

Effect of Orchard Floor Management Practices on Growth, Yield and Quality Attributes of Apple cv. Royal Delicious

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ABSTRACT

The present investigation entitled “Effect of orchard floor management practices on growth, yield and quality attributes of apple cv. Royal Delicious” was carried out on a 19-year-old private apple orchard at Arabal, Shalimar Srinagar during the years 2015 and 2016. Forty five trees of uniform growth and vigour were selected for experimentation. The effects of fifteen orchard floor management practices were studied on apple cv. Royal Delicious. The treatments were replicated thrice in Factorial Randomized Complete Block Design. The results revealed that highest growth characteristics like annual shoot extension growth (49.3 cm and 50.2 cm), plant height (4.90 m and 5.02 m), plant spread (3.87 m and 3.89 m), and leaf area (77.83 cm² and 78.57 cm²) were observed with paddy straw mulch glyphosate. Maximum fruit yield (82.03 kg/tree and 80.60 kg/tree) was recorded under paddy straw mulch followed by glyphosate. Various fruit physical characteristics viz. fruit weight, fruit length and fruit diameter were significantly improved by paddy straw mulch followed by glyphosate and fruit colour with bicolour polythene mulch. Similarly, various chemical characterizes like TSS, acidity and total sugars were also significantly influenced by treatments like bicolour polythene mulch followed by paddy straw mulch followed by glyphosate.

Key words: Apple production, straw mulch, polythene mulch, cover crop, herbicides, yield, quality.

INTRODUCTION

Apple (*Malus x domestica* Borkh.) is one of the most important temperate fruit grown in northwestern Himalayas at an elevation range of 1,500 - 2,700 m amsl. Apple is the principle fruit crop of the J&K state in term of the area and production. J&K state has emerged as the largest apple-producing region in the country with the productivity of 10.27 t/ha² which is

very low as compared to other horticultural advanced countries (30-40 t/ha). Several factor including orchard floor management practices is one of the important components in harnessing the productivity of apple with better fruit quality and yield. Tree growth is greatly influenced by the use of different organic and inorganic mulch materials.

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They conserve soil moisture in the root zone of the fruit trees. The presence of adequate moisture in the root is vital for plant growth and physiological processes. Mulches retain moisture, add organic matter to the soil and increase fruit quality to a great extent. Mulching is a beneficial practice for moisture conservation, regulating soil temperature⁴, higher income from orchards²³ and results in higher yield²¹. However, information on the use of different floor management practices in apple cultivation is lacking in Jammu and Kashmir State. Therefore, present study shall be carried out to standardize these practices for adoption in the agro-climatic condition of Jammu & Kashmir with the objectives to study the effect of different practices of orchard floor management on growth, yield and quality of apple.

MATERIALS AND METHODS

The experiment was laid out on 19-20-year-old apple cv. Royal Delicious in the randomized block design with 15 treatments. Each treatment was replicated thrice having three plant per replication with respect to orchard floor management practices adopted during 2015 and 2016 with treatments, *viz.* Control (T₁), farmer practices (T₂), zero weeds (T₃), clean cultivation (T₄), bicolour polythene mulch (T₅), paddy straw mulch (T₆), oxyflourfen @ 1.0 l ha⁻¹ (T₇), atrazine @ 4.0 kg ha⁻¹ (T₈), pendimethalin @ 2.0 l ha⁻¹ (T₉), paddy straw mulch + glyphosate @ 2.0 l ha⁻¹ (T₁₀), oxyflourfen @ 1.0 l ha⁻¹ followed by glyphosate @ 2.0 l ha⁻¹ (T₁₁), atrazine @ 4.0 kg ha⁻¹ + glyphosate @ 2.0 l ha⁻¹ (T₁₂), pendimethalin @ 2.0 l ha⁻¹ followed by glyphosate @ 2.0 l ha⁻¹ (T₁₃), cowpea (T₁₄) and white clover (T₁₅). The application of mulches (paddy straw mulch 10 cm thick and polythene mulch 250 µm), sowing of white clover and cowpea were done during the second week of April when the research work was started. Cowpea was incorporated with

soil after 48 days. The commercial formulations of oxyflourfen, atrazine, pendimethalin as and glyphosate herbicide were applied as directed spray with high volume of power knapsac sprayers. Oxyflourfen, atrazine, pendimethalin was applied as pre-emergence herbicide during the second week of April, whereas, glyphosate was applied as post-emergence herbicide (first week of June). Zero weeds were done at frequent intervals and clean cultivation was at 30 days' intervals. The plant growth was measured as annual extension of current season shoots, plant height, plant volume whereas, yield attributes were observed in terms of bloom density, initial fruit set and final fruit retention along with the yield per tree at final harvest. The quality of fruits was estimated by physical (fruit weight, diameter and length) and chemical (TSS, acidity and total sugars), attributes taking a random sample of 10 fruits from each treatment at the time of harvest.

RESULT AND DISCUSSION

Different orchard floor management practices during both the year were observed to have a significant effect on plant height, spread volume and leaf area of apple, respectively (Table 1).

It is evident from the present investigation that significant variation prevailed among the different treatments with respect to annual shoot extension growth. The maximum annual shoot extension growth (49.3 cm and 50.2 cm) was recorded under paddy straw mulch followed by glyphosate, which was at par with cowpea, white clover, paddy straw mulch. and bicolour polythene mulch. The increase in annual shoot extension growth due to paddy straw mulch was associated to suppression of weed growth and increased the availability of moisture minimum losses due to evaporation from soil surface, addition of extra organic matter and nutrient to soil. The results

are in consonance with the finding of Kaith and Bhardwaj¹³, who reported maximum shoot growth under glyphosate in apple cv. Starking Delicious under Shimla condition. Highest annual extension shoot growth with white clover, cowpea and paddy straw mulches in combination with herbicides has also been reported in apple³⁰, plum²⁸, grapevine¹⁵ and cherry⁵.

Maximum plant height (4.90 m and 5.02 m), plant spread (3.87 m and 3.89 m) and plant volume (40.00 m³ and 40.19 m³) were recorded in apple tree with paddy straw mulch followed by glyphosate, which is probably due to better moisture conservation and suppression of weed resulting in better translocation of nutrients in plants than other treatments. Similarly, Bhardwaj and Kumar⁴ observed that adequate moisture in the soil is vital for physiological process in plant as well as for nutrient solubility and availability in soil solution, which makes better uptake of nutrients. It has been further substantiated by Merwin *et al*¹⁹, who concluded that besides conserving moisture, mulching suppresses the weed growth and thus enhances the uptake of nutrients. Result are also in close conformity with the results of Shirgure *et al*²⁵,; Singh *et al*²⁷, and Bal and Singh³.

Mulching treatment had significantly effect on leaf area. The maximum leaf area (77.83 cm² and 78.57 cm²) was recorded with paddy straw mulch followed by glyphosate, which was statistically at par with paddy straw mulch and cowpea. The result is in conformity with those reported by Singh and Bal³, who observed the maximum leaf area of ber under polythene mulch and paddy straw mulch.

The maximum initial fruit set was recorded under paddy straw mulch followed by glyphosate. Among different treatments, maximum final fruit set (64.8 % and 63.9 %) were resulted with paddy straw mulch followed by glyphosate during both the year of study (Table 2). This effect may be due to

better efficiency to control weeds population, more retention of moisture and also nutrient availability which in turns increased the flower primordial, carbohydrates and nutrients essential to promote flowering and fruit set in plants which ultimately lead to increase the yield. Conversely, Pande *et al*²⁰, did not found any significant difference in bloom density and initial fruit set in apple

Observation on the fruit yield (82.03 kg/tree and 80.60 kg/tree) and yield efficiency (0.216 kg/cm² and 0.213 kg/cm²) were recorded maximum under paddy straw mulch followed by glyphosate, which was statistically at par with paddy straw, cowpea and minimum was recorded with control during both the year of study (Table 2). The increase in fruit yield per plant was directly related to the reduced crop-weed competition which conserved the soil nutrient and soil water contents and ultimately favoured better yield performance under different weed control treatments. The present results are in line with the findings of Singh²⁹, and Khokhar and Sharma¹⁴, who reported that grass mulch followed by single application of glyphosate proved more effective and resulted in highest fruit yield with good quality nuts as compared to other treatments in almond under Himachal Pradesh condition. Bhutani *et al*⁷,; Ghosh and Bauri⁹,; Meena *et al*¹⁸, and Das *et al*⁸, observed that mulching when combined with post-emergence herbicide glyphosate enable the plant roots to expand more in feeding zone for higher nutrient uptake of water and both nutrients as well as mulching and herbicides influenced the fruit yield through their moderating effect on the hydrothermal regimes of the soil in pome and stone fruits. These results are strongly supported by the findings of Kumar and Bal¹⁶ who worked on guava in Ludhiana condition and reported that glyphosate proved to be more effective in producing highest fruit yield per plant.

Significant improvement in fruit physical parameters (length, diameter, and weight firmness) under various treatments over control was registered (Table 3). Maximum fruit length (7.07 cm and 7.16 cm), fruit diameter (7.81cm and 7.91 cm), fruit weight (229.5 g and 230.1 g) and fruit firmness (7.59 kg/cm² and 7.56 kg/cm²) were observed with paddy straw mulch followed by glyphosate, similarly other treatments i.e. cowpea, paddy straw mulch were statistically at par in result of physical parameters. Increase in fruit physical parameters with mulching might be due to the effect of leaf potassium and an increase rate of photosynthesis which cumulatively improve the fruit quality. These result are in agreement with the results Pande *et al*²⁰, in apple, Singh *et al*²⁷, in aonla, Bhusan *et al*⁶, in mango and Das *et al*⁸, in litchi. The present finding regarding fruit firmness are in line with the findings of Kaith and Bhardwaj¹³ who reported that maximum fruit firmness was found under glyphosate and minimum was recorded in control in apple cv. Starking Delicious under Shimla conditions of Himachal Pradesh. These finding are further supported by Randhawa²⁴ who also reported similar results in walnut, which may be attributed to better conservation of soil moisture which ultimately cause higher nutrients uptake. Physical barrier provided by dry grass mulch reduced the emergence of weeds. The action of the herbicides in suppressing weed growth is by starvation of the weeds due to lack of photosynthesis that resulted in increased availability of soil water and nutrients the plants and subsequently enhanced fruit quality.

The data regarding fruit colour of apple during both the year of study (Table 4), maximum values of 'a' (36.56 and (35.97) were found with bicolour polythene mulch, which was statistically at par with paddy straw mulch followed by glyphosate. Minimum value of redness (27.47 and 28.84) was found in un-weeded control. These results are

consistent with previous findings by Iglesias and Alegre¹¹ who reported that anthocyanin biosynthesis is a light dependent process because the main enzymes involved in the biosynthetic pathway to anthocyanin are light inducible, as phenylalanine ammonia-lyase (PAL) and uridine diphosphate-galactose-flavonoid 3-Ogalactosyltransferase (UFGalT). Increasing the light intensity within the tree canopy stimulates anthocyanin synthesis by accelerating the activity of UFGalT and PAL. Similar results were also obtained by Li *et al.*, using a reflective plastic film spread on the floor of a 'Starking' orchard in early August, before the beginning of fruit coloration; full-red fruit rate increased from 5.5% (control) to 27%.

During the present study 2015 and 2016 (Table 5), chemical properties comprising total soluble solids, titratable acidity and total sugar were influenced by different orchard floor management practices. Maximum total soluble solids, total sugar and minimum titratable acidity with bicolour polythene mulch followed by paddy straw mulch followed by glyphosate. Bicolour polythene mulch was reflective in nature due to which, it might have improved the photosynthetic activities of the plants and accumulated more photosynthates which leads to increase in total soluble solids content in fruits. Reflective mulches also change the micro-climatic condition of the tree by increasing the temperature which results in advanced ripening and more accumulation of total sugars. These observations are in conformity with Mathieu and Aure¹⁷ who found that plastic reflective mulches improved fruit quality in apple. The findings are in accordance with several other workers namely, Akasaka and Imai¹; Jun and Hong Qing¹²; Pliakoni and Nanos²²); ShuXin *et al*²⁶, and XiangMing *et al*³¹, who also reported that reflective mulches improve these chemical parameters in different fruit crops.

Table 1: Effect of orchard floor management practices on growth characteristics of apple cv. Royal Delicious during 2015 and 2016

Treatments	Annual shoot extension growth (cm)		Plant height (m)		Plant spread (m)		Plant volume (m ³)		Leaf area (cm ²)	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
	T ₁ Control (no weeding)	45.2	45.1	4.33	4.33	3.76	3.75	38.90	38.90	70.33
T ₂ Farmer practices (Hoing during March and May)	45.9	46.0	4.50	4.52	3.79	3.80	39.17	39.19	71.33	72.33
T ₃ Zero weeds (weeding at frequent intervals)	46.5	47.7	4.53	4.54	3.81	3.81	39.65	39.83	73.17	73.87
T ₄ Clean cultivation (weeding at 30 days interval)	46.3	47.6	4.43	4.45	3.80	3.80	39.43	39.68	72.90	73.73
T ₅ Bicolour polythene mulch (250 µm)	47.8	48.3	4.78	4.89	3.82	3.83	39.77	40.00	75.06	76.17
T ₆ Paddy straw mulch (10 cm thick)	48.7	50.0	4.82	5.00	3.85	3.87	39.96	40.13	76.56	77.23
T ₇ Oxyflourfen @ 1.0 l ha ⁻¹ (pre-emergence)	45.6	45.8	4.50	4.50	3.78	3.79	39.08	39.15	70.93	71.27
T ₈ Atrazine @ 3.0 kg ha ⁻¹ (pre-emergence)	45.7	45.8	4.33	4.40	3.77	3.78	38.93	39.05	70.27	71.00
T ₉ Pendimethalin @ 2.0 l ha ⁻¹ (pre-emergence)	45.6	45.6	4.40	4.47	3.78	3.78	38.99	39.05	70.50	71.03
T ₁₀ Paddy straw mulch (10 cm thick) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	49.3	50.2	4.90	5.02	3.87	3.89	40.00	40.19	77.83	78.57
T ₁₁ Oxyflourfen @ 1.0 l ha ⁻¹ (pre-emergence) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	47.3	48.6	4.74	4.80	3.83	3.84	39.72	40.07	74.67	75.63
T ₁₂ Atrazine @ 3.0 kg ha ⁻¹ (pre-emergence) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	46.5	47.1	4.53	4.60	3.81	3.81	39.67	40.03	73.40	74.43
T ₁₃ Pendimethalin @ 2.0 l ha ⁻¹ (pre-emergence) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	46.6	48.6	4.74	4.77	3.81	3.82	39.72	40.03	74.53	75.63
T ₁₄ Cowpea (green manure)	48.3	48.6	4.80	4.97	3.83	3.86	39.90	40.13	75.89	76.77
T ₁₅ White clover (cover crop)	47.4	48.2	4.73	4.85	3.81	3.83	39.69	40.00	73.27	75.87
C.D.(p<0.05)	1.70	1.63	0.12	0.19	0.05	0.06	0.27	0.30	2.83	2.98

Table 2: Effect of orchard floor management practices on yield parameters of apple cv. Royal Delicious of apple 2015 and 2016

Treatments	Initial fruit set (%)		Final fruit set (%)		Fruit yield (Kg/tree)		Yield efficiency (Kg/cm ²)	
	2015	2016	2015	2016	2015	2016	2015	2016
	T ₁ Control (no weeding)	74.0	70.0	60.0	58.3	68.17	65.10	0.180
T ₂ Farmer practices (Hoeing during March and May)	73.7	71.7	61.0	59.5	70.57	68.03	0.192	0.187
T ₃ Zero weeds (weeding at frequent intervals)	77.3	74.0	63.8	62.5	74.23	71.60	0.198	0.196
T ₄ Clean cultivation (weeding at 30 days interval)	79.3	73.3	63.3	62.0	74.13	71.53	0.197	0.194
T ₅ Bicolour polythene mulch (250 µm)	76.7	74.3	64.0	63.0	78.10	77.13	0.203	0.203
T ₆ Paddy straw mulch (10 cm thick)	66.0	75.3	64.7	63.7	80.43	79.93	0.213	0.209
T ₇ Oxyflourfen @ 1.0 l ha ⁻¹ (pre-emergence)	78.0	71.0	60.6	59.4	70.23	68.70	0.186	0.182
T ₈ Atrazine @ 3.0 kg ha ⁻¹ (pre-emergence)	79.7	70.0	60.2	59.4	69.43	67.60	0.186	0.180
T ₉ Pendimethalin @ 2.0 l ha ⁻¹ (pre-emergence)	74.3	70.3	60.7	59.1	70.23	67.83	0.185	0.180
T ₁₀ Paddy straw mulch (10 cm thick) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	76.3	75.7	64.8	63.9	82.03	80.60	0.216	0.213
T ₁₁ Oxyflourfen @ 1.0 l ha ⁻¹ (pre-emergence) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	73.3	74.3	63.3	62.7	74.53	73.40	0.206	0.205
T ₁₂ Atrazine @ 3.0 kg ha ⁻¹ (pre-emergence) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	73.7	74.0	63.0	62.0	74.37	73.10	0.201	0.194
T ₁₃ Pendimethalin @ 2.0 l ha ⁻¹ (pre-emergence) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	74.3	74.3	63.2	62.5	74.40	73.37	0.203	0.197
T ₁₄ Cowpea (green manure)	78.7	75.0	64.3	63.6	79.13	78.00	0.208	0.203
T ₁₅ White clover (cover crop)	75.7	74.0	63.5	62.8	78.50	77.87	0.201	0.198
C.D.(p<0.05)	NS	1.92	1.30	1.21	1.14	1.42	0.009	0.011

Table 3: Effect of orchard floor management practices on fruit physical characteristics of apple cv. Royal Delicious during 2015 and 2016

Treatments	Fruit length (cm)		Fruit diameter (cm)		Fruit weight (g)		Fruit firmness (kg/cm ²)	
	2015	2016	2015	2016	2015	2016	2015	2016
	T ₁ Control (no weeding)	6.71	6.74	7.37	7.37	220.4	220.8	7.45
T ₂ Farmer practices (Hoeing during March and May)	6.85	6.90	7.47	7.50	221.8	222.9	7.48	7.48
T ₃ Zero weeds (weeding at frequent intervals)	6.94	6.99	7.68	7.71	224.4	225.5	7.50	7.47
T ₄ Clean cultivation (weeding at 30 days interval)	6.96	6.99	7.67	7.70	224.2	225.4	7.48	7.45
T ₅ Bicolour polythene mulch (250 µm)	7.02	7.06	7.70	7.80	227.4	228.0	7.53	7.49
T ₆ Paddy straw mulch (10 cm thick)	7.05	7.12	7.79	7.87	228.8	229.5	7.58	7.55
T ₇ Oxyflourfen @ 1.0 l ha ⁻¹ (pre-emergence)	6.78	6.81	7.45	7.48	221.1	221.8	7.47	7.45
T ₈ Atrazine @ 3.0 kg ha ⁻¹ (pre-emergence)	6.72	6.78	7.39	7.42	220.5	221.2	7.49	7.49
T ₉ Pendimethalin @ 2.0 l ha ⁻¹ (pre-emergence)	6.74	6.78	7.41	7.46	220.7	221.2	7.51	7.48
T ₁₀ Paddy straw mulch (10 cm thick) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	7.07	7.16	7.81	7.91	229.5	230.1	7.59	7.56
T ₁₁ Oxyflourfen @ 1.0 l ha ⁻¹ (pre-emergence) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	7.02	7.08	7.74	7.76	225.1	226.0	7.52	7.48
T ₁₂ Atrazine @ 3.0 kg ha ⁻¹ (pre-emergence) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	6.97	7.04	7.69	7.71	224.4	224.8	7.55	7.53
T ₁₃ Pendimethalin @ 2.0 l ha ⁻¹ (pre-emergence) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	6.99	7.04	7.70	7.72	224.9	225.7	7.55	7.53
T ₁₄ Cowpea (green manure)	7.04	7.11	7.77	7.85	228.2	229.0	7.58	7.55
T ₁₅ White clover (cover crop)	7.00	7.08	7.68	7.74	224.0	226.2	7.55	7.55
C.D.(p<0.05)	0.03	0.05	0.04	0.05	0.92	0.63	NS	NS

Table 4: Effect of orchard floor management practices on fruit colour of apple cv. Royal Delicious during 2015 and 2016

Treatments		Fruit colour (L*ab)					
		2015			2016		
		L*	a	b	L*	a	b
T ₁	Control (no weeding)	37.39	27.47	14.41	36.00	28.84	14.40
T ₂	Farmer practices (Hoeing during March and May)	35.46	30.57	16.54	33.90	30.63	15.60
T ₃	Zero weeds (weeding at frequent intervals)	34.72	34.69	20.67	31.86	30.91	18.58
T ₄	Clean cultivation (weeding at 30 days interval)	37.69	31.43	18.54	31.58	31.11	15.71
T ₅	Bicolour polythene mulch (250 µm)	33.44	36.56	21.62	28.58	35.97	21.63
T ₆	Paddy straw mulch (10 cm thick)	34.82	34.54	19.62	30.95	34.37	20.85
T ₇	Oxyflourfen @ 1.0 l ha ⁻¹ (pre-emergence)	36.71	27.65	15.20	35.58	29.45	15.49
T ₈	Atrazine @ 3.0 kg ha ⁻¹ (pre-emergence)	35.46	29.68	14.62	35.72	29.02	15.28
T ₉	Pendimethalin @ 2.0 l ha ⁻¹ (pre-emergence)	35.68	29.54	14.67	35.07	30.00	14.64
T ₁₀	Paddy straw mulch (10 cm thick) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	34.68	35.58	20.77	30.10	35.57	19.67
T ₁₁	Oxyflourfen @ 1.0 l ha ⁻¹ (pre-emergence) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	35.32	30.76	15.60	33.54	31.86	19.40
T ₁₂	Atrazine @ 3.0 kg ha ⁻¹ (pre-emergence) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	35.33	30.55	16.79	33.66	31.67	16.73
T ₁₃	Pendimethalin @ 2.0 l ha ⁻¹ (pre-emergence) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	37.09	30.46	15.28	34.09	31.76	16.56
T ₁₄	Cowpea (green manure)	35.45	32.34	19.62	31.75	34.30	19.65
T ₁₅	White clover (cover crop)	35.56	33.46	19.41	33.43	30.93	19.67
C.D.(p<0.05)		1.91	1.90	0.83	1.52	1.68	0.98

Table 5: Effect of orchard floor management practices on fruit chemical characteristics of apple cv. Royal Delicious during 2015 and 2016

Treatments		Fruit TSS (°Brix)		Fruit acidity (%)		Total sugars (%)	
		2015	2016	2015	2016	2015	2016
		T ₁	Control (no weeding)	13.57	13.65	0.28	0.28
T ₂	Farmer practices (Hoeing during March and May)	13.67	13.79	0.26	0.25	8.78	8.79
T ₃	Zero weeds (weeding at frequent intervals)	14.47	14.59	0.22	0.20	8.85	8.86
T ₄	Clean cultivation (weeding at 30 days interval)	14.49	14.67	0.22	0.20	8.84	8.86
T ₅	Bicolour polythene mulch (250 µm)	14.60	14.73	0.21	0.19	8.87	8.89
T ₆	Paddy straw mulch (10 cm thick)	14.33	14.70	0.23	0.22	8.84	8.85
T ₇	Oxyflourfen @ 1.0 l ha ⁻¹ (pre-emergence)	13.77	13.93	0.27	0.26	8.75	8.77
T ₈	Atrazine @ 3.0 kg ha ⁻¹ (pre-emergence)	13.77	13.85	0.28	0.27	8.73	8.72
T ₉	Pendimethalin @ 2.0 l ha ⁻¹ (pre-emergence)	13.80	13.98	0.27	0.27	8.75	8.75
T ₁₀	Paddy straw mulch (10 cm thick) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	14.53	14.63	0.22	0.20	8.85	8.86
T ₁₁	Oxyflourfen @ 1.0 l ha ⁻¹ (pre-emergence) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	13.90	14.30	0.26	0.24	8.83	8.85
T ₁₂	Atrazine @ 3.0 kg ha ⁻¹ (pre-emergence) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	13.93	14.03	0.25	0.24	8.80	8.81
T ₁₃	Pendimethalin @ 2.0 l ha ⁻¹ (pre-emergence) followed by glyphosate @ 2.0 l ha ⁻¹ (post-emergence)	13.73	13.83	0.26	0.24	8.81	8.83
T ₁₄	Cowpea (green manure)	14.17	14.53	0.24	0.22	8.83	8.85
T ₁₅	White clover (cover crop)	14.10	14.17	0.25	0.24	8.81	8.82
C.D.(p<0.05)		0.17	0.19	0.02	0.03	0.03	0.04

CONCLUSION

From the present studies “Effect of orchard floor management practices on apple production” it has been concluded that application of straw mulch followed by glyphosate was appreciably effective in

improving growth parameters as well as yield and quality owing to higher efficiency toward elimination of weed during both the years. Overall, to meet the multiple objective straw mulch followed by glyphosate provide acceptable level of weed control in apple

orchard and its adaptation is beneficial to the crop to represent a good choice with respect to feasibility in orchard floor management system.

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