IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Insect Pest Complex Of Indian Mustard (*Brassica Juncea*) In Kota District, Rajasthan And Their Management Approaches

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Abstract

Indian mustard (*Brassica juncea*) is one of the most economically significant oilseed crops cultivated during the Rabi season in Rajasthan, particularly in the Kota district. The crop plays a crucial role in ensuring income security for farmers and contributes substantially to edible oil production in the region. However, mustard cultivation is frequently constrained by infestation of a wide range of insect pests, which can cause serious quantitative and qualitative yield losses. The mustard agroecosystem supports a diverse assemblage of insects, including herbivorous pests, predators, parasitoids, pollinators, and decomposers, each performing distinct ecological functions.

Extensive field observations and regional surveys conducted in Kota district reveal high entomological diversity associated with mustard fields. Despite this richness, pest insects dominate during critical crop growth stages and significantly affect productivity. The present study documents the major, minor, and sporadic insect pests of mustard in Kota district, examines their seasonal incidence and population dynamics, and evaluates their impact on different phenological stages of the crop. Special emphasis is placed on the mustard aphid (*Lipaphis erysimi*), identified as the most destructive pest due to its rapid reproduction and high infestation potential.

Other important pests recorded include the mustard sawfly (*Athalia lugens proxima*), painted bug (*Bagrada hilaris*), leaf miner (*Phytomyza horticola*), flea beetles, and lepidopteran defoliators such as the diamondback moth (*Plutella xylostella*). Understanding pest diversity and seasonal trends is essential for designing effective Integrated Pest Management (IPM) strategies that minimize crop losses while conserving beneficial insects. The study highlights the need for sustainable, region-specific pest management practices to ensure stable mustard production in the Kota region.

Keywords: Indian mustard, *Brassica juncea*, insect pest complex, seasonal incidence, integrated pest management, Rajasthan

1. Introduction

Indian mustard (*Brassica juncea*) is a principal oilseed crop grown during the winter (Rabi) season in northern and central India. Rajasthan is one of the leading mustard-producing states in the country, contributing significantly to national oilseed output. Within Rajasthan, the Kota district occupies a prominent position due to its favourable agro-climatic conditions, irrigation facilities, and traditional farming practices that support large-scale mustard cultivation (AICRP – 2015, 2018).

Despite its agronomic importance, mustard productivity is frequently threatened by insect pests that attack the crop from seedling emergence to maturity. These pests reduce plant vigour, impair photosynthesis, damage reproductive structures, and ultimately lower yield and oil quality. Yield losses due to insect pests in mustard have been reported to range from moderate to severe depending on pest pressure, weather conditions, and management practices (Shekhawat et, al. 2012).

The semi-arid climate of Kota district, combined with canal and tube-well irrigation systems, creates a heterogeneous agricultural landscape that strongly influences insect population dynamics. Variations in temperature, humidity, rainfall, and cropping patterns affect pest abundance and seasonal occurrence. As a result, mustard fields in the region host a complex insect community consisting of herbivores, predators, parasitoids, pollinators, and decomposers (Singh and Sachan, 1994).

A detailed understanding of this insect diversity is critical for developing sustainable pest management strategies. While several studies have documented insect pests of mustard at national and regional levels, comprehensive information focusing specifically on Kota district remains limited. This study aims to bridge that gap by systematically documenting the major insect pests of mustard, analysing their seasonal incidence and population trends, and discussing appropriate management approaches under local agro-ecological conditions.

2. Materials and Methods

2.1 Study Area

The present investigation was conducted in Kota district, Rajasthan, which falls under Agro-climatic Zone V (Humid South-Eastern Plain). The district receives the highest rainfall within the state and lies between 24°25′ to 25°51′ North latitude and 75°37′ to 77°26′ East longitude. The Chambal River is the major perennial water source, supporting extensive canal irrigation networks.

Agriculture in Kota district is characterized by a distinct Kharif–Rabi cropping system. Major Kharif crops include soybean, black gram, and paddy, while Rabi crops are dominated by wheat, mustard, coriander, and garlic. The total cultivated area of the district is approximately 3.4 lakh hectares, of which about 2.1 lakh hectares are irrigated.

2.2 Field Survey and Sampling

Field surveys were carried out during the Rabi seasons of 2019–20 and 2020–21 in mustard-growing areas surrounding Kota city, primarily in peri-urban agricultural zones. Ten mustard fields were selected randomly to represent different management and irrigation conditions.

Observations were conducted weekly throughout the cropping period from October to March. Insect populations were monitored at different crop growth stages, namely seedling, vegetative, flowering, and pod formation stages.

2.3 Data Collection and Identification

Insect pests were recorded by counting the number of individuals per plant. For sap-sucking pests such as aphids and painted bugs, both nymphs and adults were counted. For defoliators like mustard sawfly and caterpillars, larval counts per plant were recorded. Specimens were collected and identified to species level using standard morphological keys.

3. Insect Diversity Associated with Mustard Fields in Kota

3.1 Species Richness

Surveys conducted in Rajasthan have reported nearly 80 insect species associated with mustard crops, representing around 10 insect orders and 39 families. These include members of Coleoptera, Lepidoptera, Hemiptera, Hymenoptera, Diptera, Orthoptera, Odonata, Dictyoptera, Neuroptera, and Embioptera (Rai, 1976).

This diversity reflects the ecological complexity of mustard agroecosystems, where insects occupy multiple trophic levels and perform varied ecological roles (Chattopadhyay et, al. 2005).

3.2 Functional Groups

The insect fauna associated with mustard fields can be broadly categorized into the following functional groups (Aslam and Razaq, 2007):

- **Herbivorous pests**, which directly damage crop tissues and reduce yield
- **Predators and parasitoids**, which naturally regulate pest populations
- **Pollinators**, which enhance seed set and yield
- **Decomposers and scavengers**, which contribute to nutrient cycling and soil health

This functional diversity highlights the importance of adopting pest management practices that suppress harmful insects while conserving beneficial organisms (Chattopadhyay et, al. 2005).

4. Major Insect Pests of Mustard in Kota District

4.1 Mustard Aphid (*Lipaphis erysimi*)

The mustard aphid is the most destructive pest of mustard in the Kota region. These small, soft-bodied insects colonize tender plant parts such as leaves, inflorescences, and pods. Aphids reproduce rapidly through parthenogenesis, allowing populations to build up quickly under favourable conditions.

Heavy infestations result in leaf curling, yellowing, stunted plant growth, reduced pod development, and poor seed formation. Yield losses due to aphid infestation may reach up to 70% in severe cases (Mishra and Kanawat, 2015). In Kota district, aphid populations typically peak during January and February, coinciding with flowering and pod development stages.

4.2 Mustard Sawfly (*Athalia lugens proxima*)

The mustard sawfly is an important defoliator, particularly during early crop stages. The larvae feed aggressively on leaf tissues, often causing skeletonization or complete defoliation in young plants (Chowdhury 2009). Severe infestations can result in reduced photosynthetic capacity and poor crop establishment. Peak activity is generally observed during December and January (Bogawat, 1967).

4.3 Painted Bug (*Bagrada hilaris*)

Painted bugs attack mustard crops mainly during early vegetative and maturity stages. Both nymphs and adults suck sap from leaves, stems, and pods, leading to wilting, stunted growth, and in extreme cases, plant death. This pest is especially problematic in newly sown crops.

4.4 Leaf Miner (*Phytomyza horticola*)

Leaf miner larvae tunnel within leaf tissues, creating serpentine mines that disrupt photosynthesis. Young plants are particularly vulnerable, and heavy infestations can lead to premature leaf drop and weakened crop growth.

4.5 Flea Beetles and Lepidopteran Defoliators

Flea beetles create characteristic shot-hole damage on leaves, particularly during the seedling stage. Lepidopteran pests such as the cabbage butterfly and diamondback moth feed on foliage and occasionally flowers, contributing to yield reduction under favourable conditions.

5. Minor and Sporadic Pests

In addition to major pests, mustard fields in Kota district occasionally experience infestations by whiteflies, jassids, thrips, pod borers, and other caterpillars. Although these pests rarely cause severe damage individually, their combined presence can weaken crops and increase vulnerability to major pest outbreaks (Bhati et, al. 2015).

6. Seasonal Incidence and Population Dynamics

6.1 Early Crop Stage (November–December)

During the initial growth stages, insect diversity is relatively low. Early infestations by painted bugs, mustard sawfly, and leaf miners are commonly observed. Beneficial insects such as predators and pollinators are largely absent at this stage.

6.2 Mid-Season (January–February)

The flowering stage marks the peak of insect diversity and abundance. Mustard aphid populations increase rapidly, often reaching outbreak levels. Other pests such as flea beetles, diamondback moths, whiteflies, and jassids also become prominent.

Pollinators including honeybees, butterflies, and flies appear in large numbers during flowering. Predators such as ladybird beetles and parasitoid wasps increase simultaneously, feeding on aphids and other pests.

6.3 Late Season (March)

As temperatures rise and humidity declines, pest populations decrease sharply. Aphid numbers drop, and defoliator activity subsides. Beneficial insects remain present but at lower densities.

7. Factors Influencing Insect Diversity

Insect population dynamics in mustard fields are influenced by temperature, relative humidity, irrigation patterns, and cropping practices. Rainfed fields generally support higher insect diversity compared to intensively irrigated areas. Aphid populations show positive correlation with temperature and sunshine hours, while sawfly and painted bug populations decline with increasing heat (Narayanan and Gopalakrishnan, 2003).

8. Yield Losses Due to Insect Pests

Studies across Rajasthan indicate that insect pests can cause avoidable yield losses ranging from 30% to 70% in mustard crops. Aphids account for the largest share of losses, followed by sawflies and painted bugs. Effective pest management is therefore essential for ensuring economic returns to farmers.

9. Integrated Pest Management (IPM) Strategies

Sustainable management of mustard pests requires an integrated approach that combines cultural, mechanical, biological, and chemical methods:

- Deep ploughing after harvest to destroy overwintering pest stages
- Use of certified and pest-tolerant varieties
- Timely sowing and balanced nutrient application
- Seed treatment with recommended fungicides and biocontrol agents
- Regular field monitoring for early pest detection
- Mechanical removal of infested plant parts
- Use of botanical pesticides such as neem seed kernel extract and neem oil
- Judicious use of chemical insecticides only when pest populations exceed economic threshold levels, with special care to protect pollinators

10. Conclusion

The mustard agroecosystem in Kota district supports a rich insect community with diverse ecological roles. However, aphids, mustard sawfly, painted bug, and leaf miners remain the most significant threats to crop productivity. Understanding seasonal pest dynamics and adopting integrated pest management strategies are essential for sustainable mustard cultivation. Continued research, farmer awareness programmes, and region-specific management recommendations will play a crucial role in minimizing pest-related losses and maintaining ecological balance in mustard-based farming systems.

11. Ecological Importance of Insect Diversity in Mustard Agroecosystems

Beyond their direct impact on crop yield, insects associated with mustard fields play a critical role in maintaining agroecosystem stability. Mustard cultivation in Kota district does not function as a simple crop–pest system; instead, it supports a dynamic food web involving herbivores, predators, parasitoids, pollinators, and decomposers. Each group contributes to ecological balance, either by regulating pest populations or by supporting essential ecosystem services.

Predatory insects such as ladybird beetles, ground beetles, lacewings, and spiders act as natural biological control agents. Their presence reduces dependence on chemical pesticides and helps delay the development of pest resistance. Parasitoids, particularly braconid and chalcid wasps, play an important role in suppressing aphid and caterpillar populations by targeting specific life stages of pests.

Pollinators are another ecologically significant group within mustard fields. Although mustard is partially self-pollinated, insect-mediated pollination substantially improves seed set, seed weight, and overall yield. Studies have reported increased productivity in mustard fields with higher pollinator visitation, highlighting the importance of conserving bees, butterflies, and dipteran pollinators during flowering stages.

Decomposer insects and scavengers contribute indirectly by aiding in organic matter breakdown and nutrient recycling, thereby improving soil fertility. Maintaining insect diversity is therefore essential not only for pest control but also for long-term sustainability of mustard-based farming systems.

12. Influence of Agricultural Practices on Pest Incidence

Farming practices in the Kota district strongly influence insect pest abundance and diversity. Variations in sowing time, irrigation method, fertilizer use, and cropping history can either suppress or promote pest outbreaks. Early sowing often helps mustard plants escape peak aphid infestations, whereas delayed sowing exposes crops to higher pest pressure during flowering.

Irrigation practices also play a significant role. Canal- and tube-well–irrigated fields generally support higher aphid populations due to improved plant succulence and favourable microclimatic conditions. In contrast, rainfed fields often exhibit greater overall insect diversity but relatively lower dominance of a single pest species.

Excessive nitrogen fertilization has been associated with increased aphid populations, as nitrogen-rich plants provide better nutrition for sap-sucking insects. Balanced fertilization, therefore, is an important component of pest management. Crop residue management and field sanitation further influence pest survival by affecting overwintering stages of insects.

13. Role of Climatic Factors in Pest Population Fluctuations

Climatic variables such as temperature, relative humidity, rainfall, and sunshine hours exert a strong influence on insect pest dynamics in mustard crops. Aphid populations show a strong positive correlation with moderate temperatures and increased sunshine, conditions commonly observed during January and February in Kota district. Conversely, extreme temperatures and low humidity during late March contribute to rapid population decline.

Mustard sawfly and painted bug populations tend to peak during cooler early-season conditions and decline as temperatures rise. Leaf miner infestations are influenced by both temperature and crop phenology, persisting longer in late-sown crops. These observations suggest that pest outbreaks are closely linked to seasonal weather patterns, making climate-based forecasting an important tool for pest management.

Climate variability and changing weather patterns may further alter pest dynamics in the future. Warmer winters could prolong aphid activity, while erratic rainfall may affect natural enemy populations. Continuous monitoring of pest–climate relationships is therefore essential for adaptive management.

14. Economic Significance of Pest Damage to Mustard

Insect pests represent one of the most serious constraints to mustard productivity in Rajasthan. Yield losses attributed to pests are not only due to direct feeding damage but also result from reduced plant vigour, delayed maturity, and poor seed quality. Aphid infestation, in particular, leads to shriveled seeds with reduced oil content, thereby lowering market value.

Economic loss assessments indicate that unmanaged pest populations can reduce mustard yield by 30–70%, depending on severity and timing of infestation. Such losses have significant implications for

small and marginal farmers who rely heavily on mustard cultivation for seasonal income. Effective pest management is therefore not merely an agronomic concern but also a socio-economic necessity.

15. Constraints in Pest Management Adoption

Despite the availability of recommended pest management practices, adoption at the farmer level remains inconsistent. Limited access to timely pest advisory services, lack of awareness about economic threshold levels, and over-reliance on chemical pesticides are common challenges. In many cases, insecticides are applied indiscriminately, leading to pest resurgence, resistance development, and decline of beneficial insects.

Small landholdings and limited resources further restrict the adoption of integrated pest management strategies. Strengthening extension services and promoting farmer training programs are essential to bridge the gap between research recommendations and field-level implementation.

16. Scope for Sustainable and Eco-Friendly Pest Management

Integrated Pest Management offers a sustainable framework for managing mustard pests while minimizing environmental impact. Emphasis on preventive measures such as crop rotation, resistant varieties, and habitat management can significantly reduce pest pressure. Conservation of natural enemies through reduced pesticide use and selective spraying is equally important.

Botanical pesticides and biocontrol agents offer promising alternatives to synthetic chemicals. Neem-based formulations have shown effectiveness against aphids and other pests while being relatively safe for non-target organisms. Incorporating such eco-friendly tools into IPM programs can enhance sustainability and long-term effectiveness (Yadav and Patel 2017).

17. Future Research Directions

Future studies should focus on long-term monitoring of pest populations across different agro-ecological zones within Kota district. Molecular tools can be employed to better understand pest resistance mechanisms and natural enemy diversity. Integration of remote sensing and weather-based pest forecasting models can further improve early warning systems.

Research on farmer participatory IPM models and economic evaluation of management strategies will help tailor recommendations to local needs. Strengthening collaboration between researchers, extension agencies, and farmers is critical for sustainable pest management.

18. Overall Summary

The mustard crop in Kota district supports a complex and diverse insect community shaped by crop phenology, climate, and farming practices. While this diversity includes beneficial insects that enhance productivity and ecological balance, pest species—particularly mustard aphid, sawfly, and painted bug—pose serious threats to yield and profitability. Seasonal monitoring, understanding pest ecology, and adoption of integrated pest management strategies are essential for sustainable mustard cultivation.

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