460-1650 seeds/ m^2. Followed by Covered the bed surface with non treated guuny bag which was promote attack of termite or other insect.
Spacing	45 × 45 cm	60 × 40 cm
Nutrient management	Recommended INM practices: NPK 75:40:30 kg/ha + VC 2.5t/ha + Slacked Lime 2 t/ha + IIHR Special 4 kg/ha Lime @ 2 t/ ha was incorporated to correct the soil acidity and to increase the availability of molybdenum. Besides lime and Vermicompost, the crop was fed with N: P: K @ 75:40:30 kg/ ha. Half dose of nitrogen and full doses of phosphorus and potash were applied as basal dressing. Remaining nitrogen was side-dressed just before start of heading (40-50 days after transplanting). Application of IIHR Special 4 kg/ha was help in managing the micronutrients deficiency.	Lime 50 kg/ha and poultry manure @ 5 t/ ha was applied at the time of field preparation. Besides lime and Vermicompost, the crop was fed with N: P: K @ 100:60: 60 kg/ha to produce good crops. Half dose of nitrogen and full doses of phosphorus and potash were applied as basal dressing at the time of transplanting. Remaining nitrogen was side-dressed just before start of heading not applied any micronutrients.
Irrigation	Gravity type Rain-port Micro sprinkler system) Mini Sprinkle: Calibrated discharge 16-18 Lph. Spreading Diameter: 3- 5 m	Manually through pipe at 3-4 days intervals
Weed management	Post-transplanting care with one weeding/ hoeing followed by mulched with dry grass leave with thickness of 5 cm for facilitate better aeration and plant stand, and avoid water and nutrient competition..	2-3 weeding/ hoeing and an earthing-up
Plant protection measures	Need based were applied with combination of biopesticides: Sprayed the young seedling with carbendazim (1g) + Mancozeb (2g) for control of Dampping Off. Sprayed the copper oxychloride (0.3%) + Streptomycine sulphate (100 ppm) for control of soft rot & black rot. For control of aphid, diamond back moth and cabbage borer sprayed 3 -4% Arka Neem Soap, DDVP @ 1 ml / water.	Spraying of pesticides without identified pest and disease.
Harvesting	Manual	Manual

local checks is shown in Table 2. The results indicated that the demonstration of Broccoli variety Solan Green Head with integrated crop management practices recorded higher gross plant weight (884.45g), number of leaves per plant (13.90 no.), Leaf weight/ plant (467.15g) and head weight (264.70 g) when compared to farmers practices which were gross plant weight (819.3g), number of leaves per plant 13.80 no.), Leaf weight/ plant (422.4g) and head weight (234.4 g) recorded in farmers practice.

Table 2: Growth attributes and yield of broccoli (pooled data for 2016-17 & 2017-18)

Parameter	Demonstration	Farmers Practices
Gross plant weight (g)	884.45	819.3
Number of leaves/ plant	13.90	13.80
Leaf weight/ plant (g)	467.15	422.4
Head weight (g)	264.70	234.4
Yield q/ha	157.00	123.50

Yield gap

The potential yield of broccoli was found to be 180.00 qt/ha and the demonstration plot yield was sustainable higher than that in the local check in all the years of the study (2016-17 and 2017-18) which was recorded 151 qt/ha & 163 qt/ha by frontline demonstrations during 2016-17 and 2017-18 respectively (Table 3).

Table 3: Yield and yield difference of broccoli under front line demonstrations

Year	No. of FLDs	Yield (kg/ha)		Additional yield over local check (kg/ha)	Per cent increase yield over local check
		FLD	Local Check		
2016-17	30	15100	12200	2900	19.20
2017-18	30	16300	12500	3800	23.31
Mean	**30**	**15700**	**12350**	**3350**	**21.25**

Whereas the actual yield obtained by the farmers on their farm with their own management practices was obtained 122 qt/ha & 125 qt/ha during 2016-17 and 2017-18 respectively. It performed better in demonstration plots due to best management practices like Introduction of high yielding variety, integrated nutrient management, micronutrient management, weed management, micro irrigation and pest management practices. Thus the FLD might have a positive impact on farming community in the district over local Aizawl enhanced yield to a tune of 19.20% during 2016-17 and 23.31% during 2017-18 respectively, over the local check. The results indicated that the front line demonstrations have given a good impact over the farming community of Aizawl district as they were motivated by the new high yielding varieties and good agricultural practices applied in the FLD plots. This finding is in corroboration with the findings of Dhaka *et al*. 2015; Lal *et al*. 2016; Meena *et al*. 2016 and Verma *et al.* 2016 and Singh *et al*. 2017. Yield of the front line demonstration trials and potential yield of the crop was compared to estimate the yield gaps which were further categorized into technology and extension gaps (Hiremath and Nagaraju, 2009).

Technology gap

The technology gap is the difference or gap between the demonstration yield and potential yield and it was 2900 and 1700, 2016-17 and 2017-18 respectively (Table 4). The technological gap may be attributed to the dissimilarity in the soil fertility status, acidity to erratic rainfall and other vagaries of weather conditions (Mukharjee, 2003).

Table 4: Yield gap and technology index

Year	No. of FLDs	Technology gap (kg/ha)	Extension Gap (kg/ha)	Technology Index (%)
2016-17	30	2900	3200	16.11
2017-18	30	1700	3800	9.44
Mean	**30**	**2300**	**3500**	**12.77**

Extension gap

The extension gap is the difference or gap between demonstration yield and farmers practices (control). Extension gap ranged from 3200 – 3800 kg/ha during the period under study (Table 4). This extension gap should be assigned to adoption of improved transfer technology in demonstrations practices resulted in higher head yield than traditional farmer practices. This emphasized the need to educate the farmers through various means for more adoption of improved high yielding varieties and newly improved agricultural technologies to bridge the wide extension gap. More use of new high yielding varieties by the farmers will subsequently change this alarming trend of galloping extension gap. The new technologies will eventually lead to the farmers to discontinuance of old varieties with the new technology. This finding is in corroboration with the findings of Hiremath and Nagaraju (2010).

Table 5: Economics of frontline demonstrations

Year	Cost of cultivation (₹/ha)		Gross Return (₹/ha)		Net Return (₹/ha)		B: C Ratio	
	FLD	Local Check	FLD	Local Check	FLD	Local Check	FLD	Local Check
2016-17	1,20,000	1,05,000	4,53,000	3,66,000	3,33,000	2,61,000	2.77	2.48
2017-18	1,27,000	1,10,000	4,89,000	3,75,000	3,62,000	2,65,000	2.85	2.40
Mean	**123500**	**107500**	**471000**	**370500**	**347500**	**263000**	**2.81**	**2.44**

Technology Index

The technology index shows the feasibility of the variety and evolved technology at the farmer's fields and a lower the value of technology index is the feasibility more. The technology index was reduced from 16.11 to 9.44 per cent during 2016-17 to 2017-18 (Table 4) which shows the higher feasibility of the demonstrated technology. This finding corroborates results of Lal *et al*. 2016; Meena *et al*. 2016 and Poonia *et al*. 2017.

Economics of front line demonstration

Economic analysis of yield performance revealed that besides higher production, participating farmers in FLDs realized a higher price of than produce compared to that in the local checks during the period under study. The economics of broccoli head production under front line demonstrations have been presented in Table 5. The results of economic analysis of broccoli production revealed that mean cost of cultivation increased in demonstration practice (₹ 123500/ha) as compared to Farmers practice plot check (₹ 107500 /ha) and it was recorded higher mean gross return (₹ 471000 /ha) and mean net returns (₹ 347500 /ha) whereas in farmers practice the mean gross returns (₹ 370500 /ha) and mean net returns (₹ 263000 /ha). And with the average benefit: cost ratio of demonstration plot (2.81) compared to the farmers practice (2.44) over the study period. These results are in line with finding of Meena *et al*. 2016; Verma *et al*. 2016 and Poonia *et al*. 2017.

CONCLUSION

The study concluded that the FLD programme is an effective tool for increasing the production and productivity of broccoli and changing the knowledge, attitude and skill of the farmers. This has not only resulted in socio-economic security but also helped in attaining food and nutrition security to the community. This will subsequently increase the income as well as the livelihood of the farming community. The mean per cent increment in yield of broccoli to the extent of 21.55 in demonstration over the farmers practice created greater awareness and motivated the other farmers to adopt the improved package of practices of broccoli crops. The concept of frontline demonstration may be applied to all farmer categories including progressive farmers for speedy and wider dissemination of the recommended practices to other members of the farming community.

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