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Soybean Mosaic Virus and Its Management

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Soybean (*Glycine max*) is one of the earliest cultivated edible plants, originating in Northern China around 1100 BC. As a cost-effective source of high-quality protein, it is the most widely grown oilseed crop in India and globally, with significant potential to address global protein deficiencies. Despite its nutritional and economic importance, soybean productivity in India remains low due to abiotic, biotic, and socio-economic constraints. Among biotic stresses, viral diseases particularly *Soybean mosaic virus* (SMV), a member of the *Potyvirus* genus pose a major threat. SMV is globally prevalent and causes severe foliar symptoms, pod deformities, and yield losses of up to 86%. The virus has a broad host range and is transmitted non-persistently by various aphid species and through infected seeds. Management of SMV is challenging due to the ineffectiveness of chemical control against viral pathogens. Integrated approaches involving resistant cultivars, border and trap crops, entomopathogenic fungi, and selective insecticides have shown promise in reducing vector populations and disease incidence. However, due to the nature of SMV transmission, insecticidal control alone offers limited efficacy. A holistic, integrated pest management strategy remains essential for sustainable soybean cultivation.

Keywords: *Soybean mosaic virus*, Aphid, Border crops, Trap crops

Introduction

The soybean is one of the earliest edible plants cultivated in Northern China around 1100 BC. Since soybean is the least expensive source of high-quality protein, soybean is the most widely grown oil seed crop in India and globally and the crop has the potential to lessen the world's pervasive protein shortage. (IISR, 2022). soybeans are used to manufacture a wide range of food items (Van *et al*., 2004). Soybean sprouts, roasted seeds, steamed raw beans, soy milk, soy sauce, fermented soybean paste, cake, soy flour, and the popular curd known as tofu are just a few of the many foods made from it (Willis, 2008).

The low productivity of soybeans in India can be attributed to a number of abiotic, biotic, and socio-economic factors (Joshi and Bhatia, 2003). Similar to other economically important crops, soybean also subjected to attack by several diseases caused by fungi, bacteria, viruses, and nematodes. The viral diseases which cause economic losses in soybean are *Soybean mosaic virus* (*Potyvirus*), *Cowpea mild mottle virus* (*Carlavirus*), bud blight caused by *Tobacco ring spot virus* (*Nepovirus*), *Mungbean yellow mosaic virus* (*Begomovirus*), *Alfalfa mosaic virus* (*Alfamovirus*), *Bean pod mottle virus* (*Comovirus*) and *Cucumber mosaic virus* (*Cucumovirus*). *Soybean mosaic virus* (SMV) is one of 39 viruses in the *Bean common mosaic virus* (BCMV) lineage of Potyviruses, most of which originated in South and East Asia (Gibbs *et al*., 2008). *Soybean mosaic virus* is a global infection that can seriously harm soybeans.

Symptomatology of *Soybean mosaic virus*

Fig. Mosaic mottling and puckering symptoms caused by *Soybean mosaic virus*

Foliar symptoms range from mild to severe leaf mottling, leaf deformity, necrosis, general stunting, puckering, seed mottling and, in rare occasions, plant mortality. Pods from infected plants were small and deformed with less hair as compare to healthy pods. Brownish patches were also seen on infected pods. Reports of yield losses in evenly infested field plots have reached up to 86 per cent (Pfeiffer *et al*., 2003). *Soybean mosaic virus* has very wide host range. Nandakishor *et al.* (2017) confirming the infection of SMV in four plant species belongs to *Solanaceae*, *Cucurbitaceae*, *Leguminosae* and *Caricaceae*.

Transmission of *Soybean mosaic virus*

Fig. Aphid (*Aphis gossypii*) vector of *Soybean mosaic virus*

The *Soybean mosaic virus* is spread naturally by non-persistent aphid species and contaminated seeds. According to early reports, *Soybean mosaic virus* is transmitted by aphids non-persistently *viz*., *Aphis glycines*, *A. citricola*, *A. gossypii*, *A. craccivora* Koch, *Macrosiphum euphorbiae* (Thomas), *Myzus persicae* (Sulzer), *Rhopalosiphum maidis* (Fitch) *and R. padi* (L.), *Dactynotus ambrosiae* (Thomas). (Clark and Perry, 2002; Balgude and Sawant, 2012).

Integrated management approaches of *Soybean mosaic virus*

The management of SMV is challenging aspect as viral disease cannot be controlled by chemical pesticides. The integrated management of disease can be undertaken to suppress the ailment. Integrated Pest management modules consisting trap crop, border crop, entomopathogenic fungi, suitable insecticide could reduce the risk of reoccurrence of the disease.

a) Use of two rows of maize or sorghum as trap crop/ border crop have shown reduced transmission of the virus by vector. (Anigol *et al*., 2019 and Waweru *et al*., 2021)
b) Use of tolerant varieties with extra-dense pubescence showed significantly lower incidence of SMV infection than more glabrous cultivars (Ren *et al*., 2000 and Pfeiffer *et al*., 2003)
c) Entomopathogenic fungi *viz*., *Pandora neoaphidis* Humber, *Lecanicillium lecanii* Gams et Zare and *Conidiobolus thromboides* Drechsler can significantly reduce soybean aphid population (Ragsdale *et al*., 2011).
d) The use of neonicotinoid insecticides applied as seed treatments has become common practice (Magalhaes *et al*., 2008). Imidacloprid, nitenpyram, thiacloprid, acetamiprid, clothianidin, thiamethoxam, dinotefuran, and lambda-cyhalothrin are the among important insecticides which can potentially reduce the aphid infestation. (Xi *et al*., 2015; Ullah *et al*., 2023).

However, like other non-persistently transmitted viruses, insecticidal control of aphid vectors usually provides little reduction in *Soybean mosaic virus* incidence (Johnson *et al*., 2008; Pedersen *et al*., 2007).

Conclusion

Soybean remains a cornerstone crop for global food security due to its nutritional value and economic importance. However, its productivity is severely hampered by viral diseases, particularly *Soybean mosaic virus*, which poses a persistent threat across diverse agro-climatic zones. The virus's wide host range, efficient aphid-mediated transmission, and seed-borne nature complicate its management. While chemical control offers limited efficacy, integrated pest management strategies combining resistant cultivars, cultural practices, biological control agents, and selective insecticides present a more sustainable path forward. Continued research into host-pathogen interactions, vector ecology, and resistance breeding is essential to mitigate SMV's impact and ensure resilient soybean production systems.

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