



## Research Article

# SURVEY ON YELLOW MOSAIC DISEASE OF SOYBEAN IN RAJASTHAN

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**Abstract:** During two seasons surveys of 2011-12 and 2012-13 in five districts, namely, Banswara, Bundi, Chittorgarh, Kota and Udaipur, the highest mean disease severity and White fly populations were recorded in Kota and Banswara, respectively the minimum were recorded in Bundi district. The variety JS-335 that covers maximum area in Rajasthan was found susceptible to YMD. YMD infection produced the symptoms like yellow mosaic, complete yellowing, size reduction, slight puckering of leaves, stunting of flower stalk bearing few flowers and yellow pods with immature and shrivelled seeds.

**Keywords:** Yellow mosaic disease, Soybean, whitefly, Survey

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## Introduction

Soybean (*Glycine max* L. Merrill) is the important pulse crop grown in India but it suffers from several diseases. Of all the diseases, yellow mosaic disease caused by a whitefly transmitted begomovirus has become a serious problem in recent years. It causes considerable damage every year and sometimes become very severe, which results in heavy losses. The yellow mosaic disease is distributed in almost all the soybean growing areas. However, there is no report which reveal about its exact time of occurrence and other epidemiological factors in Rajasthan. To know the occurrence, distribution and prevalence of yellow mosaic disease in farmer's soybean fields in major soybean growing areas of Rajasthan were surveyed. Surveys were conducted during 2011-12 and 2012-13 in five districts, namely, Banswara, Bundi, Chittorgarh, Kota and Udaipur. Prevalence of Yellow mosaic has been reported on mungbean by several workers [1,2,3] but limited reports are available on YMD on soybean. soybean fields of 20 villages of Madhya Pradesh were surveyed in Kharif 1996 and found that populations of *B. tabaci* were similar levels in all areas, whereas virus incidence occurred in patches in most of the area[4].

## Materials and Methods

Major soybean growing areas (Banswara, Bundi, Chittorgarh, Kota and Udaipur) of the state were surveyed during 2011-12 and 2012-13. Soybean fields were selected randomly at each location in each district. Twenty plants from each corner and also from the centre of the each field at each location were examined. Ten locations in each district were randomly surveyed to record the symptoms, population of white fly and disease incidence of viral syndrome on soybean crop. Numbers of healthy and infected plants with different symptoms were counted and percent disease incidence was worked out using following formula:

$$\text{Percent disease incidence} = \frac{\text{Number of infected plants}}{\text{Number of plants observed}} \times 100$$

For working out the percent disease index, 100 plants were observed at each location. These were categorized into the different grades using 0-9 scale.

Scale 0-9 categories are-

0 No symptoms on any plant

3 Yellow mottle or necrotic mottle in traces on 10% or fewer plants

5 Necrotic mottle/ mild mottle/ mild symptoms; on most plants; no reduction in plant growth; no yield loss 11-20% plants exhibiting symptoms)

7 Yellow mottle symptoms not covering the whole leaf lamina on most plants reduction on leaf and plant growth (21-50% Plants exhibiting symptoms)

9 Yellow mottle symptoms on most plants; severe reduction in leaf and plant growth as well as pod formation ( more than 51% Plants exhibiting symptoms)

Disease severity was calculated by the following formula:

$$\text{Percent disease severity/Index} = \frac{\text{Total sum of numerical ratings}}{\text{No. of leaves observed} \times \text{maximum grade}} \times 100$$

## Results and Discussion:

During the two year's survey it was observed that mainly five soybean cultivars, namely, JS-335, JS-9305, JS-9560, NRC-7, and Pratap soya were grown by various farmers. The variety JS -335 occupied the major area and was found to be susceptible to YMD. In addition to the typical mosaic symptoms, variable symptoms like, yellowing, stunting and puckering with bright yellow mosaic were also observed in various cultivars districts. The disease incidence (PDI) and white fly (WF) populations varied in different fields within each location. In the year 2011-12, the highest mean incidence of YMD was recorded in Kota (8.5%), ranging from 2.0-30%, Whitefly population ranged from 1.9-4.1/trifoliolate. Fields of Banswara had mean incidence of 7.1%, ranging from 3.0-15.5%, and WF population from 2.1-4.6%. In the fields of Bundi mean YMD incidence was 3.5%, ranging from 1.0-6.5%, and WF population 1.1-3.8. In Chittorgarh, the mean disease incidence was 4.3% (1.0-6.5), with WF populations ranging from 1.2-3.6. The minimum mean disease incidence of 3.6 % was observed in district Udaipur, where it ranged from 1.0-6.0 % and white fly population ranging from 1.2-3.3/trifoliolate [Table-1a]. The different soybean cultivars, JS-335 at Banswara showed YMD incidence from 4.0-15.5 %, WF populations from 2.8-4.6/trifoliolate, while JS-9305at one field showed YMD 3.0 % and WF population 2.1/trifoliolate. At Bundi, JS- 335 had YMD 2.0-6.5 %,WF 1.5-3.8.,while JS-9560 had YMD 1.5- 4.5 %, WF 1.7-3.2, and JS- 9305 had 1.0 %YMD and 1.1 WF/trifoliolate. At Chittorgarh JS-335 had YMD ranging from 4.0-6.5 %, and WF 2.2-3.6/trifoliolate.

Table-1 Survey for Yellow mosaic disease incidence and whitefly population during 2011-12

Banswara						
SN	Location	Area (ha)	Variety	Symptoms	PDI	White fly / Trifoliolate
1	Paloda	0.25	JS-335	Yellowing, Mosaic	10.5	4.0
2	Loharia	0.33	JS-335	Yellowing, Mosaic	4.5	2.9
3	Loharia	0.25	-	Mosaic with bright yellow colorpatches, Yellowing, puckering	9.5	3.8
4	Ganoda	0.50	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	15.5	4.6
5	Bhimpur	1.0	-	Mosaic with bright yellow colorpatches, Yellowing, puckering	8.0	3.2
6	Bhimpur	1.5	JS-335	Yellowing, puckering	4.0	2.8
7	Sundani	0.25	JS-335	Yellowing, puckering	4.5	2.6
8	Surpur	2.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	6.5	3.1
9	Tejpur	1.0	JS-9305	Yellowing, Puckering	3.0	2.1
10	Borkheda	2.0	JS-335	Yellowing	5.0	2.9
Bundi						
1	Lambapeepal	1.0	-	Yellowing	2.0	1.6
2	Lambapeepal	0.5	JS-335	Yellowing ,Puckering	4.5	2.3
3	Raghunathpura	0.33	JS-335	Yellowing, mosaic	5.5	3.5
4	Moheepura	2.0	JS-335	Yellowing	2.0	1.5
5	Moheepura	1.0	JS-9305	Yellowing ,Puckering	1.0	1.1
6	Ramganj	1.5	JS-9560	Yellowing	4.5	3.2
7	Khankhera	1.0	JS-335	Mosaic with bright yellow color patches, Yellowing, puckering	6.5	3.8
8	Khankhera	0.5	JS-335	Yellowing	4.0	2.0
9	Bundi	0.25	JS-335	Yellowing	3.5	1.9
10	Bundi	0.5	JS-9560	Yellowing	1.5	1.7
Chittorgarh						
1	Barodia	0.25	JS-9560	Yellowing	2.0	1.8
2	Bhad soda	0.5	JS-335	Yellowing, Mosaic	4.0	1.9
3	Bhad soda	1.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	6.5	3.6
4	DangiKhera	1.0	JS-335	Yellowing, Mosaic	4.5	2.9
5	Banda	0.50	JS-335	-	4.0	2.2
6	Banda	0.5	JS-9305	Yellowing	1.0	1.2
7	Sanwaria ji	0.25	JS-335	Yellowing, puckering	4.5	2.4
8	Sanwaria ji	2.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	6.5	3.2
9	Bansen	0.5	JS-335	Yellowing, Mosaic	5.0	3.1
10	Bansen	2.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	5.0	2.9
Kota						
1	Nayagaon	0.5	NRC-7	Yellowing, Mosaic	4.5	2.6
2	Nayakheda	2.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	10.5	4.0
3	Chareenda	1.0	JS-335	Yellowing, puckering	6.0	3.1
4	Hathikhera	1.0	JS-335	Yellowing, Mosaic	8.5	3.9
5	Jalkhera		JS-335	Yellowing, Puckering	6.5	3.0
6	Chhatrapura	2.5	JS-335	Mosaic with bright yellow color patches, Yellowing, puckering	30.0	4.1
7	Arapura	0.25	JS-9305	Yellowing	2.0	1.9
8	Seemliya	0.5	JS-9560	Yellowing, Puckering	4.5	2.8
9	Anta	2.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	6.5	3.7
10	Ummedganj	2.0	Pratap soya	Mosaic with bright yellow colorpatches, Yellowing, puckering	6.0	3.2
Udaipur						
1	Udaipur	2.0	Pratap soya	Mosaic with bright yellow colorpatches, Yellowing, puckering	4.5	2.3
2	Udaipur	0.5	JS-335	Yellowing, Mosaic	5.5	2.9
3	Udaipur	1.0	JS-335	Yellowing, Mosaic	6.0	3.3
4	Dheemra	0.25	JS-335	Yellowing ,Puckering	4.5	2.2
5	Bhatewar	0.5	JS-335	Yellowing	2.5	2.3
6	Bhatewar	1.0	-	Puckering	4.0	2.0
7	Khokharwas	0.25	JS-9305	Yellowing, Mosaic	1.0	1.9
8	Menar	2.0	-	Yellowing, Mosaic	5.0	2.4
9	Menar	0.5	JS-9305	Yellowing, Mosaic	1.0	1.2
10	Vana	0.25	JS-9560	Yellowing	2.0	1.5

Table-1a District wise mean YMD incidence and mean whitefly population during 2011-12

SN	District	YMD PDI range	MeanYMD	Whitefly Population range	Mean White fly population
1.	Chittorgarh	1.0-6.5	4.3	1.2-3.6	2.52
2.	Banswara	3.0-15.5	7.1	2.1-4.6	3.20
3.	Kota	2.0-30.0	8.5	1.9-4.1	3.23
4.	Bundi	1.0-6.5	3.5	1.1-3.8	2.26
5.	Udaipur	1.0-6.0	3.6	1.2-3.3	2.20

JS-9305 showed YMD 1.0 % and WF 2.0/trifoliolate, while JS-9560 had 2.0 % YMD and WF 1.8/trifoliolate. At Kota JS-335 had YMD 6.0-30 %, and WF 3.0-4.1; JS-9305 had YMD 2.0 % and WF 1.9/trifoliolate while JS-9560 had YMD 4.5 % and WF 2.8 %. Pratap soya was in one field only and had YMD 6.0 % and WF 3.2/trifoliolate, while NRC- 7 had YMD 4.5% and WF 2.6/trifoliolate. In Udaipur, JS- 335 had 2.5-

6.0 % YMD, and WF 2.3-3.3/trifoliolate, while JS-9305 had 1.0 % YMD and WF 1.2-1.9/trifoliolate. JS-9560 had 2.0% YMD and WF 1.5/trifoliolate, while Pratap Soya had 4.5% YMD and 2.3 WF/trifoliolate [Table-1]. In the year 2012-13, the highest mean YMD incidence of 13.15% (7.5-24.5%) was recorded in Banswara, WF population ranged from 2.4-3.9/trifoliolate. At Udaipur YMD incidence was 12.7% (1.0-90.0 %).

Table-2 Survey for Yellow mosaic disease incidence and whitefly population during 2012-13

SN	Location	Area (ha)	variety	Symptoms	PDI	White fly/ Trifoliolate
Banswara						
1	Adoda	0.5	JS-335	Mosaic	7.5	2.4
2	Paloda	2.0	JS-335	Mosaic, Yellowing, puckering	11.5	3.1
3	Bassi	0.25	JS-335	Mosaic Yellowing, puckering	24.5	4.2
4	Ganoda	1.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	10.5	2.9
5	Ganoda	2.5	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	16.5	3.7
6	Bhimpur	2.5	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	13.0	3.4
7	Chidiawasa	0.5	JS-9560	Yellowing, Mosaic	9.5	2.6
8	Moradi	1.0	-	Mosaic with bright yellow colorpatches, Yellowing, puckering	14.5	4.1
9	Isarwala	1.0	JS-335	Mosaic, Yellowing, puckering	14.0	3.9
10	Borkheda	2.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	10.0	2.8
Bundi						
1	Bundi	0.5	JS-335	Yellowing, Mosaic	4.5	3.0
2	Ganpatpur	1.0	JS-335	Yellowing, Mosaic	5.5	3.2
3	Ganpatpur	0.25	-	Mosaic	3.0	2.0
4	Kvkbundi	1.0	JS-9560	Yellowing, Mosaic	5.0	2.8
5	Ganeshpura	0.5	JS-9560	Yellowing, Mosaic	4.5	2.1
6	Ganeshpura	2.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	7.5	3.2
7	Jawati	2.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	9.5	3.3
8	Moheepura	1.0	JS-335	Yellowing, Mosaic	4.5	2.9
9	Raghunathpura	0.25	JS-9305	Mosaic	2.0	1.3
10	Ramgang	0.25	JS-335	Yellowing, Mosaic	3.0	1.9
Chittorgarh						
1	Chittorgarh	0.25	JS-9560	Mosaic	3.5	1.3
2	Bhad soda	1.0	JS-9560	Yellowing, Mosaic	7.5	3.0
3	Bhad soda	1.0	JS-335	Yellowing, Mosaic	7.0	2.9
4	DangiKhera	2.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	10.5	3.7
5	Banda	0.5	JS-335	Yellowing, Mosaic	6.5	2.6
6	Banda	2.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	8.0	3.2
7	Sanwaria ji	0.5	JS-335	Yellowing, Mosaic	4.0	1.9
8	Sanwaria ji	1.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	9.5	2.9
9	Bansen	1.0	JS-335	Yellowing, Mosaic	6.5	2.4
10	Bansen	0.25	-	Yellowing, Mosaic	4.0	2.6
Kota						
1	Nayakheda	1.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	11.5	2.9
2	Chinsa	0.5	Pratap soya	Yellowing, Mosaic	8.5	2.8
3	Ruggi	2.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	14.5	4.3
4	Karadia	2.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	12.5	3.6
5	Kathodi	0.5	NRC-7	Yellowing, Mosaic	6.0	2.6
6	Dahra	0.25	JS-9305	Yellowing, Mosaic	4.0	1.9
7	Dahra	2.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	13.5	3.8
8	Anta	0.25	JS-9560	Yellowing, Mosaic	6.5	2.7
9	Ummedganj	1.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	14.5	4.1
10	Ummedganj	1.0	JS-335	Yellowing, Mosaic	7.5	2.6
Udaipur						
1	Bhatewar	1.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	6.5	2.9
2	Bhatewar	1.0	JS-335	Yellowing, Mosaic	4.5	2.6
3	Amarpura	0.5	JS-335	Yellowing, Mosaic	4.0	2.4
4	Amarpura	1.0	Pratap soya	Mosaic with bright yellow colorpatches, Yellowing, puckering	5.5	2.7
5	Bansada	2.0	JS-335	Mosaic with bright yellow colorpatches, Yellowing, puckering	7.5	3.7
6	Bansada	0.25	-	Yellowing, Mosaic	2.0	1.7
7	Gopalpura	0.25	JS-9305	Mosaic	1.0	1.6
8	Neemadi	0.5	JS-335	Yellowing, Mosaic	90.0	4.2
9	Menar	0.5	JS-9305	Yellowing, Mosaic	4.0	2.1
10	Udaipur	0.25	JS-9560	Mosaic	2.0	1.9

Table-2a District wise mean YMD incidence and mean whitefly population during 2012-13

SN	District	YMD PDI range	Average YMD	Whitefly Population range	Average White fly population
1	Chittorgarh	3.5-10.5	6.7	1.3-3.7	2.65
2	Banswara	7.5-24.5	13.15	2.4-3.9	3.31
3	Kota	4.0-14.5	9.9	1.9-4.1	3.13
4	Bundi	2.0-9.5	4.9	1.3-3.3	2.57
5	Udaipur	1.0-90.0	12.7	1.6-4.2	2.58

In the districts of Chittorgarh the mean percent disease incidence was 6.7 % (3.5-10.5%) and WF population 1.3-3.7/trifoliolate. In the fields of Kota mean YMD incidence was 9.9 % (4.0-14.5%) and WF populations 1.9- 4.1/ trifoliolate. The lowest YMD incidence of 4.9% (2.0-9.5%) was observed in district Bundi, with WF population 1.6-3.7/trifoliolate [Table-2a]. The different soybean cultivars, JS-335 in fields of Banswara had 7.5-24.5% YMD, and 2.4-4.2WF/trifoliolate, in one field JS-9560 had 9.5% YMD and 2.6WF/trifoliolate. In fields of Bundi district, JS-335 showed 3.0-9.5% YMD and 1.9-3.3 WF/trifoliolate. JS-9560 had 4.5-5.0% YMD and 2.1-2.8 WF/trifoliolate. JS-9305 had 2.0% YMD and 1.3WF/trifoliolate. JS-335 in Chittorgarh fields had 4.0-10.5% YMD and WF 1.9-3.7/trifoliolate; JS-9560 had 3.5-7.5 % YMD and 1.3-3.0 WF/trifoliolate. Soybean fields with cultivar JS-335 at Kota showed 7.5-14.5 % YMD and 2.6-4.3 WF/trifoliolate; while one field with JS-9305 had 4.0 % YMD and 1.9WF/trifoliolate; and JS-9560 had 6.5% YMD and 2.7 WF/trifoliolate. PratapSoya showed 8.5% YMD and 2.8 WF/trifoliolate. In Udaipur fields, JS- 335 showed YMD 4.0-90% (at Neemdi, Bhinder tehsil), with WF 2.4-4.2/trifoliolate; JS- 9305 had 1.0-4.0 % YMD and 1.6-2.1 WF/trifoliolate, while JS-9560 had YMD 2.0 % and WF 1.9/trifoliolate. Pratap soya had 5.5 % YMD and 2.7 WF/trifoliolate [Table-2]. In our present study two year's survey of the five districts-Banswara, Bundi, Chittorgarh, Kota and Udaipur of Rajasthan the disease was found to be quite prevalent, with varied severity and its vector white fly was also largely distributed. Mainly five soybean cultivars, namely, JS-335, JS-9305, JS-9560, NRC-7, and Pratap soya were grown by various farmers. Most of the farmers had grown JS-335 only, and this had moderate to high levels of disease as well as of white fly populations. The highest mean disease severity and White fly populations were recorded in Banswara, followed by Kota, Udaipur, Chittorgarh and Bundi. The cultivars JS-9305 and JS-9560 were in a few fields only but showed moderate resistance to YMD, while NRC-7 showed resistance. In these fields typical symptoms of YMD were observed, that included bright yellow color patches and green patches on trifoliolate. Early infected plant matured late and produced fewer flower and pods. Pods were small, sometimes curled and contained only a few seeds. Chlorosis, stunting and fewer branches and premature shedding of leaves were also observed. These symptoms agreed well with those reported by Nariani and Gautam [2 ,5].

### Conclusion

Based on these studies, it may be concluded that there is need to popularize resistant/ moderately resistant varieties so that build-up of vector populations and subsequent disease loss may be avoided.

**Application of research:** Study will help to develop effective management strategy of Yellow Mosaic disease and also reduce dependency of harmful synthetic pesticides

**Research Category:** Plant virology

### Abbreviations:

YMD: Yellow Mosaic Disease, WF: White Fly, RKVY: Rashtriya Krishi Vikas Yojana

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