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**RESEARCH NOTE**

# Weed management in kinnow mandarin (*Citrus nobilis* × *Citrus deliciosa*) orchards using various orchard floor management practices in sub-mountainous region of Punjab, India

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**ABSTRACT**

The study was carried out to ascertain the influence of different floor management practices in kinnow mandarin (*Citrus nobilis* × *Citrus deliciosa*) orchard on weed infestation, fruit yield and quality under sub-mountainous zone of Punjab state of India. Six years old kinnow mandarin plants were subjected to different treatments, *viz*. clean cultivation, weed management with herbicide, mowing of weeds, black polyethylene mulch, silver polyethylene mulch, subabul (*Leucaena leucocephala*) leaf mulch and control (weedy check). No weed growth occurred under synthetic mulches (black and silver polyethylene mulches). The mulching with leaves of subabul plant and the locally abundantly available wild species also exhibited significant reduction in grassy and broad-leaved weeds density and biomass. The fruit yield and quality attributing characteristics were significantly higher under black polyethylene mulch with maximum fruit size (6.29 cm length × 7.74 cm breadth), fruit weight (160.13 g) and the yield (71.63 kg/plant). Fruit quality (10.72ÚB) in terms of total sugars and ascorbic acid (TSS), vitamin C (40.28 mg/100g pulp) was also significantly better with black polythene mulch followed by silver polyethylene mulch and subabul leaves mulch.

**Keywords:** Biomass, *Citrus nobilis* × *Citrus deliciosa*, Fruit quality, Kinnow, Mulch, Weed management

The Kinnow (*Citrus nobilis* × *Citrus deliciosa*) is a high yield mandarin hybrid plant grown extensively in the Punjab region of India and Pakistan. Weed infestation in Kinnow orchards is a big challenge in the sub-mountainous zone of Punjab (India) for many Kinnow producers. Weeds are the undesirable plants emerging at the place in between the crop plants and compete for nutrients, water, moisture and light. Weeds are considered major obstacle in agricultural production systems particularly in fruit crops as the occurrence of weeds in the orchards effects the growth and establishment of the trees. Rao (2000) reported the annual loss of agricultural produce due to weeds as 45% cultivated crops and established orchards. However, the magnitude of the effect on growth and development depends on the weed species and the combination of methods employed for the weed control. The weeds can be managed by various methods such as chemical, mechanical, manual, biological and by mulching *etc*. Although the chemical weed management is most effective, it has its own constraints like the injury to non-target vegetation, crop injury, residues in soil and water, toxicity to non-target organisms. Conventional methods of hoeing are used for controlling the weeds by removal of weeds by hands, but it is time consuming and labour intensive (Boora *et al.* 2014). Mechanical control of weeds in established orchards is rather difficult and less effective due to spreading canopy of trees, limited coverage of the implements and potential damage to root and shoots of fruit trees. Mulching or covering the soil with organic or synthetic materials has been recorded as a safe method to control weeds in comparison to herbicides application (Ramakrishna 2006). The paddy straw mulch is easily available and cheap, while, the plastic mulch is costly affair for management of weeds in established orchards. Covering or mulching the soil surface can check the germination of weed seeds or physically suppress weed emergence (Stout 1985). Organic mulches reported to be beneficial for plant growth and fruit yield and quality in addition to weed suppression (Childers *et al*. 1995). There was a substantial reduction of weed growth with organic mulches in avocado and citrus over a period of four year (Faber *et al.* 2001). Transparent or white mulch and green covering had slight effect on weeds, while the coloured mulches such as brown, black, blue or

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double-colored films reduce the weed emergence (Bond *et al.* 2003). Abouziena *et al.* (2008) obtained the greater control (94-100%) of weeds occurred with the plastic mulch (200 or 150 ìm) and three mulch layers of rice straw. The higher soil and canopy temperature under clean cultivation led to excessive flower and fruit drop in Kinnow. Thus, the floor management in orchards is of utmost importance. The present study was undertaken to evaluate the response of weeds to different orchards floor management treatments.

The present study was carried out at Dr. D.R. Bhumbla Regional Research Station, Ballowal Saunkhri (Balachaur), Punjab (India) during 2019-21 on six years old, uniform and disease-free trees of Kinnow mandarin raised on rough lemon rootstocks were selected to study the effect of different orchard floor management treatments on productivity of Kinnow mandarin (*C. deliciosa x C. nobilis*) hybrid. There were seven treatments replicated thrice and each replication had a unit of five trees. The treatments were clean cultivation, weed management with herbicide, mowing of weeds, black polyethylene of 50-micron thickness mulch), silver polyethylene mulch), subabul (*Leucaena leucocephala*) leaves mulch, and control (weedy check). The black as well as silver polyethylene mulch of (50µ) thickness was applied by spreading under the tree canopy before the emergence of weeds. The mowing of weeds was carried out throughout the year with mower when the weeds attain a height of 9 inches thrice a year. The herbicide-based management practice was followed as per the recommendation in citrus orchards using post-emergence herbicide paraquat 1.24 litre/ha in second fortnight of March and again in second fortnight of July as per recommended in package of practice for orchards in PAU, Ludhiana. The treatments were initiated in March after cleaning the orchard and application of recommended doses of inorganic fertilizers. The experiment was replicated thrice. The weed density was estimated by using quadrat (1.0 × 1.0 m) placed randomly in all the replications. The grasses, sedges and broad-leaf weeds were counted separately at a monthly interval from May to April. The weed biomass was recorded by drying the weeds at a monthly interval in a hot air oven at 65 $^{0}$C temperature for 3-4 days. The weeds were removed at ground level after placing the quadrate at random places for dry weight. The data on weed biomass and density was recorded up to April, 2021 starting from May 2019 after application of different orchard floor management treatments. The orchard floor management with mechanical methods using rotavator was carried out for comparison throughout the year. The subabul (*Leucaena leucocephala*) leaves were spread under the canopy of trees with 3-inch layer of leaves. The cultural practices and inputs were used as per package and practices for cultivation of citrus in Punjab by PAU, Ludhiana. Weight of 10 fruits randomly selected from each replication tree was recorded and average was worked out. The yield (kg/ plant) was calculated by multiplying the average fruit weight and number of fruits per plant. The biochemical characteristics were determined by the standard methods. The weed density and biomass were recorded using quadrat method from the month of May, 2019 to April, 2021. The dry weight of weeds was expressed in g/m. The data of the actual number of weeds were transformed by square root transformation for statistical analysis. Statistical analysis of the data was done using CPCS1 software and comparisons were made at 5 per cent level of significance.

The weed species occurred in experimental plot were *Cynodon dactylon, Cyperus rotundus, Eleusine indica, Digera arvensis, Euphorbia hirta* and the commonly found winter weed species in the plots were *Chenopodium album, Anagallis arvensis, Amaranthus viridis* and *Argemone Mexicana.* There were no weeds in black and silver polyethylene mulch till April. The mean weed biomass of grassy and broad-leaved weeds was maximum in control (**Table 1-4**). Different floor management practices influenced the weed biomass. However, the density varied with the season. Similarly, significant reduction in weed density was reported in acid lime with black polyethylene mulch and silver polyethylene mulch (Shirgure *et al.* 2012). Thakur *et al* (2012) also observed that plastic mulch performed best in peach due to physical barriers provided by the mulches. These barriers caused reduction in weed seed germination and seedling growth by reducing light which in turn, caused reduction in photosynthesis. Total soluble solids were influenced by different treatments. The maximum TSS (total sugars and ascorbic acid) was recorded in fruits harvested from trees under black polyethylene mulch (**Table 5**) while minimum TSS was recorded in control trees. These variations in TSS probably may be due to the results of low temperature under organic mulch, whereas under black polyethylene mulch, higher soil temperature may be the principal cause suggested by Tang *et al* (1984). Ali and Gaur (2007) in strawberry and Sheikh (2013) in plum reported maximum TSS in black polyethylene mulch. Fruits harvested from trees under control had higher acidity (0.79%) as compared to all other treatments

(**Table 5**). The black polyethylene mulch recorded minimum fruit acidity (0.72%). This decline in acidity may be due to rapid conversion of some of the acids to sugars under black polyethylene mulch. Nath and Sharma (1994) also recorded maximum acidity under control in Assam lemon. Black polyethylene mulch caused significant increase in the vitamin-C content (40.28 mg/100 g pulp) as recorded by Hasan *et al* (2000) and Ali and Gaur (2007) in strawberry. The minimum vitamin-C content (33.93 mg/100 g pulp) was recorded in control (**Table 5**). Appreciable improvement in fruit quality in terms of ascorbic acid values obtained by various orchard floor management treatments might be associated with increase in conserving soil moisture which ultimately caused mobilization of soluble carbohydrates in the fruit. Fruit size was influenced by different orchard floor management practices (**Table 5**) with maximum fruit length and width and maximum fruit weight with black polyethylene mulch and minimum fruit length (5.42 cm) in control. The influence of mulching on fruit length may be attributed to better moisture availability and nutrients conserved in the soil at the time of fruit development. The moisture stress conditions developed at time of fruit development leads to poor growth, as has been observed under control. These results were in conformity with the findings of Bal and Singh (2011) who reported maximum fruit size in ber (*Ziziphus mauritiana*) under black polyethylene mulching and in strawberry (Sharma *et al* 2013, Shiukhy *et al* 2015). Borthakur and Bhattacharyya (1992) opined that the fruit weight in guava was improved under mulched conditions which may be due to increased absorption of nutrient and moisture. Black polyethylene mulch resulted in maximum yield (71.63 kg/plant) which was

**Table 1 Influence of various orchard floor management practices on weed biomass (g/m$^2$) of grassy leaf weeds (pooled data)**

| Treatment | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Clean cultivation | (16.2) 4.02 | (17.4) 4.17 | (20.0) 4.47 | (23.2) 4.82 | (27.6) 5.25 | (29.1) 5.39 | (18.1) 4.25 | (13.1) 3.63 | (7.1) 2.66 | (8.2) 2.86 | (10.2) 3.19 | (12.3) 3.51 | (16.9) 4.01$^{c}$ |
| Chemical weed management | (10.2) 3.19 | (13.3) 3.65 | (16.1) 4.02 | (3.2) 1.80 | (13.2) 3.63 | (18.4) 4.29 | (15.7) 3.96 | (14.7) 3.83 | (12.5) 3.54 | (9.5) 3.09 | (15.4) 3.93 | (6.4) 2.53 | (12.4) 3.45$^{d}$ |
| Mowing of weeds | (18.2) 4.26 | (20.0) 4.48 | (21.8) 4.67 | (25.4) 5.04 | (29.4) 5.42 | (28.5) 5.34 | (20.4) 4.52 | (18.5) 4.30 | (13.5) 3.68 | (10.5) 3.24 | (24.0) 4.90 | (19.5) 4.42 | (20.8) 4.45$^{b}$ |
| Black polyethylene mulch | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71$^{f}$ |
| Silver polyethylene mulch | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71$^{f}$ |
| Subabul leaf mulch | (3.0) 1.74 | (4.3) 2.08 | (6.3) 2.52 | (7.7) 2.77 | (9.3) 3.06 | (12.4) 3.52 | (10.3) 3.21 | (8.7) 2.94 | (6.0) 2.45 | (6.7) 2.60 | (15.5) 3.94 | (16.5) 4.06 | (8.9) 2.99$^{e}$ |
| Control | (30.2) 5.50 | (36.0) 6.00 | (40.1) 6.33 | (41.0) 6.41 | (43.5) 6.60 | (42.8) 6.55 | (38.5) 6.21 | (33.6) 5.79 | (32.1) 5.66 | (28.8) 5.37 | (30.5) 5.52 | (31.5) 5.61 | (35.7) 5.96$^{a}$ |
| Mean | (7.1) 2.89$^{g}$ | (8.4) 312$^{ef}$ | (9.8) 3.35$^{c}$ | (8.8) 3.18$^{d}$ | (11.7) 3.63$^{b}$ | (12.8) 3.79$^{a}$ | (10.0) 3.37$^{c}$ | (8.5) 3.14$^{de}$ | (6.5) 2.78$^{h}$ | (6.0) 2.66$^{i}$ | (8.6) 3.15$^{de}$ | (8.2) 3.08$^{f}$ | |
| LSD(p=0.05) | Treatment = 0.04 Month = 0.05 | | | | | | | | | | | | |

*Data are subjected to square root transformation; values in the parentheses are original values

**Table 2 Influence of various orchard floor management treatments on weed biomass (g/m$^2$) of broad-leaved weeds (pooled data)**

| Treatment | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Clean cultivation | (20.4) 4.52 | (22.5) 4.75 | (24.0) 4.90 | (28.3) 5.32 | (31.5) 5.61 | (34.5) 5.87 | (22.4) 4.74 | (18.4) 4.30 | (11.5) 3.39 | (13.4) 3.66 | (15.7) 3.97 | (17.4) 4.18 | (21.7) 4.60$^{c}$ |
| Chemical weed management | (14.5) 3.81 | (18.5) 4.30 | (20.4) 4.52 | (9.0) 2.99 | (17.4) 4.18 | (23.6) 4.86 | (19.5) 4.42 | (19.0) 4.36 | (16.4) 4.05 | (14.4) 3.80 | (19.4) 4.41 | (11.4) 3.38 | (17.0) 4.08$^{d}$ |
| Mowing of weeds | (22.7) 4.77 | (24.5) 4.95 | (25.7) 5.07 | (30.5) 5.52 | (33.5) 5.79 | (34.0) 5.83 | (24.4) 4.94 | (23.4) 4.84 | (17.3) 4.16 | (15.4) 3.93 | (20.1) 4.49 | (24.5) 4.95 | (24.3) 4.95$^{b}$ |
| Black polyethylene mulch | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71$^{f}$ |
| Silver polyethylene mulch | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71$^{f}$ |
| Subabul leaf mulch | (7.8) 2.80 | (9.1) 3.01 | (10.3) 3.21 | (12.2) 3.49 | (13.4) 3.66 | (17.5) 4.18 | (14.4) 3.80 | (13.4) 3.66 | (10.7) 3.28 | (11.4) 3.38 | (14.1) 3.75 | (21.4) 4.63 | (12.7) 3.56$^{e}$ |
| Control | (34.4) 5.87 | (41.4) 6.44 | (43.6) 6.60 | (45.4) 6.74 | (47.4) 6.89 | (47.2) 6.87 | (42.4) 6.52 | (38.5) 6.21 | (36.5) 6.05 | (33.5) 5.79 | (34.4) 5.87 | (36.4) 6.03 | (39.9) 6.32$^{a}$ |
| Mean | (9.6) 3.31$^{f}$ | (11.2) 3.55$^{d}$ | (12.0) 3.67$^{c}$ | (11.8) 3.55$^{d}$ | (13.9) 3.93$^{b}$ | (15.5) 4.14$^{a}$ | (12.1) 3.68$^{c}$ | (11.1) 3.53$^{d}$ | (8.9) 3.19$^{g}$ | (8.6) 3.13$^{g}$ | (10.2) 3.40$^{e}$ | (11.0) 3.51$^{d}$ | |
| LSD (p=0.05) | Treatment = 0.04 Month = 0.05 | | | | | | | | | | | | |

statistically at par with silver polyethylene mulch and subabul leaf mulch (**Table 5**). The minimum yield (63.33 kg/plant) was recorded in control. Plants under black polythene mulch produced maximum yield per plant due to better plant growth owing to favourable hydrothermal regime of soil and complete weed free environment to trees which in turn caused higher crop load. These results are also in line with those of Kaundal *et al* (1995) in peach Gosh and Bauri (2003) in mango Shirgure *et al* (2003) in Nagpur mandarin, Das and Dutta (2018) in mango and Ali and Gaur (2007) in strawberry who recorded highest fruit yield with black polythene mulch.

Thus, it can be concluded that the black and silver polythene mulches were superior in terms of weed suppression improving fruit yield and quality of Kinnow under the lower Shiwaliks hills of Punjab.

**Table 3 Influence of various orchard floor management treatments on density (no./m$^2$) grassy weed (pooled data)**

| Treatment | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Clean cultivation | (23.0) 4.80 | (26.4) 5.14 | (31.0) 5.57 | (38.1) 6.18 | (42.6) 6.52 | (40.4) 6.36 | (29.3) 5.42 | (18.5) 4.30 | (12.3) 3.51 | (14.7) 3.83 | (18.4) 4.29 | (20.0) 4.48 | (26.2) 5.03$^{c}$ |
| Chemical weed management | (15.4) 3.93 | (21.0) 4.58 | (29.8) 5.46 | (8.4) 2.90 | (19.3) 4.39 | (26.3) 5.13 | (24.2) 4.92 | (20.4) 4.52 | (18.3) 4.27 | (15.3) 3.92 | (20.3) 4.51 | (10.3) 3.22 | (19.1) 4.31$^{d}$ |
| Mowing of weeds | (28.4) 5.33 | (30.6) 5.53 | (34.6) 5.88 | (38.2) 6.18 | (43.4) 6.59 | (42.2) 6.49 | (30.3) 5.50 | (28.3) 5.32 | (19.2) 4.38 | (17.7) 4.20 | (22.0) 4.69 | (26.1) 5.11 | (30.1) 5.43$^{b}$ |
| Black polyethylene mulch | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71$^{f}$ |
| Silver polyethylene mulch | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71$^{f}$ |
| Subabul leaves mulch | (5.8) 2.42 | (7.2) 2.68 | (10.1) 3.17 | (13.5) 3.68 | (15.9) 3.99 | (18.1) 4.26 | (15.1) 3.89 | (12.2) 3.49 | (11.1) 3.34 | (10.2) 3.19 | (20.5) 4.53 | (21.1) 4.59 | (13.4) 3.61$^{e}$ |
| Control | (45.3) 6.73 | (54.1) 7.36 | (63.3) 7.95 | (70.7) 8.41 | (79.1) 8.89 | (77.5) 8.80 | (57.1) 7.56 | (48.2) 6.93 | (42.0) 6.48 | (37.3) 6.10 | (40.4) 6.35 | (42.1) 6.49 | (54.7) 7.34$^{a}$ |
| Mean | (16.9) 3.53$^{h}$ | (19.9) 3.82$^{e}$ | (24.1) 4.20$^{c}$ | (24.1) 4.11$^{d}$ | (28.6) 4.54$^{b}$ | (29.2) 4.63$^{a}$ | (22.3) 4.10$^{d}$ | (18.2) 3.71$^{f}$ | (14.7) 3.34$^{i}$ | (13.6) 3.23$^{j}$ | (17.4) 3.68$^{f}$ | (17.1) 3.61$^{g}$ | |
| LSD (p=0.05) | Treatment = 0.01 Month = 0.04 | | | | | | | | | | | | |

**Table 4 Influence of various orchard floor management practices weed density (no./m$^2$) on broad-leaved (pooled data)**

| Treatment | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Clean cultivation | (27.4) 5.24 | (31.7) 5.63 | (34.4) 5.87 | (43.9) 6.63 | (46.4) 6.81 | (45.9) 6.78 | (33.9) 5.82 | (23.5) 4.85 | (16.7) 4.09 | (19.8) 4.45 | (22.6) 4.75 | (25.6) 5.06 | (30.1) 5.49$^{c}$ |
| Chemical weed management | (19.5) 4.41 | (26.4) 5.14 | (33.5) 5.79 | (13.6) 3.69 | (23.6) 4.86 | (31.9) 5.65 | (28.7) 5.36 | (25.4) 5.04 | (22.8) 4.78 | (20.4) 4.51 | (24.4) 4.94 | (15.6) 3.94 | (23.4) 4.84$^{d}$ |
| Mowing of weeds | (32.8) 5.73 | (35.5) 5.96 | (39.6) 6.29 | (43.6) 6.60 | (47.4) 6.89 | (46.5) 6.82 | (34.4) 5.87 | (32.7) 5.72 | (23.6) 4.86 | (21.5) 4.64 | (26.6) 5.16 | (31.5) 5.61 | (34.1) 5.84$^{b}$ |
| Black polyethylene mulch | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71$^{f}$ |
| Silver polyethylene mulch | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71 | (0.0) 0.71$^{f}$ |
| Subabul leaf mulch | (9.4) 3.07 | (12.5) 3.54 | (14.4) 3.80 | (18.5) 4.30 | (19.7) 4.43 | (23.5) 4.85 | (19.4) 4.41 | (17.4) 4.17 | (15.4) 3.93 | (16.0) 4.00 | (24.7) 4.97 | (26.7) 5.17 | (17.7) 4.21$^{e}$ |
| Control | (50.4) 7.10 | (59.4) 7.71 | (67.6) 8.22 | (74.7) 8.65 | (83.5) 9.14 | (81.7) 9.04 | (61.5) 7.84 | (52.5) 7.25 | (47.5) 6.89 | (42.4) 6.51 | (44.8) 6.70 | (47.5) 6.89 | (58.7) 7.66$^{a}$ |
| Mean | (19.9) 3.85$^{i}$ | (23.6) 4.19$^{e}$ | (67.6) 4.48$^{c}$ | (27.8) 4.46$^{c}$ | (31.5) 4.79$^{b}$ | (32.8) 4.96$^{a}$ | (25.4) 4.38$^{d}$ | (21.6) 4.06$^{f}$ | (18.0) 3.70$^{j}$ | (17.2) 3.64$^{k}$ | (20.5) 3.99$^{h}$ | (21.0) 4.01$^{g}$ | |
| LSD (p=0.05) | Treatment = 0.01 Month = 0.02 | | | | | | | | | | | | |

*Data are subjected to square root transformation; values in the parentheses are original values

**Table 5 Influence of various orchard floor management treatments on fruit yield and quality parameters**

| Treatment | Total soluble solids(°Brix) | Acidity (%) | Vitamin-C content (mg/100g pulp) | Fruit length (cm) | Fruit breadth (cm) | Fruit weight (g) | Yield (kg/plant) |
|---|---|---|---|---|---|---|---|
| Clean cultivation | 10.45$^{a}$ | 0.77$^{ab}$ | 34.98$^{b}$ | 5.84$^{b}$ | 6.76$^{bc}$ | 154.95$^{abcd}$ | 66.67$^{bc}$ |
| Chemical weed management | 10.51$^{a}$ | 0.78$^{a}$ | 35.18$^{b}$ | 5.76$^{b}$ | 6.64$^{c}$ | 154.41$^{bcd}$ | 66.03$^{bcd}$ |
| Mowing of weeds | 10.47$^{a}$ | 0.75$^{bc}$ | 34.88$^{b}$ | 5.76$^{b}$ | 6.55$^{c}$ | 153.69$^{cd}$ | 64.90$^{cd}$ |
| Black polyethylene mulch | 10.72$^{a}$ | 0.72$^{c}$ | 40.28$^{a}$ | 6.29$^{a}$ | 7.74$^{a}$ | 160.13$^{a}$ | 71.63$^{a}$ |
| Silver polyethylene mulch | 10.62$^{a}$ | 0.74$^{c}$ | 39.27 $^{a}$ | 6.25$^{a}$ | 7.10$^{b}$ | 159.52$^{ab}$ | 70.24$^{a}$ |
| Subabul leaf mulch | 10.45$^{a}$ | 0.74$^{bc}$ | 38.78 $^{a}$ | 6.23$^{a}$ | 7.03$^{b}$ | 158.83$^{abc}$ | 68.72$^{ab}$ |
| Control | 9.78$^{b}$ | 0.79 $^{a}$ | 33.93$^{b}$ | 5.42$^{c}$ | 6.41$^{c}$ | 150.19$^{d}$ | 63.33$^{d}$ |
| LSD (p=0.05) | 0.54 | 0.02 | 1.54 | 0.25 | 0.37 | 5.64 | 3.13 |

## REFERENCES


Abouziena HF, Hafez OM, El-Metwally IM, Sharma SD and Singh M. 2008. Comparison of weed suppression and mandarin fruit yield and quality obtained with organic mulch, synthetic mulches, cultivation, and glyphosate. *Hort Science* **43**(3): 795–799.

Ali A and Gaur GS. 2007. Effect of organic mulches on runner production of strawberry (*Fragaria* x *ananassa* Duch.), *Asian Journal of Biological Science* **8:** 175–179.

Anon. 2016. *Area, Production and Productivity of Fruits in Punjab*. Directorate of Horticulture, Government of Punjab. P 46

Bal JS and Singh S. 2011. Effect of mulching material and herbicides on tree growth, yield and fruit quality of ber. *Indian Journal of Horticulture* **68:** 189–192.

Bond W, Turner RJ and Grundy AC. 2003. A review of nonchemical weed management. http://www.organicweeds.org.uk.

Boora RS, Dhaliwal HS, Singh J, Bons HK and Arora NK. 2014. Studies on weed management in guava nursery under north-western subtropical irrigated zone of India. *Annals of Horticulture* **7**: 1–5.

Borthakur PK and Bhattacharyya RK. 1992. Effect of organic mulches on soil organic matter content and soil pH in guava plantation. *South Indian Horticulture* **40**: 352–354.

Childers NF, JR Morris and GS Sibbett. 1995. *Modern Fruit Science*. Gainesville, FL: Horticultural Publications. 248 p.

Das K and Dutta P. 2018. Effects of mulching on soil properties and post-harvest quality of mango cv. Himsagar grown in new alluvial zone of West Bengal. *International Journal of Agriculture & Environment Biotechnology* **11**: 259–264.

Faber BA, Downer AJ and Menge JA. 2001. Differential effects of mulch on citrus and avocado. *Acta Horticulture* **557**: 303–308.

Ghosh SN and Bauri FK. 2003. Effect of mulching on yield and physiochemical properties of mango fruits cv. Himsagar grown in rainfed laterite soils. *Orissa Journal of Horticulture* **31**: 78–81.

Kaundal GS, Singh S, Chanana YR and Grewal SS. 1995. Effect of glyphosate and plastic mulch on weed control in peach orchard. *Journal of Research Punjab Agricultural University* **32**: 32–38.

Nath J and Sharma R. 1992. Effect of organic mulches on assam lemon. *Horticulture Journal* **5:** 19–23.

Ramakrishna A, Tam HM, Wani SP and Long TD. 2006. Effect of mulch on soil temperature, moisture, weed infestation and yield of groundnut in northern Vietnam. *Field Crops Research* **95**(2-3): 115–125.

Rao VS. 2000. *Principles of Weed Science*. 2nd edition. New York: Science Publishers, 526 p.

Sharma NC, Sharma SD and Spehia RS. 2013. Effect of plastic mulch colour on growth, fruiting and fruit quality of strawberry under polyhouse cultivation. *International Journal of Bio-resource Stress Management* **4**: 314–316.

Shirgure PS, Sonkar AK, Singh S and Panighrah. 2012. Effect of different mulches on soil moisture conservation, weed reduction, growth and yield of drip irrigated Nagpur mandarin (*Citrus reticulata*). *Indian Journal of Agriculture Sciences* **73**: 148–152.

Shiukhy S, Sarjaz M R and Chalavi V. 2015. Coloured plastic mulch microclimates affect strawberry fruit yield and quality. *International Journal of Biometerol* **59**: 1061–1066.

Stout GJ. 1985. *Spray on Mulch Demo*. American Vegetable Grower, Meister Publishing Company, Ohio, USA.

Tang L, Yang X and Han X. 1984. The effect of mulching with silver reflex film in apple orchard. *Scientia Agricultura Sinica* **5**: 259–260.

Thakur A, Singh H, Jawandha SK and Kaur T. 2012. Mulching and herbicides in peach: Weed biomass, fruit yield, size, and quality. *Biological Agriculture & Horticulture* **28**: 280–290.