J Krishi Vigyan 2017, 6(1) : 101-104 DOI : 10.5958/2349-4433.2017.00060.5

Improving Growth, Yield and Profitability in Apple through Mulching in Rainfed Condition in Hilly Region of Uttarakhand

Pankaj Nautiyal, V K Sachan, Gaurav Papnai, R K Tiwari[1] and Manisha

Krishi Vigyan Kendra (ICAR-VPKAS), Chinyalisaur- 249 196 (Uttarkashi) Uttarakhand

ABSTRACT

Apple (*Malus domestica* Borkh.) has become pride of hill farmers for appreciably improving their economy. In rainfed area of hilly regions, where the orchards are mainly established on medium to steep slopes, make the plants prone to water stress as well as nutrient loss from the soil. In spite of no assured irrigation in the hills, the moisture conservation techniques are not in practice. Under such condition, mulching may be practiced during crop cultivation which can be a substitute of irrigation to minimize moisture and nutrient loss as well as cost of production. Considering the above factors, on farm trials were conducted at Harshil area of Uttarkashi district of Uttarakhand at 2530 ft above mean sea level during the year 2010-11 and 2011-12. The trial consisted of four treatments viz., T1, mulching with black polythene, T2, mulching with dry grasses, T3, mulching with straw and T4, clean cultivation as control. Total four treatments were replicated five times. The maximum annual growth was observed under black polythene mulch, while minimum was found under clean cultivation. The highest fruit yield was recorded in mulching with black polythene followed by mulching with dry grasses, however, lowest fruit yield was observed under clean cultivation during both the years. It can be concluded that the plastic mulch has been found efficient for enhancing growth, productivity and profitability of apple crop under rainfed condition.

Key Words: Apple, Economic analysis, Growth, Mulching, Yield.

INTRODUCTION

The major apple growing states in India are Jammu and Kashmir, Himachal Pradesh and Uttarakhand, which covers 95.4 per cent of total area under apple and 98.7 per cent of the total apple production. In India, it is cultivated on 3.20 lakh ha with production of 18.85 lakh MT and productivity of 5.89 t/ha. The overall productivity is quite low (below 6 t/ha) as compared to standard world average of 16 t/ha. In Uttarakhand alone, the apple was cultivated on 0.29 lakh ha. of land yielding 0.77 lakh MT of fruit annually (National Horticulture Board, 2014-15). It is successfully grown at an elevation range of 1600-2800 m above mean sea level (MSL) and needs chilling requirement of 1000-1600 hr at >7^{o}C (45^{o}F) to overcome the dormancy for flower bud development and flowering (Awasthi, 2001). The area under apple cultivation has increased manifold during the last four decades, however, the increase in production could not keep pace with the expansion in area (Gautam *et al*, 2005).

In recent years, there has been a gradual decline in its productivity. Several factors are attributed to this declining trend in productivity, like expansion of apple cultivation to marginal areas, supply of nutrient and availability of moisture, declining standard of soil water management, prevalence of diseases and pests, and major climatic shifts (Nautiyal and Dimri, 2009). Among various factors responsible for higher yield, supply of nutrient and availability of moisture play vital role in the production and quality of apple. Moisture is, therefore, essential for its successful production but additional irrigation causes increased cost of production. Under such conditions, mulching may be practiced in crop cultivation which can be a substitute of irrigation

(Corresponding Author's Email: pankajnautiyal2009@gmail.com)

[1]Present Address: Krishi Vigyan Kendra, Birauli (*Samastipur*), Bihar

to minimize cost of production. Mulch is again highly effective in checking evaporation and is hence recommended for most crops. Mulching also suppresses weed infestation effectively. There are several benefits of using mulch, including soil temperature modulation, enhanced fruit quality, improved soil and water management by reduced evaporation and soil erosion, reduced fertilizer leaching and suppression of weed growth which leads to better plants growth and yield.

Considering the above factors, the present On Farm Trial was undertaken to know the effect of mulching on growth and yield of apple production and identify the best mulch in respect to economic production of apple.

MATERIALS AND METHODS

The present On Farm Trial (OFT) was carried out at village Jhala (harshil area) of district Uttarkashi (Uttarakhand) during the year 2010-11 and 2011-12. The 11 to 12 yr old trees of apple cv. Royal Delicious were selected for the study. The trial consisted of four treatments viz., mulching with black polythene (100 gauge), through dry grasses (15 cm thick), straw (15 cm thick) and clean cultivation (control). The experiment was laid out in randomized block design with five replications. The growth and vigor were measured as annual extension growth of shoot. The yield attributes were obtained in terms of initial fruit set, final fruit set, yield (kg/ plant) and yield (q/ha) at the time of fruit harvesting. The economic analysis was also calculated in terms of cost of cultivation, gross return, net return and benefit cost ratio. The data were analyzed according to the procedure of analysis for Randomized Block Design. The significance of variation among the treatments was observed by applying 'F' test and critical difference at 5 per cent probability was calculated to compare the mean values of treatments for all the characters.

RESULTS AND DISCUSSION

Growth Parameters

The perusal of data (Table 1 and Fig. 1 & 2) indicate that the mulching significantly affected the growth of the plants. The annual growth of the plant was found highest (29.62 and 35.44 cm) in treatment T1 (mulching with black polythene) while treatment T4 (clean cultivation) showed the lowest annual growth during both the years of experiment. The availability of soil moisture and nutrient with less weed growth associated with mulch material can be attributed to maximum annual growth of the plant. Similar findings have also been reported by Pande *et al* (2005) and Granatstein and Mullinix (2008).

Yield attributes

The data revealed that the mulching affected the fruit yield non-significantly in first year (2010-11), while significantly affected during second year (2011-12). The highest fruit yield (kg/plant) was obtained with treatment T1 i.e. black polythene mulch (43.40 and 54.57 kg/plant) followed by dry grasses (40.62 and 50.26 kg/plant). However, the lowest fruit yield (35.31 and 37.08 kg/plant) was found with control treatment T4 (clean cultivation) during both the years of investigation. The similar trend was also observed during both the years of trial (2010-11 and 2011-12) in fruit yield in terms of q/ha. The highest fruit yield (88.53 and 110.57 q/ha) was obtained with black polythene mulch while the minimum yield (72.03 and 75.62 q/ha) was found under clean cultivation.

The maximum fruit set and highest fruit yield under black polythene mulch followed by dry grasses may probably due to the increase in soil moisture, higher nutrient availability and lesser weed infestation, however in clean cultivation less soil moisture retention and nutrient losses resulted low fruit set and fruit yield. These results were in accordance with Wiman *et al* (2009) and Neilsen *et al* (2014). .

Economic Analysis

The data pertaining to economic analysis of trial presented in Table 2 and Fig.3 & 4, reveal that the various mulches also effect on benefit cost ratio. The highest cost of treatment per hectare per year

Table 1: Effect of various mulches on growth and yield of apple cv. Royal Delicious

Treatment	Annual extension growth (cm)		Yield (kg/plant)		Yield* (q/ha)		Yield Increase %	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
T1- mulching with black polythene	29.62	35.44	43.40	54.25	88.53	110.57	22.90	46.21
T2- mulching with dry Grasses	28.02	31.94	40.62	50.26	82.87	102.50	15.04	35.54
T3- mulching with straw	24.77	28.75	38.78	49.56	79.12	101.07	09.84	33.65
T4- clean cultivation as control	21.81	25.37	35.31	37.08	72.03	75.62	-	-
CD at 5 %	2.59	2.25	NS	4.20	NS	8.55	-	-
SE(m)	0.79	0.69	2.02	1.29	4.13	2.63	-	-
CV (%)	6.13	4.56	10.24	5.41	10.24	5.40	-	-

*Plant spacing 7x7 m

(Rs. 16580 and Rs. 18150.00) accord with treatment T1 *i.e.* mulching with black polythene during both the years. However the cost of cultivation during both the years (excluded the cost of treatment) were equal to all treatments (Rs. 76,500.00/ha/year and Rs. 78,550.00/ha/year). Therefore, the cost of cultivation during both the years included cost of treatment per ha (Rs. 93,080.00/ha and 96,700.00/ha) were in accord with the treatment T1 (Black Polythene Mulching).

The maximum gross return (Rs. 3.09 lakh and 3.96 lakh/ha/year) and net return (Rs. 2.16 and Rs. 2.99 lakh/ha/year) were recorded with treatment T1 i.e. mulching with black polythene during both the years of investigation. However, the minimum gross return (Rs. 2.52 lakh and Rs. 2.6 lakh/ha/year) and net return (Rs. 1.75 lakh and 1.82 lakh/ha/year) were obtained with treatment T4 (Clean cultivation as control). The maximum benefit cost ratio (2.32 and 3.09) were obtained with black polythene mulch (T1) followed by clean cultivation (T4) during first year and dry grasses mulches (T2) during second year of trial. However, minimum benefit cost ratio (2.08) was found with the treatment T3 (Mulching with straw) during first year, while T4 (clean cultivation) in second year of experiment. The highest B:C ratio was found with black polythene mulch might due to highest fruit yield fetches higher market prices. Ghosh and Bera (2015) also reported that the maximum net return was obtained with polythene mulch in pomegranate fruit.

CONCLUSION

On the basis of On Farm Trial, it can be concluded that under hill area of Uttarakhand the apple cv. Royal Delicious recorded significantly higher annual extension growth and fruit yield with black polythene mulching. The use of black polythene mulch material can be maintained high profitability and recorded high benefit: cost ratio due to high fruit yield. Thus, for maximum return and high productivity of apple, mulching may be recommended for temperate zone of Uttarakhand and other hilly states.

REFERENCE

Awasthi R P (2001). *Apple In: Handbook of Horticulture*, Chadha, K L ed ICAR New Delhi Publication, pp 119-125.

Gautam D R, Sharma S D and Sharma G (2005). Pollination in Apple-Future Thrust for Enhancing Productivity, *Prog Hort* **37**(1):1-7.

Ghosh S N and Bera B (2015). Effect of Mulching on Soil Moisture, Yield and Quality of Pomegranate, *Indian J Soil Conservation* **43**(1):92-95

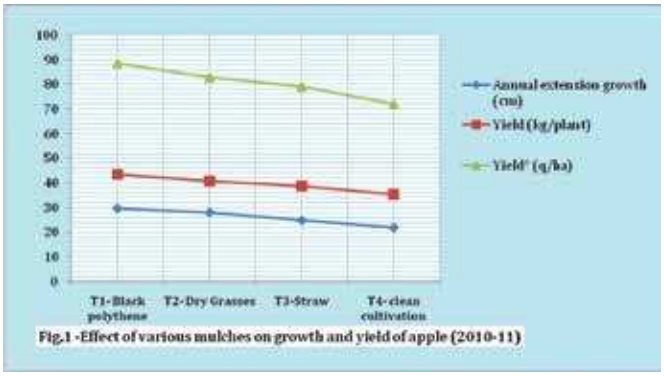

Fig.1 -Effect of various mulches on growth and yield of apple (2010-11)

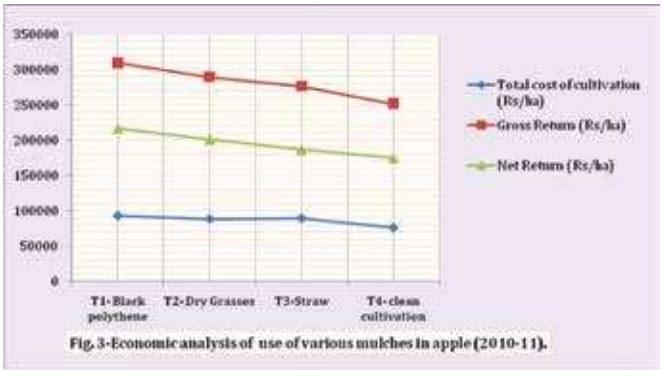

Fig. 3-Economic analysis of use of various mulches in apple (2010-11).

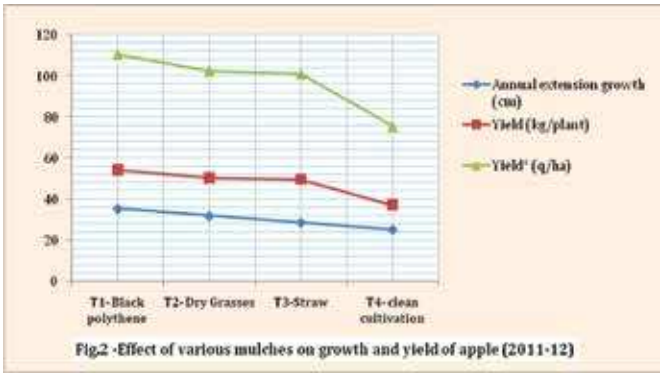

Fig.2 -Effect of various mulches on growth and yield of apple (2011-12)

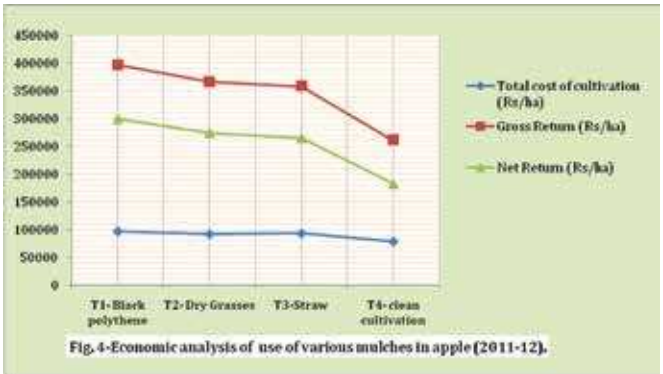

Fig. 4-Economic analysis of use of various mulches in apple (2011-12).

Table 2: Economic analysis of use of various mulches in apple cv. Royal Delicious

Treatments*	Cost of Treatment (`/ha) (a)		Cost of cultivation (`/ha) (b)		Total cost of cultivation (`/ha) (c=a+b)		Gross Return (`/ha) @35/kg (d)		Net Return (`/ha) (e=d-c)		B:C Ratio (d/c)	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
T1	16580	18150	76500	78550	93080	96700	309855	396200	216775	299500	2.32	3.09
T2	12100	13220	76500	78550	88600	91770	290045	366100	201445	274330	2.27	2.98
T3	13200	14480	76500	78550	89700	93030	276920	357700	187220	264670	2.08	2.84
T4	-	-	76500	78550	76500	78550	252105	260750	175605	182200	2.29	2.31

(*T1- mulching with black polythene, T2- mulching with dry Grasses, T3- mulching with straw and T4- clean cultivation as control)

Granatstein D and Mullinix K (2008). Mulching options for Northwest Organic and Conventional Orchards. *Hort Sci* **43**:45-50.

National Horticulture Board (2014-15). *Indian Horticulture Database*. National Horticulture Board, Gurgaon, Haryana. www.nhb.gov.in, Accessed February, 07, 2016.

Nautiyal P and Dimri D C (2009). Pollination Management in Apple for Sustainable Production. *Prog Hort* **41** (2):139-148.

Neilsen G, Forge T, Angers D, Neilsen D and Hogue E (2014). Suitable Orchard Floor Management Strategies in Organic Apple Orchards that Augment Soil Organic Matter and Maintain Tree Performance. *Plant and Soil* **378**(1): 325-335. doi:10.1007/s11104-014-2034-8

Pande K K, Dimri D C and Kamboj P (2005). Effect of Various Mulches on Growth, Yield and Quality Attributes of Apple. *Indian J Hort* **62**(2):145-147.

Wiman M R, Kirby E M, Granatstein D M and Sullivan T P (2009). Cover Crops Influence Meadow Vole Presence in Organic Orchards. *Hort Tech* **19**:558-562.

Received on 30/05/2017 *Accepted on 20/06/2017*