Status and evaluation of soybean varieties against Mungbean Yellow Mosaic (MYMV) disease under changing climatic conditions of Kaymore plateau zone, Madhya Pradesh, India

Kunika Silodia*, Usha Bhale and M.S Bhale

Department of Plant Pathology, Jawaharlal Nehru Krishi Vishwa Vidhyalaya, Jabalpur-482 004, Madhya Pradesh, India.

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ABSTRACT

For the first time in central India, an epidemic of Mungbean Yellow Mosaic Virus disease transmitted through white flies in soybean at R1-R3 stage was noticed as scattered yellow specks were noticed on upper leaves of soybean variety JS 335 during first week of August 2015 at Research Experimental Fields, JNKVV, Jabalpur. During 31st week (July, 2015), the rainfall (149.40mm, average temperature 26.7°C, and average relative humidity 80%, rainfall of 149.0mm) enhanced dramatically the population of whiteflies (from 2-25 flies/leaf) that resulted in the epidemic. At farmer’s field covering 8 villages; the overall incidence was in the range of 53-70%. In seed production units, incidence was in the range of 63.0-70.0% in JS 335, JS 95-60, JS 93-05 and JS 90-41. During first week of August to Ist week of September, the average temperature was 27.77°C and relative humidity was 76.5%. Evaluation studies of 28 varieties, under Seed multiplication chain, indicate that most of the varieties exhibited the infection of MYMV (in the range of 40-70%), however, PS 1225 did not exhibit any infection among the same set of environment. Jawahar Soybean (JS 20-69) exhibited infection up to 5% only. Other variety of soybean JS 20-34 exhibited infection up to 40%.

Key words: Mungbean Yello Mosaic Virus, Soybean, Whitflies.

INTRODUCTION

Originated from China, Soybean [Glycine max (L.) Merrill], an excellent source of major nutrients, about 40 per cent of dry matter is protein and 20 per cent fat (Cald Well, 1973). Soybean is the largest source of vegetable oil and protein in the world. The significance of soybean crop is well recognized worldwide, as a legume crop because it is capable of utilizing atmospheric nitrogen through biological nitrogen fixation system. Soybean crop fixes biological nitrogen about 270 kg N/ha compared to 58-157 kg N/ha by other pulses (Hoque, 1978). In the economic world hundreds of food, feed and industrial uses have been documented.

The crop is usually grown as a rainy season crop under rainfed situations. In India, the cultivation is concentrated in the Central niche predominantly in Madhya Pradesh, Maharashtra, Rajasthan and now Andhra Pradesh and Karnataka, around a latitude about 16° to 26° N and longitude range about 73° to 84° E (Tiwari, 2001). In Madhya Pradesh, it is grown on 55.5 lakh ha with a production of 51.6 lakh MT (SOPA, 2015).

Soybean suffers from several diseases caused by fungus, bacteria, nematode and viruses (Hartman and Hill, 2010). More than fifty phytopathogenic virus have been observed causing diseases in soybean (Gupta and Chouhan, 2005; Anonymous, 2014; Saxena, 2003). During kharif 2015, an epidemic of Mungbean Yellow Mosaic Virus disease was noticed during first week of August 2015 at Research Experimental Fields, JNKVV, Jabalpur. Within a short period of 12-15 days, the entire soybean foliage was covered by the infection of virus pathogen (Silodia, 2016). The disease spreads through vector Bemisia tabaci and non-seed transmission is reported (Karthikeyan et al., 2004; Borah and Dasgupta, 2012). The epidemic of MYMV was observed first time in Jabalpur, hence, the investigations were conducted.

MATERIALS AND METHODS

Status of MYMV disease: The status of Mungbean Yellow Mosaic disease was determined under natural high pressure conditions, at Farmer’s field, Seed Production units including 24 varieties grown at Research Experimental Fields during Kharif 2015. Disease incidence was also recorded at Farmer’s field of eight villages around Jabalpur and at Seed Production units using fixed plot monitoring technique.

The incidence of disease was recorded at R1-R3 (R1-one flower at any node; R2- flower at node immediately below the uppermost node with completely unrolled leaf and R3-pod 0.5 cm long at one of the four uppermost nodes) stage; the disease was initially identified on the basis of typical field symptoms and later causal viral organism was confirmed through ELISA.

Corresponding author’s e-mail: silodiyak@gmail.com
Incidence of disease: The incidence of disease was calculated on randomly selected 20 plants in a particular plot of field. During the study, total and infected plants were counted to calculate the disease incidence (Singh and Singh, 2000, Mayee and Datar, 1986).

Percent disease incidence (PDI) = \[
\frac{\text{Total number of plants infected}}{\text{Total number of plants observed}} \times 100
\]

Disease Severity

Population dynamics of vector: The population of whitefly (Bemisia tabaci) was determined with the help of magnifying glass (10x) on randomly selected middle leaves of 40 plants in a particular field at early day hours (around 5.30 to 6.00 am). During this period movement of the whiteflies was the least that helped in counting of in a precise manner.

Table 1: Measurement scale for MYMV disease (Salam et al., 2009).

| Scale/ Grade | Description                  | Category    |
|--------------|------------------------------|-------------|
| 0            | No plant showing any symptoms| Immune      |
| 1            | 1% or less plants exhibiting symptoms | Resistant |
| 3            | 1-10% plants exhibiting symptoms | Moderately resistant |
| 5            | 11-20% plants exhibiting symptoms | Moderately susceptible |
| 7            | 21-50% plants exhibiting symptoms | Susceptible |
| 9            | 51% and more plants exhibiting symptoms | Highly susceptible |

Table 2: Incidence of MYMV of soybean at R1-R3 stage at farmers’ field.

| Location | Per cent disease incidence* of MYMV | Variety | Disease reaction based upon grade | Range of population of whiteflies on middle leaves |
|----------|-------------------------------------|---------|----------------------------------|--------------------------------------------------|
| Patan    |                                     |         |                                  |                                                  |
| Location 01. | 65.0                         | JS 335  | Highly susceptible               | 10-20                                           |
| Location 02. | 70.0                         | JS 90-41| Highly susceptible               | 5-20                                            |
| Location 03. | 60.0                         | JS 335  | Highly susceptible               | 15-20                                           |
| Location 04. | 70.0                         | JS 90-41| Highly susceptible               | 18-25                                           |
| Location 05. | 45.0                         | JS 335  | Highly susceptible               | 18-25                                           |
| Location 06. | 63.0                         | JS 335  | Highly susceptible               | 15-20                                           |
| Katangi   |                                     |         |                                  |                                                  |
| Location 01. | 65.0                         | JS 335  | Highly susceptible               | 18-20                                           |
| Location 02. | 60.0                         | JS 335  | Highly susceptible               | 15-25                                           |
| Location 03. | 55.0                         | JS 335  | Highly susceptible               | 15-25                                           |
| Location 04. | 59.0                         | JS 90-41| Highly susceptible               | 11-22                                           |
| Location 05. | 52.0                         | JS 93-05| Highly susceptible               | 10-22                                           |
| Location 06. | 55.0                         | JS 335  | Highly susceptible               | 10-20                                           |
| Location 07. | 58.0                         | JS 90-41| Highly susceptible               | 10-20                                           |
| Location 08. | 69.0                         | JS 90-41| Highly susceptible               | 18-20                                           |
| Location 09. | 65.0                         | JS 90-41| Highly susceptible               | 18-20                                           |
| Location 10. | 63.0                         | JS 335  | Highly susceptible               | 17-20                                           |
| Location 11. | 66.0                         | JS 93-05| Highly susceptible               | 18-22                                           |
| Location 12. | 59.0                         | JS 90-41| Highly susceptible               | 17-20                                           |
| Location 13. | 49.0                         | JS 335  | Susceptible                     | 15-20                                           |
| Location 14. | 47.0                         | JS 335  | Susceptible                     | 15-18                                           |
| Location 15. | 60.0                         | JS 335  | Highly susceptible               | 13-15                                           |
| Location 16. | 49.0                         | JS 335  | Susceptible                     | 13-20                                           |
| Location 17. | 43.0                         | JS 335  | Susceptible                     | 15-20                                           |
| Location 18. | 69.0                         | JS 335  | Highly susceptible               | 15-20                                           |
| Range     |                                     |         |                                  |                                                  |
|           |                                     |         |                                  | 43-70                                            |

*Observations made on 100 plants in each field during II fortnight of August to I fortnight of September 2015; Average temperature 27.77 °C & Relative humidity 76.5%.
RESULTS AND DISCUSSION

Incidence of MYMV

At Farmer’s field: In the present studies, the incidence of MYMV was recorded in the range of 43-70%. Among eight villages covering 24 locations practically none of the field was free from the infection of MYMV disease. The incidence of MYMV was higher at fields of Patan village and Panagar village (60-70%), as compared to Tilwara village (47-49%). Observations were made on 100 plants in each field during III week of August to I week of September when the average temperature was 27.77°C and relative humidity was 76.5% (Table 2). The epidemic of MYMV was observed first time in Jabalpur, the spread of MYMV was so fast that overlapped and massed other diseases rapidly. MYMV has been reported by several workers (Salam et al., 2009; Karthikeyan et al., 2004; Gupta and Chouhan, 2005).

At seed production units: The incidence of MYMV in Seed Production units growing 4 varieties (JS 335, JS 90-41, JS 93-05 and JS 95-60) was recorded. The overall incidence was in the range of 53-70%. Incidence was in the range of 63.0-70.0% in JS 335 whereas, in JS 95-60 (55.0-60.0%), JS 93-05(53.0-59.0%) and JS 90-41(56.0-73.0%) was observed (Table 3).

Evaluation of soybean varieties: Evaluation of 28 varieties, under Seed multiplication chain, was made against MYMV infections under natural high pressure conditions. Observations were made on 100 randomly selected plants. Most of the varieties exhibited the infection of MYMV (in the range of 40-70%), however, PS 1225 did not exhibit any infection among the same set of environment. Jawahar Soybean (JS 20-69) exhibited infection up to 5% only. Other variety of soybean JS 20-34 exhibited infection upto 40%, the variety has shown promising results against dry root rot disease in previous studies. Maximum (70%) infection was recorded in MAUS 61 and MAUS 71 followed by MAUS 81 (65%) (Table 4 and 5).

During regular disease monitoring, scattered yellow specks were noticed on upper leaves of soybean variety JS 335. The incidence of disease was first noticed on August 7, 2015. At that time the incidence was not observed on rest of the three varieties. The presence of whiteflies was noticed on middle leaves (2 flies/leaf). During 31st week (July, 2015), the rainfall was 149.40mm and the average temperature was 26.7°C (maximum temperature 29.8°C and minimum 23.6°C) with average relative humidity 80%. The relative humidity was enhanced due to the rainfall (149.40mm) that dramatically favored the population of whiteflies (from 2-25 flies/leaf) (Table 4 and 5).

During the III week of August to II week of September average temperature was 27.7 C and relative

![Image](https://example.com/fig1)

Fig 1: Epidemic of MYMV disease in soybean.

Table 3: Incidence of MYMV of soybean at R1-R3 stage at Seed production units.

| Variety | Per cent disease incidence* of MYMV | Disease reaction based upon grade | Range of population of whiteflies on middle leaves |
|---------|-------------------------------------|----------------------------------|-----------------------------------------------|
| JS 335  | Location 01. 70.0                  | Highly susceptible               | 18-22                                         |
|         | Location 02. 63.0                  | Highly susceptible               | 18-22                                         |
|         | Location 03. 65.0                  | Highly susceptible               | 15-20                                         |
| JS 90-41| Location 01. 43.0                  | Susceptible                      | 13-15                                         |
|         | Location 02. 40.0                  | Susceptible                      | 15-20                                         |
|         | Location 03. 56.0                  | Susceptible                      | 18-22                                         |
| JS 93-05| Location 01. 59.0                  | Susceptible                      | 20-22                                         |
|         | Location 02. 53.0                  | Susceptible                      | 20-22                                         |
|         | Location 03. 54.0                  | Susceptible                      | 18-22                                         |
| JS 95-60| Location 01. 60.0                  | Highly susceptible               | 18-20                                         |
|         | Location 02. 60.0                  | Highly susceptible               | 15-20                                         |
|         | Location 03. 55.0                  | Susceptible                      | 15-18                                         |
| Range   | 53-70                               |                                  |                                               |

*Observations made on 100 plants in each field during II fortnight of August to I fortnight of September 2015; Average temperature 27.77°C & relative humidity 76.5%.
Table 4: Reaction of soybean varieties against MYMV disease under high disease pressure Conditions at R1-R3 stage.

| Variety        | % incidence of MYMV | Disease reaction based upon Grade | Variety | Percent incidence of MYMV | Disease reaction based upon grade |
|----------------|---------------------|-----------------------------------|---------|---------------------------|----------------------------------|
| PS1225         | 00.0                | Resistant                         | Punjab 1| 60.0                      | Highly Susceptible               |
| PS 1029        | 10.0                | Moderately resistant              | VLS 47  | 60.0                      | Highly Susceptible               |
| JS 20-69       | 05.0                | Moderately resistant              | JS 335  | 60.0                      | Highly Susceptible               |
| JS 20-34       | 40.0                | Moderately resistant              | PK 472  | 60.0                      | Highly Susceptible               |
| NRC37          | 55.0                | Susceptible                       | PK 472  | 60.0                      | Highly Susceptible               |
| NRC7           | 50.0                | Susceptible                       | PK 416  | 60.0                      | Highly Susceptible               |
| NRC12          | 56.0                | Susceptible                       | JS 97-52| 60.0                      | Highly Susceptible               |
| JS 95-60       | 65.0                | Susceptible                       | JS 80-21| 55.0                      | Susceptible                      |
| JS 93-05       | 53.0                | Susceptible                       | Pratap Soya 1 | 60.0 | Highly Susceptible       |
| JS 90-41       | 50.0                | Susceptible                       | MAUS 61 | 70.0                      | Highly Susceptible               |
| Shivalik        | 55.0                | Susceptible                       | PS2     | 50.0                      | Susceptible                      |
| Kalitur         | 50.0                | Susceptible                       | MAUS71  | 70.0                      | Highly Susceptible               |
| Pusa 97-12     | 60.0                | Highly Susceptible                | MAUS81  | 65.0                      | Highly Susceptible               |
| Pusa 98-14     | 55.0                | Susceptible                       |         |                           |                                  |

Range 40-70

*Observations made on 100 plants in each field during II fortnight of August to I fortnight of September 2015; Average temperature 27.7°C & relative humidity 76.5%.

Table 5: Meteorological data and population of whiteflies during the period of observations.

| Month | Standard week | White Fly Population* | Temperature (°C) | Relative Humidity (%) | Rainfall (mm) | Rainy days | Sunshine (hrs/day) |
|-------|---------------|-----------------------|------------------|----------------------|--------------|------------|-------------------|
|       | Min | Max | I | II |                  |              |           |                   |
| July  | 30  | 00.0 | 30.6 | 23.5 | 87.0 | 67.0 | 84.70 | 02.0 | 04.5 |                      |
|       | 31  | 02.0 | 29.8 | 23.6 | 90.0 | 70.0 | 149.40 | 02.0 | 04.7 |                      |
| August| 32  | 02.0 | 31.2 | 24.2 | 91.0 | 69.0 | 116.80 | 04.0 | 03.0 |                      |
|       | 33  | 07.0 | 31.2 | 24.5 | 91.0 | 73.0 | 116.80 | 04.0 | 03.0 |                      |
|       | 34  | 25.0 | 31.3 | 23.6 | 88.0 | 64.0 | 09.40  | 01.0 | 07.4 |                      |
|       | 35  | 30.0 | 30.4 | 23.9 | 93.0 | 76.0 | 104.60 | 05.0 | 03.0 |                      |
| September| 36  | 28.0 | 32.2 | 24.2 | 87.0 | 57.0 | 08.20  | 01.0 | 06.7 |                      |
|        | 37  | 28.0 | 33.5 | 23.1 | 91.0 | 55.0 | 03.40  | 01.0 | 08.4 |                      |
|        | 38  | 26.0 | 32.0 | 23.7 | 92.0 | 64.0 | 70.20  | 03.0 | 05.6 |                      |
|        | 39  | 29.0 | 32.6 | 21.1 | 84.0 | 45.0 | 00.0   | 00.0 | 09.2 |                      |

humidity 76.5%. The population of vector *Bemisia tabaci* ranged from 2-22 flies/leaf. MYMV has been reported by several works and different aspects of pathogen including symptoms, distribution, transmission and development is documented (Haq et al., 2010; Govindhan et al., 2014; Srivastava and Prajapati, 2012). Screening of crop varieties against MYMV has been done by several workers (Pandya et al., 1977; Ganapathy et al., 2003). The genotypes grouped under resistant and moderately resistant category may be used in MYMV resistant Breeding program.

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