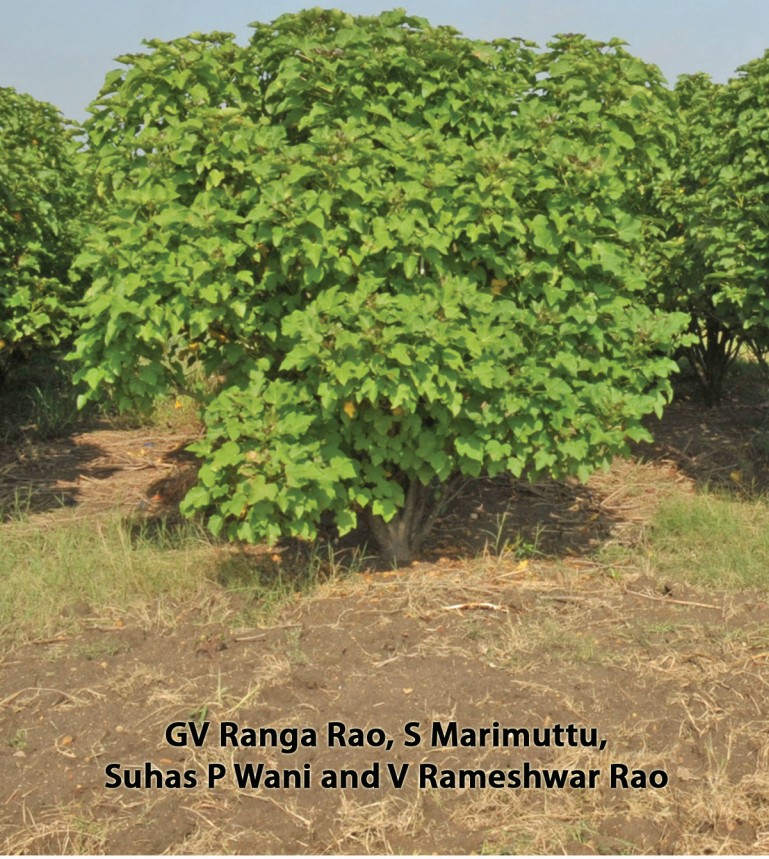
Insect Pests of *Jatropha Curcas*., L and Their Management



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Abstract

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Jatropha (*Jatropha curcas.,* L) is an important bio-fuel crop across the globe. In nature this plant is attacked by several insect species of which less than 10 are known to be important, causing considerable damage to different parts at different stages of the crop. This bulletin provides short descriptions about the biology, distribution, damage symptoms and feasible management strategies of key species.

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Collection, evaluation of germplasm, standardization of agro-techniques and Pilot demonstration for *Jatropha curcas* L. in rain shadow districts of Andhra Pradesh.

Harnessing the potential of water-use efficient bio-energy crops for enhancing livelihood opportunities of smallholder farmers in Asia, Africa and Latin America.

Cover: Jatropha plantation at ICRISAT campus.

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Preface: With jatropha gaining global importance in recent years, the cultivation of this wild plant has increased in several countries of Asia and Africa. Policy makers in developing and developed countries gave considerable importance to this crop and are trying to make impact from this new crop. It is common to notice several biotic and abiotic constraints when plants from wild are domesticated on wider scale. The new introduction of *J. curcas* to commercial cultivation left the farmers with several questions on the importance and the management of insect pests. Though about 40 insect pests were known to occur on Jatropha, less than 10 are quite frequent in their appearance. At this stage, since the economic importance of the crop as well as pest situation is not well known, farmers often approach extension personnel for appropriate management. Identification, sufficient information on pest biology, extent of damage and economically feasible management options are pre-requisites to initiate any pest management strategy. Hence, an attempt has been made to collate and develop management strategies for frequently-occuring insect pests of this crop. At present, economic thresholds of various insect pests of jatropha are not defined, hence, it is suggested to follow the general management strategies mentioned in this bulletin to minimize the risks imposed by insect pests. Close monitoring and early identification

of these potential pests is of immense value as the importance of the crop stabilizes globally.

Introduction

Jatropha curcas L. is a wild plant that belongs to family Euphorbiaceae originated from Central America. It has a long history of use as a medicinal plant, and probably was introduced by Portuguese seafarers from its native range to Africa and Asia. It is naturalized, widespread throughout the tropics, and known for live fencing in India. It is highly adaptable to harsh environment and promoted to grow in marginal lands under block plantations in India. Kernels of *J. curcas* contain 25-40% oil used for the production of biodiesel after transesterification. The available literature on *J. curcas* is based on the observations of sample trees grown naturally. However, the performance of *J. curcas* are varied significantly under block plantations. Even the claimed tolerance of *J. curcas* against pest and diseases varied widely.

India is sixth in the world in energy demand, accounting for 3.5% of world commercial energy consumption, where hydrocarbons are the major source of energy consumed in transportation sector. The overall demand of crude oil in transportation sector was more than 50 million ton in 2001 out of which domestic supply satisfiesd only 22% of the demand for crude oil, which increased the dependence on crude oil import. In 2003, National Planning Commission of India established a Committee on Development of

Biofuels to explore the feasibility of using renewable feedstock as source of fuels to reduce the country's reliance on petroleum based fuels. The Indian government approved the policy that transport fuels in India need to contain 20 per cent biofuel by 2017 and recognized *J. curcas* as one of the potential candidates for the production of biodiesel and blending with diesel. So far this plant was grown either as hedge or mostly available as wild in nature. Due to recent global fuel demands, this crop has attracted the attention of several developing countries. Though several new plantations have come up, the critical information on the identification and the management of various insect pests and ogronomic management is limited.

This information bulletin discussed the significance of insect pests observed on *J. curcas* including the biology of pest, symptoms of damage and its potential management based on the original observations in the recent plantations grown at ICRISAT campus, Patancheru, India and observations made during on-farm visits in India. Insect pests of jatropha can be broadly classified into three categories; 1) Defoliators 2) Sucking pests and 3) Root feeders.

Defoliators

Leaf webber *(Pempelia morosalis* Saalmuller)

Pyralidae, Lepidoptera

Biology: Jatropha leaf webber, *Pempelia morosalis* is a serious foliage feeding

lepidopteron pest of *J. curcas* and also reported to infest other forest species such as *Desmodium gangeticum*, *Flemingia sp.,* and *Uraria lagopides*. The adult moth is gray in color with wingspan of 20-22 mm, snout like labial palpi. The male is slightly smaller than the female with pointed abdominal tip. The larvae of *P. morosalis* greenish brown in color during early instars and turn to pink as they grow. Adults lay eggs in single or in clusters (10-15) in the terminal leaves. The total oviposition period lasts around 5 days. Eggs need about 6 days to hatch and the larval period lasts for a month. The pupal period takes 7-9 days in June to August and pupation occurs in the leaf webs.

P. morosalis pupa and adult.

Distribution: This specie is known to occur in Asia and probably infest Jatropha throughout its distribution.

Damage: Caterpillars are observed webbing the leaves and inflorescence on the tip of the branches under a cover of silk and frass. The

damage can be seen from a distance by the presence of skeletonized foliage and larval webbings. Sometimes the larvae bore into the peduncle and fruits, resulting in total drying of whole inflorescence.

P. morosalis larvae on jatropha leaf.

P. morosalis damage on foliage.

Blister leaf miner, *Stomphastis (Acrocercops) thraustica* Meyerick

Gracillariidae, Lepidoptera

Biology: Gracillariids are small moths with 8-10 mm wing span infesting Jatropha in Asia and Africa. The adult is a brownish moth with light bands on the fore wings. Eggs are laid single on the foliage. Eggs hatch in 3-5 days based on the prevailing temperatures. The young larvae mine into the leaf tissue staying in between the epidermal layers and feed on the chlorophyll. The individual mines are about

S. thraustica adult.

S. thraustica damage.

S. thraustica larva.

10-15 mm in length and 5-7 mm in width. If the mine is opened a small greenish caterpillar of 10 mm length can be seen inside. Under severe infestation it is common to see 10-15 mines on a single leaf giving a brownish field appearance from a distance. Well-grown larvae come out of the mine and pupate on the upper surface of the leaf close to the midrib. One generation needs about a month and 8-10 generations in a year are possible in tropical region.

Distribution: This species is known to occur in India, Malaysia, Congo, Ghana, Madagascar, Nigeria, South Africa, and Zimbabwe.

Damage: Blister miners under epidemics can cause severe loss to the chlorophyll there by indirectly influencing the yield. Infested plants pose burnt up appearance from a distance. Under normal situation, these cannot pose any threat to the productivity.

Management of Defoliators

- Intensive monitoring
- Selective chemical use
- Application of neem-based pestiride sprays to minimize oviposition
- Installation of light traps where ever possible in orchard
- Establish the role of natural enemies and try to augment them

Application of chemical insecticides such as monocrotophos, endosulfan, acephate, indoxacarb used against other lepidopteron pests, can be effective against P*. morosalis.* However, total dependence on chemicals may induce insecticidal resistance if they are used indiscriminately. There is every need to establish the role of various natural enemies in the system and try to augment them for effective use of natural resources.

Sucking Pests

Brown soft scale *(Coccus hesperidum*. Linnaeus)

Coccidae; Homoptera

Biology: Brown soft scale, *Coccus hesperidum* is a minor pest in *J. curcas* and common during summer. These scales are fairly flat with an oblong body, measuring 3 to 4 mm in length with a series of faint ridges across the body. The soft scale secretes waxy covering usually forms a sac like structure at the rear end of the body,

where females lay the eggs underneath the waxy covering. It takes one to three weeks for hatching and young nymphs are called crawlers which are yellow to pale-green. Crawlers move over the plant and settle in succulent part of the plant. These feed on plant juices through their sucking mouthparts. Under optimum conditions (30-35°C) one generation takes about six weeks. These scales also reproduce parthenogenetically and complete three to five generations in a year. Soft scales secrete honeydew copiously, thus attracting ants, which feed on the honey dew and assist in spreading the crawlers.

C. hesperidum infestation on plant.

C. hesperidum infestation (close up).

Distribution: This scale has a cosmopolitan distribution known to attack a wide variety of field and ornamentals. It has been reported in India, Myanmar, Algeria, Australia, Austria, British Guiana, Canada, Caucasia, Chile, Cuba, Dutch East Indies, Ecuador, England, Europe, Haiti, Japan, Mauritius, Mexico, Morocco, New Zealand, Seychelles, South Africa, and West Indies. It was first recorded in Hawaii in 1896 and is presently in all main islands.

Damage: The soft brown scale, like other soft scales, feeds from the phloem of the host plant mainly found on stems, leaves and green twigs. Heavy infestation results in yellowing, defoliation, reduction in fruit set and loss in plant vigor. Direct damage caused by soft scales is due to the actual feeding of the scale on the host plant. Indirect damage can occur as the growth of sooty mold associated with honeydew production.

Mealybug (*Paracoccus marginatus* Williams)

Pseudococcidae, Homoptera

Biology: Generally, crawlers or rapidly moving 1st instars, the settled 1st instar, pupa and adults are commonly recognized on the plants. The adult deposits eggs in the protective ovisac, which is covered with wax filaments to protect the eggs from predators and the environment. The male pupa is slender and elongate than the female. From the pupa, a winged adult male emerges. Adult males have a single pair

P. marginatus incidence.

of wing halters. Single generation takes about 15 days under optimal conditions and can multiply throughout the year in tropical climate. The incidence of mealybugs was recognized through out the jatropha distribution. However, the species may vary in different regions.

Damage: The mealy bugs feed on leaves and fruits which results in chlorosis, yellowing, stunting, deformation, early leaf and fruit drop, and buildup of honeydew. Sooty mold growing on honeydew excreted by the mealy bugs interferes with photosynthesis. Heavy mealy bug infestations may kill young plants.

Scutellerid bug *(Scutellera nobilis* Fabr.)

Scutellaridae, Hemiptera

Jewel bug *(Chrysocoris purpureaus* Westw.)

Pentatomidae, Hemiptera

Biology: Scutellerid bug, *Scutellera nobilis* is emerging as serious pest in *J. curcas*

causing economic damage. Adult lays eggs longitudinally on the stem, petiole and leaves and the egg hatch takes place in 5-9 days. The total developmental period from egg to adult emergence is recorded as about 33 days. The nymphs are pinkish in color with black abdomen. The adults are metallic green in color having black spots in elytra and scutellum with red abdomen. The length of the *S. nobilis* is proportionately more than the width of the body. Similarly, there is another bug, *Chrysocoris purpureaus* that is also found in large numbers in *J. curcas* with stout body, having black spots on scutellum and prothorax areas causing similar damage as *S. nobilis.* The female of *C. purpureaus* lays eggs individually or in clusters over the pods or leaves with incubation period of about 6 days and total nymphal period around a month.

S. nobilis adults (left) and damaged fruits (right).

Damage: Generally *S. nobilis and C. purpureaus* infestation occurs during flowering and fruit development stage in *J. curcas*. *S. nobilis* is also listed as pest of gooseberry in India and *Zizyphus numularis* in Pakistan. Both adults and nymphs of scutellerid bugs feed on developing fruits of

J. curcas, resulting in shriveled fruits turning black in color. During the fruits maturity period, it is observed more number of adults feed on the fruits than number of fruits in the bunch of *J. curcas*. Initial symptoms are brown colored secretion on fruits from the feeding area and later turn black. The infested fruits have premature seeds with less weight and poor shelling percentage.

C. purpureaus adults.

C. purpureaus nymphs and damage on fruit.

Red spider mite, *Tetranychus sp.*

Tetranichidae, Acarina

Yellow mite, *Polyphagotarsonemus latus* (Banks)

Tarsonemidae, Acarina

Biology: The mites in general have four stages in their life cycle: egg, larva, nymph and adult. Female mites are about 0.2 mm long and oval in shape. The female has swollen light yellowish/ red body. Males are similar in color but smaller (0.11mm) and move faster than females. The eggs are translucent and elliptical in shape. They are about 0.08 mm long. Adult females lay 30 to 100 eggs on the underside of leaf surface and in the depressions of fruit. The eggs hatch in two or three days. Larvae are slow moving and do not disperse far. After two or three days, the larvae develop into a quiescent larval (nymph)

Tetranychus sp. damage on foliage.

Leaf destortion caused by *P. latus* on leaves.

stage. The nymphal stage lasts about a day. Nymphs are usually found in depressions on the fruit and on the lower surface of the foliage.

Distribution: Both the species are world-wide in distribution and are known by a number of common names. They are found in Australia, Asia, Africa, Europe, North America, South America, and the Pacific Islands and known to infest several crops.

Damage: Mite damage initially starts in the older leaves. Badly infested plants will have yellow and red mottling of the lower leaves resulting in sickly appearance of the orchard followed by leaf drop.

Management of sucking pests

- Application of carbosulfan @ 1 ml in 3 litres or monocrotophos @ 1.5 ml litre^{-1} or Imidacloprid

1 ml in three litres of water around fruit formation time can provide effective control.

- Tackling of mealy bugs and scales require a constant watch on the occurrence and good cultural practices to contain the spread.
- In case of scales and mealy bugs, trimming of infested branches immediately after their first appearance and burning them is of immense value.
- In case of mite infestation application of acaricides such as wettable sulphur @ 1 gm l^{-1} or kelthane 2 ml l^{-1} of water would be effective.
- Mites are easily dislodged from the leaf surface, at least before they have a chance to begin building webbing. A weekly hard blast of water, such as overhead irrigation can prevent their build up.

Pruning of heavily infested braches and taking them away from the plots is recommended to control the spread of the scales when infestation is local in nature found in few plants under block plantations. When the infestation is well established application of any systemic insecticide such as monocrotophos or dimethoate as prophylactic measure are effective in managing the spread of scale infestation. Sprays are effective on the nymphal stages of scales. However, control is difficult on other life stages. Use of sticker such as with insecticide proved more effective @ 1 ml 1^{-1} in the management of mealybugs in several situations.

Soil Pests

Termites *(Odontotermes formosanus* Shiraki*)*

Termitidae, Isoptera

Biology: *Jatropha curcas* is often infested by termite, *Odontotermes formosanus.* They survive in the soil in large colonies in nests as deep as 3–6 m requiring moist environment. Termite colony comprises several types of individuals *viz.,* queen, king, soldiers and workers meant to perform different activities of the colony. The workers are creamy white, about 5 mm long, who are the largest group of individuals in a colony which are destructive to crops and household articles. Worker group is the one spoiling the crops and observed in pest surveillance. The matured males and females

Plants killed by termites.

emerge from the colonies during the monsoon and find their mates and form new colony. These new pairs develop in to future colonies in a span of 12-24 months. Termite species are specific to regions and are common in all jatropha growing areas with high incidence in light soils, particularly in moisture stress situations.

Damage: Termites primarily burrow through the roots and stems causing extensive tunneling, resulting in plant mortality. This is a direct loss to the plant stand and yield. Termite damage sometimes are more severe in fields where injury to branches occur during inter culture. Termite damage to any part of the plant makes them vulnerable to diseases. The third type of damage can also be seen during the drying phase when the produce is kept for drying on an open floor. Thus termites are involved in direct as well as indirect damage to the crop.

Root tunneling by termites.

Management of Soil Pests

- Follow field sanitation
- Never allow any termite mounds to establish near orchards
- Spot application of insecticides such as Chlorpyriphos @ 5 ml liter^{-1} of water to the base of the plants after rainy season
- Application of granular insecticides such as Carbofuran 3G @ 10 gms plant^{-1} during off season

Protecting plants from injuries and proper cultural care are the primary way of avoiding termites in *J. curcas*. Following clean cultivation and sanitation methods such as removing the termite mounds around the fields, timely removal of dead limbs during the dormant period keeps termites away from the plants. Application of organic mulches such as grass in the inter space of the field during the dry season can keep the termites away from the plants. Since the crop is a perennial, periodic spot application of insecticides at the base of the plant would be of immense value in effective management of termites.

Yellow Mosaic Disease

Whitefly transmitted yellow mosaic virus in jatropha belongs to geminiviruses of the genus *Begomovirus* is an important pathogen infects a wide range of crops. Mosaic disease was one among such diseases noticed recently on jatropha. The virus was found to be transmitted by the vector *Bemisia tabaci* (Aleyrodidae) in a semipersistent manner, but not through sap inoculation and seed. Manual removal of infected plants immediately after the disease occurrence will be of immense help in curtailing the disease.

Plant infected with yellow mosaic disease.

It is concluded that *J. curcas* in plantations attracts numerous pests (about 40 have been reported). However, most of them are confined to specific stages of the crop. The infestation of leaf (blister) miner and red mites occurs in spring with the onset of the vegetation where as other pest like *S. nobilis, C. purpureaus* and *P. morosalis* infests *J. curcas* during the flowering and fruit

development stage. Subterranean termite occurs during the summer season coinciding with dormant period of jatropha. Though several sucking pests such as thrips, aphids, leafhoppers and white flies known to feed on jatropha, only white fly (*B. tabaci)* was considered as important vector of yollow mosaic disease. At this stage the economic status of various species is not well defined and the corresponding thresholds are not worked out. Since this crop has attained high importance as supplement to fossile fuel world wide it is necessary to develop cost effective pest management practices with environmental concern.

Suggested Readings

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The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political organization that does innovative agricultural research and capacity building for sustainable development with a wide array of partners across the globe. ICRISAT's mission is to help empower 600 million poor people to overcome hunger, poverty and a degraded environment in the dry tropics through better agriculture. ICRISAT belongs to the Alliance of Centers of the Consultative Group on International Agricultural Research (CGIAR).

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