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A PRELIMINARY REVIEW ON MANGO MEALY BUG, DROSICHA MANGIFERAE (GREEN) A NOTORIOUS PEST TO MANGO ORCHARDS

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ABSTRACT

Mango (Mangifera indica L.) is accounting for nearly 50 % of the world tropical fruit production. Mango mealy bug, Drosicha mangiferae (Green), is the serious, dilapidating, polyphagus, dimorphic and notorious insect pest of mango orchards in Indian sub-continent, frequently distributed in indo-gangetic plains, alternatively feeding on other fruits crops, forest trees, ornamental plants and weeds. Body usually covered by wax with distinct abdomen. Adult female crawls down the tree in the month of April-May and enter in the cracks in the soil and laid eggs. Eggs remain in diapauses up to middle of December. Sometimes it extends up to January, then hatched to become nymph and became adult through three successive stages. Drosicha mangiferae causes damage of mango principally due to sucking of 'cell sap' from tender leaves, stem, inflorescence and growing fruits often causing fruit drops reducing its market value. Besides, honeydews excreta of mealy bugs, promote sooty mould causing blackening and malformation of growing leaves, stems and fruits. Long term control is required in repeated fashion due to its hiding habit and protective body covering. For this reason, chemical treatment is therefore not advised till control is not satisfactory by other methods. Biological and physical control is effective to control mealy bug population. Application of systemic insecticide is needed during heavy infestation. The presence of large alternative host range of mealy bug causes its persistence makes them a great threat in agricultural fields. Alteration of environmental factors may effect on their life cycle thereby effecting time of infestation. By following the life cycle and seasonal dynamics, mango mealy bug population can be checked. Successful pest prediction methodologies are expected that able to forecast the pest dynamics accurately for better production and make environmental less hazardous.

KEY WORDS

Mango mealy bug, Drosicha mangiferae, seasonal dynamics

INTRODUCTION

Mango (*Mangifera indica* L.) is one of the world`s most important cultivated tropical fruits that are grown in India. World production of mango was about 28.5 million tons accounting for nearly 50% of the world tropical fruit production [1]. West Bengal concerns 70-80 thousand hectares of mango cultivation field sharing 44% of the total food crop cultivation area of the state [2]. Insect pests are the major threat to underscore the mango production [3]. Mango mealy bug, *Drosicha mangiferae* (G.), is the serious, dilapidating, polyphagus, dimorphic and notorious insect pest of mango orchards in Indian sub-continent [4]. Due to the infestation of mealy bug, mango leaves are distorted, rolled, folded, stunted, and turns into yellowish colour. Heavy infestation causes dropping of leaves and flowers and reduces fruit setting. Besides honeydews, the excreta of mealy bugs, promote sooty mould that causes blackening and malformation of growing leaves, stems and fruits reducing its market value and make it unfit for human consumption. Reliance only on chemical

methods to check the insect pests is not always prudent to check the pest menace. Understanding the bio-ecology of mango mealy bug in relation to climatic parameters at regional level is thus indispensible to control the pest properly.

NOMENCLATURE AND SYSTEMATIC POSITION

Mealy bugs are so named because many of the known species are covered in a whitish 'mealy' wax which helps to retard the loss of water from their soft bodies. Mealy bug generally prefers warm, humid and shaded sites away from adverse environmental conditions and natural enemies such as beetles, bugs, lacewings and mites. Mealy bugs are generally called 'hard to kill pests'. The organism lives in protected areas such as cracks and crevices of the bark, at the base of leaf petioles, on the underside of leaves and inside the fruit bunch and most of the stages of this insect are covered with a waxy coating.

The systematic position of mealy bug is - Kingdom: Animalia, Phylum: Arthopoda, Class: Insecta, Order: Hemiptera, Superfamily: Coccoidea, Family: Margarodidae, Genus: Drosicha, Species: mangiferae.

The mealy bug species:

Six mealy bug species viz. *Planococcus citri* (Risso), *Planococcus lilacinus* (Cockerell), *Ferrisia virgata* (Cockerell), *Nipaecoccus viridis* (Newstead), *Maconellicoccus hirsutus* (Green) and *Drosicha mangiferae* (Green) had been identified on various fruit crops in Punjab [5]. Mealy bug mainly a infests mango trees; however it has the tendency to attack a variety of other trees [6].

CHARACTERS FOR IDENTIFICATION

Adult possesses segmented body usually covered by wax with distinct abdominal segments and well-developed legs and antennae. Wingless Female is bigger than winged males. The females can be identified by their flat shape, covered with white flocculent wax. The adult males appear as a stoutly built moth with brownish wings. It's a medium sized moth with 32-38 mm long at wingspan. The antemedial line of fore wings bent toward axis. Dark brown to black patches are present on the apex of fore wing and dull black curved line is present through the margin of the hind wing [7].

DISTRIBUTION

D. mangiferae and *D. stebbingi* feeds on 62 host plants under 51 genera and 28 families including fruits crops, forest trees, ornamental plants and weeds [8]. *D. mangiferae* is one of the major pests of mango in the states of Punjab, Uttar Pradesh, Bihar and Delhi and also in Pakistan [9]. It was frequently distributed in indo-gangetic plains and causes severe damage from Punjab to Assam [10] [11].

HOST RANGE OF MANGO MEALY BUG

Important host plants of mango mealy bug are tomato (*Lycopersicon esculentum*); lady finger (*Abelmoschus esculentus*); bottle gourd (*Lagenaria siceraria*); cucumber (*Cucumis sativus*); brinjal (*Solanum melongena*); chillies (*Capsicum annum*); bitter gourd (*Momordica charantia*); ridge gourd (*Luffa cylindrica*); water melon (*Cucumis melo*); ashwagandha (*Rawllfia serpentia*); parthenium (*Parthenium hysterophorus*); china rose (*Hibiscus rosa-sinensis*); nerium (*Nerium indica*); mulberry (*Mours alba*); tur (*Cajanus cajan* L. Millsp); black gram (*Vigina mungo)*; Mango (*Mangifera indica*); Guava (*Psidium guaja*); aonla (*Emblica officinalis*); lemon (*Citrus limon*); grape (*Vitis vinifera*); papaya (*Carica papaya*); pomegranate (*Punica granatum*); loquat (*Eribotrya japonica*); custard apple (*Annona squamosa* L.); ber (*Zizyphus mauritiana*); sweet orange (*Citrus sinensis*); litchi (*Litchi chinesis*); peach (*Prunus persica*); banana (*Musa paradisi*ca); Imli (*Tamarindus indica* L.); jack fruit (*Artocarpus heterophyllus*) as the host plant for mealy bug. Besides, the pest was found to perpetuates on wild plants *viz*., datura (*Datura stromonium*); husk tomato (*Physalis maxima*); parthenium (*Parthenium hysterophorus*); china rose (*Hibiscus rosa-sinensis*); bell flower (*Tecoma grandiflora* L.); lantana (*Lantana camera*); pipal (*Ficus religiosa* L.) [12].

Major host of mealy bug were papaya, cotton, shoe flower, jatropha, tapioca, mulberry, turkey berry, guava, tomato, redgram silk, brinjal, teak, country mallow, latjira, wild mustard, spider wort, chandvel, garden sprug, hazardani, dronapushpi, tulasi, congress grass, ghamra, pig weed. [13].

LIFE CYCLE OF *D. mangiferae*:

The life cycle of *D.mangiferae* completes within a month. There are three to four overlapping generations during a season each of about 28-30 days duration.

The adult:

Adult male is crimson coloured with brownish black forewings. Female bugs are 'mealy white' in colour, elliptical in shape and covered with numerous minute hairs. The adult mealy bugs colonize between bark of tree trunk, young shoots of the fruits, and on panicles. The female adult crawls down the tree in the month of April-May and enters in the cracks in the soil for laying eggs [14].

The eggs:

Oval and yellow eggs are laid in an ovisac of sculpted white wax with varying length measuring from 0.9 - 1.10 mm and breadth from 0.65 - 0.75mm as recorded at Bihar and Punjab. [11]. Morpho measurements of *D. mangiferae* egg were documented at Haryana, India [15]. Eggs of *D. mangiferae* remain in diapauses in the soil from May to middle of December [11], sometimes extending up to January [16]. The duration of diapauses of *D. mangiferae* during May to December was also found at Punjab [17]. However, hatching of egg is also influenced by temperature and annual precipitation [18]. Mealy bug lays about 336 eggs [19], pink in colour, minute and contained in an egg sack of white wax [20]. Eggs of cotton mealy bug were orange in colour and elongate which were found in clusters in ovisac [21]. The hatching time was 30-45 minutes and high ambient temperature increases its development. Hatching of mealy bug eggs at low humidity was more profound than temperature [22].

Nymph:

Moulting of mealy bug nymphs takes place after 38-80 days and ecdysis was completed within 2-5 days near the midrib on the underside of the mango leaf [23]. They further had observed that the first instar nymph was about 1.31-2.30 mm in length and about 0.70-1.90 mm in with. The second instar nymphs measure 2.9-4.7 mm in length and 1.7-2.6 mm in width. The colour of the nymphs instantaneously changes after entering into second instar to reddish brown which then transforms into light black within some days. The development of this instar is completed in about 39 days and it takes 4-5 days for moulting to attain third instar stage [24]. Third nymphal instar of mealy bug was about 4.55-7.7 mm in length and about 2.5-3.7 mm in breadth. Oviposition is generally restricted at the base of the mango tree and occasionally at some leaves of the upper branches. As the nymphs grow, the white mealy wax coverings on the body will increases. The nymphs climb the trees and settle on inflorescence causing flower drop and affects the fruit set. Nymphs secrete honey dew as excretory product which gives rise to sooty mold that alters the photosynthetic activity of the leaf [25]. Nymphs of this pest suck sap from leaves and inflorescence causing dryness leading to flower drop [14]. Duration of 1st instar for cotton mealy bug was 7-9 days at 25^{o}C [21]. Survivability of the first instrar larva decreases at 35^{o}C and the duration was extended at low temperature [26]. Elevated temperature and photoperiod significantly affected larval body weight [27].

Pupa:

The larva after complete development stops feeding and under goes pupation in dried leaf, stem or soil. After a period of 7-8 days the adult moth emerges from pupa, during summer [7]. In winter pupa diapauses in soil and the adult emerges in next summer. The reddish brown pre-pupae spin around its body to form a pupa and remains in that stage for 9-10 days before completing pupation [23]. The period of pupation may extend up to 50-57 days [16]. Nymphs started to hatch in mid-December. Mealy powder appeared just before the moult to third-instar. The nymphal period lasted for about 12-39 days and the pupal period for about 10 days. Pupal duration of 7 to 8 days at 25^{o}C also has been reported [21]. Sharp decrease in pupal duration was noted from 9.57 days to 3.78 days when the range of temperature had increased from 20^{o}C to 35^{o}C. Emergence of male mealy bug was completely halted at 40^{o}C and at 40 + 5% relative humidity. High temperature and low relative humidity resulted in increased mortality in young mealy bug nymphs [22]. Pest completed one generation in a year and diapauses in the egg stage in soil for about 7 months [24].

STATUS AND EXTENT OF DAMAGE

The mealy bug species cause considerable economic damage to agricultural and horticultural plants [28]. Both the quality and the quantity of the agro-product are greatly affected due to mealy bug infestation [29]. In West Africa, infestation of mealy bug rendered 50-90% mango fruit loss [30]. Mealy bug ranked second pests in consideration to damage to mango and after leafhopper and causes damage up to 50% to mango fruits [9]. *Chaunsa* cultivar was more susceptible to mango mealy bug followed by '*Fajli*' and '*Langra*' respectively in descending order in Punjab and Pakistan [9]. Damage to plants is principally manifested due to the unremitting sucking of 'cell sap' from tender leaves,

stem, inflorescence and even from the growing fruits. Severe infestation often leads to fruit drops or makes the fruit unfit for marketing. Considerable variation was noted in view of the extent of infestation.

IMPACT OF AGRO-CLIMATIC PARAMETERS ON THE INCIDENCE AND THE ABUNDANCE OF MANGO MEALY BUG POPULATION

Both the biotic and abiotic factors are believed to be responsible for pest population dynamics [31]. Meteorological parameters have a long term and permanent effect on insect pest population [32]. Sense on climatic parameters is thus found indispensable and obligatory to forecast insect pest incidence and accordingly to predict the extent of damage [33]. Temperature is one of the major important abiotic factors that regulate both the physiological and behavioural profile of insect organism. Maximum temperature had a positive correlation and maximum relative humidity had negative correlation with mealy bug population [34]. The effect of climatic parameters on the incidence of insect population is integrative and very rarely individualistic as noted by [35]. Seasonal incidence of mango mealy bug is positively influenced by mean temperature and humidity. The population of mealy bug was highest at the base of the tree trunk in February and lowest in December [36]. Temperature and moisture have great influence on the growth of mealy bug, development and hatching and other life parameters [37]. Agro-climatic conditions dictates and modulates the incidence of insect pest in relation to the crop phenology [38]. Most of the climatic factors are interdependent, any change of single climatic factor will lead to multiple effects on pest population and values of relation differed among the years. Hatching and transformation of different stages of life cycle depend on certain environmental condition.

EXISTING PRACTICES TO CHECK THE INFESTATION OF MANGO MEALY BUG

Plant protection procedure is of limited effectiveness against mealy bug population due to its hiding habit in crevices, and the waxy body covering [39]. Further, for long term control it requires repeated application. For this reason, chemical treatment is therefore not advised till control is not satisfactory by other methods. Cultural control is suitable for initial stage of mealy bug infestation and only in single host but may be difficult when the mealy bug attacks several host plants at the same time.

Eco-friendly approach:

Mango mealy bugs could be checked by banding of tree trunks with polythene sheet at a height of about 30 cm from the earth level and grease should be used at the lower edge of band during the 3rd to 4th week of December to prevent nymphs crawling up the tree [40].

Localized quarantine:

Regional quarantine should be employed to avoid moving infested plants or plant material from place to place and outside of the infested area. Wash plants with mild soapy water helps to dislodge mealy bugs physically by hosing down plants frequently [41].

Physical approach:

Spray:

Spray a steady stream of water reasonably with high pressure on the host plant to knock-off mealy bugs. Once on the ground, the fallen ones will be available to ground predators, and this will also make their return to the plant difficult [41].

Handpicking:

Rubbing or handpick of mealy bugs population from affected plants considerably reduces insect populations. They release chemicals that signal others to drop and also to leave the plant [41].

Pruning:

Pruning of the affected plant parts to remove mealy bugs is found effective. The most common method used by local farmers to control mealy bug is cutting down infested trees [42]. This will cut down sites of infestation and reduce future populations. Control ants, which feed on the honeydew produced by the mealy bugs. Ants also protect mealy bugs from natural enemies and transport them from place to place.

Sticky bands:

The sticky bands along with burning and burying treatments significantly reduced the frequency of infestation of mango mealy bug by 0.00-15.79%. Burlap bands reduced population of mango mealy bug nymphs by 78.98% [3].

Chemical approach:

Chemical control should be applied carefully to avoid killing natural enemies *i.e.* parasites and predators. Tree trunk should be scaled with good soil up to a height of 6-8" from the ground level. This should be followed by application of 1.5 per cent chlorpyriphos dust @ 250 g/ tree around tree trunk generally in 3rd to ^{4th} week of

December. If the process is not undertaken in December, it should be completed by the 1st week of January. If nymphs are found to ascend the trees, spray of carbosulfan (0.05%, 25 EC, @ 2 ml/liter of water) or dimethoate (0.06%, 30 EC @ 2 ml/liter of water) during January-March as per requirement is suggested [43]. Maximum mortality of 1st instar mango mealy bug was observed in case of Mospilan treatment applied with 80, 85 and 91% after 24, 72 and 168 h of spray. In case of 2nd and 3rdinstar, Decis and Curacron gave maximum mortality 71 and 70, 24 h after spray. Supracide was found to be most efficient insecticides for the control of adult female at all the post treatment intervals i.e. 60, 72 and 73% mortality under field conditions [44].

In laboratory conditions profenofos showed maximum percent mortality of 93.3% and 86.67% of the 1st and 2nd instar mango mealy bug. While triazophos proved to be an effective insecticide for the control of the 4th instar by showing 64.0 and 100% mortality in leaf dip method and foliar application. Out of seven insecticidal band applications tested in the field conditions, the combination of cotton + buprofezin proved effective by manifesting 99.10% control of mango mealy bug. Profenofos, methomyl and triazophos, and cotton + buprofezin band application provided effective control of the mango mealy bug. The control of this insect pest throughout the orchards predominantly depends on judicious use of chemicals like profenofos, triazophos, methoniyl, acetamiprid, buprofezin and deltamethrin, for the development of an integrated pest management strategy [45].

Systemic insecticides are only the immediate option to control heavy infestations [46]. Acephate 75 WP @ 2g/lit recorded 11.11 per cent infestation followed by dichlorvos @ 1 ml/lit (21.11 %), profenophos 50 EC @ 2 ml/lit (32.22%) at 5 DAT. *B. bassiana* @ 5 g/lit, Consortia @ 10 g/lit and Consortia + *B. bassiana* (5 + 5 g/lit) recorded 57.78, 66.67 and 57.78 per cent infestation, respectively. Spray or drench the mango roots with imidacloprid every 5-6 weeks are also very helpful for further infestation. Spray of other insecticides such as Perfekthion, Neemex, Carbaryl, white (mineral) oils are helpful. Recommended chemical insecticides includes profenophos 50 EC (2 ml/litre), chlorpyriphos 20 EC 2ml/litre), buprofezin 25 EC (2 ml/litre), dimethoate 30 EC (2 ml/litre), thiomethoxam 25 WG (0.6 g/ litre), imidacloprid 17.8 SL (0.6 ml/litre) for mango orchards.

Biological control of mealy bug:

Success of mealy bug control programmed has been attributed due to the application of parasitoids on mealy bug pests [47]. Release of parasitoid wasps, *Acerophagus papaya* [48], *Anagyrus loecki*, *Anagyrus californicus* Compere, and *Pseudaphycus* sp., *Acerophagus* sp. has brought a 99.7% reduction of mealy bug density at Dominican Republic, and 97% reduction at Puerto Rico [49], with parasitism levels between 35.5% and 58.3% respectively. *Pseudleptomastix maxicana* is a potential parasitoid for papaya mealy bug [48]. Among the predator the larvae and adults of Australian ladybird beetle, *Cryptolaemus montrouzieri*, *Scymnus* sp., *Diadiplosis coccidarum* (Cockerel), lacewing larvae and adults and Syrphid (hover fly) larvae are important. *Spalgis epius*, a carnivorous butterfly feed efficiently on the ovisacs, nymphs and adult of mealy bug [50].

CONCLUSION

The presence of large alternative host range of mealy bug causes its persistence throughout the year, makes them a great threat in agricultural fields. Alteration of environmental factors may effect on their life cycle thereby effecting time of infestation. By following the life cycle and seasonal dynamics, mango mealy bug population can be checked. To mitigate the fruit loss due to mealy bug infestation, successful pest prediction methodologies are expected that able to forecast the pest dynamics accurately for better production and make environmental less hazardous. Pest forecasting system is an important component of IPM which can reduce the cost of cultivation and frequency of application of pest management measures and environmental safety by reducing chemical usage.

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