



SUSTAINABLE ECOFRIENDLY MANAGEMENT POLYPHAGOUS DEFOLIATOR PESTS OF GROUNDNUT: A REVIEW

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Abstract

Pea nut is legume crop having fourth valuable oilseed in the world. Large number of insect pest attack on this crop but only few defoliator crossed economic threshold level and decrease production. Advanced breeding lines possessing resistance to major insect pests is in pipe line. Biocontrol agents like NPV against *Spodoptera litura*, *Helicoverpa armygera*, and thuricides for red hairy caterpillar. Early sowing of groundnut escape incidence of pest as well as use resistance variety like BG-2, M13, ICGV8603 and ICG57 Ground intercropped with soybean, pearl millets and cowpea at the rate of 4:1 to avoid the outbreak of pest leaf miner. New approaches like pheromones for gram pod borer, tobacco caterpillar and leaf miner, and use of neem products against major insect pests would go a long way in reducing the economic pressure of farmers. If all possible pest management tools are integrated in an optimum proportion and proper monitoring of pests activity is strengthened further, maximum production gained by farmer.

Key words: *Spodoptera litura*, *Helicoverpa armygera*, red hairy caterpillar, leaf miner and NPV.

Introduction

Pea nut is an annual legume crop, also known as ground nut, earthnut, monkey- nut and goobers. It forms the world's largest source of edible oil and ranks 13th among the food crops and is also 4th most important oilseed crop of the world. It is grown in tropical and subtropical countries. Cultivated groundnut has been reported from South America (Weiss, 2000), it is one of the most valuable cash crops for our country. It is a low priced commodity but a rich source nutrient. It has sixth rank among oilseed crop in the world. It contains 48-50% of oil and 26-28% of protein, and is a rich source of dietary fiber, minerals and vitamins. Its cultivation is 26.4 million ha with a total production of 37.1 m metric tonnes and an average productivity of 1.4 metric t/ha. Worldwide groundnut is grown over 100 countries. Developing countries constitute 97% of the global area and 94% of the global production of this crop. The production of groundnut is concentrated in Asia and Africa with 56% and 40% of the global area and 68% and 25% of the global production, respectively.

Foliage feeder pest cause serious damage and significant reduction in yield of preferred crops including oilseed (Singh and Singh, 1992). It is known fact that the Red hairy caterpillar, Bihar hairy caterpillar, Tobacco caterpillar and Gram pod borer showed certain levels of behavioral resistance to various type of chemical (Mandal *et al.*, 2013) hence successful control of this pest is to some extent difficult. Traditionally synthetic pesticides have been the most effective means of pest control but, continuous and indiscriminate use of insecticides over the years has resulted imbalance in our agro ecosystem (Pavela, 2012) The risk to human health and environmental side effects have force to

look for greener alternatives like botanicals (Koul *et al.*, 2008; Yadav *et al.*, 2015). Today, crop production must also ensure healthy, ecofriendly and sustainable food supply to us. The use of botanical resources for agrochemical purpose is one of the important alternatives to manage insect-pests in place of synthetic insecticides (Isman, 2006; Pavela, 2007).

1. Red hairy caterpillar: *Amsacta albistriga*, Walker

Distribution and status: *Amsacta* is economically the most important genus of Arctiinae in India. It includes the red hairy caterpillar *Amsacta albistriga* (Walker). *A. moorei* (Butler) and *A. lactinea* (Cramer). *A. albistriga* is a serious pest in South India whereas *A. moorei* is serious in North India. This pest widely in the orient including India. It feed all type vegetation of kharif season act as polyphagous in nature.

Host range: Agricultural crops of Kharif season.

Mark of Identification: Full grown caterpillar is 25mm in length of different colour variation from radish -amber to olive green body fully covered by numerous long hairs grown from fleshy tubercles. In adult wings are white with black spot and stoutly build. The anterior of thorax, whole abdomen and outer margin of forewing are scarlet red in colour. Abdomen covered by black dot and bands.

Damage symptoms: Newly hatch caterpillar of this pest is called 'kutra' that prefer to feed on growing point of crops and later they start feed voraciously vegetative part of plant their results reflect like disaster. After devastating one field completely they show army like movement toward another field due to its several infestation there may chance complete failure of Kharif crop.

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Life Cycle: Incidence and activeness of this pest start from June to end of August and rest of time period of years have pupal stage in soil. Emergence of moth start after first shower of monsoon from pupae. Adults are mostly active at night time and deposition of pale yellowish spherical shape eggs masses in bunch of 750-800 under lower surface of leaf of host plant. Fecundity of adult is up to 1500, hatching period 2-3 days. Larval time span completed by passing six instar within 15-23 days later on they enter in the soil up to depth of 23cm before this shed their hair and make earthen cocoon. This stage remain in soil for many month till emerge next year from cocoon.

ETL: 20-25 percent defoliation of crop at 40 days after emergence.

Management:

Cultural practices: Collection and destruction of pupae at the time of ploughing in summer this same work perform for egg masses and larvae formation. Digging the trench around the field for migratory movement from infested field to another. Vegetative trapping of migratory larvae by keeping of twigs of *Jatropha* or *Calotropis* Grow cowpea and Pigeon pea as border crop to attract adult for oviposition purpose.

Mechanical practices: Moth are strongly attracted toward artificial light due to nocturnal habit establish 4-5 light trap per hectare of electric or petromax lamp keep just above a broad flat basin full of kerosenized water should be put on night following the first shower of monsoon and continued throughout period of adult emergence. The grown up larvae destroyed by crushing them under feet or deep in to kerosenized water.

Biological practices: Jacob and Subramaniam (1972) for the, first time isolated a nuclear polyhedrosis virus from the larvae of *A. albistriga*. Field studies have been carried out in Tamil Nadu to test the efficacy of the virus against the RHC (Jayaraj *et al.*, 1976; Chandramohan and Kumaraswami, 1979; Rabindra and Balasubramanian, 1980; Baskaran *et al.*, 2001). Spray AaNPV @ 250 LE/ac or dose of 1.5×10^{12} POB/ha was as effective as chlorpyrifos @ 20g a. i. / ha against red hairy caterpillar (Veenakumari *et al.*, 2005) third instar stage or *Bacillus thuringiensis*.

Botanical practices: Patel, 1968 evaluated efficacy of neem seed extract, neem leaf extract at 10% and neem oil 2% in comparison with Monocrotophos on the hairy caterpillar *Amsacta albistriga*. Though Monocrotophos gave the highest pod yield, crude neem oil gave 1542 kg/ha pod which was significantly higher compared to control.

Chemical practices: In case of tremendous attack spray 1.25 lit. of Quinalphos 25 EC or dichlorovos 100 EC 500-625 ml/ha (or) chlorpyrifos 1250 ml/ha in 500 liter of water for quick control.

2. Bihar hairy caterpillar: *Spilarctia obliqua*, Walker

Distribution and Status: It is sporadic pest and widely distributed Orient. Its incidence in Bihar, M.P., U.P. and

Punjab in India (Singh and Singh, 1992).

Host Range: Larvae are a notorious pest and a major limiting factor in oil production. It is a polyphagous and sporadic pest attacking nearly 126 plants species distributed in 24 families (Singh and Varatharajan, 1999) cause extensive damage to crops such as oilseeds, pulses, vegetables, fodder, fiber crops, and fruit trees (Singh and Singh, 1992).

Mark of Identification: Caterpillars are covered with long grayish hairs 5cm in length having body length 40-45mm in fully growth condition. Wing expansion of moth 50mm. Head and thorax under side of body are pale yellow and black colour antennae as well as eyes are present in moth.

Life cycle: Biology of the Bihar hairy caterpillar, *Spilarctia obliqua* (Walker) reared on field bean leaves revealed that the eggs were creamy white when laid became pale yellow in colour before hatching. The number of eggs per mass varied from 148 to 232. Egg, larval and pupal period varied from 5 to 6, 20 to 21 and 8 to 9 days, respectively. The average eggs laid by a female moth were 148 - 232. Larvae had six instar with a total larval duration of days. The length of male and female moth varied from 51 to 55 mm and 55 to 59 mm, respectively. The total life span of male and female ranged from 37 to 42 days and 39 to 44 days (Warad and Kallleshwaraswamy, 2017).

Monitoring: By using pheromone traps at the rate of five per hectare flying intensity of male moth recorded and defoliated percent of leaf.

Economic and action thresholds: ETL is 20-25 percent damaged leaves observed.

Management:

Botanical practices: Efficacy of two botanicals [Mahogany (*Swietenia mahagoni*) and Indian beach or karanja [*Millettia (Pongamia) pinnata*] leaf extract] in 5% neem oil individually and in combined mixture for determination of LC90 by Log-probit analyses. Due to lowest LC90 value of the combined botanicals in 5% neem oil (16.49%, w/v) over the synthetic pesticide (Indoxacarb @ 5%) was used for sustainable and ecofriendly management of *S. obliqua* on the crop in the field conditions. (Parui and Roy, 2016) other management practices are similar like red hairy caterpillar.

3. Tobacco caterpillar: *Spodoptera litura*, Fabricius

Distribution and status: Occurrence of this pest takes place Tropical and sub-tropical.

Host range: Agricultural crops.

Mark of Identification: Full grown caterpillar measure 30-40 mm in length act as main destructive stage of crop. Larvae have velvety black, white lateral bands with yellowish green upper side stripes. Size of adult moth 22mm long and wing expansion 40mm. its forewing have most attractive due to develop golden and grayish brown pattern.

Nature of damage: Newly emerge larvae start scrapping chlorophyll content at night time. Later they consumed whole vegetative portion and plant get defoliated. At the day time

larvae hide around the base of the plants in the soil. At the time after heavy feeding that only petioles and branches are left behind.

Life cycle: Egg laying process of this pest carried whole year but its growth and development became slow in winter season. After mating females start deposition of eggs near about 300 egg mass in bunch covered by brown hairs on the abaxial surface of groundnut leaves at night. Incubation period 3-5 days. Larval time span completed by passing six instar within 15-30 days. Full grown larvae enter in soil for pupation purpose for 7-15 days. Longevity of adult 7-10 days. Lifecycle completed in 30 days with 12 generation annually in southern India (Jasani, 2009; Mallikarjuna *et al.*, 2004). Earthnut and its wild species show host plant resistance due to presence of three flavonoids chlorogenic acid, quercetin and rutin against this pest (Mallikarjuna *et al.*, 2004).

Monitoring: For monitoring purpose set up at the rate of ten pheromone trap per hectare.

Economic and action thresholds: ETL for this pest is 20-25 percent defoliated plants at 40 days after emergence (Bhubaneswar, 2008).

Management:

Cultural practices: Apply proper intercultural operation like in summer deep ploughing expose pupae for bird feeding and sun drying. Early sowing helpful to reduce incidence of pest reason behind unfavorable weather condition. Use resistance cultivar like BG-2, ICGV-86031 and FRDS10. Castor and Sunflower use as trap crop to attract female moth for oviposition and destruction of newly hatch larvae.

Mechanical practices: After 15-20 days of sowing by mechanical weeding reduce oviposition site of this pest. Installation of light traps for attract moth.

Biological practices: *Telenomus remus* (Nixon), *Apanteles africanus* (Cameron), *T. chilonis* @50000/ha, followed by 7-10 days interval followed by *B. hebetor* @ 5000/ha two time at 7-10 days interval in two times. Spraying of S1-NPV@250LE/ha. Sahayaraj & Martin (2003) reported that *Rhynocoris marginatus* (F.) significantly reduced *S. litura* population (85.89%). Natural enemies, *Compoletis* species, *Rogas sp.*, *Strobliomyia orbata* effective to larval population.

Botanical practices: Neem kernel suspension (1%) and neem seed extract shown growth inhibition on the *H. armigera* and on *S. litura* larvae (Kuhn and Demski, 1984; Logiswaran and Mohanasundram, 1985). The neem based insecticides (Margoside OK and CK) suppressed the *S. litura* damage as there were least foliage damage in groundnut and also gave higher pod yield (Anon, 1991). Growth regulating hormones for *S. litura* have been recorded from 43 plants species belonging to 27 families. Among them Indian neem (*Azadirachta indica* A Juss.), *Pongamia glabra* and *Parthenium hysterophorus* are important.

Chemical practices: Spraying of emamectin benzoate 0.005%, chlorpyrifos 0.05%, cypermethrin 0.016 % and chlorantraniliprole 0.006% were found to be the most effective (Kumar *et al.*, 2015)

4. Leaf miner: *Approeroma modicella* Deventer

Distribution and status: This pest is distributed all over India, Sri Lanka, Pakistan, South Africa and Myanmar. In India it is most serious in Tamil Nadu.

Host range: Although it has been reported feeding on other plants, but it is consider serious pest of Groundnut only.

Mark of Identification: Eggs deposition of adult takes place lower side of leaf one by one. Adults are dark brownish having white spot on the costal margin of each forewings. Hind wings are small covered with minute hairs. Occurrence of adult briskly whirling around plants.

Nature of Damage: larvae start feed on green tissue and leaflet and create brownish patches result in drying of leaf later instar larvae gradually beginning folding and gathering of leaf as result formation of mines skeletonizing and webbing of leaf takes place cause serious loss of crop. Pest attack on crop in rainfed condition from September to November and in irrigated March to April month.

Life cycle: During day time the moth remain concealed under clods of soil or in the crevices. They became active at night when they are also strongly attracted toward light. Female moth lays 150-200 eggs on the apical vegetative part of plant. Hatching duration 2-3 days. The newly hatch caterpillar measure about 1.5mm in length. After wondering about for some time, it mines in to leaves and later on bites its way out, it then web together a number of leaflets and feed inside the chamber, thus formed. Immature stage in final instar having length of 6-8mm for attains this size required 4-17 days and convert in to pupa that have silken cocoon within web leaflet with reddish brown in colour and finally through it adult emergence takes place survived 5-6 days. In time span of 20-25 days whole life cycle completed.

ETL: 5 mines per plant at one month after crop germination followed by 10 to 15 mines per plant found after 50 to 75 day respectively.

Management:

Cultural practices: A significant negative correlation was observed between incidences of leaf miner with maximum-minimum temperature, positive correlation was existed with relative humidity and maximum-minimum temperature. In an another experiment, groundnut either as pure crop with 30 x 10 cm or 20 x 10 cm spacing alone with straw as mulch gave the maximum control of leaf miner as well as increased the percent larval parasitization (Muthiah *et al.*, 1991) With regard to intercrop, cowpea with groundnut turn out to be better combination with least larval population. Interestingly, groundnut with paddy straw mulch resulted in least weed number/unit area. (Nofal *et al.*, 1990) a report indicated that low incidence (20.8%) of leaf miner, when bajra was intercropped in groundnut, apart from giving higher net income. The same authors reported 74% reduction in egg lying by leaf miner on the foliage treated with 10% concentration of bajra leaf extract in water. A highly significant positive correlation was observed between 3

generation of leaf miner and percent leaflets attacked and larvae per plant. The population of leaf miner moth catch was high in the month of October followed by August and September (Subrahmanyam *et al.*, 1990) reported high leaf miner population at high plant populations levels irrespective of varieties or level of nitrogen applied. This observation was further confirmed as there was highly significant positive correlation between the plant density and leaf miner incidence ($r=0.588$). Yield reduction was more when groundnut was intercropped with pearl millet (986.7kg/ha), while in the sole crop the yield was 1300 kg/ha which was on par with yield of cowpea intercropped in groundnut (Mohammad, 1981) Early sowing of groundnut escape incidence of pest. Use resistance variety like BG-2, M13, ICGV8603 and ICG57 Ground intercropped with soybean, pearl millets and cowpea at the rate of 4:1 to avoid the outbreak of pest (Kennedy and Raveendran, 1989).

Mechanical practices: Raising of Pheromone trap at the rate of 20-25/hectare for monitoring. Set up 5-6 light traps/ha for attraction and destruction of moth (Logiswaran and Mohanasundram, 1985) make field free from weed to avoid oviposition sites and destroy egg mass on trap as well as groundnut crop.

Botanical control: use of NSKE@ 12 kg ha⁻¹ can control pest population by disturbing in egg lying of female. Crude neem oil has been successfully utilized in the management of gram pod borer, hairy caterpillar and leaf miner in groundnut.(Chandramohan and Sivasubramaian, 1987) Ovicidal property of crude neem oil was demonstrated recording 100% suppression of eggs of leaf miner (Patel, 1968).

Biological practices: Among 28 parasites recorded from South India, Maharashtra and Gujarat none were put to use under field conditions. a peak (23.5%) in the parasitism of leaf miner during October, while (Kuhn *et al.*, 1978) reported 38-83% parasitism during August to September from Maharashtra. Mean parasitism of 50% during March-May by *Gonizus* sp. and 79.2% by *Stenomiesius japonicus* (Rajagopal *et al.*, 1988) reported a fungus *Aspergillus flavus* on the larvae of leaf miner. Occurrence of a mermithed nematode from larvae of leaf miner was also reported (Lewis, 1973). The eggs of this pest are parasitized by *Trichogramma chilonis* at the rate of 50000/ha (Trichogrammatidae) two times at 7-10 days interval followed by Braconids, *Bracon hebetor* Say and *Apanteles javensis* Rohwer (Braconidae), eulophids, *Asympiesiella indica* Girault, *Stenomiesioideus ashmeaddi* Subha Rao @ 5000/ha respectively. *Euplectrus* sp. (Eulophidae), parasitize its larvae. Activity of predator like lady bird beetle and spider are highly effective for reduce population in intercropping of groundnut with maize as compare monocropping of groundnut (Yadav *et al.*, 1987).

Chemical practices: When pest population cross the ETL either dusting with Carbaryl 10 D @ 25 Kg /ha or spraying of Lambda Cyhalothrin 5EC 200-300ml, Quinolphos 25EC 750ml, Dichlorovos 76SC 625ml/ha in 375 Lit. of water.

5. Gram pod borer: *Helicoverpa armigera*, Hubner

Distribution and status: Cosmopolitan, *Heliothis zea* is native of USA, Exotic pests in India, tropics and subtropics.

Host range: Polyphagous in nature.

Mark of Identification: Size of moth is about 35 mm long having small light patches in dark area of hindwings border dull black and 'V' shaped speck on forewing having grayish wavy lines and different size black spot on upper side and underside kidney shaped round spot. Moth is stoutly built and yellowish brown in colour. Diameter of eggs 0.5mm, longitudinal rib. At six instar caterpillar have 3.5 cm in length, grey line develop along both side of body, white hair around head and formation of 4 segment. Pupa tapering parallel spines at posterior end having smooth surface and round shape (Vennila, n.d.)

Nature of Damage: 10 percent damage of leaf considers ETL of this pest. Caterpillar of this pest is polyphagous in nature feed on vegetative portion by creating symmetrical holes and damage noticed on unfolding leaflets then prefers flower and bud.

Life cycle: Female deposited spherical greenish yellow eggs singly on tender portion of plants. Fecundity of each female 650-700 eggs within 4-5 days, they hatched 2-4 days from April to October and 5-6 day in February. Caterpillar change colour from greenish with dark brown to grey lines its colour variation depend upon feeding host plant. The first instar larvae enter in the pod and feed on developing grain. While feeding their body is lying outside. The larval period is 14-20 days. Full grown larvae are about 30 mm long, green with longitudinal grey stripes laterally. Last instar drop down in to soil for pupation occurred in earthen cocoon. Pupation of this pest takes place in soil and in completed within 10 days. It undergoes hibernation during winter. Cannibalism is common among larvae. They completed 8-10 generation during year.

Management:

Cultural practices: Expose pupae in summer by deep ploughing for bird feeding. Ground nut intercropped with pigeon pea in 6:1. Avoid sole cropping of Groundnut. Balance use of nitrogenous fertilizer which reduces pest population. Crop rotated with sorghum, maize and sugarcane also helpful for minimize the attacked of pests.

Mechanical practices: Install light trap and pheromone trap for monitoring purpose. Create restriction in migration of larvae from infested field digging trench 30cm deep and 25cm wide with perpendicular sides around the field.

Biological practices: Release of larval parasitoid *Campoletis chlorideae* Uchida in the vegetative stage of earthnut during peak period of larvae, it may parasitized near about 50-60 percent caterpillar population. Introduce *Trichogramma chilonis* @ 1 lakh/ha *Chrysoperla carnea* @ 50000/ha at 40 and 50 day after sowing of earthnut can effective to manage pest population. Use biopesticides like *Bacillus thuringiensis* one kg per hectare or HaNPV @250-500 LE/Ha with 2.5 kg

crude sugar spraying should be done an evening hours on first instar larvae more effective.

Botanical practices: Sesamum oil and Karanj oil act as synergists as well as compatible with OP group insecticide against pod borer. Prepare poison bait by using following ingredients for one hectare field. Molasses 2.5kg, Rice bran 12.5 kg and carbaryl 20WP 1.25kg. All material mix homogenously, slowly sprinkled water and bring bait to a dough consistency. At the evening time mix poison bait in the soil and around the field immediately after preparation.

Chemical practices: Flubendamine 39.35SC @ 0.01%, Spinosad 45 SC @ 0.02%, Indoxacarb 14.5SC @0.007%, Rynaxypyr 18.5SC @0.006%, Emamectin benzoate 5SG@0.02 were found effective against Pod borer in lab condition. Spray E. benzoate 5 SG 220 g or spinosad 45 SC 180-220 ml/ha in 375-500 L of water. In newer insecticides lowest number of survival population of larvae was recorded in treatment Spinosad 45 SC @ 75 g a.i./ha 0.61 number of larvae per ear head followed by Chlorantraniliprole 18.5 SC @ 10 g a.i./ha 0.62, Emamectin benzoate 5 SG @ 9.5 g a.i./ha 0.64 (Tarate *et al.*, 2018).

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