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Gradient Outbreak of Coconut Slug Caterpillar, *Macroplectra nararia* Moore in East Coast of India

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Abstract

Gradient outbreak of coconut slug caterpillar. *Macroplectra nararia* Moore (Limacodidae: Lepidoptera) in East Godavari district, Andhra Pradesh during April-May 2009 is closely interlinked with rise in ambient temperature and humidity along the water bodies. This favoured large scale explosion of pest population leading to widespread damage in coconut plantations ranging from 90-95% in severely affected gardens, indicating the sporadic nature of the pest. Exacerbation by grey leaf blight fungus, *Pestalotiopsis palmarum* accelerated the damage causing rampant scorching of coconut leaflets in pest affected gardens. In the field, some caterpillars were found infected by entomopathogens. Light trapping is suggested as an effective monitoring tool and a feasible mechanical control strategy of the pest.

Keywords: coconut slug caterpillar, *Macroplectra nararia*, gradient outbreak

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Introduction

Climatic variables such as temperature and precipitation limit population growth for insect species (Gutierrez, 1987). Climatic patterns form a major part of the abiotic setting for population and community interactions of a species (Huffaker and Messenger, 1964). Temperature and moisture are critical factors in the growth of host plants of herbivorous insects and of their invertebrate predators, parasitoids and pathogens. Outbreaks are thought to be triggered by several successive years of weather conditions favourable to population growth. Outbreaks can be of eruptive in nature driven by intrinsic population processes and trophic-level factors. It can also be gradient in nature as a consequence of changing environmental factors favouring population growth. Clearly, gradient outbreaks are very likely to be caused directly by climate change, whereas eruptive outbreaks are much less likely to be affected by it.

Coconut provides livelihood securities to more than 10 million people in 18 States and 3 Union Territories of India. The crop occupies an area of 1.9468 million ha with a production of 15,840 million nuts (2006-2007). It is a source of permanent income to 5 million farm families (Mathew, 2008). Extensive damage to coconut palms by slug caterpillar, *Macroplectra nararia* on the East Coast of India was reported by Nirula (1955) and Menon and Pandalai (1960). In a recent survey conducted during May 2009 at East and West Godavari districts of Andhra Pradesh there has been a gradient outbreak of this indigenous species of slug caterpillar, *M. nararia*, in large areas of about 3000 ha of coconut gardens. East Godavari has 49,592 ha under coconut producing 6130 lakh nuts whereas West Godavari has 22,664 ha producing 3838 lakh nuts out of 1,05,043 ha and 12264 lakh nuts produced by Andhra Pradesh during 2006-2007.

Materials and Methods

Four representative mandals *viz*., Sakhinetipalli, Razole, Mamidikuduru and Island Polavaram of East Godavari district and two mandals *viz.*, Yalamanchali and Palkoderu of West Godavari district, Andhra Pradesh, India were surveyed for the occurrence of coconut slug caterpillar and percentage level of infestation was worked out based on the intensity of infestation from randomly selected 100 palms in at least two villages in each mandal. Various stages of the pest were examined for the presence of any biocontrol agent. Temperature and relative humidity of the region was obtained from Horticultural Research Station, Ambajipet to correlate its effect on the pest, *M. nararia*.

Results and Discussion

Description of life stages and damage of the pest

The eggs are very tiny, scale-like and translucent and laid on coconut leaflets. The early-instar caterpillar feeds on undersurface of coconut leaflets by scrapping the surface tissues giving a glistening appearance on the feeding area. Leaf spot-like black halo marking develops on the feeding areas which later coalesce and form bigger lesions. The caterpillars of early instars consume only the epidermis of leaf tissue, leaving the adaxial surface intact. Feeding damage is often exacerbated by grey leaf blight fungus, *Pestalotiopsis palmarum* which may infect leaf tissue breached and damaged by early larval instars. This association has been reported from slug caterpillar species such as *Chalcocelis albiguttatus*, *Darna catenatus*, *D. trima*, *Parasa balitkae*, *Setora nitens* and *Thosea lutea* (Holloway *et al*., 1987).

In general, caterpillars are short, fleshy and slug-like wherein suckers have replaced the typical larval prolegs, and the larvae seem to glide rather than crawl. Caterpillars are yellowish-green with V-shaped black markings on the mid dorsal line and tubercles along the margin. Tubercles at caudal end are longer than the rest (Sujatha *et al*., 2008). The last-instar larvae are voracious feeders on the lamina. In addition to the damage that this caterpillar causes to plants by their feeding, their urticating setae can cause minor but painful injury to workers in plantations and nurseries (Howard *et al*., 2001). In oil palm, the slug caterpillar *Darna minanensis* causes extensive damage during their immature larval stages (Gallego *et al*., 2001).

Pupae are enclosed in a small 5-7 mm ovoid brownish shell sparsely covered with yellowish brown silk and are attached to the leaflet. Adults of *M. nararia* are small brownish moth with faint stripes (Nair, 1986). Adult moths are ephemeral, active during night and are attracted to bright light. Hence, light traps can be used to catch the adult moths (PCA-UNDP/FAO Report, 1994).

Scorched / burnt appearance of leaves is the characteristic symptom observed in the field on severe infestation. When larval population increases, caterpillars start feeding on green petioles, spathes and nuts besides feeding on leaflets. In severely infested palms, all functional leaves are dried up leaving only the inner leaves thus affecting the photosynthetic efficiency of the palm. When the lamina portions of the leaflets are completely eaten away by the caterpillar, the lower and middle whorls Premature drooping of leaves and shedding of nuts were also observed in heavily infested gardens bringing drastic reduction in nut yield. In severe infestation, the pest attacks other plants grown in the garden like cocoa, banana, weeds *etc.* indicating its polyphagous feeding habit. Damage symptoms and life stages of the pest are illustrated in Plate 1. The pest incidence was found recurring in Sakhinetipalli, Razole, Mamidikuduru, Island Polavaram, Yalamanchali and Palkoderu from 2004 onwards.

Effect of climatic factors on pest outbreak

Severe damage was observed during the last three years coinciding with higher temperature (>39^{o}C) and humidity (>85%) in these tracts during April-May. In Yedurlanka village of Island Polavaram mandal of East Godavari district, the coconut slug caterpillar incidence was reported as early as 1998. Similar gradient outbreaks of coconut leaf eating caterpillar, *Opisina arenosella* Walker have been reported from parts of Kerala along the course of permanent water bodies wherein the temperature did not raise beyond 39^{o}C (Menon and Pandalai, 1960). In Sri Lanka, most outbreaks of *O. arenosella* occur between October and February, when cooler temperature inhibit the development of parasitoids (Perera, 1987). It is therefore inferred that ambient temperature as well as the relative humidity are key climatic elements favouring the gradient outbreaks of slug caterpillar under coconut system. In all the tracts surveyed, the peak incidence was reported during April-May even though different stages of pest could be observed from early March onwards. During this period (April-May 2009) the average maximum temperature in the affected fields was recorded as 38.8^{o}C and 39.5^{o}C, respectively. The mean relative humidity during April-May 2009 was 87.9% and 82.7%, respectively (Fig.1 and Fig. 2). However, the temperature ranged from 36-41^{o}C during April and 36-42^{o}C during May 2009. In our observations maximum larval population was observed during March-April (24-25 larvae/ leaflet). In the field the build up of the pest was noticed in March onwards when the mean temperature was 35.2^{o}C and the outbreak level of the pest could be noticed in April where the field temperature reached beyond 39^{o}C and relative humidity as high as 88%. The pest population was found receding with the receipt of rain consequent to drop in temperature as well as build up of natural enemies.

The increase in temperature can make an impact on the change in the landscape of the ecosystem that would lead to occurrence of new pests and diseases. Similarly stresses on the ecosystem could create natural disturbances which are critical to the functioning of the ecosystem and lead to upsurge of new species of insects and their outbreak. There could be also an increase in frequency and intensity of pest outbreak through the direct effects of climate change on insect population and disruption of community interaction (Eusebio, 2009). In our investigation we could observe an increase in the rate of pest incidence and intensity of pest outbreak of *M. nararia* in the affected fields with rise in temperature (Fig 1).

The following representative mandals were surveyed and percentage level of infestation was presented in Table 1.

In general the intensity of infestation was found to be higher in East Godavari district (50-90%) than West Godavari district (5-70%). In

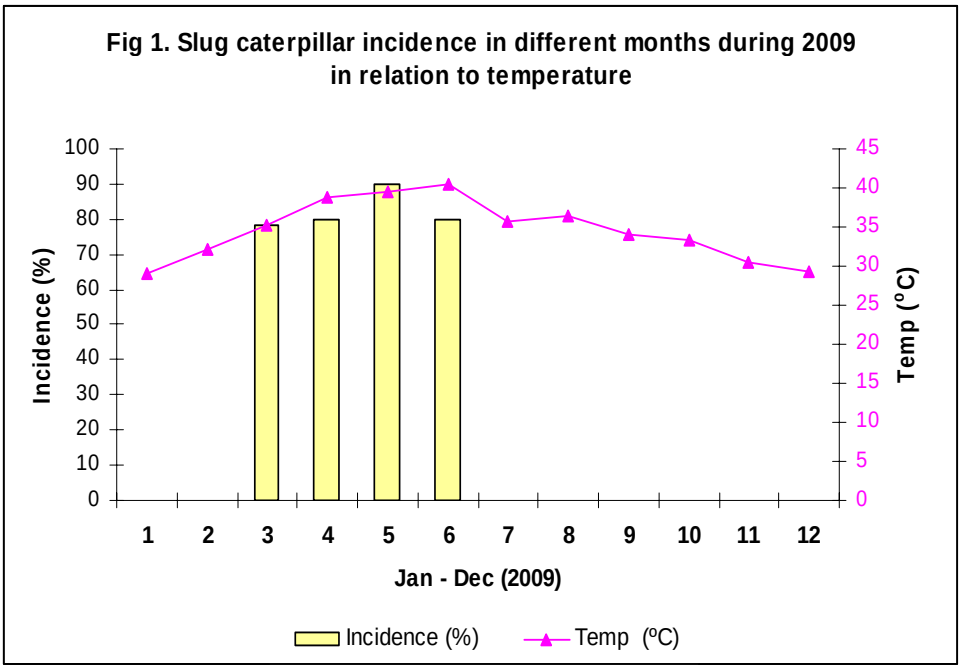
Fig 1. Slug caterpillar incidence in different months during 2009 in relation to temperature
Incidence (%)
Temp (°C)
Jan - Dec (2009)
Incidence (%)
Temp (ºC)

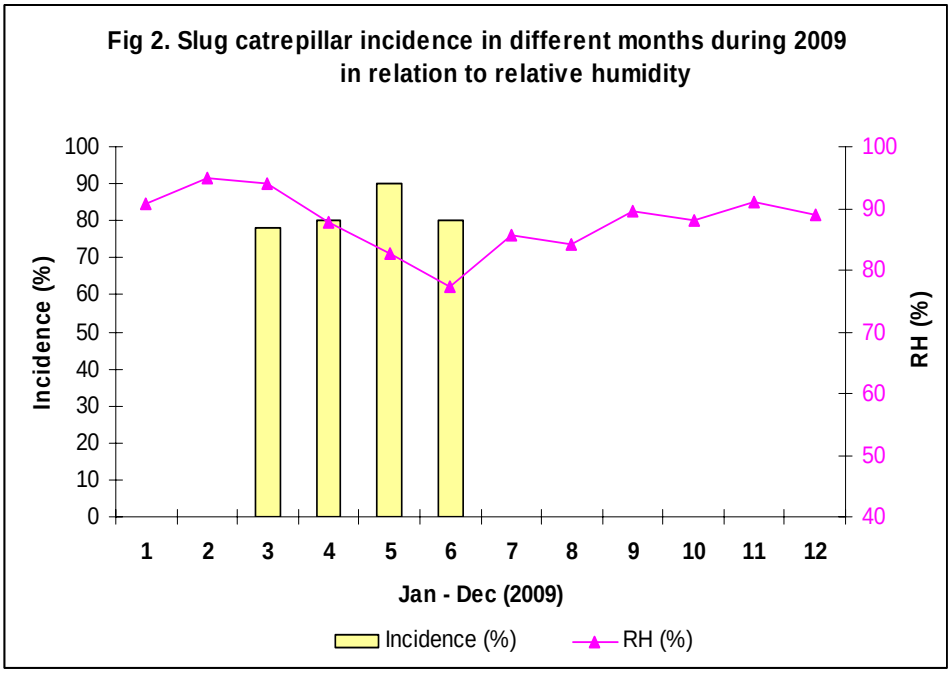
Fig 2. Slug catrepillar incidence in different months during 2009 in relation to relative humidity
Incidence (%)
RH (%)
Jan - Dec (2009)
Incidence (%)
RH (%)

Table 1. Area surveyed and pest infestation levels in Andhra Pradesh

District	Mandal	Level of infestation (%)
East Godavari	Sakhinetipalli	80-90
	Razole	50-55
	Mamidikuduru	60-70
	Island Polavaram	70-80
West Godavari	Yalamanchali	60-70
	Palkoderu	5-10

most of the gardens examined in East Godavari district the intensity of infestation was found to be higher on account of closer planting of palms which provides a conducive microclimate favourable for the build up of the pest. However, the incidence was comparatively lower in those plots where palms are raised with recommended spacing. Coconut palms that are located near to permanent water bodies are found to be highly susceptible due to the prevalence of higher humidity coupled with high ambient temperature.

Effect of infestation on crop loss

The crop loss in terms of nut yield due to the pest infestation was found to be very high ranging from 90-95% in severely affected gardens. As all the leaves of middle and lower whorls are dried, the nut production has been totally affected and vigour and vitality of the palms are completely lost. Scorching of coconut leaves are more aggravated during hot weather condition prevailing in the region. Similar outbreaks of coconut slug caterpillar have been reported from a 15 acre garden in Devanahalli taluk near Karnataka during May 1995 (Mallik *et al*., 1996) and previously from Athreyapuram, Razole of East Godavari district, Andhra Pradesh during May 2007 (Sujatha *et al*., 2008). The outbreak of *Menosca* sp. (Homoptera: Lophopidae) on coconut resulted in a significant yield loss as high as 50% in one year after initial attack (Gallego, 1986). The pest *M. nararia* inflicts higher yield losses as the functional leaves of the palms were dried thereby affecting the nut production of the palm. The extent of crop loss due to the pest has to be systematically studied in the endemic areas in detail; however, it takes about 20-24 months to recoup the vitality of affected palms for which good nutritional management and irrigation are essential.

Natural enemies under field conditions

A close examination of dead caterpillars in the locality revealed the presence of small exit holes of parasitoids on the body of the slug caterpillar. However, no parasitoids / predators could be collected from the field during the survey. Some caterpillars were found infected by entomopathogenic fungus *Aspergillus* sp. Search for natural enemies and their augmentative release will be an ideal solution for the bio-suppression of the pest. Success stories on the augmentative release of parasitoids such as *Goniozus nephantidis*, *Bracon brevicornis*, *Elasmus nephantidis* and *Brachymeria nosatoi* on bio-suppression of *O. arenosella*, a pest of similar nature are well documented (Chandrika Mohan *et al*., 2008). Larvae of *M. nararia* are parasitized by *Eurytoma tatipakensis* Kur., *Euplectromorpha natadae* Kur. and *Secodes nararіae* Kur (Nair, 1986). The nymphs and adults of the pentatomid bug *Cantheconidea furcellata* (Wolff) were found predaceous on larvae of *M. nararia* (Malik *et al*., 1996). Efforts are also made for evaluating *Bacillus thuringiensis* and *Beauveria bassiana* against *M. nararia*.

Monitoring and suppression of the pest

Establishment of light traps in endemic tracts proved effective in monitoring the pest incidence well in advance. Such an indicator could forewarn the outbreak of pest and thereafter effective prophylactic measures could be initiated. In oil palm, regular monitoring and trapping of adult moths of the slug caterpillar *Darna mindanensis* by use of UV light traps were effective in reducing the pest population below economic threshold level and increasing the yield to the tune of 24.3% (Gallego *et al*., 2001). Pest forecasting model using temperature and relative humidity data would be quite

beneficial for the farmers to get activated for implementing Integrated Pest Management strategies against coconut slug caterpillar.

Conclusion

Gradient outbreaks of insect pests have been correlated with climate change which is a result of higher emission level of green house gases and rise in temperature globally. Outbreak of coconut slug caterpillar is closely associated with increase in ambient temperature as reported from Andhra Pradesh and Tamil Nadu during 2009. Emergence of insect pests on coconut such as slug caterpillars (*M. nararia*) and rampant scorching of coconut leaflets under high temperature could be attributed as an effect of climate change. Though prediction favours the emergence of sucking insects as an outcome of climate change (Hogenhout *et al*., 2008), instances of widespread outbreak of lepidopterous pests such as coconut slug caterpillars were recorded in the epidemic spots. In Kerala, where coconut is extensively cultivated in India, the non-occurrence of coconut slug caterpillar (*M. nararia*) in epidemic proportions can be attributed to the fact that the average ambient temperature of the State does not shoot beyond 40^{o}C along the vicinity of water bodies. Establishment of light traps in endemic tracts could help in monitoring of the pest and can be used as an effective mechanical control strategy. Studies on natural enemies of the pest, crop loss assessment and management strategies have to be investigated in detail.

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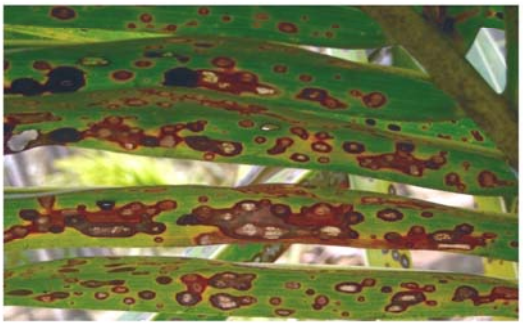
Plate 1. Damage symptoms and life stages of *M.nararia*

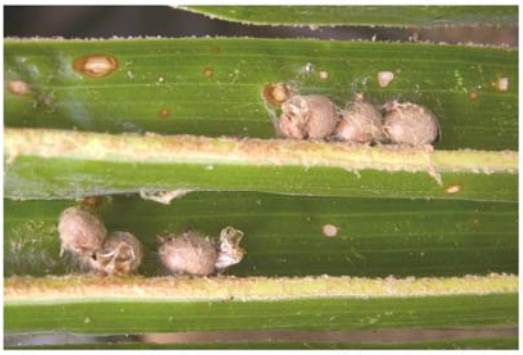
a) Slug caterpillar infested coconut garden

b) Severe incidence of slug caterpillar on palms near water bodies



c) Grey leaf blight fungus on slug caterpillar fed leaves

d) Different instars of slug caterpillars

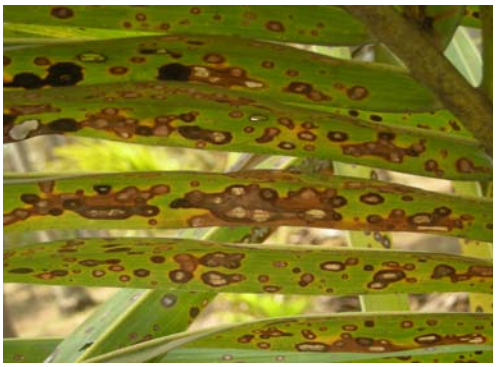


e) Ovoid shell cocoons

f) Adult moth

Slug caterpillar infested coconut garden

Severe incidence of slug caterpillar on palms near water bodies



Grey leaf blight fungus infection on slug caterpillar fed laves

Different instars of slug caterpillars

Ovoid shelled cocoons

Adult moth