REVIEW ARTICLE:

MANAGEMENT OF BANANA (*MUSA PARADISIACA* LINNAEUS) ORCHARD AGAINST INSECT PESTS

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Abstract

Banana (*Musa* spp.) is one of the world's most important crops grow in a range of environments and produces fruit all year round. As well as being an easily produced source of energy, banana is also rich in a number of important vitamins and minerals. The crop is also environment-friendly, combating soil erosion on hilly slopes and readily lends itself to intercropping and mixed farming. Insect pests pressure has been increasing considerably on banana plantation in recent years, leading to deteriorate its gardens in Pakistan. At present, no single management strategy appears likely to provide complete control of banana insect pests. Therefore, a broad integrated pest management strategy might provide the best chance for success in controlling banana pests. This article reports the important insect pests of banana, their mode of damage and control strategy for sustainable crop protection.

Introduction

Banana is the most important fruit of the Asia and Pacific regions. The crop grown is of high value and serves to meet the diverse market demands in the region of many ethnic groups. Consumers are offered a wide choice of banana and plantain cultivars of varying color (yellow, red, orange and green), flavor, texture, size and shape. Many cultivars are consumed fresh as dessert fruit, while, a great number of culinary varieties are also produced for the hundreds of recipes which use cooking bananas and plantains. During 2009-2010, acreage of banana in Pakistan was approached 34.8 thousand hectares with an average yield of 154.8 thousand tones (Pakistan Statistical Year Book, 2011). Many problems affect banana production, natural calamities such as typhoons, floods, droughts and occasional volcanic eruptions cause devastating losses in banana production. Biotic factors caused by pests and diseases present constant threats to banana farmers. Out of many causes for decline in its yield, insect pests contribute to the maximum strength of losses. Unfortunately, they are all present in the Asia and Pacific regions (Ostmark, 1974). The most important insect pests of banana affecting its production are:-

1. Foliage feeders: There are only three Lepidopterous defoliators that cause more than minor damage: *Ceramidia*, *Caligo* and *Sibine*, and bagworms.

i. *Ceramidia* species: It is the most destructive defoliators; caterpillars live on the underside of the leaves and chew narrow holes paralleling the major leaf veins. Although the damage appears severe, the leaf portion distal to the holes remains functional. Occasionally, the caterpillars move to green fruit, causing scarring when attempts are made to feed.

ii. Brassolid caterpillars – *Caligo* species: These caterpillars chew large holes in leaves, especially along the margins. They rest along the midrib during hottest part of the day. When the populations are high, the day flying butterflies can be seen clustering by the hundreds on the rotting bananas.

iii. Saddlebacks – *Sibine* species: The larvae feed gregariously on leaf margins with a preference for older leaves. Occasionally, fruit is damaged. The larvae have stinging spines that fallen the workers when fruit is harvested.

iv. Bagworms: The larval stage feeds inside the bag, while, hanging to the underside of the leaf. Younger bagworms can be pulled apart to see an internal parasite that appears as whitish maggots along the digestive tract.

2. Pseudo stem borers: There are two pseudo stem borers that cause occasionally some damage. The larvae of the curculionid *Odoiporus longicollis* bore into the Pseudo stem near the ground usually entering through a wound or pseudo stem that has been cut. If the larval tunnel passes through the central growing point, the plant

is killed. Severe losses are occasionally caused by Lepidpterous stalk borer *Castniomera humboldti.* The larvae make large tunnels in the rhizome, which often extend to the heart of the pseudo stem. Leaves may turn yellow or brown. Fruit weight may be reduced. Population can be estimated by counting holes exuding gelatinous latex. Ants are the major biological control destroying eggs and larvae.

3. The Banana borer or Banana Weevil *Cosmopolites sordidus* (Germer): The banana weevil, *Cosmopolites sordidus* (Germar), is an important pest of banana, plantain and ensete. Weevil attack can prevent crop establishment, cause significant yield reductions in ratoon crops and contribute to shortened plantation (Price, 1994; Rukazambuga *et al*. 1998). The banana borers lay eggs at the base of pseudo stem and the larvae bore into the rhizome. The tunneling can kill young plants and increase toppling of older plants life (Gold, 2001).

4. Fruit and flower pests: High quality bananas must be green and free of unsightly insect blemishes on arrival. None of the insect described here enter the pulp and most of the blemishes are confined to the outer skin. Thus, eating quality is not affected.

i. Rust red thrips: *Chaetanaphothrips* species feeding causes a reddish stain between the fingers. The stain is oval shaped where the finger touch but can extend the entire length of the finger. In case of severe attack, the peel cracks. Other species feed on pseudo stem and suckers as well as on fruits. This causes a rust colored mark on the suckers that is an indicator of thrips population.

ii. Corky scab thrips: One of thrips forums complex causes a corky scabbing of fruit. There are a gray brown to reddish roughening of the skin sometimes with cracking. These thrips begin to feed on flower tips, fruit and adjacent brackets before the bud emerges from the plant and up to 14 days after the emerging fruit is first seen.
The combined heavy feeding damage and puncturing later turns brown, and as the bunch approaches maturity assumes the characteristics of corky scab. Control Consists of injecting the flower bud soon after it emerges with pyrethroids.

iii. Flower thrips: There are five *Frankliniella* species whose oviposition marks cause the raised pimples found on the almost every fruit cluster. Flower thrips are found mainly on recently shit to two-week-old fruit. The adults lay eggs in the peel of fruit causing a small, raised pimple formation at each ovipositing site.

iv. Peel scarring beetles *Colaspis* species: Peel scarring beetles are light brown chrysomelid beetles. The larvae or grubs feed on grass and banana roots. The beetles chew holes along the edges and across the surface of young banana fingers. They also feed on young unfurled leaves but cause no serious damage.

v. Banana scab moth: *Nacoleia* species lays eggs on the brackets of the inflorescences; the larvae migrate under the brackets and feed on the young fingers. This causes severe scarring and cracking as the fruit matures.

vi. Minor peel feeders: The Platynota peel-feeding caterpillar normally feeds on weeds and seldom invades fruit. Occasionally population explodes and eggs are laid on all parts of the banana plants. The larva feeds on peel, especially between the fingers near the tip. The smooth pupal skins are frequently found on the fruit.

5. Sucking insects and disease vectors: Aphids, mealy bugs, scales, lace bugs and mites are frequently found on foliage and fruits. Usually, however, these insects are minor pests. Mealy bugs and scales often infest fruit especially near the crown. Mealy bugs also excrete honeydew leading to the development of sooty mould.

Aphid *Pentalonia nigronervosa* Coquerel: One important pest is the Aphid *Pentalonia nigronervosa* that is found wherever bananas are grown. Its excretion of honeydew provides a substrate for sooty mould fungi. Some of the major disease problems affecting bananas are caused by viruses. Banana bunchy top is the most important virus disease of banana in the region. Its vector, the banana aphid, is an efficient transfering agent. The disease is not soil-borne, and the only means of transmission is through its insect vector, the banana aphid (*Pentalonia nigronervosa* Coq). The aphids are usually found clustered around the unfurled heart-leaf and the sheathing leaf-base of petioles, the ideal locations for feeding and protection. They are also found on the base of the pseudostem and on very young suckers. The aphids flourish throughout the year, but are more numerous during the rainy season. Both winged and wingless individuals occur in a normal aphid colony. Banana aphids produce large quantities of "honey-dew" which attracts ants. The presence of ants is a good indication of the presence of

aphids on a banana plant. Banana aphids are seldom found on plants other than banana, although colonies of the aphid are sometimes observed on members of the banana family, such as *Heliconia*, *Strelitzia* and *Ravenala*. They are also occasionally found on *Canna* and *Zingiber* but do not colonize these plant species for extended periods of time. The disease can be effectively controlled by eradication of diseased plants and the use of virus-free planting materials. For eradication to be effective, plants must be uprooted and chopped into small pieces, or killed by herbicide sprays. All new growth must be destroyed. Control should cover the entire production area to prevent infection of virus-free planting materials.

Banana mosaic is cosmopolitan, and is found wherever bananas are grown. The virus has many alternate hosts and can be readily transferred by a number of insect vectors. Fortunately, it causes only minor problems except for occasional outbreaks when alternate host crops are grown close to banana plantings. The cucumber mosaic virus in banana is readily transmitted by several species of aphids. The two most common aphids, and those with the widest host range, are the cotton aphid, *Aphis gossypii*, and the corn aphid, *Rhopalosiphum maidis*. Transmission has also been recorded by *Myzus persicae*, *Macrosiphum pisi* and *Rhopalosiphum prunifoliae*. This led to the suggestion that the main spread of mosaic is by aphids dispersing from vegetable crops to banana, and not between banana plants. It seems therefore, that banana mosaic is generally acquired from a wide range of host plants growing near banana fields, and is transmitted by a number of aphid vectors that do not usually colonize banana. Ideally, banana fields should be sited far from vegetables and legumes, which should not be grown as intercrops. There should also be good weed control in banana plantations.

Banana streak is another virus disease of minor importance in the region, and is found mainly on some cultivar. The banana streak virus is transmitted by the citrus mealybug, *Planococcus citri* from banana to banana. The pink sugarcane mealybug, *Saccharicoccus sacchari*, has been shown to transmit ScBV from sugarcane to banana. However, the principal means of dissemination is infected planting materials. Banana streak disease can be controlled by the eradication of infected plants, and the use of virus free planting materials. The virus disease causing most concern is banana bract mosaic, which affects many cultivars and is spreading rapidly throughout the banana growing areas. Bract mosaic causes a marked reduction in yield and is transmitted by the banana aphid. Disease transmission is through aphid vectors, including *Rhopalosiphum maidis*, *Aphis gossypii* and *Pentalonia nigronervosa*.
delivery

Control Measures: Although a crop profile does not currently exist for banana, key insects identified for banana include aphids, mealy bugs, thrips, and beetles, in that order. Effective control of the disease is similar to that of other viral diseases. It requires early detection, and immediate eradication of infected plants. In establishing new banana plantings, only virus-free propagating materials should be used. Specialists concurred that these diseases can be managed culturally, rather than chemically. It was also suggested that tissue culture plantlets be employed whenever possible, as they are free of bacterial, fungal, and nematode pests. Most promising approach is to control the population of insect vectors. Spinosad is newly registered for banana. Other insecticides for banana insects' management include imidacloprid and bifenthrin. Insecticides can be replaced by granular formulation such as cartap, monomehypo and carbofuran. The granules are applied around the base of mother and daughter suckers after removing trash leaves and other debris.

Research priorities for banana are: Investigate damage, Identify aphids, thrips and mealy bug species that damage banana fruit. Determine efficacy of new or pending insecticides on aphids, thrips and mealy bugs. Determine efficacy of new or pending fungicides on banana diseases. Education priorities for educating growers are on and propagation sanitary practices. Encourage growers to propagate or utilize tissue culture plantlets. Regulatory priorities are continuing the registration process for newer toxicants.

Many of the causative organisms that are pests on this fruit are unidentified. Similarly, the pathogens or predators of these pests are also largely unknown. Pest management in these fruit groves is occurring naturally (but undocumented) in many cases. However, certain pests can occasionally (and significantly) affect the production of fruit crop. Overarching areas of investigation for this fruit in general include: investigations on the biology of numerous scale, mite, and other production-limiting or quality-affecting insects; identification and biology of a number of fruit and leaf eating insects; development of IPM programs for certain insect pests; and crop phenology models. Integrated pest management can make as much as possible use of cultural practices and natural enemies of pests in order to reduce the use of pesticides to the essential minimum. Sustainable banana production for Hawaii is dependent on the availability of a variety of pest management tools, including multiple chemical control options (Pinese and Piper, 1994). Different approaches based on IPM developed have led to a 65% decrease in pesticide use in banana (Cote *et al.* 2009). These strategies include: - use of clean planting material and clean site, improved agronomic practices (weeding, mulching and application of manure), management of crop residues, host resistance to weevil and nematodes and use of insecticides when the methods have been found to be ineffective.

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