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EFFECT OF VARIOUS MULCHES ON GROWTH, YIELD AND QUALITY OF KINNOW

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ABSTRACT
The experiment was conducted at Research Farm of the Department of Horticulture, CCS Haryana Agricultural University, Hisar during the year 2013 to assess the effect of different mulches on growth, yield and quality of Kinnow. The treatments comprising six levels viz., control, black polythene 100 micron, black polythene 200 micron, paddy straw (5 cm thickness), sugarcane trash (5 cm thickness) and pearl millet straw (5 cm thickness) of mulches which were laid out in a randomized block design with three replications. In mulching experiment, maximum values for plant girth (6.27), spread (EW-9.28, NS- 8.55), height (8.52), fruit weight (177.41), length (7.16), breadth (7.28), number of fruits (246.72) and yield (43.77) were recorded with black polythene of 200μ mulch. However, maximum TSS (8.33), ascorbic acid (41.66) and minimum acidity (0.77) were recorded in paddy straw mulch and maximum juice content (54.58) was recorded with black polythene 200μ mulch. Leaf water potential was influenced by various mulches, but minimum leaf water potential was observed in black polythene 200μ mulch (11.50).

INTRODUCTION

Citrus is a commercially important fruit crop of India that belongs to family Rutaceae and is the third most important fruit crop of India. Kinnow, a mandarin hydrid (*Citrus nobilis* Lour. × *Citrus deliciosa* Tan.) was developed by H.B. Frost in USA in 1935 and introduced in India in 1959. In India, citrus occupies an area of 1,042.5 thousand hectares with annual production of 10,089.7 thousand MT (Tiwari *et al.*, 2013). The Kinnow fruit is large and orange in colour, with 12-25 seeds and a globular shape. It matures in December- January. Kinnow has assumed special economic importance and export demand due to its high juice content, special flavour, and as a rich source of vitamin C and pectin. Kinnow helped in replacing the traditional citrus fruits viz. Sweet Orange and local mandarin to some extent and strengthening the status of citrus industry in India (Ghosh, 2001).

Mulching practices in fruit cultivation ensures the better quality fruits with high yield and better return to the growers. The most encouraging results have been reported in fruit crops like banan (Gurung and Chattopadhyay, 1994) and guava (Borthakur and Bhattacharya, 1998). The uses of mulches help to reduce water consumed (Keramat *et al.*, 2011). Mulches also play an important role in reducing soil erosion, improving soil structure, organic matter, microbial flora, soil aeration, regulating soil temperature, conserving moisture *in-situ,* controlling weeds and reducing nutrient removal by weeds (Mostert, 1993, Jiang *et al.,* 1997). Different organic mulches significantly increased the soil organic carbon and nutrients (Kumar, V., 2014). The mulching results in higher total and marketable yield as compared to non-mulching treatment (Kumar *et al.*, 2015).

Mulches not only conserve soil moisture but also impart manifold beneficial effects, like suppression of extreme fluctuation of soil temperature and reduction of water loss through evaporation, resulting is more stored soil moisture (Shirgure *et al.*, 2003), maintenance of soil fertility (Slathia and Paul, 2012). Moreover, mulching with plastic polyethylene is found effective in conserving the soil moisture and increasing the growth, yield and quality in different citrus cultivars (Lal *et al.*, 2003, Shirgure *et al.*, 2005). Considering the beneficial effect of mulching, this investigation was undertaken to assess the effect of various mulches on growth, yield and quality of kinnow.

MATERIALS AND METHODS

The present investigation was carried out on Kinnow trees at experimental orchard of the Department of Horticulture, CCS HAU, Hisar during the year 2013 and data was collected on various parameters. The experiment was laid out in randomized block design with 6 mulch treatments viz., control (No mulch), black polythene 100 micron, black polythene 200 micron, paddy straw (5 cm thickness), sugarcane trash (5 cm thickness), pearl millet straw (5cm thickness) each were tried at three replications.

Plant girth was measured with the help of digital Vernier Calipers from the base of the trunk. Plant spread was determined by measuring distance between point to which most of the branches of the tree had grown in the east-west and north-south direction. The height of the tree was measured with the help of measuring pole up to the maximum point of height, ignoring only the off type shoots. The leaf water potential was determined by pressure chamber apparatus.

The TSS of the representative fruit juice was determined by using hand refractometer.

The titratable acidity was determined as per the method given by AOAC (1990). Two milliliters of freshly extracted juice was titrated against N/10 NaOH using phenolpthlein (1%) as an indicator. The appearance of the light pink colour was taken as the end point. The acidity was expressed in terms of percent citric acid. Ascorbic acid was estimated as per the method given by AOAC (1990). Two ml of fruit juice mixed with 2 ml of 3% metaphosphoric acid as buffer. It was titrated with 2, 6-dichlorophenol indophenol dye till the light pink colour appeared. The results were expressed as mg of ascorbic acid per 100 gm of juice.Ten randomly selected fruits from the tree were picked and weighed. The juice from the fruits was extracted with the help of muslin cloth.

$$\text{The average juice content was calculated as: } \frac{\text{Total juice weight}}{\text{Total weight of fruits}} \times 100$$

Ten randomly selected fruits from different position of the tree were picked and weighed on top pan electric balance. The average weight was calculated by dividing the total fruit weight by total number of fruits taken. Fruit length and breadth of ten randomly selected fruits per replication was measured with the help of digital Vernier Calipers and the average value was calculated. The number of fruits per tree was calculated by visually dividing the canopy of the tree into two equal halves and then counting the number of fruits on both halves and total number of fruits is obtained by adding the number of fruits of two halves. The total fruit yield per tree was calculated by multiplying total number of fruits per tree with the average fruit weight.

RESULTS AND DISCUSSION

Plant spread, height and girth

Table 1:

Treatments	Spread EW	NS	Height	Girth
Control (No mulch)	7.48	6.56	7.33	5.43
Black polythene 100μ	9.09	8.43	8.35	6.05
Black polythene 200μ	9.28	8.85	8.52	6.27
Paddy straw	8.82	8.21	8.21	5.94
Sugarcane trash	8.51	8.11	7.94	5.87
Pearl millet straw	8.22	7.79	7.82	5.77
SE(m) ±	0.33	0.34	0.17	0.59
C.D. at 5%	1.05	1.08	0.51	NS

Data given in Table 1 revealed that there was significant increase in plant spread and height whereas non-significant increase in plant girth. The maximum per cent increase in plant spread EW (9.28) and NS (8.85) was recorded in black polythene 200μ mulch which was at par with all the treatments except control where minimum per cent increase EW (7.48) and NS (6.56) was observed. The maximum per cent increase in plant height (8.52) was recorded with black polythene 200μ mulch which was at par with black polythene 100μ (8.35) mulch and paddy straw (8.21) mulch and minimum (7.33) was in control. The maximum plant girth (6.27) was recorded in black polythene 200μ mulch and minimum (5.43) was in control.

This might be due to the positive response of organic and inorganic mulches on growth characteristics may be attributed to improved physico-chemical properties of soil through providing congenial environment to the root zone. The data indicated that all the mulching treatments had positive impact, varying in levels of nutrients compared to no mulching, where, high evaporation from the bare soil surface and less nutrient availability to the plants might have cause the minimum growth of plants. The highest plant height was recorded under the mulching treatment compared to non-mulching treatment in potato (Kumar *et al.*, 2015). More or less similar results have been reported by Shirgure *et al.* (2003) in Nagpur mandarin, Dutta and Majumder (2009) and Khan *et al.* (2013) in guava.

Fruit length, breadth, weight, number of fruits and yield

Observations presented in Table 2 showed that the fruit length, breadth, weight, number of fruits and yield were significantly increased by various mulches. The maximum fruit length (7.16) and breadth (7.28) was recorded with black polythene 200μ mulch which was at par with all the treatments except control where minimum fruit length (6.34) and breadth (6.56) was observed. The maximum fruit weight (177.41) was recorded with black polythene 200μ mulch which was statistically at par with black polythene 100μ (174.46) mulch and minimum (150.93) was recorded in control. The number of fruits was found maximum (246.72) with black polythene 200μ mulch and minimum (213.05) were observed in control. Significantly highest yield (43.77) was recorded with black polythene 200μ mulch whereas lowest yield (32.16) was recorded in control.

This might be due to fact that the black polythene mulch having more pronounced effect as compared to organic mulches and maximum availability of nutrients under polythene mulch and also more availability of soil moisture for longer duration while in control these parameters are minimum due to lower soil moisture regimes, more weed infestation resulted in higher water loss from the soil surface. These findings are in close

Table 2:

Treatments	Length (cm)	Breadth (cm)	Weight (g)	Number of fruits	Yield (kg/plant)
Control (No mulch)	6.34	6.56	150.93	213.05	32.16
Black polythene 100μ	7.14	7.20	174.46	239.26	41.74
Black polythene 200μ	7.16	7.28	177.41	246.72	43.77
Paddy straw	7.02	7.16	171.03	236.85	40.51
Sugarcane trash	6.91	7.09	166.31	236.08	39.26
Pearl millet straw	6.82	7.01	162.42	235.04	38.18
SE(m) ±	0.15	0.13	1.33	2.33	1.58
C.D. at 5%	0.49	0.40	4.26	7.45	5.05

Table 3:

Treatments	TSS (^{0}B)	Acidity (%)	Ascorbic acid (mg/100g)	Juice content (%)
Control (No mulch)	7.77	0.88	31.53	42.83
Black polythene 100μ	7.94	0.84	35.21	52.95
Black polythene 200μ	8.00	0.82	36.82	54.58
Paddy straw	8.33	0.77	41.66	50.43
Sugarcane trash	8.26	0.79	39.17	49.08
Pearl millet straw	8.08	0.80	37.60	46.50
SE(m) ±	0.08	0.02	1.12	1.14
C.D. at 5%	0.26	0.06	3.58	3.63

Table 4: Effect of mulches on leaf water potential of Kinnow plants

Treatments	Leaf Water Potential (bars)
Control (No mulch)	13.50
Black polythene 100μ	11.83
Black polythene 200μ	11.50
Paddy straw	12.03
Sugarcane trash	12.08
Pearl millet straw	12.22
SE(m) ±	0.24
C.D. at 5%	0.75

conformity with the results of Shirgure *et al*. (2005) in acid lime, Kotur (2007) and Das *et al*. (2010) in guava, Singh *et al*. (2009) in mango and in potato (Kumar *et al*., 2015).

TSS, acidity, ascorbic acid and juice content

Observations presented in Table 3 showed that the TSS, acidity and ascorbic acid contents were significantly influenced by various mulches. The maximum TSS (8.33) was observed with paddy straw mulch and it was at par with sugarcane trash (8.26) mulch and pearl millet straw (8.08) mulch and minimum (7.77) was recorded in control. Minimum acidity (0.77) was observed with paddy straw mulch and it was at par with sugarcane trash (0.79) mulch, pearl millet straw (0.80) mulch, black polythene 200μ (0.82) and maximum (0.88) was in control. The maximum retention of ascorbic acid was recorded in paddy straw mulch (41.66) which was at par with sugarcane trash (39.17) and minimum (31.53) was recorded in control. The maximum juice content (54.58) was recorded in black polythene 200μ mulch which was at par with black polythene 100μ (52.95) mulch and minimum (42.83) was recorded in control.

The most desirable changes in quality parameters viz. TSS, acidity, ascorbic acid and juice content might be due to the proper availability of soil moisture content continuously during the experimentation period and improved soil nutrient status while in control the fluctuation in temperature and lower soil moisture content with severe weed infestation is the main cause of low quality fruit. These findings were agreement with the results of Shirgure *et al*. (2003) in Nagpur mandarin, Maji and Das (2008) in guava and Moor *et al*. (2004) in strawberry.

Leaf water potential

Data depicted in Table 4 clearly showed that the leaf water potential was significantly influenced by various mulches. The minimum leaf water potential (11.50) was recorded with black polythene 200μ mulch which was at par with all the treatments except control where maximum leaf water potential (13.50) was recorded. It might be due to maximum water conservation and less weed infestation through black polythene mulch and in control due to loss of water through penetration of numerous weeds under the canopy of kinnow plants during the experimentation period. Urdaneta *et al*. (2003) and Tavora *et al*. (2001) also reported the same results in guava.

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