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PERFORMANCE OF THREE SAUDI ARABIAN DATE PALM VARIETIES UNDER THE AGRO-CLIMATIC CONDITIONS OF KHAIRPUR

Adel Ahmed Abul-Soad[1,*], Mushtaque Ahmed Jatoi[2] and Ghulam Sarwar Markhand[2]

[1]Horticulture Research Institute, Agricultural Research Center, Cairo, Egypt
[2]Date Palm Research Institute, Shah Abdul Latif University, Khairpur, Sindh, Pakistan
***Corresponding author's e.mail: adelaboelsoaud@gmail.com**

Date palms of 10 year old Ajwa, Safawi and Ruthana varieties from Al-Madina, Saudi Arabia were evaluated under the agro-climatic conditions of Khairpur, Sindh, Pakistan throughout the growing seasons from 2009 to 2011. The results obtained indicated better fruit quality similar to those fruits obtained from the original place of origin. The palms of the three varieties were thriving successfully. The edible stage of vars. Ajwa and Safawi is tamer and rutab for var. Ruthana. The fruit was harvested early from 13 to 20th of July before the onset of monsoons. The fruit size of vars. Ajwa, Safawi and Ruthana at their edible stages were 3.16, 4.25 and 3.52 cm long, and 2.31, 2.05 and 2.38 cm in diameter, respectively. The average fruit and seed weight of vars. Ajwa, Safawi and Ruthana were 11.42, 10.49 and 12.42 g, and 1.23, 0.88 and 1.1 g, respectively. The fruit flesh percentage in vars. Ajwa, Safawi and Ruthana reached 89.14%, 90.84% and 90.92%, respectively. It was found that the climatic conditions of Khairpur are suitable for the cultivation of these three exotic varieties. The vegetative, flowering and fruit characteristics of the three varieties were described, and the impact of climatic conditions on fruit quality was discussed in this study.

Keywords. Ajwa, date palm, fruit quality, germplasm, varietal performance

INTRODUCTION

During Colonial period of sub-continent India, a number of Arabian date palm varieties were imported in 1910 - 12 from Basra (Iraq) by British Indian Government and planted in Multan and Muzaffargarh (Punjab). These varieties were Halawee, Khadrawee, Sayer, Zaydi and Deree (Milne, 1918). However, var. Halawee which can be consumed mainly at Khalal stage became an integral part of the horticulture industry in Punjab, Pakistan. Main reason is the humid climate during fruit maturation and ripening period that restricted the cultivation of other varieties. The date palm eco-system is mostly of dry nature. Date palm growth is affected by different factors (Afzal *et al*., 2011; Ata *et al*., 2012).

Dates occupy third position after citrus and mango in terms of fruit area and production in Pakistan (Khushk *et al*., 2009). The export of dates is mainly occurring from Khairpur and Turbat districts of Pakistan. Khairpur is the center of biodiversity for dates in Pakistan having more than 300 date palm varieties (Markhand *et al*., 2010). Unfortunately, few of these existing varieties are of commercial importance such as Aseel, Begum Jangi and Dahkki. Thus, the introduction of elite exotic date varieties into Pakistan is the need of the day.

Ajwa, Safawi and Ruthana are among the elite varieties of the world belonging to Al-Madina, Saudi Arabia. It is worth mentioning here that there is no any published evidence for the presence of these three varieties in Pakistan. Moreover, it is claimed that var. Ajwa is restricted to climatic conditions of Al-Madina and if established anywhere, variation occurs in the fruit size, texture and quality. Nevertheless, hard efforts have been made for last several decades through dispersed individual trials in the country to cultivate Ajwa, Safawi and Ruthana varieties. Unfortunately these trials were not fruitful despite few successful established palms which produced inferior fruit quality as compared to those in Al-Madina. Reason of this variation could be the cultivation at unsuitable climate outside the main area of date palm in Pakistan, i.e. Khairpur district.

Several investigators studied and evaluated different date palm varieties at different countries (Asif *et al*., 1982; Gasim, 1994; Godara *et al*., 1994; Vij *et al*., 2005; Osman, 2008). Introducing new varieties from native place to check their adaptability under another environment is of a paramount importance as aim of this study. The deviation in characteristics particularly physical fruit properties of newly established varieties in comparison to their characteristics at the place of their origin is investigated in current study.

MATERIALS AND METHODS

This work was carried out in Date Palm Research Institute (DPRI), Shah Abdul Latif University (SALU), Khairpur district, Pakistan during 2009-2011. The site was selected after preliminarily study of official records to find common climatic conditions between Khairpur and Al-Madina. The

reading included the average of minimum and maximum temperatures and relative humidity.

Small offshoots (4-year old) of vars. Ajwa, Safawi and Ruthana were brought from Saudi Arabia in 2006 and cultivated at the research orchard of SALU. Data on vegetative and reproductive attributes were recorded annually for 3 years and the average has been calculated. Optimal quantities of chemical fertilizers (1000 N, 1000 P_2O_5 and K_2O 800 g/palm/year) were applied at couple of weeks interval during summer and farm yard manure (50 Kg/palm/year) a once in winter were given to the trees as a soil application and regularly irrigated. The average mean temperature was 35.61°C during the period from February to September and air relative humidity was 44.13%. However, these readings changed during the fruit harvesting months from June - July to 40°C approx. and from 40-60% approx. as air relative humidity according to a weather station at SAL University, Fig. 1 (e-Talk Newsletter, 2012).

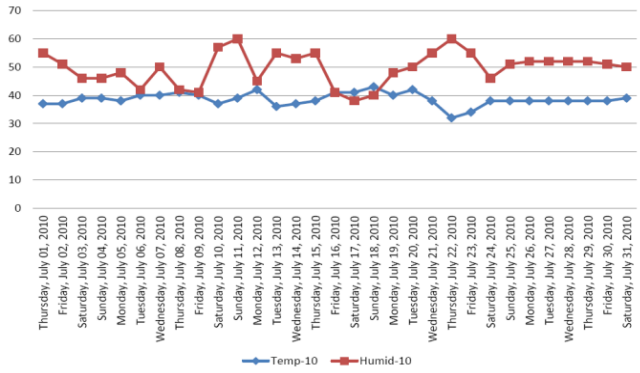

Figure 1. The average temperature (about 40°C) and humidity (40-60%) during harvesting month of July, 2010 at Khairpur, Pakistan (e-Talk Newsletter, 2012)

Data Collection

***Vegetative characteristics*:** The collected data of vegetative characteristics for each variety were number of mature leaves (fronds)/palm, average frond length (m) and midrib width (midrib measured after 100 cm from the base), average no. of leaflets (pinnae)/frond, leaflet length (cm), no. of thorns/frond, thorn length (cm), leaflet's and thorn's area length (m) and leaflets distribution pattern (Table 1).

Table 1. Vegetative growth characteristics of vars. Ajwa, Safawi and Ruthana for 10 years old trees cultivated at Khairpur district, Pakistan

Characters	Ajwa	Safawi	Ruthana
Leaves No.	18	34	26
Adult Leaf Length (m)	3.13	3.62	3.62
Midrib Width (cm)	2.4	2.3	2.5
Leaflets No./Leaf	129	117	119
Leaflets Length (cm)	52.07	47.75	69.85
Leaflet's Area Length (m)	1.86	2.38	2.29
Thorn's Area Length (m)	0.91	0.95	0.95
Thorns No./Leaf	19	36	19
Thorn Length (cm)	19	15.24	19.05
Leaflets' Distribution Pattern	Alternate	Alternate	Alternate

The values are averages

***Flowering*:** Due to the difference in timing of spathes emergence, they were pollinated more than one time. The time of spathe emergence and last date of pollination, total number of spathes/palm, length of bunch, strands/bunch and length of strand were recorded (Table 2).

***Fructification*:** Fully ripened fruit were harvested regularly every 2 - 3 days by hand picking. When the total number of fruit on a bunch reached to 50% at rutab stage, fruit bunches were harvested and exposed under sun light for 2 - 3 days till full ripening.

The physical characters of fruit were measured at Khasi (Kimri), Doka (Khalal), Dung (Rutab) and Khajoor or Kharak (Tamer) stages. Fruit length and diameter (cm) were measured using a vernier caliper while weight of the fruit and the seed (g) were determined using a digital balance. The flesh percentage of the fruit was also calculated (Table 3).

***Statistical Analysis*:** Factorial Randomized Complete Block Design was used and data were subjected to analysis of variance. Separation of means among treatments was determined using L.S.D test at 5% according to Steel *et al.* (1997).

Table 2. Flowering characteristics of vars. Ajwa, Safawi and Ruthana for 10 years old trees cultivated at Khairpur district, Pakistan in 2011 season

Variety Name	Date of Spathe Emergence		Date of Pollination		Spathes Number /Tree	Bunch Length (cm)	Spike Number /Bunch	Spike Length (cm)	Harvest time
	1st One	Com-plete Set	1st Set	Late Set					
Ajwa	28 Feb	9 Mar	24 Mar	28 Mar	4	22-91	48-57	25-50	16 July 2011
Safawi	10 Feb	01 Mar	3 Mar	9 Mar	7	48-91	26-28	25-35	13 July 2011
Ruthana	24 Feb	6 Mar	9 Mar	15 Mar	4	45-90	41-52	23-45	20 July

Table 3. Fruit physical characteristics of vars. Ajwa, Safawi and Ruthana for 10 years old trees cultivated at Khairpur district, Pakistan

Fruit stage	Variety Name	Fruit			Seed & Flesh		
		Length (cm)	Width (cm)	Weight (g)	Seed Weight (g)	Flesh Weight (g)	Flesh (%)
Kimri	Ajwa	2.49	2.08	7.76	0.64	7.21	92.91
	Safawi	4.27	2.28	16.40	1.31	15.01	91.52
	Ruthana	3.39	2.16	10.03	1.37	8.63	86.04
Khalal	Ajwa	3.45	2.70	15.92	1.74	14.14	88.81
	Safawi	5.00	2.50	21.30	1.23	20.02	93.99
	Ruthana	3.50	2.42	12.08	1.62	10.48	86.75
Rutab	Ajwa	3.20	2.33	12.56	1.32	9.41	74.92
	Safawi	4.44	2.30	17.34	1.02	16.16	93.19
	Ruthana	3.52	2.38	12.45	1.10	11.32	90.92
Tamer	Ajwa	3.16	2.31	11.42	1.23	10.18	89.14
	Safawi	4.25	2.05	10.49	0.88	9.53	90.84
	Ruthana	3.20	1.90	7.12	1.02	6.04	84.83
The L.S.D at 0.05	Ajwa	0.12	0.10	3.09	0.26	3.21	4.87
	Safawi	0.09	0.05	2.80	0.12	1.81	1.02
	Ruthana	0.11	0.90	1.41	0.17	2.94	1.70

RESULTS AND DISCUSSION

The general features of date palm culture in Al-Madina (Saudi Arabia) are not much different from those in Khairpur, especially when climate, cultivation and utilization are concerned. Introduction of elite exotic varieties may improve the date palm varietal structure and date palm industry in Pakistan. Investigation fruiting quality under the new climate was essential to recommend such studied varieties to growers at similar places.

***Vegetative characteristics*:** The data in Table 1 indicated the no. of mature leaves/palm and leaflets/frond in vars. Ajwa, Safawi and Ruthana were 18, 34 and 26, and 129, 117 and 119, respectively. Whereas the mature frond length (m) and midrib width (cm) in vars. Ajwa, Safawi and Ruthana were 3.13, 3.62 and 3.62 m, and 2.4, 2.3 and 2.5 cm, respectively. The leaflet length (cm) 52.07, 47.75 and 69.85 cm were recorded in vars. Ajwa, Safawi and Ruthana, respectively. The no. of thorns/frond 19, 36 and 19 were found in vars. Ajwa, Safawi and Ruthana, respectively. The thorn length (cm) at 19, 15.24 and 19.05 were recorded in vars. Ajwa, Safawi and Ruthana, respectively. The leaflet's and thorn's area length (m) were as 1.86, 2.38 and 2.29 m, and 0.91, 0.95 and 0.95 m in Ajwa, Safawi and Ruthana, respectively. The leaflet's distribution pattern was "alternate" in all varieties.

These are the vegetative characteristics of those Saudi varieties under the new environment at Khairpur, Pakistan. Based on above recorded properties, these varieties showed vigorous vegetative growth and no significant deviation from those of the native place at Al-Madina.

In addition to that, no insect/pest infestation was observed on the vegetative parts of growing palms although no insecticide/fungicide was used in this regard. Most probably the appropriate nutritional and cultural management affected the health of the palms, as shown in Fig. 2 the healthy and vigorous growth of palm and fruit of var. Safawi.

***Flowering characteristics*:** It was observed that Ruthana var. was the latest variety to enter flowering at all. On the other hand, other two varieties started giving spathes a couple of years earlier. Number of the spathes has increased from 2 - 3/palm in the first year of this study to 4 - 7 spathes/palm in the third year (Table 2). Data in Table 2 showed a variation in emergence of spathes among these three varieties. In 2011, spathes emerged earlier in var. Safawi (10 Feb.) followed by var. Ruthana (24 Feb) and var. Ajwa (28 Feb). Recording the time of flowering for early emerged spathes could help to explain recorded data of fruit growth and development. Mostly the early emerged spathes had the chance to be pollinated earlier, consequently the fruit set of these will be expectedly earlier than late pollinated inflorescences. As it happened in this study, var. Safawi pollinated from 3 – 9 March followed by Ruthana from 9 – 15 March and Ajwa from 24 – 28 March. Asif *et al.* (1982) reported that vars. Ajwa and Safawi are mid-season varieties

Figure 2. Tree and fruit bunch growth of Safawi variety under the climate of Khairpur

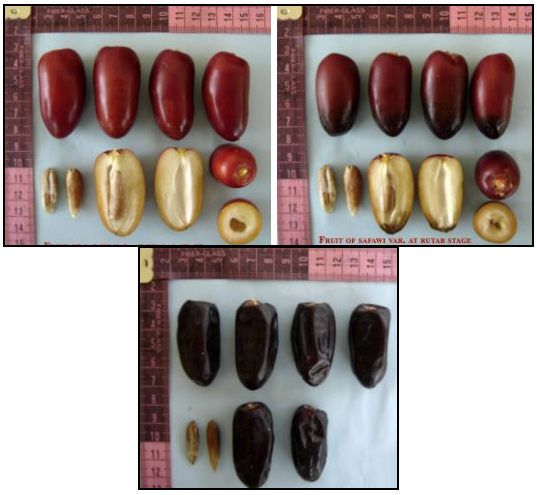

Figure 3. Fruit maturity and ripening of Safawi variety at Khalal, Rutab and Tamer stages.

Figure 4. Fruit maturity and ripening of Ruthana variety at Khalal, Rutab & Tamer stages.

Figure 5. Fruit maturity and ripening of Ajwa variety at Khalal, Rutab and Tamer stages, respectively

Figure 6. Obtained fruit quality of var. Ajwa (at the left) and var. Safawi (at the right) at Khairpur, Pakistan as compared to that one's of the origin place at Al-Madina at Saudi Arabia

while var. Ruthana is an early variety. Most of the date palm varieties of Khairpur also lies under mid-season varieties, starting emergence of spathes from the mid of February like vars. Aseel and Karbalian. While few are early varieties like vars. Gajjar and Kashoo wari start flowering in January (Markhand *et al*., 2010). The reason for var. Ruthana late

flowering at Khairpur could be due to the change in climate when cultivated at Khairpur.

The range of bunches' length, strands number per bunch, strands length varies in all three varieties. Furthermore, no clear cut relation was observed between the bunch length and the number of internal strands whereas little strand length variation was noticed among different bunches (Table 2).

***Fruit physical characteristics*:** The Data concerning physical properties of fruit is presented in Table 3.

The edible stage of vars. Ajwa and Safawi is tamer while rutab for var. Ruthana. The fruit size of vars. Ajwa, Safawi and Ruthana at their edible stages were 3.16, 4.25 and 3.52 cm long, and 2.31, 2.05 and 2.38 cm wide, respectively. The average fruit and seed weight of vars. Ajwa, Safawi and Ruthana were 11.42, 10.49 and 12.42 g, and 1.23, 0.88 and 1.1 g, respectively. The fruit flesh percentage in vars. Ajwa, Safawi and Ruthana reached 89.14%, 90.84% and 90.92%, respectively.

There is no major variation appeared in fruit physical characteristics as compared to its place of origin. Asif *et al*. (1982) while working on Saudi Arabian dates varieties recorded following measurements in vars. Ajwa and Safawi without mentioning the fruit growth stage as fruit length 2.89 and 4.02 cm, fruit width 2.17 and 2.17 cm, fruit weight 10.39 and 9.76 g, fruit pulp 9.25 and 8.86 g, seed weight 1.14 and 0.90 g, pulp% 89.03 and 90.78%, respectively. Whereas Gasim (1994) reported the following measurements at tamer stage in vars. Ajwa and Safawi; fruit length 3.07 and 4.07 cm, fruit width 2.21 and 2.45 cm, fruit weight 8.24 and 9.46 g, seed weight 0.97 and 1.0 g, pulp percentage 89% and 89%, respectively. These little differences in the characters studied may be due to environmental and edaphic factors and could be associated with palm vigour, capacity of palm to bear fruit load and pollen used (Elshibli, 2009; Jaradat, 2011).

The average length and width of fruit and weight of fruit and seed of vars. Ajwa, Safawi and Ruthana increased as the dates reached the khalal stage (Fig. 3, 4 & 5) and then a drastic reduction occurred in the rutab and tamer stages (Fig. 3, 4 & 5). Similar results were obtained by Sawaya *et al*. (1982) in Khudari, Sellej and Sifri date palm varieties grown in Riyadh and Gasim (1994) in five different varieties of date palm at Al- Madina.

***Impact of climatic conditions on date fruit quality*:** Air humidity affects the date quality during the maturation process. At high humidity, fruits become soft and sticky, while at low humidity they become very dry. When air humidity is high during maturation (date plantations in Bahrein, Minab/Iran), the skin of the date fruit shows several cuts or breaks with an edge-blackening (Blacknose), the soft fruits fall to the ground and consequently lose their commercial value (Zaid and de Wet, 2002).

The number of these breaks and the manner in which they occur (longitudinal, transverse, or irregular) varies between varieties. Deglet Nour's checking occurs mainly near the tip of the fruit (Zaid and de Wet, 2002). The checking phenomenon was not observed during fruit maturation of the three varieties at Khairpur although the air relative humidity was mostly near to 60%. The air relative humidity during fruit maturation from March to August was between 40 - 60% and temperature around 40°C (Fig. 1). Four hundred kilometers away from Khairpur, fruit of var. Khalas was affected by air relative humidity and showed checking phenomenon. The measured air relative humidity during Khalal stage was around 60% as well, but temperature was almost below 35°C and during whole fruit maturation season was around 30°C. This is indicating that checking phenomenon of dates' fruit is not only as a result of high air relative humidity but also the prevailing temperature. Increasing the air temperature around 40°C (in shade) demolished the impact of high air relative humidity on fruit that appeared free from any breaks. However, a separation between outer fruit skin and flesh occurred excessively in vars. Safawi and Ruthana, but not in var. Ajwa. This defect has occurred whether fruit were still on the palm or after harvesting and during sun curing. Preserving packed fruit in carton at fridge temperature 0–5°C for a month relatively reduced this phenomenon as fruit moisture content might be decreased. Stored fruit of var. Ajwa at room temperature (24°C) rapidly lost moisture and became drier while the fruit of other two varieties especially var. Safawi started to deteriorate as flesh became sticky and taste has changed after a month. In addition that skin defect remained in the majority of fruit. Skin defect occurred in var. Safawi fruit might be due to the genetic makeup of the variety and accelerated by air relative humidity absorption (Zaid and de Wet, 2002).

***Conclusions*:** It was concluded from the field evaluation during three years that the climatic conditions of Khairpur are very much suitable for planting of alien varieties of dates like vars. Ajwa, Safawi and Ruthana. The fruit of these varieties at Khairpur resembles morphologically to Date samples brought from Al-Madina (Fig. 6). However, skin separation from the fruit flesh was noticed in var. Safawi. Total yield of var. Ajwa was low as the number of fruit bunches were 4/palm. Semi-dry varieties of date palm could be cultivated in regions with high air relative humidity above 40% without fear on fruit quality, i.e. fruit checking or/and unripe fruit, if the temperature gone up to 40°C particularly during fruit maturation and ripening months.

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