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Integrated Pest Management Package for Yellow Mosaic Disease and its Vector with Correlation to Weather Parameters of Blackgram

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ABSTRACT

Blackgram (*Vigna mungo* L. Hepper) is the fourth important short-duration pulse crop Similar to the other pulses, it enriches soil nitrogen content .In view of existing situation and importance of blackgram in Indian economy, the necessary prerequisite is development and popularization of economically sound and environmentally safe integrated management approach for successful management of Yellow Mosaic Disease in blackgram. YMV disease in mungbean is one of the major disease causing heavy losses annually throughout the country. As the disease is transmitted by insect vector, management of vector is important to check the YMV disease that can minimise the losses. The present investigation was aimed to evaluate different IPM modules for management of YMV disease of Blackgram. This experiment was conducted in RBD. The least white fly population was recorded in IPM module treated plots. The lowest yellow mosaic virus (YMV) incidence and whitefly symptom reflected in terms of highest grain yield by reducing the cost of chemicals. The maximum and minimum temperature showed significant correlation with Yellow Mosaic Virus Maximum disease incidence developed at maximum temperature of 35-42^{0}C and minimum temperature of 21-29^{0}C during summer 2020 in blackgram. However, the extension gap and technology gap were more so, there is an urgent need to create awareness among farmers about the implementation of IPM against YMV through the services of extension personnel to improve the blackgram yield and to reduce the extension and technology gaps in the Pudukottai district.

Keywords Blackgram- Yellow Mosaic Disease – vector-regression -correlation.

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INTRODUCTION

Blackgram (*Vigna mungo* L.) popularly known as urdbean in India is an important short duration and self-pollinating legume. Ghosh 2008 and Pandey *et al.* 2009. It is rich in all nutrients, which includes proteins (25-26%), carbohydrates (60%), fat (1.5%), minerals, amino acids and vitamins (Karamany 2006) For vegetarians, blackgram is therefore an inexpensive source of protein (Fary 2002). Grown in practically every region of India, it is one of the most valuable pulse crops. After pigeonpea, it is India's second most significant pulse crop in terms of both production and area. The world's greatest producer of uradbeans, India grows them on roughly 32.46 lakh hectares, yielding 19.59 lakh tonnes and 604 kg/ha of productivity. Andhra Pradesh, Bihar, Karnataka, Maharashtra, Madhya Pradesh, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal are the states that produce the most blackgram.

Blackgram is grown on 0.7 lakh hectares of land in Karnataka, yielding 300 kg/ha of productivity and 0.21 lakh tonnes of output. The primary cause of low productivity is the crop's vulnerability to weeds, insects, and bacterial, viral, and fungal diseases. Of them, viruses are the most significant class of plant diseases that impact agricultural yield. They reduce blackgram seed yield and quality, trigger serious illnesses, and result in financial losses. Obaiah *et al.* (2014). Plant viral infections lower seed production and quality, which results in significant financial losses for many pulse crops Schreinemahers *et al,* 2015. The most dangerous viral illness and a main hindrance to blackgram production is yellow mosaic disease, which is brought on by the Mungbean yellow mosaic virus (MYMV). This illness, commonly referred to as the "yellow plague of *kharif* pulses," is presently widespread throughout India's agricultural regions, including Karnataka's southern dry zone. Because of its severity and potential to significantly reduce yield depending on the crop's type and stage, it received extra attention. The management of whitefly as insect pest and vector become more complicated now a days. Farmers relay on chemical insecticides for its management but the excessive and indiscriminate use of chemical insecticides not only cause economical restrain on farmers but also imposes harmful effect on the environment as well as human's health. Repeated use of insecticides results in development of resistance in insect pests, adverse effects on non-target organisms, resurgence of secondary insect pests, residues on the food commodities.. [9]. In view of existing situation and importance of blackgram in Indian economy, the necessary prerequisite is development and popularization of economically sound and environmentally safe integrated management approach for successful management of YMD in blackgram. Even though, strategies for management of YMD caused by MYMV include planting resistant varieties, vector management, management of alternate hosts of viruses and modifying the cultural practices of the crop are effective in managing the disease remarkably. Therefore, there is need to develop a better management practices. In this context, the present study was taken on different aspects of integrated management of Yellow Mosaic virus Disease by using different chemicals and biocontrol agents.

MATERIALS AND METHOD

A field trial was conducted with two treatments with three replication at National Pulses Resarch Centre, Vamban during *kharif,* 2020 the observation are recorded for the viral disease viz., Yellow mosaic disease along with the vector population of white flies and yield (kg/ha) using the variety CO 5. The following treatments were imposed and the disease incidence was recorded periodically calculated for each treatment separately at 20, 40 and 60 days interval. The results are given below.

Evaluation of different treatments for the management of fungal foliar diseases in blackgram

The experiment was conducted with eight treatments and three replications using the variety VBN 8. The following treatments were imposed and the disease incidence was recorded periodically.

Assessment of disease incidence for Yellow Mosaic Virus disease in blackgram

Assessment of disease severity

It refers to degree of symptom expression and was

Table 1. Score chart for Yellow Mosaic Virus diseases.

Grade	Description	Reaction
1	No visible symptoms on leaves	Free
2	Small yellow specks with restricted spread covering 0.1-5% leaf area	Highly resistant (HR)
3	Mottling of leaves covering 5.1-10% leaf area	Resistant (R)
4	Yellow mottling covering 10.1-15% leaf area	Moderately resistant (MR)
5	Yellow mottling and discolouration of 15.1-20% leaf area	Moderately susceptible (MS)
6	Yellow coloration of 20.1-30% leaves and yellow pods	Susceptible (S)
7	Pronounced yellow mottling and discoloration of leaves and pods, reduction in leaf size and stunting of plants covering 30.1-50% 0f foliage	Susceptible (S)
8	covering Severe yellow discoloration of leaves 50.1-75% of foliage, stunting of plants and reduction in pod size	Highly susceptible (HS)
9	Severe yellowing of leaves covering above 75% of foliage, stunting of plants and no pod formation	(HS)

assessed based on –5 scale (Hahn *et al*. 1980) (Table 1) as follows,

The number of plants under each grade was counted and multiplied with their representative grade and divided with total number of plant assessed for disease incidence. The plants scored with grade one (healthy) were not included for calculating the disease incidence (Sseruwagi *et al.* 2004).

Assessment of disease incidence for crinkle disease

Disease incidence was assessed by the number of visibly diseased plants, usually in relation to the total number of plants assessed and expressed as the proportion or percentage of plants infected with Crinkle. Each and every field was observed with about 50 blackgram and green gram plants at random and scored as infected and healthy and percent disease incidence was calculated.

The following formula was used to calculate disease incidence,

$$\frac{\text{Number of plants with visible symptoms}}{\text{Total Number of observed plants}} \times 100$$

Assessment of disease severity

It refers to degree of symptom expression and was assessed based on 1 – 5 scale (Hahn *et al.* 1980) as follows,

Simple correlation coefficients were estimated as follows,

$$r_{xy} = \frac{Cov_{x.y}}{\sqrt{(var_{x.}\ var_{y})}}$$

Where,

r_{xy}	=	Correlation coefficient between the traits x and y.
$Cov._{xy}$	=	Covariance between the traits ‘x’ and ‘y’.
var_x	=	Variance of the trait ‘x’.
var_y	=	Variance of the trait ‘y’.
x	=	Variable x and
y	=	Variable y

The significance of the correlation estimates was tested by using the formula.

$$\text{Standard Error (SE)} = \frac{\sqrt{1-r^2}}{\sqrt{n-2}}$$

Where,

r = Correlation co-efficient
n = Number of paired observation
$t_{cal} = r / SE$

By comparing the ‘t’ calculated value with ‘t’ table values at 5 per cent and 1 per cent levels at (n - 2) degrees of freedom, the significance was worked out.

Regression coefficient
regression coefficient (b_i)

The regression coefficient is the regression of the performance of each genotype under different environment on the environmental means of all the genotypes. This was estimated as follows.

$$b_i = \frac{\sum_j Y_{ij} I_j}{\sum_j I^2_j}$$

Where,

$\sum_j Y_{ij} I$ the sum of products of environmental index (I_j) with corresponding mean of that genotype at each environment (Y_{ij})

$\sum_j I^2_j$ the sum of squares of the environmental index (I_j)

(a) For each value of regression coefficient I_j^2 is common and equal to

$$\sum_j I_j^2 = I_i^2 + . . + I_i^2 + .. I_{45}^2$$

(b) On the other hand $\sum_j Y_{ij} I_j$ for each genotype is the sum of products of environmental index (I_j) with the corresponding mean ($\bar{X}$) of that genotype in each environment.

These values were obtained in the following manner

$$[\bar{X}] \times [I_j] = [\sum_j Y_{ij} I_j] = [S]$$

Where,

$[\bar{X}]$ = Matrix of means
$[I_j]$ = Vector for environmental index and
$[S]$ = Vector for sum of products (ie) $\sum_j Y_{ij} I_j$

(c) Then b_i values for each genotype was calculated by dividing $\sum_{ij} Y_{ij} I_j$ for each genotype by $\sum_j I_j^2$

I_j = environmental index of j^{th} environment which can be calculated as follows.

Whitefly population

Population of whitefly was counted on five randomly selected plants by observing three leaves (upper, middle and lower), during early morning hours in each plot when it remains on leaves with the help of a hand lens of 10x magnification. The whitefly reduction over control (WROC) percentage for the treatments was calculated using the following formula.

WROC (%) = C-T / C ×100 where, C = Per cent incidence in control and T = Per cent incidence in treatment

Yield

Periodical harvest was conducted, and the total yield (kg/plot) was calculated by recording the total number and weight of the fruits per plot for each treatment, whereas the marketable yield was recorded by omitting those affected by abiotic and biotic factors. The yield was then presented for hectares (ha) and represented as quintal per hectare (q/ha). The formula for yield calculation is mentioned below.

Yield (kg/ha) = Total yield per plot (kg)/ plot size (m^2) ×10,000 (m^2)

Cost-benefit ratio (CBR)

Economics of all the treatments were worked out by considering the price of products, cost of fungicides and labour charges. Cost Benefit Ratio (CBR) was worked out to compare the economics of treatments.

Statistical analysis

All the glasshouse experiments were carried out in completely randomized design (CRD) with adequate replications. Field experiments were carried out in Randomized Block Design (RBD). Statistical analyses of the experiments were performed using IRRISTAT version 3.1 developed by Biometrics unit, IRRI, Manila, The Philippines.

RESULTS AND DISCUSSION

Observations were taken on the YMV disease at three stages during vegetative (20 DAS) flowering (40 DAS), pod formation (60 DAS). The YMV incidence was recorded in IPM module treated plots (Grade 1), whereas farmers practice plots recorded with highest YMV disease (Grade 5). Observations were taken on the whitefly at three stages during 20,40 and 60 DAS. The white fly population was recorded in IPM module treated plots (4 nos), whereas farmers practice

Table 2. Integrated management of viral disease in blackgram (pooled analysis).

Sl. No.	Treatments	YMV 1-9 grade	Crinkle (%)	Powdery mildew (PDI)	White fly No/Plant	Yield kg/ha
1	Seed soaking with borax @ 2g / kg + 10% notchi leaf extract @ 300ml/kg followed by seed treatment with imidacloprid 600FS @ 5g/kg	1	0	5.92	6	872
2	Soil application of *Pseudomonas fluorescens* (Pf1) @ 2.5kg / ha	1	0	12.36	5	785
3	Border row planting of maize (2 rows)	0	1	7.83	3	852
4	Rogue out virus infected plants upto 25 DAS	1	1	6.78	7	800
5	Installing yellow sticky traps @ 12 no. / ha	1	0	7.22	5	857
6	Foliar spray of borax @ 0.1% and notchi leaf extract 10% at 30 DAS	1	1	4.63	3	899
7	Need based spraying of acetamiprid 20 WP @ 250g/ha	1	1	5.82	4	877
8	Control	5	9	20.33	9	702
9	Non IPM	5	5	30.89	10	650
	SE(d)			0.49		40.07
	CD (p=0.05)			1.05		85.90

Mean of three replication.

plots recorded with highest whitefly populations (10 nos.) respectively (Archana *et al.* 2018). (Table 2). The lowest YMV incidence and whitefly symptom reflected in terms of highest grain yield in IPM treated plots by recording the yield of 873 Kg/ha with the BC ratio 1:1.80 of compared to farmers practice which yielded 763 kg/ha with BC ratio of 1:1.90 by reducing the cost of chemicals. Utilizing a microbial consortium (the Arka Microbial Consortium) may boost agricultural productivity and enhance produce quality. through improving plant vigor and nutrient uptake (Aswathi *et al.* 2020).

Table 3. Correlation analysis in Blackgram of Yellow Mosaic Virus during summer and *kharif* 2020.

Disease	Maximum temperature	Minimun temperature	Rainfall (mm)	Sunshine hours SSH
Summer 2020				
Yellow Mosaic Virus	-0.02	0.04	0.81	-0.08
Leaf Crinkle	-0.59	0.49	0.45	0.06
Kharif 2020				
Yellow Mosaic Virus	0.00	0.10	-0.21	-0.36
Leaf Crinkle	-0.08	0.15	-0.28	-0.22
Powdery Mildew	0.34	0.22	-0.07	0.35

Out of four weather parameters considered for studying their influence on the increment of disease severity, maximum sunshine hours, rainfall and maximum temperature were identified as critical parameters through multiple regression analysis and had their significant positive or negative contributions towards the disease increment. The maximum and minimum temperature showed significant correlation with Yellow Mosaic Virus Maximum disease incidence developed at maximum temperature of 35-420C and minimum temperature of 21-290C during summer 2020 in blackgram. Yellow Mosaic Virus is positively correlated with minimum temperature and rainfall Leaf Crinkle is positively correlated with minimum temperature, rainfall and sunshine hours during Summer, 2020 (Table 3 and Fig.1). Ahila Devi *et al.* 2021 found that Yellow Mosaic Virus is positively correlated with minimum temperature (0.04), Leaf Crinkle is positively correlated with minimum temperature (0.10) and Powdery mildew is positively correlated with max temp (0.34) , min temp (0.22) and sunshine hours (0.35).

Influence of weather parameters such as Maximum (R^2=0.08%) and Minimum (0.003%) temperature on YMV showed least association. While, rainfall (R^2=67%) and SSH (R^2=82.10%) showed significant association with YMV during Summer 2020 (Table 4).

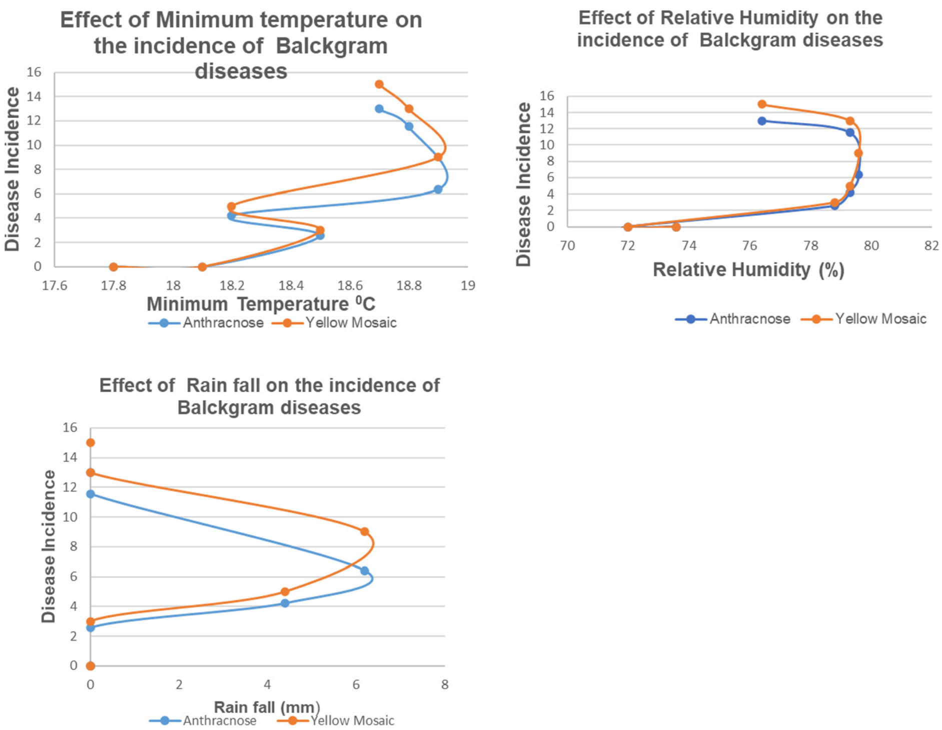

Fig 1. Influence of weather paraments in Black gram of YMV and fungal disease during summer and *kharif* 2020.

The Maximum (R^2=33.90%) and Minimum (R^2=33.60%) temperature and rainfall (R^2=17.90%) found to be significant association with leaf crinkle. While, SSH (R^2=4.0%) had least association with leaf crinkle.

Table 4. Regression analysis in Blackgram of YMV and leaf crinkle during *rabi,* 2020-21.

Sl. No.	Weather parameters	YMV (R^2)	LC (R^2)
1	Maximum temperature	0.0008 (0.08%)	0.339 (33.90%)
2	Minimum temperature	0.003 (0.30%)	0.336 (33.60%)
3	Rainfall	0.670 (67.00%)	0.179 (17.90%)
4	Sunshine hours	0.821 (82.10%)	0.040 (4.00%)

Influence of weather parameters such as Maximum (R^2=0.5%) and rainfall (R^2=1.20%) and SSH (R^2=9.00%) on YMV showed least association during *Kharif* 2020.

The Maximum (R^2=86.50%) and Minimum (R^2=87.10%) temperature and SSH (R^2=79.10%) found to be significant association with leaf crinkle. While, rainfall (R^2=9.10%) had least association with leaf crinkle (Table 5).

The Maximum (R^2=41.20%) and Minimum (R^2=40.70%) temperature and SSH (R^2=46.00%) found to be association with powdery mildew. While,

Table 5. Regression analysis in Blackgram of YMV during *Kharif* 2020.

Sl. No,	Weather parameters	YMV (R^2)	LC (R^2)	PM (R^2)
1	Maximum temperature	0.005 (0.50%)	0.865 (86.50%)	0.412 (41.20%)
2	Minimum temperature	-2.306 (-ve)	0.871 (87.10%)	0.407 (40.70%)
3	Rainfall	0.012 (1.20%)	0.091 (9.10%)	0.047 (4.70%)
4	SSH	0.090 (9.00%)	0.791 (79.10%)	0.460 (46.00%)

rainfall (R^2=4.70%) had least association with powdery mildew (Ahila Devi *et al.* 2021) found that the influence of weather parameters on Yellow Mosaic Virus (YMV) in Pudukottai district of Tamil Nadu. The results of the field experiment conducted at National Pulses Research Centre revealed that the maximum temperature positively correlated with the Yellow Mosaic Virus (YMV) incidence during *kharif, rabi* and summer in blackgram. The minimum temperature, maximum and minimum relative humidity (RH) negatively correlated with the YMV during *kharif, rabi* and summer in blackgram. The minimum temperature positively correlated with the YMV incidence during *kharif*, *rabi* and summer. The maximum and minimum RH along with rainfall negatively correlated with the YMV disease incidence during *kharif, rabi* and summer season.

Yellow mosaic virus

Observations were taken on the YMV disease at three stages during vegetative (20 DAS) flowering (40 DAS), pod formation (60 DAS). The YMV incidence was recorded in IPM module treated plots (Grade 1), whereas farmers practice plots recorded with highest YMV disease (Grade 5).

White fly

Observations were taken on the whitefly at three stages during 20,40 and 60 DAS. The white fly population was recorded in IPM module treated plots (7nos), whereas farmers practice plots recorded with highest whitefly populations (10 nos.) respectively.

Yield and BC ratio

The lowest YMV incidence and whitefly symptom reflected in terms of highest grain yield in IPM treated plots by recording the yield of 873 Kg/ha with the BC ratio 1:1.80 of compared to farmers practice which yielded 763 kg/ha with BC ratio of 1:1.90 by reducing the cost of chemicals.

CONCLUSION

Even though, strategies for management of YMD caused by MYMV include planting, vector management, management of alternate hosts of viruses and modifying the cultural practices of the crop are effective in managing the disease remarkably. Therefore, there is need to develop a better management practices. The different aspects of integrated management of YMD by using different chemicals and neem based pesticides has been evaluated for better management.

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