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## Field and serological evaluation of black gram and green gram genotypes for resistance against necrosis causing viruses, *Peanut bud necrosis virus* (PBNV) and *Tobacco streak virus* (TSV) at hot spot locations of Andhra Pradesh and Telangana

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### Abstract

In the recent years, viruses causing necrosis, transmitted by thrips has assumed epidemic proportion and became a serious production constraint in pulses like blackgram. Leaf curl disease caused by *Peanut bud necrosis virus* (PBNV)-Tospo group considered being a major threat. *Tobacco streak virus* (TSV)-Iilar group has also been reported to be a cause of leaf curl symptoms. Controlling thrip vectors by physical, chemical and biological methods can reduce thrips population to economically viable direct damage level, but not enough to prevent the spread of disease. Development of genetic resistance has become the best management strategy for these diseases in both medium and the long term. Fifty of each black gram and green gram genotypes, obtained from All India Coordinated Pulses Improvement Project (AICPIP), RARS, Lam and NBPGR-RS, Hyderabad, were screened for resistance against PBNV and TSV during *kharif* under field conditions at hot spot locations, Tandur and Anantapur, respectively. None of the entries was recorded with resistant reaction where all the genotypes showed susceptible reaction with a range of chlorotic to necrotic symptoms at both the locations. At Anantapur, hundred per cent disease was recorded in LBG-20 at 45DAS followed by LBG-741, -752 with 90% while OBG-15 (77.55%), 99-U-21 (77.08%) and TAU-1 (77.08%) showed susceptible reaction and all the remaining genotypes showed a range of PDI 80-90. At 30 DAS, PDI ranged between 11.76% (99-U-19) and 50.00% (LBG-611) whereas the green gram genotypes screened under field conditions showed a range of disease incidence 62.50-93.33% at 45 DAS. Susceptible reaction was observed in LGG-505 (62.50%), -527 (63.82%), -526 (66.66%), and LGG-470 (79.59%), while all the remaining genotypes were recorded with >80% indicating highly susceptible reaction. At Tandur, the PDI ranged from 83.30 to 100 where minimum was recorded in LBG-744 at 45DAS in black gram genotypes. Hundred per cent disease was recorded in LBG-709, -735, -752, PANT-U-30, NSM-74 and CN-9027 while the remaining showed highly susceptible reaction with >80% whereas green gram genotypes showed a range of disease incidence 96.15-100% at 45 DAS, while it was 93.75-100% at 30DAS indicating highly susceptible reaction where hundred per cent disease incidence was recorded in majority of the genotypes screened including the susceptible check K-851.

**Keywords:** Field evaluation, PBNV, TSV, Blackgram, Greengram, hot spot locations, Serological affinities

### Introduction

India is the largest producer and consumer of the pulses in the world. Pulses play an important role in meeting the dietary requirements of proteins in India and contribute sustainability to the production systems by enriching the soil through biological nitrogen fixation. Among pulses, blackgram (urdbean-*Vigna mungo* L. Hepper) and greengram (mungbean-*Vigna radiata* L. Wilczek) are major grain legumes and are cultivated in both upland and rice fallows in India. These two crops together contribute 80 per cent to the total pulse production. Blackgram and greengram have been subjected to the attack of several biotic stresses such as fungi, bacteria and viruses, affecting the productivity and among them; viral diseases became great menace and are the great yield reducers. Of several viral diseases attacking greengram and blackgram necrosis disease caused by *Peanut bud necrosis virus* (PBNV) (= *Groundnut bud necrosis virus*-GBNV) transmitted by *Thrips palmi* (Karny) in a propagative manner (Sreekanth *et al.*, 2002) [9] was considered to be a major threat, causing 40% yield loss (Nene, 1972) [1]. Recently, *Tobacco streak virus* (TSV) has also been reported to be a cause of necrosis and leaf curl symptoms on blackgram and greengram Prasad Rao *et al.*, 2003c) [4].

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Paving confusion in field diagnosis to assess the disease incidence. Although both the viruses cause necrotic symptoms and are transmitted by thrips, the method of transmission and the virus vector relationship vary and hence need different approaches of management practices. Hence, development of genetic resistance has become the best management strategy for these diseases in both medium and the long term. The present study was conducted to find out genetic resistance against PBNV and TSV in blackgram and greengram under field conditions by screening different genotypes at hot spot locations.

## Materials and methods

### Field screening of blackgram and greengram genotypes

Fifty each blackgram as well as greengram genotypes were obtained from All India Coordinated Pulses Improvement Project (AICPIP), Regional Agricultural Research Station, Lam and NBPGR-RS, Hyderabad. Screening of germplasm/cultivars for resistance to PBNV and TSV was done under field conditions. Screening of blackgram and greengram genotypes for resistance to PBNV and TSV was conducted during *kharif*, 2008 under field conditions at hot spot locations, Agricultural Research Station (ARS), Tandur, Rangareddy district and Agricultural Research Station (ARS), Rekulakunta, Anantapur, respectively. Each genotype was sown in single row of 5.0 m length with a single row of susceptible check (LBG-20, K-851) at every sixth row in Augmented Design (Fig. 9). Disease incidence observations were recorded on total plant stand at 30 DAS and those attacked by disease at 30 and 45 days after sowing. Scale based on per cent disease incidence (Table 1) was formulated according to with modifications to classify the genotypes.

$$\text{Per cent disease incidence (PDI)} = \frac{\text{Number of infected plants}}{\text{Total number of plants}} \times 100$$

### Serological affinities of symptomatic plants

Hundred random samples each were collected from blackgram and greengram genotypes showing chlorosis and necrosis symptoms at 30DAS and subjected to DAC-ELISA against PBNV and TSV antisera to determine the serological affinities.

## Results

### Field screening at Anantapur

Out of fifty each blackgram and greengram genotypes screened under field conditions for resistance to necrosis disease at hot spot location, Anantapur, no genotype recorded resistant reaction where the genotypes showed a range of susceptible to highly susceptible reaction with a range of chlorotic to necrotic symptoms.

The susceptible check, LBG-20 showed highly susceptible reaction (85.84%) consistently at 45DAS (Table 2). Ninety per cent disease was recorded in LBG-741, -752 with 90% while OBG-15 (77.55%), 99-U-21 (77.08%) and TAU-1 (77.08%) showed susceptible reaction. All the remaining genotypes showed a range of 80-90 per cent disease incidence indicating highly susceptible reaction to necrosis disease. The per cent disease incidence observed in blackgram genotypes at 30DAS was in a range of 11.76-50.00%. Maximum PDI was recorded in LBG-611 while the minimum was in 99-U-19 with 11.76%. Disease incidence below 20 per cent was recorded in LBG-728, -753, -170, -738, -734, 99-U-19, Berham and TAU-1 among

which TAU-1 showed consistently lower disease incidence at 45DAS with 77.08% while others showed highly susceptible reaction with > 80%. Blackgram genotypes showed per cent mortality in a range of 3.92-47.5 and 19.6-90 at 30 and 45 DAS respectively, where minimum was recorded in 99-U-19 and maximum in LBG-611.

The greengram genotypes screened under field conditions at Anantapur showed a range of disease incidence 62.50-93.33% at 45DAS (Table 3) where minimum was recorded in LGG-505. Susceptible check, K-851 was recorded with 87.55 per cent disease incidence. Susceptible reaction was observed in LGG-505 (62.50%) -527 (63.82%), -526 (66.66%), -450 (73.46%) and LGG-470 (79.59%) while all the remaining genotypes were recorded with > 80% indicating highly susceptible reaction. Maximum disease incidence was recorded in LGG-480 (77.77%) at 30DAS while minimum was observed in LGG-526 (20.83%). LGG-505, -526 and LGG-527 showed lower disease incidence consistently at 30DAS (29.16, 20.83 and 23.40%) and at 45DAS (62.50, 66.66 and 63.82%) while LGG-470 showed lower (61.22%) disease incidence at 30DAS but susceptible reaction at 45DAS. The per cent mortality recorded in greengram genotypes was ranged from 12.50% to 77.77% at 30DAS and 28.57% to 75.00%.

### Field screening at Tandur

Out of fifty each of blackgram and greengram genotypes screened under field conditions for resistance to necrosis disease at Tandur, which is a hot spot location, no variety was recorded with resistant reaction where the all the genotypes showed highly susceptible reaction with a range of chlorotic to necrotic symptoms.

The per cent necrosis disease in blackgram genotypes was ranged from 83.30 to 100 (Table 4) where minimum was recorded in LBG-744 at 45 DAS. The susceptible check LBG-20 showed highly susceptible reaction (96.32%) consistently at 45DAS. Cent per cent disease index was recorded in LBG-709, -735, -752, PANT-U-30, NSM-74 and CN-9027 while all the remaining genotypes also showed highly susceptible reaction with disease incidence >80%. The per cent disease incidence observed in blackgram genotypes at 30DAS was in a range of 72.91-98.03%. Maximum PDI was recorded in LBG-752 while the minimum was in LBG-744 with 72.91%. Per cent mortality was found in a range of 6.00-20.00% at 30DAS where minimum recorded in 99-U-19 and maximum in LBG-693 and 21.56-40.00% at 45 DAS where minimum recorded in LBG-753 and maximum in LBG-693.

The greengram genotypes screened under field conditions at Tandur showed a range of disease incidence 96.15-100% at 45DAS (Table 5) indicating highly susceptible reaction where hundred per cent disease incidence was recorded in 28 accessions *viz.*, LAM-M2, LGG-476, -473, -480, -481, -483, -485, -496, -479, -474, -498, -525, -503, -450, -497, -469, -470, M-267, KARA-433, KARS-212, KARS-171, KSAS-06-105, KSAS-06-44, NSM-40, KSAS-06-91, KSAS-06-235 and NSKMS-148, including the susceptible check K-851. The per cent disease incidence observed in greengram genotypes at 30DAS was in a range of 93.75-100 while LAM-M2, LGG-476, -483, -485, -496, -479, -474, -498, -503, -497, -470, M-267, KARA-433, KARS-171, KSAS-06-105, KSAS-06-44, NSM-40, KSAS-06-91, KSAS-06-235, NSKMS-148 and susceptible check K-851 recorded hundred per cent disease incidence. The per cent mortality recorded in greengram genotypes was ranged from 6.25% (LGG-498 and M-267) to

15.38% (LGG-485) at 30 DAS and 26.92% (LGG-479) to 37.25% (LGG-410).

### Serological affinities of symptomatic plants

Of 100 each blackgram and greengram symptomatic samples collected from Anantapur field showing chlorosis and necrosis 52 and 62 turned out positive to PBNV and 40 and 38 reacted

positive to TSV, respectively (Table 6). Whereas samples collected from Tandur, out of 100 each of blackgram and greengram 61 and 77 reacted positive to PBNV and 8 and 15 samples found to be positive to TSV, respectively. Majority of the TSV positive plants were found dead at 45DAS among the tagged plants in the field.

**Table 1:** Scale used for determining resistance grades based on per cent disease incidence

Per cent disease incidence	Resistance grade
0	Highly resistant
1-10	Resistant
11-39	Moderately resistant
40-50	Moderately susceptible
50-79	Susceptible
80-100	Highly susceptible

**Table 2:** Field screening of blackgram genotypes for resistance against necrosis disease at ARS, Anantapur, AP.

S. No.	Genotype	Total Plants	30 DAS <sup>a</sup>				45 DAS <sup>a</sup>				Reaction Grade <sup>c</sup>
			INFE	Dead	PDI <sup>b</sup>	%Mortality	Infe	Dead	PDI <sup>b</sup>	%Mortality	
1	LBG-611	40	20	19	50.00	47.50	40	36	100.00	90.00	HS
2	LBG-748	45	16	15	33.33	33.33	39	30	86.66	66.66	HS
3	-685	50	21	20	40.00	40.00	44	31	88.00	62.00	HS
4	-756	49	24	21	48.97	42.85	43	33	87.75	67.34	HS
5	-17	48	13	12	27.08	25.00	40	29	83.33	60.41	HS
6	-709	52	15	14	28.84	26.92	46	29	88.46	55.76	HS
7	-728	45	06	08	13.33	17.77	39	25	86.66	55.55	HS
8	-753	46	08	07	17.39	15.21	40	28	86.95	60.86	HS
9	-170	51	09	08	17.64	15.68	44	30	86.27	58.82	HS
10	-735	51	12	11	23.52	21.56	45	31	88.23	60.78	HS
11	-741	50	14	13	28.00	26.00	45	23	90.00	46.00	HS
12	-727	51	12	12	23.07	23.52	43	20	84.31	39.21	HS
13	-745	47	12	11	25.53	23.40	40	21	85.10	44.68	HS
14	-648	46	12	10	26.08	21.73	40	17	86.95	36.95	HS
15	-738	51	10	08	19.23	15.68	46	16	90.19	31.37	HS
16	-744	51	15	14	29.41	27.45	44	21	86.27	41.17	HS
17	-752	50	13	10	26.00	20.00	45	18	90.00	36.00	HS
18	-734	49	08	06	16.32	12.24	40	19	81.63	38.77	HS
19	-623	52	14	11	26.92	21.15	45	20	86.53	38.46	HS
20	-693	50	11	10	22.00	20.00	41	16	82.00	32.00	HS
21	WBG-26	49	17	14	34.69	28.57	40	21	81.63	42.85	HS
22	T-9	51	15	12	29.41	23.52	42	18	82.35	35.29	HS
23	OBG-15	49	11	10	22.44	20.40	38	17	77.55	34.69	S
24	99-U-19	51	06	02	11.76	3.92	43	10	84.31	19.60	HS
25	99-U-21	48	16	13	33.33	27.08	37	19	77.08	39.58	S
26	LBG-22	47	10	09	21.29	19.14	40	14	85.10	29.78	HS
27	BERHAM	51	07	06	13.72	11.76	43	15	84.31	29.41	HS
28	SARALA	49	17	16	34.69	32.65	41	30	83.67	61.22	HS
29	TAU-1	48	08	08	16.66	16.66	37	14	77.08	29.16	S
30	PANT-U-30	50	12	10	24.00	20.00	42	16	84.00	32.00	HS
31	NSM-74	51	11	10	21.56	19.60	42	16	82.35	31.37	HS
32	NSM-75	48	18	16	37.50	33.33	40	20	83.33	41.66	HS
33	CN-9024	49	12	11	24.48	22.44	40	19	81.63	38.77	HS
34	SKN-134	47	10	08	21.27	17.02	40	20	85.10	42.55	HS
35	SKN-158	52	18	16	34.61	30.76	45	21	86.53	40.38	HS
36	SK-47	48	12	11	25.00	22.91	42	18	87.05	37.50	HS
37	NSM 52	50	20	18	40.00	36.00	40	24	80.00	48.00	HS
38	SKN-127	48	14	12	29.16	25.00	41	18	85.41	37.50	HS
39	CN-9019	49	15	12	30.61	24.48	41	19	83.67	38.77	HS
40	CN-9078	48	08	07	16.66	14.58	40	18	83.33	37.5	HS
41	CN-8009	54	12	11	22.22	20.37	47	19	87.03	35.18	HS
42	NSM-59	47	12	10	25.53	21.27	40	21	85.10	44.68	HS
43	KDRS-82-B	50	12	09	22.64	18.00	44	21	88.00	42.00	HS
44	PSR54/D	43	12	11	27.90	25.58	38	23	88.37	53.48	HS
45	CN9011	49	15	12	30.61	24.48	40	23	81.63	46.93	HS
46	CN9043	51	16	15	31.37	29.41	44	29	86.27	56.86	HS

47	CN9062	46	12	09	26.66	19.56	37	19	80.43	41.30	HS
48	CN-9027	44	15	12	34.09	27.27	36	22	81.81	50.00	HS
49	CN-9064	47	16	14	34.04	29.78	39	25	82.97	53.19	HS
50	CN-9032	45	12	11	26.66	24.44	36	20	80.00	44.44	HS
Check <sup>d</sup>	LBG-20	48.63	16.63	14.72	33.90	30.28	41.81	24.81	85.84	50.97	HS

a) DAS-Days after sowing b) PDI-Per cent disease incidence. c) Reaction Grade based on PDI at 45DAS d) Average values of 11 rows of susceptible check. Inf-infected D-death.

**Table 3:** Field screening of greengram genotypes for resistance against necrosis disease at ARS, Anantapur, AP

S. No.	Genotype	Total Plants	30 DAS <sup>a</sup>				45 DAS <sup>a</sup>				Reaction Grade <sup>c</sup>
			INFE	Dead	PDI <sup>b</sup>	%Mortality	Infe	Dead	PDI <sup>b</sup>	%Mortality	
1	LAM M2	51	31	21	62.00	41.17	43	33	84.31	64.70	HS
2	LGG-476	50	33	19	66.00	38.00	41	29	82.00	58.00	HS
3	-473	49	37	22	75.51	44.89	40	32	81.63	65.30	HS
4	-480	45	35	18	77.77	40.00	39	26	86.66	57.77	HS
5	-481	51	29	14	56.86	27.45	41	27	80.39	52.94	HS
6	-483	45	34	20	75.55	44.44	42	32	93.33	71.11	HS
7	-485	49	27	22	55.10	44.89	41	33	83.67	67.34	HS
8	-491	46	27	21	58.69	45.65	40	29	86.95	63.04	HS
9	-496	52	20	12	38.46	23.07	46	25	88.46	48.07	HS
10	-479	51	28	10	54.90	19.60	44	28	86.27	54.90	HS
11	-474	43	33	20	76.74	46.51	40	29	93.02	67.44	HS
12	-460	48	20	11	41.66	22.91	41	21	85.41	43.75	HS
13	-498	48	28	18	58.33	37.50	40	23	83.33	47.91	HS
14	-500	49	21	10	42.85	20.40	42	17	85.71	34.69	HS
15	-525	48	18	07	37.50	14.58	40	16	83.33	33.33	HS
16	-503	43	28	21	65.11	48.83	38	27	88.37	62.79	HS
17	-505	48	14	10	29.16	20.83	30	19	62.50	39.58	S
18	-450	49	15	11	30.61	22.44	36	18	73.46	36.73	S
19	-407	46	14	10	30.43	21.73	40	17	86.95	36.95	HS
20	-410	46	17	12	36.95	26.08	39	19	84.78	41.30	HS
21	-497	40	32	20	80.00	50.00	33	30	82.50	75.00	HS
22	-469	54	24	18	44.44	33.33	44	23	81.48	42.59	HS
23	-526	48	10	06	20.83	12.50	32	14	66.66	29.16	S
24	-470	49	30	28	61.22	57.14	39	33	79.59	67.34	S
25	-527	47	11	07	23.40	14.89	30	15	63.82	31.91	S
26	M-267	50	23	14	46.00	28.00	42	20	84.00	40.00	HS
27	TARAM-1	49	16	12	32.65	24.48	41	19	83.67	38.77	HS
28	DHOULI	47	22	21	46.80	44.68	40	25	85.10	53.19	HS
29	WGG-37	46	14	10	30.43	21.73	39	22	84.78	47.82	HS
30	TM-96-2	46	19	15	41.30	32.6	40	25	86.95	54.34	HS
31	NSKMS-72	48	22	20	45.83	41.66	41	24	85.41	50.00	HS
32	KARA-433	44	25	22	56.81	50.00	38	28	86.36	63.63	HS
33	KSAS-06/360	47	23	20	48.93	42.55	40	25	85.10	53.19	HS
34	KARS-212	49	21	06	42.85	12.24	41	14	83.67	28.57	HS
35	KSAS-06/319	44	23	07	52.27	15.90	36	16	81.81	36.36	HS
36	KARA-173	47	22	06	46.80	12.76	40	26	85.10	55.31	HS
37	KARS-171	46	18	08	39.13	17.39	41	17	89.13	36.95	HS
38	KSAS-06/105	44	24	10	54.54	22.72	37	17	84.09	38.63	HS
39	KSAS-06/359	51	23	12	45.09	23.52	46	19	90.19	37.25	HS
40	KSAS-06/243	48	24	11	50	22.91	42	18	87.50	37.50	HS
41	NDS-299	48	28	11	58.33	22.91	40	27	83.33	56.25	HS
42	KSAS-06/44	43	21	12	48.83	27.90	36	24	83.72	55.81	HS
43	KSAS-06/140	50	23	15	46	30.00	43	26	86.00	52.00	HS
44	NSM-40	49	24	11	48.97	22.44	42	26	85.71	53.06	HS
45	KARS-388	49	22	10	44.89	20.40	40	24	81.63	48.97	HS
46	KSAS-06/91	44	21	12	47.72	27.27	36	23	81.81	52.27	HS
47	KSAS-06/235	51	23	09	45.098	17.64	45	24	88.25	47.05	HS
48	NSKMS-48	48	24	11	50	22.91	41	23	85.41	47.91	HS
49	KARS-178	50	26	09	52	18.00	44	25	88.00	50.00	HS
50	NSKMS-148	51	22	12	43.13	23.52	43	24	84.31	47.05	HS
Check <sup>d</sup>	K-851	48.81	20.81	14.45	42.67	29.58	42.72	24.63	87.55	50.59	HS

a) DAS-Days after sowing; b) PDI-Per cent disease incidence; c) Reaction Grade based on PDI at 45DAS; d) Average values of 11 rows of susceptible check. Inf-infected.



**Table 4:** Field screening of blackgram genotypes for resistance against necrosis disease at ARS, Tandur, A.P

S. No.	Genotype	Total Plants	30 DAS <sup>a</sup>				45 DAS <sup>a</sup>				Reaction Grade <sup>c</sup>
			Infe	Dead	PDI <sup>b</sup>	%Mortality	Infe	Dead	PDI <sup>b</sup>	%Mortality	
1	LBG-611	46	41	5	89.10	10.86	44	11	95.65	23.91	HS
2	LBG-748	50	47	5	94.00	10.00	49	12	98.00	24.00	HS
3	-685	49	46	4	93.80	08.16	48	11	97.90	22.44	HS
4	-756	54	48	4	88.80	07.40	51	12	94.44	22.22	HS
5	-17	53	46	7	86.70	13.20	50	14	94.33	26.41	HS
6	-709	53	47	6	95.90	11.32	49	16	100.00	30.18	HS
7	-728	50	45	5	90.00	10.00	48	13	96.00	26.00	HS
8	-753	51	48	4	90.50	07.84	51	11	96.22	21.56	HS
9	-170	49	45	5	90.00	10.20	47	13	94.00	26.53	HS
10	-735	50	50	4	98.00	08.00	51	12	100.00	24.00	HS
11	-741	51	40	7	81.63	13.72	46	15	90.19	29.41	HS
12	-727	48	42	4	87.50	08.33	45	14	93.75	29.16	HS
13	-745	47	40	4	85.10	08.51	44	12	93.61	25.53	HS
14	-648	54	46	5	85.18	09.25	48	12	88.88	22.22	HS
15	-738	49	43	3	87.75	06.12	46	13	93.87	26.53	HS
16	-744	48	35	5	72.91	10.41	40	13	83.30	27.08	HS
17	-752	51	50	6	98.03	11.76	51	13	100.00	25.49	HS
18	-734	52	48	5	92.30	09.61	50	12	96.15	23.07	HS
19	-623	51	43	5	84.31	09.80	47	13	92.15	25.49	HS
20	-693	40	38	8	95.00	20.00	39	16	97.50	40.00	HS
21	WBG-26	48	41	5	85.41	10.41	45	12	93.75	25.00	HS
22	T-9	49	42	7	85.71	14.28	48	14	97.95	28.57	HS
23	OBG-15	51	49	4	96.07	07.84	50	14	98.03	27.45	HS
24	99-U-19	50	37	3	74.00	06.00	43	11	86.00	22.00	HS
25	99-U-21	49	48	5	97.95	10.20	48	11	97.95	22.44	HS
26	LBG-22	51	46	6	90.19	11.76	48	13	94.11	25.49	HS
27	BERHAM	48	41	6	85.41	12.50	46	12	95.83	25.00	HS
28	SARALA	51	48	5	94.11	09.80	50	13	98.03	25.49	HS
29	TAU-1	49	47	6	95.91	12.24	48	14	97.95	28.57	HS
30	PANT-U-30	51	49	5	96.07	09.80	51	14	100.00	27.45	HS
31	NSM-74	49	48	6	97.95	12.24	49	12	100.00	24.48	HS
32	NSM-75	47	45	5	95.74	10.63	45	11	95.74	23.40	HS
33	CN-9024	52	40	6	76.92	11.53	48	13	92.30	25.00	HS
34	SKN-134	53	47	7	88.67	13.20	50	15	94.33	28.30	HS
35	SKN-158	51	48	5	94.11	09.80	50	12	98.03	23.52	HS
36	SK-47	48	40	6	83.33	12.50	46	13	95.83	27.08	HS
37	NSM 52	49	40	5	81.63	10.20	45	11	91.83	22.44	HS
38	SKN-127	47	38	7	88.85	14.89	44	14	93.61	29.78	HS
39	CN-9019	49	40	5	81.63	10.20	46	15	93.87	30.61	HS
40	CN-9078	54	40	4	74.07	07.40	48	13	88.88	24.07	HS
41	CN-8009	48	43	5	89.58	10.41	46	12	95.83	25.00	HS
42	NSM-59	48	36	6	75.00	12.50	42	16	87.50	33.33	HS
43	KDRS-82-B	47	40	4	85.10	08.51	45	15	95.74	31.91	HS
44	PSR54/D	49	41	7	83.67	14.28	44	14	89.79	28.57	HS
45	CN9011	47	40	5	85.10	10.63	45	11	95.74	23.40	HS
46	CN9043	47	37	5	78.72	10.63	43	12	91.48	25.53	HS
47	CN9062	48	40	5	83.33	10.41	46	11	95.83	22.91	HS
48	CN-9027	47	45	5	95.74	10.63	47	15	100.00	31.91	HS
49	CN-9064	49	42	7	85.71	14.28	44	15	89.79	30.61	HS
50	CN-9032	48	37	5	77.08	10.41	40	14	83.33	29.16	HS
Check <sup>d</sup>	LBG-20	49.54	44.72	6.09	90.06	12.29	47.81	13.90	96.32	28.08	HS

a) DAS-Days after sowing; b) PDI-Per cent disease incidence; c) Reaction Grade based on PDI at 45DAS; d) Average values of 11 rows of susceptible check. Inf-infected.

**Table 5:** Field screening of greengram genotypes for resistance against necrosis disease at ARS, Anantapur, AP

S. No.	Genotype	Total Plants	30 DAS <sup>a</sup>				45 DAS <sup>a</sup>				Reaction Grade <sup>c</sup>
			INFE	Dead	PDI <sup>b</sup>	%Mortality	Infe	Dead	PDI <sup>b</sup>	%Mortality	
1	LAM M2	48	48	06	100.00	12.50	48	14	100.00	29.16	HS
2	LGG-476	48	48	07	97.95	14.58	49	16	100.00	33.33	HS
3	-473	47	47	06	100.00	12.70	47	15	100.00	31.91	HS
4	-480	51	51	05	100.00	09.80	51	16	100.00	31.37	HS
5	-481	50	49	05	98.00	10.00	50	15	100.00	30.00	HS
6	-483	48	48	06	100.00	12.50	48	14	100.00	29.16	HS

7	-485	52	52	08	100.00	15.38	52	17	100.00	32.69	HS
8	-491	53	52	07	98.11	13.20	52	15	98.11	28.30	HS
9	-496	51	51	06	100.00	11.76	51	16	100.00	31.37	HS
10	-479	52	52	06	100.00	11.53	52	14	100.00	26.92	HS
11	-474	54	54	07	100.00	12.96	54	15	100.00	27.77	HS
12	-460	49	48	06	97.95	12.24	48	17	97.95	34.69	HS
13	-498	48	48	03	100.00	06.25	48	14	100.00	29.16	HS
14	-500	52	51	05	98.07	09.61	50	16	96.15	30.76	HS
15	-525	49	48	06	97.95	12.24	49	15	100.00	30.61	HS
16	-503	50	50	05	100.00	10.00	50	17	100.00	34.00	HS
17	-505	49	48	05	97.95	10.20	48	16	97.95	32.65	HS
18	-450	48	47	05	97.91	10.41	48	14	100.00	29.16	HS
19	-407	49	48	06	97.95	12.24	48	16	97.95	32.65	HS
20	-410	51	50	05	98.03	09.80	50	19	98.03	37.25	HS
21	-497	51	51	06	100.00	11.76	57	17	100.00	33.33	HS
22	-469	49	48	07	97.95	14.28	49	16	100.00	32.65	HS
23	-526	48	47	05	97.91	10.41	47	16	97.91	33.33	HS
24	-470	50	50	06	100.00	12.00	50	15	100.00	30.00	HS
25	-527	50	49	03	98.00	06.00	49	15	98.00	30.00	HS
26	M-267	48	48	04	100.00	08.33	48	14	100.00	29.16	HS
27	TARAM-1	51	49	05	96.07	09.80	50	16	98.03	31.37	HS
28	DHOULI	45	43	04	95.55	08.88	44	15	97.77	33.33	HS
29	WGG-37	53	50	06	94.33	11.32	52	18	98.11	33.96	HS
30	TM-96-2	48	45	05	93.75	10.41	47	15	97.90	31.25	HS
31	NSKMS-72	51	50	06	98.03	11.76	50	17	98.03	33.33	HS
32	KARA-433	49	49	05	100.00	10.20	49	14	100.00	28.57	HS
33	KSAS-06/360	52	49	06	94.23	11.53	50	18	96.15	34.61	HS
34	KARS-212	49	49	04	100.00	08.16	49	14	100.00	28.57	HS
35	KSAS-06/319	50	49	07	98.00	14.00	49	15	98.00	30.00	HS
36	KARA-173	49	46	04	93.87	08.16	48	16	97.95	32.65	HS
37	KARS-171	48	48	04	100.00	08.33	48	15	100.00	31.25	HS
38	KSAS-06/105	54	54	06	100.00	11.11	54	15	100.00	27.77	HS
39	KSAS-06/359	52	50	06	96.15	11.53	51	17	98.07	32.69	HS
40	KSAS-06/243	48	46	04	95.83	08.33	47	13	97.90	27.08	HS
41	NDS-299	47	46	05	97.87	10.63	46	16	97.80	34.04	HS
42	KSAS-06/44	49	49	07	100.00	14.28	49	16	100.00	32.65	HS
43	KSAS-06/140	54	50	06	92.59	11.11	52	17	96.29	31.48	HS
44	NSM-40	50	50	05	100.00	10.00	50	14	100.00	28.00	HS
45	KARS-388	49	48	06	97.95	12.24	48	15	97.95	30.61	HS
46	KSAS-06/91	49	49	06	100.00	12.24	49	14	100.00	28.57	HS
47	KSAS-06/235	48	48	05	100.00	10.41	48	16	100.00	33.33	HS
48	NSKMS-48	46	46	06	100.00	13.04	46	16	100.00	34.78	HS
49	KARS-178	51	49	07	96.07	13.72	50	15	98.03	29.41	HS
50	NSKMS-148	49	47	06	95.91	12.24	48	17	97.95	34.69	HS
Check <sup>d</sup>	K-851	50.09	49.72	6.36	99.27	12.72	50.09	16	100.00	31.94	HS

a) DAS Days After Sowing; b) PDI Percent Disease Incidence; c) Reaction Grade based on PDI at 45DAS; d) Average values of 11 rows of susceptible check. Inf-infected.

**Table 6:** Serological affinities of symptomatic plant samples of field screening at Anantapur and Tandur by DAC-ELISA

Crop	Symptomatic plant samples			
	Anantapur		Tandur	
	PBNV	TSV	PBNV	TSV
Blackgram	52/100	40/100	61/100	8/100
Greengram	62/100	38/100	77/100	15/100

## Discussion

Of the 50 entries of blackgram and greengram screened for necrosis disease, none of the entries was found resistant screened at hot spot locations of Andhra Pradesh, Anantapur and Tandur for TSV and PBNV, respectively. All the blackgram genotypes screened at Anantapur, were recorded with susceptible to highly susceptible reaction. Hundred per cent disease was recorded in LBG-20 at 45DAS followed by LBG-741, -752 with 90% while OBG-15 (77.55%), 99-U-21 (77.08%) and TAU-1 (77.08%) showed susceptible reaction. All the remaining genotypes showed a range of per cent disease

incidence 80-90, indicating highly susceptible reaction to necrosis disease. While PDI ranged between 11.76-50.00 % at 30 DAS, maximum was recorded in LBG-611 while the minimum was in 99-U-19 with 11.76%. Disease incidence below 20% was recorded in LBG-728, -753, -170, -738, -734, 99-U-19, Berham and TAU-1 at 30 DAS and at 45DAS showed highly susceptible reaction with >75%. Blackgram genotypes showed per cent mortality in a range of 3.92-47.5% and 19.6-90% at 30DAS and 45 DAS, respectively, where minimum was recorded in 99-U-19 and maximum was in LBG-611. At Tandur, the per cent necrosis disease in blackgram genotypes

ranged from 83.30 to 100 where minimum was recorded in LBG-744 at 45DAS. The susceptible check LBG-20 showed highly susceptible reaction consistently at 45DAS. Hundred per cent disease was recorded in LBG-709, -735, -752, PANT-U-30, NSM-74 and CN-9027 while all the remaining genotypes also showed highly susceptible reaction with disease incidence >80%. The per cent disease incidence observed in blackgram genotypes at 30DAS was in a range of 72.91-97.95%. Maximum PDI was recorded in NSM-74 and 99-U-21 while the minimum was in LBG-744 with 72.91%. Blackgram genotypes showed per cent mortality in a range of 6.00-20.00% at 21.56-40.00% at 45 DAS where minimum was recorded in LBG-753 and maximum was in LBG-693.

Varied resistance was observed by several workers in the previous studies. Nene (1972) <sup>[1]</sup> screened blackgram genotypes against blackgram leaf curl virus under field conditions at Pantnagar and identified the lines N-212 and Khargoan to be free from the disease. Sreenivasulu (1994) studied the reaction of 38 genotypes against the blackgram leaf curl disease, among them seven genotypes PLV-807, PLV-1149, PANT-U-30, PANT-U-426, NP-3, LBG-648 and LBG-667 were moderately susceptible, 16 genotypes were susceptible and rest 15 genotypes were highly susceptible. At Hyderabad, 47 genotypes of blackgram were screened where genotypes, 99-U-19 and Pant U-30 showed comparatively less incidence and rest all high incidence (Prasada Rao, 2003) <sup>[5]</sup>. Jain *et al.* (2000) <sup>[2]</sup> screened 30 entries of blackgram varieties with two different dates of sowing under field conditions and none showed resistance.

At Anantapur, the greengram genotypes screened under field conditions showed a range of disease incidence 62.50-93.33% at 45 DAS. Susceptible reaction was observed in LGG-505 (62.50%), -527 (63.82%), -526 (66.66%) and LGG-470 (79.59%), while all the remaining genotypes were recorded with >80% indicating highly susceptible reaction. A maximum disease incidence was recorded in LGG-480 (77.77%) at 30 DAS while minimum was observed in LGG-526 (20.83%). LGG-505, -526 and LGG-527 showed consistent lower per cent disease incidence at 30DAS (29.16, 20.83 and 23.40%) as well as at 45 DAS (62.50, 66.66 and 63.82%) while LGG-470 showed lower (61.22%) disease incidence at 30DAS but susceptible reaction at 45DAS. The per cent mortality recorded in greengram genotypes was ranged from 12.50% (LGG-526) to 77.77% (LGG-480) at 30DAS and 28.57% (KARS-212) to 75.00% (LGG-497).

The greengram genotypes screened under field conditions at Tandur showed a range of disease incidence 96.15-100% at 45 DAS, while it was 93.75-100% at 30DAS indicating highly susceptible reaction where hundred per cent disease incidence was recorded in majority of the genotypes screened including the susceptible check K-851. The per cent mortality recorded in greengram genotypes was ranged from 6.25% (LGG-498 and M-267) to 15.38% (LGG-485) at 30DAS and 26.92% (LGG-479) to 37.25% (LGG-410). Out of 38 greengram genotypes screened for mungbean leaf curl disease and *Thrips palmi* in both *rabi* and *kharif* seasons of 2000, four genotypes *viz.*, LGG-460, LGG-480, LGG-491 and LGG-582 consistently exhibited resistant reaction, 18 genotypes were rated as moderately susceptible, 11 highly susceptible and five very highly susceptible (Sreekanth *et al.*, 2002b) <sup>[9]</sup>. At Hyderabad, 40 genotypes of greengram were screened where none of them were completely free from PBNV. However, genotypes, LGG-480, LGG-460, LGG-491, LGG-482 and LAM-M2 showed

comparatively less incidence (Prasada Rao, 2003) <sup>[5]</sup>. All these greengram genotypes were found highly susceptible in the present study. If farmers in necrosis disease caused by PBNV-prone areas could be supplied with agronomically acceptable cultivars that are resistant to PBNV in greengram, blackgram or groundnut, this disease could no longer be a problem. Unfortunately, intensive efforts over a number of years to detect resistant, either the resistance is not found or if found in few cultivars, it is lost over a period of time. None of the 7000 groundnut genotypes tested against PBNV has proved to be resistant, except a few field tolerant cultivars (Reddy *et al.*, 1990) <sup>[7]</sup>. Some of the blackgram and greengram cultivars reported to be resistant (Nene, 1972; Prasada Rao, 2003; Sreekanth *et al.*, 2002b; Sreenivasulu, 2005) <sup>[1,5,9,8]</sup> were found to be susceptible in the present study. Under the situation where, all the cultivars showing > 80% disease incidence under field conditions the efforts to classify the cultivars based on early infection < 30 days or late infections > 45 days, did not give good results due to the mortality of most of the plants irrespective of infection in case of TSV.

Although Anantapur and Tandur were considered to be hot spots for TSV and PBNV, respectively, in view of the changing climate conditions and spread of parthenium to many of the regions, it necessitated to identify precisely the viruses involved in the necrosis at each place. As it is difficult to distinguish the two viruses by symptomatology, leaf samples for 100 each blackgram and greengram samples collected from Anantapur field showing chlorosis and necrosis 52 and 63 turned out positive to PBNV and 40 and 38 reacted positive to TSV, respectively. Whereas in Tandur, out of 100 samples each from blackgram and greengram 61 and 77 were positive to PBNV and 8 and 15 samples found to be positive to TSV, respectively. Majority of the TSV positive plants were found dead at 45DAS among the tagged plants in the field. This can be attributed by rapid/faster spread of necrosis by TSV when compared to PBNV, in the early infected plants resulting in death. Lower TSV positive reactions in DAC-ELISA at TSV hot spot location, Anantapur, where an epidemic was recorded in the year 2000, can be due to the fact that the early infection of TSV as the abundant inoculum is available from parthenium throughout the year, leading to death (Prasada Rao *et al.*, 2003a, 2003b, 2003c) <sup>[5]</sup> and it is obvious that the symptomatic samples collected from surviving plants showing necrosis will give PBNV positive reaction. The low inoculum pressure of TSV might have led to lower TSV positive reactions in Tandur.

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