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Tree crown bending disorder in tissue culture date palms

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Abstract
Date palms were propagated in large numbers clonally through tissue culture technology. Tissue culture derived date palm cultivars planted in the KISR tissue culture orchard showed crown bending at the fruiting stage. The affected palms on dissection in the field showed the insect attack and secondary infection by fungi on the wound. The larvae collected from the infected tree were reared inside the laboratory for the identification of the insect. The insect was identified as *Arenipses sabella.* The infected trees were recovered after the treatment with insecticide and fungicide solutions at the right time prior to the complete damage of the shoot meristem. The findings of the study could solve the mystery behind the date palm tree crown bending and the confusion over the tissue culture method of propagation.

Key words: Date palm, crown bending, *Arenipses sabella* and insecticide.

Introduction

Date palm (*Phoenix dactylifera* L.) is a tree of value and a major food crop of the Arabian Peninsula. The conventional propagation of the date palm is sexually through seeds and vegetative means through offshoots (suckers). Since the species is genetically heterogeneous, offshoot propagation was used for many generations to maintain the genetic integrity of the selected cultivars. On the other hand, offshoot propagation is slow, expensive and prone to transmit insects and diseases. Tissue culture micro propagation technology was developed and successfully implemented to produce several thousand young and uniform plants that were planted in orchards for production of dates (Sudhersan et al., 1993a,b; Sudhersan and AboEl-Nil, 2004). Field observations indicated the true-to-type nature of the plants in terms of growth morphology and fruiting (Sudhersan and AboEl-Nil, 2004). However, certain growth abnormalities and leaf malformation were observed in some tissue cultured plants of few cultivars (Zaid and Al-Kaabi, 2003). Hapaxanthic axillary shoot formation and hermaphroditism were also observed in tissue cultured date palms and reported (Sudhersan and AboEl-Nil, 1999; Sudhersan et al., 2001). In addition to these malformations, sudden bending of the tree crown was noticed in a few 5-years old tissue culture derived date palms. These malformations in tissue culture derived young date palms caused worries among the tissue culture researchers and farmers.

During our field survey on date palms, we noticed this tree crown bending disorder in many seedling originated palms and offshoot propagated palms (Sudhersan and Al-Shayji, 2007). A previous report (Zaid and Al-Kaabi, 2003) on this date palm disorder indicated it as a date palm disease. Our recent observation on this disorder indicated that it is caused primarily by an insect larva in the beginning, and latter on a secondary fungal infection in the wound caused by the larva. In order to clear the contradiction on this disorder, a case study was carried out on tree crown bending disorder of date palms in our laboratory during the period April 2005 to March 2006 using the tissue culture derived date palms growing in the KISR date palm tissue culture orchard. The detail of the study is presented in this communication.

Material and Methods

Sixty (60) young palms of 12 different cultivars were used for the study. Among the 60 palms, the trees showing the disorder were identified and 2 trees per cultivar were selected for the study. Later on, one of the selected trees from each cultivar was uprooted completely and the other was dissected out on site without uprooting.

The leaves of the infected palms were carefully removed from the base to the tip one by one using a hack-saw and a sharp knife. The leaf malformations, infected leaves, insect larvae and other abnormal characteristic features noticed on the leaf or stem tissue were photographed using a Nikon Coolpix 4100 digital camera and documented.

The dissected out trees with shoot tips in the field were sprayed with Malathion (2 ml/l) and Benlate fungicide (1 g/l) solutions. All the treated trees were maintained for observations. The remaining trees were treated with 2 g/l Benlate fungicide solution followed by 2 ml/l Malathion insecticide solution. The fungicide

and the insecticide were poured on the tree crown once every 30 days from February to May. The trees were observed frequently and the growth changes were recorded. The insect larvae collected from the fronds during the dissection of the infected palm were maintained in the laboratory for identification. The larvae were fed by the young date palm fronds until they changed into pupae. At the pupa stage the larvae were maintained at 28 ± 1° C to permit insect identification.

Results

During the period of the study (April 2005 - March 2006), among the 12 date palm cultivars tested, cultivars Succari, Sultana and Anbarah showed this bending disorder. Out of 6 palms from each cultivar, two Sultana, two Anbarah and three Succari showed tree crown bending disorder (Table 1). One of the trees was dissected in the field (Figs. 1-4) using a hack-saw and a sharp knife. While dissecting out the tree crown, we noticed many holes and furrows at the basal leaf sheaths. At the middle part of the crown, many insect larvae were noticed and collected for identification (Fig. 5). All the older leaves showed furrows on the leaf rachis which ended at the basal sheath. More insect larvae were noticed at the basal part of the tender leaves. After completely dissecting out the expanded leaves, we observed wounds at one side of the stem tender tissue caused by these insect larvae (Fig. 4).

Table 1. Tissue culture derived date palm cultivars and percentage of crown bending disorder

S.No	Date palm Cultivars	% of Crown Bending
1	Kyara	0
2	Oaidi	0
3	Sheshi	0
4	Anbara	33
5	Succari	42
6	Siwi	0
7	Nebut seif	0
8	Majdool	0
9	Barhi	0
10	Khlas	0
11	Sultana	33
12	Hilali	0

Several furrows and holes were observed on the fronds, that were filled with large quantities of “frass” (fibrous excrement) produced by small larvae (Fig. 3). The larvae were feeding on tissue between veins or ribs of the fronds midrib and base, thus, disrupting vascular tissue and causing front malformation followed by death. Some of the furrows were tunneled from the leaf base into the tree tender part of the stem. The larvae entered the large terminal bud (Fig.4) of the tree and fed on the tender leaf primordia causing leaf malformation. In addition to insect damage, fungal infection of the meristem caused malformation and dwarfing of fronds, and bending of the crown followed by death of the tree.

Finally after removing all the fronds, the infected tree exposing its shoot tip was treated with fungicide and insecticide for the recovery. After the treatment, the tree was carefully observed for the new leaf development. After a month, new normal leaves developed from the treated palms.

The larvae collected from the fronds (Fig 5) fed with the tender date palm fronds kept inside the container. After 24 hours, we noticed the same furrows and holes on the fronds similar to the furrows observed on the infected tree fronds. The dissected out tree produced new leaves after the pesticide and fungicide treatment. After 6 months, the tree became normal with normal leaves and also produced flowers and fruits. The remaining trees treated without dissecting the crown also recovered. The insect larvae reared inside the laboratory after a week time became the pupa stage and latter metamorphosed into the adult insect (Fig. 6). The adult insect was identified as the greater date moth *Arenipses sabella* Hampsm (Abuthuraya and Al-Buraidi, 1989). Some of the unrecognized trees with crown bending disorder left without treatment gradually died due to the severe damage of the growing meristem.

Discussion

Many insects attack the floral and vegetative parts of the date palm trees (Hamad et al., 1983; Kadous et al., 1983). At the initial stages of infestation with the larvae of greater date palm moth (*Aphomia sabella* Hampsm), leaflets of the entire frond show malformations or, perhaps, part of the frond shows malformed leaflets, with stunting of the entire frond. The crown bending is due to the damage of the meristematic tissue and young fronds at one side of the growing point. The new leaf production and growth of the fronds on the other parts make the entire tree crown bend towards the point of insect or fungal attack. If the initial

infestation was at the base of a leaf, larvae feed on the leaf tissue disrupting the vascular flow causing death of the entire leaf. A few months after insect infestation, fungal infection through wounds follows and extends into the terminal meristem. Axillary shoots that develop from buds at the leaf axils of unaffected leaves developed into normal offshoots in the affected tree. Axillary shoots were induced more when the terminal shoot meristem was completely damaged. The new axillary shoots were normal if the mother tee was treated. On the other hand, if the insect infestation was not treated, offshoots were also infested and showed the symptoms of frond malformation followed by death of the axillary shoots. Palms that show any sign of leaf malformation or death of a single leaf or presence of the frass of the insect on the leaves should be treated for insect infestation by spraying the entire tree with a systemic insecticide.

Crown bending called leaning crown syndrome (LCS) was noticed in many palm species (Hodel, 2007). However no particular cause was reported on this syndrome. According to Hodel, it is due to multiple causes including virus or virus like agents and genetic instability. Our present study on date palm crown bending showed that the primary cause for this syndrome is due to the damage at the tender part of the tree crown followed by the secondary fungal infection at one side of the palm. Further studies are in progress in our laboratory to identify all the possible causes for this syndrome and its control measures under the research study entitled “physiological disorders of date palms in Kuwait”.

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1. *Phoenix dactylifera* L. cultivar Succari showing crown bending symptom.
2. Affected palm after the removal of leaves.
3. Leaf showing insect larval frass on the rachis.
4. Dissected out infected palm showing the wound.
5. Insect larvae collected from the affected palms.
6. The adult insect *Arenepsis sabella*.

References

AbuThuraya, N. H. and F. H. Al-Buraidi. 1989. List of date palm pests andtheir economic importance in Saudi Arabia. Proceedings of the Second Symposium on the Date Palm. Al-Hassa, Saudi Arabia. Mars Publishing House, Riyadh, Saudi Arabia. pp. 345-357.

Hamad, S. M., A. A. Kadous and M. M. Ramadan. 1983. Predators and parasites of date palm insects in Al-Hassa and Al-Qatif regions, Saudi Arabia. Proceedings of the First Symposium on the Date Palm. King Faisal University, Al-Hassa, Saudi Arabia. pp. 322-341.

Hodel, D.R. 2007. Leaning crown syndrome. *Palms* **51**:5-7.

Kadous, A. A., S. M. Hamad and M. M. Ramadan. 1983. Assessment of damage inflicted upon date palms by *Pseudophilus testaceus* and *Oryctes elegans* in Al-Hassa oasis. Proceedings of the First Symposium on the Date Palm. King Faisal University, Al-Hassa, Saudi Arabia. pp. 352-361.

Sudhersan, C., M. M. AboEl-Nil and A. Al-Baiz. 1993a. Occurrence of direct somatic embryogenesis on the sword leaf of in vitro plantlets of *Phoenix dactylifera* L, cultivar Barhee. *Current Science* **65**:887-888.

Sudhersan, C., M. M. AboEl-Nil and A. Al-Baiz. 1993b. Direct somatic embryogenesis and plantlet formation from the leaf explants of *Phoenix dactylifera* L. cultivar Barhi. *J. Swamy Bot. Cl*. **10**:37-43.

Sudhersan, C. and M. AboEl-Nil. 1999. Occurrence of hermaphroditism in the male date palm. *Palms* **43**:48-50.

Sudhersan, C., M. AboEl-Nil and J. Hussain. 2001. Hapaxanthic axillary shoots in date palm plants grown *in vivo* and *in vitro*. *Palms* **45**:84-89.

Sudhersan, C. and M. AboEl-Nil. 2004. Axillary shoot production in micropropagated date palm. *Current Science* **86**: 771-773.

Sudhersan, C. and Y. Al-Shayji. 2007. Physiological disorders of date palm. Technical Report No.8800, KISR, Kuwait.

Zaid, A., and H. Al-Kaabi, 2003. Plant off-types in tissue culture-derived date palm (Phoenix dactylifera L.) *Emir. J. Agric. Sci*.**15**:17-35.