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(REVIEW ARTICLE)

# An overview of jatropha (*Jatropha curcas*) pests, diseases and management in North-Western Nigeria

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## Abstract

The growing and management of *Jatropha curcas*, either on private, public or community land is poorly documented and there is little field experience that is being shared especially in North western Nigeria where it is still grown wild. The few growers are unable to achieve the optimum economic benefit from the plants. However, the recent importance attached to Jatropha in the Nigerian Savanna agro-ecology have revealed that, the crop is subject to attack by a diversity of arthropod pests' species and diseases, some of which may warrant control measures taken against them. Diseases caused by a number of plant pathogenic (disease-causing) organisms such as fungi, bacteria, virus etc often have a significant economic impact on yield and quality of Jatropha plant, hence the need for adopting control measures become imperative in order to be managed for successful production. Therefore, there is need to conduct a research on common diseases affecting the growth and development of *J. curcas* and possible management practices in north western Nigeria.

**Keywords:** Insect Pest; Disease; Management; *Jatropha curcas*

## 1. Introduction

*Jatropha curcas*is a small tree or shrub with smooth gray bark, which exudes whitish colour, watery, latex when cut. Normally, it grows between three and five meters in height but can attain a height of up to eight or ten meters under favourable conditions. Leaves are large green to pale-green, alternate to sub-opposite, three to five lobed with a spiral phyllotaxis. The petiole length ranges between 6 -23mm and inflorescence is formed in the leaf axils. Flowers are formed individually, with female flower usually slightly larger and occur in hot season [1].

Jatropha is not browsed, for its leaves and stems are toxic to animals, but after treatment, the seeds or seed cake could be used as an animal feed. Being rich in nitrogen, the seed cake is an excellent source of plant nutrients. Various parts of the plant are of medicinal value; its bark contains tannin; the flowers attract bees and thus the plant has honey production potential [2].

Insect pests affecting *Jatropha curcas* include army worms, aphids, mealy bugs, citrus root weevil etc. [3]. Disease caused by fungal pathogens results in the destruction of leaf tissue of which photosynthesis is reduced, this affects the growth and development of the Jatropha plant and subsequently its potentials, other diseases like root rot, caused by *Fusarium moniliforme,* causes wilt and death of Jatropha in waterlogged condition, and diseases like leaf spot, rusts, collar rot can also damage and kill *Jatropha curcas*. However, diseases and pests vary by climate and location depending on the growing area.

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Fungicides are important tools for management of plant diseases caused by fungal and oomycete pathogens. However, fungicide usages need to be carefully planned with a good understanding of plant disease epidemics, their components (host, environment and pathogens), fungicide mode of action (biochemical, biological, physical), risk of resistance development and host physiology, among other aspects [4]. With the increasing demand for Jatropha as a source of biofuel in the world market [1], and several national governments' emphasis on domestic sourcing of industrial raw materials, Jatropha has recently assumed a priority status for research and development [3].

## 2. Pests and Diseases of *Jatropha curcas*

The attack of insect pests and diseases is a limiting factor in achieving optimum production, and sometimes even makes harvest to fail [5]. If *J. curca s*is cultivated in intercropping systems, the problem of pests and diseases is not very significant, and can in this case be overcome easily [6], but if the cultivation is done in large scale monocultures or in the wild, pests and diseases management may become important.

## 3. Insect Pests of *Jatropha curcas*

Existing literature indicates that contrary to popular belief that toxicity and insecticidal properties of *J. curcas* are of sufficient deterrent for insects that cause economic damage in plantation, several groups of insects have overcome this barrier [7]. [5] stated that the insect order *Heteroptera* that has at least 15 species in Nicaragua can extract nutrients from physicnut, also the stem borer from the *Coleoptera* family of *Cerambycidae* that is known as minor pest in cassava can kill mature physicnut tree, However, the relatively few leaf-eating insects present are not capable of doing much damage once the tree has passed the seedling stage [5]. Several parts of the plant such as root, stem, leaf, flower, fruit and seeds, can be attacked by the insect pests. Common insect pests of *Jatrophacurcas*include cutworm (*Agrotisip silon*) which attacks seedling and young that just appeared from the soil surface. It is indicated by the stem which cuts near the soil surface and the plant will be withered [8]. The larva of *Scarabacid* beetle, (Family *Scarabacidae)* can destroy the root of plant, this pest can be found in sandy soil, land with green manure, and land with good drainage, the grubs are found around the plant, in the beginning, they will eat humus or other organic materials and then they will attack the roots. Larva attack on the young plant may kill the plant [9]. Some grasshoppers may attack the *Jatropha curcas* plant, *Valanga nigricornis* and *Locusta migratoria* may attack the plant anytime [10]. However, in Indonesia, the attack of *L. migratoria* seldom occurred, generally heavy attack would occur on the young plant, perhaps, the attack is periodic and sudden [5]. Armyworm (*Spodoptera litura*) is a widely distributed insect pest, especially in Asia, Pacific and Australia [11]. About 120 kinds of plants are used as host plant by this pest, such as tobacco, corn, paddy tomato, chili and legumes including soybean and *Jatropha curcas* [12]. The larva eats the leaves of the young and mature plants, often left the leaves bitten [5], if the attack is heavy, only bones of the leaves will be left and plant becomes bald. Generally pest which damages the stem is the stem borer. In Indonesia, there are two potential stem borers namely *Ostrinia furnacalis* and *Xyleborus* spp. The stem damage usually is caused by the old larva, the stem attached usually fall down or the plant broken down by the wind, sometimes there is a hole at the stem, indicating an entry point of larvae [5]. Leaf caterpillar (*Achaea janata*) is able to eat all leaves in a short time. Heavy attack will influence the quantity and quality of the seeds, and no available plant can withstand *A. janata* [13]. Larva of the nettle caterpillar may attack the *Jatropha curcas* periodically. The female adult lays its eggs on the soft part of the plant in an egg mass, it causes the leaves to curl, it is only 1.5 – 2.5cm and the colour is green and blue length wise [13]. *Empoasca* species is the main insect pest of *Jatropha curcas* in tropics and sub-tropic regions. On the field, they could be found for the whole year, but very dangerous to the plant on the seed bed. Female lays its eggs on the leaf net, close to the leaf bones at the lower surface. Nymph and adult suck the plant sap from the lower surface of the leaf and make it dry and die, sometimes, the curly leaf occurred at the tip [14]. Mite (*Tetranychus* spp) damages the leaf and makes the plant weak, it looks like a yellow or red spot commonly found at the lower surface of the leaf, it can only makes the leaf fall, but does not kill the plant, the top leaves attacked will become malformed [14]. Stink bug (*Nezara viridula*), is very important in the tropical region, it attacks *Jatropha curcas* at the flowering time, which causes heavy damage to the fruit capsules and it is easily recognized for its green colour [15]. *Chrysocoris javanus*, an insect of only 2cm at maturity, bold red with black lines across its body attacks the fruit of *Jatropha curcas* by sucking the fruit fluid [16]. *Dichocrosis punctifexalis* (Tip borer) is found in South East Asia, Australia and Pacific Islands. Its attack usually occurred when flowering season begins. Female imago lays its eggs on the soft part of the plant, after the eggs hatched into larva; the attack begins at the tip of the young plant, or at the seed of an old plant [16]. Natural termite (*Odontotermis* spp.) colony/mound is found around the base of the *Jatropha curcas* seedling which causes uprooting due to heavy thrush of pre-monsoon storm in May – June, West Bengal, India [11].

There is scanty information with respect to Jatropha pests in Africa. The flea beetles (*Aphthona spp*.) constitute the most serious pests in some parts of East and Southern Africa particularly, Uganda, Kenya, Tanzania, Malawi and Mozambique [17, 18] where the adults eat the leaves and their larvae penetrate the roots. The yellow flea beetle (*Aphthona dilutipes*),

and other *Aphthona spp*. Appeared to cause more severe damage than the golden flea beetle (*Podagrica spp*), sometimes resulting in upto 100% mortality in Mozambique and Malawi [18]. In preliminary studies conducted in Zaria and in some parts of savannah zones in Nigeria from 2006 to mid-2009. [3] Revealed that one of the major biotic constraints to Jatropha production is ravages due to insect pests and diseases, among the most important pest of economic importance are leaf bloth miners, pentatomoid bugs, several species of Orthopteran insects, tailed (striped) mealybugs, thrips, termites, spiraling whiteflies etc. [3].

## 4. Diseases of *Jatropha curcas*

Several important diseases which attack *Jatropha curcas* cause an appreciable decrease in its growth rate and final yield as a whole. Spots on seedling which mostly occurs in the rainy season generally attack seedling or young plant and the yield loss may reach 30 – 40% [19]. The appearance of the disease is in circular spots on both leaf surfaces which finally widen and the leaf spoiled. Sometimes, it spreads further to the stem which may kill the plant, the old plant can also be infected, but the intensity of damage is lower than that found on seedling. The leaf colour usually changes initially to yellow and finally brown [1, 2]. Alternaria spots caused by *Alternaria ricini* develops very quickly on the fruit capsule usually when the humidity is high making the fruit to become black. The pathogen may attack the whole plant making it stunted and finally dies [5]. Rust is another disease caused by *Melapsora racini*, it looks like rust spots on the lower surface of the leaf and yellow in colour, a heavy damage may dry the leaf [11]. Cercospera leaf spot is a disease that causes a serious damage to *J. curcas* [20], the symptoms are black or brown spots surrounded by ring with pale green in colour, the spots are found on both leaf surfaces, when the spot is getting bigger, it becomes grey, surrounded by brown colour. Fusarium wilt caused by *Fusarium oxysporium* attack the plant in the seed bed or in the field. If the seedlings are attacked, the leaves become pale green, wither and finally die. Leaves on the lower part of plant may fall initially leaving those in the upper part [10]. Botrytis disease caused by *Botrytis ricini* become a serious problem in the rainy season when the fruit capsule is formed, the infected flower will be spoiled and covered by gray mold and it easily spreads to all the flowers and the fruit capsule. Also, *Xanthomonas ricinocota* bacterium attacks the cotyledon and the leaf resulting in black spots, round and irregular in form, this disease is called bacteria spot [10]. Conidia phase of *Dothiorella gregaria* and *Diplodia* spp. were identified as the causal agents of stalk rot and root and stem rot diseases, respectively on *Jatropha curcas* base in new a forestation forest land in Yunan Yongren, China [8], the damage of diseases was said to be serious. Phomopsis, a genus of ascomyceta fungi cause dead-arm on *Jatropha curcas with* infections usually beginning during early growth stages in spring; it affects leaves, fruits and shoot of plants. This disease causes the formation of lesions on shoots leaves and also fruit rot [21]. Colletotrichum fungi cause anthracnose spots and blight of aerial plant parts. Members of this genus cause major economic losses, especially of fruits, vegetables and ornamentals including Jatropha, other crops affected include food crops like bananas, cassava, sorghum etc [22]. Curvularia species cause a leaf spot on leaves of *Jatropha* in form of tan to dark brown, showing on both sides of the leaf, bordered with a brown spring slightly depressed and with a narrow yellowish region between the spot and normal green of the leaf, this mostly occurs in areas that experience prolonged leaf wetness for several consecutive days and temperatures between 25 – 30$^{o}$C [18, 21]. Seedling die-back and collar rot are also common in *Jatropha* nurseries, they can be severe when produced under irrigation in semi-arid environment [6]. Other fungal diseases reported to infect *Jatropha* plant include; leaf spots (*Helminthosporium tetramera, Curvularia lunata, Pestalotiopsis paraguarensis, Pestalotiopsis versicolor, Cercospora jatrophae-curces),* damping-off (*Pythium spp. Phytophthora species, Fusarium species),* root rot *(Pythium species, Fusarium species, Clitocybeta bescences, Phymatotricum omnivorum),* rust (*Phakopsora jatrophicola*) and black mildew (*Meliola jatrophae*) [7, 14].

## 5. Management of Disease

Phytopathogenic fungi are living organisms responsible for nearly half of known diseases in crop plants [4]. Among the difficulties with managing foliar disease is timing. Once the symptoms are visible, it is too late for any effective treatment in the current season [2]. Fungicides are biocide chemical compounds or biological organisms used to kill or inhibit fungal spores [13]. Chemicals used to control oomycites, which are not fungi, are also referred to as fungicides since oomycites use the same mechanisms as fungi to infect plants [13]. In contrast with most human medicines, most fungicides need to be applied before disease occurs or at the first appearance of symptoms to be effective, also, unlike many diseases of humans and animals, the damage caused by diseases on plants often does not go away, even if the pathogen is killed [4]. She further stressed that, fungicides can only protect new uninfected growth from a disease; also, few fungicides are effective against pathogens after they have infected a plant. Fungicides are applied as dust, granules, gas, and, most commonly as liquid [1]. They are applied to soil either in-furrow at planting, after planting as a soil drench (including through drip irrigation), or as a directed spray around the base of the plant and on foliage and other aboveground parts of a plants by means of a sprayer [4].

Fungicides can either be contact, translaminar or systemic. Contact fungicides are not often taken up into the plant tissue, and protect only the plant where the spray is deposited; translaminar fungicides redistribute the fungicides from the upper, sprayed leaf surface to the lower, unsprayed surface; systemic fungicides are taken up and redistributed through the xylem vessels, by and large, few fungicides move to all parts of a plant [1].

Fungicides kill fungi by damaging their cell membrane, inactivating critical enzymes or proteins, or by interfering with key processes such as energy production or respiration [23]. Others impact specific metabolic pathways such as the production of sterols or chitin. For example, phenylamide fungicides bind to inhibit the function of RNA polymerase in oomycetes, while the benzimidazole fungicides inhibit the formation of beta tubulin polymers used by cells during nuclear division [13]. Mode of action determines which fungi will be affected by a fungicide and thus, which diseases can be controlled by using the fungicides. Similarly, fungicides with different modes of action are needed in a disease management program to delay fungicide resistance development [23].

Stephen and Pawel [24] stated that, fungal foliar diseases can also be managed through the followings:

- As with northern corn leaf blight caused by fungus *Helminthosporium turcicum* and southern corn leaf blight caused by *H. maydis*, control is by rotation, destruction of debris and use of resistant hybrids.
- Removal of fallen leaves and debris promptly.
- Many fungal pathogens are favored by moisture, so avoid overhead sprinkler and irrigate early in the day so that the foliage dries more quickly.
- Fordisease to occur, three ingredients are essential; a susceptible host, the pathogen and environmental conditions for pathogen development on the host must coincide, eliminating any one of these key factors affect disease progress.
- FAO [19] added that, many strategies can be done collectively to reduce fungal leaf spot diseases on trees and shrubs;
- Rake up and destroy fallen leaves before the onset of rainfall where pathogens can survive to re-infect the plant in the following growing season.
- Do not overcrowd plants, use size at maturity as a spacing guide when planting.
- Prune trees or shrubs to increase light penetration and improve air circulation throughout the canopy.
- Reduce stress to your trees.
- Do not fertilize trees and shrubs suffering from leaf spot diseases, unless it is recommended by a soil test to correct a nutrient deficiency.

## 6. Conclusion

The attack of insect pests and diseases in *J. curcas* is a limiting factor in achieving optimum production, and sometimes even makes harvest to fail. Insect pests affecting *Jatropha curcas* include army worms, aphids, mealy bugs, citrus root weevil etc. Diseases caused by a number of plant pathogenic (disease-causing) organisms such as fungi, bacteria, virus etc often have a significant economic impact on yield and quality of Jatropha plant, hence the need for adopting control measures become imperative in order to be managed for successful production. Fungicides are important tools for management of plant diseases caused by fungal and oomycete pathogens. However, fungicide usages need to be carefully planned with a good understanding of plant disease epidemics, their components, fungicide mode of action, risk of resistance development and host physiology, among other aspects. Therefore, there is need to conduct a research on common diseases affecting the growth and development of *J. curcas* and possible management practices in north western Nigeria.

## Compliance with ethical standards

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### *Disclosure of conflict of interest*

No any conflict.

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