Introduction

Many essential plants, including high-quality food and industrial oils, common vegetables, and weeds, belong to the Brassicaceae family, which includes the genus Brassica. The strong attack of many pests and diseases not only degrades the quality of crops, but also significantly affects the oil content of many oil-producing brassica crops. Aphids, a severe insect pest of Brassicaceae species, which include key vegetable and oilseed crops, have evolved with their host plant to become the most economically important insect pest of agricultural Brassicas. This page provides an overview of pest biology in general insect habit and nature of pests which includes physical, cultural, biological, innovative methods, plantation of resistant varieties, chemical applications and integrated pest management technologies. Some cultural techniques to deal with the aphid population include fertilizer applications at the proper dose, irrigation, and resistant cultivars. For crop security, natural enemies are currently effective and spectacular.

Keywords

industrial oils, Brassicaceae family, insect, techniques

1. Introduction

Green peach aphid (Myzus persicae S.), cabbage aphid (Brevicoryne brassicae L.), and turnip aphid infest the oil seed Brassica (Lipaphis erysimi Kalt.). Air force (Indian mustard) is predominantly infested by L. erysimi (Bhatia et al., 2011). The mustard aphid, Lipaphis erysimi (Kalt.), is the most damaging insect pest of rapeseed-mustard, with productivity losses ranging from 35.4 to 96 percent depending on weather conditions (Sahoo and Bengal, 2012). According to the United Nations, rapeseed-mustard (Brassica sp.) is an important oilseed crop grown in 53 countries across six continents. India is the world’s third-largest producer, behind China and Canada, according to (Sahoo and Bengal, 2012).

The adults have soft bodies, generally yellowish green in colour, are small to medium-sized, globular, and pear-shaped, and show wing dimorphism depending on resource availability. At levels of crop damage below the economic threshold, their unusual feeding mechanism and reproductive biology make them difficult to control. These insects have unique mouthparts that allow them to consume sap from vascular phloem tissue by piercing and swallowing it, depriving the plant of nutrients and inflicting significant losses to their target agricultural plants directly and indirectly (Bhattacharyya, 2019). Recent research has also found that phloem feeders (aphids) can cause substantially more harm to host plants than other herbivore insects, owing to their superior flexibility to host defense mechanisms.

Aphids affect the crop at all phases of growth, but the flowering and pod formation periods do the most damage. Both nymphs and adult aphids devitalize the crop by sucking the cell sap. Plasticity in the reproductive mode, whether sexually or asexually induced as an adaptive response to cope with seasonal changes, increases the chances of survival when predators are outnumbered. The mustard aphid attacked the host plant in three ways: first, by sucking the plant phloem through styliets, which are needle-like piercing-sucking mouthparts that cause harm such as leaf bending and yellowing, stunting, and drying. Second, by excreting a sticky substance (honeydew) on which "sooty mould" grows, blocking the photosynthetic process. Thirdly, it causes secondary plant damage through the transmission and spread of viruses, such as turnip mosaic viruses (Koirala, 2020).

2. Scenario in Case of Nepal and Asian Countries

Nepal had a total area under oilseed crops of 184,718 ha, with a total production of 161,927 t and an average productivity of 0.88 t/ha. However, due to biotic and abiotic causes, mustard yields were severely reduced. Insect pests have the greatest impact on yield when biotic restrictions are present. Mustard aphid is one of the most destructive insect pests, producing output reductions of 35.4 percent to 91.3 percent. Not only did it lower yield, but it also decreased the oil content of rapeseed and mustard by 5.6 percent. Farmer’s spray 2-3 times with a chemical insecticide to reduce aphids, however it has been shown that this kills natural enemies and bee populations, as well as harming the environment and human health (Kafle and Jaish, 2020).

This aphid infests mustard, radish, shepherd’s purse, turnip, watercress, and other crops in the United States of America (USA), Canada, India, and other areas of the world. In the southern United States, it routinely causes considerable direct and indirect losses to mustard crop farmers. Outside of the South, considerable damage has been recorded in Maine, Connecticut, New York, New Jersey, Maryland, Pennsylvania, Delaware, Indiana, Ohio, Michigan, Wisconsin, Illinois, Nebraska, Kansas, New Mexico, Colorado, Wyoming, Arizona, Utah, Idaho, California, and Washington. Furthermore, the turnip aphid has been discovered to transmit around 13 different viruses, including important Brassicaceae viruses such as Beet mosaic virus, Cabbage black ring spot virus, Cauliflower mosaic virus, and Radish mosaic virus.

In states where aphids are present, a variety of management strategies have been used to reduce damage from aphids (Bhattacharyya, 2019). Aphids cause considerable damage on the Indian subcontinent and in New Zealand, however other pests from other orders are also important in India. Aphids in oilseed brassica crops are controlled with insecticides throughout Asia (Lamb, n.d.). In India, around a third of a dozen insect pests have been discovered infesting mustard crops. Out of three types of aphids, mustard aphids are regarded the most important pests in terms of economic relevance. The first, Lipaphis erysimi Kalt., Myzus persicae Sulzer, and Brevicoryne brassicae Linn., is the most serious, cosmopolitan, and has gained national pest status, causing yield losses ranging from 35.4 to 91.3 percent (Patel, 2004). In India, aphid host-plant resistance is being studied (Lamb, n.d.).
3. Insect Habit and Nature of Damage

3.1 Biology and Lifecycle

Aphid emergence begins in the field the first week of November and lasts until the harvest. Aphids exhibit fluid in reproductive mode—either asexually or sexually—and are viewed as an adaptive reaction to cope with climatic change. Females (stem mothers) travel from the hills to the plains, reproduce sexually at first, then parthenogenetically generate nymphs (Ogawa and Miura, 2014). Males are less required to fertilize females in parthenogenetic viviparity, and the egg stage of the life cycle is reduced. Surprisingly, aphids reproduce clonally and give birth to young, and the embryonic development of an aphid begins before its mother’s birth, allowing for generation telescoping. All these particular characteristics help aphids conserve energy and begin on brief generation times. Under ideal conditions, such a prolific multiplication rate manifests itself in exceptionally high aphid pycnegy. Furthermore, aphids can exhibit winged dimorphism, resulting in extremely fertile wingless variants or less prolific winged progeny that can spread to other host plants depending on resource availability. Wingless aphids are abundant, whereas winged aphids develop at high aphid densities or when the quality of the host plant is poor. All of these abilities contribute to the aphids’ success (Koirala, 2020).

Egg: Eggs are white in colour and laid along the veins of leaves.

Nymph: There are four nymphal stages (instars). The general appearance of each stage is similar except for increase in size during subsequent instars. The first, second, third and fourth nymphal stages last 1-2, 2, 3, and 3 days respectively.

Adult: Aphids are pear-shaped insects with a pair of cornicles (wax-secreting tubes) extending from the fifth or sixth abdominal segment. Female aphids are wingless and have a yellowish green, grey green, or olive-green body with a white waxy bloom. Female mature aphids with wings have a dusty green abdomen with dark lateral stripes dividing the body segments and dusty wing veins. Male aphids are olivegreen to brown in color. The aphid attacks generally during 2nd and 3rd week of December and continues till March. (AESA BASED IPM Package AESA Based IPM-Mustard/Rapeseed, n.d.)

Figure 1: The lifecycle of mustard aphid

3.2 Nature of damage

The neaphis Brassicaceae pest aphid causes severe damage to crop by sucking plant sap and transmitting pathogens during the feeding process. Aphids are one of the most damaging pest groups in modern agriculture due to their unique biological characteristics and unusual reproductive habits. Both the nymph and adult stages are dangerous to Brassica crops. Aphid infestations can occur at any stage of crop development, but the most damage is caused by sucking of the cell sap during the flowering and pod formation stages (Bhattacharya, 2019).

3.3 Disease and Symptoms

On the younger sections of the plant, it is a sap-sucking obligate ectoparasite. The nymphs and adults feed on sap from various sections of the plant above ground, including as leaves, young shoots, inflorescence, and young pods, resulting in a loss in chlorophyll or even plant death (Liu and Yue, 2001).

3.4 Management strategy

The essential period for mustard exposure to aphids was discovered to be three weeks following aphid arrival, when the crop was in flowering stage, hence control methods must be implemented prior to flowering (Patel, 2004). Lipaphis erysimi (Kalt.) is a major mustard aphid pest in India and other tropical locations across the world. Aphids are still active throughout the winter. North India is harvesting mustard from November to March, with a peak in population from mid-February to mid-March. Around 65-96% of the loss in seed yield and 15% of the loss in oil content is caused by mustard aphid (Kumar and Kumar, 2016).

3.4.1 Cultural method

In mustard, cultural and agronomic methods such as timely sowing, sanitation, ploughing, crop rotation, intercropping, spacing, and nutrient management can help to reduce losses caused by crop losses. Sowing a balanced NPK application – N100 P40 K40 – in early October and cleanliness are the most critical top priority activities in aphid infestation management. In most mustard-growing areas across the country, the increase in AB, WR, and SSR aphid infestation rates is directly related to the delay in planting the crop (Gautam Sardar Vallabhbia Patel et al., 2019).

3.4.2 Biological/biorational method

Bio-agents are more compatible with environmental components, ecologically sound for plant health, and non-hazardous to humans (Kumar and Kumar, 2016). C. uncidentumucata (L) adult and grubs demonstrated significant feeding potential on all aphid species. Overall, the population of insect pests and predators remained constant across all kinds, according to the data. M. anisopliae (83.23 percent) was shown to be the most efficient entomopathogenic biopesticide against mustard aphid, followed by B. bassiana (78.33 percent) and B. thuringiensis (73 percent). After field efficacy, bio-pesticides can be considered as a promising choice for integrated pest control against the mustard aphid. Biological pest and disease control has been proven to serve an important role in minimizing the overuse of chemical pesticides (Gautam Sardar Vallabhbia Patel et al., 2019).

3.4.3 Innovative methods/ use of sex pheromone

Pheromones and other semiochemicals offer a lot of potential when it comes to insect pest control. Problems in achieving economical and efficient synthesis starting from fine molecules have limited commercial production (Birkett and Pickett, n.d.)

3.5 Resistant varieties

The use of resistant varieties such as MM014-02w and Binaasriaha-4 is the most effective and important weapon for reducing aphids without the use of insecticides, and thus plays an essential part in the IPM program. As a result, the farmer will be advised to grow high yielding types that are resistant or less sensitive to the pests. This will assist them in achieving a better yield of mustard without posing a health risk or causing harm to the environment (Mamun et al., 2010). The damage caused by mustard aphids is shown to be more severe, resulting in a 35-91 percent drop in output. Although systemic insecticides have been found to be effective in eliminating aphid infestations, the lingering problem and environmental repercussions have forced the use of innovative aphid management techniques. The dearth of naturally resistant cultivars has made standard breeding procedures for generating aphid-resistant Brassica crops impractical, necessitating the use of genetic engineering to supplement traditional breeding for adding aphid resistance. Although the use of genetic engineering strategies has resulted in moderate success in developing aphid resistance in some crops, commercialization of such transgenic crops has yet to be considered, implying the need for more research into the host plant and aphid interactions in order to develop better aphid resistance strategies. For future commercialization of aphid resistant transgenic brassica crops improvements in the genetic engineering method can be made (Bhattacharya, 2019).

3.6 Chemical method

If the aphid population has exceeded action thresholds, or natural enemies have been unable to deal with the rapidly increasing aphid population, different pesticide treatments are required for successful control (Koirala, 2020). The chemical insecticides have been found more or less toxic to a number of parasitoids and predators (Sharma et al., 2019). Chemical pesticides used inadvertently can cause agro-ecosystem vulnerability, which is a major issue. Therefore, that is an important time to time, different researchers have examined and advised selective insecticidal treatments against mustard aphid in various parts of the world. Chemical pesticides are divided into two categories: contact and systemic. Because they infest the abaxial surface of the leaves and...
sucking through stylets inserted directly from the phloem sap, aphids are resistant to contact pesticides. Importantly, systemic insecticides, which are directly digested by plants, are largely used and well-known to control aphids since they are drawn by phloem sap and kill aphids regardless of their shelter or food source, even if they are eating under the leaf (Bahlai et al., n.d.). The major chemicals used for the control of aphid are Carbamates, organo-phosphates, pyrethroids, cyclodienes, etc.

3.7 Integrated pest management

Among the treatments tested, Dimethoate @ 1 ml/l followed by C. septempunctata @ 5,000 beetles/ha and NSKE @ 5% followed by C. septempunctata @ 5,000 beetles/ha may be recommended for the most cost-effective and efficient management of the mustard aphid, Lipaphis ersyimi on the rapeseed mustard crop (Yadav and Singh, 2015).

4. CONCLUSION

Lipaphis ersyimi is one of the major insect pests seen in the mustard which causes heavy damage of plant and oil content of mustard. Different above mentioned management strategies must be applied to overcome the damage of the pest. Not only mechanical, chemical, and cultural are effective for the management of the pest. Furthermore, other strategies like integrated pest management, resistant varieties, host plant resistance and ideotype varieties should be taken into consideration.

The way forward for control of lipaphis ersyimi should include the following measures:

1) Creating an efficient Integrated Pest Management (IPM) strategy that suit Nepal context and should include capacity building programs on IPM.
2) Encourage for developing bio-friendly pesticides as means of controlling and preventing aphids.
3) Conducting awareness campaigns involving mustard farmers about the impending danger of Lipaphis ersyimi invasion.
4) The ministry of agriculture should develop an effective strategy to control and eliminate leaf miners completely.
5) Adopt both boarder and in-country quarantine measures to prevent its introduction.
6) Mass trapping of the pest using sex pheromone traps is an effective method for control of Lipaphis ersyimi. The government through ministry of agriculture needs to subsidize the cost of traps.

REFERENCES

Aesa Based Ipm Package Aesa Based Ipm-Mustard/Rapeseed. (N.D.).