



Effect of Mulches on Soil Properties, Leaf Nutrient Status and Weed Growth of Pomegranate under Rainfed Conditions

Bhawna Kaushal^{1*}, D. D. Sharma¹ and M. A. Kuchay¹

¹Department of Fruit Science, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, 173 230, Himachal Pradesh, India.

Authors' contributions

This work was carried out in collaboration among all authors. Author BK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors DDS and MAK managed the analyses of the study. Author MAK managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2020/v32i130237

Editor(s):

(1) L. S. Ayeni, Department of Agricultural Science, Adeyemi College of Education, P.M.B. 520, Ondo State, Nigeria.

Reviewers:

(1) Chemutai Roseline, Bukalasa Agricultural College, Uganda.

(2) Fábio Henrique Portella Corrêa de Oliveira, Universidade Federal Rural de Pernambuco, Brazil.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/54495>

Received 29 November 2019

Accepted 02 February 2020

Published 24 February 2020

Original Research Article

ABSTRACT

The present study entitled "Effect of mulches on soil properties, leaf nutrient status and weed growth of pomegranate under rainfed conditions" at the experimental farm of HR&TS and KVK Kandaghat at Jadari, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, during 2017-2018. The different mulches like Nylon mulch mat, Silver polyethylene mulch, Black polyethylene mulch, Red polyethylene mulch and Coir mulch mat, Grass mulch were used in this investigation. Results revealed that maximum soil temperature and moisture were recorded in black polyethylene mulch. Nylon mulch mat was found effective in controlling weed growth followed by silver polyethylene mulch and black polyethylene mulch. Soil and leaf nutrient content were significantly higher found under grass mulch. The soil hydrothermal regimes were significantly higher under black polyethylene mulch. This provides better prevention of soil water evaporation and retaining soil moisture under rainfed conditions.

*Corresponding author: E-mail: bhawna2919@gmail.com;

Keywords: *Mulches; soil temperature; soil moisture; weed growth; hydrothermal.*

1. INTRODUCTION

Pomegranate (*Punica granatum* L.), a member of family Punicaceae, is a favourite table fruit of tropical and subtropical regions. It is very much liked for its cool refreshing juice, sweet-acidic arils and valued for its medicinal properties. It is an ancient fruit which has originated in Persia, Afghanistan and Baluchistan [1].

Pomegranate can be grown throughout India but due to its better adaptability to arid climate, commercial cultivation is being done in Maharashtra, Karnataka and Rajasthan. It is also grown to a lesser extent in Uttar Pradesh, Himachal Pradesh, Punjab, Haryana, Tamil Nadu and Andhra Pradesh. Total area under pomegranate in India is 2,16,000 hectares with annual production of 26,13,000 metric tonnes [2]. Main cultivars grown in India are Kesar, Dholka, Kabul, Alandi, G-137, Ganesh, Kandhari kabuli, Mridula and Jyoti [3].

During past decades, pomegranate has been introduced in the foot hills of Himachal Pradesh and valley areas of shivalik hills (mainly in mid-hill areas of Solan, Sirmour, Shimla, Chamba, Mandi, Kullu and Kangra districts). In Himachal Pradesh total area under pomegranate is 2670 ha with an annual production of 2,742 MT [4].

The 'Bhagwa' cultivar of pomegranate is presently under commercial cultivation in Himachal Pradesh. This cultivar is heavy yielder and possesses highly desirable fruit characters. This variety matures in 170-180 days. Fruits are medium to large in size, attractive, smooth glossy with dark saffron thick skin and arils are soft sweet in taste with red colour and fetches good price in the market. This cultivar is less susceptible to fruit cracking. The growth habit of tree is spreading type [5]. Considering all these characters, 'Bhagwa' cultivar is good for cultivation in pomegranate growing regions of Himachal Pradesh.

In summer, the soil moisture becomes a limiting factor in dry areas due to uneven rainfall. Pomegranate cultivation exposed to prolonged moisture stress in May and November due to high rate of evapo-transpiration, becomes a limiting factor for quality fruit production. Weeds also reduce crop productivity and fruit quality through competition for resources including water, nutrients and light [6].

To reduce the rate of evapo-transpiration and competition between weeds and main crop, different mulching materials are useful. Mulching is an important soil management practice of covering the soil surface in the basins of plants to check the weed growth and to conserve the available soil moisture and nutrients. Main objective of mulching is to conserve soil moisture and control weed growth. The other benefits of mulching are regulation of soil temperature, improvement of soil aeration and to increase organic matter content. Two major types of mulches used in production system are inorganic and organic [7,8]. Inorganic mulches include various types of gravel, stone and polyethylene [9,10].

Plastic mulches reduce the amount of water lost from the soil due to evaporation and reducing the need for irrigation. Plastic mulches also aid in even distribution of moisture to the soil which reduces plant stress. Plastic mulches prevent sunlight from reaching the soil so it inhibits the growth of most annual and perennial weeds [11]. The most popular plastic mulches used worldwide are black, white-on-black and clear mulches [12,13] reported that white-on-black and silver mulch reflects 39 and 48% of shortwave radiation, respectively. Albert et al. [14] reported that mulching significantly influence the soil pH and nutrient content.

On the other hand, organic mulches such as dry grass, rice straw, wheat straw, palm leaf, compost and banana leaves are being used for a long time. Presently, there is a general shift from hay mulching to black or other colour plastic mulches. Since different coloured mulches are known to reflect different wavelengths of light, and have a favourable effect on plant growth and fruit quality which needs to be investigated. The present study was carried out with an objective to assess the effect of organic and inorganic mulches on weed growth, soil properties and leaf nutrient status of pomegranate.

2. MATERIALS AND METHODS

The study area is located at an elevation of 1,344 m above msl at 30°58'1.339"N latitude and 77°5'44.626"E longitude HR&TS and KVK Kandaghat, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh. Nine-years-old plants of pomegranate cultivar Bhagwa. The experimental

design used was Randomized Complete Block Design (RCBD) with four replications and seven treatments. Twenty-eight trees having uniform vigour and size, planted at a spacing of 4 x 4 m were selected for the study. These treatments were: T₁- Nylon mulch mat (90 gram per square meter), T₂- Silver polyethylene mulch (100 micron), T₃- Black polyethylene mulch (100 micron) T₄- Red polyethylene mulch (100 micron), T₅- Coir mulch mat (10 mm), T₆- Grass mulch (10 cm) and T₇- Control.

Soil samples (0–30 cm) were collected at the end of season for analysis. Each sample was dried at laboratory room temperature (25°C) to a constant weight and sieved (2 mm) to eliminate coarse soil particles. Organic carbon was estimated by Walkley and Black wet digestion method [15]. Total N was determined using the macro Kjeldahl distillation method, available potassium was determined using a flame photometer [16]. Available phosphorus was extracted using 0.5 M NaHCO₃ solution and measured calorimetrically using ammonium molybdate procedure by spectrophotometer according to Olsen et al. [17].

Leaf samples collected from fully mature leaves located at the 8th position from the apex were collected at least 50 leaves all around the periphery of the tree on 15th August [18]. The leaf samples collected, were brought directly to the laboratory, thoroughly washed first under tap water, followed by 0.1 N HCl, distilled water and finally with double distilled water. The washed samples were first air dried in the shade by spreading on clean blotting papers and final drying was accomplished in an oven at 65°C for 48 hours. The digestion mixture (potassium sulphate 400 parts, copper sulphate 20 parts, mercuric oxide 3 parts and selenium powder 1 part) was used for estimation of nitrogen as suggested by [19]. For estimation of other nutrients, 20 ml of diacid mixture of nitric acid and perchloric acid in the ratio of 4:1 was used. Total nitrogen was determined by Auto analyzer Kjel Tech Model Foss Tecator 2300 and the results were expressed as per cent on a dry weight basis. Total phosphorus was estimated by vanado molybdo phosphoric acid method [19]. The potassium in plant tissue was estimated on flame photometer Jackson [19].

Soil moisture content was determined at fortnightly interval by a portable soil moisture monitoring system i.e. Tzs-IIW soil moisture temperature analyzer at 15 cm depth. Soil moisture was expressed as per cent. Soil

temperature was recorded at 15 days intervals with soil temperature monitoring system i.e. Tzs-IIW soil moisture temperature analyzer 15 cm depth and temperature was recorded.

Weed count (No.) were estimated by the permanent quadrants of 0.3 x 0.3 m were randomly fixed at one location of each experimental plot (tree basin) before the emergence of weeds. The total number of weeds present in the quadrant frame was counted at 30 days interval after initiation of treatment. The weed count per 0.3 square meters was then worked out. The sum of total weeds was recorded as total weeds per 0.3 square meters.

3. RESULTS AND DISCUSSION

3.1 Organic Carbon

Data presented in (Table 1) clearly showed that the levels of organic carbon among different mulching treatments had statistical variation. Mulching with grass recorded the maximum organic carbon content (1.88%) in soil. Minimum soil organic carbon content (1.03%) was found with treatment control (T₇).

The highest organic carbon content was found in grass mulch, this mulch slowly decompose and provide carbonaceous materials to the soil which helped to keep the soil loose. Organic matter is a source of plant nutrients and provides an ideal environment for beneficial soil organisms. Similar results were found by Leinfelder [20] in apple and Shylla [21] in plum.

3.2 Soil Nutrient Content

Significantly higher available nitrogen, phosphorus and potassium of (349.52, 37.91 and 359.24 kg/ha) were recorded in treatment grass mulch which was found closely to coir mulch mat. However, the minimum available nitrogen, phosphorus and potassium (317.50, 29.65 and 327.03 kg/ha) were recorded in the treatment control.

The available soil nutrients showed consistent variation with different mulching treatments in respect to N, P and K (Table 1) content. Grass mulch was found to exert significant influence on nutrient availability as compared to no mulch treatment. Such an increased in the availability of nutrients may be attributed to higher organic carbon content more favourable soil moisture (Table 2) and temperature (Table 3) and fast decomposition of organic mulches resulting in

better availability of nutrients in the soil under mulch treatments. The results are similar to the findings [22] in apple. Grass mulching resulted in the increase in soil N build up probably on account of higher organic carbon and low leaching losses of N from the soil. The potential to add significant nitrogen in soil by organic mulches is well known [23]. The available soil P increased under the grass mulches because of increased microbial activity, fast decomposition, mineralization of mulches in the presence of nitrogen and elimination of competitive weeds. Similar results were also found by Khokhar et al. [24] in olive.

3.3 Leaf Nutrient Content

The highest leaf nitrogen, phosphorus and potassium (1.85, 0.21 and 1.50%) were recorded under grass mulch followed by coir mulch mat. Whereas, the lowest leaf nitrogen, phosphorus and potassium (1.21, 0.13 and 1.17%) was found in control. The increase in leaf N may be due to higher organic carbon content which increased the biological activities under grass mulch (Table 1) possibly resulted in fast mineralization and

nitrogen availability and high translocation of N from soil to the leaves. Deep and Khokhar [25] found that grass mulch increased leaf nitrogen content in apricot.

Different mulches increased the phosphate content of leaves because surface soil was kept moist for a longer time. The highest potassium uptake under mulched plots may be due to the presence of a higher moisture regime, maintenance of optimum level of soil temperature and reduction in temperature fluctuation [26]. Merwin et al. [27] observed that apple leaf N and K concentrations were greater with hay mulch than clean cultivation. [28] found that rice straw mulching in Balady lime (*Citrus aurantifolia*) improved leaf content of P and K. Similar results were recorded by Shylla et al. [29] while studying the effect of orchard floor management practices on leaf nutrient status of plum observed that mulching with hay resulted in higher leaf phosphorus content closely followed by black polyethylene mulch treatment. They also reported that hay mulch treatment recorded higher leaf K content as compared to other soil management practices.

Table 1. Effect of organic and inorganic mulches on soil and leaf nutrient status of pomegranate cv. Bhagwa

Treatments	Organic carbon (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)	N (%)	P (%)	K (%)
Nylon mulch mat	1.57	330.19	31.33	343.97	1.51	0.17	1.28
Silver polyethylene mulch	1.62	334.69	32.05	345.17	1.57	0.18	1.33
Black polyethylene mulch	1.69	336.90	32.59	347.38	1.65	0.19	1.38
Red polyethylene mulch	1.48	326.85	30.97	340.84	1.44	0.16	1.24
Coir mulch mat	1.83	346.91	35.92	357.61	1.78	0.20	1.48
Grass mulch	1.88	349.52	37.91	359.24	1.85	0.21	1.50
Control	1.03	317.50	29.65	327.03	1.21	0.13	1.17
CD _(0.05)	0.15	11.23	2.97	10.85	0.10	0.01	0.04

Table 2. Effect of organic and inorganic mulches on soil moisture in pomegranate cv. Bhagwa

Treatments	01 April	15 April	01 May	15 May	01 June	15 June	01 July	15 July
Nylon mulch mat	12.2	12.6	11.3	10.6	12.7	17.9	21.9	21.4
Silver polyethylene mulch	12.9	13.7	12.3	12.5	13.6	18.9	22.4	22.0
Black polyethylene mulch	13.3	14.7	13.1	13.0	14.7	19.2	22.7	22.5
Red polyethylene mulch	12.8	14.1	12.6	12.7	14.0	18.3	21.8	21.9
Coir mulch mat	10.0	10.7	9.3	9.9	11.1	16.5	19.2	19.5
Grass mulch	10.0	10.3	9.1	9.3	10.9	16.1	18.8	19.4
Control	8.0	8.6	7.4	6.5	7.95	14.0	17.3	18.0
CD _{0.05}	0.4	0.6	0.7	0.5	0.8	0.5	0.4	0.9

3.4 Soil Moisture and Temperature

Observations pertaining to soil moisture and temperature were presented in the (Tables 2 and 3) showed that different mulching treatments significantly influenced the soil moisture at 15 cm depth. Black polyethylene mulch recorded highest (13.35%, 14.70%, 13.15%, 13.02%, 14.77%, 19.27%, 22.75% and 22.55%) soil moisture content from 1st April to 15th of July. In case of 1st April, 15th June and 1st July was at par with silver polyethylene mulch, in case of 15th April, 1st May and 1st June black polyethylene mulch was at par with the red polyethylene mulch. In case of 15th May and 1st July black polyethylene mulch was statistically at par with the silver polyethylene mulch and red polyethylene mulch. However, the minimum soil moisture was recorded in control and is ranged from 18.02 to 6.52 per cent.

The higher soil moisture content was found in black polyethylene mulch which was almost on the same level of significance to other treatments i.e. silver polyethylene mulch and red polyethylene mulch. This was due to the prevented moisture loss through evaporation from the surface of the soil and control weed growth [30] in apple, Kathiravan [31] in plum). Mulches increased soil water by increasing percolation and retention, reducing evaporation and weed population. Mulches also protected soils from water, wind erosion and compaction, thereby maintaining the soil moisture at an optimal level which was conducive for plant growth. Similar findings with [32,33] in strawberry and Scott [34] who also reported that black polyethylene mulch recorded higher soil moisture.

The data presented in the (Table 3) indicating that different mulching treatments had a significant effect on soil temperature at 15 cm soil depth, maximum soil temperature was

recorded under the black polyethylene mulch in all dates of observation, which ranged from 17.92°C to 24.45°C. However, temperature values with respective dates were found statistically at par with the silver polyethylene mulch, red polyethylene mulch and control.

On 1st April, 15th April, 15th May and 1st June black polyethylene mulch was statistically at par with silver polyethylene mulch, red polyethylene mulch and control. On 1st May, 15th June, 1st July and 15th July black polyethylene mulch was statistically at par with silver polyethylene mulch and red polyethylene mulch. The minimum soil temperature ranging from 15.25°C to 20.46°C on all dates was observed in grass mulch.

The effect of different mulching treatments on soil temperature at 15 cm depth showed variable values. Treatment black polyethylene, silver polyethylene mulch and red polyethylene mulch enhanced the soil temperature as compared to the organic mulches. However, lower temperature was found in grass mulch, coir mulch mat and nylon mulch mat. An increase in soil temperature in respect of inorganic mulches (black polyethylene mulch, silver polyethylene mulch and red polyethylene mulch), may be attributed to the fact that these mulches absorb more sun radiation and caused physical barrier to heat loss as compared to other organic mulches. These results are in accordance with the findings of [35,36,37] in strawberry cv. Chandler who reported higher soil temperature under black polyethylene mulch as compared to the organic mulches.

3.5 Weed Population per 0.3 m² at 30, 60, 90 and 120 Days Interval

The data pertaining to weed population per 0.3 m² was recorded after 30, 60, 90, 120 days intervals in treated basins The data recorded, is.

Table 3. Effect of organic and organic mulches on soil temperature in pomegranate cv. Bhagwa

Treatments	01 April	15 April	01 May	15 May	01 June	15 June	01 July	15 July
Nylon mulch mat	16.9	16.8	19.1	21.4	21.9	22.0	20.4	20.9
Silver polyethylene mulch	17.6	17.8	20.2	23.7	24.2	23.9	22.6	23.8
Black polyethylene mulch	18.1	17.9	20.4	24.0	24.4	24.2	23.1	24.0
Red polyethylene mulch	17.7	17.7	20.0	23.8	24.0	23.8	22.8	23.7
Coir mulch mat	15.3	16.3	18.7	20.6	20.9	20.9	19.7	20.1
Grass mulch	15.2	15.6	18.5	20.4	20.0	20.4	19.5	19.9
Control	17.5	17.4	19.8	23.2	23.9	23.1	21.9	23.1
CD _{0.05}	0.7	0.6	1.0	1.0	0.9	0.6	0.7	0.4

Table 4. Effect of organic and inorganic mulches on weed population per 0.3 m² in pomegranate cv. Bhagwa

Treatments	30 days	60 days	90 days	120 days
Nylon mulch mat	0.00	0.00	0.00	0.00
Silver polyethylene mulch	0.00	0.00	2.50	3.50
Black polyethylene mulch	0.00	0.00	2.00	3.00
Red polyethylene mulch	0.00	0.00	2.75	3.25
Coir mulch mat	14.75	26.00	22.75	53.25
Grass mulch	13.00	24.50	21.50	50.75
Control	209.50	287.50	318.50	328.50
CD _{0.05}	13.29	26.28	23.19	42.56

presented in (Table 4) with respect to weed population. The different mulching treatments significantly affected the weed population. There was no weed growth recorded under nylon mulch mat. Maximum weed population after 30 days (209.50 weeds/m²), 60 days (287.50 weeds/m²), 90 days (318.50 weeds/m²) and 120 days (328.50 weeds/m²) was recorded under control and less weed population was recorded in coir mulch mat and grass mulch. In case of black polyethylene mulch, silver polyethylene mulch and red polyethylene mulch there was emergence of few weeds after 90 days. The significant weed control by mulching treatments was also observed in the studies of earlier workers [38] in peach and [39] in apple.

4. CONCLUSION

The results of the study indicated that different mulches showed significant difference on soil temperature, moisture, weed growth and nutrient status of soil and leaf. On the basis of results obtained, it is clear that the different mulching treatments responded differently to different parameters. The soil moisture and temperature was recorded higher under black polyethylene mulch at 15 cm depth. Nylon mulch found to be effective in weed control was counted at 30 days interval after the application of treatments. Furthermore, grass mulch was effective in maintaining soil and leaf nutrient status.

COMPETING INTERESTS

The authors declare that the manuscript is original, has not been published before and is not currently being considered for publication elsewhere. There are no conflicts of interest associated with publication and there is no significant financial support for this work that could have influenced its outcome. Author Bhawna Kaushal confirmed that manuscript has

been read and approved for submission by all authors.

REFERENCES

- De-Candolle A. Origin of cultivated plants. Hafner Publishing Company, New York. 1967;441.
- Anonymous. Final estimate of area and production of horticulture crops; 2016-2017. Available:<http://nhb.gov.in/area-pro/Areapro.2017a;16-17>.
- Wasker DP, Sushanta, K. Post harvest technology of pomegranate fruit: A review. Indian Food Packaging. 2004;58:78-84.
- Anonymous. Horticulture Development in Himachal Pradesh at a Glance; 2016-2017. Available:<http://hpagrisnet.gov.in>
- Ranpise SA, Sankaran M, Babu KD, Prakash J, Hiwale SS. Tropical and sub tropical fruit crops: Crop improvement and varietal wealth, (Ghosh SN ed). Jaya Publishing House, New Delhi. 2014;549-79.
- Wisler GC, Norris RF. Interactions between weeds and cultivated plants as related to the management of plant pathogens. Weed Science. 2005;53:914-17.
- Liang YI, Zhang CE, Guo DW. Mulch types and their benefit in crop landecosystem on the loess plateau in China. Journal of Plant Nutrition. 2002;25:945-55.
- Pakdel P, Tehranifar A, Nemati H, Llalzian A, Kharrazi M. Effect of different mulching materials on soil properties under semi arid conditions in North Eastern Iran. Wudpecker Journal of Agriculture Research. 2013;2:80-85.
- Yuan C, Tingwu L, Lili M, Han L, Yang W. Soil surface evaporation processes under

- mulches of different sized gravel. *Catena Journal*. 2009;78:117-21.
10. Aly MA, Nagwa A, Abd EIM, Afaf MAY. Organic fertilization, cover crops and plastic mulching effects on soil temperature and moisture, vegetable growth, yield and fruit quality of Anna Apple trees. *Alexandria Science Exchange Journal*. 2010;31:394-403.
 11. Tarara JM. Microclimate modification with plastic mulch. *Journal of Horticultural Sciences*. 2000;36:169-80.
 12. Schales F. Agriculture plastic use in United States. *Proceeding of the 11th International Congress of Plastic Agriculture*. 1990;54-56.
 13. Ham JM, Kluitenberg G, Lamont W. Optical properties of plastic mulches affect the field temperature regimes. *Journal of American Society for Horticulture Science*. 1993;118:188-193.
 14. Albert T, Karp M, Starast, Paal T. The effect of mulching and pruning on the vegetative growth and yield of the half-high blueberry. *Agronomy Research*. 2010; 8: 759-69.
 15. Walkley A, Black IA. An examination of Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. *Soil Science*. 1934;37:29-38.
 16. Merwin HD, Peech M. Exchange ability of soil potassium in the sand, silt and clay fractions as influenced by the nature and complementary exchangeable cations. *Soil Science American Proceedings*. 1951;15: 125-28.
 17. Olsen SR, Cole CV, Watanabl FS, Dean LA. Estimation of available phosphorus by extraction with sodium bicarbonate. *U S Department of Agriculture Circular*. 1954; 939:19.
 18. Bhargava GS, Dhandar, DG. Leaf sampling technique for pomegranate. *Progressive Horticulture*. 1987;19:196-99.
 19. Jackson ML. *Soil chemical analysis*. Prentice Hall of India Private Limited, New Delhi. 1973;498-99.
 20. Leinfelder MM, Merwin IA, Brown MG. Soil health indicators, apple tree growth and carbon sequestration differ among orchard groundcover management systems. *Acta Horticulturae*. 2012;938:333-40.
 21. Shylla B. Effect of different orchard floor management practices on the growth, cropping and quality of Santa Rosa plum. M.Sc. Thesis. Department of Fruit Science. Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan. 1993;127.
 22. Bhutani VP, Raina SS, Khokhar UU. Effect of herbicides, mulching and clean cultivation on weed population, growth and cropping of apple trees. *Journal of Horticulture*. 1994;7:7-13.
 23. Harley CP, Moon HH, Regesmbal LO. The release of certain nutrient elements from simulated orchard grass mulch. *Proceeding of American Society of Horticultural Science*. 1951;57:17-23.
 24. Khokhar UU, Gautam JR, Sharma MK. Effects of various floor management system on growth, yield and leaf nutrient status of olive cv. Laccino. *Journal of Horticulture* 2001;14:43-48.
 25. Deep JB, Khokhar CU. Effect of orchard floor management practices on nutrient status and micro biological activities in apricot orchard. *Journal of Research SKUAST-J*. 2009;8:50-57.
 26. Russell EWC. *Soil condition and plant growth*. ELBS and Longman, 10th ed. UK. 1975;17.
 27. Merwin IA, Rosenberger DA, Engle CA, Rist DL, Fargione M. Comparing mulches, herbicides and cultivation as orchard ground cover management system. *Horticulture Technology*. 1995;5:151-58.
 28. Eissa MA, Helail BM. A comparative study on some weed control treatments in Balady lime nursery. *Annals of Agricultural Science Moshtohor Journal*. 1997;35:935-47.
 29. Shylla B, Chauhan JS, Awasthi RP, Bhandari AR. Effect of orchard floor management practices on leaf nutrient status of plum. *Indian Journal of Horticulture*. 1999;56:34-37.
 30. Raina SS. Effect of herbicides, mulching and clean cultivation on the growth, yield, quality and leaf nutrient content of royal delicious apple trees. M.Sc. Thesis. Department of Fruit Science. Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan. 1991;126.
 31. Kathiravan G. Effect of Mulches on soil hydrothermal regime, growth, yield and quality of plum (cv. Santa Rosa). M.Sc. Thesis. Department of Soil Science and Water Management. Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan. 2007;122.
 32. Mehraj S, Qurtulane Peer FA, Bisati, IA, Mir MM, Hassan S. Effect of organic and inorganic mulches on TSS, acidity, TSS/

- acidity, yield efficiency, soil hydrothermal conditions and leaf nutrient content under temperate conditions. Ecology, Environment and Conservation. 2015;21: 1331-37.
33. Kumar S, Dey P. Effects of different mulches and irrigation methods on root growth, nutrient uptake, water-use efficiency and yield of strawberry. Scientia Horticulture. 2011;12:318-24.
34. Scott LC. Impact of mulches on landscape plants and the environment: A review. Journal of Environmental Horticulture. 2007;25:239-49.
35. Gupta R, Acharya CL. Effect of mulch induced hydrothermal regime on root growth, water use efficiency, yield and quality of strawberry. Journal of the Indian Society of Soil Science. 1993;41:17-25.
36. Kher R, Baba JA, Bakshi P. Influence of planting time and mulching material on growth and fruit yield of strawberry cv. Chandler. Indian Journal of Horticulture. 2010;67:441-44.
37. Bakshi P, Bhat DJ, Wali, VK, Sharma A, Iqbal M. Growth, yield and quality of strawberry (Fragaria × ananassa Duch.) cv. Chandler as influenced by various mulching materials. African Journal of Agricultural Research. 2014;9: 701-06.
38. Thakur A, Singh H, Jawandha SK, Kaur T. Mulching and herbicides in peach: Weed biomass, fruit yield, size and quality. Biological Agriculture and Horticulture. 2012;28:280-90.
39. Hipps NA, Davies MJ, Johnson DS. Effects of different ground vegetation management systems on soil quality, growth and fruit quality of culinary apple trees. Journal of Horticultural Science and Biotechnology. 2004;79:610-18.

© 2020 Kaushal et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

*The peer review history for this paper can be accessed here:
<http://www.sdiarticle4.com/review-history/54495>*