

Original Research Article

<https://doi.org/10.20546/ijcmas.2021.1003101>

Survey for Natural Incidence of Soybean Yellow Mosaic Disease in Western Maharashtra

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ABSTRACT

Keywords

Soybean, Yellow mosaic disease, Survey, Whitefly, Bemisia tabaci

Article Info

Accepted:

14 February 2021

Available Online:

10 March 2021

Soybean (*Glycine max* (L.) Merrill), (2n=40) is a worldwide major oil seed crop. The soybean crop is affected with number of biotic and abiotic stresses. Among the biotic stresses, the important diseases like, rust, sclerotium wilt, fusarium wilt, bacterial blight and more than 50 various viruses are known to strike soybean. Out of 50 viral diseases, the yellow mosaic disease is the major viral disease of soybean. In present study, the roving survey was conducted in Western Maharashtra to measure the natural incidence of the yellow mosaic disease of soybean. Among the seven districts surveyed in Western Maharashtra for the incidence of soybean yellow mosaic disease in kharif season of 2018, the highest mean disease incidence was recorded in Sangli (27.87%) and lowest recorded in Solapur (17.66%) district. Hence, there is necessity for awareness and implementation of effective management practices for soybean yellow mosaic disease among the farming communities of the disease affected districts.

Introduction

Soybean (*Glycine max* (L.) Merrill), (2n=40) is a worldwide major oilseed crop. Soybean's base of origin lies in China. In production, soybean ranks first in the world among other oil seed crops. The United States of America is the world's largest soybean producer. Brazil, Argentina, China and India are other

top soybean producers in the world (Shahbandeh, 2020). Global soybean production in 2019-2020 was 335.35 million metric tons, around 6.91 percent less than last year's soybean production around the globe. In India, the total harvested area was 12 million hectares and produced 9.30 million metric tons (MT) with 0.78 MT/Ha yield in 2019-20 (World agricultural production,

FAS/USDA, 2020). In Maharashtra, during kharif season of 2019, sowing area was 37.37 lakh Ha. with production was 39.42 lakh MT and yield was 1055 Kg/Ha. (SOPA Databank, 2019).

Soybean containing various nutritious properties is therefore called a miracle bean or golden bean, with 20% oil and 38% to 43% protein, which has a biological significance as meat and fish protein and is abundant in amino acids such as lysine (5%) and tryptophan (Quayum *et al.*, 1985). The average soybean yield per ha in India is still below average in recent years. In addition to several other causes, weed infestation, crop attacking diseases and invading pests are key elements that are responsible for sub-jacent production. The infestation of weeds and area limited abiotic and biotic stresses are the three key limitations in soybean production. So any efficiency boost can be accomplished by fixing these three issues (Meseldžija *et al.*, 2020).

Among the biotic stresses, the important diseases like, rust, sclerotium wilt, fusarium wilt, bacterial blight (*Pseudomonas glycines*), brown leaf spot (*Septoria glycines*), bud blight and more than 50 various viruses are known to strike soybean (R. F. Nyvall, 1989). In India, the number of known viruses of soybean are lower than 10. The major ones are soybean yellow mosaic virus (Lal *et al.*, 2005, Ramteke *et al.*, 2007), soybean mosaic virus, and groundnut bud necrosis virus, which invokes soybean bud blight (Bhat *et al.*, 2002, and Lal *et al.*, 2002).

In India, Yellow mosaic diseases (YMD) are the significant restriction for raising grain legume production. Due to YMD of blackgram, mungbean and soybean collectively yield loss per annum was appraised to be \$ 300 million (Varma and Malathi, 2003). In North India, YMD of

soybean was first detected in the year 1970s (Nariani, 1960 and Suteri, 1974) and has since been transmitted at unprecedented proportions. Studies on the basis of enzyme-linked immunosorbent assay (ELISA), transmission studies through whitefly and immune-specific electron microscopic (ISEM) have indicated that the aetiological virus causing YMD in soybean is a begomovirus family Geminiviridae. Begomoviruses have distinctive icosahedral geminate particles which encapsidate the genome of single-stranded and circular DNA. This virus infects dicots, and they are spread by the whitefly species, *Bemisia tabaci*, Gennadius. They have a genome which is monopartite or bipartite. DNA A encodes proteins needed for replication, transcription and encapsidation while DNA B encodes proteins necessary for movement functions, in bipartite begomoviruses (van Regenmortel, 2000).

Considering the importance of yellow mosaic disease of soybean and its impact on yield, the systematic studies were conducted regarding survey for the yellow mosaic disease incidence in major soybean growing districts of Western Maharashtra.

Materials and Methods

Survey for disease incidence

To calculate the percent disease incidence of yellow mosaic disease, a survey was carried out during the month of July to September 2018 (*kharif*, 2018), in soybean growing districts of Western Maharashtra *i.e.*, Kolhapur, Sangli, Satara, Solapur, Pune, Ahmednagar and Nashik. The percent disease incidence was determined by measuring the number of plants exhibiting symptoms of disease out of the total number of plants inspected at survey, using formula given below.

$$\text{Percent disease incidence} = \left\{ \frac{\text{Number of diseased plants}}{\text{Total number of plants examined}} \right\} \times 100$$

During the survey, additional information such as, name of the farmer, land holding, area under soybean cultivation, source of seed, date of sowing, varieties grown, fertilizers and manures applied, perception on the disease and the vector, plant protection measures followed for management of the disease, expected date of harvesting, expected yield and price of soybean, mode of disposal or sale were recorded.

Collection of soybean yellow mosaic disease samples

Samples of soybean yellow mosaic disease were collected from fields in polythene covers and disease was maintained on healthy plants by inoculating through whitefly vector (*Bemisia tabaci*).

Results and Discussion

Studies on survey of the yellow mosaic disease incidence in major soybean growing districts of Western Maharashtra

A survey was carried out in 48 soybean growing localities of seven selected districts viz., Kolhapur, Sangli, Satara, Solapur, Pune, Ahmednagar and Nashik districts of western Maharashtra to record incidence of yellow mosaic virus in kharif, 2018. The disease incidence was assessed based on the symptoms of the leaf area affected (Table 1). The incidence of yellow mosaic disease varied with locations, age of the crop.

The incidence of the disease varied from 0 percent to 33 percent in different villages. Among the districts, the highest mean disease incidence was recorded in Sangli (27.87%) followed by Satara (27.66%), Ahmednagar (25.66%), Pune (21.80%), Kolhapur (20.5%),

Nashik (19.90%) and Solapur (17.66%) (Table 2).

The disease incidence in Sangli district ranged from 3 percent to 33 percent. The incidence was lowest in Nerle village of Walwatehsil with incidence of 3 percent and highest was recorded in Peth village of Walwatehsil with incidence 33 percent (Plate 1).

In Satara district, the percent disease incidence varied from 27 percent to 29 percent. The disease incidence was lowest in Sakurdi village of Karadtehsil with incidence of 27 percent and highest was recorded in Kusr village of Patantehsil with incidence of 29 percent.

The incidence of yellow mosaic disease in Ahmednagar district ranged from 25 to 27 percent. The lowest incidence was in Vadzare (khurd) village of Sangamnerthehsil with incidence of 25 percent and highest was recorded in Guha village of Rahuri tehsil with 27 percent incidence.

The yellow mosaic disease incidence ranged from 19 to 24 percent in Pune district. The lowest disease incidence recorded in Rajuri village of Junnartehsil with 19 percent disease incidence and highest was recorded in Aane village of Junnartehsil with incidence of 24 percent.

In Kolhapur district, the percent disease incidence of yellow mosaic disease varied from 0 to 33 percent. The lowest incidence was recorded in Mahagaon village of Gadhinglajthehsil with incidence of 0 percent and highest in Bahirewadi village of Ajaratehsil with 33 percent disease incidence.

The disease incidence in Nashik district ranged from 17 to 23 percent. The lowest disease incidence was recorded in Satara

village of Yeolatehsil with 17 percent disease incidence and highest disease incidence was recorded at Sarul village of Nashik tehsil with 23 percent disease incidence (Plate 2).

The incidence of yellow mosaic disease in Solapur district ranged from 16 to 19 percent. The lowest incidence was in Yawali village of Moholtehsil with incidence of 16 percent and highest was recorded in Narkhed village of

Moholtehsil with 19 percent incidence. The differences in incidence of disease in areas surveyed might be due to variation in the source of inoculum, vector population, crop and weather condition. The abundant source of inoculum might be the reason of high level of incidence at certain locations. Results of this study has epidemiological significance for monitoring and management of the disease.

Table.1 Survey of soybean yellow mosaic virus disease incidence in major soybean growing districts of Western Maharashtra in Kharif 2018

Sr. No.	Place	Name of Farmer	Variety	Percent Disease Incidence	Symptoms	Insects recorded
1.	District- Kolhapur					
	Tehsil- Gadhinglaj Mahagaon	DigambarGangadharDharangutti	DS 228	0	-	Leafhoppers
	Mahagaon	DayanandHaribaSurnge	DS 228	1	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Mahagaon	NingappaBassappaMugali	JS 335	29	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Mahagaon	Manohar Krishna Kokitkar	JS 335	30	Yellowing and yellow mosaic	Whiteflies, leafhoppers and aphids
		Prashant AppasoPatil	JS 335	29	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Tehsil- Ajara Bahirewadi	Anil Pundlik Naik	JS 335	32	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Bahirewadi	Dattatraya Sawant	JS 335	33	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Bahirewadi	Vishnu DattuJondhale	JS 335	30	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Tehsil- Hatkanangale Toap	EknathYuvraj Sisal	DS 228	2	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Toap	Rahul Sayaji Sisal	DS 228	0	Yellowing and yellow mosaic	Leafhoppers
	VathartarVadgaon	Dattatraya BaburaoKarnali	JS 335	29	Yellowing and yellow mosaic	Whiteflies, aphids
	VathartarVadgaon	Raghunath Nana Shinde	JS 335	31	Yellowing and yellow mosaic	Whiteflies, aphids
2.	District- Sangli					
	Tehsil- Walwa Peth (Jambhulwadi)	Narayan Ananda Mali	JS 335	33	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Peth (Jambhulwadi)	SambhajiShivaji Mali	JS 335	32	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Jambhulwadi	Sanjay JaysinghJangale	JS 335	32	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Kameri	Sunil Sawashe	JS 335	31	Yellowing and	Whiteflies,

					yellow mosaic	leafhoppers
	Nerle	Mahesh Vishnu Rokade	DS 228	3	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Ashta	BhausoGanpatiSawant	JS 335	32	Yellowing and yellow mosaic	Whiteflies, leafhoppers, aphids
	Tehsil- Miraj Samdoli	MhaiskarKeshavVinayak	JS 335	29	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Tehsil-Shirala Shirala	Ganesh Sakharam Gaikwad	JS 335	31	Yellowing and yellow mosaic	Whiteflies, leafhoppers
3.	District- Satara					
	Tehsil- Karad Sakurdi	Rahul AnandShinde	JS 335	27	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Beldare	Sandip Shankar Chavan	JS 335	29	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Tehsil- Patan Kusur	ChandrakantLohar	JS 335	27	Yellowing and yellow mosaic	Whiteflies, aphids
4.	District- Pune					
	Tehsil-Junnar Aane	DeoramBajabaAaaher	JS 335	24	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Aane	Prakash Shankar Date	JS 335	22	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Rajuri	EknathSakharamAuti	JS 335	19	Yellowing and yellow mosaic	Whiteflies, aphids
	Tehsil-Ambegaon Peth	Tukaram Anil Shinde	JS 335	21	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Tehsil-Rajgurunagar (Khed) Kiwale	Sunil Salunkhe	JS 335	23	Yellowing and yellow mosaic	Whiteflies, leafhoppers, aphids
5.	District- Ahmednagar					
	Tehsil-Sangamner Vadzare (khurd)	SuryabhanKashinathSupekar	JS 335	25	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	NannajDhumala	Bhagwat Nana Kadhar	JS 335	25	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Tehsil- Rahuri Guha	AnnasahebParvatSaudagar	JS 335	27	Yellowing and yellow mosaic	Whiteflies, aphids
6.	District- Solapur					
	Tehsil- Mohol Dokewasti	PradipDoke	JS 335	18	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Yawali	Somnath Yadav	JS 335	16	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Narkhed	Samadhan Mote	JS 335	19	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Narkhed	MahadevShinde	JS 335	19	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Dukhal	Dipak Jadhav	JS 335	18	Yellowing and yellow mosaic	Whiteflies, leafhoppers
	Kalewadi	Vinayak Kulkarni	JS 335	16	Yellowing and yellow mosaic	Whiteflies, leafhoppers
7.	District- Nashik					
	Tehsil-Nashik	Manohar DamodarDhongade	JS 335	18	Yellowing and	Whiteflies,

Palase					yellow mosaic	leafhoppers
Palase	Arjun VishnopantGaikhe	JS 335	20	Yellowing and yellow mosaic	Whiteflies, leafhoppers	
Vilholi	Anil KacharuBhavnath	JS 335	21	Yellowing and yellow mosaic	Whiteflies, leafhoppers	
Sarul	MuralidharNathuNawale	JS 335	23	Yellowing and yellow mosaic	Whiteflies, leafhoppers, aphids	
Lakhalgaon (Ramachi)	Sandip Ramesh Shinde	JS 335	19	Yellowing and yellow mosaic	Whiteflies, leafhoppers	
Tehsil- Niphad Rasalpur	BhausashebMadhukarKamankar	JS 335	21	Yellowing and yellow mosaic	Whiteflies, leafhoppers	
Tehsil- Yeola Satara	Sunil Mahale	JS 335	22	Yellowing and yellow mosaic	Whiteflies, leafhoppers	
Satara	Sadashiv Makhare	JS 335	20	Yellowing and yellow mosaic	Whiteflies, leafhoppers	
Satara	AppasahebRanguPathare	JS 335	18	Yellowing and yellow mosaic	Whiteflies, leafhoppers	
Satara	Shankar Makhare	JS 335	17	Yellowing and yellow mosaic	Whiteflies, aphids	
Tehsil- Sinnar Datali	Raghunath LahanuChandore	JS 335	20	Yellowing and yellow mosaic	Whiteflies, leafhoppers	

Table.2 Average percent disease incidence (PDI) of yellow mosaic disease on soybean in different districts of Western Maharashtra in Kharif 2018

Sr. No.	District	Tehsil	Average percent disease incidence	Average percent disease incidence of District
1	Kolhapur	Gadhinglaj	17.80	20.50
		Ajara	31.66	
		Hatkanangale	15.50	
2	Sangli	Walwa	27.16	27.88
		Miraj	29	
		Shirala	31	
3	Satara	Karad	28	27.66
		Patan	27	
4	Pune	Junnar	21.66	21.80
		Ambegaon	21	
		Rajgurunagar (Khed)	23	
5	Ahmednagar	Sangamner	25	25.66
		Rahuri	27	
6	Solapur	Mohol	17.66	17.66
7	Nashik	Nashik	20.20	19.91
		Niphad	21	
		Yeola	19.25	
		Sinnar	20	

Plate.1 A general view of soybean field infected with yellow mosaic disease at Sangli district



Plate.2 Soybean field severely affected by yellow mosaic disease at Nashik district



Nene (1972) conducted a survey in different districts of Uttar Pradesh and reported that the yellow mosaic incidence in mungbean ranged from 5-100 percent and depending upon the stage at which the plants were infected, the yield loss varied from 10-100 percent. From the survey results, he determined that yellow mosaic of urid bean causing virus is the same one that causes mungbean yellow mosaic.

Bansal *et al.*, (1984) led a survey for the incidence of yellow mosaic in different districts of Punjab. The results revealed that yellow mosaic was more prevalent on mungbean. YMD incidence was higher in Gurdaspur (20.00%) and Sangrur (13.85%) district and reasonably less in Jalandhar (4.60%), Bhatinda (4.50%) and Ferozepur

(1.25%) districts. The similar trend of incidence was reported earlier by Singh *et al.*, (1979), Jeyarajan *et al.*, (1988), Bhugabati and Goswami (1992), Nath and Saikia (1995), Singh *et al.*, (2000), Pathak and Jhamaria (2004), Salam *et al.*, (2011), Jyothi and Nagaraju, (2013), Manjunath *et al.*, (2013), Bhagyashree (2014).

The yellow mosaic disease of soybean, caused by MYMV, occurred in Jabalpur (Madhya Pradesh) and it could not be transmitted by sap of infected plants (Dantre *et al.*, 1996). The soybean disease loss estimation study indicated that the yellow mosaic disease of soybean naturally occurred at northern parts of India, especially in foothills of Himalayas called as Tarai region and this disease causes

yield losses of about 105,000 metric tonnes in year 1996 (Wrather *et al.*, 1997).

The field survey of 20 villages of Madhya Pradesh, India was conducted and the incidence of yellow mosaic virus, whitefly (*Bemisia tabaci*) and stem fly (*Melanagromyza sojae*) reported in soybean (Singh *et al.*, 1998). Usharani *et al.*, (2004); Girish and Usha (2005) reported that in North and Central India, a strain of MYMIV causes soybean YMD, while in South and West India, a strain of MYMV causes YMD. The YMD of soybean occurred naturally at fields of the National Botanical Research Institute Lucknow, Northern India with the percent disease incidence up to 80-90% (Raj *et al.*, 2006). The yellow mosaic disease of soybean, a predominant viral disease occurs in North Eastern region of India (Baruah *et al.*, 2014).

Among the seven districts surveyed in Western Maharashtra for the incidence of soybean yellow mosaic disease in kharif season of 2018, the highest mean disease incidence was recorded in Sangli (27.87%) followed by Satara (27.66%), Ahmednagar (25.66%) and lowest recorded in Solapur (17.66%) district. Therefore, it is important for awareness and implementation of effective crop protection and disease management practices for soybean yellow mosaic disease among the farming communities of the disease affected districts.

Acknowledgement: Authors are thankful to Associate Dean, Post Graduate Institute, Mahatma PhuleKrishiVidyapeeth, Rahuri, Ahmednagar, Maharashtra, India for providing field and laboratory facilities.

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How to cite this article:

Gaikwad, H. D., C. D. Deokar, S. V. Kolase, M. P. Deshmukh, V. P. Chimote, T. K. Narute and Prabha, K. 2021. Survey for Natural Incidence of Soybean Yellow Mosaic Disease in Western Maharashtra. *Int.J.Curr.Microbiol.App.Sci*. 10(03): 800-809.
doi: <https://doi.org/10.20546/ijcmas.2021.1003.101>