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Field Screening of Blackgram Genotypes against Whitefly (*Bemisia Tabaci* Genn.)

P Prashanthi, Ch Chiranjeevi, C Sandhya Rani and P Anil Kumar
Department of Entomology, Agricultural College, Bapatla, A.P.

ABSTRACT

An experiment was conducted to screen 25 blackgram genotypes including six checks against whitefly population at the Agricultural College Farm, Bapatla during *kharif* and *rabi,* 2017-18. The genotypes, KU-17-114 and KU-17-130 recorded minimum population of whiteflies (1.59 and 3.70 per plant respectively). KU-17-114, having low preference for the whiteflies has recorded higher trichome density (43.33 trichomes/ cm^2), higher amount of total phenol content (12.34 and 10.35 mg, during vegetative and reproductive stages, respectively) and lesser quantity of total sugars (33.86 and 26.24 mg, during vegetative and reproductive stages, respectively). The whitefly population was positively correlated with leaf area, total sugars whereas, negatively correlated with leaf thickness, trichome density and total phenol content.

Key words: *Blackgram, Phenols, Total sugars, Trichomes, Whiteflies.*

Blackgram, *Vigna mungo* (L.) is an important pulse crop of India sharing 10 per cent of total pulse production *i.e.,* 12-15 million tons, occupying an area of 3.00 m. ha with a production of 1.3-1.5 million tons (www.indiastat.com, 2014-15). In Andhra Pradesh blackgram, is grown in an area of 5.39 lakh ha with a production of 3.67 lakh tonnes.

Insect pests damage is a serious limiting factor in cultivation of pulses leading to reduced production and productivity. Blackgram is ravaged by an array of insect pests from sowing to harvest in the field as well as in storage (Lal and Sachan, 1987). Among them, sucking pests such as thrips and whiteflies are important pests in Andhra Pradesh during early stages of crop growth, which not only reduces the plant vigour but also act as vectors for deadly viral diseases and spotted pod borer is the major pest during flowering stage.

Whitefly, *Bemisia tabaci* (Gennadius) is the most serious pest causing damage by sucking cell sap from leaves and tender parts, and secretes honeydew on which sooty mould develops that hinders photosynthesis. Besides, it also acts as vector for yellow mosaic virus, which is a serious threat to pulse production in India. In blackgram, YMV leads to irregular alternate yellow green chlorotic patches on older leaves and complete yellowing of young leaves of susceptible varieties thereby reducing the photosynthetic ability finally leading to yield reduction to the tune of 25-78 per cent (Naresh and Nene, 1981).

The cheapest, practical and economical control of the pest can be achieved by the resistant source for insect pests. Therefore, it is necessary to identify resistant /moderately resistant genotype to reduce the insect pest population and the production cost to protect the environment. Host plant resistance is a primary component to fight against the insect pests throughout the crop stage. The morphological and biochemical characters of the plants like trichome density, leaf thickness, leaf area and amount of carbohydrates and phenols etc. are considered to play an important role in plant defence mechanisms.

MATERIAL AND METHODS

Investigation was carried out to screen the possible resistant sources against whitefly with twenty five blackgram genotypes. The experiment was conducted in the Agricultural College farm, Bapatla during *kharif* and *rabi,* 2017-18 in RBD with two replications and twenty five genotypes including six check varieties as treatments. Each genotype was sown with a spacing of 30 cm between rows and 10 cm between plants in two rows of four meter length, by leaving one row gap between each treatment.

The population of whiteflies were recorded from three trifoliate leaves *i.e.,* top, middle and bottom of the plant during the early morning hours. Observations were recorded at ten days interval from 5 randomly selected plants in each genotype from two replication till crop maturity during both *kharif* and *rabi* 2017-18.

The genotypes were categorized into four categories based on whiteflies population recorded from the genotypes as below (Nataraja *et al.,* 2008).

Low preference : Mean incidence in the genotype < [Overall mean – CD]

Moderate preference : Mean incidence in the genotype between [overall mean - CD and overall mean]

Table 1. Cumulative reaction of blackgram genotypes against whiteflies and their morphological characters, biochemical factors during 2017-18

S.No.	Genotype	Whitefly	Leaf area	Leaf thickness (mm)	Trichome density	Total phenols (mg)		Total sugars (mg)	
		(no./ plant)	(Cm^2)		(per cm^2)	Vegetative stage	Reproductive stage	Vegetative stage	Reproductive stage
1	KU-17-110	4.08 (2.02)	161.54 (12.73)	0.21	31.48 (5.65)	9.23	7.9	34.36	26.02
2	KU-17-111	8.29 (2.88)	156.13 (12.51)	0.2	12.59 (3.60)	6.13	5.72	66.56	42.63
3	KU-17-113	3.45 (1.86)	160.69 (12.69)	0.21	22.96 (4.84)	12.34	10.77	34.56	28.2
4	KU-17-114	1.59 (1.26)	167.88 (12.98)	0.28	43.33 (6.88)	14.36	10.35	33.86	26.24
5	KU-17-116	6.05 (2.46)	143.02 (11.98)	0.2	11.48 (3.46)	10.91	8.43	54.85	39.87
6	KU-17-117	3.96 (1.99)	150.32 (12.28)	0.21	35.56 (6.00)	8.2	7.3	35.2	26.17
7	KU-17-118	4.68 (2.16)	166.65 (12.93)	0.25	14.81 (3.91)	11.76	9.7	40.16	32.55
8	KU-17-119	4.43 (2.10)	165.90 (12.90)	0.21	27.78 (5.32)	9.15	8.31	40.67	25.81
9	KU-17-120	4.73 (2.17)	165.85 (12.90)	0.2	21.48 (4.69)	10.4	8.54	55.61	36.5
10	KU-17-121	8.48 (2.91)	159.97 (12.67)	0.18	13.33 (3.71)	6.07	5.45	66.38	41.91
11	KU-17-122	6.35 (2.52)	146.58 (12.13)	0.18	18.89 (4.40)	12.67	11.66	52.78	37.55
12	KU-17-123	5.46 (2.34)	162.83 (12.78)	0.19	21.48 (4.69)	7.4	7.05	53.45	37.34
13	KU-17-124	5.30 (2.30)	155.12 (12.47)	0.24	31.48 (5.65)	7.55	5.99	61.12	36.1
14	KU-17-127	5.61 (2.37)	157.28 (12.54)	0.18	21.85 (4.73)	6.54	5.74	66.27	37.16
15	KU-17-128	8.63 (2.94)	167.42 (12.96)	0.19	12.22 (3.55)	6.07	5.47	68.23	39.8
16	KU-17-130	3.61 (1.90)	148.78 (12.21)	0.22	35.93 (6.03)	9.9	8.65	36.54	30.59
17	KU-17-133	6.13 (2.47)	155.00 (12.47)	0.2	12.59 (3.62)	8.55	7.88	42.39	30.36
18	KU-17-134	4.00 (2.00)	167.76 (12.97)	0.19	33.70 (5.85)	9.17	7.25	39.81	26.68
19	KU-17-135	3.13 (1.77)	158.98 (12.63)	0.17	20.74 (4.60)	8.51	6.04	37.77	27.26
20	LBG-20 (C)	7.03 (2.53)	163.96 (12.82)	0.22	19.26 (4.44)	10.52	8.68	61.85	37.55
21	LBG-648 (C)	10.45 (3.24)	163.07 (12.79)	0.18	17.04 (4.18)	6.09	4.91	73.96	42.63
22	LBG-709 (C)	7.53 (2.74)	162.00 (12.75)	0.25	12.96 (3.67)	6.58	5.68	70.55	40.34
23	LBG-752 (C)	5.35 (2.31)	164.18 (12.83)	0.23	14.07 (3.82)	7.21	6.33	57.71	36.32
24	LBG-933 (C)	9.09 (3.01)	166.23 (12.91)	0.21	14.44 (3.86)	6	5.56	66.63	36.54
25	PU-31 (C)	4.68 (2.16)	147.08 (12.13)	0.24	15.93 (4.05)	10.7	8.61	65.33	33.49
	SEm±	0.05	0.26	0.01	0.17	0.47	0.33	1.77	1.35
	CD (p=0.05)	0.16	NS	NS	0.35	1.39	0.96	5.18	3.96
	CV%	8.42	3.91	11.5	4.8	7.61	6.24	4.7	5.56

High preference: Mean incidence in the genotype, between overall mean and overall mean + CD
Very high preference: Mean incidence in the genotype > Mean + CD

Morphological Characters

In order to study the morphological characteristics of the test genotypes, observations were recorded from 25 days after sowing. To measure the leaf area of different blackgram genotypes, one trifoliate leaf each from the upper, middle and lower canopy was detached from the plant and the leaf area was determined by using Leaf Area Meter (Model No. LP-80). To study leaf lamina thickness, three trifoliate leaves were removed and transverse leaf sections were prepared and placed laterally on the glass slides in a drop of water and imaged under microscope. Trichome density was studied by collecting healthy leaves from the all the genotypes and circular discs of diameter 0.45 cm were made from the leaves with the help of punching machine. The discs were soaked in saffron dye for 5-10 minutes, later the bits were observed under the stereo zoom microscope to count the number of trichomes present on the disc of leaf bit.

Biochemical factors

Plant samples of each genotypes were collected and analysed for total sugar and phenols estimation of total sugar was done by using anthrone reagent as per the procedure outlined by Hedge and Hofreiter (1962). The total phenol content in each genotype was estimated as per the procedure described by Malick and Singh (1980).

Statistical analysis

The data was subjected to ANOVA to test for significance of differences among the genotypes. Morphological characters and biochemical factors were compared among the genotypes and correlation analysis along with coefficient of determination was done.

RESULTS AND DISCUSSION

Under natural field conditions, the cumulative data on mean number of whiteflies (Table 1) was assessed in twenty five blackgram genotypes during *kharif* and *rabi*, 2017-18. The morphological characters and biochemical factors were estimated in all the genotypes in both the seasons. The results revealed that there were significant differences in reaction among the genotypes against whiteflies.

Whiteflies

Data on the mean number of whiteflies revealed that there is highly significant difference among the genotypes and it varied from 1.59 to 10.45 per plant. The lowest population was recorded in the genotypes KU-17-114 (1.59), KU-17-135 (3.13), KU-17-113 (3.45) and KU-17-130 (3.61), whereas the highest population was recorded in the genotypes, LBG 648 (10.45), KU-17-128 (8.63) KU-17-121 (8.48) and KU-17-111 (8.29).

The present observations were supported by the research findings of Manojkumar and Singh (2014) who screened blackgram genotypes against major insect pests and reported that VBG-10- 024 recorded maximum number of whitefly population (no/plant) followed by KU-11-06 similarly, the minimum population was observed on ACM05-007, TPU-4 and UH-08-05 and the findings of Srujana (2014) revealed that VBG-10-008 recorded the lowest mean population of whiteflies (2.12 nymphs/ trifoliate leaf/ plant) and was grouped under the less preferred genotype for the whiteflies whereas, maximum population of 5.02 nymphs/ trifoliate leaf/ plant was recorded in the genotypes, TPU-4 and TU-631 indicating that there was significant variation among the genotypes towards the preference against whiteflies.

Leaf area and Leaf thickness

The cumulative leaf area revealed that there is no significant difference among the genotypes and it varied from 143.02 (KU-17-116) to 167.88 (KU-17-114). The cumulative leaf thickness was non significant and maximum in the genotype KU-17-114 (0.28) followed by KU-17-124 (0.24) whereas minimum in KU-17-135 (0.17) followed by KU-17-121, KU-17-122, KU-17-127 which recorded 0.18 mm thickness.

Trichome density

The data pertaining to pooled trichome density showed significant variation among the genotypes and it ranged from 11.48/ cm^2 to 43.33/ cm^2. The maximum number of trichomes observed in genotype KU-17-114 (43.33) followed by KU-17-130 (35.93) and KU-17-117 (35.56) whereas minimum number of trichomes observed in genotypes KU-17-116 (11.48) followed by KU-17-128 (12.22), KU-17-111 (12.59) and KU-17-121 (13.30).

Phenols and total sugars

The quantity of phenol content at vegetative stage ranged from 6.07 (KU-17-121) to 14.36 mg (KU-17-114) and at reproductive it ranged from 5.45 mg (KU-17-121) to 10.77 mg (KU-17-114). The minimum quantity of total sugars recorded in genotype, KU-17-114 (36.18 and 28.92 mg) whereas maximum quantity recorded in KU-17-128 (67.87 and 40.31 mg) during vegetative and reproductive stages respectively.

Table 2. Grouping of blackgram genotypes based on Mean ± CD values of number of whitefly adults per plant

Less preferred genotypes (< Mean – CD, 5.28)	Moderately preferred genotypes (between Mean – CD and Mean, 5.28 and 5.62)	Highly preferred genotypes (between Mean and Mean+ CD, 5.62 and 5.96)	Very highly preferred genotypes (> Mean + CD, 5.96)
KU-17-110, KU-17-113, KU-17-114, KU-17-117, KU-17-118, KU-17-119, KU-17-120, KU-17-130, KU-17-134, KU-17-135 and PU 31	KU-17-123, KU-17-124, KU-17-127 and LBG 752	Nil	KU-17-111, KU-17-116, KU-17-121, KU-17-122, KU-17-128, KU-17-133, LBG 20, LBG 648, LBG 709 and LBG 933

Table 3. Correlation between whitefly population and morphological characters, biochemical factors of blackgram genotypes during 2017-18

Morphological and bio chemical characters	Whitefly population	
	Correlation coefficient value	R^2
Leaf area	0.15	0.5755
Leaf thickness	-0.37	
Trichome density	-0.59	
Phenols at vegetative stage	-0.67	0.6800
Total sugars at vegetative stage	0.79	
Phenols at reproductive stage	-0.65	0.7500
Phenols at reproductive stage	0.81	

Grouping of genotypes based on mean ± CD values of whitefly population

Cumulative results on whitefly population revealed that among the screened 25 genotypes, 11 genotypes were found as less preferred with a range of, 1.59 (KU-17-114) to 4.73 (KU-17-120) per plant. Ten genotypes were found as very highly preferred by whiteflies as they recorded 6.05 (KU-17-114) to 10.45 (KU-17-114) per plant. The genotypes KU-17-123 (5.46 per plant), KU-17-124 (5.30), KU-17-127 (5.61) and LBG (5.35) were moderately preferred (Table 2).

Correlation studies

The data highlighting the correlation between morphological characters of blackgram and whitefly population are presented in Table 3. Leaf area showed non significant and positive correlation with number of whiteflies, thus indicating that the greater the leaf area, the more oviposition, number of whiteflies there would be. The results were in accordance with Taggar and Gill (2012) who reported that leaf area was significantly and positively correlated with whitefly population. Leaf thickness had non significant and negative correlation with number of whiteflies. The results were in agreement with Jindal and Dhaliwal (2011) who carried out studies to standardize the plant stage and identify resistant cotton genotypes against whitefly, stated that leaf lamina thickness was negatively correlated with egg laying by whitefly.

However, negative correlation was observed between trichome density and number of whiteflies, indicating that the greater the trichome density or leaf pubescence, the lower would be the whiteflies. Thus, pubescent black gram genotypes were less preferred for feeding and oviposition by *B. tabaci* as compared with glabrous ones. Leaf trichome density is a defensive character which prevents the infestation of whiteflies by deterring or limiting their establishment and thus making the locomotion, feeding and oviposition difficult (Sanchez-Pena *et al.* 2006). The present study also in accordance with the findings of Taggar and Gill (2012), who reported that, trichome density and angle were negatively correlated to with whitefly population in blackgram.

The correlation between biochemical factors and whitefly population was presented in the table 3. The results indicated that positive correlation existed between whiteflies and total amount of sugars at vegetative stage (r=0.79) and at reproductive stage (r=

0.81) whereas, negative correlation existed between the whitefly population and phenol content at vegetative (r= -0.67) and reproductive (r= -0.65) stages of genotypes. This is because of large concentrations of phenols having toxic effect on the whitefly population and the results are in accordance with Rao and Panwar (2001). Similarly, Bhavani *et al.* (2012) who reported that the sugars were considered as the vital nutrients in plants and were acting as the phagostimulants for insect pests.

CONCLUSION

The blackgram genotypes, KU-17-114 and KU-17-130 that are less preferred by whiteflies recorded highest number of trichomes, higher amount of total phenols and lesser quantity of total sugars. Hence these type of genotypes can be utilized in resistant breeding programmes.

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