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Evaluation of Some Green Gram Genotypes against Whitefly, *Bemisia tabaci* Gennadius and Leafhopper, *Empoasca kerri* Pruthi under Field Conditions

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Studies were carried out on 51 genotypes of green gram, evaluated to identify the genotypic response against whitefly, leafhoppers and yellow mosaic virus infestation during kharif, 2010 at CCS Haryana Agricultural University, Hisar. Out of 51 genotypes, MH 732, MH 717, MH 719 and MH - 125 (Basanti) and MH 717 harboured minimum population of whitefly (2.68 /cage/plant), green leafhopper (0.45 /cage/plant), brown leafhopper (0.15 /cage/plant) and mixed (green and brown) leafhopper (0.69 /cage/plant), respectively, as compared to maximum whitefly population observed on genotype SM 9-117 (8.30 /cage/plant), green leafhopper on MH 809 (1.12 /cage/plant), brown leafhopper on MH 748 and MH 808 (0.41 /cage/plant) and mixed leafhopper counts recorded on SM

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9-113 (1.49 /cage/plant). Genotype MH 742 affected least 2.80 per cent with the incidence of YMV as compared to maximum (56 per cent) incidence on SM 9-112. Highest grain yield (908 kg/ha) was obtained from the genotype MH 742 as compared to 355 kg/ha lowest observed from the genotype SM 9-112.

Keywords: Vigna radiata (L.) Wilczek; Bemisia tabaci gennadius; Empoasca kerri pruthi; YMV.

1. INTRODUCTION

Green gram is an excellent source of vegetable protein, commonly known as poor man's meat for vegetarians. About 64 insect species are known to attack the green gram crop [1]. Among various pests, *Bemisia tabaci* Gennadius [Order: Homoptera, Family: Aleyrodidae] and *Empoasca kerri* Pruthi [O: Homoptera, F: Cicadellidae] are two major sucking pests to cause yield loss. Besides above pests, whitefly is a well known vector for spreading yellow mosaic virus (YMV) and capable of disease transmission within 15 to 30 minutes after the insect alights on the mung bean plant [2]. Whereas, the *E. kerri* is non vector of the YMV, but considered to be potential sap feeder after whitefly on green gram [3]. The productivity is low due to high incidence of above pests. Keep inview, some genotypes were evaluated against these pests under field conditions.

2. MATERIALS AND METHODS

Field evaluation of 51 green gram genotypes including 4 recommended check cultivars was conducted in a Randomized Block Design replicated thrice during *kharif*, 2010.The seed was sown in plots of paired rows of 4 m length each, on July 14th at Research Farm of Department of Entomology, Chaudhary Charan Singh Haryana Agriculture University, Hisar, Haryana. The observations on whitefly (nymphs and adults) and leafhopper (green, brown and mixed adults) were recorded at an interval of 10 days from 20-60 Days After Sowing (DAS) on five randomly selected plants from each genotype. While taking the observations during morning hours for the population of both test insects, the cage was placed over a single plant and glass pan side was kept towards the sun without disturbance, so that population of whitefly and leafhopper being photo tactic congregated on the glass screen and could be easily assessed Nath [4]. Per cent mosaic infected plants was worked out by counting total number of plants and affected plants from each genotype at 22, 42 and 63 DAS. The disease incidence was rated according to the visual grading (0-9) taken by the mean per cent mosaic infected plants with slight modifications suggested by Mayee and Datar [5] as follows:

List 1. Disease incidence rating according to the visual grading (0-9) scale

Scale	Plants with disease symptoms	Category
0	Disease free/without any symptoms	Highly resistance
1	1- 2 % or less plants exhibit disease symptoms	Resistance
3	3 - 5 % Plants exhibit disease symptoms	Moderately resistance /tolerance
5	6 - 15 % Plants exhibit disease symptoms	Moderately susceptible
7	16 – 32 % Plants exhibit disease symptoms	Susceptible
9	> 32 % Plants exhibit disease symptoms	Highly susceptible

Mayee and Datar [5]

Similarly, the grain yields from each genotype were recorded at harvest and converted to kg/ha and were subjected to statistical analysis.

3. RESULTS AND DISCUSSION

The majority of tested green gram genotypes started flowering at 50 % stage varied from 33 - 46 days and belonged to extra early maturity group with crop maturity ranged from 65 - 75 days. However, drastic decrease in the test insect population was recorded at 60 DAS. The population of whitefly decreased with the advancement of crop growth probably due to less preference for matured plant as host and unfavourable weather conditions. Puneet [6] reported decrease in whitefly population at 60 days after sowing due to maturity of the crop. Data analyzed on the basis of mean population of the different intervals, the lowest whitefly number (2.68 /cage/plant) recorded on genotype MH 732 which was statistically on par with MH 421-1 followed by MH 521, MH 539, MH 560, MH 563, MH 708, MH 742, MH 901 and SM 9-115 in comparison to highest number of whitefly 8.30 /cage/plant on SM 9-117. The minimum whitefly number (2.68 /cage/plant) recorded on MH 732 performed significantly better than standard checks Asha and Muscan which exhibited 5.48 /cage/plant. But, the performance of genotypes MH 810 and MH 918 was on par with the another recommended check Satya, which exhibited 3.70 /cage/plant and statistically they did not differ to each other. Similarly, mean number of whitefly recorded on genotypes MH 729 and MH 3-18 as 3.48 /cage/plant, which were on par with the recommended check variety Basanti and the difference among them were non significant. The green leafhopper population, although gradually increased but statistically did not differ significantly among genotypes from 20 – 60 DAS. Although, population data was initially observed low 0.07/cage/plant at 20 DAS i.e. first week of August which gradually shoots up and reached peak later on as 2.50 /cage/plant at 60 DAS coinciding with second week of September. Babu and Santharam (2002) found the highest infestation of jassid, *Amrasca bigutula bigutula* during July to September. However, on the basis of overall mean population, lowest green leafhopper (0.45/ cage/plant) recorded on genotype MH 717 as compared to slightly higher population from 1.11 and 1.12 /cage/plant from MH 809 and SM 9-113, respectively. The minimum green leafhopper number (0.45 /cage/plant) recorded on MH 717 performed significantly better than standard checks Satya and Asha which exhibited 0.79 and 0.87 /cage/plant, respectively. However, performance of genotypes MH 560 and SM 9-115 was on par with the another recommended check Muscan, which exhibited 0.63 /cage/plant and statistically they did not differ to each other. Similarly, mean number of green leafhopper recorded on genotypes MH 702 and MH 721 as 0.67 /cage/plant which were on par with the recommended check variety Basanti and the difference among them were non significant. However, on the basis of overall mean data of population, lowest brown leafhopper (0.15 /cage/plant) was observed on genotypes MH 717, MH 719 and MH 125 (Basanti). Except on genotypes MH 748 and MH 808 which had slight deviation from 0.41 /cage/plant. Likewise, the population of brown leafhopper follow the similar population trend as green leafhopper. But difference among the test material did not vary statistically indicated low and uniform population trend from all the tested genotypes of green gram. The minimum brown leafhopper number (0.15 /cage/plant) recorded on MH 715 and MH 719 performed significantly better than standard checks Satya and Asha which exhibited 0.24 and 0.35 /cage/plant, respectively. However, performance of genotypes MH 715 and MH 719 was on par with the another recommended check Basanti, which exhibited 0.15 /cage/plant and statistically they did not differ to each other. Similarly, mean number of brown leafhopper recorded on genotype MH 707, MH 709, MH 742, MH 918, and SM 9-115 as 0.18 /cage/plant which were on par with the recommended check variety Muscan and the difference among them were non significant. The data on mixed leafhopper counts was observed low 0.07 /cage/plant at 20 DAS i.e. first week of August which gradually reached peak later upto 3.50 /cage/plant at 60 DAS coincided with second week of September. Rathod et al. [7] reported *Empoasca* spp. were abundantly found on cotton from Maharastra and active during mid August - mid September. Average mean population of green and brown leafhopper was recorded low as 0.69 /cage/plant on genotype MH 717 as compared to slightly higher counts of 1.49 /cage/plant recorded from MH 808 and SM 9-113. However, differences among the tested genotypes for mixed population of green and brown leafhopper did not differ statistically, indicated uniform low population pressure at different developmental stages of the crop. The minimum mixed leafhopper number (0.69 /cage/plant) recorded on MH 717 performed significantly better than standard checks Satya and Asha which exhibited 1.03 and 1.22 leafhopper /cage/plant, respectively. However, performance of genotypes MH 521, MH 729 and MH 814 was on par with the another recommended checks Basanti and Muscan, which harboured 0.83 and 0.82 leafhopper /cage/plant, respectively and statistically they did not differ to each other. The number of affected plants with YMV infection gradually increased from seedling stage of 3 weeks (22 DAS) to the pod initiation stage (63 DAS) on different test genotypes. Shad et al. [8] also reported that development and spread of yellow mosaic disease was highly critical during the period of 2-3 weeks after establishment. However, on the basis of mean per cent YMV infection, lowest plant population with mosaic symptoms (2.80 per cent) was recorded on genotype MH 742 and statistically on par with MH 124 and few other genotypes as compared to highest 56 per cent observed on genotype SM 9-112. Differences among the tested genotypes for mosaic affected plants at different intervals were statistically significant among the tested material. Based on pooled mean of mean of YMV infected plants, two genotypes MH 732 and MH 742 performed better than standard check cultivar Asha and the differences were statistically significant among them. However, performance of genotypes MH 732 and MH 742 were on par with the standard check cultivars Basanti, Muscan and Satya and statistically they did not differ to each other. The grain yield was obtained highest on MH 742 (908 kg/ha) as compared to lowest (355 kg/ha) on SM 9-112 (Table 1).

Table 1. Evaluation of green gram genotypes against whitefly, leafhopper, yellow mosaic virus and grain yield under natural field conditions

Genotype	50% flowering days	Maturity days	Mean no. of whitefly/ cage/plant	Mean no. of leafhopper /cage/plant			Mean yellow mosaic infected plants (%)	Grain yield kg/ha
				Green leafhopper	Brown leafhopper	Total leafhopper		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
MH 124	43	74	5.60(2.57)*	0.53 (1.20)*	0.21 (1.08)*	0.74(1.28)*	4.4(10.91)**	866
MH 3-18	35	75	3.43(2.10)	0.71 (1.26)	0.16 (1.06)	0.87(1.32)	9.0(15.58)	673
MH 421	37	73	4.52(2.35)	0.85 (1.31)	0.28 (1.11)	1.13(1.41)	9.6(16.69)	642
MH 421-1	38	73	3.24(2.06)	0.60 (1.22)	0.37 (1.14)	0.97(1.37)	3.6(9.64)	898
MH 521	37	72	2.72(1.92)	0.53 (1.20)	0.29 (1.11)	0.82(1.31)	6.3(13.13)	739
MH 534	38	73	3.90(2.21)	0.64 (1.24)	0.27 (1.10)	0.91(1.34)	6.2(13.39)	746
MH 539	37	71	3.40(2.09)	0.79 (1.28)	0.16 (1.06)	0.95(1.34)	3.8(10.33)	896
MH 560	39	75	3.34(2.08)	0.63 (1.23)	0.23 (1.09)	0.85(1.32)	8.4(15.17)	695
MH 562	37	75	4.02(2.24)	0.55 (1.20)	0.24 (1.09)	0.79(1.29)	7.7(14.77)	708
MH 563	35	74	3.3(2.07)	0.77 (1.27)	0.33 (1.13)	1.10(1.40)	6.5(13.69)	728
MH 564	35	73	4.08(2.25)	0.72 (1.27)	0.31 (1.11)	1.03(1.38)	9.6(16.42)	642
MH 565	45	69	3.72(2.17)	0.66 (1.24)	0.27 (1.10)	0.93(1.34)	6.9(14.47)	716
MH 612	40	72	4.40(2.32)	0.66 (1.24)	0.25 (1.10)	0.91(1.34)	6.3(12.97)	739
MH 702	35	64	4.3(2.30)	0.67 (1.24)	0.22 (1.09)	0.89(1.33)	14.0(20.06)	577
MH 705	36	64	4.84(2.41)	0.86 (1.30)	0.24 (1.09)	1.10(1.39)	17.5(22.21)	534
MH 707	33	65	3.66(2.15)	0.53 (1.19)	0.19 (1.07)	0.72(1.27)	14.7(20.53)	562
MH 708	35	65	3.32(2.08)	0.73 (1.26)	0.29 (1.11)	1.03(1.38)	15.0(20.17)	550
MH 709	34	75	3.59(2.14)	0.55 (1.21)	0.18 (1.07)	0.73(1.28)	6.4(13.13)	736
MH 714	39	73	3.74(2.17)	0.73 (1.26)	0.31 (1.12)	1.03(1.37)	6.2(12.94)	746
MH 715	35	63	3.84(2.20)	0.74 (1.27)	0.15 (1.06)	0.89(1.33)	10.4(16.91)	630
MH 717	35	73	4.58(2.36)	0.45 (1.17)	0.24 (1.09)	0.69(1.26)	7.4(14.30)	712
MH 719	40	68	4.36(2.31)	0.65 (1.23)	0.15 (1.06)	0.80(1.29)	6.2(13.39)	746
MH 721	41	73	4.20(2.28)	0.67 (1.25)	0.23 (1.09)	0.91(1.34)	4.4(11.08)	866
MH 724	39	70	4.88(2.42)	0.66 (1.24)	0.20 (1.08)	0.86(1.32)	23.1(25.80)	479
MH 729	36	73	3.47(2.11)	0.56 (1.21)	0.27 (1.10)	0.83(1.31)	10.3(16.91)	634
MH 732	35	73	2.68(1.91)	0.55 (1.21)	0.21 (1.08)	0.77(1.29)	2.90(8.95)	902
MH 735	36	73	3.76(2.18)	0.56 (1.21)	0.33 (1.13)	0.89(1.34)	6.8(13.71)	718
MH 736	38	74	3.52(2.12)	0.81 (1.29)	0.22 (1.08)	1.03(1.37)	7.6(14.55)	710
MH 742	34	66	2.75(1.93)	0.83 (1.30)	0.16 (1.07)	0.99(1.37)	2.80(8.87)	908
MH 748	34	67	3.56(2.13)	0.75 (1.27)	0.41 (1.15)	1.16(1.41)	7.8(15.07)	704
MH 805	36	73	4.08(2.25)	0.57 (1.21)	0.33 (1.13)	0.91(1.33)	5.6(12.49)	768
MH 807	35	73	5.56(2.56)	0.74 (1.27)	0.21 (1.08)	0.95(1.35)	14.2(20.32)	570
MH 808	37	75	4.21(2.28)	0.99 (1.35)	0.41 (1.15)	1.39(1.50)	18.9(23.47)	510
MH 809	36	73	4.26(2.29)	1.12 (1.39)	0.24 (1.09)	1.37(1.48)	18.3(23.04)	524
MH 810	41	75	3.7(2.16)	0.61 (1.22)	0.30 (1.11)	0.91(1.33)	5.7(12.77)	762
MH 814	39	63	4.51(2.34)	0.59 (1.22)	0.23 (1.09)	0.82(1.31)	9.5(15.79)	648
MH 815	39	74	4.33(2.30)	0.70 (1.25)	0.32 (1.12)	1.02(1.37)	5.8(12.43)	758
MH 836	36	75	4.04(2.24)	0.55 (1.20)	0.21 (1.08)	0.77(1.28)	8.0(15.07)	696
MH 901	42	64	3.38(2.09)	0.65 (1.24)	0.21 (1.08)	0.85(1.32)	14.2(19.84)	575
MH 918	39	64	3.70(2.16)	0.57 (1.21)	0.18 (1.07)	0.75(1.28)	9.0(16.10)	673
SM 9-111	45	70	3.74(2.17)	0.73 (1.26)	0.30 (1.11)	1.03(1.37)	19.4(23.62)	512
SM 9-112	44	70	6.76(2.78)	1.01 (1.35)	0.36 (1.13)	1.37(1.48)	56.0(48.85)	355
SM 9-113	45	69	4.49(2.34)	1.11 (1.38)	0.37 (1.14)	1.49(1.52)	19.9(24.49)	506
SM 9-114	46	70	4.38(2.32)	0.64 (1.24)	0.30 (1.11)	0.94(1.35)	12.8(18.86)	598
SM 9-115	44	71	3.1(2.02)	0.62 (1.23)	0.18 (1.07)	0.80(1.30)	6.4(13.24)	736
SM 9-116	44	70	3.5(2.12)	0.81 (1.30)	0.27 (1.10)	1.08(1.40)	17.9(22.57)	530

Genotype	50% flowering days	Maturity days	Mean no. of whitefly/ cage/plant	Mean no. of leafhopper /cage/plant			Mean yellow mosaic infected plants (%)	Grain yield kg/ha
				Green leafhopper	Brown leafhopper	Total leafhopper		
SM 9-117	46	72	8.30(3.05)	1.02 (1.37)	0.24 (1.10)	1.26(1.46)	50.1(44.89)	366
MH-125 (Basanti)#	40	75	3.48(2.11)	0.68 (1.25)	0.15 (1.06)	0.83(1.31)	9.2(14.77)	669
MH 96-1 (Muscan)#	41	72	5.47(2.54)	0.63 (1.23)	0.19 (1.07)	0.82(1.30)	8.5(14.19)	692
MH 2-15 (Satya)#	40	75	3.70(2.16)	0.79 (1.28)	0.24 (1.09)	1.03(1.36)	12.2(18.66)	610
MH 83-20 (Asha)#	44	69	5.48(2.54)	0.87 (1.31)	0.35 (1.13)	1.22(1.44)	12.8(19.28)	598
Range	33-46	63-75	2.68-8.30	0.45-1.12	0.15-0.41	0.69-1.49	2.80-56.00	355-908
S. E (m) ±	-	-	(0.11)	(0.04)	(0.02)	(0.05)	(3.59)	6.85
C.D (p=0.05)	-	-	(0.32)	(NS)	(NS)	(NS)	(10.08)	19.26

**Figures in the parenthesis are $\sqrt{n+1}$ values*
***Figures in the parenthesis are angular transformed values*

Table 2. Clustering of green gram genotypes for yellow mosaic virus based on visual grade disease scale of 0-9

Scale	Plants with YMV disease Symptoms (%)	Entry/Genotypes	Total number of genotypes	Category
0	Disease free/without any symptoms	Nil	0	Immune
1	1 – 2 % Plants exhibit disease symptoms	Nil	0	Resistant
3	3 – 5 % Plants exhibit disease symptoms	MH 124, MH 421 1, MH 539, MH 721, MH 732 and MH 742	6	Moderately resistant/tolerant
5	6 – 15 % Plants exhibit Disease symptoms	MH 3-18, MH 421, MH 521, MH 534, MH 560, MH 562, MH 563, MH 564, MH 565, MH 612, MH 702, MH 707, MH 708, MH 709, MH 714, MH 715, MH 717, MH 719, MH 729, MH 735, MH 736, MH 748, MH 805, MH 807, MH 810, MH 814, MH 815, MH 836, MH 901, MH 918, SM 9-114, SM 9-115, MH 125 (Basanti), MH 96-1 (Muscan), MH 2-15 (Satya) and MH 83-20 (Asha)	36	Moderately susceptible
7	16 – 32 % Plants exhibit disease symptoms	MH 705, MH 724, MH 808, MH 809, SM 9-111, SM 9-113 and SM 9-116	7	Susceptible
9	> 32 % Plants exhibit disease symptoms	SM 9-112 and SM 9-117	2	Highly susceptible

(Mayee and Datar,[5])

The differences among the genotypes for whitefly population, yellow mosaic affected plants and grain yield were statistically significant among them where as leafhoppers population did not differ among the various genotypes, with non significant differences among them. The results on present studies indicated that, non of the genotype was completely free from infestation of whitefly, leafhopper and yellow mosaic virus. The present research findings, which revealed following promising genotypes MH 732 and MH 717 against whitefly and leafhoppers, respectively are in accordance with the results of Chhabra et al. [9] found different mungbean genotypes performed well against whitefly, jassid and YMV. Chhabra and Kooner [10] further reported PDM 84-146, MH 484 and MH 309 as the best sources of resistance against the *B. tabaci*, *Empoasca* spp. and MYMV further strengthen the present work Chhabra and Kooner [11] found ML 537 and ML 370 mung bean genotypes as promising against *B. tabaci*, *Empoasca* spp. and MYMV.

These test genotypes were categorized on the basis of disease grading scale (0-9). Of which six genotypes viz. MH 124, MH 421-1, MH 539, MH 721, MH 732 and MH 742 found moderately resistant with scale 3, whereas two genotypes as SM 9-112 and SM 9-117 were graded highly susceptible with scale 9, seven genotypes viz. MH 705, MH 724, MH 808, MH 809, SM 9-111, SM 9- 113 and SM 9-116 were grouped susceptible with scale 7 and remaining 36 genotypes were categorized moderately susceptible and none of the genotype was free from the disease symptoms as highly resistant and resistant in the scales categorized for 0 and 1 respectively (Table 2).

The present findings also revealed that none of the genotype was free from the disease symptoms as highly resistant/resistant which further confirmed the results of Yadav and Dahiya [12], Shad et al. (2006) who reported genotypes with maximum per cent infection of yellow mosaic virus, categorized as moderately susceptible and highly susceptible [13].

4. CONCLUSION

Out of 51 genotypes, MH 732, MH 717, MH 719 and MH - 125 (Basanti) and MH 717 harboured minimum population of whitefly (2.68 /cage/plant), green leafhopper (0.45 /cage/plant), brown leafhopper (0.15 /cage/plant) and mixed (green and brown) leafhopper (0.69 /cage/plant), respectively, as compared to maximum whitefly population observed on genotype SM 9-117 (8.30 /cage/plant), green leafhopper on MH 809 (1.12 /cage/plant), brown leafhopper on MH 748 and MH 808 (0.41 /cage/plant) and mixed leafhopper counts recorded on SM 9-113 (1.49 /cage/plant). Genotype MH 742 affected least 2.80 per cent with the incidence of YMV and obtained highest grain yield (908 kg/ha) as compared to maximum (56 per cent) incidence of YMV and lowest grain yield (355 kg/ha) on SM 9-112. The genotypes for whitefly population, yellow mosaic affected plants and grain yield were statistically significant among them where as leafhoppers population did not differ among the various genotypes, with non significant differences among them. The results on present studies indicated that, non of the genotype was completely free from infestation of whitefly, leafhopper and yellow mosaic virus disease symptoms as highly resistant/resistant which further confirmed the results of Yadav and Dahiya (2000).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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