Review Article

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Pest status of date palm (*Phoenix dactylifera*) in arid regions of India: a review

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Abstract

Date Palm tree (*Phoenix dactylifera* L.) is considered one of the fruit trees that belong to Palmaceae. The genus consists of fourteen species distributed in the tropical and sub-tropical regions. Many arthropod species are known as pests of the date palm throughout the World. Its reported on more than 50 species of insects and mites as pests of date palms in worldwide. In which, approximately 25% of these species of insects and mites are considered serious pests. In India, the main pests are white scale, *Parlatoria blanchardii*; lesser date moth, *Batrachedra amydraula*; red palm weevil (coconut weevil), *Rhynchophorus ferrugineus*; rhinoceros beetle, *Oryctes rhinoceros*, great date moth, *Arenipses sabella*, *Alternaria* leaf spot, *Alternaria alternate*, fruit rot, *Aspergillus niger* and *Fusarium* wilt, *Fusarium oxysporum* and they are well adapted to the oasis environment, have been reported to cause serious losses to date palm. Date palm scale is very serious on young palms between two to eight years of age, but even under severe attacks, the palm and its offshoots do not die. The scale insect was observed as major pests in all the orchards in mild to severe form ranging from 1.10 cm² at Dantore to 18.77 cm² at Bikaner. Lesser date moth is an important insect pest of date palm infesting fruits. The lesser date moth is second major pest of date palm in Rajasthan and the incidence of this pest was around 16 to 35 %. Fruit rot disease incidence was recorded during survey program from 10.0 and 30.5% in Bajju and Bikaner, respectively. *Alternaria* leaf spot disease incidence was noticed in KVK, Fatehpur (Rajasthan) up to 45.50%.

Key Words: Date palm, pest status, *Phoenix dactylifera*, arid region

Introduction

Phoenix dactylifera, commonly known as date or date palm, is a flowering plant species in the palm family Arecaceae, cultivated for its edible sweet fruit. Although its place of origin is unknown because of long cultivation, it probably originated from lands around Iraq (Morton 1987). The species is widely cultivated and is naturalized in many tropical and subtropical regions worldwide. In India, Gujarat, Rajasthan and Punjab are major states for datepalm cultivation. The area under date palm orchards is 500 ha in Rajasthan and 10 ha in Punjab. However, the production and productivity is concern low as compared to world average mainly because of biotic and abiotic stresses and non availability quality planting material. Of the more common biotic stresses, insects, mites, bird pests and diseases cause considerable damage to the palms, at both vegetative and fruiting stages. Many arthropod species are known as pests of the date palm (*Phoenix dactylifera* L.) throughout the World. Carpenter & Elmer (1978) reported on more than 50 species of insects and mites as pests of date palms in worldwide. In Israel, approximately 25% of these species of insects and mites are considered serious pests. The most dominant and economically important pests are scale insects (*Parlatoria blanchardii*, and *Phoenicococcus marlatt*), a mealy bug (*Dysmicoccus brevipes*), the lesser date moth (*Batrachedra amydraula*) and the termite, *Psammotermes hypostoma* (Blumberg 2008; Swaminathan & Haldhar 2010; Haldhar et al. 2015; Haldhar et al. 2016; Rathore & Goyal 2016; Samadia 2016).

In India, the main pests are *Parlatoria blanchardii*, *Batrachedra amydraula*, *Rhynchophorus ferrugineus*, *Arenipses sabella* and *Oryctes rhinoceros* and they are well adapted to the oasis environment, have been reported to cause serious losses to date palm (Swaminathan & Haldhar 2010; Haldhar et al. 2013; Haldhar et al. 2015). Unlike the traditional methods of date palm cultivation, presently tissue culture propagated plants widely planted by the farmers therefore, the it needs essentially extra care especially at pre-propagation stage (also called stage 0) requires proper maintenance of the mother plants in the greenhouse under disease- and insect-free conditions. Clean enclosed areas, glasshouses, plastic tunnels, and net-covered tunnels, provide high quality explant source plants with minimal infection. Collection of plant material for clonal propagation should be done after appropriate pretreatment of the mother plants with fungicides and pesticides to minimize contamination in the *in vitro* cultures (Holdgate & Zandvoort 1997). The major among these pests are reviewed and discussed in this review paper:

White scale, *Parlatoria blanchardii* Targioni-Tozzetti

White scale, *Parlatoria blanchardii* Targ is widely distributed throughout most of the date growing regions of the world (Carpenter & Elmer 1978; Howard et al. 2001). It is generally believed to be native to the Arabian Gulf countries (as is the date palm). Commerce in date offshoots over the centuries paved the way to spread of this pest into India, Central Asia, the

Middle East, North Africa and Turkey, and later to Australia and America (Smirnoff 1957). Date palms are the preferred host of scale, but it also been recorded on other hosts belonging to four plant families: Arecaceae (Palmae), Apocynaceae, Oleaceae and Rhamnaceae (Ben-Dov 2006).

The adult female is covered oval and flat, with a posterior projection of wax with elliptical, convex armor and white-gray in color. Its body length is 1–1.5 mm and 0.6–0.8 mm width. The body (underneath the armor) is elongate, reddish. The female is neotenic and lays its eggs beneath the armor. The crawler is reddish, 0.23 mm in length. The male bears flattened and elongate armor, white in color, and its body is 0.8mm in length.

Female semicircular, elongated and apterous

Egg is oblong with whitish yellow color

It mainly infests the leaves and sucking the sap, if full leaf is covered with white scales finally the leaves dry out. In heavy outbreaks, fruits also attacked and falloff before maturity. Nymphs and adults suck the sap from the leaflet, midribs and the fruits. Under each scale insect, a discoloured area appears on the leaflet. Heavy infestation causes leaflets to turn yellow and contributes to premature death of the fronds. Respiration and photosynthetic activities are

Incidence scale insect on date palm leaves

almost stopped resulting in early death of the infested leaf. Damage on fruits is easily noticeable and the production is not marketable, especially due to poor acceptability. The infestation of date palms scale, *Parlatoria blanchardii* began in December, and peaked in October. The infestation began on the basal tissues of the pinnae and moved upwards. Older leaves and upper leaf surfaces near the pinane were preferred, and the tips remained free of infestation. Infestation of the pinnae declined in May-June and was concentrated on the floral parts and berries. Crawlers

were most active in February-April (Swaminathan & Verma 1991) and have 5 overlapping generations a year. The first moult of all nymphs occurs on leaves itself, but the duration of the instars varied according to the generation. After the first moult, the scale was green but later developed a black spot that was near the head region of the male scale but in the centre of the female scale (Abdul-Ahad & Jassim, 1983).

Lesser date moth, *Batrachedra amydraula* Meyerick

The lesser date moth (*Batrachedra amydraula* Myer) is a pest that damages fruits in both fields and stores (Dowson 1982). The pest distribution is in Egypt, Iraq, Kuwait, Libya, Qatar, Oman, UAE, Yemen, Bahrain and Saudi Arabia. It is one of the major pests of date palm cause the yield loss upto 50-70% (Elwan 2000). Larvae found to damage the large number of young fruits from April to June or July (Zaid 1999). Since 1980s, it has gradually spread throughout most of the date growing plantations of the country, where it has become a major pest of newly set and young green date fruits. The moth is highly specific to the date palm and no reports are known of infestation of other host plants by this moth.

The adult moth is gray brownish color; its length is 8–10 mm, and its wingspan 11–14 mm. The wings are characterized by a marked longitudinal gray stripe in their center. The egg is white-yellow, with a diameter of 0.7 mm. The larva is white-gray and reaches a length of 12 mm.

Hind wing long, narrow; marginal fringe longer than hind wing width

The larvae attack newly formed inflorescences, but the main injury is to the young green fruits. Approximately 80% of the fruits are attacked while between 0.6 and 1.0 cm in diameter. The larva chews a hole near the calyx, through which it penetrates the fruit and feeds on the pulp and the soft immature seed. A damaged fruit is easily recognizable by the black feces attached to the penetration site. The larva also moves from fruit to fruit within the bunch, thus increasing the damage. A larva seldom eats more than one-third of a fruit before seeking another one, and damage about three to four fruits during its lifespan. About 4 weeks of infestation, the fruits become dark, dry and fall off. In severe infestation most of the infested fruits drop to the ground; the bunch ceases to grow, and then dries. Thus lesser date moth injuries to the palms cause considerable fruit drop and losses of upto 75% of the yield (Blumberg 1975). The first larvae appear in April to start the damage on the newly formed fruits. The larva has a period of dormancy from August and remains inactive

till March of the next year between the bases of the terminal fronds. Pupation takes place in March and adults of the new cycle emerges in April, giving more larvae in 3 overlapping generations to damage different growth stages of dates. Larvae of the last generation of each year construct elongated white cocoons which are well hidden inside the fiber at the bases of the palm fronds. They apparently remain in this condition during the second half of the summer and the winter (late August to

Dates bunch damage with lesser moth

early March), pupate in the following spring (probably during early to mid March), and give rise to the first generation adults. The larvae of this first generation attack the newly set date fruits. The shortening of the insect exposure to day light during late summer is probably the main factor in inducing diapauses in the larvae and conversely, the increase in day length in early spring probably triggers the termination of the larval diapauses (Blumberg 1975).

Red palm weevil (coconut weevil), *Rhynchophorus ferrugineus* Olivier

The red palm weevil, *Rhynchophorus ferrugineus* Oliv also called the Indian palm weevil, is well known in the Middle East where it causes severe damage on date palms. Approximately, 5 to 6 % of palms in the Middle East region are infested with the red palm weevil with an annual rate of infection of about 1.9 %. Indeed, as early as 1970, the red palm weevil was found in India attacking date palms (Khawaja & Akmal 1971). According to Oehlschlager (1998) there are five species of palm weevils in the genus *Rhynchophorus* that are economically damaging to palms. The incidence also has been reported in several countries viz., Burma, China, Egypt, India, Indonesia, Iran, Iraq, Malaysia, Pakistan, Papua New Guinea, Philippines, Saudi Arabia, Sri Lanka, Taiwan, Thailand, Tanzania, UAE, Jordan, Israel, Palestine and Vietnam (Zaid 1999). In India, the serious damage of this pest reported in date growing region of Kachchh, Gujarat. Difficulty in early detection (due absence of any external symptoms) and most of the life stages passes in concealed condition inside the palm trunk make this insect very difficult to control.

The adult is reddish-brown with long proboscis that comprises one third of the entire body length; it measures approximately 35× 12 mm. The male weevil has a tuft of soft reddish-brown hairs. The egg is creamy

white in color, long and oval in shape and has an average size of 2.6× 1.1 mm. The fully grown larva is a conical, legless, fleshy grub, measuring 50×20mm on average. It appears yellowish brown, whereas the newly hatched larva is yellowish white, with a brown head; its mouthparts are well developed and strongly chitinized, enabling the grub to burrow in to the palm trunk. The pupa is brown-white with an average size of 15×35 mm.

Infestation is often not apparent until extensive damage has already been caused and the palms are beyond recovery. In these infested plantations shows wilting symptom with yellow inner leaves and rotting odour could smelt from the damaged tissues. Small round holes at the sites of removed offshoots were also a clear indication of the presence of the weevil. Chewed

up date palm fibres were extruded and a brown fluid was oozing out of the holes on the stem. Cocoon, weevil and pupal fibres are frequently found in the palm leaf base (Giblin-Davis 2001). Heavily infested palms may contain 80 or more simultaneously developing larvae, and more than one generation may develop in the same palm (Soroker et al. 2004). Infestation may adversely affect the potential yield, lower the palm's growth rate and eventually cause its collapse and death. After emergence, the adult weevil stays inside the cocoon for approximate 8 days, until attaining sexual maturity. The pre-oviposition period lasts 1–7 days, after which the female lays 300–500 eggs over a period of 8–10 weeks, in separate holes in the bases of young palm leaves, mainly in the soft damp tissues of wounds caused by cutting and by other pests such as rhinoceros beetles (*Oryctes* spp.). The red palm weevil preferentially digs its burrows in the palm

transport tissues and in the apical growing point. The eggs hatch in 2–5 days in to legless grubs which bore in to the interior of the palms, moving by peristaltic muscular contractions of the body and feed on the soft succulent tissues, discarding all fibrous material. The larval period varies from 1 to 3 months. The grubs pupate in elongate, oval, cylindrical cocoons made out of fibrous strands. The pre-pupal and pupal stages last 3 and 12–20 days, respectively. At the end of 14–21 days of pupation the adult weevils emerge. Thus, the life cycle is approximately 4 months (Giblin-Davis 2001; Murphy & Briscoe 1999). The adults live for 2–3 months and feed on the palm; they are not able to survive for more than 1 week without food. The weevils may fly relatively long distances, approximate 1km per day, usually in the day time, and are active for most of the year (Oehlschlager 1998).

Rhinoceros beetle, *Oryctes rhinoceros* (L.) (Coleoptera: Scarabeidae)

Many species of rhinoceros beetles are borers of palms in different regions of the world; the most economically important species are members of the genus *Oryctes* (Carpenter & Elmer 1978; Giblin-Davis 2001). *Oryctes* spp. specializes on different parts of the palm. A subspecies, *Oryctes Agamemnon sinaicus* Walker is abundant in Israel, where it was first recorded in the late 1980s and rapidly became an important pest in date plantations in the AravaValley and the southern Jordan Valley (Eitam & Ucko 1993). The rhinoceros beetle, *Oryctes rhinoceros* L. is one of the serious and important pests of date palm in India. This beetle is widespread in all date palm growing areas of India. Besides, date palm it attacks and damages pineapple, sugarcane, palmyrah, coconut, African oil palm, tali-pot palm and royal palm. When the attack is on the unopened spathe, the inflorescence becomes badly damaged and can cause 10 per cent annual reduction in yield. Frequent infestation results in reduction of leaves and stunting of trees. The damage can cause death in seedlings and young palms but adult palms can withstand infestations. The adult beetle burrows and remains between leaf sheaths near the crown and cuts the leaf in the folded stage thereby causing permanent damage.

Adult beetles are brown to black, shiny 44–49 mm long and 20–23 mm wide with prominent horn on head (Bedford, 1974). The males can be differentiated from females by the longer horn on their heads and by the absence of reddish coloured hairs on the last ventral segments of the abdomen.

Both males and females of many species of the Dynastinae possess a dorsal horn on the head and a forward facing pronotal concavity; both features are larger in the male than in the female of the same size.

The major injury to the palm is caused by the grubs, which feed on the roots and bore into the underground bases and even the trunks. Severe damage is inflicted particularly to offshoots and young palms, in which the mortality rates may be very high. Mature and old palms also infested with grubs, which results in yellowing of the palms and reduction in yield. This rhinoceros species is an opportunistic feeder and easily survives by feeding on roots of grasses also (Eitam & Ucko 1993.). An attack by rhinoceros beetles may facilitate lethal secondary attacks by palm weevils (*Rhynchophorus* spp.) and by pathogens (Bedford 1980). It produces one generation per year. Adult activity begins in early May, peaks during June–July and ends in September. The female lays eggs that hatch in approximately 2-3 weeks; they are white when laid, but within a few days their color changes to glossy brown and they reach their final size of 4 x 3 mm. The insect has three larval instars. The duration of the larval instars is 10 to 21, 12 to 21 and 60 to 165 days, respectively. The pre-pupa stage lasts 8 to 13 days and the pupa period lasts 17 to 28 days. The pupae are caramel-brown in color and occupy cells in the soil. The adult beetle stays in the shell for at least three weeks which undergoes maturity. The adult could live up to 5 to 9 months and the female would lay an average of 50 eggs per life cycle (Waterhouse & Norris 1987).

Mites of Date Palm

Bou Faroua, also called Goubar or Old World date mite is caused by *Oligonychus afrasiaticus* McGregor, and *O. pratensis* Banks. This mite is present in all date growing areas and damage is severe in neglected plantations. Immediately after fruit set (Hababouk stage), mite eggs are deposited to produce larvae which will feed on the fruits and later cover these with a web retaining sand particles. The cycle length is about ten to fifteen days depending on temperature. Mites will rapidly multiply causing the drop-off of the fruits. Affected mature fruits are of no commercial value. Under Iraq's climate, the Old World date mite has six overlapping generations during the fruiting season of palms (Hussain 1974). The mite population on dates reaches its peak during the middle of July. The first appearance of mite on immature dates is during the first week of July. Even though they are found on all parts of the date, the majority of mites congregate near the calyx area, where most of the eggs are laid.

***Alternaria* leaf spot, *Alternaria alternata* (Fr.) Keissler**

This disease was recorded from moderate to severe form depending upon cultivars as well as climatic conditions in Western Rajasthan and Kachchh area of Gujarat. Disease incidence was noticed in KVK, Fatehpur (Rajasthan) up to 45.50% (Anon. 2010).

The gray to brown powdery spots are most common on the lower leaves (pinnae) of the plants, whereas, on upper leaves the spots are few and small size. The disease causes heavy losses to the date industries in both quality and quantity of production (Pal et al. 2006). The fungus perpetuates as mycelium in infected crop debris. The infection starts from the fruits on which numerous conidia are formed. These conidia are spread by wind, rain splash and cause

secondary disease. The conidia germinate in the presence of moisture at temperature nearly 25-30°C giving rise to germ tubes, which enter the host tissue. It requires hot and humid weather conditions for disease initiation. Disease development is favoured between 20 to 30° C. High relative humidity coupled with rainy days favors the disease development. High relative humidity coupled with rainy days favors the disease development.

Fusarium wilt, *Fusarium oxysporum*

Fusarium wilt in date palm was first reported from Qassim region, Saudi Arabia in 1990. This disease has been observed in date palm growing areas. It is also noticed at date palm block of our Institute.

The fungus attacks old date palms as well as offshoots and young palms. Spines begin to whiten from bottom to top, then whitening turn to the spines starting from top to bottom, with a brown discoloration along the midrib of the leaves. Symptoms extend from the outer leaves to the young ones, then to the apical meristeme, leading to the death of the date palm tree. A discoloration of the parenchymal and vascular tissues occurs in the transverse section of affected leaves. Pathogen grows in the vascular system and blocks the flow of nutrients and water. Leaves are drying due to fungal infection. The pathogen can survive in crop debris in the field. Soil temperature and moisture are known to affect the disease development. Disease is severe at temperature between 23-30°C. Light intensity and higher RH coupled with high evaporation rate increase the disease development.

Fruit rot, *Aspergillus niger* Van Tieghem

This disease was also recorded in date palm production during rainy season from moderate to severe form in Western Rajasthan. Disease incidence was recorded during survey program from 10.0 and 30.5% in Bajju and Bikaner (Rajasthan), respectively (Anon. 2010). The rot has been reported from America, South Africa and India in citrus orchard. Even though losses vary from one country to another and from one variety to another, they can be easily estimated to be between 10 % and 50 % of the harvest (Djerbi et al. 1986).

The rot begins as a small, circular spots which enlarge and turn brown to black spores. Fruit rot damage varies from one year to another depending on the humidity and rain and time from the Khalal stage until fruit maturation. Phialides directly develop on the vesicle which forms by swelling of conidiophores tip. Conidia are formed in chains. These conidia caused infection by air and rain splashes. Rotting is more when humidity is high and temperature between 25-30°C.

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