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Effects of various Mulches on quality of Pomegranate (*Punica granatum* L.) cv. Bhagwa under Central Dry Zone of Karnataka

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ABSTRACT: The field experiment entitled "Effects of various mulches on quality of Pomegranate *(Punica granatum* L.) cv. Bhagwa in central dry zone of Karnataka," was carried out in 2017–18. The experiment was set up using a Random Block Design and consisting of ten treatments and replicated three times. Nine different mulching treatments, including black polyethylene, newspaper, arecanut husk, coconut husk, sawdust, maize stover, leaf litter, peanut hulls, pebbles, and a control (without mulch), were employed. Among the different mulches Treatment 1 (Black polythene) mulch recorded the highest total soluble solids (TSS) (15.28°Brix), minimum acidity (0.54%), highest TSS: acid ratio (13.81%) and highest juice recovery (88.86%). In the same treatment (Black polythene) mulch, maximum total sugar (14.35%) and reducing sugar (13.72%) were found. The minimum TSS (13.17°Brix), TSS: Acid ratio (12.19%), total sugars (12.86%) and (11.36%) reducing sugars and highest acidity (0.66%) were recorded in control treatment.

Keywords: Pomegranate, Mulching, Black polythene, Quality, Sugars, TSS.

INTRODUCTION

Pomegranate (*Punica granatum* L) is a deciduous shrub of genus *Punica* and belongs to family Lytheraceae, it is a popular table fruit in tropical and subtropical areas of the world (Abubakr *et al*., 2013). Additionally, it was raised in the mild environment of the Mediterranean area. This tree species may thrive on arid soils and marginal lands (Ozguuven *et al*., 2009; Sawarsan *et al*., 2011). Pomegranate fruit contains polyphenolic compounds, including anthocyaninis, flavonoids and punicalagins, which are the most important members of ellagitannis family (Gil *et al*., 2000). Punicalagin (PUN; 2, 3-hexahydroxydiphenoyl-gallagyl-d-glucose) is the most abundant polyphenol found in pomegranate (*Punica granatum* L.) husk (Yao *et al*., 2017). Polyphenols present in pomegranate such as gallic acid, ellagic acid, punicalagins and punicalins are the major chemical component, and pomegranate possessed the highest concentration of punicalagin α and β among the commonly consumed natural fruits (Fischer *et al*., 2011). 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).

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. Pomegranate cultivation still faces a number of challenges, and improved crop management practices need to be developed (Rao and Subramanyam 2010). Therefore, the only option for increasing crop management through the creation of pertinent research is to increase crop output and quality. Along with other agriculture practices application of mulches in pomegranate orchard helps in changing the soil surface and influences the hydrothermal properties of the soil. Mulches affect the temperature and moisture content of the soil and directly influences on yield quality of the crops. During extreme weather conditions like transpiration fluctuation and regulation of soil temperature these mulches will protect the plants (Sharma and Geol 2017; Kumar *et al*., 2018; Liang *et al*., 2002). Soil temperature and moisture are very important for biological and chemical process in the soil that controls nutrient cycling (Donkvan *et al*., 2004). Hence, application of mulch helps in moisture conservation and reduction in evaporation, improves soil organic matter and these mulches avoids the nutrient loss through leaching and increase the nutrient availability and uptake of nutrients to the plants (Ngente *et al*., 2021; Sinkeviciene *et al*., 2009; Khalifa, 1994; Kristina *et al*., 2013). Two types of mulches are there organic and inorganic mulches, orgainic mulches includes paddy straw, wheat straw, sugarcane trash, sawdust, coconut and arecanut husk, leaf litter, maize stove, banana sheath, etc., and inorganic mulches like black polythene, silver polythene and white transparent polythene mulches.

Hence, to increase quality 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 (Datta and Majumder 2009). Further, degraded mulch would increase the soil structure to hold more moisture. By considering the importance of mulches in fruit orchard the present investigation was undertaken with combination of both organic as well as inorganic mulches in pomegranate orchard.

MATERIAL AND METHODS

The field experiment was conducted at T. Nagenalli, Chitradurga located in Central Dry Zone Karnataka (Zone-4). For this experiment variety used was Bhagwa, it is a promising variety of pomegranate suitable for dry regions. The variety is high in demand for export markets particularly in United Kingdom, Holland, other European and gulf countries *etc*. Fruits are attractive red in colour with smooth and glossy peel having bold and cherry red coloured arils, which are suitable for both table and processing purpose. It is highly suitable for long distant transport due to thick peel (Less weight loss, less possibility of damage due to bruises).

The experiment was laid out in Randomized Block Design consisting of ten treatments and three replications. The treatments includes both organic as well as inorganic mulches, like T_1- Black polythene mulch (100 µ) as an inorganic mulch, T_2- Newspaper (1 layer) T_3- Arecanut husk (3" thickness), T_4- Coconut husk (3" thickness), T_5- 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) are the organic mulches and T_{10}- without any mulch served as a control. Mulches were applied at plant basin immediately after the pruning *i.e*., first week of September 2017.

The organic mulches were collected locally and applied to base of three plants in a replication to a thickness of 3 inches. Inorganic mulch like black polythene of 100 microns (400 gauges) of width 1.5 m having dual colour black on lower side and respective colour on the upper side of the sheet were applied to the base of plant and edges were buried in the soil. Six hundred grams of polythene was used for three plant at the rate of 200 g of polythene for each plant and similarly newspaper (15-20g) and organic mulches like arecanut husk (6 kg/plant), coconut husk (5 kg/plant), sawdust (10 kg/plant), maize stover (5 kg/plant), leaf litter (6 kg/plant), peanut hulls (8 kg/plant) and pebbles (> 50 kg). Before mulching entire plant basin was weeded, cleaned and mulched after the pruning. Mulching to the base of the tree around one square meter area was done by using man power and implements. However, organic mulches pour into the soil two to three inches deep within the circle.

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 liter per square meter. Fruits were harvested at the second week of February month *i.e*., after five months of blooming. Observations like Total Soluble Solids (TSS°Brix) of the juice was determined by using digital refractometer and acidity was determined in terms of tartaric acid (Anon. 1960). Total sugar content of the pomegranate arils was estimated by anthrone reagent method, reducing sugars in the juice was determined by Dinitro-Salicylic acid (DNSA) method (Miller, 1972) and sugar to acid ratio was calculated by dividing the value of total sugars (%) with the value of titrable acidity (%). Non reducing was calculated by using the formula, (Per cent total sugar – per cent reducing sugar) × 0. 95. Juice content of the aril was measured by crushing the arils of the fruit.

It is calculated by using the formula and expressed in percentage.

RESULTS AND DISCUSSION

The results from the investigation reported that there was a significant difference among the different mulching material on quality attributes of pomegranate fruits cv. Bhagwa and presented in Table 1.

The results from the data showed that the highest level of total soluble solids (15.28 °Brix) was recorded in treatment black polythene (100 µ) which was statistically on par with pebbles mulch (14.58 °Brix), sawdust mulch (14.55 °Brix) and coconut husk mulch (14.37 °Brix). The lowest level of TSS was recorded in control (13.17 °Brix). Significant difference among the treatments with respect to acidity, lowest acidity (0.54%) was recorded in plants mulched with black polythene which was followed by pebbles mulch (0.57%) and peanut hulls mulch (0.58%). The highest acidity (0.66%) was recorded in control.

The increase in TSS and decrease in acidity might be due to the fact that black polythene mulch might have exerted positive influence in enhanced availability and uptake of nutrients, because of the increased temperature and microbial activity. Availability of nutrients to the plants may also be due to the conservation of moisture and suppressed weed growth. These factors would have increased the uptake of nutrients and translocation of carbohydrates leading to increased quality of different fruits. These results were accordance with the findings of Panigrahi *et al.* (2010) in mango; Samant *et al*. (2016) in guava and Pandey *et al*. (2016) in strawberry. The difference TSS might be explained in terms of higher moisture and nutrient availability, higher root activity including higher uptake of water and nutrients, high photosynthesis and higher enzymatic activity (Ngente *et al*., 2021 in strwaberry).

The juice content of aril was influenced by different mulches was found significant among the different mulching treatments. The highest juice content of the aril was recorded in the treatment black polythene mulch (88.86%) and on par with peanut hulls mulch (85.81%), while, it was lowest in control (79.88%) treatment. The increase in juice content of the pomegranate arils is might be due to the better effects caused by the black polythene *viz*., moisture conservation, temperature regulation, better activity of soil microflora and translocation of nutrients and carbohydrates. These results are conformity with the findings of Manoj *et al*. (2015) in kinnow and Pandey *et al*. (2016) in strawberry.

The results pertaining to total sugars (%), reducing sugars (%), non-reducing sugars (%) and sugar to acid ratio of pomegranate cv. Bhagwa fruits is presented in Table 2. Data revealed that there was a significant difference among the different mulching material on total sugars, reducing sugars and sugars to acid ratio while, non-reducing sugars were found non-significant.

The treatment black polythene (100 µ) recorded maximum total sugar (14.35%) which was statistically on par with pebbles mulch (14.08%) followed by peanut hulls (14.01%), sawdust (13.90%) and coconut husk (13.80%). The minimum total sugar was recorded in control (12.86%) (Table 2). The reducing sugars in fruits were significantly influenced by different types of mulches. The highest percentage of reducing sugars (13.72%) was recorded in treatment black polythene which was on par with pebbles mulch (13.22%), maize Stover mulch (13.16%) followed by peanut hulls mulch (13.10%), coconut husk mulch (13.02%), leaf litter (12.74%) and sawdust (12.70%), while, it was least in control (11.38%).

Accumulation of maximum total sugars, reducing sugars and non-reducing sugars to arils might be due to greater utilization and assimilation of carbohydrates favoured by better hydrothermal regime of soil and higher absorption of nutrients, regulated temperature, suppressed weed growth and conservation of soil moisture as a result of which there was high ion concentration in the cell which increased the osmotic pressure at the cell solute and consequently opening of the stomata and further change in the proportion of starch to sugar might have increased considerably. The beneficial effects of black polythene mulch were noticed by Sharma *et al*. (2017) in pomegranate cv. Khandari Kabuli, Iqbal *et al*. (2015) in aonla and Pandey *et al*. (2016) in strawberry. The good fruit quality is related to higher moisture conservation in soil, free of weed, and maximum nutrient uptake under black polythene mulch treatment (Kumar *et al*., 2018 in strawberry).

There was non-significant difference between the mulching treatments with respect to non-reducing sugars in fruits (Table 2). However, the highest non-reducing sugars (1.48%) was recorded in control treatment and it was least in the treatment black polythene (0.62%). Sugar/acid ratio was significantly highest (13.81%) in plants mulched with black polythene which was statistically on par with pebbles mulch (13.52%), peanut hulls mulch (13.43%), coconut husk (13.17%) and sawdust (13.28%). The lowest sugar/acid ratio (12.19%) was recorded in control. The increase Sugar/acid ratio in the treatment black polythene mulch was due to increase in TSS content, reduction in acid content of the arils, higher soil moisture and nutrient availability, higher root activities including uptake of water, high photosynthesis, and other enzymatic activities. The similar results were obtained by Pandey *et al*. (2016) in strawberry and availability of nutrients to the plants increased under black polythene mulch due to the conservation of moisture and suppressed weed growth and these factors would have increased the uptake of nutrients and translocation of carbohydrates leading to increased quality of fruit crops (Ngente *et al*., 2021 in strwaberry).

Table 1: Effects of different mulches on TSS (°Brix), acidity (%), juice content (%) in pomegranate cv. Bhagwa .

Treatments	TSS (°Brix)	Acidity (%)	Juice content (%)
T_1	15.28	0.54	88.86
T_2	13.59	0.61	81.41
T_3	13.54	0.60	82.17
T_4	14.37	0.63	83.74
T_5	14.55	0.62	83.16
T_6	13.83	0.63	81.62
T_7	13.32	0.65	82.54
T_8	14.01	0.58	85.81
T_9	14.58	0.57	83.34
T_{10}	13.17	0.66	79.88
S. Em. ±	0.41	0.02	1.26
CD @ 5 %	1.21	0.07	3.75

Legend:
T_1- Black polythene mulch (100 µ), T_2- Newspaper (1 layer), T_3- Arecanut husk (3" thickness), T_4- Coconut husk (3" thickness), T_5- 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), T_{10}- Control (without mulch)

Table 2: Effects of different mulches on Total sugars (%), reducing sugars (%), Non reducing sugars and sugars to acid ratio (%) in pomegranate cv. Bhagwa.

Treatments	Sugars			
	Total (%)	Reducing (%)	Non reducing (%)	To acid ratio (%)
T_1	14.35	13.72	0.62	13.81
T_2	13.58	12.55	1.03	12.97
T_3	13.58	12.19	1.38	12.97
T_4	13.80	13.02	0.78	13.17
T_5	13.90	12.70	1.20	13.28
T_6	13.31	13.16	0.15	12.68
T_7	13.46	12.74	0.72	12.78
T_8	14.01	13.10	0.91	13.43
T_9	14.08	13.22	0.86	13.52
T_{10}	12.86	11.38	1.48	12.19
S. Em. ±	0.25	0.38	0.36	0.26
CD @ 5 %	0.74	1.13	NS	0.77

Legend:
T_1- Black polythene mulch (100 µ), T_2- Newspaper (1 layer), T_3- Arecanut husk (3" thickness), T_4- Coconut husk (3" thickness), T_5- 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), T_{10}- Control (without mulch)
NS - Non significant

CONCLUSION

Based on present investigations, it was concluded that use of black polythene mulch (100 µ) was found to be better for plant growth and fruit production by maintaining soil moisture, temperature and control the weed growth and helps in better uptake of nutrients. These beneficial effects caused by black polythene mulch enhance the yield and quality characters of fruits of pomegranate cv. Bhagwa. Therefore, use of polythene mulch in pomegranate orchard could be recommended to the farmers for better yield to improve quality as well as to obtain higher economic returns.

FUTURE SCOPE

In the light of the results obtained from the investigation, the following suggestions are made for formulating future research programme.
1. Long term studies with respect to growth and yield of pomegranate by using black polythene mulch is needed.
2. Relation of microbes, nutrients, growth and productivity have to be investigated in detail.
3. Total organic cultivation procedures for pomegranate has to established by using different organic mulches.
4. Further studies on degradable mulches for sustainable production system in pomegranate is needed.

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Conflict of Interest. None.

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