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Survey for Mungbean Yellow Mosaic Virus Disease and its Vector *Bemisia tabaci* in Mungbean (*Vigna radiata* (L.) Wilczek) Growing Regions of Southern Karnataka

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ABSTRACT: Mungbean yellow mosaic virus disease is the most devastating disease of mungbean world widely causing qualitative and quantitative losses in yield upto cent percent. Information regarding disease severity and vector population may help in planning of better management strategies. Therefore, a roving survey was conducted to know the incidence of MYMV and its vector *Bemisia tabaci* in southern Karnataka during *Rabi* summer 2016-17 and 2017-18. Among the thirty villages, the percent disease incidence ranged from 27.00-87.80 and 30.25-95.58 in respective years. The highest percent disease incidence of 79.81 and 83.73 was recorded in Chamarajanagar district in 2016-17 and subsequent year respectively, followed by Tumakuru (52.89% and 48.21%) and Bengaluru urban (43.00% and 45.34%). While, the lowest incidence was recorded in Bengaluru rural (29.38% and 33.65 %) followed by Mandya (37.05% and 41.96%). The average whitefly population ranged from 2.3-4.5 and 2.7-5.2 per plant in *Rabi* summer 2016-17 and 2017-18 respectively, in thirty villages surveyed. Among the districts, the highest vector population of 3.90 and 4.60/plant was recorded in Chamarajanagar and the lowest was recorded in Bengaluru Rural and Mandya with whitefly population of 2.70/plant in each district during 2016-17, while Bengaluru rural and urban with average of 3.00/plant vector population in 2017-18.

Keywords: MYMV, disease severity, mungbean, whitefly, survey.

INTRODUCTION

Mungbean (*Vigna radiata* L.) Wilczek), popularly known as mung or green gram is the third most important pulse crop after chickpea (*Cicer arietinum*) and pigeon pea (*Cajanus cajan*), in India. Being an important source of high-quality digestible protein, carbohydrate, vitamins, minerals, folate and dietary fibres, it is consumed in variety of ways such as whole grain, cooked vegetable (*daal*), sprouts and salad. It also has nutraceutical and prebiotic properties (Sudhakaran and Bukkan, 2021). Besides this, green gram improves soil health through well-known mechanism of nitrogen fixation. Productivity and grain quality of this legume crop is adversely affected by many biotic and abiotic stresses, among which Mungbean Yellow Mosaic Virus (MYMV) disease is the most important (Nair *et al*., 2019). It can cause severe yield losses ranging from 10 to 100 percent based on the stage of crop at the time of infection and host genotype (Mishra *et al*., 2020)

MYMV is a member of begomovirus which is the largest genus of the largest plant virus family *Geminiviridae* (Ruhel and Chakraborty, 2019; Hanley-Bowdoin *et al*., 2013). It is transmitted by whitefly *i.e., Bemisia tabaci* (Genn.) under natural conditions. Infection starts when a whitefly containing virions feeds on host plant. Thus, epidemics by MYMV have been attributed to virulence of the virus and efficient transmission by whitefly. Information regarding disease severity in different regions may help in development of management strategies for this disease. Therefore, present study was taken up to know the disease severity and whitefly population in mungbean growing regions of southern Karnataka.

MATERIAL AND METHODS

A. MYMV disease incidence in mungbean growing regions

A roving survey was carried out during *Rabi* summer seasons of 2016-2017 and 2017-2018, in mungbean growing regions of southern Karnataka *viz*., Bengaluru rural, Bengaluru urban, Chamarajanagar, Mandya and Tumakuru districts, to know the present status of MYMV disease and prevalence of its vector (*Bemisia tabaci*). In each field, five plots measuring 10 m^2 were marked randomly and diseased plants were identified based on the typical symptoms *viz.,* presence of bright yellow patches on leaves interspersed with green areas, complete yellowing and stunting of the plants (Fig. 2). The number of plants infected out of total number of plants in each marked plot was enumerated and the percent disease incidence was calculated by using the formula stated below

$$\text{PDI} = \frac{\text{Number of infected plants}}{\text{Total no. of plants examined}} \times 100$$

B. Determination of whitefly population (Bemisia tabaci) in mungbean crop

For recording whitefly population, five plants were selected randomly from each marked plot and three leaves representing top, middle and bottom trifoliate leaves of each plant were selected and number of whiteflies found on the three leaves were counted during early hours of the day and the overall mean whitefly population was calculated.

RESULTS AND DISCUSSION

A. MYMV disease incidence in mungbean growing regions of Southern Karnataka

A total of eleven taluks and 30 villages were surveyed under present investigation during *Rabi* summer 2016-17 (Table 1) and 2017-18 (Table 2). The percent disease incidence (PDI) of MYMV ranged from 27.00-87.80 and 30.25-95.58 respectively. During *Rabi* summer 2016-17, among thirty villages across eleven taluks, the highest disease incidence of 87.80 percent was observed in Kandayyanapaly village of Kollegal taluk of Chamarajanagar district and the lowest incidence was recorded in Bisuvanahalli (27.06%) of Doddaballapura taluk. During *Rabi* summer 2017-18, the highest disease incidence of 95.58 percent was recorded in Yeriyur village of Yelandur taluk. However, lowest PDI was observed in Koira village of Devanahalli taluk (29.67 %).

The average disease incidence of Bengaluru rural district was 29.38 and 33.65 percent during *Rabi* summer 2016-17 and 2017-18 respectively. A total of six villages were surveyed, among them Varadenahalli recorded highest disease incidence of 31.86 % and the lowest was Bisuvanahalli (27.06 %) in 2016-17. The results of second season revealed that, Bashettihalli village recorded highest disease incidence of 43.01 percent and the lowest incidence of 29.67 percent was recorded in Koira. Bengaluru urban district recorded an average of 43.00 percent disease incidence during *Rabi* summer 2016-17. Among the taluks surveyed, the highest incidence was reported in Yelahanka (49.47 %). Sadenahalli village of Yelahanka taluk recorded 58.41 percent disease incidence which was higher than other villages. In *Rabi* summer 2017-18, Bengaluru urban recorded an average disease incidence of 45.34 percent. Sadenahalli village recorded the highest disease incidence of 60.42 percent in second season also.

In Chamarajanagar district, the highest disease incidence was recorded in Yelandur taluk with PDI of 85.23 and 91.34 percent in *Rabi* summer 2016-17 and 2017-18 respectively. Among ten villages surveyed, Kandayyanapalya and Yeriyur recorded the highest disease incidence (87.80% & 95.58% respectively) during 2016-17 and 2017-18.

Chamarajanagar Tumakuru Mandya Bengaluru rural

Fig. 1. MYMV disease severity in different districts of southern Karnataka.

Average percent disease incidence of Tumakuru district was found to be 52.89 and 48.21 respectively in *Rabi* summer 2016-17 and 2017-18. Turuvekere taluk recorded highest disease incidence of 63.37 and 55.13 percent during 2016-17 and 2017-18 respectively (Table 3). The highest disease incidence was recorded in Aralikere village (65.79 %) in 2016-17 and Madihalli village (61.26 %) during 2017-18.

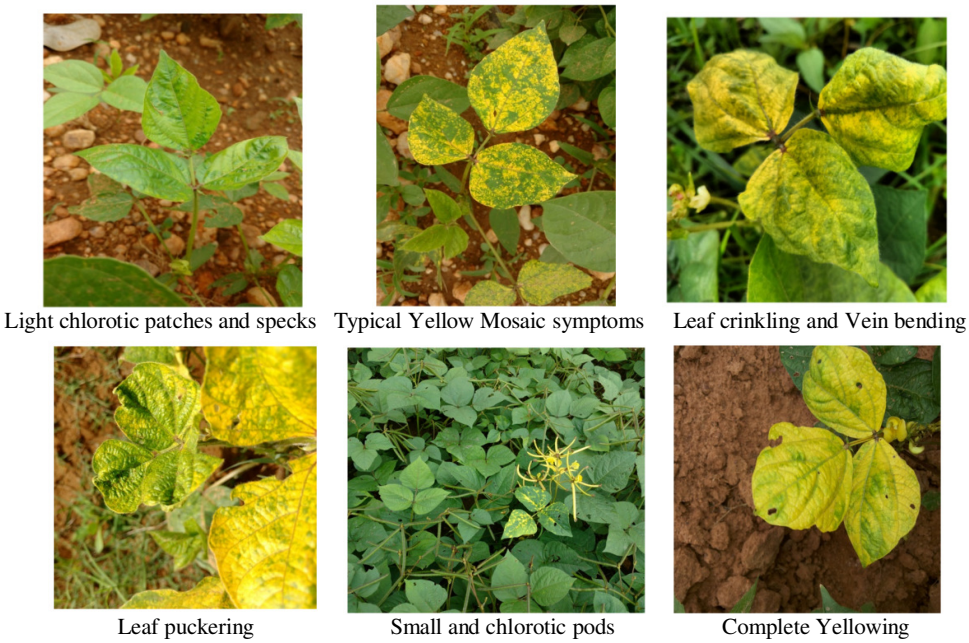
In Mandya district, an average disease incidence was 37.05 and 41.96 percent in *Rabi* summer 2016-17 and 2017-18 respectively. In both the seasons, Mandya taluk recorded the highest disease incidence of 38.68 and 43.72 percent respectively during 2016-17 and 2017-18 (Table 3). Survey results of five villages revealed that, Holalu village recorded highest disease incidence of 40.82 and 43.72 percent during 2016-17 and 2017-18 respectively. In both the seasons, lowest disease incidence was recorded in Hosakere village (Table 1, 2).

Among the districts, highest PDI of 79.81 and 83.73 was recorded in Chamarajanagar (Table 3) and lowest incidence was recorded in Bengaluru rural with PDI of 29.38 and 33.65 respectively during *Rabi* summer 2016-17 and 2017-18. Among the eleven taluks surveyed (Table 3), the lowest disease incidence was recorded in Doddaballapura with PDI of 28.73 and the highest incidence was found to be in Yelandur (85.23 %) during *Rabi* summer 2016-17. The results of *Rabi* summer 2017-18 revealed that the highest percent disease incidence was recorded in Yelandur taluk of Chamarajanagar district with average PDI of 91.34, whereas Devanahalli taluk of Bengaluru rural recorded as lowest with average disease incidence of 31.28 percent.

B. Prevalence of whitefly population (Bemisia tabaci) in mungbean crop

The average whitefly population per plant ranged from 2.3-4.5 and 2.7-5.2 in mungbean fields surveyed in different villages during *Rabi* summer 2016-17 and 17-18 respectively (Table 1, 2). In 2016-17, maximum whitefly population was found in Sathegala village (4.5) of Kollegal taluk, followed by Agara (4.3) and Kandayyanapalya (4.1) while minimum whitefly population (2.3) was observed in Cheelenahalli village of Doddaballapura taluk and Puttamadhihalli village of

Turuvekere taluk, followed by Bisuvanahalli, Madihalli and Hosakere with 2.4 whiteflies per plant. Disease incidence was found to be more in villages with high whitefly population. In 2017-18, whitefly population was maximum (5.2) in Agara followed by Yeriyur (5.1) and Madhuvanahalli (5.0) while minimum in (2.8) Cheelenahalli followed by Bashettihalli, Bisuvanahalli and Hebbal having an average of 2.7 whiteflies per plant.



Light chlorotic patches and specks | Typical Yellow Mosaic symptoms | Leaf crinkling and Vein bending

Leaf puckering | Small and chlorotic pods | Complete Yellowing

Fig. 2. Various symptoms of Mungbean Yellow Mosaic Virus disease.

Table 1: Mungbean Yellow Mosaic Virus disease incidence in different districts of southern Karnataka during *Rabi* summer 2016-17.

District	Taluk	Village	Crop stage (Days)	Avg. no. of whiteflies/ plant	PDI	Symptoms* observed
Bengaluru rural	Doddaballapura	Cheelenahalli	50	2.3	28.00	Y, YM
		Bashettihalli	55	3.0	31.13	Y, YM, M
		Bisuvanahalli	55	2.4	27.06	Y, YM
	Devanahalli	Koira	50	2.5	28.13	Y, YM, M
		Boodhihal	55	2.9	30.10	Y, YM
		Varadenahalli	50	3.2	31.86	Y, YM
Bengaluru urban	Hebbal	Hebbal	55	3.3	36.52	Y, YM, M
	Yelahanka	Rajankunte	55	3.5	40.54	Y, YM, M
		Sadenahalli	60	3.5	58.41	Y, YM, M
Chamarajanagar	Kollegal	Sathegala	60	4.5	85.25	Y, YM, M, YP
		Madhuvanahalli	60	3.9	79.63	Y, YM, M, YP
		Kandayyanapalya	60	4.1	87.80	Y, YM, M, YP
	Yelandur	Agara	60	4.3	83.50	Y, YM, M, YP
		Yeriyur	60	3.9	86.96	Y, YM, M, YP
	Chamarajanagar	Shivapura	55	3.3	77.17	Y, YM, M, YP
		Mukkadahalli	60	3.1	74.77	Y, YM, M, YP
		Mudnakudu	60	3.1	67.05	Y, YM, M, YP
		Uthavalli	60	3.4	61.11	Y, YM, M, YP
		Nagavalli	55	3.5	69.84	Y, YM, M
Tumakuru	Tiptur	Mattihalli	60	3.2	41.82	Y, YM, M
		Honnavalli	60	2.9	39.80	Y, YM, M
		Lakkihalli kaval	55	3.2	45.63	Y, YM, M
	Turuvekere	Aralikere	60	3.1	65.79	Y, YM, M, YP
		Madihalli	50	2.4	65.45	Y, YM, M
		Puttamadhihalli	55	2.3	58.88	Y, YM, M
Mandya	Mandya	Shivhalli	50	2.5	36.94	Y, YM, M
		Holalu	55	3.2	40.82	Y, YM
		K M dodi	55	2.8	38.30	Y, YM
	Maddur	Hosakere	60	2.4	33.33	Y, YM
		Tubinakere	60	2.9	37.50	Y, YM, M

*Y-Yellowing, YM- Yellow Mosaic, M-Mottling, YP- Yellow Pods

Table 2: Mungbean Yellow Mosaic Virus disease incidence in different districts of southern Karnataka during *Rabi* summer 2017-18.

District	Taluk	Village	Crop stage (Days)	Avg. No. of whiteflies/plant	PDI	Symptoms* Observed
Bengaluru rural	Doddaballapura	Cheelenahalli	55	2.7	31.37	Y, YM
		Bashettihalli	60	2.8	43.01	Y, YM, M, YP
		Bisuvanahalli	62	2.8	33.70	Y, YM, M
	Devanahalli	Koira	55	3.1	29.67	Y, YM
		Boodhihal	55	3.2	33.93	Y, YM, M
		Varadenahalli	60	3.3	30.25	Y, YM
Bengaluru urban	Hebbal	Hebbal	50	2.8	38.30	Y, YM, M
	Yelahanka	Rajankunte	55	3.2	44.33	Y, YM
		Sadenahalli	55	3.2	60.42	Y, YM, M, YP
Chamarajanagar	Kollegal	Sathegala	58	3.9	81.74	Y, YM, M, YP
		Madhuvanahalli	60	5.0	90.20	Y, YM, M, YP
		Kandayyanapalya	60	4.1	76.52	Y, YM, M
	Yelandur	Agara	65	5.2	87.10	Y, YM, M, YP
		Yeriyur	63	5.1	95.58	Y, YM, M, YP
	Chamarajanagar	Shivapura	65	4.6	77.53	Y, YM, M, YP
		Mukkadahalli	60	4.4	81.82	Y, YM, M
		Mudnakudu	65	4.4	75.47	Y, YM, M, YP
		Uthavalli	60	4.3	70.99	Y, YM, M, YP
		Nagavalli	58	3.7	79.44	Y, YM, M, YP
Tumakuru	Tiptur	Mattihalli	55	3.4	40.71	Y, YM, M
		Honnavalli	55	3.0	35.05	Y, YM, M
		Lakkihalli kaval	55	3.4	48.11	Y, YM, M
	Turuvekere	Aralikere	60	4.0	55.79	Y, YM, M, YP
		Madihalli	60	3.7	61.26	Y, YM, M
		Puttamadhihalli	55	3.1	48.33	Y, YM, M
Mandya	Mandya	Shivhalli	50	3.4	43.10	Y, YM, M
		Holalu	55	3.2	47.01	Y, YM, M, YP
		K M dodi	55	3.1	41.05	Y, YM, M
	Maddur	Hosakere	60	3.6	38.89	Y, YM, M
		Tubinakere	60	3.2	41.49	Y, YM, M

*Y-Yellowing, YM- Yellow Mosaic, M-Mottling, YP- Yellow Pod

Table 3: Mean percent incidence of Mungbean Yellow Mosaic Virus disease in different districts of southern Karnataka.

District	Taluk	PDI* (2016-17)		PDI (2017-18)	
		Avg. of Taluks	Avg. of Districts	Avg. of Taluks	Avg. of Districts
Bengaluru rural	Doddaballapura	28.73	29.38	36.03	33.65
	Devanahalli	30.03		31.28	
Bengaluru urban	Hebbal	36.52	43.00	38.30	45.34
	Yelahanka	49.47		52.37	
Chamarajanagar	Kollegal	84.23	79.81	82.82	83.73
	Yelandur	85.23		91.34	
	Chamarajanagar	69.99		77.05	
Tumakuru	Tiptur	42.42	52.89	41.29	48.21
	Turuvekere	63.37		55.13	
Mandya	Mandya	38.68	37.05	43.72	41.96
	Maddur	35.42		40.19	

*Percent Disease Incidence

Table 4: Mean whitefly population (*Bemisia tabaci*) in mungbean growing districts of southern Karnataka.

District	Taluk	No. of whiteflies (2016-17)		No. of whiteflies (2017-18)	
		Avg. of Taluks	Avg. of Districts	Avg. of Taluks	Avg. of Districts
Bengaluru rural	Doddaballapura	2.6	2.7	2.8	3.0
	Devanahalli	2.8		3.2	
Bengaluru urban	Hebbal	3.3	3.4	2.8	3.0
	Yelahanka	3.5		3.2	
Chamarajanagar	Kollegal	4.2	3.9	4.3	4.6
	Yelandur	4.1		5.2	
	Chamarajanagar	3.3		4.3	
Tumakuru	Tiptur	3.1	2.9	3.3	3.4
	Turuvekere	2.6		3.6	
Mandya	Mandya	2.8	2.7	3.2	3.3
	Maddur	2.6		3.4	

A total of eleven taluks were surveyed (Table 4), among them Doddaballapur, Maddur and Turuvekere reported to have minimum average whitefly population 2.6) while maximum number of whitefly (4.2) was reported from Kollegal taluk of Chamarajanagar district in 2016-17. In successive year, Doddaballapur and

Hebbal remained at lowest (2.8) among the taluk while highest population of whitefly (5.2) was observed from Yelandur taluk followed by Kollegal (4.3) and Chamarajanagar (4.3) taluk of Chamarajanagar district.

Among the districts, the average whitefly population per plant ranged from 2.70-3.90 and 3.00-4.60 in *Rabi* summer 2016-17 and 17-18 respectively (Table 4). Highest vector population of 3.90 and 4.60/plant was recorded in Chamarajanagar in both seasons and lowest was recorded in Bengaluru rural and Mandya with whitefly population of 2.70/plant in 2016-17 and Bengaluru rural and urban with average of 3.00 /plant vector population in 2017-18.

Whiteflies were found in every infected field surveyed. In all the mungbean fields surveyed, infected plants exhibited, irregular yellow and green patches on trifoliate leaves, puckering, reduction in leaf size, complete yellowing, bare peduncle with stunted internodes bearing few flowers and upturned yellow pods with small and immature seeds (Fig. 2). MYMV is transmitted through whitefly in nature and thus whitefly population directly influence the disease spread and hence incidence. In every infected field surveyed, variable number of whiteflies was found. Number of whiteflies per plant could be correlated to incidence of disease. Higher disease incidence in Chamarajanagar was attributed to higher whitefly population coupled with congenial environmental conditions, while both the parameters were found to be the lowest in Bengaluru rural. Meghashree *et al*., (2017) reported the highest disease incidence in Koppal (33.33%) followed by Bellary, Raichur and Kalaburgi while least was in Bidar. Further they found positive correlation between MYMV incidence and whitefly population. Jayappa *et al*., (2017) also reported positive correlation between disease incidence and vector population. MYMV disease incidence ranged from nil to 58.26 percent with maximum in Tumakuru district and minimum in Chitradurga. Archith *et al.,* (2017) observed MYMV disease incidence on French bean in all the surveyed agroclimatic zones of Karnataka. They also reported that variations in the disease incidence was favored by the genotype grown, and whitefly population, which was most influenced by temperature. Present study revealed that MYMV disease incidence varied place to place depending upon whitefly population. Although, disease severity is also attributed to host genotype, stage of crop at the time of infection, and congenial environmental conditions for multiplication of vector.

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