Integrated Pest Management in Chilli

Narayana Bhat M[1], Vinay Kumar MM[2], PS Ajjappalavar[3], Ravikumar B[3] and M Abdul Kareem[4]

[1]ICAR-National Research Institute for Integrated Pest Management, New Delhi
[2]Horticulture Research & Extension Centre, Devihosur, Haveri, Karnataka
[3] College of Horticulture, Shirsi, Karnataka
[4] College of Horticulture, Bidar, Karnataka

Chili pepper (*Capsicum annuum* L.)) is indeed a highly important commercial crop cultivated globally in temperate, tropical, and subtropical regions, valued as both a spice and a vegetable due to its unique flavor, color, and rich nutritional content. With over 400 varieties globally, it is commonly referred to as hot pepper belong to the family *Solanaceae*, holds a significant position in global agriculture and cuisine. India is the largest producer, consumer, and exporter of chillies globally, with cultivation covering 844.3 thousand hectares with an annual production of 2278.50 thousand tonnes. Andhra Pradesh is the leading chilli-producing state, followed by Maharashtra, Karnataka, Odisha, and Madhya Pradesh. Approximately 80% of India's chilli production is consumed domestically, with only 15-20% allocated for export. Apart from culinary uses, chillies are utilized in various industries. Despite its importance, chilli cultivation faces numerous challenges, including pest infestations by thrips, whiteflies, mites, and fruit borers, as well as diseases leaf curl, wilt, fruit rot and leaf spots. Climatic changes have further impacted chilli cultivation in regions like Haveri, Karnataka, where a 37.31% annual reduction in cultivation area has been reported over the past decade. To meet the growing demand for chillies, there is a need to expand the cultivation area and enhance productivity per unit area. Adopting advanced techniques such as Integrated Pest Management (IPM) offers a sustainable solution. IPM minimizes pest damage while promoting ecological balance and ensuring higher yields and quality. This study examines the socio-economic impact of adopting IPM technology in chilli cultivation.

IPM strategy

This IPM implementation study was conducted in collaboration with Horticulture Research and Extension Centre (HRES), Devihosur, Haveri, for successive three years from 2020 to 2022. The study area focused on four selected villages *Viz*., Devihosur, Hosalli, Aladakatti, and Kabbur. The project aimed to provide knowledge and technical expertise on Integrated Pest Management (IPM) practices and supported by supplying IPM components such as selected label claim pesticides, traps and lures and vermicompost to farmers. Seven progressive farmers, each owning at least 2 acres of land, were selected. IPM module consisted of seed treatment with *Trichoderma asperellum* @

10g; raised nursery beds about 10 cm above ground level for good drainage; covering nursery bed with nylon net of 40-50 mesh to protect seedlings from sucking pests; destruction of previous crop residues, weeds etc. and levelling of main land avoiding water-stagnation; application of vermicompost @ 10 q / acre, neem cake @ 1 q/acre at the time of planting; application of *Trichoderma asperellum* @ 2 kg/acre enriched with well rotten FYM (1 t/acre); nipping of seedling tips five days before transplanting to reduce sucking pest, *murda* complex and increase side shoots; grow maize around chilli field as a barrier crop to avoid the entry of sucking pests and support natural enemies; planting marigold as trap crop after every 25 rows of chili crop; erect T-shaped bird perches @ 10/ acre to facilitate visits by predatory birds; install yellow sticky trap/ blue sticky traps @ 20 traps /acre for thrips, white fly and leaf hopper trapping; spray azadirachtin based neem oil 3000 ppm @ 0.5 % in the initial stages of crop growth during initiation of insect pests and spray of locally prepared *Beauveria bassiana* @ 10gm/l against black thrips during 2022; rogue out and bury murda infested plants in the early stages; erection of pheromone traps @ 5/ acre for *Helicoverpa armigera* for monitoring of adults; apply need based application of label claim pesticides against major pests and diseases.

Impact of IPM on insect-pests and diseases

During three years of validation, thrips population mean ranged from 0.8 to 2.35 in IPM while FP recorded 1.3 to 2.77/leaf. Mites mean population was <1.0 in IPM while FP recorded 0.7 to 1.0 /leaf. Whitefly population was < 1.0/leaf in both IPM and FP. *Helicoverpa* fruit borer incidence was low (0.57 to 0.79 %) during 2022 compared to 2020 and 2021 where IPM recorded mean incidence of 2.5 and 4.13 % respectively (Fig.1). During the same period, incidence in FP was 3.7 and 4.54 % respectively. Spider mean population was high (0.48 and 0.58/plant) in IPM compared to FP (0.34 and 0.35/plant) during 2021 and 2022. Similarly, coccinelids population mean was high (0.43 and 0.58/plant) compared to FP (0.28 and 0.31/plant). Powdery mildew, die back and *murda* complex severity was low in IPM compared to FP. In IPM, powdery mildew severity was < 20 % in both IPM and FP during 2021. While in 2020 and 2022 powdery mildew severity was 35.2% and 25.2 % respectively. In FP during 2020 and 2022 powdery mildew severity was 41.9 and 20.5 % respectively. Similarly, die back severity was maximum (24.5 %) in IPM during 2020 while its severity was maximum (30.9 %) in FP during the same year. Similarly *murda* complex severity was maximum (35.2 %) in IPM during 2020 during which FP recorded 40.2 % severity. During 2021 and 2022, murda severity ranged from 14.8 % in IPM to 31.5 % in FP. *Sclerotium* wilt was noticed only in 2022 during which its incidence was 4.6% in IPM while FP recorded 10.5 % (Fig.2).

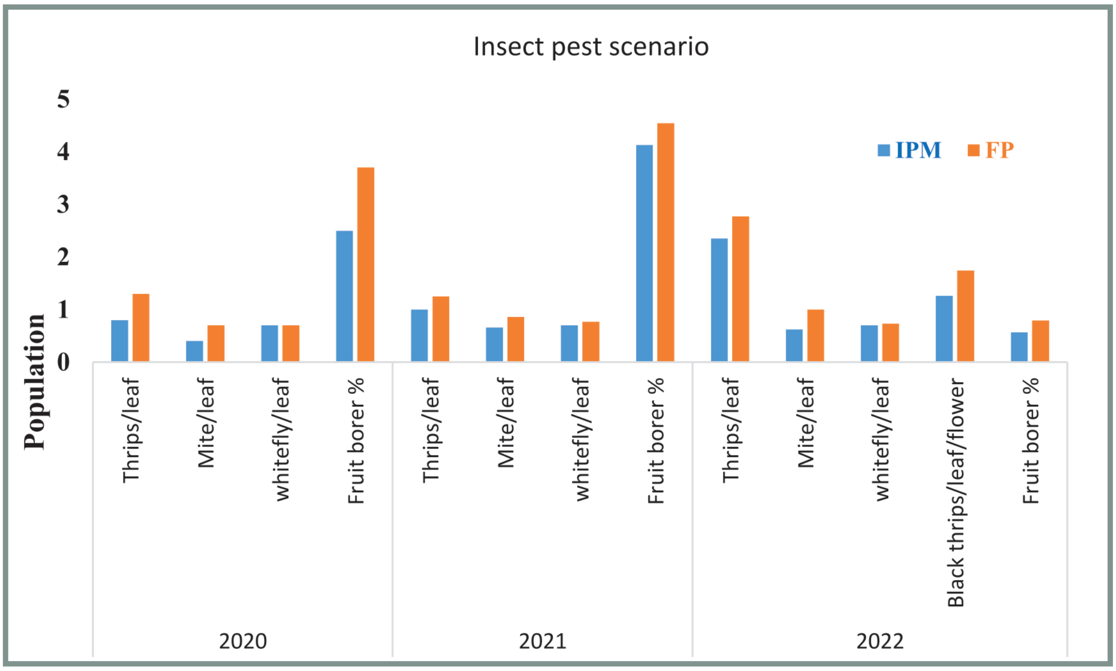

Fig.1 : Insect pest scenario in Chilli during 2020-22.

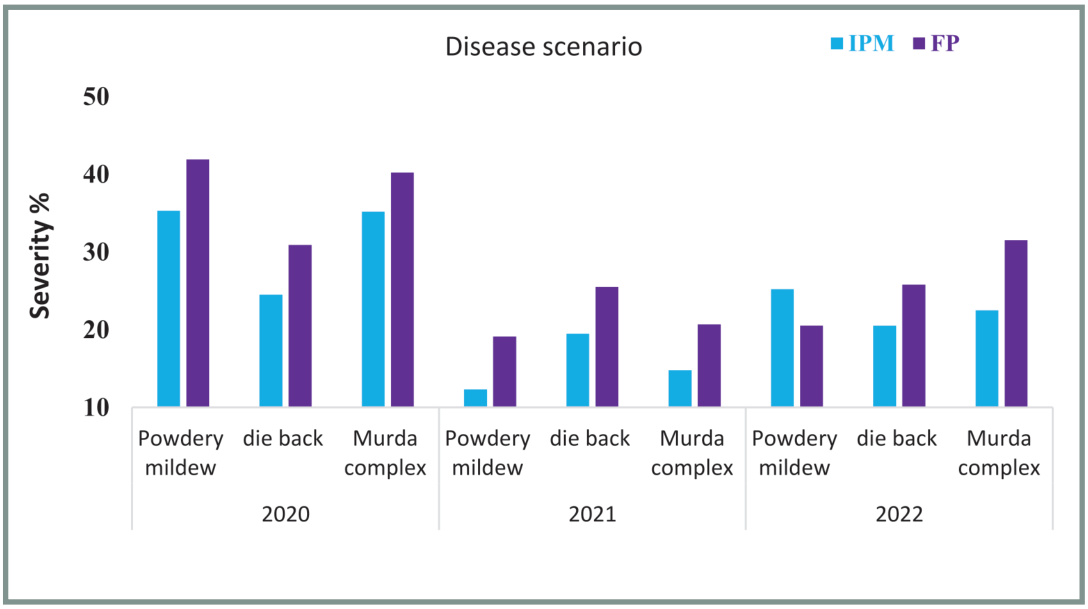

Fig.2 : Disease scenario in Chilli during 2020-22.

Economic impact of IPM

Further, number of pesticide spray reduction was maximum (42.8 %) recorded during 2020 which was followed by 2021 and 22 with 23.8 and 24.8 % reduction. Reduction in cost of production ranged from 3.7 to 14.6 % in IPM over FP during 2022 and 2021 respectively. Yield increase in IPM over FP was 4.3 and 6.1 % respectively during 2021 and 2022 respectively. The impact assessment was conducted in 2024, following the completion of the demonstration project. Using a purposive sampling technique, the same farmers involved in the initial project were surveyed between May and July 2024. The data from 25 farmers, who were trained and engaged during the project, were analyzed using descriptive statistical tools such as totals and percentages to interpret the findings.

The study highlighted that all the respondents (100%) possessed knowledge about Integrated Pest Management (IPM). A common agricultural practice among respondents was the use of raised seedbeds for cultivating seedlings. The frequency of farmers visiting *Krishi Vigyan Kendras* (KVKs) or related institutions was low with only 4% visiting regularly, 16% occasionally, and 80% rarely with many (>60 %) communicate through whatsApp. The limited visits may be due to factors like the distance of institutions from villages or inadequate transport facilities. Farmers acknowledged the effectiveness of discussions with experts in reducing the number of pesticide sprays. Regarding technical needs, all respondents prioritized pesticide information. Additionally, 100% of the farmers identified mites as a major cause of yield reduction, while 52 % highlighted the role of thrips 44 % fruit borers, and 20 % whiteflies. After three years of IPM demonstrations, 76 % of respondents confirmed a significant reduction in pest and disease infestations. However, only 12 % of the farmers were familiar with the concept of Economic Threshold Levels (ETL), while 60 % lacked this knowledge, indicating a need for further training. All respondents considered IPM a convenient, useful, and economical approach to sustainable plant protection. While 100% integrated chemical methods with botanicals and bioagents, only 36 % showed higher interest in using bio-agents, whereas, other farmers expressed a strong willingness to continue using IPM practices in the future.

The study revealed that 60 % of respondents were unaware of banned pesticides and the risks of overuse, highlighting the need for enhanced training programs. Nevertheless, all farmers were aware of the environmental and health hazards posed by pesticide contamination. While all respondents reported that, washing their hands after spraying, only 72 % covered their face and body during spraying. The remaining 28% failed to adopt these protective measures, underscoring the need for awareness campaigns. Innovativeness among the farmers was assessed, with 24% being highly innovative, 44 % exhibiting medium innovation, and 32 % classified as low innovative. In total, 68 % of respondents demonstrated some level of innovation. Majority (76 %) of the farmers gained 10,000 to 20,000 Rupees/acre by adopting IPM. The additional income through adoption of IPM helped 36 % farmers to buy critical inputs for next season.

This study highlights the positive impact of IPM on farming, showing that farmers benefit from lower production costs and more sustainable yields. IPM improves farm productivity while ensuring environmental safety. Economically, IPM reduces input costs and increases returns. Despite the initial cost of IPM inputs, long-term savings on pesticides and higher yields make it a financially viable option. However, many farmers still lack adequate knowledge about IPM, which limits its adoption. To bridge this gap, investments in training, demonstrations, and extension services are crucial. These efforts will promote IPM's environmental and economic benefits, enabling farmers to adopt sustainable methodologies for sustainable economic growth and social responsibility.