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Quality of pomegranate fruits as influenced by pre harvest bagging under hot arid climate

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Abstract

An experiment was conducted to study the effect of different bagging material on fruit quality and cracking in pomegranate which is severe problem under hot arid climate of Rajasthan. Pomegranate fruits of cv. Bhagwa were covered with different bagging material i.e. white paper bags, brown paper bags, butter paper bags, perforated transparent polyethylene bags, muslin cloth bags, markin cloth bags, non woven fabric bags, shrink wrapping (cling film) and control without bagging. The fruits were covered in each treatment after two month of fruit set during September and data were recorded on different fruit physical and physico-chemical quality attributes. Among the treatments, perforated transparent poly bags were significantly reduced fruit cracking (11.12%) as against control (25.20%). Perforated transparent polyethylene bags also resulted in highest marketable yield (4.72 kg/plant) followed by butter paper bags (4.00 kg/plant) as compared to lowest in control (3.30 kg/plant). Improved bright red colour fruits was obtained in perforated transparent poly bags and shrink wrapping treatments, while in control fruits colour faded and turn light brown red due to sun scald and frost damage. The total soluble solids and TSS/acid ratio were significantly affected by fruit bagging material, while non significant differences were observed in ascorbic acid, total sugar, reducing sugars and acidity of fruits. The maximum maturity index was recorded in perforated transparent polyethylene bags (35.82) followed by butter paper bags (31.91) as compared to minimum observed in control (25.12). Thus, pre harvest fruit bagging of pomegranate not only improved marketable fruit yield and quality of fruits but also significantly reduced fruit cracking under hot arid climatic conditions.

Key words: Fruit bagging, fruit cracking, maturity index and quality

Introduction

Pomegranate (*Punica granatum* L.) is an emerging fruit crop of hot arid region of India. The pomegranate area and production is increasing very fast owing to its hardy nature, wider adaptability and high nutritional and medicinal value, availability of quality planting material, steady demand and remunerative prices. In India,pomegranate is grown commercially in the states of Maharashtra, Gujarat, Karnataka, Andhra Pradesh, Tamil Nadu, Madhya Pradesh and Rajasthan. The fruit is mainly used for dessert purpose and also processed for making juices, syrup, jelly and anardana. The fruit are rich in Fe, Zn, Ca and antioxidant component like anthocyanins, phenol, flavonoids and tannins. India is one of the leading growers and producers of pomegranate in the world. During 2018-19, pomegranate was cultivated over 2.62 lakh ha with an annual production of 30.34 lakh tonnes and a productivity of 11.58 tonnes/ha in India (Anonymous, 2019). Maharashtra is the leading state in acreage covering 63.23 % of the total area and 62.90 % of total production followed by Gujarat (13.04 % area and 16.23 % production) and Karnataka (11.10 % area and 9.42 % production) under pomegranate. In Rajasthan, it is mainly grown in Barmer, Jalore, Sirohi, Bhilwara, Jaisalmer, Jodhpur, Chittorgarh, Bikaner, Nagaur, Jaipur, Ajmer, Alwar, Sri Ganganagar, Pali, Kota, Banswara, Sawai Madhopur, Jhunjhunu, and Sikar districts over 7.47 thousand ha area with 13.13 thousand tonnes production (Anonymous, 2020). In Rajasthan pomegranate is harvested in all three seasons during March-April, August-September and November-December. The Bhagwa variety of pomegranate grown extensively in India, has become popular owing to its high yield, big fruit size, dark purple-red rind and aril colour, semi-soft arils and high juice content.

In hot arid region of Rajasthan, fruit cracking, frost damage and sun scald are the major physiological disorders which results in inferior quality fruits and makes them unfit for shipment and marketing. Almost all the varieties cultivated in this region are susceptible to fruit cracking resulting economic loss to the farmers. It may be due to moisture imbalances, temperature variation and deficiency of micro nutrients. By adopting fruit-bagging, growers could minimize losses and get an additional price over unbagged fruits (Asrey *et al.*, 2013). Fruit bagging considerably reduced cracking, scratches, and development of bacterial spots with reduced incidence of sun burning in pomegranate. Fruit bagging not only improves higher marketable fruit yield but also provides protection to fruits from birds and pests. Covering of fruits with bags modify the micro-climate around fruit, which exerts manifold effects on the growth, development and quality of fruits (Guzman, 2004; Son and Lee, 2008; Li *et al.*, 2008). The fruit bagging is

commercially adopted in fruit crops like mango, apple, pear, litchi, guava, grape, longan *etc.* for fruit quality improvement and reducing pesticide residues by minimization of insect or disease incidence and fruit cracking (Wang *et al.*, 2003; Wei *et al.*, 2005). Fruit cracking caused huge loss and it varies from 35 to 75 % in different *bahars* under hot arid conditions. The number of biotic (bacterial blight, anthracnose, fungal spot and mite) and abiotic stress (drought, frost and salinity) along with fruit cracking possess an emerging threat to the pomegranate industry. Therefore, the present study was formulated to improve fruit quality and to minimize fruit cracking, frost damage and sun scald in pomegranate through different bagging material.

Materials and Methods

The present study was carried out during two consecutive years 2018-19 and 2019-20 at ICAR-Central Institute for Arid Horticulture, Bikaner. The experiment was conducted on three years old uniform plants of pomegranate cv. Bhagwa planted at 4x3 m^2 spacing and irrigated through drip system. The fruits were covered with different bagging material i.e. white paper bags, brown paper bags, butter paper bags, perforated transparent polyethylene (PTP) bags, muslin cloth bags, markin cloth bags, non woven fabric bags, shrink wrapping (cling film) and control without bagging. The experiment was conducted in randomized block design with three replications. The fruits were covered in each treatment after two month of fruit setting during September. The uniform intercultural operations were performed as per the package and practice of the crop. To protect the plants from mite, plants were first sprayed with propargite (57 % EC) 2 ml/l in May and second spray of spiromesifen (240 SC) 0.4 ml/l was done during September. The plants were sprayed twice with mancozeb (75 % WP) 0.2% + carbendazim (50 % WP) 0.2% to control fungal spots disease during rainy season. Data were recorded on yield parameters and quality indices *viz.* fruit weight and diameter, total fruit yield, fruit cracking (%), marketable yield, fruit rind colour, total soluble solids (TSS), acidity, ascorbic acid, total sugar, reducing sugar and maturity index. The total soluble solids of the fruit juice were determined with digital refractometer Atago PAL II. The acidity of juice was determined by titration with 0.1 N sodium hydroxide using phenolphthalein indicator. The ascorbic acid was determined by titration using 2, 6, dichlorophenol indophenol dye. Total sugar was estimated by the phenol sulphuric acid method (Dubois *et al.*, 1956). Reducing sugar was determined by the Nelson and Somogyi method (Somogyi, 1952). The data were analyzed statistically as per the methods suggested by Gomez and Gomez (1984).

Results and Discussion

The different bagging material significantly influenced fruit physical and yield attributes of pomegranate. Among all the treatments, significantly maximum fruit weight was recorded in perforated transparent poly bags (213.38 g) followed by markin cloth bags (190.95 g) and butter paper bags (190.54 g), whereas minimum fruit weight was recorded in control treatment (182.81 g) which is at par with brown paper bags (183.38 g), non woven fabric bags (185.39) and white paper bags (185.57 g). Similarly, fruit diameter was found highest in perforated transparent poly bags (8.35 cm) which was statistically at par with markin cloth bags (8.19 g) and butter paper bags (8.17 cm). The minimum fruit diameter was recorded in control treatment (7.96 cm) and brown paper bags (7.99 cm). The total fruit yield was recorded maximum in perforated transparent poly bags (5.36 kg/plant) followed by butter paper bags (4.80 kg/plant) as compared to minimum found in control (4.59 kg/plant). In pomegranate, fruit external appearance and quality are important criteria for fetching higher prices in the market as fruit cracking and sun scald along with mite and fungal spot deteriorate fruit quality under hot arid climatic conditions.

The marketable fruit yield was also significantly influenced by different treatments of bagging materials and registered significantly maximum marketable fruit yield in perforated transparent poly bags (4.72 kg/plant) followed by butter paper bags (4.00 kg/plant) as compared to minimum in control (3.30 kg/plant) (Table 1). Fruit rind colour also influenced by different bagging material. The improved bright red colour of fruit was obtained in perforated transparent poly bags and shrink wrapping treatments, whereas in control fruits colour was observed faded light red due to sun scald and frost damage. Xu *et al.* (2008) reported that bagging with plastic bags

Table 1. Effect of different bagging material on fruit and yield attributes of pomegranate

Treatments	Fruit weight (g)	Fruit dia. (cm)	Total yield (kg/plant)	Marketable yield (kg/plant)	Fruit rind colour
White paper bags	185.57	8.10	4.67	3.99	Red
Brown paper bags	183.38	7.99	4.62	3.91	Light Red
Butter paper bags	190.54	8.17	4.80	4.00	Dark Red
Perforated transparent poly bags	213.38	8.35	5.36	4.72	Bright red
Muslin cloth bags	187.84	8.14	4.71	3.64	Red
Markin cloth bags	190.95	8.19	4.79	3.69	Red
Non woven fabric bags	185.39	8.10	4.69	3.88	Red
Shrink wrapping	188.82	8.18	4.75	3.92	Bright red
Control	182.81	7.96	4.59	3.30	Faded light red
SEm±	1.70	0.07	0.11	0.13	–
CD (5%)	5.09	0.23	0.32	0.39	–

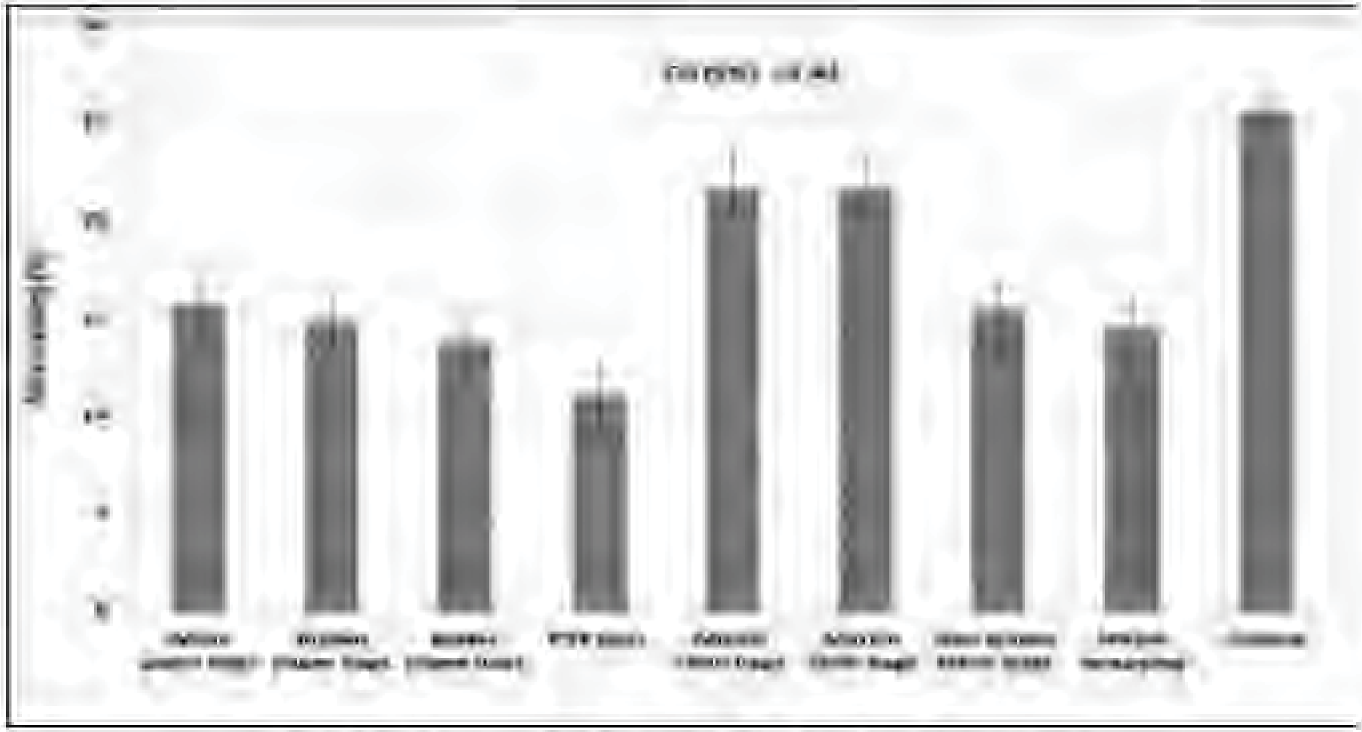

Fig. 1. Effect of different bagging material on fruit cracking of pomegranate

increased fruit weight in carambola. These results are in accordance with those obtained by Abd El-Rhman, (2010), who reported that, the covering of pomegranate fruits with bags resulted in higher fruit weight as compared to control. The different bag types were significantly increased fruit weight in longan (Yang *et al.*, 2009). Bunch bagging increased bunch weight compared to the control (Mohamed *et al.*, 2012). Fruit bagging has increased fruit size probably due to development of optimum micro-climate around fruit. Similarly, Wei *et al.* (2009) and Abd El-Rhman (2010) also reported that, bagging of pomegranate fruit gave higher positive effect on fruit diameter as compared with the control. The higher marketable yield in bagged fruits was possible due to lower incidence of fruit cracking, frost damage, sun scald and improved colour as compared to un-bagged fruits. Fruit cracking was significantly reduced by different bagging material (Fig. 1) and minimum fruit cracking was recorded in perforated transparent poly bags (11.12%) followed by butter paper bags (13.75%) and shrink wrapping (14.45%) as compared to maximum fruit cracking found in control (25.20%) followed by muslin cloth bags (21.67%) and markin cloth bags (20.50%). These results are in agreement with those obtained by Wei *et al.* (2009), who reported that, bagging minimized fruit cracking incidence (5.10%) significantly as compared to the control (32.80%). The berry cracking rate of the non-bagging treatment was higher as compared to berry treated with white paper bag, yellow bag and blue bag (Son and Lee, 2008). The fruit cracking incidence of 'Daqingpitian' was lower (4.1%) in bagged treatments as compared to the maximum (46%) in un-bagged control (Yuan *et al.*, 2010; Li *et al.*, 2011). Sakineh *et al.* (2015) reported that white bag was the most effective treatment for increasing quality and reducing sunburn in pomegranate fruit cv. Rabab Neiriz.

The total soluble solids and maturity index were significantly influenced by different bagging material while non-significant differences were observed in other fruit physico-chemical quality attributes like acidity, ascorbic acid, total sugar, reducing sugar of fruits. The maximum TSS, total sugar and reducing sugar content were recorded in perforated transparent polyethylene bags (16.07°Brix, 13.11 and 12.10%) followed by muslin cloth bags (15.66°Brix, 12.54 and 11.51%) as compared to minimum TSS, total sugar and reducing sugar content recorded in butter paper bags (14.98°Brix, 11.81 and 10.66%), respectively. The titrable acidity ranged from minimum 0.45% in perforated transparent polyethylene bags to maximum 0.61 % in control. The maximum ascorbic acid content was recorded in perforated transparent polyethylene bags (22.73 mg/100 g) as compared to minimum found in brown paper bags (20.35 mg/100 g) (Table 2). The maturity index is an important quality for pomegranate, which varied significantly among different fruit bagging treatments (Fig. 2). The maximum maturity index was recorded in perforated transparent polyethylene bags (35.52) followed by butter paper bags (31.91) as compared to minimum found in control (25.12). Similar results were also obtained by Abou El-Wafa (2014) and Asrey *et al.* (2019) in pomegranate.

Table 2. Effect of different bagging material on physico-chemical quality of pomegranate

Treatments	TSS (°Brix)	Acidity (%)	Ascorbic Acid (mg/100g)	Total sugar (%)	Reducing sugar (%)
White paper bags	15.61	0.582	20.77	12.27	11.12
Brown paper bags	15.11	0.520	20.35	11.82	10.70
Butter paper bags	14.98	0.485	20.81	11.81	10.66
Perforated transparent polybags	16.07	0.453	22.73	13.11	12.10
Muslin cloth bags	15.66	0.503	21.82	12.54	11.51
Muslin cloth bags	15.65	0.616	21.09	12.52	11.19
Non woven fabric bags	15.61	0.589	20.72	11.84	10.89
Shrink wrapping	15.42	0.581	22.14	12.09	11.04
Control	15.29	0.610	20.61	11.96	10.91
SEm±	0.11	0.007	0.29	0.05	0.04
CD (5%)	0.31	NS	NS	NS	NS

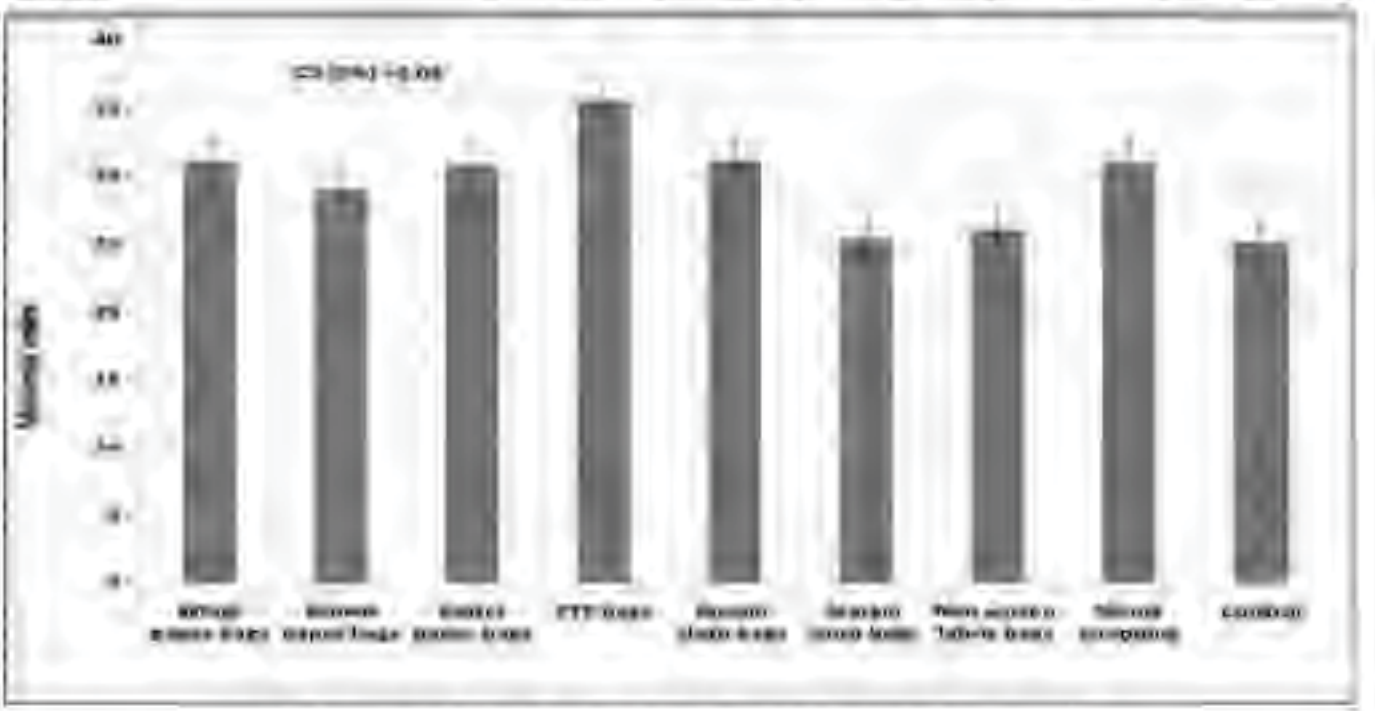

Fig. 2. Effect of different bagging material on maturity index of pomegranate

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