Introduction to Insect Pests of Niger[*Guizotiaabyssinica(L.f.)* Cass.]and Their Management: A Review

Abstract

Niger, a country located in the Sahel region of West Africa, is primarily dependent on agriculture for food security and economic stability. However, agricultural productivity in Niger is severely threatened by various insect pests, which cause significant losses in crop yield and quality. This review explores the major insect pests affecting in Niger, including their biology, ecology and the current management strategies employed. Additionally, it addresses the challenges faced by local farmers and the potential for integrated pest management (IPM) approaches in enhancing sustainable agricultural practices.

Keywords: Agricultural practices, economic stability, crop yield, *Guizotiaabyssinica*

1. Introduction

Niger (*Guizotiaabyssinica*) is an important oilseed crop, primarily grown in Ethiopia, India, and parts of Africa. Niger agricultural sector faces a multitude of challenges, including harsh climatic conditions, soil degradation, and the prevalence of insect pests. It is known with different names in different part of the country *viz.,jagni* or *jatangi* (Hindi); *ramtal* or *kharsani* (Gujarati); *karale* or *khurasani* (Marathi); *uhechellu* (Kannada); *payellu* (Tamil); *verrinuvvulu* (Telugu); *alashi* (Oriya); *sarguza* (Bengali); and *sorguja* (Assamese) (Dwarka *et al.*, 2024a).Insect pests cause substantial damage to the Niger plant, affecting both its growth and seed quality. Due to the country dependence on rain-fed agriculture, crops such as millet, sorghum, cowpea, and groundnut are highly susceptible to damage from insect pests. The increasing frequency of pest outbreaks is exacerbated by climate change, which alters pest distribution and reproductive cycles. In Madhya Pradesh its cultivation is restricted to eroded soils, particularly in the state hilly districts of Chhindwara, Dindori, Mandla, Seoni, Jabalpur and Shahdol (Dwarka *et al.,* 2023b). This review aims to provide an overview of the primary insect pests in Niger and the various pest management strategies implemented to mitigate their impact.Niger oil, extracted from its seeds, is characterized by its paleyellow color, nutty flavor, and pleasant aroma. With a protein content ranging from 18 to 24% and a quality oil content of 32-40%, niger oil is highly valued(Dwarka *et al.*, 2024b; Dwarka *et al.,* 2022). Niger seed oil is free from antinutrients and rich in (70% linoleic acid) essential fatty acids and the biology of

Niger flowers consists of two types of florets: Disc and ray florets. Niger is a diploid oil crop (2n = 2x = 30) from the Asteraceae family. It is capitulum that contains six to eight fertile female ray florets and 40–60 hermaphroditic disk florets (Vishwakarma *et al.,* 2023b).The latter are eight to fifteen in number and are bright yellow in colour, which turns golden as they age. Disc florets are organized in three whorls and have a number of less than 45 but occasionally more. Each capitulum has a flowering cycle of about 7 to 8 days (Dwarka *et al.*, 2023a;Dwarka*et al.*, 2023c). Insect pollination not only ensures the increase in seed yields of various cross pollinated crops including niger but also improve their quality (Dwarka *et al.*, 2024c). The damage caused by these pests can result in reduced oil content, lower seed quality, and overall yield losses. Pests affecting Niger can attack at various stages of the plant's development, from germination to maturity. Understanding the main pests affecting Niger and their control measures is crucial for maintaining its production.

2. Major Insect Pests of Niger

2.1. Aphid, *Aphis craccivora*Koch and *Uroleuconcarthami*Hille Ris Lambers, Aphididae, Hemiptera

Cowpea (*Vigna unguiculata*) is another critical crop in Niger, commonly infested by the cowpea aphid (*Aphis craccivora*). Aphids damage crops by sucking sap from leaves, flowers, and pods, which leads to stunted growth and reduced pod formation. They also act as vectors for viral diseases, further compounding the damage to crops (Vishwakarma *et al.,* 2023a;2023b).

2.2. Cutworm, *Agrotisipsilon* Hufnagel, Noctuidae, Lepidoptera

They feed by cutting through the stems of seedlings at or just below the soil surface. This cutting typically occurs at night, and the larvae often drag the cut plant parts into the soil to feed on them. When seedlings are cut off, they wilt and eventually die, causing thinning of the crop stand, especially in high infestation areas. This is most common during the early stages of plant development. In some cases, older larvae may also feed on the leaves and stems of larger plants, although this is less common. However, the most severe damage occurs when they cut down the entire plant at the seedling stage. The random nature of their feeding leads to patchy areas in the field where plants are missing or have been damaged. This uneven growth can reduce yield and make crop management more difficult. The moth seeks shelter beneath dried twigs during the day and deposits its eggs on the leaves. The larvae then attack the crop, targeting plants at ground level(Ranganatha, 2013).

2.3 Bihar Hairy caterpillar, *Spilosomaobliqua* Walker, Erebidae, Arctiinae, Lepidoptera

Larvae chew large irregular holes in the leaves, often resulting in complete defoliation during heavy infestations. In severe cases, they eat all parts of the leaf, leaving only the midrib and veins intact. Defoliation weakens the plants, reducing their ability to photosynthesize, which can severely impact growth and yield. In the early stages, the caterpillars stay grouped together beneath the leaves, and significant yield loss occurs during the third and fourth instar stages (Ranganatha, 2013). The incidence of the hairy caterpillar was observed in both scattered and uniform populations (Sandipan *et al.*, 2016).

2.4 Surface grasshopper, *Chrotogonus* sp. Serville, Pygromorphidae, Orthoptera

The larvae voraciously feed on the leaves, leading to holes and notches. Severe feeding can result in skeletonized leaves. In heavy infestations, they consume entire leaves, leaving only veins, which reduces the plant photosynthetic ability and overall vigor. Defoliation can weaken young plants, delay flowering, and reduce seed yield and quality. These insects are typically active during the early stages of the crop. As general feeders, grasshoppers can cause substantial damage during this period (Ranganatha, 2013).

2.5 Semilooper, *Plusiaorichalcea* Fabricius, Noctuidae, Lepidoptera

The larvae of *Plusiaorichalcea* feed on the leaves of host plants. They create irregular holes as they chew through the leaf tissue, significantly affecting the plant's ability to photosynthesize. In cases of severe infestation, the caterpillars can cause significant defoliation, removing large portions of foliage. This can weaken the plants and hinder their growth and development. The semilooper consumes the leaves, leading to defoliation of the plant (Ranganatha, 2013).

2.6 Niger capsule fly, *Dioxymasarorcula* Weidemann, Tephritidae, Diptera

The larvae of Dioxymasarorcula primarily feed on flower buds and developing flowers, which can severely damage the reproductive parts of the plant. This feeding often leads to the destruction of flower buds before they can open, resulting in reduced flower and seed formation. The maggot feeds on the seeds and pulp within the capitula (Ranganatha, 2013). Vishwakarma *et al.*,(2023a) who reported from flower bud initiation stage with 0.96 fly/plant and continued till maturity stage of the plant growth.

2.7 Leaf hopper, *Amrasca* app. Ishida, Cicadellidae, Hemiptera

Leaf hoppers feed by piercing the plant tissues with their specialized mouthparts and sucking out the sap. This feeding can lead to wilting, stunted growth, and reduced vigor in plants. The feeding activity can cause yellowing of leaves, known as chlorosis, which affects the plant's ability to photosynthesize effectively. This may also lead to leaf drop in severe cases. As they feed, leaf hoppers excrete a sticky substance called honeydew, which can lead to sooty mold growth on leaves. This mold can further inhibit photosynthesis and reduce plant vigor. Leafhoppers were first noticed on the crop 11 days after sowing. They feed by sucking the cell sap from the plant foliage (Patel *et al.,* 2022). Vishwakarma *et al.,*(2023a;2023b) evaluated the e incidence of leafhopper was observed from 40th standard week to continued till 49^{th} standard week and the peak period for the incidence of leafhopper was observed during 46th standard week.

2.8 Green stink bug,*Nezaraviridula* Linnaeus, Pentatomidae, Hemiptera

The green stink bug uses its piercing mouthparts to feed on the sap of plants. This feeding primarily occurs on leaves, stems, and developing fruits or seeds, leading to cell damage. Feeding can cause leaves to yellow and become mottled. In severe cases, this can result in leaf drop, which reduces the plant overall health and vigor. *Nezaraviridula* feeds on the seeds and pods of crops, causing direct damage. This feeding can lead to shriveled or deformed seeds, reducing both the quality and quantity of the harvest. In oilseed crops, the oil content may also be affected. Green stink bugs were detected on the crop 39 days after sowing. Both nymphs and adults feed by sucking cell sap from the foliage (Patel *et al.,* 2022).Vishwakarma *et al.,*(2023a) who reported from 43^{th} standard week to continued till 49^{th} standard week and peak period for the activity of *Nezara* bug was recorded in 48^{th} standard week.

2.9 Whiteflies, *Bemisiatabaci* Gennadius, Aleyrodidae, Hemiptera

Whiteflies feed by piercing plant tissues with their specialized mouthparts and sucking out the sap. This feeding weakens the plants and can lead to stunted growth, reduced vigor, and lower yields. As they feed, whiteflies cause yellowing of leaves, known as chlorosis. Whiteflies excrete a sticky substance called honeydew, which can lead to sooty mold growth on leaves. This mold can further inhibit photosynthesis and negatively affect plant health. This discoloration can be a result of nutrient deficiency as the plants struggle to transport nutrients due to feeding damage. Vishwakarma *et al.,*(2023a) evaluated the population of whitefly was gradually increased from 40^{th}standard week, (0.26 whitefly/three leaves) and reached on peak during 47^{th} standard week.

2.10 Flea beetle, *Phyllotreta* spp. Fabricius, Chrysomelidae, Coleoptera

Adults are small, shiny flea beetles, measuring 4 to 5 mm in length, with a metallic bronze color and six dark spots on their elytra, the grub is small and dirty white. Adults feed aggressively on sprouting buds and tender shoots after pruning, causing the buds to dry up and fail to develop. The beetles also feed on mature leaves, resulting in a shot-hole appearance. While grubs feed on the roots, they do not cause significant damage (Dwarka, 2021). Flea beetles were observed on the crop 46 days after sowing. They feed on the surface of the leaves (Patel *et al.*, 2022).

2.11 Tobacco caterpillar, *Spodoptera litura* Fabricius, Noctuidae, Lepidoptera

The larvae primarily feed on leaves, causing irregular holes and notches. They can consume entire leaves, leading to significant defoliation, particularly in young plants. In cases of severe infestations, Spodoptera litura can completely defoliate plants. This extensive leaf loss reduces the plant's ability to photosynthesize, significantly impacting growth and yield. The larvae also feed on flower buds, fruits, and pods, damaging the reproductive structures. This can lead to reduced seed formation and quality, particularly in crops like cotton and legumes. Tobacco caterpillars were spotted on the crop 18 days after sowing. The caterpillars feed on the leaves, causing defoliation of the plant (Patel *et al.*, 2022).

3. Integrated Pest Management (IPM)

IPM is a holistic approach that combines multiple control strategies, including cultural, mechanical,biological and chemicalmethods, to achieve long-term pest management with minimal environmental impact. While IPM has been promoted by agricultural extension services in Niger, its implementation remains limited due to a lack of resources, training, and access to appropriate technologies.

3.1 Cultural methods

1. Proper crop spacing (30 x 10 cm).
2. Timely sowing (Third week of July to second week of August in M.P. & C.G. region) (Rangnatha, 2013).
3. Keep the field free of weeds for the first 30 days after sowing.
4. Crop rotation is effective in reducing pest population.
5. Apply the recommended amount of fertilizers at the appropriate time (20:20:10, N:P:K (kg/ha) at the time of sowing as basal and remaining 20 kg N/ha at 30 days after sowing(for MP)).

6. Deep ploughing during the summer exposes soil-dwelling insects and disrupts volunteer plants and weeds, which serve as food sources and breeding grounds for numerous pests.
7. Crop rotation.
8. Intercropping with Niger + Kodo/ Kutki/ Pearl millet/ Green gram (2:2) and Niger + Groundnut (4:2 or 6:2) minimized the incidence of various insect pests (Rangnatha, 2013).
9. Follow cropping system (Early Black gram – Niger) (Rangnatha, 2013).

3.2 Mechanical methods

1. Birds readily eat the caterpillars and help to check when they are numerous, 40-50 bird perches are sufficient for one hectare.
2. Collection and destruction of egg masses of early instars of caterpillars
3. Install the light trap one per hectare.
4. Clipping the galls and collecting and burning the fallen buds are effective preventive measures against bud flies.

3.3 Biological methods

1. Conserve larval parasitoids, such as *Eurytomadentipectus, Pteromalus fasciatus* and *Braconhebetor*. Additionally, protect *Cotesia* species, which are key parasitoids of moth larvae, along with predators like spiders, ladybird beetles, and lacewings.
2. *Beauveria bassiana* showed greater effectiveness compared to *Metarhizium anisopliae* in controlling the pest, *Verticillium lecanii* was found to be the least effective against the larvae (Anonymous, 2011).
3. Spray NSKE 5% or Neem based insecticide (Nimbecidin 5 ml/l water).

3.4 Chemical methods

1. Two sprays of Chloropyriphos 20 EC 1.5 ml/litre of water.
2. Spray crop at bud initiation stage with any one of the following insecticides Profenophos 40 EC 1 ml/l or Imidacloprid 17.8% SL 0.25ml/litre of water (Ranganatha, 2013).
3. Two foliar sprayings profenofos 50 EC (2 ml/l) or Chlorantraniliprole 18.5 SC (0.4 ml/l) or Novaluron 10EC (2 ml/l) at 30 and 45 days after sowing (DAS) has been found to be effective and cost-efficient for managing major insect pests of niger Panday *et al.*, (2021&2023).

4. Future prospects

4.1. Strengthening IPM Programs

There is a need for greater investment in research, education, and extension services to promote the adoption of IPM practices in Niger. Training programs for farmers on the benefits of IPM, along with support for the development and distribution of biological control agents, could help reduce reliance on chemical pesticides.

4.2. Climate-Smart Pest Management

Adapting pest management strategies to account for the impacts of climate change is essential. Monitoring and forecasting systems that predict pest outbreaks based on weather patterns could help farmers prepare in advance and minimize crop losses. Additionally, the development of pest-resistant crop varieties through breeding programs could provide long-term protection against insect pests.

4.3. Policy Support and Access to Resources

Governments and NGOs can play a critical role in supporting sustainable pest management practices by providing financial assistance, subsidies for IPM inputs, and access to affordable technologies. Strengthening the regulatory framework for pesticide use and promoting safer alternatives will also contribute to a more sustainable agricultural sector.

6. Conclusion

Insect pests represent a significant challenge to agricultural productivity in Niger, threatening food security and the livelihoods of millions of people. While chemical control remains the primary method of pest management, there is an urgent need to adopt more sustainable approaches such as IPM, biological control, and climate-smart pest management strategies. By addressing the challenges of pesticide misuse, climate change, and limited access to resources, Niger can move towards a more resilient agricultural system capable of withstanding future pest pressures.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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