Introduction and management of mustard aphid [*Lipaphiserysimi* Kaltenbach (Homoptera: Aphididae)]: A review

Abstract

Mustard crops tend to be more vulnerable to various insect pests compared to other oilseed crops. This increased susceptibility is due to several factors, including the crop growth habits, environmental conditions, and the range of pests that specifically target mustard plants.One of the major causes of reduced production is the introduction of insects, such as *L.erysimi* (K.), *B. brassica* (L.), *Athelialugensproxima* (K.), *Pierisbrassicae* (L.), *B. picta* (K), *Spodopteralitura*(F.), *Chromatomyiahorticola* (G.) *Thripstabaci* and *Bemesiatabaci* (G.). Among them, *Lipaphiserysimi* K., is the most destructive pest in India and is present in many other nations. It is also discovered that the most favored crop for sucking complexes. Aphids are small, soft-bodied insects with a pearl-like shape and two cornicles, or honey tubes extending from the 5^{th}or 6^{th}abdominal segment. They go through four instars or nymphal stages before reaching adulthood. The abdomen of winged female aphids is a dark green color marked by dark lateral stripes between the body sections and dark veins on the wings. Aphids in males are typically olive-green to brown. The infestations usually begin in December and persist until March, thriving at temperatures of 20°C or lower. Cloudy and cold weather conditions further promote their growth. Aphids can produce about 45 generations annually.

Keywords: Cornicles, olive-greencolour, nymphal stages, pearl-shaped and *Lipaphiserysimi*.

1. Introduction

Mustard crops are susceptible to several pests, including painted bugs, mustard sawflies, mustard aphids, potato aphids, leaf miners, flea beetles, diamondback moths, Bihar hairy caterpillars, cabbage butterflies, and tobacco caterpillars. Among these, *L.erysimi* K. is the most destructive. It can cause significant seed yield losses of up to 73.3% and reduce oil content by as much as 66.9% (Bakhetia and Sekhon, 1989).Mustard is the primary oilseed crop in north-west Madhya Pradesh, with the mustard aphid (*Lipaphiserysimi* K.) being its principal pest. This pest inflicts significant damage by sucking sap from the tender shoots and flowers early on, and later from the tender pods. Infested plants become weak and stunted. The aphids excessive honeydew

excretion leads to the growth of black sooty mold on the leaves, which hinders photosynthesis (Ashutosh and Kunwar, 2024; Singh, 2024). Although managing this pest with systemic insecticides is effective, it negatively impacts the pest's natural predators and parasitoids. However, apart from the high cost of insecticides, chemical control has several other disadvantages. These include the pest comeback, development of resistance to widely used pesticides, and secondary pest outbreaks, the accumulation of insecticide residues in oil and cake beyond permissible limits, and environmental degradation (Singh and Sharma, 2009).Among all insect pests, *Lipaphiserysimi* K. is recognized as the primary pest of rapeseed-mustard in India. It damages the crop by sucking sap from the host plant, with crop damage ranging from 9% to 96% depending on the agro-climatic conditions across the country (Singh and Sharma, 2002; Bakhetia, 1984; Chorbandi and Bakhetia, 1987; Singh and Sachan, 1994; Singh and Sachan, 1995; Parmar *et al*., 2007). In some mustard-growing regions, the loss could reach 100 per cent (Singh and Sachan, 1999). Aphid colonies of a considerable size have the potential to distort plants by causing their leaves to shrink and curl (Metcalf, 1962). Both sides of leaves are affected during a strong infestation (Yadav *et al.,* 1988). *Lipaphiserysimi* loves to eat both the leaves and the flowers of mustard plants (Singh *et al.,* 1965).

2. Identification

Lipaphiserysimi adult apterae are tiny to medium-sized aphids that usually have an olive, grey, or yellowish-green color and a thin white wax bloom. In humid environments, the wax coating on them could be thicker. On the thorax and abdomen of the apterae, there are two rows of black bands that combine into a single band close to the tip of the abdomen. The mature *Lipaphiserysimi*apterae has pale siphunculi with black tips, and their body length varies between 1.4 and 2.4 mm.

3. Symptom of damage

Heavy infestations result in symptoms such as yellowing, curling, and drying of leaves, leading to the formation of weak pods and small seeds. The aphids also secrete honeydew, which fosters the growth of sooty mold and reduces the photosynthetic rate (Sekhon, 1989). Consequently, it is essential to monitor mustard crops regularly during the aphids breeding season. In cases of severe infestation, chemical control becomes the only viable option to manage the mustard aphid outbreak. Therefore, this study was conducted to assess each insecticide bio-efficacy against *Lipaphiserysimi*, the mustard aphid.

4. Population dynamics of *Lipaphiserysimi.*

The most important factor for raising aphid populations was found to be the greatest relative humidity three days before observation (Singh and Rai, 1994). Similar findings were reported by Singh *et al.,* (1986), Jaglan*et al.,* (1988), and Rossi (1990). Narang *et al.,* (1983) found that mustard aphid populations were abruptly and dramatically decreased by rainfall, with simulated rainfall of 1.0 to 2.0 cm resulting in a 45.47 per cent to 66.43 per cent reduction in population. Tomar and Yadav (2009) observed that the aphid infestation peaked in the third week of February, with temperatures ranging from 10.5 to 25.7°C and a relative humidity of 68%, having started in the fourth week of December.Debjani-Dey and Akhtar (2008) shown that the dispersion parameter and the variance/mean relationship (from 0.005 to 0.605) were used to aggregate the aphid distribution,Rumki*et al.,* (2018) discovered that there was a negative association with relative humidity and a positive correlation with temperature for aphid numbers. A mean population of 6.03 aphids (averaged over 30 plants) was found during the 17th standard week in April, the lowest, and 94.7 aphids, the highest, during the 48th standard week.

5. Bionomics

This aphid reproduces in two ways: through sexual reproduction, where females are fertilized by males to produce eggs, and through parthenogenesis, where adult females give birth to live female nymphs without male fertilization. Parthenogenesis is the predominant mode of reproduction since male are not common. Almost entirely, female viviparous (giving birth to live young) year-round, with males observed only during the cooler months (Kawada and Murai, 1979).

5.1 Eggs

This aphid usually deposits its eggs along the veins of leaves (Kawada and Murai, 1979). Nonetheless, no evidence of this aphid species eggs has been found in Hawaii.

5.2 Nymphs

Four nymphal phases, or instars, exist in this aphid species. Each stage appears similar in general appearance, with the size increasing in subsequent instars. According to Sachan and Bansal (1975), the durations of the first, second, third, and fourth nymphal stages are 1-2 days each, totaling approximately 8-9 days for the nymphal stage overall. When raised on cabbage, cauliflower, mustard, and radish, there are slight differences in these durations between winged

and wingless forms (Sachan and Bansal, 1975). For a thorough description of the first and fourth instars, Sidhu and Singh (1964).

5.3 Adults

Wingless female aphids, known as apterae, exhibit colors ranging from yellowish-green to gray-green or olive-green, covered with a white waxy bloom over their bodies (Blackman and Eastop, 1984). This waxy coating becomes denser in humid conditions. Winged female and adult aphids, referred to as alates, possess a darkish green abdomen, dusky wing veins, and dark lateral stripes separating body segments (Blackman and Eastop, 1984). With the exception of the base, the antennae are black (Deshpande, 1937). Female apterae measure approximately 1.2-2.4 mm (3/50-1/10 inch) in length, while alate forms measure about 1.4-2.2 mm (3/50-1/12 inch) long (Blackman and Eastop, 1984). For detailed illustrations of apterous and alate adults, refer to Sidhu and Singh (1964).

7. Host crop

Brassicas belong to the Cruciferae family and are predominantly cultivated in India during the *rabi* season for their roles as oilseed, condiment, and medicinal crops. They hold a distinct agricultural significance by serving as sources of vegetables, oilseeds, forage, Green manure, sauces, and feed. Application areas for brassica seed oil include the culinary, lubricant, and polymer sectors; the cake is used as animal feed and organic manure in agriculture. Mustard-rapeseed seeds are particularly valued for their high oil content, ranging from 32% to 42%, with the oil being primarily used for edible purposes. Additionally, the mustard verdant leaves and stalks plants are also rich sources of oil (Jat *et al.*, 2007).

8. Injury

Aphids feed by extracting sap from their host plants. When colonies grow large, they can distort the plants, causing leaves to curl, shrivel, and turn yellow (Metcalf, 1962). The turnip aphid, in particular, tends to congregate in significant numbers in the flowers (inflorescences) or on the undersides of the outer leaves (Blackman and Eastop, 1984). In extreme situations, the leaves may have a heavy infestation on both sides (Yadav *et al.*, 1988). High populations of cabbage can lower output and alter the size of the leaves (Deshpande, 1937; Jagan Mohan *et al.*, 1981). These aphids favor the blossoms of mustard plants above the foliage (Singh *et al.*, 1965). Aphids, like other soft-bodied insects like mealybugs, scales, and leafhoppers, secrete a sweet,

watery excretion called honeydew, which is eaten by wasps, ants, bees, and other insects. Honeydew promotes the growth of a black sooty fungus known as sooty mold, giving cabbage plants a grimy appearance that lowers their market value (Deshpande, 1937). Aphids also transmit numerous plant diseases, often causing more damage through disease transmission than through direct feeding. The turnip aphid, for instance, acts as a vector for approximately ten non-persistent plant viruses, such as the ones that cause turnip, radish, and cauliflower mosaic diseases and cabbage black ring spot (Blackman and Eastop, 1984). The virus multiplies inside the plant during non-persistent transmission, and aphids aid in the infection process and virus's dissemination.

9. Management

9.1 Using agronomic practices to address diseases and pests:

9.1.1 Cultural control

A substantial amount of experimental data from Indian literature demonstrates how well cultural and agronomic approaches may lower insect losses in mustard crops. Practices such as timely sowing in early October (Kolte, 1985), balanced nutrient application like N_{100}:P_{40}:K_{40}(Sharma and Kolte, 1994), sanitation, plowing, crop rotation, intercropping, spacing, and nutrient management. Delayed planting directly correlates with increased infestation rates of aphids like AB, WR, and SSR in most mustard-growing regions of the country.

9.2 Inter-culture operation

Thinning operations were conducted to maintain an optimal plant population by selecting healthy seedlings in both of them. Manual weeding was performed one month after sowing, ensuring that the field remained free of weeds for the entire season.

9.3 Biological

Mari *et al.,* (2016) discovered that *C. undecimpunctata* (L) adults and larvae demonstrated noteworthy feeding abilities on every species of aphid investigated. During the study period, alfalfa aphids showed the highest feeding efficiency when compared to mustard and maize aphids, most likely because alfalfa aphids have a higher survivability rate than other species. Hakim *et al.,* (2016) observed predator activities on varieties with the highest pest activity, indicating consistent populations of insect pests and predators across all varieties. Sajid

et al., (2017) reported that among entomopathogenic biopesticides, *M. anisopliae* (83.23%), *B. bassiana* (78.33%) and *B. thuringiensis* (73%) were effective against mustard aphids. They suggested that biopesticides could serve as valuable components of integrated pest management strategies against mustard aphids, following successful field trials. Liz *et al.,* (2017) highlighted the significant role of biological control in crop pest and disease management, reducing dependency on chemical pesticides.

9.4 Botanical

Kumar and Patel (2017) investigated the crude aqueous extracts of several plants, including *Ageratum conyzoides*, *Parthenium hysterophorus*, *Lantana camera*, *Solanum nigrum*, *Cannabis sativa*, *Calotropis gigantea*, *Livistonachinensis* and *Cassia angustifolia*, for their insecticidal and repellent effects against *Myzuspersicae* and *Brevicorynebrassicae*. They found that the repellent activity of these extracts decreased with increasing concentration.Inayat *et al.,* (2017) evaluated the antioxidant activities of different fractions of methanolic extracts from these plants, ranging from 69.08% to 84.89%. The study indicated that these selected plants possess potential antimicrobial and antioxidant properties, which are beneficial for controlling diseases caused by various bacterial pathogens and neutralizing free radicals in the body.

9.5 Chamical

The use of systemic insecticides can effectively manage the mustard aphid *Lipaphiserysimi* (Kalt); however, this approach does not provide a long-term solution, as the aphid population returns to previous levels within two weeks after chemical application (Singh *et al.,* 1984).Imidacloprid 17.8 SL at a concentration of 0.2 g/litre demonstrated the most significant reduction among the insecticides tested against the mustard aphid *Lipaphiserysimi*Kalt.Imidacloprid 17.8 SL applied at a concentration of 0.2 g/litre resulted in an 87.53% reduction in mustard aphid incidence, while fipronil 5 SC applied at 1.0 ml/litre achieved an 83.56% reduction seven days after the initial spray.Similarly, a comparable trend was observed 15 days after spraying, with both chemicals showing reductions of 83.86% and 78.90%, respectively. The experiment was repeated after 15 days to monitor the aphid population, revealing that imidacloprid 17.8 SL at 0.2 g/litre remained the most effective, followed by fipronil 5 SC at 1.0 ml/litre and neem oil 2% at 2.0 ml/litre, as recorded 7 and 15 days after spraying (Dotasara*et al.,* 2017). Insecticides tested against *Lipaphiserysimi*, the mustard aphid, included imidacloprid 17.8 SL at 0.2 g/litre showed the highest reduction,

decreasing the incidence of mustard aphids by 87.53%, followed by fipronil 5 SC at 1.0 ml/litre with an 83.56% reduction seven days after the first spray.

Fig .1 Infested crop by the mustard aphid, *Lipaphiserysimi*

10. Conclusion

One of the most harmful insects to mustard is the aphid. One of the main causes of India`s declining mustard yield was this insect. It was discovered that the incidence of insects was noticeably higher in Jan.-Feb., when the mustard flowering season is characterized by low temperatures and higher relative humidity. Aphid infestations were once managed by farmers using two to three insecticide sprays. Even though they all agreed that insect pests were the leading cause of the reduction in India`s mustard crop, none of them had expressed any interest in switching to alternative methods of chemical insecticides for aphid control. Therefore, growers need to educate people about using non-chemical pesticides to reduce aphids and growing mustard.

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12. References

Ahmed TU and Jalil AFMA. BangladesherKrishirOnistokariPokamakor, Jiban BrittantaNyantron (Bangla). Bangla Academy, Dhaka. 1993;381.

Arshad Ali and Parvez Qamar Rizvi. Influence of abiotic and biotic factors on the population dynamics of mustard aphid, *Lipaphiserysimi* (Kalt.) On Indian mustard, *Brassica juncea* with respect to sowing dates. Academic Journal of Plant Sciences. 2012;5(4):123-127.

Bath DS and Singh D. Studies on the economic threshold level of mustard aphid *Lipaphiserysimi* (Kaltenbach) on the radish seed crop in India. Tropical Pest Management. 1989;35:154-156.

Bhadauria NS, Bahadur J, Dhamdhere SV and Jakhmola SS. Effect of different sowing dates to the attack of mustard aphid, *Lipaphiserysimi* (Kalt.). J Insect Sci. 1991;5(1):37-39.

Blackman RL and Eastop VF. Aphids on the World's crops: An identification and information guide. John Wiley and Sons: Chichester, New York, Brisbane, Toronto, Singapore. 1984;466.

Chaudhary RI and Patel CC. Screening of Brassica germplasm for resistance to mustard aphid, *Lipaphiserysimi* (Kalt.) International journal of plant protection. 2017;9(1):62-67.

Chorbandi S and Bakhetia M. Yield loss by turnip aphid. Indian Journal of Crop Protection. 1987; 9(10):671-679.

Debjani Dey and Akhtar MS. Spatial distribution and population dynamics of mustard aphid (*Lipaphiserysimi*) on Indian mustard (*Brassica juncea*). Indian Journal of Agricultural Sciences. 2008;78(8):719-722.

Deshpande VG. Cabbage aphid (*Siphocoryneindobrassicae*) and its Control with home-made nicotine spray. Agric. and Live-Stock in India. 1937;7(6):756-762.

Dotasara SK, Agrawal N, Singh N and Swami D. Efficacy of some newer insecticides against mustard aphid *Lipaphiserysimi*Kalt. In cauliflower. Journal of Entomology and Zoology Studies. 2017;5(2):654-656.

Hakim AS, Solangi R, Kousar T, Shah ZS and Mangrio WM. Population fluctuation of aphids, *Lipaphiserysimi* (Kalt) with response of biological control under mustard field conditions. Journal of Entomology and Zoology Studies. 2016;4(5):326-331.

Inayat U, Gul S, Khan RU, Khan MI, Rehman HU, Ahmad, *et al*. Antibacterial and antioxidant activity analysis of some wild medicinal plants. Journal of Entomology and Zoology Studies. 2017;5(6):1771-1775.

Jagan Mohan N, Krishnaiah K and Kumar NK. Chemical Control of mustard Aphid, *Lipaphiserysimi*Kalt and Leaf webber, Crocidolomiabionotalis Zell on Cabbage. Pesticides. 1981;15(2):29-32.

Jat SL, Jat BL and Choudhary RK. Screening of different mustard varieties for resistance against mustard aphid, *Lipaphiserysimi* (Kaltenbach). Journal of Oilseed Research. 2007;24(1):212-214.

Kawada K and Murai T. Short Communication. *Entomologiaexperimentalis et applicata*. 1979;26:343-345.

Kolte SJ. Diseases of Annual Edible Oilseed Crops. Rapeseed-Mustard and Sesame Diseases, CRC Press, Boca Raton, USA, 1985;2:135.

Lal OP. Field Studies for Varietal Resistance in Rape and Mustard against Mustard Aphid *Lipaphiserysimi*Kalt. A. App. Ent. 2009;64(1-4):394-400.

Liz J, Mampallil MH, Faizal and Anith KN. Bacterial bioagents for insect pest management. Journal of Entomology and Zoology Studies. 2017;5(6):2237-2244.

Mari JM, Bugti GA, Wang Bin and Cao NA. Biological parameters and preferential feeding response of *Coccinellaundecimpunctata* L. on three aphid species. Journal of Entomology and Zoology Studies. 2016;4(4):1306-1310.

Metcalf RL. Destructive and useful Insects: Their Habits and Control. McGraw-Hill Book Company, New York, San Francisco Toronto, London., 1962;1087.

Morzia B and Huq SB. Evaluation of different genotypes of Indian mustard (*Brssicajuncea*) for their reaction to Mustard aphid *L. erysimi*. Indian J Agril. Sci. 1991;61(3):210-213.

Narang DD, Mann GS and Goel SC. Effect of variable intensity of simulated rainfall on the buildup of *Lipaphiserysimi* (Kalten.) and *Myzuspesicae* (Sulz.) Population on different cruciferous Plants. Indian Ecology and Resource Management. 1983;45-49.

Parmar GM, Kapadiia MN, Jadav NB and Zizala VJ. Avoidable losses due to *Lipaphiserysimi*(Kalt.) in mustard. Asian journal of Bioscience. 2007;2(1/2):73-75.

Rana JS. Performance of *Lipaphiserysimi* (Homoptera: Aphididae) on different *Brassica species* in a tropical environment. J Pest sci. 2005;78(3):155-160.

Rohilla HR, Singh H and Kumar PR. Preliminary screening of national varieties of *Brassica junces*(L.) Czern and Cross against mustard aphid, *Lipaphiserysimi* (Kalt.). J Oilseeds Res. 1990;7(2):81-83.

Rossi MM, Motioli JC and Carralho CF. Effect of climatic factors on some aphid species (Homoptera: Aphididae) on potato in larvas. M.G. Anais da Socidedada. EntomologecadaBrasil. 1990;90(1):75-86.

Rumki H Ch Sangma, Geetanjali Pradhan, Singh RK. Seasonal incidence of aphid, *Macrosiphum luteum* (Hemiptera: Aphididae) on Epidendrum radicans in Sikkim Himalayas. Journal of Entomology and Zoology Studies. 2018;6(1):698-701.

Sachan JN and Bansal OP. Influence of Different Host Plants on the Biology of Mustard Aphid, *Lipaphiserysimi*Kalt. Indian J Entomology. 1975;37(4):420- 424.

Sahito HA, Lanjar AG and Mal B. Studies on population dynamics of sucking insect pests of mustard crop (*Brassica campestris*). *Pak. J Agri., Agri. Engg., Vet. Sci.* 2010;26(1):66-74.

Sajid M, Bashir NH, Batool Q, Munir I, Bilal M, Jamal MA, *et al*. In-vitro evaluation of biopesticides (*Beauveriabassiana, Metarhiziumanisopliae, Bacillus thuringiensis*) against mustard aphid *Lipaphiserysimi*kalt. (Hemiptera: Aphididae). Journal of Entomology and Zoology Studies. 2017;5 (6):331-335.

Sekhon BS. Insect pests and their management in rapeseed mustard. Journal of Oilseeds Research. 1989;6:269-299.

Setokuchi O. Seasonal prevalence of *Myzuspersicae* Sulzer. and *L. erysimi*Kalt. (Homoptera: Aphididae) Kagoshima prefecture. Japanase J Appil. Entomol. Zool. 1983;21:219-233.

Sharma SR and Kolte SJ. Effect of soil applied NPK fertilizers on severity of black spot disease caused by *Alternaria brassicae* (sacc) Berk. and yield of oilseed rape. Plant and soil. 1994;167:313-320.

Sidhu HS and Singh S. Biology of the Mustard Aphid - *Lipaphiserysimi* (Kaltenbach) - in the Punjab. Indian Oilseeds J. 1964; 8(4):348-359.

Singh CP and Sachan GC. Assessment of yield losses in yellow sarson due to mustard aphid, *Lipaphiserysimi*kalt. Journal of Oilseed Research. 1994;11(2):179-184.

Singh CP and Sachan GC. Ecofriendly management of *Lipaphiserysimi*Kalt. in *Brassicacarinata*. Proceeding of 10th international Rapeseed conference Canberra, Australia; 1999.

Singh CP and Sachan GC. Estimation of losses in yield rapeseed. *Brassica campestris* by the mustard aphid, *Lipaphiserysimi*Kalt. in Tarai, India. Insect science and its application. 1995;16:283-286.

Singh H, Kalra VK and Rohilla HR. Studies on the efficacy and economics of sprays of synthetic pyrethroids against mustard aphid, *Lipaphiserysimi* (kalt.) on rapeseed. Indian Journal of Plant Protection. 1986;14(1):1-5.

Singh H, Rohilla HR, Kalra VK and Yanava TP. Response of Brassica varieties sown on different dates to the attack of mustard aphid, *Lipaphiserysimi* (Kalt.). J Oilseeds Res. 1984;1(1):49-56.

Singh RK and Verma RA. Relative efficacy of certain insecticides against mustard aphid (*Lipaphiserysimi*) on Indian musard (*Brassica juncea*). Indian J Agric Sci. 2008;78(9):821-823.

Singh SR, Srivastava NKPA and Siddiqui JA. Fecundity of mustard aphid of different rapes and mustard species. Indian Oilseeds Journal. 1965;9(3):215-219.

Singh YP and Sharma KC. Effect of sowing dates on the incidence of mustard aphid, *Lipaphiserysimi* Kaltenbach in mustard. Indian J Appl. Ent. 2009;23(2):120-124.

Tajwar SS, Khanzada MS, Khanzada SR, Abro GH, Salman M, Sarwar M, *et al*. Population dynamics of thrips, whiteflies and their natural enemies on mustard (*Brassica*

campestris L.) Crop in different localities of Sindh, Pakistan. Journal of Entomology and Zoology Studies. 2016;4(1):07-16.

Tomar SK and Yadav PR. Studies on population and infestation of mustard aphid *Lipaphiserysimi* (Kalt.). Journal of Experimental Zoology, India. 2009;12(1):149-152.

Verma AK, Patyal SK, Bhalla OP and Sharma KC. Bioecology of painted bug (*Bagradacruciferarum*) (Hemiptera: Pentatomidae) on seed crop of cauliflower (*Brassica oleracea*) var. (botrytis) Subvar. (Cauliflora). Indian J. Agri. Sci. 1993; 63(10):676- 678.

Yadav PR, Yadav LS and Dashad SS. Comparative efficacy of some insecticides against the aphid, *Lipaphiserysimi*Kalt. on Cabbage crop. Indian Journal of Entomology. 1988;50(1):61-68.

Yadav SK and Patel S. Insecticidal and repellent activity of some plant extracts against *Myzuspersicae* (Sulzer) and *Brevicorynebrassicae* (Linnaeus). Journal of Entomology and Zoology Studies. 2017;5(2):1434-1439.

Ashutosh BR, Kunwar R. Mustard aphid: identification and control strategies. Journal of Oilseed Brassica. 2024 Mar 15;15(1):26-32.

Singh S. Mustard aphid, Lipaphiserysimi (Kaltenbach)(Homoptera: Aphididae): Its management and impact on predatory fauna in rapeseed mustard under organic farming conditions. International Journal of Tropical Insect Science. 2024 Feb 1:1-9.