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Vinod Kumar Malik
Department of Plant Pathology, CCS Haryana Agricultural University, Hisar, Haryana, India

Preety Verma
Department of Plant Pathology, CCS Haryana Agricultural University, Hisar, Haryana, India

Mamta Khaiper
Department of Forestry, CCS Haryana Agricultural University, Hisar, Haryana, India

Rakesh Kumar
Department of Plant Pathology, CCS Haryana Agricultural University, Hisar, Haryana, India

Tarun Verma
Department of Entomology, CCS Haryana Agricultural University, Hisar, Haryana, India

Poonum Kumari
Department of Plant Pathology, CCS Haryana Agricultural University, Hisar, Haryana, India

KS Ahlawat
Department of Forestry, CCS Haryana Agricultural University, Hisar, Haryana, India

RS Chauhan
Department of Plant Pathology, CCS Haryana Agricultural University, Hisar, Haryana, India

Manjeet Singh
Department of Plant Pathology, CCS Haryana Agricultural University, Hisar, Haryana, India

Monika Jangra
Department of Forestry, CCS Haryana Agricultural University, Hisar, Haryana, India

Corresponding Author:
Vinod Kumar Malik
Department of Plant Pathology, CCS Haryana Agricultural University, Hisar, Haryana, India

Role of biorational approaches in mungbean on mungbean yellow mosaic viral disease (MYMV)

Vinod Kumar Malik, Preety Verma, Mamta Khaiper, Rakesh Kumar, Tarun Verma, Poonum Kumari, KS Ahlawat, RS Chauhan, Manjeet Singh and Monika Jangra

Abstract
Mungbean (*Vigna radiata* (L.) Wilczek) is a very ancient annual crop in. Indian farming which is commonly known as greengram, green bean, moong, mash bean, golden gram and green soy. Mungbean originated.in India or the Indo- Burmese region. The standard yield of mungbean worldwide is very low (730 kg/ha) and the mungbean production has not increased yet to the potentials. The main reasons for the low yield do fungus, virus, bacterium, insect, weed etc. Out of all diseases of mungbean. MYMV disease is one of the most prevalent and destructive diseases. MYMV in the southern and northern states is currently causing serious concern to mungbean growers and to the industrialist in these regions. The most vulnerable stage is from 30 to 45 days. MYMV a member of *Geminiviridae* family, belong to genus *Begomovirus* that was identified in 1955 and it was observed that it is not transmitted mechanically but transmitted by whitefly (*Bemisia tabaci* Genn) in persistent manner. All the biorational approaches significantly reduced MYMV PDI and with increase in the yield as compared to control. Salicylic acid as seed priming and then foliar spray have maximum per cent disease control followed by sarpagandha leaves extract as seed priming which was statistically at par to that recorded for neem oil as seed treatment. The salicylic acid, sarpagandha leaves extract and neem oil were effective to increase yield and test weight.

Keywords: MYMV, *Geminiviridae*, *Begomovirus*, persistent manner and salicylic acid

1. Introduction
India is a country of diverse argo climates viz., tropical, subtropical and temperate. Such climates are ideal for growth and development of different types of pathogens. The virus is one amongst them and. MYMV is very destructive in. Indian and adjacent areas of South-East Asia causing up to 100 per cent yield losses. MYMV causes deadly disease in mungbean by plummeting seed yield and quality (Kang *et al.*, 2005). The MYMV in India was first time reported by. Nariani in 1960 from IARI (Indian Agricultural Research Institute), New Delhi fields with the incidence of 20-30 per cent. Several others reports are also there stating the occurrence and severity of. MYMV incidence from India, Sri Lanka, Pakistan, Bangladesh, New Guinea, Philippines and. Thailand (Honda *et al.*, 1983; Chenulu.*et al*,.1988;). MYMV also infects mungbean, soybean, mothbean, cowpea, urdbean and few other leguminous hosts (Dhingra *et al.*, 1985 and Qazi *et al.*, 2007).

2. Symptomatology
The symptoms of yellow mosaic start appearing on the susceptible lines within 15 days after sowing. Initially it produces scattered yellow specks of mild intensity, which was observed on young leaves (Deepa *et al.*, 2017). Infected plant produces fewer flowers and pods, pods remain small, contain few seeds which are often malformed, shriveled, discolored, affecting qualitatively and quantitatively (Dhingra and Chenulu, 1985). At reproductive stage pods turn yellow and become curvy at the tips (Patel *et al.*, 2018). Singh *et al.*, 2018 reported that maturity is also delayed in the diseased plants. Seeds that develop on severely infected plants are small and immature.

3. Effect on concentration of biochemical contents
Mungbean yellow mosaic virus causes severe yield loss in mungbean which generally make many biochemical changes such as in phenol, protein, chlorophyll, total sugar content, etc. which are when compared with healthy plants.

Biochemical changes.in the leaves of mungbean yellow mosaic virus (MYMV) resistant and susceptible varieties have indicated that infection results in malfunctioning of polyphenol metabolism by increasing total sugars, total phenols, whereas ortho-dihydroxy phenol and flavanols only in the resistant variety as compared to their respective healthy ones.

3.1 Epidemiology

Environmental factors play significant role in the development of disease in the given population (Vanderplank, 1968). The most important factors for epidemiological studies are temperature, relative humidity, rainfall, wind velocity and sunshine hours. The environmental factors affect the whitefly population and its activities, which have indirect effect on diseases development.

4. Management of mungbean yellow osaic virus disease

Yellow mosaic disease of mungbean is the most serious disease and the main constraint in increasing the production of this crop. It has potential to inflict 100% damage to this crop (Nene, 1973). As the damaging potential of MYMV disease is very high. So, it is necessary to manage the disease early and efforts also have been made. All the efforts were focused in the direction of management of. MYMV disease by managing whiteflies through different means like varying sowing dates, physical and crop barriers, different spacing between plants, use of different plant extracts, resistance inducers and chemical insecticides etc. The main focus of all these efforts is for the management of mungbean yellow vein mosaic virus disease through control of whitefly and also by inducing the resistance.

4.1 Management through cultural practices

Yellow mosaic disease is the most serious limiting factor in mungbean cultivation. Many cultural practices have been found effective for management of. MYMV diseases such as use of resistant varieties, manipulation in sowing dates, plant density, intercropping, removing collateral weed hosts around the field and rogue out the diseased plants, proper nutrient management etc. Exclusion of leaves of plants infested with the non-mobile nymph and pupa stages may trim down the populations to the levels that natural enemies can suppress the further population build-ups (Karthikeyan *et al.*, 2015).

Jayappa *et al.*, 2017 reported the MYMV management.by manipulating the sowing dates. The observations revealed that, the percent disease incidence varied from. 26.65 to 28.00 per cent in first sown and.28.17 to 30.13 in late sown summer crop. Magar (2007) stated that closer plant spacing viz., 30 x 30 cm (1.24 whiteflies/leaf), 50 x 30 cm (1.15 whiteflies/leaf) and. 60 x 40 cm (1.31 whiteflies /leaf) had remarkably less whitefly population than wider spacing 60 x 60 cm (1.61 whiteflies/leaf). The used barrier crops such as cowpea considerably obstructed whiteflies and thus lowered disease incidence (Singh, 1980).

4.2 Management through bio rational approaches

Amongst various methods of whitefly management, chemical control is the primary method adopted. Systemic chemical insecticides viz., acetamiprid, ethion, imidacloprid, triazophos, provide better control of whiteflies; they also kill on contact. But if they are taken inside the plant where they go onto protect against further attack for more than a few weeks (Wang *et al.*, 2009). Khan *et al.*, 2012 suggested that chemical imidacloprid was most effective to control whitefly population and MYMV. Application of neem seed kernel extract (NSKE) and foliar spray of neem oil had a major impact by preventing the "nymphal" stage of whitefly from developing into. Adult, the nymphs tend to disappear from the treated plants (Dubey *et al.*, 2011)

Reang *et al.*, 2018 used different botanicals such as lemon oil, clove oil, neem oil, pine oil, garlic oil and chemicals such as imidacloprid, phorate, dimethoate. Out of all botanicals, neem @ 0.2% showed the lowest incidence (10.49%) and severity (9.58%) and among three insecticides the significant lowest incidence (8.19%) and.severity (6.61%) was recorded when imidacloprid @ 1ml/3 litre of water was sprayed over the crop. Akram *et al.*, 2016 observed that treatment involving seed treatment with imidacloprid 17.8SL @5ml/kg seeds and two foliar sprays with an insecticide consisting of. 50% chlorpyriphos and 5% cypermethrin @0.1% at.15 and 45 days after sowing showed statistically significant enhancement of grain yield of mungbean.

4.3 Management through resistance inducers

Use of resistant varieties offer a cheap and best mean of avoiding losses caused by MYMD. A number of MYMD resistant varieties of mungbean have been developed and released for cultivation in different parts of the. India can be deployed to mitigate the losses caused.by MYMV disease in mungbean. In case of mungbean, Khattak *et al.*, (1999) worked out the mode of inheritance of resistance to. YMD in crosses involving a highly resistant mungbean line (NM 92), a moderate resistant line (ML-5), a tolerant line (6601), 2 moderate susceptible lines (VC 2272 and Pusa Baisakhi), and.4 susceptible lines (VC 1560D, VC 3902A, Berken, and Emerald) and also found a single recessive gene to be involved in imparting resistance against the MYMD. Some recent studies have also shown MYMD resistance to be under the control of single recessive gene.

A variety of mechanisms through which plants defend themselves against pathogens can be either constituted or inducible (Abdel-Monaim, 2012). The inducible mechanism includes systemic acquired resistance (SAR) and induced systemic resistance (ISR). SAR is very effective against a wide range of viral, bacterial, and fungal pathogens (Waheed and Tehmina, 2011).

Several reports are also available on induction of resistance against plant viruses by using chemicals and one among them is salicylic acid which is natural messenger used to control tobacco mosaic virus (Murphy and Carr, 2002). Nabila (1999) also reported that squash plants gained resistance against. CMV infection after seed treatment with oxalic acid, salicylic acid or hot water that is at 10 mM, salicylic acid and oxalic acid induced resistance by reducing infective virus particles by 83.3 per cent and 37.5 per cent, respectively.

Karthikeyan *et al.*, (2009) studied effect of chemicals on the induction of systemic resistance in blackgram against urdbean leaf crinkle virus (ULCV). The pre-inoculation spraying of blackgram plants with resistance-inducing chemicals, namely salicylic acid and benzothiadiazole (BTH) at. 100ppm concentration was found effective in reducing ULCV infection and increasing the incubation period of the virus under controlled conditions.

5. Conclusion

Resistance to. MYMV infection can be induced in mungbean plants by activating the salicylic acid (SA) pathway. Salicylic acid which is natural messenger used to control other viral disaeses. The constituted mechanisms include changes in cell wall composition that can inhibit the penetration of pathogen, synthesis of antimicrobial compounds, hypersensitive response and systemic response. The role of salicylic acid (SA) in inducing resistance to. MYMV infection in *Vigna mungo*, predicted to be involved in stress responses, metabolism, photosynthesis, transport and signal transduction, showed increased abundance upon SA treatment. Susceptible plants showed characteristic yellow mosaic symptoms upon MYMV infection.

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7. Conflict of Interest

None.

8. References

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