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Short Communication

STANDARDIZATION OF LEAF: BUNCH RATIO IN DATE PALM (*PHOENIX DACTYLIFERA* L.)

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Short Title : Leaf: Bunch Ratio in Date palm

Date palm (*Phoenix dactylifera* L.) is one of the oldest cultivated fruit crops in the world, while in India its cultivation was expected to be around 500 years old and is mostly concentrated in the north-western states *i.e.* Gujarat, Rajasthan and Punjab. However, in the last two decades, the area under date palm cultivation has almost doubled with the new non-traditional area under its cultivation which includes states like Maharashtra, Tamil Nadu, Andhra Pradesh, Telangana, *etc.* which further enhances the importance of the crop (Baidiyavadra *et al.*, 2019; Muralidharan *et al.*, 2008). After the multi-location trial under AICRP-Arid Zone fruits, two varieties (Barhee and Halawy) were recommended for commercial cultivation, among them Barhee is now a popular variety in Gujarat (Sharma *et al.*, 2019). Both the cultivars are high yielding where the number of bunches may go as high as twenty per plant which often make the plant vulnerable to bunch breaking. Moreover, maintaining a higher number of bunches may impact the plants' source: sink relationship which ultimately hampers fruit size and quality along with the plant growth and yield in the subsequent years. Thinning is one of the important cultural practices to improve fruit quality and yield (Al-Sekhan, 2009). Thinning can be followed by multiple methods like fruit thinning, strand thinning, thinning using chemicals or removal of spathes. Among all the methods, removal of spathes is relatively easy to proceed but the best quality of fruits was observed when strand thinning is done. Many earlier reports suggest that at different leaf: bunch ratio the plant responds differently, particularly with fruit and yield characters and better performance is observed with a higher number of productive leaves (Hassan, 1993; Harhash *et al.*, 1998; Mohammad, 2009). Moreover, it is also reported to improve regular bearing in date palm, although irregular bearing in cultivar Barhee and Halawy is not of frequent occurrence.

To confirm the impact of the different leaf to bunch ratio on fruit quality and yield an experiment was conducted

at Date palm Research Station, Mundra during 2014-2016. Two cultivars namely, Halawy and Barhee were selected for the experiment with 48 palms each and the treatments for leaf: bunch ratio (LBR) was 4:1, 6:1 and 8:1. The treatments were replicated eight times with two plants in each replication. All the palms were ten years old at the time of initiation of the experiment and were planted using offshoot propagated plants. To maintain the leaf: bunch ratio, 6 bunches were maintained in each plant and their proportionate numbers of leaves were kept as per the treatment, *i.e.* for LBR 4:1 24 leaves were kept; LBR 6:1 36 leaves were kept and for LBR 8:1, 48 leaves were kept and rest of the leaves were pruned. The number of bunches was maintained by keeping the initially emerged well-formed inflorescences and thinning the rest during the month of February-March. The number of leaves was maintained by pruning the leaves annually during October. Pollination was done using the fresh pollen collected from the same male plant on the day of the spathe opening during February and March. The same number of leaves in the same plant was maintained for 3 years (2014-2016) in the same plant and observation on date of start of doka stage; date of peak doka stage, fruit characters (fruit weight, seed weight, fruit length, fruit width and TSS) and yield were recorded. The data were statistically analyzed by "R" using "agricolae" package and graphs were plotted using "ggplot2" package (Core Team, 2019; Mendiburu, 2019; Wickam, 2016).

In all the three years of observation cv. Halawy, the start of doka stage was initiated during the first or second month of June and they attain the peak doka stage during the first and second week of July (Table 1). While in Barheedoka stage was started in the first and second week of July and peak doka stage was attained in the first week of August. No major variation in attaining the maturity stage was observed among the treatments; however, variation among varieties was due to the varietal character. Pooled influence of fruit characters evaluated is presented in Table 2. Results of the

fruit characters were found to be non-significant within each variety representing no influence on fruit characters. However, there were significant differences in the yield of the plant (Figure 1). The results indicate that on increasing the number of leaves per bunch the final yield of the plant increases proportionately. The pooled yields for Halawy were 40.95 kg, 49.55 and 59.75 kg for LBR 4:1, 6:1 and 8:1 respectively, while in Barhee the yields were 36.28 kg, 44.35 kg and 55.84 kg for LBR 4:1, 6:1 and 8:1 respectively. In both the varieties, LBR 8:1 was resulting significantly higher yield. The higher yield was in relation with the higher individual bunch weight as all treatments were having the

same number of bunches which combine resulted in the final yield. Similar results were observed by (Harhashet *et al.*, 1998; Mostafa and Akkad, 2011; Omar *et al.*, 2013; Soliman, *et al.*, 2010). A few of the earlier experimentation showed that the fruit characters were also improved with higher leaf bunch ratio (Mostafa and Akkad, 2011; Soliman, *et al.*, 2010) but the same was not observed in our experimentation. However, Marashi and Mousavi (2007) also observed that there was no significant effect of thinning on fruit characters supporting our result. With the current experimentation, it was clear that to fetch higher yield and manage its crop load maintaining a leaf bunch ratio of 8:1 can be an effective approach.

Table 1: Start of doka stage and peak attaining doka stage cv. Halawy and Barhee

Treatment	Start of doka stage			Peak attaining doka stage		
	2014	2015	2016	2014	2015	2016
Halawy						
T1 (4:1)	8-11 June	7-12 June	6-10 June	8-10 July	7-11 July	6-10 July
T2 (6:1)	9-10 June	8-11 June	4-8 June	10-12 July	8-11 July	4-8 July
T3 (8:1)	8-11 June	8-11 June	5-9 June	8-10 July	8-11 July	5-9 July
Barhee						
T1 (4:1)	5-8 July	7-9 July	6-9 July	6-8 August	6-9 August	6-9 August
T2 (6:1)	6-9 July	8-11 July	8-11 July	8-10 August	9-12 August	8-11 August
T3 (8:1)	7-11 July	7-9 July	7-9 July	4-6 August	9-12 August	7-9 August

Table 2: Effect of different L: B ratios on fruit characters (pooled for 2014-2016)

Treatment	Fruit Weight (g)	Seed Weight (g)	Fruit Length (mm)	Fruit Width (mm)	TSS (°Brix)
Halawy					
T1 (4:1)	11.50	1.23	41.33	21.88	26.00
T2 (6:1)	11.50	1.24	41.39	21.92	25.75
T3 (8:1)	11.58	1.24	41.72	22.33	26.50
SEm ±	0.08	0.02	0.28	0.18	0.25
CD @ 5 %	NS	NS	NS	NS	NS
CV%	2.55	6.33	2.24	2.63	3.59
Barhee					
T1 (4:1)	9.79	0.95	28.30	21.98	25.54
T2 (6:1)	9.52	0.98	27.99	22.69	25.83
T3 (8:1)	9.71	0.96	28.20	22.95	26.50
SEm ±	0.10	0.01	0.22	0.24	0.29
CD @ 5 %	NS	NS	NS	NS	NS
CV%	2.34	3.71	2.79	2.63	3.84

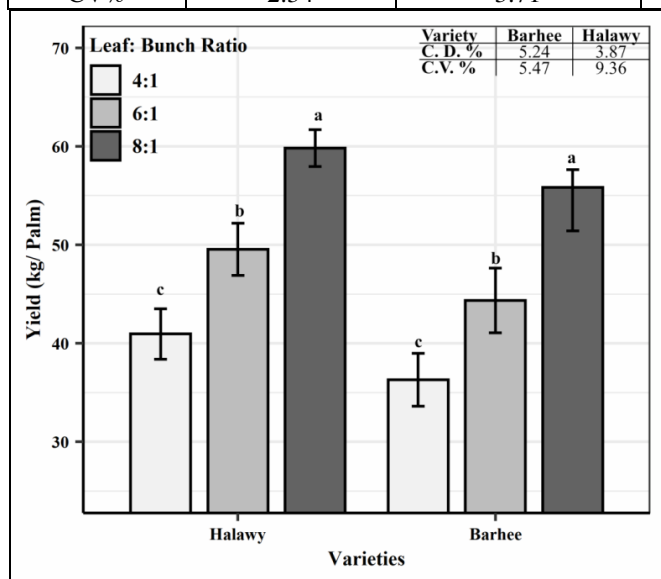


Fig. 1: Effect of different leaf: bunch ratio on date palm cv(s) Barhee and Halawy.

Note: The data are pooled for the year (2014-2016); Values marked in each variety with different alphabets are significantly different with each other; Bar in the figure represents standard error of mean; C. D. ($p = 0.05$) = Critical Difference at 5 % level of significance; C. V. % = Coefficient of Variation in percentage.

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Contribution

CNP, CMM and DAB formulated and conducted the experiment; CNP and CMM did the statistical analysis; CNP, CMM and KMS wrote the manuscript and all the authors had reviewed approved for submission.

Conflict of Interest

There is no conflict of interest among the authors.

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