Eco-friendly and Integrated Management of Sucking Pests in Chilli

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Chilli or hot pepper being an indispensable spice in our daily kitchen usage is also very popular on the industrial forefront due to the presence of several bio-active compounds. Chillies possess over 15 capsaicinoids, a preponderance of which are dihydrocapsaicin, capsaicin, nordi-hydrocapsaicin etc. besides compounds like capsanthin, capsorubin and oleoresins which not only impart flavour and colour but also have therapeutic values. For the year 2022-2023, the Spice Board of India reported that chilli valued at Rs. 10,445.92 crore rupees was exported from India arising from the cultivation in 4,00,000 hectares, resulting in a production of 4,221,000 metric tons (NHB, 2021-2022). The Guntur Chilli Market Yard holds the distinction of being the largest chilli market in Asia, significantly this highlights the crop's importance in southern India especially in this region.

The crop chilli thrives well under warm conditions, which unfortunately coincides with periods of peak activity of sucking pests. Hence, the damage of thrips, whiteflies, aphids, etc. is frequently observed on the crop. The insect population experiences a significant surge with rising temperatures, facilitating heightened reproductive activity through increased flight rates. The sucking pests are most attracted to the young succulent flesh of the plants thus turning the nursery stage plants most susceptible to the infestation, following the overall vegetative phase.

Recently in 2021-2022, the menace of novel black thrips was also observed on this crop in states like Andhra Pradesh, Telangana, Karnataka, Madhya Pradesh, Chhattisgarh etc. causing huge losses to the growers and thus impacting the domestic trade and exports. These notorious sucking pests also act as vectors causing numerous viral diseases to the crop. Amongst viruses, GBNV is one of the economically important viruses causing an estimated loss of more than US$ 89 million per annum in Asia, with 70–90% yield losses. The cucumo (CMV) & Poty (ChVMV) viruses which are transmitted by aphids have been reported to affect crop yield and fruit quality by up to 60% if infected at early stages. Among all the viral diseases that affect the chilli crop, the chilli leaf curl virus transmitted by the whiteflies stands at the prime by causing up to 100% crop loss. The persistent manner of disease spread along with the unique feature of multiplication makes this disease immensely difficult to control.

It is a big challenge to manage the insect vectors spreading viral diseases, thus demanding a large number of pesticidal sprays. Owing to the consumption of chillies being preferred in both fresh and dehydrated forms and in addition to the crop's huge export potential making a lower load of plant protection chemicals a prime requisite, necessitates integrating biological, chemical and cultural practices alongside appropriate agronomic strategies to significantly mitigate the impact of damage and reduce the havoc caused by pests and its related diseases.

In this present article, the approaches to prevent and control the sucking pest-mediated disease transfer in chilli are highlighted. The suggested measures for controlling vectors and implementing appropriate cultural practices are furnished. Owing to the systemic nature of viruses, the host plant resistance stands as the main strategy. However, employing an integrated approach assists in managing and enhancing the crop's tolerance levels to various viruses.

Symptoms

A critical examination of the plant tissues reveals a significant difference between the damage caused by vector feeding and the damage caused by viral infections. Distinct changes in the plant's foliage and reproductive structures are witnessed.

An integrated approach for control of pests /vectors in chilli

Integrated pest/vector control is crucial as it combines multiple strategies to manage pests and ultimately the diseases sustainably transmitted through them for the safe harvest of chilli intended for different uses i.e. fresh, dry and processing. This approach minimizes the use of chemicals, reduces resistance development of insects and promotes environmental as well as economic benefits thus ensuring healthier crops and ecosystems. Integrated vector management includes various components such as cultural, chemical, biological and mechanical, along with different preventive strategies.

Among the various methods for controlling vectors, organic products are ideal due to their natural origin and environmental safety.

Organic applications

- Application of neem or pongamia oil 3 ml/litre as spray thoroughly over the plant, especially on the lower side of leaves where egg laying by the sucking pests is observed.

Various symptoms expressed in chilli crop due to sucking pests and viral disease damage

- Application of 5% Neem Seed Powder Extract (NSPE) or Neem Seed Kernel Extract (NSKE) as foliar spray can be performed.
- Spraying of commercial formulations of neem-based insecticides such as azadirachtin 3000 ppm @ 2 ml/ L can be practised. Other commercial neem formulations can also be used such as neemark, neemrich, achook, bioneem, margocide etc.
- It is recommended to install sticky traps at the specified spacing, alternating between blue, yellow, and white traps, preferably arranged in a triangular pattern throughout the field. Use yellow traps for whiteflies, and blue or white traps for thrips and aphids, with a total of 100 traps per hectare.
- Applying a diluted dishwashing soap solution or a deterrent to the plant surface will make it slippery, causing aphids and other sucking pests difficult to hold the grip and fall off the plant.

Biological agents

- Employing natural predators is also an effective way to control these sucking pests without environmental damage. The release of lacewings, big-eyed bugs and minute pirate bugs (6 larvae/plant) in the fields will aid in naturally controlling the sucking pests.
- The Release of predatory mite Amblyseius swirskii (50,000-100000 /ha) is also highly useful.

Chemical control

- Due to the longer period required for organic and biological control methods to address anticipated disease or pest damage, the integrated management system incorporates chemical control as one of its components.
- The Application of systemic insecticides like imidacloprid 0.05% (3 ml/L) or dimethoate 0.02% (2 ml/L) preferably during morning or evening hours, coinciding with low to no wind flow is ideal. It is always advisable to spray the insecticides in rotation, to avoid any kind of resistance development or resurgence.
- The addition of suitable stickers and spreaders like teepol (1ml) or soap water (2%) in the spray solutions helps in increasing the efficiency by decreasing the drift and ensuring appropriate application of the chemical all over the plant surface.
- A combination of natural repellents along with the chemicals such as the addition of

Pongamia or neem oil @ 3 ml/L along with insecticides is a novel approach that includes both the immediate effect on the sucking pest and a longer-lasting deterrent, which helps in reducing pest populations more effectively over time.

Mechanical practices

- To effectively manage pests and vectors, practice the removal and burning or burying of early-infested plants and implement clean cultivation techniques. Regularly monitor the main crop for signs of infection and control weeds, which can serve as alternative host crops.
- Dispose of plant / post-harvest debris by ploughing deep or burning.

Cultural practices

- Overall cultural practices of a crop are essential for maintaining crop health, optimizing yields, and promoting sustainable agriculture.
- The Adoption of resistant varieties against specific pests or viruses such as Arka Meghana (tolerant to ChVMV), Arka Sweta (tolerant to CMV), Arka Tanvi and Arka Gagan (tolerant to ChLCV)
- Establishing tall growing barrier/ trap crops (sorghum/maize/pearl millet (bajra) / fodder grasses etc.) around field borders in 2-3 rows, sown thickly to prevent pest movement
- Seed treatment with imidacloprid 70 WS @ 10 g per kg seed
- Good Nursery Management practices such as the usage of seedlings raised under scientifically managed protected structures having nylon mesh/ nets (50-64 mesh net tunnels/ greenhouses/ plastic houses)
- Practising deep summer ploughing and soil application of 500 kg/ ha of neem cake
- Following drip irrigation and mulching with silver-coloured polythene sheets/ reflective mulches of 25–30-micron thickness to the soil
- Treating the seedlings as a dip with insecticide (20 g/L for 30 Sec.) before transplanting
- Following recommended spacing (60 x 30 cm or 45 x 45 cm) and avoiding close spacing, as the high-density planting favours the pest incidence and multiplication
- Ensuring proper irrigation and nutrition tailored to the specific needs of the nursery crop.
- Transplanting 35-40 days old seedlings. Transplanting at appropriate age, avoid very young or overaged seedlings owing to their increased susceptibility towards these sucking pests
- Proper nutrition strengthens the plant's immune system, supporting healthy growth and development while also enhancing tolerance to viral diseases. Applying fertilizers as recommended based on soil requirements
- Fifteen days after transplanting apply water-soluble KNO3+ CaNo3@ 5g/L through drip (100 L/acre) at weekly intervals until the end of the crop.
- Foliar application of water-soluble (19-19-19 N-P-K @ 5g/L) from the flowering stage and micronutrient application @ 3-5g/L alternatively at 10 days interval is recommended
- Regular weeding 2-3 times during the season to make host-free conditions
- Harvesting green/red fruits as per the market requirements on rain-free days is advisable

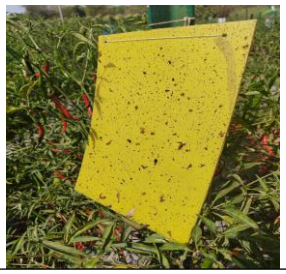
Preventive measures

- Incorporate mixed crops/ crop rotation to attract beneficial insects.
- Lower concentrations of prophylactic sprays are ideal to avoid the need for heavy, concentrated chemical applications right before the vector population threshold is hit, which can be harmful to overall plant health. Therefore, apply acephate at a concentration of 2 g/L as a prophylactic spray.
- Timely use of the recommended dosage of branded pesticides and fungicides preferably of a systemic nature is ideal
- Ideally, transplant hardened seedlings in the late afternoon in moist soil.
- The use of Bioformulations such as Arka microbial consortium, Arka actino plus, Vegetable special, Arka plant growth promoter etc. in turn, enhances the plant's resilience and ability to withstand potential threats of pests and diseases and manage specific viruses.

Community action

- Embracing integrated practices on a wide area basis or through community engagement of the entire village is vital for achieving successful management outcomes, promoting sustainability, and fostering a supportive agricultural environment.
- Knowledge exchange and application of seeing is believing: In a community or a cluster where the chilli growers can act together; share insights, experiences, and effective techniques; implement the modules for the pest/disease dynamics, and promote collective decision-making for action, management of these insect pests is easy and effective.
- Cost savings: Insect vectors can never be managed by applying pesticides/ botanicals in isolation. Implementing integrated practices on a larger scale can lead to cost savings for farmers by reducing the need for expensive chemical treatments and minimising crop losses. There are overall savings in expenses. The integrated practices are safe for the

Maintaining spacing



Yellow Sticky Trap

Pheromone Trap

Construction of barrier

environment by reducing pollution and harm to ecosystems, water sources, and non-target organisms.

Conclusion

Intensive cropping and crop rotations are the major factors contributing towards the continuum of any disease and pests. Furthermore, erratic weather events and climate change are key factors influencing the practice of their managemental strategies on a large scale, ultimately leading to a build-up of insect pests and vector populations thereby damaging commercial crops through infections. The sucking pest and insects of chilli need integrated management modules, which would drastically reduce the disease intensity and crop damage. The application of need-based chemicals and safer alternatives would allow desired management of pesticide residues. This is especially relevant for crops like chilli, which have become major export commodities where crop clusters are emerging. Hence, it is crucial to educate growers and industries on these issues.