

# Fluctuation of divergence angle in areal shoot in three Cultivars of date palm (*Phoenix dactylifera* L) at two ages of reproduction.

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The phyllotactic pattern of date palm (*Phoenix dactylifera* L) is spiraled and gives rise to one conspicuous parastiche pair (8,5) winding oppositely. According to Fundamental Theorem of Phyllotaxis (FTOP) the divergence angle  $d$  for such phyllotactic system must be in the interval of  $[135^\circ, 144^\circ]$  and  $[135.95^\circ, 138.14^\circ]$  under contact pressure [Alder 1974 ; Jean, 1994]. The given intervals are modeled in shoot apices, however we do not know if divergence angle between two successive fronds in aerial shoots is consistent with predicted interval or not. This study aims to measure the means and the range of variation of divergence angle in areal shoot of three cultivars of date palm at two ages of production, less than 5 years and 12 years old, and to determine whether factors of cultivars or age could influence the divergence angle by proceeding to statistical analysis.

## MATERIAL AND METHODS

**Cultivars of date palm :** Asian' (Asn), 'Boufeggous' (Bfg) and 'Aziza bouzid' (Azb)

**Ages and samples:** less than 5 years and 12 years old with 30 accessions in each sample

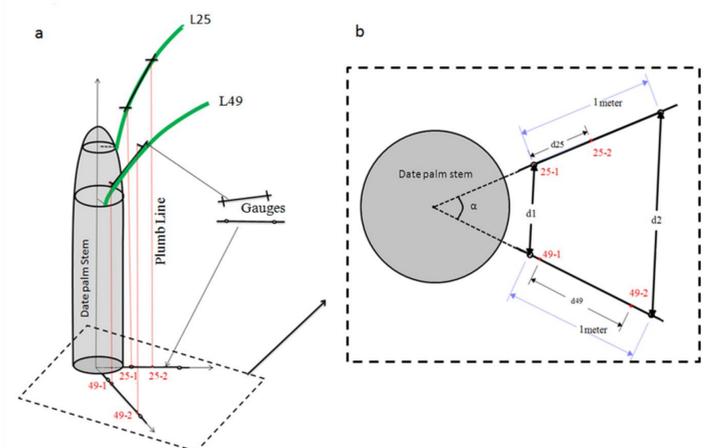
**Method used :** it consists to project on a horizontal plane of land, two fronds X and Y=X+ 23 of date palm (ex. 25 and 49) belonging to the same 8 ordre parastiche (fig.1). The angle formed between is determined geometrically by using trigonometric formulas (Lecoustre et al 2012) :

$$\alpha = 2 * \arcsin \left[ \frac{d2-d1}{200} \right], \quad \text{then} \quad d = \frac{\alpha}{X-Y} + 135^\circ$$

$\alpha$  : angle of two sampled fronds in order parastiche in degrees

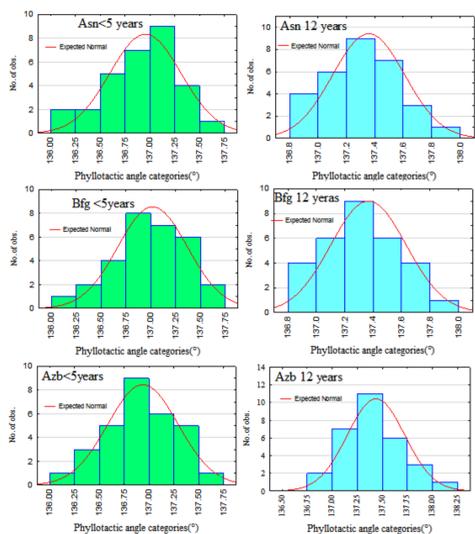
$d$  : divergence angle (degrees)

X and Y are respectively the ranks of upper and lower fronds and X-Y=24



**Fig. 1** Geometrical method used to measure divergence angle  $d$ ;  $d1$  and  $d2$  (in cm) the used distance to calculate alpha angle [Lecoustre and Jaeger, 1987, Lecoustre et al 2012 and Elhoumaizi 2002]

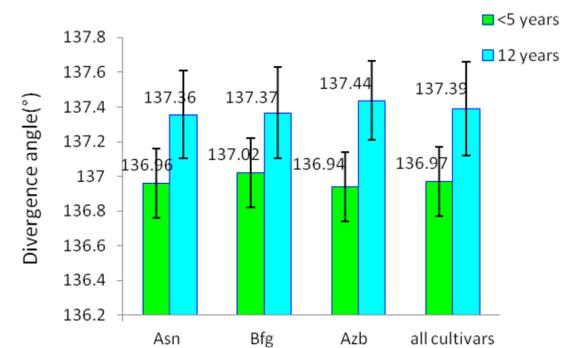
## RESULTS



**Fig.2** Distribution in class of observed phyllotactic angle in three cultivars: Asn, Bfg and Azb at two ages of production: palm in early age of production (< 5 years) and those in advent stage of production (12 years).

The random variable  $d$  is normally distributed for all ages and all cultivars (Shapiro-Wilk P-values>0.05) and varies between 136 and 138.1° (fig.2). The range of variation of angle  $d$  is larger in young date palms (<5 years) thus revealing some instability at this stage of development.

Variance analysis, using ANOVAs two ways (Table 1) confirms that divergence angle is not affected by cultivars, but a significant difference is observed between two categories of ages, where P-value is less than 0.05. Therefore the intergroup means of angles  $d$  are equal at same age for Asn, Bfg and Azb cultivars (fig.3). The means are  $136.97 \pm 0.35$  and  $137.39 \pm 0.27$  in young producing date palms and those in full maturity.



**Fig.3** the means of divergence angle  $d$  measured cultivars Asn, Bfg and Azb at two ages of production.

Source of variation	SS	D.F	MS	F	P-value
Age of production	8	1	8	78	0.000
Cultivars	0	2	0	0	0.787
Age * Cultivars	0	2	0	1	0.418
Error	17	174	0		

## CONCLUSION

- The range of variation of divergence angle of adult date palm (*Phoenix dactylifera* L) is in congruence with the predicted intervals by Fundamental Theorem of phyllotaxy (FTOP) for (5, 8) phyllotaxis system.
- Divergence angle can be reduced temporary at first stage of production as a secondary effect of growth (lengthening of the main stem).
- The result confirms that that the divergence angle in aerial shoot is consistent with the values that could be estimated in the shoot apex for (5,8) conspicuous parastiche pair of date palm.

### References

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