



## Fertigation management in high density apple plantation in District Chamba, Himachal Pradesh

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### ABSTRACT

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Water and nutrient most critical inputs for getting higher crop yield. However, these two inputs are even more important under high density apple plantation and essential for ensuring optimum growth of newly planted apple orchards. For high-density orchards, the economic success really depends on obtaining significant yields in the third, fourth, and fifth years to repay the establishment costs. Therefore, efforts have been made through front line demonstrations (FLD) to demonstrate the use of water soluble fertilizers through drip irrigation in high density apple plantation by Krishi Vigyan Kendra, Chamba at different locations of Chamba District, in the year 2020. During the period under study, it was observed that in front line demonstrations; the yield under demonstrations was 47.22 % higher as compared to check. The results revealed that check gives an average fruit yield of 90 q/ha, while use of water soluble fertilizers along with drip gives highest average yield of 132.5 q/ha. Similarly, the demonstration gave higher average gross returns (13,25,000 /ha) and net returns (10,75,000 /ha) with average benefit cost ratio of 4.3 compared to benefit cost ratio of 4.14 under check. With frontline demonstration of proven technology revealed that yield potential and net income from high density apple plantation could be enhanced to a great extent resulting in higher income to the apple grower.

### 1. Introduction

High density plantation concept of orcharding under different fruits is now days widely adopted by most of the farmers. Apple also has great advantage under high density plantation and now being highly adopted by apple growing states like Himachal Pradesh, Jammu & Kashmir etc. High density planting (HDP) means to increase the plant production per unit area for increasing the production of fruits (Goswami *et al.*, 2014) and accommodates more than 1000 plants per ha depending upon the spacing. Such high density plantation reduces yield ha<sup>-1</sup> but increases yield per unit area significantly, besides having an increased number of trees/ha, a high density orchard also come into bearing within 2-3 years after planting (Hampson *et al.*, 2002). To achieve this early production and to ensure optimum growth of newly planted plants, it is essential to supply all the essential

nutrients and water at the right time, right rate and right place to meet the plant requirements. Water management options include micro-irrigation systems which are well-designed to meet daily water demand of the plant. Drip irrigation is an important irrigation management system and provides the efficient use of limited water with increased water use efficiency (Kapoor and Sandal 2021). 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. The most effective way to match nutrient requirements to plant demand is through fertigation, which works best with drip. Drip fertigation optimizes the nutrient use by applying them at critical stages resulting in better nutrient uptake and higher use efficiency thus ensure water and nutrient saving as well as higher crop yield with better quality (Sandal and Kapoor 2015).

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High-density planting is highly precocious, bearing on the second year of planting and reaches full production in the 4<sup>th</sup> year, therefore, has very small payback period compared to conventional orchards (Majid *et al.*, 2018). Besides, precocity (coming to fruit-bearing within 1–2 years) is the essence of the system which is a function of dwarfing rootstock, such as Mailing series rootstocks: M9, M7, etc. (Rom and Stasiak 1990). Whereas, conventional apple plantation system uses standard type tree apples grafted on seedling rootstocks which accommodate 100–500 plants ha<sup>-1</sup> (Majid *et al.*, 2018) and starts bearing after six to eight years. Thus for high-density apple orchards, the economic success really depends on obtaining significant yields in the third, fourth, and fifth years to repay the establishment costs. Therefore, efforts have been made through front line demonstrations (FLD) to demonstrate the use of water soluble fertilizers through drip irrigation in high density apple plantation by Krishi Vigyan Kendra, Chamba at different locations of Chamba District, in the year 2020. Front line demonstrations are important method of transferring the latest package of practices to the farmers. By which, farmers learn latest technologies of crop production under real farming situation at their own field which would ensure better livelihood, high nutritional security and economic empowerment of marginal farmers.

## 2. Materials and Methods

The Front line demonstrations were conducted in three villages viz. Chacho, Banjal and Lagga of District Chamba, Himachal Pradesh, India. District Chamba is situated between North latitude 32°11' and 33°13' and East longitude 75°49' and 77°3', at an altitude 645-6776 m amsl and is surrounded on all sides by lofty hill ranges. 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 of the study area is Wet temperate and high hills at an altitude 1660-2689 m amsl. In these villages apple is one of the main fruit crop and was grown traditionally. But now with guidance of Krishi Vigyan Kendra some of the farmer's have adopted high density apple plantation. Under high density apple plantation water and nutrient management are more important and essential for ensuring optimum growth of newly planted plants. To achieve maximum yield and quality fruit under high density apple plantation efficient use of water and nutrients through drip system was suggested and demonstrated by the scientists of KVK. Drip irrigation also result in timely and proper application of water and fertilizers directly into the root zone of the plant, less weed infestation, reduces labour, increase in water and fertilizer saving. As a result, we planned a front line demonstration (FLD) on fertigation with water soluble fertilizers (WSF) in high density apple to obtain significant yield and to repay the establishment cost in the first 3-5 years.

The critical inputs were applied as per the scientific package of practice recommended by Dr. YS Parmar University of Horticulture and Forestry. There were two treatments laid in FLD are T1 (Demonstration) and T2 (Check). Here T1: Adoption of fertigation at regular intervals in high density apple plantation and T2: Farmer's practice (without fertigation). The demonstration was laid out on 3 year old apple plants cv. King rot, Jeromine, Galaval. In demonstration water soluble fertilizers viz. 19:19:19 @ 75 gm/plant, urea @ 30 gm/plant and MOP @ 25 gm/plant were applied in 15 equal splits at one week interval. In check soil application of urea, SSP, MOP was applied as basal. 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 demonstration and check on fruit yield, cost of cultivation, gross returns, net returns, benefit cost ratio, % increase in yield and finally estimated the extension gap. To estimate the extension gap following formulae have been used (Matharu and Tanwar 2018).

Extension Gap = Demonstration yield - Farmer's yield.

## 3. Results and Discussion

### Yield parameters

The results indicated that the front line demonstration of fertigation under high density apple gave higher yield. The yield of different locations varied from 125 to 140 q ha<sup>-1</sup>. The average yield under demonstration was 132.5 q ha<sup>-1</sup> where as in check average yield was 90 q ha<sup>-1</sup> (Table 1). Yields of demo plots were higher because of more efficient utilization of water and soluble fertilizers at regular intervals around the root zone of plants through drip irrigation. Fertigation with full, 2/3<sup>rd</sup> and ½ dose NPK caused increase in fruit yield over control (Banyal and Sharma 2011). FLD also results in increased fruit size and better fruit colour development (Table 2). Under FLD about 80 percent of the apple harvest falls in Grade-A of superior quality. HDP has the highest ratio of A grade (>80%) fruits which are better both in terms of quality and price (Majid *et al.*, 2018; Wani *et al.*, 2021). Thus the FLD might have a positive impact on apple grower due to enhanced yield to the tune of 47.22 per cent over check. The extension gap is the difference between demonstration yield and check and it was observed very wide (42.5 q ha<sup>-1</sup>). This emphasized the need to educate the farmers through various extension means for the adoption of scientific practices under high density apple plantation to bridge the wide extension gap.

**Table 1.**Yield and yield difference of high density apple under front line demonstrations and check.

Year	Yield (q/ha)			Check	Percent increase over check	Extension Gap
	Demo		Avg			
	Max	Min				
2020	140	125	132.5	90	47.22	42.5

**Table 2.** Data on fruit quality parameters in relation to technology demonstrated

Crop	Technology to be demonstrated	Variety	Parameter with unit	Demo	Check
Apple	Use of water soluble fertilizers in 15 splits at 1 week interval through drip irrigation	King rot, jeromine, Galaval (HDP)	Colour development in fruit (%)	90-95 %	60-70 %
			Grade A (%)	80 %	60 %
			Grade B (%)	15 %	30 %
			Grade C (%)	5 %	10 %

**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 of 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 demonstration plot compared to check plot (Table 3). The reason was higher yield and good quality apple where farmer's were getting Rs. 130-150 per kg for grade A and Rs. 100-120 per kg for grade B. Hence, the awareness and adoption of recommended scientific package of practices have increased the socio-economic status of farming community. The adoption of fertigation technology in farmers' field greatly affected the economy of the farmers of the district Chamba (Kapoor *et al.*, 2022).

**4. Conclusions**

From the present study it could be concluded that front line demonstration was successful in changing the outlook of the farmers towards use of water soluble fertilizers despite of its higher initial

investments because of manifold increase in apple productivity and better quality of produce. Thus, the farmers can get the higher returns and achieve maximum yields by adopting scientific methods of cultivation compared to farmer's old and unscientific approaches.

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**6. Conflict Of Interest**

The authors declare that they have no conflict of interest.

**Table 3.** Economics of front line demonstrations and check

Year	Economics of demonstration (Rs./ha)				Economics of check (Rs./ha)			
	Gross cost	Gross return	Net return	B:C ratio	Gross cost	Gross return	Net return	B:C ratio
2020	250000	1325000	1075000	4.3	175000	900000	725000	4.14

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