**Effect of mulching and micronutrients spray on growth and quality of strawberry (*Fragaria* x *ananassa* Duch) cv. Winter Dawn**

**Abstract**

The study used Randomized Block Design, which is a type of experimental design that helps investigate the effects of few factors simultaneously. The treatments comprising different mulches and fertigation *viz.* three types of mulching (black polythene, white polythene and 5 cm thick rice husk mulch) and three types of micronutrients *viz.* (0.4 % ZnSO4, 0.4 % FeSO4, and 0.2% Boron) and control. Among the various types of mulching and different types of micronutrients spray, maximum plant height, plant spread, plant weight (fresh and dry), fruit length, fruit width, fresh and dry fruit weight, maximum TSS, TSS/acid ratio, total sugar, reducing sugar, non-reducing sugar, ascorbic acid content, juice content and anthocyanin content was recorded under the treatment Black polythene +0.2 % Boron. This aligns with the well-established understanding that both mulches and fertigation are critical factors in regulating the growth and quality parameters of strawberry.

**Keywords: *Strawberry, Micronutrients, Mulching, Sugar***

**Introduction**

Strawberry (*Fragaria* x *ananassa* Duch) is a cross between two American species *Fragaria × chiloensis* Duch and *Fragaria × virginiana* Duch which belongs to the family Rosaceae. Its cultivated varieties is octaploid (2n=56) in nature. It occupies a considerable position in fruit crops since it is cultivated in plains and also up to the elevation of 3000 MSL in humid or dry areas of the world. Botanically, strawberry fruits are known as Eterio of achenes and means have numerous small achenes present on periphery of the fruit. Achenes are monocarpous and indehiscent seeds (doesn’t split open) that are present on the surface of fruit, which helps in escalation of berries. Strawberry is an aggregate fruit type (developing from single flower with many ovaries) and highly perishable because of delicateness (Finn and Strike 2008). It is herbaceous plant, which behaves as an annual in the sub-tropical and perennial in temperate region. Strawberry has refreshing, delicious, attractive, nutritive, tremendous aroma and tantalizing flavour (Kher *et al.,* 2010). Fruit contains 98 per cent edible portion and are widely accepted due to pleasant flavour, conspicuous color and varied blendof taste. The delicacy of taste, richness in mineral nourishment makes berries a food in the diet of millions of populace around the world (Bhat *et al.,* 2005); and have low calorific value and fatty acids; also possesses higher P, K, Ca and Fe contents (Kumar and Dey 2011). Vitamin B, C and proteins also makes strawberry good for health. Strawberry is mostly utilized for table purposes and various value supplementary products like jam, canning, ice- cream preparations, RTS beverages, wine; soft drinks etc are prepared from its fruit.

Mulching is application of mulched (covered) soil with loose extraneous organic and inorganic materials. It reduces evaporation and moderates widely an increase and decrease in diurnal soil temperature especially near the root zone. Though, it restricts solar radiation falling on the ground but being an insulating agent, mulched soils are warmer in winter and cooler in summer. It also inhibits weed population and represses weed competition with the main crop for nutrients and water uptake as the result; these get more available to crop plants. Moreover, the practice of mulching enhanced infiltration of water and its percolation deeper in the soil profiles. It also reduces water losses due to fall in thermal gradients and exchange of vapours. Investigation on the influence of various type of mulches material on vegetative growth, yield and quality attributes depicted in the literature that strawberry plant is more responsive to the different mulch materials. Mulches directly influence duration of harvesting, organoleptic and other production parameters and which primarily depend upon soil moisture conservation, soil temperature, nutrient accessibility, inhibition of weeds and shelter from frost injury and check the soiled and contaminated berries (Sharma and Singh 1999; Sharma *et al* 2001; Sharma 2003).Strawberry is a surface feeder plant, thus requires more frequent irrigations to maintain optimum soil moisture. Optimum vegetative growth of strawberry has been obtained under soil moisture conditions where tension does not exceed 1.0 atm. In general, strawberries are irrigated with furrow method but now a day’s drip irrigation has gained popularity because of maximum water use efficiency (Mitra and Bose 1986).

**Materials and Methods**

***Location***

Kota district is located at 25.18° N to 75.83° E Latitude in South Eastern Rajasthan. It covers an area of 221.36 km2. Agro-climatically, the district falls in Zone V, known as Humid South Eastern Plain. The average rainfall in the region is 660.6. mm. Maximum temperature range in the summer is 40 to 48°C and minimum 1.0- 2.6°C during winter.

***Plant Material***

We acquired the strawberry plants cv. Winter Dawn from K.F. Bioplants, located in Pune (Maharashtra), and were pleased to find them in excellent health and uniformity in terms of growth and vigor. To ensure the accuracy of our assessment on the effects of various treatments, we maintained uniform cultural practices across all experimental plots. This included the application of fertilizers and plant protection measures as needed. Raised beds were prepared for planting, and white mulch materials used under open field conditions in all treatments. The experiment was carried out according to proposed plan,

***Experimental Details***

The present experiment was conducted at the Department of Horticulture, School of Agricultural Sciences, Career Point University, Kota (Rajasthan) during the year 2023-24. The experiment involved using a raised bed planting system with spacing of 60 x 30 cm to grow a specific crop. The experimental design used for the study was Randomized Block Design, which helps in reducing bias and obtaining reliable results by randomly assigning treatments to different blocks. The treatments comprising different mulches and fertigation *viz.* four types of mulching (No mulch, 25 micron gauge black polythene, 25 micron gauge white polythene, and 5 cm thick rice husk) and three levels of fertigation (0%, 50%, 75% and 100% RDF through fertigation). So that, total sixteen treatments comprising of different mulching and fertigation levels *viz.* No mulch+0% RDF (T0), No mulch+50% RDF, (T1), No mulch+75% RDF (T2), No mulch+100% RDF (T3), Black polythene +0% RDF (T4), Black polythene +50% RDF (T5), Black polythene +75% RDF (T6), Black polythene +100% RDF (T7), White polythene+0% RDF (T8), White polythene+50% RDF (T9), White polythene+75% RDF (T10), White polythene+100% RDF (T11), Rice husk+0% RDF (T12), Rice husk+50% RDF (T13), Rice husk+75% RDF (T14), Rice husk+100% RDF (T15).

***Fertilizer schedule***

The total quantities of soluble fertilizers were divided in splits based upon the fertilizer treatments and were applied along with irrigation at four days intervals. At the time of experimentation, fertigation (0, 50, 75 and 100 % SDF) was applied along with three levels of fertigation in experimental plots.

## List 1 : Fertigation schedule for strawberry cultivation

|  |  |  |
| --- | --- | --- |
| **Days after transplanting (DAP)** | **Grades of water soluble fertilizers** | **Applied fertilizer Kg/day/ac** |
| 6 -35 | 19 N:19 P2O5:19 K2O  17 N:44 P2O5:00 K2O  Urea (46% N) | 0.82  1.00  0.65 |
| 36-60 | 19 N:19 P2O5:19 K2O  Urea (46% N)  17 N:44 P2O5:00 K2O | 1.68  0.23  0.70 |
| 61-90 | [Muriate of Potash (MOP)](http://www.impactfertilisers.com.au/products/potassium/mop/) 60% K2O  Urea (46% N)  [Sulphate of Potash (SOP)](http://www.impactfertilisers.com.au/products/potassium/sop/) 41% K2O | 0.81  1.00  0.55 |
| 91-120 | 19 N:19 P2O5:19 K2O  [Sulphate of Potash (SOP)](http://www.impactfertilisers.com.au/products/potassium/sop/) 41% K2O | 0.87  0.55 |
| 121-155 | 16 N: 08 P2O5:24 K2O | 0.72 |

***Measurement of the morphological parameters***

The plant height was taken from the tagged plant in each replication after completion of harvesting period with the help of a meter scale, total number of leaves were counted from tagged plants in every replication behind completion of harvesting time and expressed as standard number of leaves per plant the spread of the tagged plants was recorded in east-west and north-south direction individually with the help of a meter scale and the average for all direction was calculated, fresh and dry weight of the plants was measured after completion of harvesting, tagged plants were uprooted and cleaned properly. They were then dried in oven at 70°C and the weight was recorded.

***Determination of the quality parameters***

Fruit length and width was recorded of 10 fruits from every treatment by the help of digital vernier caliper. The fruits weight from every tagged plant was taken on each date of harvest by the help of electronic weight balance and the mean was articulated as weight of fruit in gram. The dry weight of the strawberry fruit was observed by drying the fruits in oven at 70°C temperature till the invariable weight up to 2 days. The value was averaged to record the data. The acidity and vitamin c of the fruit juice was measured the method given by A.O.A.C. TSS: acid ratio was estimate mathematically by dividing the value of TSS with titrable acidity and the data so obtained was expressed as TSS: acid ratio, sugars content was measured by the fehling’s solution method, juice was weighed with the help of balance and the percentage of juice was worked out on the basis of total weight of fruit and weight of juice, for anthocyanin weighing 5.0 g of the homogenized strawberry fruits samples were dissolved in 25 ml methanolic hydrochloric acid (85:15) solution and samples were kept for one day at cool temperature (4-5 0C) for the taking out of anthocyanin. The flocculate was filtered off by a Whatman filter paper No. 1 and the absorbance of the resulting apparent liquid was measured at 535 nm in Spectrophotometer.

**Results**

***Morphological parameters***

The data recorded regarding the effect of different mulch materials and fertigation levels on plant height of strawberry are presented in Table 1. The treatment M1T3: Black polythene+100% RDF recorded the maximum plant height (45.09 cm), whereas, the minimum plant height (12.71 cm) was recorded in treatment (M0T0): No mulch+100% RDF. Treatments M1T2 was found at par from each other. All other treatments were found significantly different from each other. Irrespective of the mulch materials and fertigation recorded significantly higher number of leaves per plant in strawberry (Table 1). The maximum number of leaves per plant (99.02) was recorded in treatment M1T3: Black polythene+100% RDF. In contrast, lower number of leaves (19.91) was recorded in the treatment M0T0: No mulch+0% RDF. Treatments M1T2 was noted at par with each other.

Data pertaining to plant spread (E-W and N-S) of strawberry plants grown with use of mulches and different fertigation levels. Table 1 reveal that in both E-W and N-S directions, irrespective of mulch material, there was more spread in plants grown under different fertigation levels. The maximum E-W spread (54.04 cm) and N-S (52.12 cm) spread was recorded in plants grown with the treatment M1T3: Black polythene+100% RDF whereas, minimum E-W spread (24.48 cm) and N-S spread (24.94 cm) was observed in treatment M0T0: No mulch+0% RDF. Treatments M1T2, was observed at par with each other in respect to E-W and N-S spread. Observations recorded for plant weight (fresh and dry weight) of strawberry as a result of mulching and fertigation levels are presented in Table 1. Strawberry plants in treatment M1T3: Black polythene+100% RDF recorded maximum fresh weight (237.38g) and dry weight (59.42 g) in comparison to all other treatment combinations. Plants grown in treatment M0T1: No mulch+0% RDF had significantly minimum plant fresh weight (20.56g) and minimum plant dry weight (5.00g).

***Physical quality parameters***

There was significant difference among various treatment combinations with respect to their effect on fruit length of strawberry (Table 2). The fruit length in plants grown in treatment M1T3: Black polythene+100% fertigation was maximum (55.71 mm) than those obtained in this study. However, the minimum (28.71 mm) length of fruit was recorded in treatment M0T: No mulch+0% RDF. However, fruits produced in the treatment M1T3: Black polythene+100% fertigation had the maximum fruit width (43.81 mm). Fruits grown in the treatment M0T0: No mulch+0% RDF recorded the minimum fruit width (21.62 mm). The fresh weight and dry weight of strawberry fruits grown with different mulching materials in different growing fertigation are given in Table 2. Fruits in the treatment M1T3: Black polythene+100% fertigation recorded the maximum fresh weight (32.35 g) and dry weight (4.12 g) as compared to other treatments. Treatment M0T0: No mulch+0% RDF recorded minimum fresh weight (10.79 g) and dry weight (1.75 g) among all the treatments respectively.

***Chemical quality parameters***

Table 3 depicts the total soluble solids of strawberry fruits grown with different mulches and fertigation. The TSS of strawberry fruits ranged from 6.09 – 7.53 °B. There was significant difference among various treatment combinations for their effect on TSS. However, strawberry plants grown using treatment M1T3: Black polythene+100% fertigation had fruits with the maximum TSS (7.53°B) while the minimum (6.09°B) was recorded in treatment M0T0: No mulch+0% RDF. No significant difference was recorded among various treatment combinations in their effect on titratable acidity of the fruits (Table 3). The titratable acidity of strawberry fruits ranged from 1.44 to 1.93 per cent with no difference between them. The maximum (1.93 per cent) mean titratable acidity was recorded in fruits grown in treatment M0T0: No mulch+0% RDF, while, the minimum (1.44 per cent) was found in fruits grown in treatment M1T3: Black polythene+100% fertigation.

Table 3 depicts the TSS/acid ratio of strawberry fruits grown with different mulches and fertigation. Maximum TSS/acid ratio (5.23) was observed in treatment M1T3: Black polythene+100% fertigation. The minimum TSS/acid ratio (3.16) was recorded in treatment M0T0: No mulch+0% RDF. Rest all treatments were found significantly different from each other. Although no significant differences were found among various treatment combinations for their effect on total sugars, there was variability among treatments for total sugars content (Table 3). A perusal of the data reveals that maximum total sugar content (5.18%) was recorded in fruits grown in treatment M1T3: Black polythene+100% fertigation, whereas the minimum total sugars content (2.13%) was found in fruits grown in the treatment M0T0: No mulch+0% RDF. Similarly, maximum reducing sugar (4.09%) in fruits produced in treatment M1T3: Black polythene+100% fertigation, while minimum (1.54%) in treatment combination M0T0: No mulch+0% RDF.

Table 4 depicts the data regarding the non-reducing sugar recorded in the strawberry fruits. They reveal maximum non-reducing sugar (1.11%) in fruits produced in treatment M1T3: Black polythene+100% fertigation, while minimum (0.59%) in treatment combination M0T0: No mulch+0% RDF. The data pertaining to the effect of mulch material and fertigation on vitamin C content of strawberry are presented in Table 4. The vitamin C content of fruits ranged from 38.03 mg100g-1 to 53.75 mg100g-1. The maximum vitamin C (53.75 mg100g-1) was recorded in treatment M1T3: Black polythene+100% fertigation while minimum (38.03 mg100g-1) was recorded in treatment M0T0: No mulch+0% RDF.

The data recorded as regard to the effect of different mulch materials and fertigation levels on juice percentage of strawberry fruits are given in Table 4. There were significant differences among the treatment combinations for their effect on juice percentage of strawberry fruits which ranged between 61.83 to 97.61 per cent. The maximum juice percentage (97.61) per cent was observed in fruits which were grown in the treatment M1T3: Black polythene+100% fertigation, while, the minimum juice percentage (61.83 per cent) was recorded in treatment M0T0: No mulch+0% RDF. Treatments M2T0, M3T1, M0T3 and M3T2 were observed at par with each other. However, the total anthocyanin content in strawberry fruit ranged between 26.89–46.92 mg100 g-1. The maximum total anthocyanin content (46.92 mg 100 g-1) was recorded in plants grown in treatment M1T3: Black polythene+100% fertigation and the minimum total anthocyanin content (26.89 mg 100 g-1) was recorded in treatment M0T0: No mulch+0% RDF. Treatments M2T3, M1T1, M0T2 and M3T0 were at par for anthocyanin content of fruit.

**Discussion**

It is evident from the results obtained, that the application of plant growth regulator treatments at different concentration significantly influenced various vegetative growth as compared to control. Among the various treatments M1T3 (Black polythene +100% RDF) increased all vegetative growth related parameters such as plant height, plant spread, number of leaves and plant weight.

This maximum increase in growth parameters might be due to the favourable influence of plant growth regulators and fertigation management on vegetative characteristics. In the present experiment, it was found that fertigation treatments with upper levels of plant growth regulators and NPK had significant influence on plant growth characters. Different levels of nutrients applied through fertigation and spray of various plant growth regulators in different concentrations had significant influence on the growth characters and registering optimistic response on increase in plant height, plant spread canopy volume and leaf area of strawberry. Similarly findings were also reported by Santos and Chandler (2009) and concluded that higher doses of nitrogen fertilizers significantly increased the plant height. The improved growth parameters observed in the present investigation can be attributed to the optimal availability of moisture regime and also nutrients at root zone. Also observed that drip fertigation at numerous intervals provides a standardized moisture regimes and nutrient pool within the soil and therefore, roots remain active for a extended period and increased the provision of nutrients and translocation of food materials which accelerate the vegetative growth of plant parts besides maintaining the soil moisture likewise as temperature at optimum level. However, these findings may be attributed to favourable environment and better moisture conservation vis-à-vis suppression of weeds in better treatment which might have resulted in better plant growth parameters than other treatments. Katiyar *et al.,* (2009) also studied the effect of mulching on plant growth in strawberry under Kanpur agro-climatic conditions and recorded maximum crown height and crown spread in the plants mulched with black polythene sheets followed by white polythene and paddy straw. Increase in vegetative growth related parameters under mulching could be due to better soil moisture retention capacity of the soil. Similar results were also reported by Hassan *et al.,* (2000) that mulching improved vegetative growth in “Oso Grande” strawberry. Similerly, In “Vilnus” Region of Lithuania, Kesik and Maskalaniec (2003) reported that “Senga Sengana” strawberries mulched with black plastic foil had more number of leaves than mulched with rye straw and wood bark.

Maximum fresh and dry weight of the plant in treatment M1T3 may be explained in the light of better growth of the plant under its influence. Similar findings were also noted in strawberry cv. Nyoho by Nam *et al.,* (2006) that plant dry weight was increased significantly with elevated level of N and P content but were not influenced by K content.

Data pertaining to various quality parameters *viz.* TSS (°B), titratable acidity (per cent), TSS/Acid ratio, sugars (per cent), juice content (per cent), vitamic C (mg100g-1) and anthocyanin content (mg100g-1). The results obtained in various treatments differ from each other. The maximum TSS was observed in M1T3 and minimum TSS was recorded in M0T0. These results are corroborated with the findings of Kumar *et al* (2012) that total soluble solids (TSS) was comparatively higher in strawberry fruits harvested from drip fertigation than those from other irrigation levels. However, the maximum TSS is might be due to nitrogen stimulates the functioning of enzymes in the physiological processes, which have improved the total soluble solids content of the fruits.

The titratable acidity was observed in non-significant. Maximum TSS/acid ratio) was observed in treatment M1T3. The minimum TSS/acid ratio was recorded in M0T0. However, TSS, titratable acidity and TSS/acid ratio are non-significantly different from each other. These findings may be explained in relation to higher moisture conservation and maximum nutrient uptake in the treatment M1T3. The maximum total, reducing and non-reducing sugars were recorded in fruits grown in treatment M1T3. The minimum total sugars content was found in fruits grown in the treatment M0T0. These findings are corroborated with the results obtained by Rajna and *et al.,* (2005) and they reported that sugars was significantly higher in the strawberry fruits harvested from plants applied with fertilizer @ 100 kg N/ha as compared to the control.

Maximum vitamin C (52.54mg100g-1) was recorded in M1T3 while the minimum was recorded in M0T0. Ascorbic acid (vitamin C) content of fruits is altered by environmental factors, time of harvesting, plant vigour and age of plant *etc*. Similarly findings were also observed by Moor *et al.,* (2005) and reported that fertigation increase juice ascorbic content in strawberries. Maximum juice and anthocyanin content was observed in the treatment M1T3 while minimum was recorded in M0T0. Anthocyanin accumulation in the ripening fruits depends on phenylalanine ammonia lyase (PAL) and UDPGFT (Uridine diphosphate glucose: flavonoid 3-o transferase) regulatory enzyme activities. In Nagpur mandarin, Shrigure *et al.,* (2001) observed that fruit juice content was highest in plant fertigated with 500:140:70 g N: P: K/tree through drip system.

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**Table 1: Effect of mulches and fertigation on different morphological characteristics of strawberry (*Fragaria× ananassa* Duch.) cv. Winter Dawn**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Treatments** | **Plant height (cm)** | **Plant Spread** | | **No. of leaves per plant** | **Plant Weight (g)** | |
| **Fresh weight** | **Dry weight** |
| **E-W** | **N-S** |
| M0T0 | 12.71 | 24.48 | 22.45 | 19.91 | 20.56 | 10.01 |
| M0T1 | 14.68 | 28.29 | 27.18 | 22.13 | 23.38 | 12.68 |
| M0T2 | 15.33 | 28.78 | 28.96 | 30.8 | 28.25 | 14.59 |
| M0T3 | 16.68 | 31.02 | 29.18 | 34.69 | 32.81 | 17.68 |
| M1T0 | 26.15 | 50.29 | 47.85 | 79.91 | 187.71 | 45.73 |
| M1T1 | 30.16 | 51.74 | 49.85 | 84.02 | 128.29 | 47.89 |
| M1T2 | 36.41 | 52.56 | 50.68 | 95.69 | 189.45 | 57.28 |
| M1T3 | 45.09 | 54.04 | 52.12 | 99.02 | 237.38 | 59.42 |
| M2T0 | 23.07 | 44.74 | 43.63 | 74.13 | 117.47 | 30.99 |
| M2T1 | 23.11 | 45.85 | 44.9 | 74.92 | 123.35 | 36.01 |
| M2T2 | 23.61 | 47.12 | 45.63 | 77.13 | 128.29 | 39.38 |
| M2T3 | 25.39 | 47.71 | 46.3 | 77.91 | 157.48 | 42.75 |
| M3T0 | 19.68 | 32.68 | 32.07 | 46.79 | 67.45 | 19.71 |
| M3T1 | 20.78 | 41.4 | 40.79 | 56.59 | 96.36 | 25.61 |
| M3T2 | 20.94 | 42.29 | 41.62 | 70.02 | 99.80 | 26.47 |
| M3T3 | 12.71 | 43.58 | 42.23 | 19.91 | 107.80 | 29.18 |
| **CD at 5%** | 3.45 | 6.21 | 7.21 | 12.47 | 10.63 | 12.50 |
| **SEm±** | 1.21 | 3.08 | 3.23 | 4.18 | 3.80 | 4.12 |

**Table 2: Effect of mulches and fertigation on physical quality of strawberry (*Fragaria x ananassa* Duch.) cv. Winter Dawn**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatments** | **Fruit**  **length (mm)** | **Fruit**  **width (mm)** | **Fruit Weight (g)** | |
| **Fresh weight** | **Dry weight** |
|
| M0T0 | 28.71 | 21.62 | 10.79 | 1.75 |
| M0T1 | 29.08 | 24.38 | 11.86 | 1.82 |
| M0T2 | 29.6 | 25.53 | 12.57 | 1.93 |
| M0T3 | 30.05 | 27.47 | 12.78 | 1.96 |
| M1T0 | 45.68 | 38.86 | 28.09 | 2.36 |
| M1T1 | 49.17 | 39.72 | 29.42 | 3.38 |
| M1T2 | 49.4 | 41.88 | 31.38 | 3.41 |
| M1T3 | 55.71 | 43.81 | 32.35 | 4.12 |
| M2T0 | 35.66 | 31.66 | 19.78 | 2.15 |
| M2T1 | 39.51 | 31.58 | 21.48 | 2.19 |
| M2T2 | 40.35 | 33.01 | 24.82 | 2.33 |
| M2T3 | 42.15 | 33.38 | 25.48 | 2.35 |
| M3T0 | 30.58 | 28.64 | 12.88 | 2.00 |
| M3T1 | 30.95 | 29.63 | 14.42 | 2.01 |
| M3T2 | 32.87 | 30.03 | 16.55 | 2.06 |
| M3T3 | 33.85 | 30.8 | 18.09 | 2.14 |
| **CD at 5%** | 5.30 | 6.20 | 12.54 | 30 |
| **SEm±** | 1.90 | 2.10 | 4.20 | 0.14 |

**Table 3: Effect of mulches and fertigation on chemical quality of strawberry (*Fragaria x ananassa* Duch.) cv. Winter Dawn**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatments** | **TSS (°B)** | **Tit. Acidity (%)** | **TSS/ acid ratio** | **Total sugars (%)** | **Reducing sugars (%)** |
| M0T0 | 6.09 | 1.93 | 3.16 | 2.13 | 1.54 |
| M0T1 | 6.21 | 1.89 | 3.29 | 2.31 | 1.67 |
| M0T2 | 6.31 | 1.87 | 3.38 | 2.79 | 1.99 |
| M0T3 | 6.39 | 1.82 | 3.51 | 2.91 | 2.05 |
| M1T0 | 7.11 | 1.63 | 4.36 | 3.78 | 2.77 |
| M1T1 | 7.15 | 1.50 | 4.77 | 4.04 | 3.04 |
| M1T2 | 7.41 | 1.46 | 5.08 | 4.72 | 3.61 |
| M1T3 | 7.53 | 1.44 | 5.23 | 5.18 | 4.09 |
| M2T0 | 6.69 | 1.70 | 3.94 | 3.31 | 2.39 |
| M2T1 | 6.71 | 1.68 | 4.00 | 3.33 | 2.44 |
| M2T2 | 6.85 | 1.68 | 4.08 | 3.54 | 2.55 |
| M2T3 | 7.09 | 1.65 | 4.30 | 3.65 | 2.67 |
| M3T0 | 6.41 | 1.79 | 3.58 | 3.01 | 2.16 |
| M3T1 | 6.51 | 1.78 | 3.66 | 3.14 | 2.28 |
| M3T2 | 6.61 | 1.72 | 3.85 | 3.16 | 2.30 |
| M3T3 | 6.65 | 1.70 | 3.91 | 2.13 | 1.54 |
| **CD at 5%** | 0.18 | NS | 0.24 | 0.60 | 0.48 |
| **SEm±** | 0.52 | 0.10 | 0.08 | 0.21 | 0.16 |

**Table 4: Effect of mulches and fertigation on chemical quality of strawberry (*Fragaria x ananassa* Duch.) cv. Winter Dawn**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatments** | **Non reducing sugars (%)** | **Vitamin C (mg/100g)** | **Juice (%)** | **Anthocyanin content (mg/100g)** |
| M0T0 | 0.59 | 38.03 | 61.83 | 26.89 |
| M0T1 | 0.64 | 41.09 | 66.55 | 31.16 |
| M0T2 | 0.80 | 41.45 | 69.95 | 31.56 |
| M0T3 | 0.86 | 41.58 | 77.03 | 31.61 |
| M1T0 | 1.01 | 49.86 | 91.86 | 41.4 |
| M1T1 | 1.00 | 50.04 | 92.54 | 41.59 |
| M1T2 | 1.11 | 50.43 | 96.31 | 42.21 |
| M1T3 | 1.09 | 53.75 | 97.61 | 46.92 |
| M2T0 | 0.92 | 46.42 | 88.29 | 37.1 |
| M2T1 | 0.89 | 46.47 | 89.3 | 37.38 |
| M2T2 | 0.99 | 49.04 | 89.49 | 39.91 |
| M2T3 | 0.98 | 49.34 | 90.01 | 40.31 |
| M3T0 | 0.85 | 44.14 | 80.95 | 32.88 |
| M3T1 | 0.86 | 44.2 | 82.21 | 32.93 |
| M3T2 | 0.86 | 44.77 | 83.85 | 33.15 |
| M3T3 | 0.92 | 45.62 | 85.01 | 36.94 |
| **CD at 5%** | 0.09 | 6.60 | 7.56 | 4.80 |
| **SEm±** | 0.03 | 2.21 | 2.18 | 1.66 |