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Effects of different mulches on yield of pomegranate (*Punica granatum* L.) cv. Bhagwa

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Abstract
The present study was conducted to study the "Effects of different mulches on yield of Pomegranate cv. Bhagwa" during 2017-18. This investigation consist ten treatments, which are replicated into three times and laid out in Randomized Block Design. The treatments comprised of 9 different mulching material like black polyethylene, newspaper, arecanut husk, coconut husk, sawdust, maize stover, leaf litter, peanut hulls, pebbles and control (without mulch). Among the different mulching treatments given, the plants treated with black polythene (100 µ) recorded the higher yield parameters like fruit number (65.22), fruit yield (18.97 kg/plant and 15.81 t/ha), fruit weight (311.31 g), volume (345.93 cm^3) and fruit diameter (8.50 cm) while lowest values were recorded in control treament. In addition to increase in fruit parameters the black polythene mulch has incresed the aril parameters such as aril number per fruit (452.44), weight of 100 arils (36.23 g), aril thickness (8.48 mm) and aril percantage (73.66%) of pomegranate.

Keywords: Pomegranate, mulching, black polythene, yield, aril

Introduction
Pomegranate (*Punica granatum* L.) belongs to the family Lytheraceae, regarded as `Fruit of paradise', `Anar', 'Fruit of love'. It is an ancient favourite fruit of tropical and sub-tropical regions of the world. It is believed to be originated from Iran and is widely cultivated in Afghanistan, Pakistan, India, China and Mediterranean countries. The fruit is the symbol of `plenty' and referred as' Seed apple'. Edible part of Pomegranate is the juicy outgrowth of seed called aril. Fruits with their sweet acidic taste are used mainly for the table purpose. Pomegranate is rich in carbohydrates, Vitamin C, calcium, iron, carotenoids and antioxidants. Among the neutraceutical aspects, pomegranate is a rich source of carbohydrate (14.5%), protein (1.6%), calcium (10 mg/100 g), phosphorus (70 mg/100 g), iron (0.3 mg/100 g) and vitamin C (65 mg/100 g), besides its calorific value of 65 Kcals/100 g. Hence, pomegranate is referred as 'Elixir of life' (Patil and Manjunath, 2014) [6]. Recently, processed products like bottled juice, syrups and jelly made of fruits have high demand in both traditional and international markets. Normally the pomegranate is cultivated in arid to semiarid areas where the problem of water scarcity is observed, due to lack moisture there will be reduction in fruit size, yield, improper development of colour, more fruit cracking and less quality fruits were obtained which may fetches lower prize in the market causes loss for the growers. However, to increase the yield of pomegranate, application of mulches (organic and inorganic) in an orchard can be a good idea to conserve the moisture, better nutrient uptake and maintain the soil temperature; this would increase the quality and yield (Datta and Majumder, 2009) [3]. Further, degraded mulch would increase the soil structure to hold more moisture. Keeping in view of these points the present investigation was undertaken.

Material and Methods
The field experiment was conducted at farmer's field in T. Nagenalli village Hiriyur taluk, Chitradurga district of Karnataka, India. It is situated in the Central Dry Zone (Zone-4) of Karnataka. The experiment was laid out in Randomized Block Design consisting of ten treatments and three replications. Different treatments are T_1- Black polythene mulch (100 µ), T_2- Newspaper (1 layer) T_3- Arecanut husk (3" thickness), T_4- Coconut husk (3" thickness), T5- Sawdust (3" thickness), T_6 - Maize Stover mulch (3" thickness), T_7 - Leaf litter (3" thickness), T_8- Peanut hulls (3" thickness), T_9 - Pebbles (1 layer) and T_{10}- Control (without any

without any mulch). Mulches were applied at plant basin immediately after the pruning first week of September. Plants were supplied with recommended dose of fertilizers recommended by the University of Horticulture Sciences, Bagalkot, Karnataka (20 to 40 kg FYM/plant/year 400: 200: 200 kg/ha N:P_2O_5:K_2O). Drip irrigation is the main irrigation practice followed in pomegranate orchard. The daily requirement water is based on climatic condition; it varies from month to month. However, the plants were supplied with 1776.5 liter of water per plant through drip irrigation at three days interval during the crop period. The rainfall received during the crop period was about 478 l/sq. meter.

Yield and yield attributes
From each treatment, fruits were randomly selected for studying the yield attributes wherein following physical characters were studied.

Number of fruits per plant
The number of fruits per plant was physically counted after maturity and were expressed as numbers per tree

Fruit weight (g)
Five randomly selected pomegranate fruits were weighed using digital analytical balance and the average value of fruit was expressed in grams.

Diameter of the fruit (mm)
Fruit diameter in each treatment was measured with the help of digital Vernier calipers at widest middle point where maximum girth was noticed and it was expressed in millimeters (mm).

Fruit yield (kg/plant)
The fruit yield was recorded at the time of harvest and expressed in kilograms per plant.

Fruit yield per hectare (tonnes/ha)
The fruit yield per hectare was computed by multiplying the yield per plant with the number of plants that were accommodated in one hectare and was expressed as tonnes per hectare.

Fruit volume (cm^3)
Five fruits from each treatment were brought to laboratory and volume of the fruits was recorded by water displacement method and expressed in milli litre. The average value of the five fruits was calculated for statistical analysis.

Weight of 100 arils (g)
Weight of hundred arils from each treatment were recorded and expressed in grams.

Number of arils
Five fruits from each treatment were brought to laboratory and the arils were separated from the rind and they were counted manually.

Aril thickness (mm)
Aril thickness in each treatment was measured with the help of digital Vernier calipers at widest middle point where maximum girth was noticed and it was expressed in millimeters (mm).

Arils percentage
Arils from five fruits per replication were separated and weighed on a digital top balance. Arils percentage was calculated by dividing the total aril weight with total fruit weight and average values were expressed in percentage.

$$\text{Aril percentage} = \frac{\text{Aril weight}}{\text{Fruit weight}} \times 100$$

Results
Fruit physical and yield parameters
Effects of different mulches on fruit yield in pomegranate cv. Bhagwa are presented in Table 1.
The results with respect to fruit number, fruit weight (kg/plant and t/ha) varied significantly with the treatments. The number of fruits produced were highest in the treatment black polythene mulch (65.22) which was *on par* with peanut hulls (60.89), while, it was least in control treatment (47.11). Fruit yield (kg/plant) was highest in the treatment black polythene mulch (18.97 kg/plant) followed by peanut hulls (16.96 kg/plant). The least fruit yield was observed in control (13.51 kg/pant). Yield per hectare was highest in the treatment black polythene mulch (15.81 t/ha) followed by peanut hulls (14.13 t/ha). The minimum yield was observed in control (11.26 t/ha).
It is evident from the data that different mulch treatments exerted a significant difference with respect to fruit weight, fruit diameter and fruit volume (Table 2). The maximum fruit weight was recorded in the treatment black polythene mulch (311.31 g) which was *on par* with peanut hulls (287.81 g). The minimum fruit weight was obtained in control (243.37 g) treatment. Similarly, the results with respect to fruit diameter also varied significantly with maximum fruit diameter (8.50 cm) was recorded in the treatment black polythene (100 µ) mulch followed by coconut husk (8.17 cm) which was *on par* with peanut hulls (8.13 cm), pebbles (7.89 cm) and leaf litter (7.86 cm), while it was least in control (7. 32 cm).
The fruit volume recorded was highest in black polythene mulch treatment (345.93 cm^3) followed by peanut hulls treatment (304.60 cm^3). The least fruit volume was observed in control (232.73 cm^3) (Table 2).

Table 1: Effects of different mulches on yield in pomegranate cv. Bhagwa

Treatments	Fruit		
	Number/plant	Kg/plant	Tonnes / ha
T_1	65.22	18.97	15.81
T_2	52.33	14.92	12.43
T_3	53.89	14.97	12.47
T_4	57.33	16.43	13.69
T_5	60.11	15.34	12.78
T_6	54.56	15.66	13.05
T_7	52.11	15.78	13.15
T_8	60.89	16.96	14.13
T_9	48.44	15.56	12.97
T_{10}	47.11	13.51	11.26
S. Em. ±	2.12	0.51	0.42
CD @ 5%	6.29	1.50	1.25

Legend
T_1- Black polythene mulch (100 µ) T_6 - Maize Stover mulch (3" thickness)
T_2- Newspaper (1 layer) T_7 - Leaf litter (3" thickness)
T_3- Arecanut husk (3" thickness) T_8- Peanut hulls (3" thickness)
T_4- Coconut husk (3" thickness) T_9- Pebbles (1 layer)
T_5- Sawdust (3" thickness) T_{10}- Control (without mulch

Table 2: Effects of different mulches on yield parameters of pomegranate cv. Bhagwa

Treatments	Fruit		
	Weight (g)	Diameter (cm)	Volume (cm^3)
T1	311.31	8.50	345.93
T2	243.81	7.43	251.40
T3	268.88	7.72	279.07
T4	260.06	8.17	282.87
T5	272.81	7.61	299.53
T6	260.58	7.62	260.13
T7	262.67	7.86	266.40
T8	287.81	8.13	304.60
T_9	264.68	7.89	275.33
T10	243.37	7.32	232.73
S. Em. ±	9.10	0.23	8.22
CD @ 5%	27.04	0.68	24.44

Legend
T_1- Black polythene mulch (100 µ) T_6 - Maize Stover mulch (3" thickness)
T_2- Newspaper (1 layer) T_7 - Leaf litter (3" thickness)
T_3- Arecanut husk (3" thickness) T_8- Peanut hulls (3" thickness)
T_4- Coconut husk (3" thickness) T_9- Pebbles (1 layer)
T_5- Sawdust (3" thickness) T_{10}- Control (without mulch

Aril parameters

It is clear from the data that, there was a significant difference among different mulches on the production of number of arils per fruit (Table 3). Maximum number of arils were recorded in the fruits where plants were treated with black polythene mulch (452.44), followed by coconut husk (424.60) and peanut hulls (419.72), whereas, it was minimum in control (378.19) treatment. Weight of 100 arils in a fruit differed significantly among mulch treatments (Table 3). Maximum weight of 100 arils (36.23 g) was recorded in the treatment black polythene (100 µ) which was *on par* with sawdust mulch (35. 21 g) and peanut hulls mulch (35.20 g). The minimum weight of 100 arils (32.25 g) was noticed in control. Highest percentage of arils was recorded in the treatment black polythene (73.66%) which was *on par* with coconut husk (69.90%) and peanut hulls (68.54%) fallowed by pebbles (66.98%), whereas, it was minimum under control (61.09%) (Table 3). The aril thickness was significantly influenced by different mulches (Table 3). Highest aril thickness was recorded in treatment black polythene mulch (8.48 mm), which was also differed significantly different over all other treatments. The lowest aril thickness (6.50 mm) was observed in control plants (without mulch).

Discussion

In the present study, different mulching treatments varied significantly for the fruit yield in pomegranate. Among different mulches, application of black polythene mulch (100 µ) caused higher increase in yield. The highest number of fruits per plant (65.22) was recorded in black polythene mulch and was least in the control treatment (47.11). Similarly, the treatment black polythene increased the yield in terms of kg/plant (18.97) and t/ha (15.81) followed by peanut hulls treatment. Correspondingly, the minimum values 13.51 kg/plant and 11.26 t/ha are recorded in control.

It is evident that the increase in the yield through fruit number, yield (kg/plant) and yield per hectare (t/ha) are mainly due to the beneficial effects caused by black polythene mulch, such as conservation of soil moisture, regulation of temperature, suppression of weed growth, availability of the nutrients and increase in the fruit size due to better plant growth owing to favorable hydrothermal regime of soil. Similar, kind of beneficial effects due to application of black polythene on growth and yield parameters pomegranate are recorded by Yogaraj *et al*. (2017) [7], El- Taweel and Farag (2015) [4] using gravel mulch in pomegranate cv. Bhagwa and Bakshi *et al*. (2014) in strawberry cv. Chandler [1].

Results on the effects of different mulches on fruit parameters *viz*., weight, volume and diameter were influenced significantly. Highest values for fruit weight (311.31 g), fruit volume (345.93 cm^3) and fruit diameter (8.50 cm) were recorded in the treatment black polythene mulch whereas, lowest values were recorded in control (243.37 g, 232.73 cm^3 and 7.32 cm, respectively).

Increased physiological developments of fruits might be due to more plant growth and development under micro-climatic condition resulting in better nutrient uptake, reduced weed density, better moisture availability, nutrients conserved at the time of fruit development and increase in fruit volume in turn is due to enhanced cell division and cell elongation by the application of black polythene mulch (Yogaraj *et al*., 2017, Iqbal *et al*., 2015 and Bakshi *et al*., 2014) [7, 5, 1].

And also in general, application of mulches will increase the phosphate uptake by the crop, it is an integral part in plant photosynthesis glycolysis, respiration, fatty acid synthesis *etc.* contributing to the overall better performance of the plant hence phosphorus uptake will increase the yield of guava crop (Das *et al*., 2010 in guava cv. L-49) [2]

The present investigations showed that, the aril parameters with respect to number of arils, weight of 100 arils, aril thickness and aril per cent were found significantly influenced by different mulches.

It was observed that highest number of arils (452.44), hundred aril weight (36.23 g), aril thickness (8.48 mm) and aril percentage (73.66%) were maximum in the treatment black polythene correspondingly, lowest values were recorded in control (378.19 No, 32.25 g, 6.50 mm and 61.09%, respectively for all of the parameters) (Table 3). The increase in aril parameters may be due to larger size of fruits produced by the plants due to the favorable effect of black polythene mulch soil temperature also enhanced the fruit development by black polythene mulch. These findings are conformity with Yogaraj *et al*. (2017) in pomegranate cv. Bhagwa. Similar findings are also reported by El- Taweel and Farag (2015) [4] in pomegranate arils, however in the case of pebble mulch.

Table 3: Effects of different mulches on number of arils, weight of 100 arils (g), aril thickness (mm) and aril percentage (%) of pomegranate cv. Bhagwa

Treatments	Aril			
	Number	Weight of 100 Arils	Thickness (mm)	Percentage (%)
T1	452.44	36.23	8.48	73.66
T2	386.44	33.04	6.71	62.63
T3	388.89	33.83	6.77	64.90
T4	424.60	35.01	7.12	69.90
T5	390.53	35.21	6.84	68.03
T6	380.62	33.71	7.02	62.89
T7	380.15	32.88	7.15	63.67
T8	419.72	35.20	7.62	68.54
T_9	395.44	33.10	6.98	66.98
T10	378.19	32.25	6.50	61.09
S. Em. ±	6.89	0.63	0.35	1.89
CD @ 5%	20.48	1.88	1.05	5.62

Legend
T_1- Black polythene mulch (100 µ) T_6 - Maize Stover mulch (3"

thickness)
T_2- Newspaper (1 layer) T_7 - Leaf litter (3" thickness)
T_3- Arecanut husk (3" thickness) T_8- Peanut hulls (3" thickness)
T_4- Coconut husk (3" thickness) T_9- Pebbles (1 layer)
T_5- Sawdust (3" thickness) T_{10}- Control (without mulch

Conclusion

From the results of this experiment, it is inferred that, use of black polythene mulch is useful in altering the hydrothermal regime of soil and provided the favorable soil environment for plant growth, yield and quality of pomegranate than the other mulches. Therefore, use of polythene mulch in pomegranate orchard is found to be more effective due to the durability and congenial effects it has created. Hence, this practice could be recommended to the farmers for their pomegranate orchards to get the higher yield and better income.

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