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Epidemic of Mungbean Yellow Mosaic Virus (MYMV) Disease of Soybean: A Potential Threat in Changing Weather under Agro-climatic Conditions of Jabalpur, Madhya Pradesh

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Abstract

In all 11 major diseases were observed at VC-V3, R1-R3 and R5-R6 stage at pre-selected farmer's field of 8 villages covering 24 locations employing fixed plot monitoring method. An epidemic of MYMV was experienced which had never been major disease problem- threat under Jabalpur (22°49' and 20°80' N latitude and 70°21' and 80°58' East longitude at an altitude of 411.78 MSL) conditions. In the changing weather conditions, the congenial temperature and humidity during first and second fortnight of August, 2015 boosted up the population of virus vector whitefly and epidemic of MYMV. In the first week of August, MYMV appeared as scattered specks on few top leaves in JS 335. Within a short period of 10–12 days the disease spread rapidly and covered more than 90% plant population. In the first week of August, at initial stage, presence of whiteflies (2 flies/leaf) was noticed. During 31st standard week (July, 2015), the rainfall was 149.40 mm and maximum temperature 29.8 and minimum 23.6 °C (av. 26.7 °C) with average relative humidity 80% was noticed.

Keywords: MYMV, soybean diseases distribution, plant growth stages whiteflies

1. Introduction

Soybean [*Glycine max* (L.) Merrill], is valued due to high quality protein (40–42%) and oil content (18–20%) and on account of its ability to fix biological nitrogen 270 kg N/ha as compared to 150 kg N ha⁻¹ by other pulses. The crop is grown on 55.5 lakh ha with a production of 51.6 lakh MT and productivity of 930 kg ha⁻¹. The golden nugget, soybean] is one of the five sacred grains, was originated from China as early as 2853 BC. The then, Emperor Sheng-Nung valued the crop for protein and oil contents (Hymowitz, 1970). Seeds of grain legume, soybean contains 40% oil and 20% quality protein apart from having a unique quality of utilizing atmospheric nitrogen through biological nitrogen fixation. About 270 kg N ha⁻¹ is fixed by soybean as compared to 58–157 kg N ha⁻¹ by other pulses (Hoque, 1978; Tiwari, 2001). In the present world, soybean has become the largest source of vegetable oil and protein and its large scale cultivation is concentrated in Argentina, Brazil, China, India and USA (Anonymous, 2017). Among 130 diseases observed globally, 35 diseases are economically important under agro-conditions of India, as observed at various stages of crop growth (Hartman and Hill, 2010; Gupta and Chouhan, 2005). The present paper deals with the incidence of various diseases at different vegetative and reproductive stages of

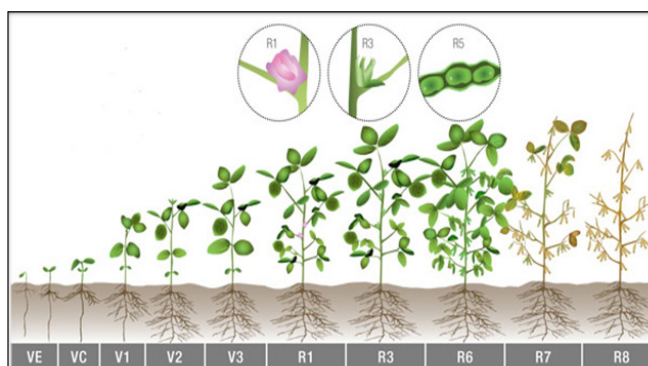
the crop under agro-climatic conditions of Jabalpur, Madhya Pradesh (Silodia, 2016).

2. Materials and Methods

2.1. Status of diseases

2.1.1. Stage of the crop

The incidence of diseases was recorded at three stages viz., VC-V3 (cotyledon spread to 3rd node stage; 3 nodes on the main stem with fully developed leaves beginning with unifoliate node); R1-R3 (one flower at any node, pod 0.5 cm long at one of the four uppermost node); R5-R6 (Beans beginning to develop, pod contains full size green beans).



2.1.2. Location

Disease incidence was recorded at pre-selected farmers field of eight villages covering 24 locations around Jabalpur (22°49' and 20°80' N latitude and 70°21' and 80°58' East longitude at an altitude of 411.78 MSL) at fortnight intervals and meteorological data were also recorded.

2.2. Incidence of diseases

The diseases were identified on the basis of typical field symptoms. The incidence of major diseases was recorded on randomly selected total 100 plants in a particular plot of field. The diseases were identified initially on the basis of visual and typical field symptoms and later confirmed by microscopic observations.

During the study, total and infected plants were counted to calculate the disease incidence as per formula advocated by Singh and Singh (2000).

$$PDI = \frac{TIP}{TPO} \times 100$$

Where,

PDI=Percent disease incidence i.e. percent plant infected

TIP =Total number of infected plants

TPO=Total number of plant observed

3. Results and Discussion

3.1. Incidence of disease at VC-V3

At VC-V3 stage, incidence of seedling rot (*Sclerotium rolfsii*) was observed in the range of 2–14% during fixed plot monitoring at eight villages (Table 1). The seedling decay was in the range of 2–12%. The microscopic examination of blighted, dried and dead seedlings revealed the presence and association of species of *Fusarium*, *Colletotrichum* and *Rhizoctonia*. Observations were taken during 2nd fortnight of June to 1st fortnight of July and the average temperature was 28.42 °C and relative humidity was 41.75%.

Incidence of common mosaic and yellow mosaic expressed upto 5%. Hartman and Hill (2010) reported the early season diseases as seed-decay and damping-off, mid-season crop diseases including leaf spots, pustules and anthracnose and various viral diseases, whereas late season crop diseases included charcoal root rot, pod blight and stem canker.

3.2. Incidence of disease at R1-R3

At R1-R3 stage, five diseases were observed under variable proportions. Leaf spots due to *Alternaria alternata* and *Cercospora sojina* ranged upto 30 and 15%, respectively. During the period of observation (2nd fortnight of August to 1st fortnight of September) average temperature was 27.7 °C and relative humidity 76.5%. Incidence of aerial blight (*Rhizoctonia solani*) and bacterial pustule (*Xanthomonas axonopodis* pv. *glycines*) ranged up to 15 and 17%, respectively.

3.3. Incidence of MYMV

A sudden outbreak of MYMV was recorded during the 2nd

Table 1: Incidence of major diseases of soybean at VC-V3 stage at farmers' field during Kharif 2015 as recorded under fixed plot survey method

Location	Per cent disease incidence*				
	SR	SD	CM	YM	MYMV
<u>Patan</u>					
Location 01	05.0	06.0	02.0	00.0	00.0
Location 02	14.0	00.0	00.0	00.0	00.0
Location 03	03.0	05.0	00.0	01.0	00.0
<u>Katanga</u>					
Location 01	03.0	04.0	00.0	00.0	00.0
Location 02	07.0	11.0	03.0	02.0	00.0
Location 03	04.0	03.0	01.0	04.0	00.0
<u>Panagar</u>					
Location 01	02.0	00.0	00.0	00.0	00.0
Location 02	12.0	03.0	00.0	05.0	00.0
Location 03	10.0	04.0	03.0	00.0	00.0
<u>Maharajpur</u>					
Location 01	10.0	02.0	03.0	00.0	00.0
Location 02	05.0	05.0	02.0	00.0	00.0
Location 03	04.0	00.0	00.0	04.0	00.0
<u>Jabalpur -</u>					
Location 01	03.0	04.0	00.0	00.0	00.0
Location 02	07.0	07.0	04.0	00.0	00.0
Location 03	06.0	04.0	03.0	00.0	00.0
<u>Bhedaghat</u>					
Location 01	09.0	05.0	02.0	00.0	00.0
Location 02	00.0	09.0	05.0	00.0	00.0
Location 03	00.0	03.0	04.0	03.0	00.0
<u>Tilwara</u>					
Location 01	00.0	02.0	05.0	05.0	00.0
Location 02	00.0	11.0	02.0	03.0	00.0
Location 03	00.0	10.0	00.0	03.0	00.0
<u>Barela road</u>					
Location 01	11.0	12.0	02.0	00.0	00.0
Location 02	03.0	00.0	00.0	00.0	00.0
Location 03	00.0	05.0	01.0	01.0	00.0
Range	02–14	02–12	01–05	01–05	00.0

SR: Sclerotial Rot; SD: Seedling decay; CM: Common mosaic; YM: Yellow Mosaic; *Observations made on total 100 plants in each field during II fortnight of June to I fortnight of July 2015; Average temperature 28.42 °C & relative humidity 41.75%.



week of August and within a period of 10–15 days, the incidence spread in the range of 43–70% as observed at eight villages covering 24 locations. In some fields, the viral disease incidence was more than 90% and practically each plant was infected. MYMV disease had never been a major threat under Jabalpur conditions. In the 1st week of August, presence of vector, whiteflies (2 flies leaf⁻¹) was noticed. During 31st week (July, 2015) the rainfall was 149.40 mm and the average temperature was 26.7 °C with average relative humidity 80%. Within two weeks, the population of whiteflies was almost tripled in number and increased from 7-25 flies/leaf. High humidity (more than 93%) with 104.6 mm rainfall and only three hours sunshine period triggered the development of the disease spread of vector population that resulted in the epidemic of Mungbean Yellow Mosaic Virus disease (MYMV). Mungbean Yellow Mosaic Virus disease has never been a problem in central India; however different aspects of this disease have been well documented (Haq et al., 2010; Sunitha et al., 2013) (Table 2).

3.4. Incidence of disease at R5-R6

Pod blight complex involving a dominant fungus, *Colletotrichum dematium* was recorded in the range of 4–21%. The infected pods turned brown and shriveled. The average incidence of dry root rot (*Rhizoctonia bataticola*) was in the range of 2–27% (Table 3). Pod blight complex has been mentioned (Bhatia et al., 2002; Sharma and Shukla, 1993). Several diseases at VC-V3, R1-R3 and R5-R6 stages have been described by workers (Gupta and Chouhan, 2005; Sarbhoy and Mahendra Pal, 1997; Dwivedi et al., 1991; Hussain and Khan, 1989).

3.5. Progressive development of mungbean yellow mosaic virus disease (MYMV)

3.5.1. Development of MYMV

Development of MYMV was recorded on pre-tagged soybean plants under field conditions in the research field. Incidence of scattered yellow specks was noticed on upper leaves (JS 335) on August 7, 2015 (32nd standard week). The presence of whiteflies on middle leaves was 2 flies leaf⁻¹. In the previous week (31st standard week, July, 2015) the rainfall was 149.40 mm and the average temperature was 26.7 °C (maximum temperature 29.8 and minimum temperature 23.6 °C) with average relative humidity 80%. In the second week of August (33rd standard week) the incidence of MYMV increased up to 13% and during that period the rainfall was 116.80 mm, with a relative humidity of 82% and 27.85 °C average temperature. Within a period of seven days, the average population of whiteflies increased upto 7 flies/leaf. In the third week of August (34th standard week) the incidence of disease boosted up to 60%. In the fourth week of August, beyond 70% crop canopy was infected. At the same time, within a period of two weeks the population of whiteflies was almost tripled

and increased from 7–25 flies leaf⁻¹ (Table 4 and Figure 1).

Table 2: Incidence of major diseases of soybean at R1-R3 stage at farmers' field during Kharif 2015 as recorded under fixed plot survey method

Location	Per cent disease incidence*					
	CLS	ALS	AB	Rust	BP	MYMV
Location 01	30.0	11.0	03.0	00.0	12.0	65.0
Location 02	11.0	00.0	10.0	00.0	15.0	70.0
Location 03	15.0	00.0	05.0	00.0	17.0	60.0
Katangi						
Location 01	14.0	05.0	00.0	00.0	05.0	70.0
Location 02	25.0	05.0	07.0	00.0	03.0	45.0
Location 03	04.0	06.0	07.0	00.0	00.0	63.0
Panagar						
Location 01	05.0	07.0	15.0	00.0	00.0	65.0
Location 02	06.0	00.0	02.0	00.0	05.0	60.0
Location 03	11.0	03.0	05.0	00.0	00.0	55.0
Maharajpur						
Location 01	03.0	00.0	00.0	00.0	00.0	59.0
Location 02	00.0	04.0	00.0	00.0	00.0	52.0
Location 03	10.0	05.0	02.0	00.0	04.0	55.0
Jabalpur						
Location 01	14.0	07.0	05.0	00.0	00.0	58.0
Location 02	17.0	00.0	11.0	00.0	00.0	69.0
Location 03	12.0	02.0	10.0	00.0	03.0	65.0
Bhedaghat						
Location 01	11.0	11.0	08.0	00.0	00.0	63.0
Location 02	00.0	14.0	12.0	00.0	05.0	66.0
Location 03	02.0	15.0	07.0	00.0	00.0	59.0
Tilwara						
Location 01	05.0	12.0	06.0	00.0	00.0	49.0
Location 02	05.0	10.0	12.0	00.0	00.0	47.0
Location 03	00.0	10.0	02.0	00.0	00.0	60.0
Barela road						
Location 01	03.0	05.0	10.0	00.0	00.0	45.0
Location 02	00.0	00.0	00.0	00.0	05.0	43.0
Location 03	00.0	02.0	08.0	00.0	11.0	69.0
Range	02-30	02-15	02-15	0	03-17	43-70

CLS: Cercospora leaf spot; ALS: Alternaria leaf spot; AB: Aerial blight; BP: Bacterial pustule; *Observations made on total 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 3: Incidence of major diseases of soybean at R5-R6 stage at farmers' field during Kharif 2015 as recorded under fixed plot survey method

Location	Per cent disease incidence*	
	Pod blight complex	Dry root rot
Patan		
Location 01	05.0	11.0
Location 02	17.0	14.0
Location 03	21.0	07.0
Katangi		
Location 01	14.0	05.0
Location 02	03.0	09.0
Location 03	10.0	11.0
Panagar		
Location 01	10.0	13.0
Location 02	11.0	27.0
Location 03	17.0	20.0
Maharajpur		
Location 01	12.0	10.0
Location 02	14.0	05.0
Location 03	17.0	00.0
Jabalpur		
Location 01	19.0	19.0
Location 02	12.0	12.0
Location 03	07.0	05.0
Bhedaghat		
Location 01	05.0	03.0
Location 02	04.0	00.0
Location 03	17.0	00.0
Tilwara		
Location 01	13.0	00.0
Location 02	00.0	00.0
Location 03	05.0	02.0
Barela road		
Location 01	00.0	05.0
Location 02	00.0	02.0
Location 03	05.0	00.0
Range	04–21	02–27

*Observations made on total 100 plants in each field during II fortnight of October to I fortnight of November 2015; Average temperature 24.4 °C & relative humidity 65.8%.

Table 4: Progressive development of MYMV disease

August	SW;	PI	WP	TA	RH	RD	SS
1 st week	32	03.00	02.00	27.70	80.0	2	4.6
2 nd week	33	13.00	07.00	27.85	82.0	4	3.0
3 rd week	34	60.00	25.00	27.45	76.0	1	7.4
4 th week	35	70.00	30.00	27.15	84.5	5	3.0

SW: Standard week; PI: % incidence of MYMV; WP: Whitefly population; TA: Temperature average (°C); RH: Relative humidity (%); RD: Rainy days; SS: Sunshine (hrs day⁻¹)

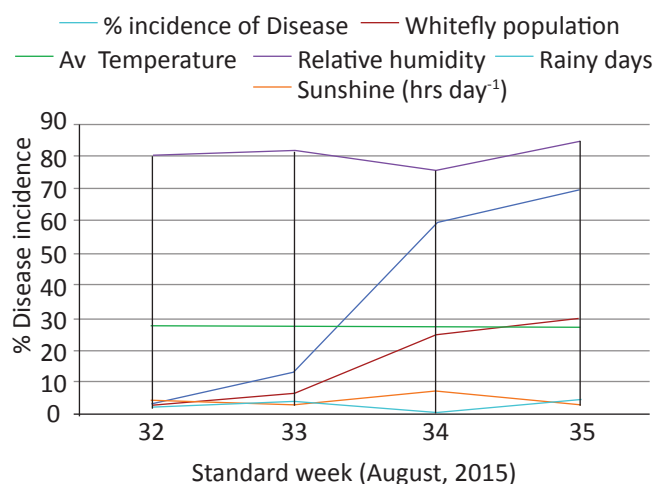


Figure 1: Progressive development of MYMV under field conditions (JS 335)

4. Conclusion

In all 11, soybean plant diseases were observed including leaf spots & infection (*Cercospora soja*, *Alternaria alternata*, *Xanthomonas axonopodis* and *Rhizoctonia solani*), root & stem infection (*Sclerotium rolfsii*, *Macrophomina phaseolina*), pod infection (*Colletotrichum dematium*). In the changing weather conditions, corresponding with the congenial temperature (27.77 °C) and humidity (76.5%) during 1st fortnight of August, sudden outbreak of MYMV was experienced which had never been a major disease threat under Jabalpur conditions. Progressive disease development studies indicate that higher rainfall (116.80 mm) with greater number of rainy days (04) resulted in intense relative humidity (more than 75%), that triggered the higher population of whiteflies (20-30/leaf) during second fortnight of August that resulted in epidemic of MYMV disease in soybean with more than 75% plant infection.

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