

Original Research Article

<https://doi.org/10.20546/ijcmas.2020.910.297>

Effect of Mulching and Supplemented Irrigation on Growth, Yield and Fruit Quality of Wood Apple (*Feronia limonia* Swingle)

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ABSTRACT

The present experiment on wood apple conducted at the Horticultural Research Station, Mondouri of Bidhan Chandra Krishi Viswavidyalaya to find out the effect of mulching and supplemented irrigation on plant growth, yield and fruit quality of wood apple (*Feronia limonia* Swingle). The experiments were laid out in a Randomized Block Design. Which comprised of five treatments (T₁-No mulching + no irrigation, T₂-black polythene mulching + no irrigation, T₃- black polythene mulching + irrigation @ 15 liters/plant at 10 days interval, T₄-black polythene mulching + irrigation @ 15 liters/plant at 20 days interval, T₅-black polythene mulching + irrigation @ 15 liters/plant at 30 days interval) and each treatment has four replications. The results of the investigation revealed significant effect of mulching and irrigation on growth, yield and fruit quality of wood apple. The highest trunk girth (6.25 cm), plant height (0.56 m), plant spread (N-S 1.18 m and E-W 1.25 m), fruit set (2 %), retention (66.88 %), fruit per plant (78.25), yield per plant (19.01 kg) and yield per hectare (7.60 ton) were found in T₃. Similarly highest fruit length (7.72 cm), girth (27.33 cm), weight (252.5 g), pulp contents (68.86 %), TSS (17.10° Brix) and Vitamin C (4.69 mg/100g) were significantly increased in T₃ followed by T₄, while minimum was observed in T₁. Where acidity, total sugar and reducing sugar found non-significant. Lowest acidity 2.46 %, highest total sugar 8.14 % and reducing sugar 2.84 % were noted in T₃, followed by T₄ and highest acidity 2.86 %, lowest total sugar 7.1% and reducing sugar 2.57% were noted in T₁. So, it was concluded that black polythene mulching + irrigation @ 15 liters/ plant at 10 days interval (T₃) found effective for increasing plant growth, yield and fruit quality of wood apple among the stated treatments.

Keywords

Wood apple, Mulching, Irrigation, Plant growth, Fruit yield and quality

Article Info

Accepted:

17 September 2020

Available Online:

10 October 2020

Introduction

India is the centre of origin for many fruit tree species, most of which are not commercially cultivated but provide a significant source of livelihood support for many rural communities. They are locally abundant, but

restricted in their geographical dispersion and have a high use value. One of those is Wood apple (*Feronia limonia* Swingle *syns.* *F. Elephantum* correa; *Limonia acidissima* L.) a deciduous plant belongs to the family Rutaceae. It is also called monkey fruit, curd fruit and *kathabel*. It is reported to be native

to India. The wood apple is mainly found in the forest and dry plain areas of Indian subcontinents. More common in Deccan, Maharashtra, Madhya Pradesh, also occurs from up to an elevation of about 500m in the western Himalayas. It can grow in wide range of soils including degraded soils of arid region and it also tolerate to salinity and drought. Wood apple has got high medicinal value. Every part of the fruit posse's medicinal property. Fruit pulp has anti-inflammatory, antipyretic and analgesic activity (Ahamed *et al.*, 2008). Fruit used as a liver and cardiac tonic and when unripe, as an astringent means of halting diarrhoea and dysentery and effective treatment for hiccough, sore throat and diseases of the gums (Shil, 2019). The fruit plant is grown in poor soil and adverse climatic situation where fruit set and fruit drop is a common problem and moisture stress is may be one of the main reasons. To tackle this problem, providing water or conserving moisture to the root zone may be a good solution. Mulching plays an important role in the conservation of soil moisture during dry periods by reduction of water loss through evaporation, providing better nutrient availability, avoiding soil erosion, improve water and fertilizer use efficiency. Mulching also suppresses weed growth and provide nutrient to the plant and improve soil temperature. There are so many reports regarding beneficial effect of mulching and irrigation on fruit quality of arid fruit crops but such report on wood apple partially nil in India. With the view an investigation was conducted to know effect of mulching and supplemented irrigation on growth, yield and fruit quality of wood apple.

Materials and Methods

The present experiment entitled "Effect of mulching and supplemented irrigation on fruit quality of Wood apple" was conducted at Horticultural Research Station, Mondouri,

Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, India during the period of 2016- 2018. The soil texture of the experimental field was sandy loam having 6.8 soil pH and the pre-experimental soil status has been presented in Table 1.

The experimental sites were situated in the sub-tropical humid climate where summer and winter both are short and mild. So this region is not subjected to extreme winter. The climate of research station is sub-tropical humid with maximum temperature ranging from 35.62° C to 23.35° C and that of the minimum temperature ranging from 23.75° C to 8.09° C during the period of investigation. Major rainfall was received during the month of June and July. The relative atmosphere humidity prevailed during the period of experiment varied from 91.32 % to 66.04 %. The experiments were laid out in a Randomized Block Design (RBD). Which comprised of five treatments viz., T₁- No mulching + No irrigation (control), T₂- Black polythene mulching + No irrigation, T₃- Black polythene mulching + irrigation @ 15 litres/ plant at 10 day interval, T₄- Black polythene mulching + irrigation @ 15 litres/ plant at 20 day interval, T₅- Black polythene mulching + irrigation @ 15 litres/ plant at 30 day interval and each treatment has four replications. Total number of experimental plants is twenty (10 year old) and spacing is 5m. × 5m. Mulching was provided at first fortnight of November, 2016 and irrigation through basin was started from 3rd February 2017 and continued up to 15th June, 2017.

The plant growth parameter viz, plant height (cm), girth (m) and spread (m) were collected from first week of February (before irrigation started), 2017 to last week of December. For fruit set percentage, 100 numbers of flowers are tagged after 30 days of flower opening and for fruit retention percentage, a 40 numbers of fruit tagged from marvel stage to

harvesting and number of fruits per plant was calculated by counting at maturity from every plant. Fruit yield per plant and per hectare was calculated by multiplying number of fruits per plants with average fruit weight and multiplying fruit yield per plant with number of plants per hectare. For physical and chemical analysis of fruits, three fruits for each plant were collected randomly at mature stage. The length (cm) and girth (cm) of fruit were taken with the help of vernier callipers and a tape. Fruit weight (g) was taken with help of a balance and fruit pulp percentage was calculated. Total soluble solid content (TSS) of fruits estimated with the help of a digital hand refractometer (range 0- 53%) and calibrated at 0°Brix at 20°C, Total titratable acidity content (%) of the fruits was estimated by titrating the aqueous extract of known quality of fruit juice against N/10 NaOH alkali solution using phenolphthalein as an indicator and expressed as percentage (Rusk, 1969). For vitamin C (mg/100g), total sugar (%) and reducing sugar (%) analysis of fruits, the methods were followed as described by A. O. A. C. (1984).

Results and Discussion

Growth parameters

Result of experiment showed that effect of black polythene mulching and irrigation significantly increased plant growth (Table 2) as compare to control (T₁). The highest trunk girth (6.25 cm), plant height (0.56 m) and plant spread (N-S 1.18 m and E-W 1.25 m) were found in T₃ treatment as compare to T₁. Mulch and water plays an important role in the growth and development of plants. Mulching suppress weed growth and conserve soil moisture in the root zone of fruit trees. The presence of adequate amount of moisture in the soil is essential for plant growth and physiological processes. Increase water supply also increase growth rate of plants.

These results were in conformity with the findings of Shirgure *et al.*, (2003) in Nagpur mandarin; Shukla *et al.*, (2000) in aonla (*Emblica officinalis*) cv. NA-7 and Bhanukar *et al.*, (2015) in Kinnow. In Nagpur mandarin (Shirgure *et al.*, 2003) highest stock girth, scion girth, plant height and tree canopy volume were recorded in black polythene mulch. In aonla (Shukla *et al.*, 2000) found that black polyethylene was the most effective inorganic mulching material for increasing plant height, canopy spread and stock girth compared to control. Bhanukar *et al.*, 2015 found maximum per cent increase in plant spread EW (9.28) and NS (8.85) and plant height (8.52) was recorded with black polythene 200µ. In Passion fruits, Rao *et al.*, (2013) found longest vine growth (176.00 cm) in I1: irrigation at 10 days interval among all of different irrigation treatments.

Yield Parameters

It is evident from the data in Table 3 that fruit set, fruit retention, number of fruit, yield per plant and yield per hectare varied significantly. The highest fruit set (2%), retention (66.88 %), fruit per plant (78.25), yield per plant (19.01 kg) and yield per hectare (7.60 ton) was found in T₃ and it is due to beneficial effect of black polythene mulching and irrigation. Mulch helped to conserve moisture that caused physiological changes for synthesis of metabolites, required for flowering and fruiting. Similar result found by Iqbal *et al.*, (2016) in NA 7 cultivar of aonla. In their experiment, application of black polythene mulch was superior to all other mulching treatments in terms of yield attributes as it registered maximum fruit set, minimum fruit drop. Where maximum number of fruit per plant was due to highest retention of fruit. Water play a vital role during growth and development of fruits as water helps mobilization of nutrients and food materials to the growing fruits and mulching

conserve soil moisture for longer duration and it also suppress weed growth which are result for loss of water from soil. Similar result was found by Ghosh and Pal (2010) in Mosambi; Panigrahi *et al.*, (2010) in mango and Meghwal and Kumar (2014) in ber cv. Gola. In their experiment they were found that highest yield obtained from application of irrigation along with black polythene mulch.

Physical and chemical parameters

Data presented in Table 4 indicated that application of mulching and irrigation significantly increased fruit length (7.72 cm), fruit diameter (24.33 cm), fruit weight (252.50 g) and pulp content (68.86 %) were found in T3 (fruit length 6.2 cm, fruit diameter 19.14 cm, fruit weight 152.00 g and pulp content 64.15 %).

Table.1 Pre-experimental soil status

Chemical properties	Values
Available nitrogen (kg/ha)	230
Available P ₂ O ₅ (kg/ha)	36
Available nitrogen K ₂ O (kg/ha)	87

Table.2 Effect of mulching and irrigation on growth rate of girth, height and spread of wood apple plant during 2017

Treatments	Girth growth (cm)	Height growth (m)	Plant spread from N-S (m)	Plant spread from E-W (m)
T ₁	4	0.38	0.63	0.64
T ₂	5.13	0.44	0.88	0.80
T ₃	6.25	0.56	1.18	1.25
T ₄	5.88	0.49	1.04	0.98
T ₅	5.38	0.48	0.94	0.88
SE(m) ±	0.43	0.03	0.08	0.10
C.D. at 5%	1.25	0.08	0.25	0.32

Table.3 Effect of mulching and irrigation on yield and yield component of wood apple

Treatments	Fruit set (%)	Fruit Retention %	No. of fruits/plant	Fruit yield/plant (Kg)	Fruit yield (ton/ha)
T ₁	0.50 (1.21)	51.25 (45.70)	49.00	5.99	2.40
T ₂	1.25 (1.49)	58.13 (49.67)	70.50	13.51	5.40
T ₃	2.00 (1.72)	66.88 (54.87)	78.25	19.01	7.60
T ₄	1.50 (1.57)	63.75 (52.97)	74.00	15.96	6.39
T ₅	1.25 (1.49)	61.25 (51.56)	69.75	14.04	5.61
SE(m) ±	0.25 (0.24)	2.65 (1.58)	4.67	0.94	0.38
C.D. at 5%	0.76 (0.08)	8.16 (4.93)	14.40	2.90	1.16

Table.4 Effect of mulching and irrigation on physical and chemical characteristics of wood apple

Treatments	Length (cm)	Girth (cm)	Fruit Weight (g)	Pulp %	TSS (°Brix)	Acidity (%)	Vitamin C (mg/100g)	Total sugar (%)	Reducing sugar (%)
T ₁	6.2	19.14	125.00	64.15	14.33	2.86	3.19	7.1	2.57
T ₂	7.28	22.14	196.25	66.11	16.13	2.72	3.75	7.53	2.63
T ₃	7.72	24.33	252.50	68.86	17.10	2.46	4.69	8.14	2.84
T ₄	7.47	23.49	218.75	67.17	16.73	2.59	4.50	7.79	2.81
T ₅	7.29	21.80	206.25	66.70	16.38	2.66	4.13	7.68	2.80
SE(m) ±	0.32	0.86	25.78	0.58	0.50	0.09	0.31	0.50	0.12
C.D. at 5%	0.98	2.65	79.44	1.78	1.55	NS	0.95	NS	NS

It may be due to increase of amount of water which result increase of volume of fruits. This result also near to Ghosh and Pal (2010) in Mosambi; Panigrahi *et al.*, (2010) in mango in their report highest weight, size and pulp content found in irrigation along with black polythene mulch. A similar report also found by Bhanukar *et al.*, (2015) in kinnow. The maximum fruit length, breadth and fruit weight were recorded with black polythene 200µ mulch.

Effect of black polythene mulching and irrigation on chemical composition of wood apple fruits helped to improve in TSS and Vitamin C of wood apple fruits significantly and black polythene mulching and irrigation @ 15litres/plant at 10 days interval was found the best in all case with 17.10°brix, and 4.69 mg/100 g compare to control (TSS 14.33° brix and Vitamin C 3.19 mg/100 g) (Table 4). The higher TSS recorded under black polythene mulching may be attributed due to better availability of nutrients, optimum soil moisture and temperature that might have been maintained due to mulching treatments. Similar result was found by Kumer *et al.*, (2017) in karonda when they applied Black polythene mulching and irrigation (15 litre per plant) at 15 days interval and noted highest total soluble solids (22.01 °Brix) and vitamin C (16.05 mg/100g) as compared to other treatments. This result also near to Ghosh and Pal (2010) in Mosambi and Panigrahi *et al.*, (2010) in mango. In mosombi vitamin C was highest of the plants received irrigation through drip at 0.8 Epan + polythene

mulch and in mango TSS content was highest under drip irrigated treatment of 0.6 V volume of water with black polythene mulch.

Acidity, total sugar and reducing sugar content in the fruit were non- significant however, highest total sugar and reducing sugar content (8.14 % and 2.84 %) with lowest acidity were found (2.46 %) in application of black polythene mulching + irrigation @ 15litres/plant at 10 days interval (Table 2). This results were also near to Kumer *et al.*, (2017) in karonda where total sugar and reducing sugar found highest and acidity found lowest with the application of black polythene mulching and irrigation (15 litre per plant) at 15 days interval. These are in confirmed with the results noted by Ghosh and Pal (2010) in Mosambi. In their experiment result was non-significant but highest total sugars (8.5 %) found with irrigation through drip at 0.8 Epan + black polythene mulch.

In conclusion the results of the investigation revealed that a significant effect of mulching and irrigation on physical and chemical characteristic of wood apple fruits. Highest fruit weight, length, diameter, pulp contents, TSS, and Vitamin C were recorded from plant treated with black polythene mulching + irrigation @ 15 liters/plant at 10 days interval. Where acidity, total sugar and reducing sugar found non-significant. Lowest acidity, highest total sugar and reducing sugar were noted on application black polythene mulching + irrigation @ 15 liters/plant at 10 day's interval. There for it was

concluded that black polythene mulching + irrigation @15 liters/ plant at 10 days interval was best treatment for increasing plant growth, yield and fruit quality of wood apple.

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How to cite this article:

Subrata Mahato, Subham Ghosh and Satya Narayan Ghosh. 2020. Effect of Mulching and Supplemented Irrigation on Growth, Yield and Fruit Quality of Wood Apple (*Feronia limonia* Swingle). *Int.J.Curr.Microbiol.App.Sci*. 9(10): 2479-2484. doi: <https://doi.org/10.20546/ijcmas.2020.910.297>