



Impact of fertigation in capsicum (*Capsicum annuum*) on socio economic status of marginal farmers of Chamba, Himachal Pradesh

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ABSTRACT

Vegetables have been the backbone of agricultural economy of India. The productivity of most of vegetables in Chamba district is low due to non-adoption of improved package of practices. Therefore, efforts have been made through front line demonstrations (FLDs) to demonstrate improved production technologies to increase productivity. FLDs on fertigation with water soluble fertilizers in capsicum (*Capsicum annuum* L.) were conducted at different locations in Chamba district of Himachal Pradesh during 2018 and 2019. The results of demonstrations showed that farmers could increase the capsicum productivity by switching over to adoption of improved production technology. Most of the farmers who tried it were convinced with fruit yield, quality and colour. During the year 2018, average high yield obtained in demonstration was 675 q/ha with 29.81% increase over check (520 q/ha). During second year also demonstration yield was higher (806 q/ha) with 46.54% increase over check (550 q/ha). The benefit:cost ratio was also high in demonstration (8.0 and 9.4) and low in check (6.8 and 4.8). The adoption of fertigation technology in farmers' field greatly affected the economy of the farmers of the district. Technological and extension gaps exist in the district which can be bridged by popularizing package of practices and location specific integrated approaches.

Keywords: Extension gap, Front line demonstration, Technology gap, Yield

Capsicum (*Capsicum annuum* L.) is one of the most important vegetables in India. Capsicum is day-neutral plant belonging to the Solanaceae family, which requires mild climate for its growth and development. The fruits are harvested either at green mature stage or at colouring stage and are a very good source of vitamin A and C. It also contains appreciable amount of protein, calcium, thiamine, riboflavin and niacin. The plant grows at soil temperatures between 18–35°C (Kumari and Kaushal 2014). The crop requires day temperature of 25–30°C and night temperature of 18–20°C with relative humidity of 50–60 %. Fruit setting is affected if temperature exceeds 35°C or falls below 12°C. The root system is highly branched, located up to 20–30 cm of soil layer (Tiwari *et al.* 2013). The crop is very sensitive to environmental factors. Owing to its sensitivity

to environmental factors, its yield is affected significantly. Prevailing low night temperature, high rainfall, hails, frost, higher relative humidity and cold wind are limiting factors for growing sweet pepper under open field conditions. To make its cultivation successful, low and medium cost polyhouses are the viable approach for cultivation of high value vegetables during winter and spring season (Chandra *et al.* 2000). Further, efficient application of water and nutrients plays a major role in achieving maximum yield in vegetable crops when grown under polyhouse conditions (Singh *et al.* 2003). Thus judicious use of these resources through more efficient methods of application like drip irrigation is necessary to enhance the yield, water use efficiency and nutrient use efficiency.

Drip irrigation provides water and fertilizer through drippers directly into the root zone of each plant. It is eco-friendly irrigation system saving maximum up to 60% water and results in an increase in the yield to the extent of 30–40% over existing methods (Magar and Nandgude 2005). Moreover, this system recharges the root-zone and maintains the uniformity of seed-zone moisture throughout the planting area for a longer period as compared to conventional method of irrigation (Kumar *et al.* 2017). The added advantage of drip system is that water soluble fertilizers can also be applied through this system and the process is known as fertigation. Fertigation leads to saving

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of fertilizer by 25–40%, increased returns and reduced leaching of the nutrients (Sandal and Kapoor 2015).

The front line demonstration is an important method of transferring the latest package of practices to the farmers. Though this, farmers learn latest technologies of crop production under real farming situation at his own field. In India, farmers are still producing crops based on the knowledge transmitted to them by their ancestors leading to an unscientific agronomic, nutrient and pest management practices. As a result, they often fail to achieve the desired potential yield of various crops and varieties. Keeping in view the constraints, Krishi Vigyan Kendra, Chamba conducted front line demonstrations in capsicum to ensure better livelihood, high nutritional security and economic empowerment of marginal farmers.

MATERIALS AND METHODS

Front line demonstrations were conducted during the year 2018 and 2019 in different villages of District Chamba, Himachal Pradesh, India. The mean annual rainfall of the study area is 1000 to 1200 mm. The mean annual temperature lies between 14.2–22.1°C. The agro climatic zone is sub temperate, sub humid, and cereal, pulse, fruit and vegetable based cropping systems are predominant in this zone (Table 1). The KVK, Chamba has adopted 14 villages for conducting front line demonstration and other crop improvement activities in Chamba district based on the concept of improving farmers' practical knowledge in cultivation of various crops, and increasing the net returns. Out of these adopted villages, five villages, viz. Bhanouta, Dulla, Kiri, Banjal and Lagga were selected for conducting the present FLD. Capsicum is one of the main cash crops grown by small and marginal farmers under polyhouse conditions in these villages. KVK scientists on their frequent visits to these villages identified the problem of low yields. To achieve maximum yield and quality fruit under polyhouse efficient use of nutrients was suggested and demonstrated by the scientists of KVK. To solve low yield problem KVK scientists demonstrated application of water soluble fertilizers through drip irrigation system. Drip fertigation results in proper and timely application of water and fertilizers directly into the root zone of the plant, less

weed infestation, reduces labour, and leads to water and fertilizer saving. Thus a front line demonstration (FLD) on fertigation with water soluble fertilizers (WSF) was planned in capsicum to increase the yield and productivity which in turn would improve the socio economic status of the farmers.

The critical inputs were applied as per the scientific package of practice recommended by Dr Y S Parmar University of Horticulture and Forestry. There are only two treatments laid in any FLD. Those are T1 (Demo) and T2 (Check). In present FLD, these were T1: adoption of fertigation at regular intervals in capsicum under polyhouse and T2: Farmers' practice (Check). In three villages (Bhanouta, Dulla and Kiri) green capsicum cv. Indira was cultivated, and in remaining two villages (Banjal and Lagga) coloured capsicum cv. Orebella was cultivated. In demonstration NPK @50 kg/ha was applied as basal through urea, SSP and MOP. Further, remaining NPK @150 kg/ha was applied through fertigation in equal splits twice a week by using 19:19:19 WSF. Opinion of the farmers about technologies used under demonstration was collected for further improvement in research and extension activities. Complete data was collected from farmers about demo and check on fruit yield, cost of cultivation, gross returns, net returns, benefit:cost ratio, per cent increase in yield and finally the technology and extension gaps were estimated. To estimate the technology gap, extension gap and technology index given formulae were used (Matharu and Tanwar 2018).

Technology Gap = Potential yield – Demonstration yield.

Extension Gap = Demonstration yield – Farmer's yield.

$$\text{Technology Index (\%)} = \frac{\text{Technology gap}}{\text{Potential yield}} \times 100$$

RESULTS AND DISCUSSION

Yield parameters: The results indicated that the demonstration of capsicum cv. Orebella and cv. Indira with fertigation recorded higher crop yield. The capsicum yield of different locations varied from 650 to 700 q/ha and 762 to 857 q/ha during 2018 and 2019, respectively. Average yield data from five locations in the year 2018 was 675 q/ha

Table 1 Agro-climatic details of different villages

Village	Agro-climatic zone	Altitude (amsl)	Latitude Longitude	Cropping system
Bhanouta	Sub-tropical Sub mountain and low hills	890 m	32° 36.89'N 76° 04.23'E	Wheat-maize-vegetables
Dulla	Sub humid- Sub temperate and mid hills	944 m	32° 35.13'N 76° 05.25'E	Wheat-maize-Vegetables
Kiri	Wet temperate and high hills	1660 m	32° 33.54'N 76° 15.13'E	Wheat-maize-vegetables-pulses-fruits
Banjal	Wet temperate and high hills	2689 m	32° 32.09'N 76° 16.25'E	Wheat-maize-vegetables-pulses-fruits
Lagga	Wet temperate and high hills	2530 m	32° 31.57'N 76° 15.25'E	Wheat-maize-vegetables-pulses-fruits

Table 2 Yield and yield difference of capsicum under front line demonstrations and check

Year	Yield (q/ha)		Per cent increase over check	Technology Gap	Extension Gap	Technology Index %
	Demo	Check				
2018	675	520	29.81	225	155	25
2019	806	550	46.54	94	256	10.44
Mean	740.5	535	38.17	159.5	205.5	17.72

Table 3 Economics of front line demonstrations and check

Year	Economics of demonstration (₹/ha)				Economics of check (₹/ha)			
	Gross cost	Gross return	Net return	B:C ratio	Gross cost	Gross return	Net return	B:C ratio
2018	6,00,000	54,00,000	48,00,000	8.0	4,00,000	31,20,000	27,20,000	6.8
2019	6,00,000	56,42,000	50,42,000	9.4	4,00,000	19,25,000	15,25,000	4.8
Mean	6,00,000	55,21,000	49,21,000	8.7	4,00,000	25,22,500	21,22,500	5.8

obtained in demo plot and 520 q/ha obtained in farmers' practice (Check). In the year 2019, average yield of demo was 806 q/ha where as in check average yield was 550 q/ha (Table 2). Yields of demo plots were higher because of more efficient utilization of water and soluble fertilizers at root zone of plants through drip irrigation. FLD also results in increased fruit size, shelf life and quality of fruits. Thus, the FLD might have a positive impact on farming community due to enhanced yield to a tune of 29.81% and 46.54% during 2018 and 2019, respectively, over check. These findings are in the conformity with the results of Singh (2017) in tomato. Kapoor and Sandal (2018) reported significant increase in capsicum growth parameters, marketable yield and nutrient use efficiency under drip fertigation as compared to conventional method of fertilizer application.

The potential yield of capsicum grown under polyhouse was 900 q/ha (average). The technology gap is the difference between the potential yield and demonstration yield and it was 225 q/ha and 94 q/ha during 2018 and 2019, respectively (Table 2). The technological gap may be attributed to the dissimilarity in the soil fertility status, acidity to erratic rainfall, proper seed rate and spacing, marginal land holdings and other environmental factors (Mishra *et al.* 2007). Further, the extension gap is the difference between demonstration yield and check and it was observed to be very wide (155 q/ha and 256 q/ha) during 2018 and 2019, respectively (Table 2). This emphasized the need to educate the farmers through various extension means for the adoption of scientific practices in cultivation of all the vegetable crops to bridge the wide extension gap. The technology index shows the feasibility of the improved technology at the farmers' fields. The lower is the value of technology index; the more is the feasibility of technology demonstrated. The technology index was reduced from 25% to 10.44% during 2018 to 2019, respectively, which shows the higher feasibility of the demonstrated technology in the district (Table 2).

Economic impact: Economic analysis of yield performance revealed that besides higher cost of cultivation, participating farmers in FLDs realized a higher price

compared to that in the local checks during the period under study. Cost of cultivation was highest in demo due to high cost of input materials used like water soluble fertilizers (19:19:19) as compared to conventional fertilizers. Net profit was highest in demo plot compared to check plot (Table 3). The reason was high yields and good quality capsicum. The benefit:cost ratio in demo plot was 8:1 and 9.4:1 during 2018 and 2019, respectively. The results were in conformity with the findings of Karipe and Krishnaveni (2017). Hence, the awareness and adoption of recommended scientific package of practices have increased the socio economic status of farming community.

From the present study, it could be concluded that frontline demonstration was successful in changing the outlook of the farmers towards use of water soluble fertilizers despite the higher initial investments. Higher production under front line demonstration over farmers' practices has created better awareness among the farmers and motivated other farmers to adopt suitable technology. Results also showed that initial investment was high in demonstration and the net profits are also very high compared to the farmers' practice. Technological and extension gaps existed which can be bridged by popularizing package of practices with emphasis on other agronomic practices like use of improved varieties, proper seed rate and spacing, timely irrigation, proper use of plant protection measures, weed management etc. Thus, the farmers can get higher returns and achieve maximum yields by adopting scientific methods of cultivation.

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