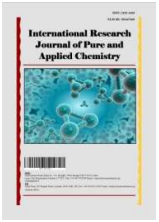

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Response of Mulching with Supplementary Irrigation on Physiochemical Properties of Bael (*Aegle marmelos* Correa.)

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Authors' contributions

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

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ABSTRACT

The experiment was conducted at Horticultural Research Station, Mondouri, BCKV during 2015-2017 to find out the effect of mulching and supplementary irrigation on physical and chemical properties i.e fruit weight, length, diameter, pulp percentage, TSS, acidity, vitamin-C, anthocyanin etc. of Bael (*Aegle marmelos* Correa.) The experiment was put on factorial RBD consist of nine treatments viz. M_0I_0 - No mulch + no irrigation (Control). M_0I_1 - No mulch + basin irrigation with 15 litres/plant at 10 days interval, M_0I_2 - No mulch + basin irrigation with 15 litres/plant at 20 days interval, M_1I_0 - Black polythene mulching + no irrigation M_1I_1 - Black polythene mulching + basin irrigation with 15 litres/plant at 10 days interval, M_1I_2 - Black polythene mulching + basin irrigation with 15 litres/plant at 20 days interval. M_2I_0 - Dry leaves mulching + no irrigation, M_2I_1 - Dry leaves mulching + basin irrigation with 15 litres/plant at 10 days interval, M_2I_2 - Dry leaves mulching + basin irrigation with 15 litres/plant at 20 days interval. Which are interaction of two factor i.e. mulching and irrigation and each treatment has three replications. Mulching with black polythene followed by basin

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irrigation with 15 litres/plant at 10 days interval was most effective in improving fruit weight (1089.17g), size (length 12.89cm and diameter 39.18cm) and pulp content (56.16%) followed by dry leaves mulching + basin irrigation 15 litres/plant at 10 days interval. The fruit quality like vitamin C and anthocyanin content were also improved by mulching with black polythene followed by basin irrigation 15 litres/plant at 10 days interval but TSS, acidity whereas total sugar content in the fruits were not affected due to mulching and supplementary irrigation

Keywords: Bael; mulching; irrigation; physiochemical; fruit quality.

1. INTRODUCTION

Bael (*Aegle marmelos* Correa.) is a hardy handsome tree belongs to family of Rutaceae, also known by other vernacular name like Bengal quince, Golden apple, Stone apple, Maredu (Andhra Pradesh), Bel (Bengal), Bil (Gujrat), Bael (Himachal Pradesh), Malura (Karnataka), Vilwam (Kerala), Kuvalum (Tamilnadu), Bilwa (Sanskrit). The tree is a medium to tall, deciduous, slow growing and 5-10 meter in height. Its leaves are green aromatic, trifoliate; branches have spines and trunk is strong and stout. Leaves are alternate, pale green, trifoliate, having a long petiole; the two lateral leaflets almost sessile, ovate to lanceolate having reticulate pinnate venation. Bael fruit is globuse with grey or yellowish hard woody shell. Inside this, there is soft yellow or orange colored mucilaginous pulp with numerous seeds. It has numerous seeds, which are densely covered with fibrous hairs and are embedded in a thick, gluey, aromatic pulp.

The bael fruit is highly nutritious. According to Sharma et al. [1] the nutritive value of 100g edible fruit contains Moisture 64.2 g, Protein 1.8g, Fat 0.2 g, Mineral 1.5 g, Fibre 2.2 g, Carbohydrate 30.6 g, Calcium 0.09 g, Phosphorus 0.05 g, Potassium 0.6 g, Iron 0.3 g, Vitamin A 186 IU, Vitamin B_1 0.01 g, Nicotinic Acid 0.9 g, Riboflavin 1.2 g, Vitamin C 0.01 g and Calorific value 129 kcal.

Every part of plant such as fruit, seed, bark, leaf and root are important ingredients of several traditional formulations. Due to its curative properties, it is one of the most useful medicinal plants of India. It is utilized in day-to-day life in various forms. The products obtained from bael, being highly nutritive and therapeutic are getting popularized in Indian as well as in international market. A different medicinal system like Siddha, Unani and Ayurvedic systems provide information about the potential effects of bael Bhardwaj et al. [2]. Gastro-intestinal problems, diseases like diabetes, cardiac issues, and inflammation-related problems may be cured with the fruit. Protective effects against the wound, radiation, microbes, free radical generation, and depression have also been exhibited by bael. These records prove the natural healing power of bael Manandhar et al. [3]. The bael fruit pulp contains many functional and bioactive compounds such as carotenoids, phenolics, alkaloids, coumarins, flavonoids, terpenoid and other antioxidants which may protect us against chronic disease Ullikashi et al. [4].

Bael is one of the most important underutilized fruit crops grown in poor soils and adverse climatic situation. But recent years, due to its ability to tolerate in arid condition and huge demand in processing and ayurvedic industry, it is receiving umpteen attentions from scientists for improvement. That's why continuous use of mulching & supplementary irrigation during dry period is helpful in conserving moisture in the soil, improving the soil properties, microbial flora and soil aeration which ultimately resulted into better growth and yield of the plant and improving the physical and chemical properties of the fruit. Under rainfed condition, application of mulching in tree basin is very beneficial for successful cultivation of bael.

2. MATERIALS AND METHODS

The present experiment entitled "Response of mulching with supplementary irrigation on physiochemical properties of Bael (*Aegle marmelos* Correa.)" was conducted at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya during the period of 2015-2017. The experimental site situated at the subtropical region and the maximum maximum temperature ranging from 25.05^0 C to 38.21^0 C and that of minimum temperature ranging from 8.55^0 C to 25.38^0 C during the period of investigation. Major rainfall was received during the month of July and August. The relative atmospheric humidity prevailed during the period of experiment varied from 42.61% to 98.40%. (Source - Department of

Agricultural Meteorology and Physics, Faculty of Agriculture, Bidhan Chandra Krishi Viswa vidyalaya, Mohanpur, Nadia, West Bengal, 741252).

The experiments were laid down in Factorial Randomized Block design. Which comprised of two factor treatments, first one is mulching i.e. M_0 - No Mulch, M_1 - Black Polythene Mulch (200 gauge thickness) and M_2 - Dry Leaves Mulch, the second factor is irrigation i.e. I_0 - No Irrigation, I_1 - Basin Irrigation with 15 litres plant^{-1} at 10 days interval and I_2 - Basin Irrigation with 15 litres plant^{-1} at 20 days interval. So, total numbers of treatments are nine *viz.* M_0I_0 - No mulch + no irrigation (Control). M_0I_1 - No mulch + basin irrigation with 15 litres plant^{-1} at 10 days interval, M_0I_2 - No mulch + basin irrigation with 15 litres plant^{-1} at 20 days interval, M_1I_0 - Black polythene mulching + no irrigation M_1I_1 - Black polythene mulching + basin irrigation with 15 litres plant^{-1} at 10 days interval, M_1I_2 - Black polythene mulching + basin irrigation with 15 litres plant^{-1} at 20 days interval. M_2I_0 - Dry leaves mulching + no irrigation, M_2I_1 - Dry leaves mulching + basin irrigation with 15 litres plant^{-1} at 10 days interval, M_2I_2 - Dry leaves mulching + basin irrigation with 15 litres plant^{-1} at 20 days interval. Each treatment has three replications. Mulching was provided during first week of November, 2015. The mulching was applied up to 4 feet from the trunk. Irrigation treatment was started from 1st March, 2016 and continued up to 15th June, 2016. Basin was prepared with a radius of 2 meter away from the trunk.

2.1 Physical Properties

For physical characteristics of fruits, five fruits for each plant were collected randomly at mature stage.

2.1.1 Fruit weight

Average fruit weight was measured at mature stage in the month of April 2017 on the basis of five fruits taken from each plant randomly with the help of weighing balance and average weight was expressed in grams (g).

2.1.2 Fruit length

The length of each five fruits at mature stage was measured with the help of a slide calipers by measuring the distance from the point of attachment to the extremity at the distal of the fruit and the mean value per treatment was recorded in centimeter (cm).

2.1.3 Fruit diameter

The fruit diameter of each five fruits per plant was measured at maturity with the help of tape and the mean value in each treatment was recorded in centimeter (cm).

2.1.4 Pulp content

Pulp was extracted from each five fruits separately and after weighing the pulp in a weighing balance average pulp weight was calculated and expressed in grams (g). The pulp percentage was calculated by dividing the average pulp weight by the average fruit weight of the same fruit and multiplied with 100 and expressed in percentage.

2.2 Chemical Properties

For chemical characteristics of fruits, five fruits for each treatment were collected randomly at mature stage.

2.2.1 Total soluble solids content (TSS)

TSS of fruits estimated with the help of a digital hand refractometer (Range: 0-53%). A drop of squeezed out and strained pulp with juice was placed on the round hole to record the refractometer reading, calibrated at 0^0 brix at 20^0C.

2.2.2 Total titratable acidity content

Acidity percentage of the fruit was estimated by titrating the aqueous extract of known quantity of fruit juice against (N/10) NaOH solution using phenolphthalein as indicator Rusk [5].

2.2.3 Total sugar content

Total sugar content of the fruit as determined by titrimetric procedure. Firstly the non reducing sugar content of juice sample was converted into reducing sugar by acid hydrolysis. After conversion, the sugar of the aqueous solution were determined by titrating against freshly prepared mixture containing equal proportion of Fehling's solution A and Fehling's solution B and using methylene blue as indicator A.O.A.C. [6]. It is expressed in percentage.

2.2.4 Reducing sugar content

The reducing sugar content of the aqueous extract was determined by titrating against the

Fehling's solution as stated above A.O.A.C. [6]. It is expressed in percentage.

2.2.5 Non-reducing sugar content

Non-reducing sugar content was determined by the formula: Percentage of non-reducing sugar = Total sugar – Reducing sugar.

2.2.6 Vitamin C content

Vitamin C content of the fruit was estimated by using 2,3- dichloropyenolindophenol dye titration method A.O.A.C. [6] and it is expressed as mg/100 g of fruit pulp.

2.2.7 Anthocyanin content

Anthocyanin content of fruit was measured by adding a mixture of ethanol and HCl (85:15) to the sample and kept for 24 hours, then filtering the extract by filter paper; the reading was taken in sprectophotometer at wave length of 535 nm.

3. RESULTS AND DISCUSSION

3.1 Physical Properties

3.1.1 Fruit weight

The average fruit weight showed significantly variation due to different mulching treatments (Table 1). The maximum fruit weight (1020.46 g.) was noted from the plants under black polythene sheet mulch, followed by dry leaves mulching (957.68 g) and minimum (901.39 g) fruit weight was obtained from the unmulched plants. Irrigation treatments also significantly increased the fruit weight and basin irrigation with 15 litres/plant at 10 days interval (1065.00 g) proved to be effective. The fruit weight of the plants treated with basin irrigation with 15 litres/plant at 20 days interval was 944.35 g and the plants with no irrigation gave lowest (870.18 g) fruit weight. Interaction of mulching and irrigation showed significant increase in fruit weight and it was recorded that the fruits from the plants treated with black polythene mulching + basin irrigation with 15 litres/plant at 10 days interval produced heaviest fruit (1089.17 g) which was statistically at par with plants that were mulched with dry leaves + basin irrigation with 15 litres/plant at 10 days interval (1069.17 g). The lowest fruit weight (820.83 g) was recorded from the plants with no mulching and irrigation.

3.1.2 Fruit length

According to Table 1 different treatments with mulching and irrigation showed significant variation in fruit length. It is noted that the maximum fruit length (12.63 cm) was measured from the plants under black polythene mulching, followed by dry leaves mulching (12.17 cm) and minimum (11.85 cm) under the plants with no mulching. Application of basin irrigation with 15 litres/plant at 10 days interval resulted maximum fruit length (12.74 cm) and the fruit length of the plants treated with basin irrigation with 15 litres/plant at 20 days interval measured 12.11 cm. The minimum fruit length was measured in the plants under no irrigation i.e 11.80 cm. The combined effect of mulching and irrigation on fruit length was found significant. The fruit length was measured highest (12.89 cm) from the plants which were experienced with black polythene mulching + basin irrigation with 15 litres/plant at 10 days interval followed by application of dry leaves + basin irrigation with 15 litres/plant at 10 days interval (12.82 cm). The fruit length was minimum (11.22cm) in the fruits collected from control plants.

3.1.3 Fruit diameter

It is evident from Table 1 that different treatments with mulching and irrigation caused significant variation in fruit diameter. The mulching treatments with black polythene resulted in maximum fruit diameter of 37.93 cm, followed by mulching with dry leaves (37.68 cm) and no mulching (36.10 cm). The irrigation treatment on tree basin with 15 litres/plant at 10 days interval gave the maximum (38.64 cm) fruit diameter. The plants treated with basin irrigation with 15 litres/plant at 20 days interval was measured 37.64 cm fruit diameter. And minimum (35.42 cm) was found in the plants with no irrigation.

The interaction effect of mulching and irrigation on fruit diameter was found to be significant during the period of investigation. Maximum fruit diameter (39.18 cm) was measured from the plants under the treatment of black polythene mulching + basin irrigation with 15 litres/plant at 10 days interval which was at par with dry leaves mulching + basin irrigation with 15 litres/plant at 20 days interval. The plants with no irrigation and no mulching gave minimum (34.10 cm) fruit diameter.

3.1.4 Pulp content

It is clear from Table 1 that the application of mulching has significant variation in pulp content. Pulp content was found highest (504.72 g) in the plants treated with black polythene mulching,

followed by dry leaves mulching (441.11 g) and unmulched plants (368.44 g). Similarly the pulp percentage was found according to pulp content, i.e black polythene mulch (49.22%) > dry leaves mulch (45.95%) > no mulch (40.73%). The treatments with irrigation also found significant result. Highest pulp content (520.67 g) was measured from the plants which were under basin irrigation with 15 litres/plant at 10 days interval followed by basin irrigation with 15 litres/plant at 20 days interval (421.11 g) and the plants experienced no irrigation measured lowest pulp content (372.50 g). Similarly the pulp percentage was measured according to the pulp content i.e 48.78%, 44.46% and 42.66% in the plants treated with basin irrigation with 15 litres/plant at 10 days interval, basin irrigation with 15 litres/plant at 20 days interval and no irrigation respectively. The interaction treatment also showed the significant result during the period of experiment. The highest pulp content (611.67 g) and pulp percentage (56.16%) was obtained from the fruits collected from the plants which were treated with black polythene mulching + basin irrigation with 15 litres/plant at 10 days interval. The second highest pulp content (510.00 g) and pulp percentage (47.70%) was found in the treatment of dry leaves mulching + basin irrigation with 15 litres/plant at 10 days interval. The fruits collected from the plants with no mulching + no irrigation gave the minimum pulp content (310.00 g) and pulp percentage (37.77%).

Similar results regarding these physical parameters were also found by Sing et al. [7] in guava. They reported that the highest fruit weight (107.3 g) with the application of irrigation at 80% PE per day per plant coupled with black polyethylene mulching. These results were also near to Bal and Singh [8] in ber where maximum fruit length (4.37 cm) and fruit breath (3.21 cm) was measured under black polythene mulched plants. These findings were in close agreement with the findings of Chattopadhyay and Patra [9] in pomegranate. They found that use of black polyethylene mulching resulted in the highest fruit weight (171 g), largest fruit size (7.34 cm long, 7.47 cm in diameter) was compared to control.

Table 1. Effect of mulching and irrigation on physical characteristics of bael

Single Effect					
Treatments	**Weight (g)**	**Length (cm)**	**Diameter (cm)**	**Pulp Weight (g)**	**Pulp %**
M_0	901.39	11.85	36.10	368.44	40.73
M_1	1020.46	12.63	37.93	504.72	49.22
M_2	957.68	12.17	37.68	441.11	45.95
SE (m) ±	2.58	0.03	0.04	1.79	0.24
C.D. at 5%	7.81	0.09	0.13	5.42	0.72
I_0	870.18	11.80	35.42	372.50	42.66
I_1	1065.00	12.74	38.64	520.67	48.78
I_2	944.35	12.11	37.64	421.11	44.46
SE (m) ±	2.58	0.03	0.04	1.79	0.24
C.D. at 5%	7.81	0.09	0.13	5.42	0.72
Interaction Effect (M X I)					
Treatments	**Weight (g)**	**Length (cm)**	**Diameter (cm)**	**Pulp Weight (g)**	**Pulp %**
$M_0 I_0$	820.83	11.22	34.10	310.00	37.77
$M_0 I_1$	1036.67	12.51	37.75	440.33	42.48
$M_0 I_2$	846.67	11.82	36.44	355.00	41.93
$M_1 I_0$	914.17	12.50	36.25	417.50	45.67
$M_1 I_1$	1089.17	12.89	39.18	611.67	56.16
$M_1 I_2$	1058.05	12.50	38.36	485.00	45.84
$M_2 I_0$	875.55	11.68	35.91	390.00	44.54
$M_2 I_1$	1069.17	12.82	39.00	510.00	47.70
$M_2 I_2$	928.33	12.00	38.13	423.33	45.60
SE (m) ±	4.47	0.05	0.07	3.10	0.41
C.D. at 5%	13.52	0.16	0.22	9.38	1.25

M_0 = No Mulch, M_1 = Black Polythene Mulching, M_2 = Dry leaves mulching, I_0 = No Irrigation, I_1 = Basin Irrigation with 15 litres/plant at 10 days interval, I_2 = Basin Irrigation with 15 litres/plant at 20 days interval, NS = Not significant

3.2 Chemical Properties

3.2.1 Total soluble solids content (TSS)

The data presented in the Table 2 clearly indicated that mulching and irrigation had a significant effect on total soluble solids content of bael. The most effective treatment in increasing the total soluble solids content of fruits was noted with black polythene mulching (35.4^0 Brix), followed by dry leaves mulching (34.8^0 Brix) and then unmulched treatment (32.9^0 Brix). Application of irrigation on the tree basin also caused significant improvement in TSS content watering with 15 litres/plants at 10 days interval resulted highest (35.37^0 Brix) TSS content of the fruits as compared to the treatment with no irrigation (33.2^0 Brix). Interaction of mulching and irrigation did not vary significantly on the total soluble solids. However, it was found highest TSS (36.4^0 Brix) in the fruits treated with black polythene mulch + basin irrigation with 15 litres/plants at 10 days interval, followed by dry leaves mulching + basin irrigation with 15 litres/plants at 20 days interval. Whereas, the lowest TSS (31.5^0 Brix) was measured from the fruits which were collected from the treatments with no mulching + no irrigation.

3.2.2 Total titratable acidity content

The data on effect of mulching and irrigation and their interaction on acidity of the fruit have been presented in Table 2. Application of mulching and irrigation caused significant variation in acidity of the fruit. The minimum acidity (0.33%) was found in the plants treated with black polythene mulching, followed by dry leaves mulching (0.37%) and the maximum (0.39%) acidity was obtained from the fruits collected from unmulched plants. Basin irrigation with 15 litres/plants at 10 days interval recorded the lowest acidity (0.31%) among the treatments and it is followed by basin irrigation with 15 litres/plants at 20 days interval (0.35%) and highest acidity (0.43%) was in the plants with no irrigation. None of interactions between mulching and irrigation caused significant effect on the acidity content of the fruits. However, the lowest acidity content was obtained (0.29%) from black polythene mulching + basin irrigation with 15 litres/plants at 10 days interval treatment, followed by dry leaves mulching + basin irrigation with 15 litres/plants at 10 days interval (0.31%). Fruits of plants with no mulching + no irrigation were resulted maximum acidity (0.46%).

3.2.3 Total sugar content

Data represented in Table 2 indicated that total sugar content was vary significantly with the treatments of mulching and irrigation. Treatments with black polythene mulching resulted in highest total sugar content (23.23%) as compared to dry leaves mulching (22.55%) and plants with no mulching (21.72%). Highest total sugar content (27.74%) was also obtained from the fruits which were collected from the plants treated with basin irrigation 15 litres/plants at 10 days interval, followed by basin irrigation with 15 litres/plants at 20 days interval treatment (21.84%) and no irrigation treatment (17.92%). The total sugar content of the fruit was found varying non-significantly with the combined effect of mulching and irrigation. The fruits from the plants with black polythene mulching + basin irrigation with 15 litres/plants at 10 days interval, showed the highest total sugar content (28.60%) and the second highest total sugar content was obtained from the plants treated with dry leaves mulching + basin irrigation with 15 litres/plants at 10 days interval (27.62%). The fruits which were collected from the plants with no mulching + no irrigation gave lowest (17.28%) data.

3.2.4 Reducing sugar content

It is evident from Table 2 that reducing sugar content of fruits varied significantly with the treatment of mulching and irrigation. Plants treated with black polythene mulching resulted in maximum reducing sugar content in fruits (7.36%); compared to plants treated with dry leaves mulching (6.82%) and unmulched plants (6.40%). The plants which were received basin irrigation with 15 litres/plants at 10 days interval showed maximum reducing sugar content (8.12%) followed by plants with basin irrigation with 15 litres/plants at 20 days interval (6.95%) and plants received no irrigation (5.51%). Reducing sugar content of the fruit did not vary significantly with the interaction of mulching and irrigation. However, it was found highest (8.84%) in the fruits treated with black polythene mulching + basin irrigation with 15 litres/plants at 10 days interval, followed by the treatment with dry leaves mulching + basin irrigation with 15 litres/plants at 10 days interval (8.04%). It was found lowest in plants with no mulching + no irrigation (5.23%).

3.2.5 Non-reducing sugar content

The non reducing sugar content of the fruits due to application of mulching and irrigation on the

tree basin was found to be significantly increased (Table 2). The plants mulched with black polythene had the maximum (15.88%) non reducing sugar in fruits followed by dry leaves mulching (15.72%) and minimum (15.32%) in case of no mulching treatment. Basin irrigation with 15 litres/plants at 10 days interval proved to be most effective (19.62%) treatment in increasing non reducing sugar followed by basin irrigation with 15 litres/plants at 20 days interval (14.88%) and the lowest non reducing sugar (12.41%) was found in the fruits of plants with no irrigation. The interaction effect of mulching and irrigation resulted in statistically insignificant on the content of non reducing sugar. The plants with the treatment of black polythene mulching + basin irrigation with 15 litres/plants at 10 days interval resulted in highest non reducing sugar (19.76%) followed by in the fruits of dry leaves mulching + basin irrigation with 15 litres/plants at 10 days interval treatment (19.58%). The lowest non reducing sugar (12.05%) was found in fruits of plants with no mulching and no irrigation.

3.2.6 Vitamin C content

Effect of mulching and irrigation application on vitamin C content of the fruit has been presented in Table 2 and it is clear that the treatments of mulching and irrigation showed significant improvement on vitamin C content in the fruits. The highest vitamin C content (4.9 mg/100g) was measured from the fruits collected from the plants treated with black polythene mulch followed by dry leaves mulching (4.3 mg/100g) and unmulched plants (3.5 mg/100 g). The plants which were received basin irrigation with 15 litres/plants at 10 days interval measured highest vitamin C content (5.2 mg/100 g) as compared to basin irrigation with 15 litres/plants at 20 days interval (4.2 mg/100 g) and lowest vitamin C (3.3 mg/100 g) was found in fruits of control plants.

Table 2. Effect of mulching and irrigation on chemical characteristics of bael

Single Effect							
Treatments	**TSS (^{0}Brix)**	**Acidity (%)**	**Total Sugar (%)**	**Reducing Sugar (%)**	**Non-reducing Sugar (%)**	**Vitamin C (mg/100g)**	**Anthocyanin (mg/100g)**
M_0	32.9	0.39	21.72	6.40	15.32	3.5	4.58
M_1	35.4	0.33	23.23	7.36	15.88	4.9	12.23
M_2	34.8	0.37	22.55	6.82	15.72	4.3	6.69
SE (m) ±	0.25	0.02	0.28	0.15	0.14	0.09	0.10
C.D. at 5%	0.77	0.05	0.83	0.44	0.44	0.28	0.30
I_0	33.2	0.43	17.92	5.51	12.41	3.3	6.18
I_1	35.3	0.31	27.74	8.12	19.62	5.2	9.53
I_2	34.6	0.35	21.84	6.95	14.88	4.2	7.80
SE (m) ±	0.25	0.02	0.28	0.15	0.14	0.09	0.10
C.D. at 5%	0.77	0.05	0.83	0.44	0.44	0.28	0.30
Interaction Effect (M X I)							
Treatments	**TSS (^{0}Brix)**	**Acidity (%)**	**Total Sugar (%)**	**Reducing Sugar (%)**	**Non-reducing Sugar (%)**	**Vitamin C (mg/100g)**	**Anthocyanin (mg/100g)**
$M_0 I_0$	31.5	0.46	17.28	5.23	12.05	2.7	3.67
$M_0 I_1$	33.6	0.34	27.00	7.47	19.53	4.0	5.28
$M_0 I_2$	33.7	0.37	20.88	6.51	14.37	3.7	4.80
$M_1 I_0$	34.4	0.39	18.69	6.03	12.66	3.5	10.70
$M_1 I_1$	36.4	0.29	28.60	8.84	19.76	6.2	13.50
$M_1 I_2$	35.4	0.32	22.41	7.2	15.21	5.2	12.50
$M_2 I_0$	33.6	0.44	17.80	5.28	12.52	3.7	4.18
$M_2 I_1$	36.1	0.31	27.62	8.04	19.58	5.5	9.80
$M_2 I_2$	34.7	0.35	22.22	7.15	15.07	3.7	6.10
SE (m) ±	0.44	0.03	0.48	0.25	0.25	0.16	0.17
C.D. at 5%	NS	NS	NS	NS	NS	0.49	0.52

M_0 = No Mulch, M_1 = Black Polythene Mulching, M_2 = Dry leaves mulching, I_0 = No Irrigation, I_1 = Basin Irrigation with 15 litres/plant at 10 days interval, I_2 = Basin Irrigation with 15 litres/plant at 20 days interval, NS = Not significant

The interaction between mulching and irrigation has showed significant variation in the vitamin C content of the fruit throughout the period of investigation. The vitamin C was measured maximum (6.2 mg/100 g) in the fruits under the treatment of black polythene mulching + basin irrigation with 15 litres/plants at 10 days interval followed by the treatment of dry leaves + basin irrigation with 15 litres/plants at 10 days interval (5.5 mg/100 g). The lowest vitamin C (2.7 mg/100 g) was found in the plants with no mulching and no irrigation.

3.2.7 Anthocyanin content

It is revealed from Table 2 that the anthocyanin content in the fruit was significantly improved by mulching and irrigation of the tree basin. The anthocyanin content in plants treated with black polythene was recorded significantly highest (12.23 mg/100g) followed by dry leaves mulching treatment (6.69 mg/100g) The fruits of unmulched plants contained only 4.58 mg/100g anthocyanin. Basin irrigation with 15 litres/plants at 10 days interval also increased anthocyanin content of 9.53 mg/100g of pulp as compared to 7.80 mg/100g and 6.18 mg/100g in the treatment of basin irrigation with 15 litres/plants at 20 days interval and no irrigation respectively. The combination effect of mulching and irrigation on anthocyanin content was found statistically significant. Anthocyanin content was highest (13.50 mg/100 g) in the fruits of the plants with black polythene mulching + basin irrigation with 15 litres/plants at 10 days interval and it is followed by dry leaves mulching + basin irrigation with 15 litres/plants at 20 days interval (12.50 mg/100 g). The lowest anthocyanin content (3.67 mg/100 g) was measured from the fruits of plants with no mulch and no irrigation.

The beneficial effect of mulching and supplementary in chemical parameters were also reported by Sing et al. [7] in guava. They reported that drip irrigation coupled with polyethylene mulching increased TSS (12.1^0 Brix), total sugars (6.61%), ascorbic acid (169.2 mg/100 g) and reduced acidity (0.27%) as compared to control. Ghosh and Bauri [10] worked with mango cv. Himsagar and reported that the highest TSS of 18.3% in mango was obtained with black polythene mulch plants. Another report on vitamin C content obtained by Maji and Das [11] in guava where they stated that highest vitamin C content of 189.79 mg/100 g fruit pulp was obtained with black polythene mulch. Improvement in TSS content and reducing sugar content due to mulching was also close argument with Chattopadhyay and Patra [9]. They found that pomegranate fruits from plants with polyethylene mulch had the highest percentage TSS and reducing sugar content (14.0 degrees Brix and 10.8%, respectively). Fruit quality improvement with the application of mulching was also observed by Ghosh and Tarai [12] in ber.

4. CONCLUSION

The treatment with black polythene mulching followed by basin irrigation with 15 litres/plant at 10 days interval recorded heaviest and maximum sizable fruit with high pulp content. This treatment also resulted in significant improvement of fruit quality with maximum increased in Vitamin C and anthocyanin content in fruit although total soluble solids, total sugar content, reducing sugar content, non reducing sugar content and acidity percentage was not significantly affected by different mulching and basin irrigation treatments.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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