



## Research Article

# Vulnerability of Date Palm cv. Dhakki to Climate Change and Viable Options for Adaptation

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**Abstract** | Even though date palm is a thermophile species and can withstand large temperature fluctuations, yet recent climate changes especially prolonged monsoon patterns, starting earlier (end of June) and lasting till September with sporadic changes, has posed multiple threats for Dhakki dates causing spoilage of fruits at early ripening stage, hindering ripening and drying processes at the end. Growers are adapting some alternate options of making 'Chuhara' (dried dates) at Khalal stage instead of processed Rutab dates. Experiments were conducted to find out comparative yield potentials of 'Chuhara' as well as processed dates produced from the fruits collected from trees protected from rain-fall. The results show that BCR for fresh dates was 2.85, while, it was 1.06 for dry dates. It is depicted that fresh dates give double economic return as compared to dry dates. It was observed that 1Kg Khalal fruits yields ½ Kg dry dates whereas the same quantity of Rutab fruits on ripening and drying yields ¾ Kg of fresh dates. General evaluation of bunches bagging treatments on fruiting traits was conducted. It was concluded that bunches covered with blue paper bags obtained highest score among all the traits and is recommended to achieve best results under current climate change scenario. Generally, fruit covering shields the fruit from adverse effects of monsoon rains, birds, pests and dust.

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**Keywords** | Vulnerability, Climate change, Date palm, cv. Dhakki, Bunches bagging



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## Introduction

Date palm (*Phoenix dactylifera* L.) is one of the important fruit trees and plays a vital role in the nutritional supplements and biochemical supplied for industries (Khayyat *et al.*, 2007). Pakistan stands among the top four countries to produce and

contribute dates. World fame date palm cv. Dhakki is a cultivar of Dera Ismail Khan, Khyber Pakhtunkhwa (KPK), Pakistan with fruit size (5cm long, 2.5cm thick and 36g/fruit) (Iqbal *et al.*, 2015).

It is worth mentioning here that the nature of Dhakki dates is different from other dates; as in

contrast to other date varieties it cannot ripe on plant. The bunch; are harvested at Rutab stage to carry out ripening process on ground (Iqbal *et al.*, 2011). Due to climate change, there is one big threat in the form of monsoon season which coincides with the Khalal and rutab stages of dates every year (Hussain *et al.*, 2013). It adversely affects its availability of fresh dates. Moreover, dates ripening and drying processes require different temperature and humidity regimes. For ripening low temperature and high humidity is required and for drying it is vice versa i.e. high temperature and low humidity is needed (Awad, 2007).

Traditionally, Dhakki dates with a water activity close to  $0.61 \pm 0.01$  aw are used in cured form (Shazada *et al.*, 2005), but, now due to climatic variability moon soon rains are occurring on its ripening times hence it is being processed in Chuhara form (Boiled and dried). Among scientific community and economists, it was presumed that Chuhara production has potential losses than Dhakki dates production.

To cope with the situation different researches/studies were conducted. Shazada *et al.* (2005) recommended chemical treatments to accelerate ripening of Dhakki dates, but it adversely affects the chemical characteristics of fruit (Diboun *et al.*, 2015).

The other option is to cover bunches with bags; to protect date palm bunches from rainfall; covering with variant material bags has several advantages and is being practiced in many dates palm producing areas. Moustafa (2007) reported that covering bunches additionally protects fruits from high humidity, rain, bird and insects. They further reported that covering bunches of date palm with different bags during fruit setting period has a beneficial effect on yield, fruit set and fruit quality. When the fruit is exposed to weather conditions, its evapotranspiration rate is high due to which the skin gets ruptured and flesh of fruit detached from seed. Covering fruit with bags controls the evapotranspiration and hence protects the fruit from being adversely affected. As a result, the available water content in the fruits retains which accelerates the ripening rate.

According to (Harhash and Al-Obeed, 2010) covering bunches show best results for the fruit weight, flesh weight, total soluble solids, total sugars percentage and lowest tannins percentage. Generally, canvas,

gauze or palm fibers and polyethylene bagging at early fruit maturity stage (Khalal) with amputation at advanced growth stages, causes expressively early fruit ripening, improves the yield, fruit quality and also decrease the fraction of tip broken fruits at harvest time comparing with control (Mostafa *et al.*, 2014). Blue color outdone the other bag colors in the same characters (Bashir *et al.*, 2015). Harhash and Al-Obeed (2010) and Kassem *et al.* (2011) stated that blue color polyethylene bag increased fruit weight, flesh weight and fruit mass of Khalas and Succary cultivars. According to (El-Salhy, 2000) black paper lead to higher fruit content of nitrogen and calcium in Khalal stage and making the fruit suitable for storage.

Bunch bagging is carried out at Dhoka stage and removed at Rutab stage for Dhakki dates, to protect it from rainfall (Bashir *et al.*, 2015). To convert from Rutab to Tamar stage, the fruit is placed on mats under open sun for ripening/drying (SBI, 2010). The fruit is still exposed to rainfall, varying temperatures and humidity levels, dust, insects etc. These factors negatively affect the fruit quality. The controlled ripening can be well-thought-out as a way forward to overcome the problems, by limiting the time of ripening, risk of rains and late marketing period.

Major fruit losses in date palm occur due to monsoon rainfall at the time of fruit maturity. The current study was carried out to eliminate fruit loss due to monsoon precipitation in Dhakki date cultivar by casing the bunches with bags made of different material looking for the appropriate bunch cover as well as considering the economics of date palm growers.

## Materials and Methods

The experiments were conducted during the years 2016 and 2017 on Dhakki date palms which are grown in an orchard located at Arid Zone Research Center, Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan.

### *Treatments applied*

A set of treatments comprising five treatments including bunches without covering/control treatment (T1), bunches covered with polythene bags in blue color (T2), bunches covered with dull paper bags (T3), bunches sheltered with art paper bags (T4) and bunches shielded with polypropylene bags (T5), was applied to marked bunches on a sole palm. The

bags were knotted from upper side casing the whole bunch leaving downside of the bags open. Each set of treatments (5 treatments) was practiced to a single palm, repeating the experiment with 3 replications (3 date palm tree) in harmony with Randomized Complete Block Design (RCBD).

*Period of covering and un-covering the bunches*

The aforesaid treatments were applied to marked bunches of fruits at Khalal stage on each selected palm tree earlier the inception of monsoon rains in mid July. The bunches were randomly selected for carrying out the study. All the treatments were repeated three times to eradicate the error. At Rutab stage the covering was removed and bunches were harvested in the mid of August each year. As per guidelines by Abul-Soad (2010), the bunches covering and uncovering stages were finalized

*Cultural practices applied*

All traditional practices including application of fertilizers, irrigation and artificial pollination were applied homogeneously to all treatments.

*Parameters focused*

The parameters considered under study included bunches fruit ripening (%), bunch weight (Kg), fruit moisture (%), fruit weight (g), pulp weight, fruit length (cm), fruit size (cm), total soluble solids (%), reducing and non reducing sugars (%). For economic analysis, Benefit Cost Ratio (%) for fresh and dry dates was calculated. The parameters considered are in accordance with (Karampour and Davoodian, 2010).

*Statistical analysis*

Statistical analysis of the data was carried out were using Analysis of Variance technique, followed by comparison of treatment means by LSD test at 5% significance (Steel et al., 1997).

*Producing fresh and dry dates*

The fruit harvested at Khalal stage was processed in Green Glass House to produce fresh dates. For producing Dry dates, the fruit was immersed in boiling water for five minutes and then shifted to GGH in perforated trays. It was observed that 1Kg Khalal fruits yielded ½ Kg dry dates whereas the same quantity of Rutab fruits on ripening and drying yielded ¾ Kg of fresh dates.

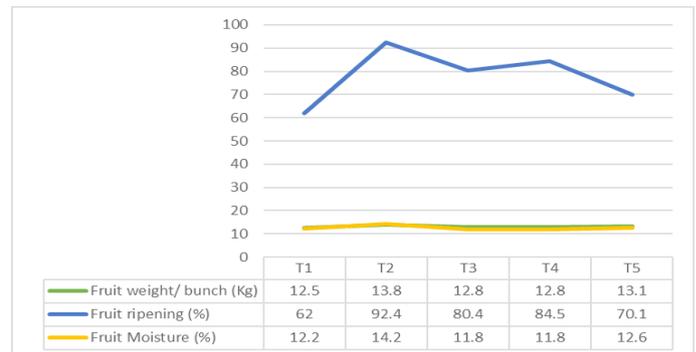
*Market survey*

Survey was conducted to collect the Market Rates of both Dhakki dates as well as Dhakki Chuhara. The average cost of Dhakki dates per Kg was observed to be PKR 200, while it was PKR 125 per Kg of Chuhara.

The expenses occur including daily wages of labor for picking of fruits, detachment from bunches, cleaning and sorting, transportation for dates to “Khorī” (Open sun drying place for dates processing), 10-12 days for processing and then selling in marketing were collected.

**Results and Discussion**

The fruit weight (Kg), fruit ripening (%) and fruit moisture (%) of bunches attained as an average of two years (Figure 1). The average maximum bunches weight (13.8Kg), fruit ripening (92.4%), pulp weight (88%) and fruit weight (36g) were observed for bunches covered with blue polythene bag, while, it was minimum (12.5Kg) for uncovered bunches (Hazbavi et al., 2015).



**Figure 1:** Effect of bunch bagging treatments on fruiting characteristics of Dhakki dates.

The average maximum fruit moisture (14.2%) was observed for bunches covered with blue polythene bag, while, it was minimum (11.8%) for bunches covered with dull paper bag (Bashir et al., 2015).

Figure 2 shows fruit weight (g), pulp weight (%), fruit length (cm) and fruit diameter (cm) as an average of two years. The average maximum fruit length (5cm) was observed for uncovered bunches, while, it was minimum (4.7) for bunches covered with blue polythene bags. The average maximum fruit diameter (2.5cm) was observed for bunches covered with blue polythene bags, while, it was minimum (2.3) for bunches covered with dull paper bags.

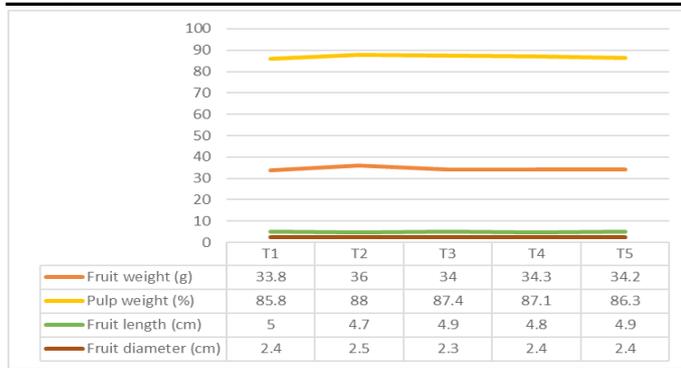


Figure 2: Effect of bunch bagging treatments on physical properties of Dhakki dates.

Figure 3 shows T.S.S (%), Reducing Sugars (%), Non-Reducing Sugars (%) and Total Sugars (%) as an average of two years. The average maximum T.S.S (82.4%) was observed for bunches covered with blue polythene bag, while, it was minimum (79.2%) for bunches covered with dull paper bags. The average maximum reducing sugars (65.9%) was observed for bunches covered with art paper bag, while, it was minimum (63.3%) for bunches covered with dull paper bag. The average maximum non reducing sugars (9.8%) was observed for bunches covered with dull paper bag, while, it was minimum (8.8%) for bunches covered with polypropylene bag. The average maximum Total sugars (75.4%) was observed for bunches covered with blue polythene bag, while, it was minimum (72.8%) for bunches covered with polypropylene bag.

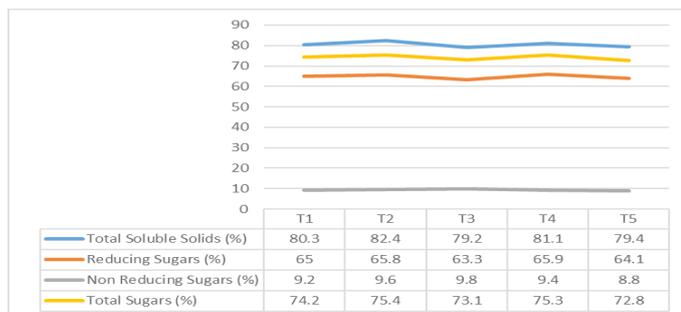


Figure 3: Effect of bunch bagging treatments on chemical properties of Dhakki dates.

From Figure 4 it can be concluded that fresh dates gave double return as compared to dry dates.

Monsoon rains coincide with the ripening stage of Dhakki dates. Resultantly, the fruit may drop or spoil. Fruit losses occur and economics of date fruit adversely affects due to increase in air humidity during monsoon rainfalls. Covering bunches especially with bags shields fruit against adverse effects of rainfall (Bashir et al., 2015). The obtained results are in

alignment with the findings of Mostafa et al. (2014), they indicate that TSS % and sugar contents were significantly varied according to bagging treatments. The obtained results showed that all the treatments improved fruit weight, pulp weight, fruit size, TSS, reducing, non-reducing and total sugars contents comparing with control.

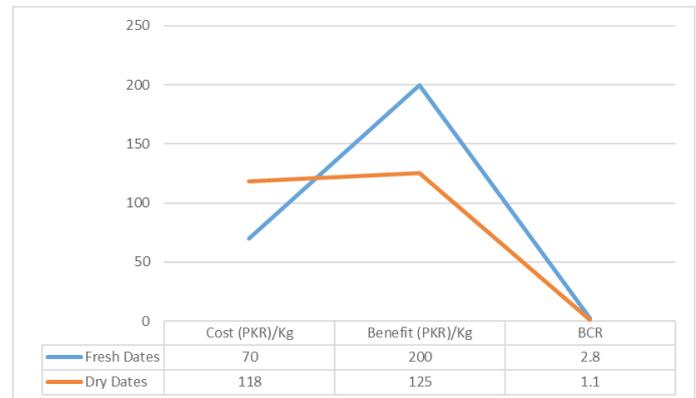


Figure 4: Comparative economic analysis of fresh and dry dates (Chuhara).

### Conclusions and Recommendations

In order to cope with the climate, change an adaptation of pre-harvest bunches bagging with blue polythene bags proved the best option. Moreover, for getting good quality dates; ripening and drying together with blue polythene bagging if carried out in solar dates processing units equipped with automatically controlled modules can prove highly desirable. The integrated technology is expected to give economically viable solution to Dhakki date growers convincing them to continue on to date’s production instead of ‘Chuhara’ formation.

### Novelty Statement

As far as the authors are aware, there is no similar research work carried out related to identify the yield and water productivity of capsicum irrigated with treated municipal wastewater.

### Author’s Contribution

**Muhammad Mansoor:** Conceived the idea, conducted literature review, synthesize the data, wrote the paper and presented the results, discussions and conclusions while utilizing his field experience and research background.

**Shahid Hameed Khan Khalil:** Overall management of the article. As correspondence author addressed

the peer reviews and incorporated desired changes

**Zafar Islam:** Supported in field experimentation and data collection.

**Muhammad Asif:** Supported in data collection and data compilation.

**Ghani Akbar:** Supported in literature review.

**Muhammad Ashraf Khan:** Supported in field experimentation and data analysis.

Ibadullah Jan: Worked on methodology.

### Conflict of interest

The authors have declared no conflict of interest.

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