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Effect of nutrients and mulches on qualitative aspects of Strawberry (*Fragaria* × *ananassa* Duch.) cv. Chandler

Vipnesh Singh, Sanjay Kumar, Shatrunjay Yadav, Lalit Kumar, Usha Shukla and Devi Darshan

Abstract
The present experiment was entitled "Effect of nutrients and mulches on qualitative aspects of Strawberry (*Fragaria* × *ananassa* Duch.) cv. Chandler. The different nutrients (FYM, Vermi compost and NPK) and different use of mulches (White polythene &Black Mulches) are practiced in strawberry. Mulching is practiced in strawberry (*Fragaria* × *ananassa* Duch.) to conserve water, control weeds, and keep fruit clean, resultantly improving quality. The most commonly used plastic mulch colour is black, but coloured mulch is reported to perform better than black polyethylene mulch. The present study was conducted over a period of three years to see the effect of different coloured polyethylene mulches on performance of strawberry under hot dry subtropical climatic conditions prevailing at Lucknow region of Uttar Pradesh, India. The experiment was laid out in randomized block design (RBD) with seven treatment combinations replicated four times. Strawberry performance for most of the Physico-chemical parameters was recorded best under yellow polyethylene mulch followed by black polyethylene mulch over control. Vegetative growth, fruit yield and berry size was observed significantly better in yellow than black polyethylene mulch. However, fruit quality in respect of sugars, vitamin A and anthocyanin content was found superior in black polyethylene mulch. The inductive resonance effect of green and yellow light absorption by plant under yellow polyethylene mulch appears to have a role in enhancing photosynthesis resulting in better vegetative growth, fruit quality and higher yield of strawberry.

Keywords: Strawberry, qualitative, nutrients, mulches

Introduction
The Strawberry is a most important man made horticultural fruit crop. The modern cultivated octaploid Strawberry (*Fragaria* X *ananassa* Duch.) originated in France. It belongs to the family Rosaceae. It is one of the delicious and nutritious among soft fruit with wider adoptability. This crop is chiefly grown in the temperate world. However, it can be grown under sub- tropical climate and even at high altitude of tropical climate. Strawberry can be grown wide range of soil from heavy clays to light sand and gravels. However, strawberry plant grows well in sandy loam soil with pH of 5.5- 6.5 (Anon, 1956) [1]. The strawberry requires an optimum day temperature of 22 ^{0}C & night temperature of 7 ^{0}C to 13 ^{0}C for maximum growth and development. In cold climate frost damage as well as winter injury greatly reduced yield of strawberry. Frost may damage centre of open flower causing the characteristics 'Black eye' disease. Frost free site make strawberry cultivation comparatively easy, it is also grown under the green house and covered plastic. Flower before opening and after set are slightly more resistant to frost damage. Proper nutrition is very important for its profitable cultivation. 'Albinism' is a physiological disorder probably caused by certain climatic condition and extremes in nutrition. The fruit of strawberry is a complete fruit with 98% edible portion. The first plant of the cultivated strawberry *Fragaria x ananassa* has originated in France and the two American diploids *F. chiloensis* and *F. virginiana*are considered in progenitors. The cultivated strawberry *F. ananassa* is grown all over the world but its progenitors are the Native to the new world. *F. chiloensis* is found to occur in Chile and along the coast from California to the Aleutian island while *F. virginiana*is located in Canada and United States of America. Natural population of *F. ananassa* is restricted to the coastal California, Oregan and Washington (Sologalov, 1987) [7]. The most broadly distributed natural species is the diploid *F. vasca* which is found in North and South America, Europe, Asia and Hawai (Heike, 1997) [4]. The modern cultivated strawberry is of recent origin in Europe between 1714 and 1759 (Staudt, 1962). Strawberry species are found in a diverse array of climates including temperate, grassland, Mediterranean and subtropical.

Fragaria species are found a polyploidy series ranging from diploid to octoploid, the basis chromosome set having 7 chromosomes (X=7).At least sixteen species of wild strawberry are believed to occur all over the world. *F. virginiana* was introduction in Europe from 1624 while *F. chiloensis* was introduction in 1714 from Chile, where it had been cultivated by Indian. *F. virginiana* plant are tall, produce abundance of runner. Flower are imperfect; fruits are of good quality but small in size, light to deep red in colour with soft flesh and aroma. The strawberry fruit are highly perishable in nature and need quick disposal after harvest. Fruits are mostly consumed fruit. It is also feasible to make high grade processed products like jam, syrup, candy, preserved, etc. from strawberry. The fruit rich in vitamins and minerals. The taste of fruits mainly depends on three different compounds *viz*., sugar, acids, and aromatic compounds. The strawberry fruit contains 0.5% total sugar and 0.90%to 1.85%acidity the prominent mailic acid and citric acid. As reported by Watt and Merrill (1959) 100 g of natural strawberry fruit contains protein 0.7g, fat 0.5 g, carbohydrate 8.4 g, Vitamin A 60 IU., thiamine 0.03 mg riboflavin.07 mg, niacin 0.60mg, vitamin C 59.0mg, calcium 21.0mg, phosphorous 21.0 mg, iron1.0 g, potassium 164 mg and sodium 1.0 mg. Mussinan and Walradt (1975) indentified 13 organic acid in fresh California strawberry fruits. Stahr and Hermaun (1975) found 10 to70gm catechin, 10 mg epicatechin, 10 mg caffeic acid, 10 to 15 mg P-coumaric acid, 10 to 35 mg 4- hydroxybenzoic acid, 5 mg protecatechuic acid and 10 to 40 mg gallic acid per kg of fresh fruit. Ethyl Easters are the major volatile compounds responsible for the flavour of fruits. Ethyl butanoate and ethyl hexanoate are the main easters identified in ripe fruits and asparagine, glutamine and alanine are the most prominent free amirto acid [Perez *et al*., (1992)] [6]. Green and ripe, red achenes and leaf tissue of strawberry contain ellagic acid –an antimutagenic and anticarcinogenic plant phenol. Couture *et al*. (1988) [3] found that ripe fruit contains slightly more lipid than unripe fruit, and it contains more eleic acid and less linoleic acid.

Material and Methods

Experimental location: The experiment was place at Babasaheb Bhimrao Ambedkar University's Horticultural Research Farm in Lucknow during the 2018-19 academic years (Uttar Pradesh). The experimental site, which has a subtropical climate, with temperatures ranging from 3.50°C to 450°C. January is the coldest month, while May and June are the hottest, with relative humidity (RH) ranging between 50 and 77 percent depending on the season. This area had an average yearly rainfall of 650-750 mm, which was spread out over more than 100 days, with the peak months being July and August. During the winter, it also has sporadic performances. The soil on the experimental farm was saline, with a pH below 8.3, an electrical conductivity above 4.0, and a sodium exchangeable percentage below 15.0.

Experimental details: The runners of Chandler variety of strawberry were brought from the Central Institute of Temperate Horticulture, Kashmir (J&K) in the month of October, 2018 and they were kept for two days in shade for hardening before transplanting in well- prepared beds under open field condition. The healthy runners was transplanted on 22th October 2018 during evening hour was done in single row system. An area of 18 m x 7.80 m size was divided into 42 plots having the size of 1.8 m x 1.2 m and the experiment was laid out in randomized block design having 14 treatments with three replication. The details of the treatment were T_1-White Polythene (control), T_2-Whiten Polythene + FYM 100% T_3-White Polythene + vermin-compost 100%, T_4-White Polythene + NPK 100%, T_5-White polythene FYM 50%+ Vermi-compost 50%, T_6-White Polythene FYM 50% + NPK 50%,T_7-White polythene Vermi-compost 50% + NPK 50%,T_8-Black Polythene,T_9-Black polythene + FYM 100%,T_{10}-Black Polythene + Vermi-compost 100%,T_{11}-Black polythene +NPK 100%,T_{12}-Black Polythene FYM 50%+ Vermi-compost 50%,T_{13}-Black Polythene FYM 50%+ Vermi-compost 50% and T_{14}-Black Polythene Vermi-compost 50%+ NPK 50%. Mulching was done two days after transplanting black polythene and white polythene (200 gauge) was used for covering the soil surface in the bed.

Observation recorded: Biochemical parameters *viz.*; total soluble solids were estimated at ambient temperature by digital hand refractometer (ATAGO Pocket 3810, PAL-1). Titrable acidity was calculated by titrating the fruit pulp extract with 0.1N NaOH using the phenolphthalein indicator (Ranganna, 2010). Ascorbic acid, total sugar, reducing sugar, and non-reducing sugar content in fruit samples were estimated by the method described by Ranganna (2010).

Statistical analysis: The analysis of variance (ANOVA) for randomised block design (RBD) was performed using the OPSTAT (http://14.139.232.166/opstat) programme, according to the criteria provided by Gomez and Gomez (1984). Fisher and Yates' table was used for comparing 'F' values and computing critical difference (CD) at a 5% level of significance.

Results and Discussion

Effect of different nutrients and mulches on quality attributes of strawberry

The Total soluble solids (T.S.S.) content of strawberry fruits were recorded with the help of Erma Hand Refractometer. The average values were presented in Table-1.1 and graphically depicted in Fig-1.1. The that total soluble solids contents of fruits were increased significantly with different effect of FYM, NPK, Vermicompost, and Mulched with black and white polythene in comparison to control plants. The maximum total soluble solids (11.167) were recorded in the treatment nine fruits treated with black polythene with FYM followed by treatment Ten (10.100) treated with black polythene vermi-compost whereas, Table No. 11. Effect of different Nutrients and Mulches on Total Soluble Solid (T.S.S.) 0Brix. These results are in conformity with the finding of Patil *et al.* (2004) [5] in strawberry. The percentage acidity of strawberry fruits was estimated under each treatment and the mean values were presented in Table-1.1 and illustrated in Fig-1.1. The maximum acidity was observed with controlled treatment one (0.657%) followed by treatment Four (0.67), whereas, the minimum acidity was recorded treatment Ten (0.363) untreated plants. These results are in agreement with those obtained by Rajbir *et al*. (2008). In case of ascorbic acid the maximum data clearly showed that the treatment T9 49.767 mg/100g followed by the treatment T10 43.900 mg/100g. Minimum value was found in the treatment T1 (control) 28.067 mg/100g. significantly higher ascorbic acid content in fruits was also recorded in Black polythene

FYM 100% in comparison to white polythene Patil *et al.* (2004) [5]. The total sugar was observe maximum in treatment T9 8.567%, reducing was high in T9 7.267% and non-reducing was highest in treatment T1.667%. However non-reducing sugar was minimum recorded treatment T1 1.33%. The data for total sugar content of berries were estimated separately under each treatment and the mean values obtained are given in Table-1.1 and exhibited in Fig-1.1. It is evident from the mean observation that this character was significantly improved by the application of different doses of FYM, NPK and vermicompost as compared to control. Among all the treatments the maximum amount of total sugar (8.567) was estimated when treatment treated with FYM and mulched of black polythene and fallowed by treatment ten (7.533) in which black polythene and vermi-compost. The minimum amount of total sugar (5.200) was noticed under controlled treatment.

Table 1: Effect of different nutrients and mulches on qualitative aspects of strawberry

Treatments	TSS	Acidity	Ascorbic Acid	Reducing sugar	Non-reducing sugar	Total sugars
White Polythene	7.70	0.65	28.067	3.567	1.33	5.20
Whiten Polythene FYM 100%	8.76	0.53	39.133	4.900	1.53	6.36
White Polythene vermin-compost 100%	8.63	0.52	38.733	4.733	1.50	6.16
White Polythene NPK 100%	8.26	0.56	31.733	3.833	1.43	5.56
White polythene FYM 50%+ Vermi-compost 50%	8.50	0.52	36.367	4.500	1.50	5.93
White Polythene FYM 50% + NPK 50%	8.36	0.39	33.933	4.100	1.43	5.63
White polythene Vermi-compost 50% + NPK 50%	8.40	0.41	36.167	4.43	1.5	5.86
Black Polythene	7.80	0.36	29.63	3.70	1.40	5.26
Black polythene FYM 100%	11.167	0.34	49.76	7.2	1.66	8.56
Black Polythene Vermi-compost 100%	10.10	0.36	43.90	6.433	1.63	7.53
Black polythene NPK 100%	9.30	0.53	39.50	5.433	1.53	6.43
Black Polythene FYM 50%+ Vermi-compost 50%	9.76	0.56	41.00	6.200	1.60	7.67
Black Polythene FYM 50% + NPK 50%	9.53	0.55	40.23	5.733	1.53	6.46
Black Polythene Vermi-compost 50%+ NPK 50%	9.56	0.55	40.53	6.03	1.60	6.93
C.D.	1.68	0.04	3.01	1.197	0.18	1.32
S.E(m)	0.57	0.01	1.03	0.41	0.06	0.45
S.E(d)	0.81	0.02	1.46	0.579	0.88	0.63

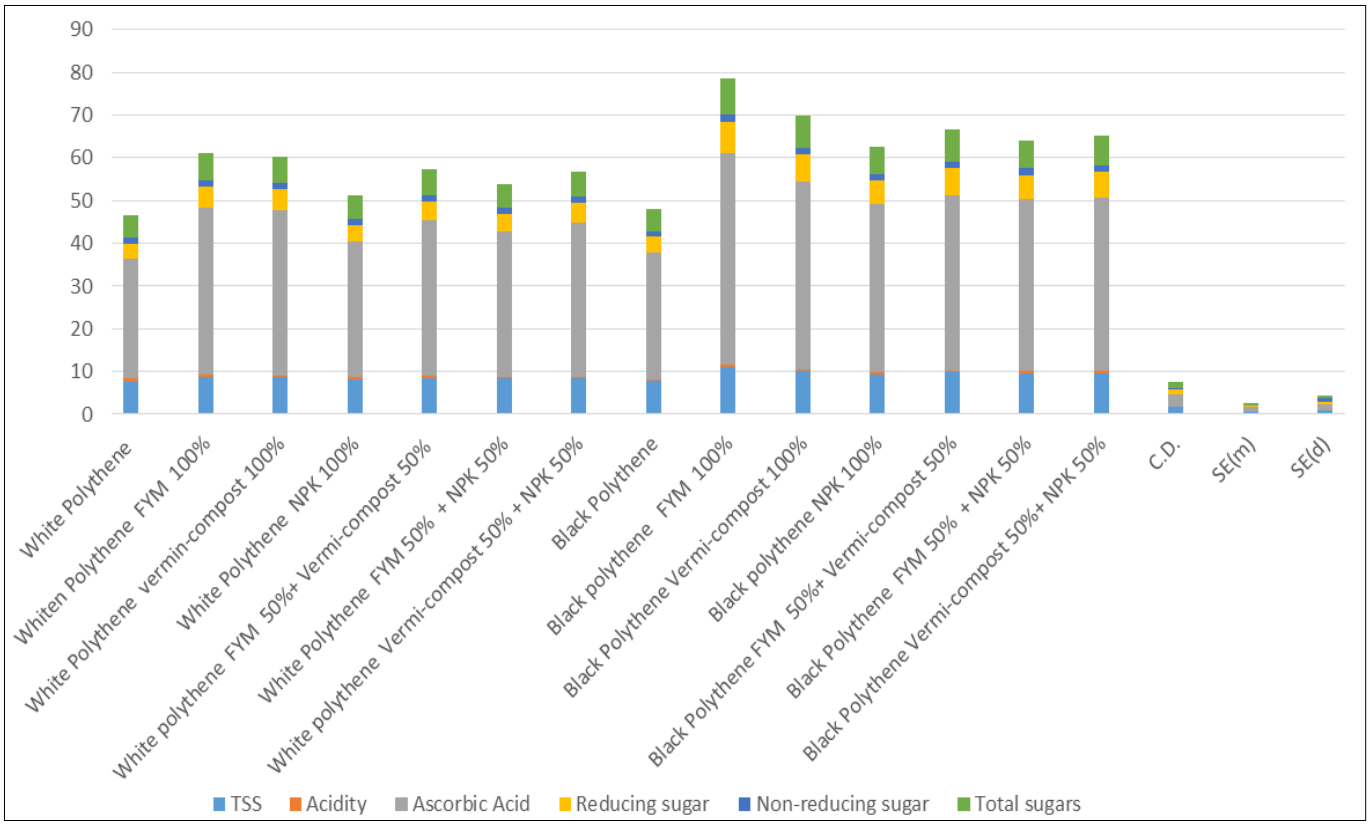

Fig 1: Effect of different nutrients and mulches on qualitative aspects of strawberry

Plate 1: A general view of experimental field after mulching

Plate 2: A general view of single plant of strawberry

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