

# IDENTIFICATION OF HOST PLANT RESISTANCE TO BEAN COMMON MOSAIC VIRUS (BCMV) IN COWPEA (*VIGNA UNGUICULATA* L. WALP.) GENOTYPES

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## ABSTRACT

One hundred cowpea genotypes screened under field condition during *khari*, 2013 and 2014 and further evaluated at greenhouse condition by artificial sap inoculation. The disease incidence varied from 0 to 60 % and 0 to 63.33 % in field and artificial condition respectively. The most of the genotypes studied were categorized as moderately resistant to moderately susceptible. Three out of hundred genotypes appeared to be immune (IC-8966, V-5 and IC-202782) under both in field and artificial condition. The genotypes showed immune and resistant reaction would be utilized as donors to develop BCMV resistant varieties.

## INTRODUCTION

Cowpea (*Vigna unguiculata* L. Walp.) is one of the most important pulse crops native to Central Africa, belongs to family Fabaceae. Among the pulses, cowpea holds an important position in the country (Bashir *et al.*, 2002; Reena Nair and Mehta, 2014). Cowpea is mainly grown mainly as a vegetable and seed purpose and to lesser extent as a fodder crop. Cowpea seed is valued as a nutritional supplement to cereals because of its high protein (25%) content (Basavaraj *et al.*, 2013; Hasan Khan *et al.*, 2015). In India cowpea occupies an area of around a one million hectare with an annual production of 2.24 million tonnes with an average productivity of 570 kg per hectare (Anono, 2013). The main production constraints of pulses in general and cowpea in particular are biotic and abiotic stresses. Diseases are prominent among biotic stresses known to affect the productivity. Cowpea is susceptible to a variety of diseases caused by fungi, bacteria, viruses and nematodes. Of these, viruses constitute the major group of pathogens infecting cowpea (Mali and Thottappilly, 1986).

Cowpea is infected by about 140 viruses worldwide (Hughes and Shoyinka, 2003). Among these viruses infecting cowpea bean common mosaic virus (BCMV) is serious problem belongs to potyvirus group and transmitted by vector aphids and through seeds (Bock and Conti, 1994; Taiwo, 2003). The

occurrence of BCMV on common bean from India was first reported by Muniyappa (1976). Now it is distributed worldwide (Brunt *et al.*, 1996; Taiwo, 2003) and causes a big economic damage by reducing yield as much as 80% and quality of harvested product (Drijfhout, 1991).

Plants which are infected in early stages remain dwarf with small leaves, and less number of branches and fruits. In the present days after realization of severity of disease, farmers have become reluctant in cultivation of cowpea in India. Controlling BCMV incidence is only possible by the way of reducing the vector *viz.*, aphid population using insecticides and use of virus free seeds but, which are ineffective under severe infestations. The application of certain pesticides, which is mostly inefficient, uneconomical, causes environmental hazard and pose a health risk to human beings and cattle.

So, use of virus resistant variety is the best alternative to alleviate occurrence of BCMV disease. Hence, present investigation was mainly focused to screen cowpea genotypes and identify resistant genotypes against BCMV disease through both field and artificial condition.

## MATERIALS AND METHODS

The experimental material in the present study consisted of 100 cowpea genotypes collected from AICRP on Arid legumes, Zonal Agricultural Research Station (ZARS), GKVK, Bengaluru.

Initially, cowpea genotypes were screened for their reaction to BCMV disease under field condition during *kharif* season of 2013 and 2014. Under field condition each entry sown in single row of three meter length with the spacing of 45 × 10 cm in two replications. One row infector line C-152 was raised after every ten test entries. All the recommended agronomic practices were followed. No insecticidal spray was given in order to allow the aphid population to spread the disease. Disease incidence was recorded periodically and Percentage Disease Incidence (PDI) was worked out using the formula.

$$\text{Percent disease incidence (PDI)} = \frac{\text{No. of plants infected}}{\text{Total no of plants}} \times 100$$

Then same genotypes of cowpea were evaluated for their resistance to BCMV disease in under artificial condition. The

seeds of each genotype were sown in polythene bags. Eight to ten days old seedlings were mechanically inoculated with virus sap and kept them in insect proof cages for symptoms development. Number of plants infected in each genotype was recorded. The experiment was repeated thrice for accurate results and disease incidence was recorded.

The genotypes were later grouped into different categories based on 0-5 scale from immune to highly susceptible described by Diwakar and Mali (1976) (Table 1).

## RESULTS AND DISCUSSION

In present investigation, 100 genotypes were tested for their reaction to BCMV under field and artificial condition. The disease incidence varied from 0 to 60 and 0 to 63.33 % in field and artificial condition respectively (Table2 & Table3). In

**Table 1: Disease scoring Scale (0-5) for BCMV based on disease incidence (%)**

Scale	Description	Category
0	No visible symptoms	Immune
1	1-5 per cent of plants showing symptoms	Resistant
2	5-15 per cent of plants showing symptoms	Moderately resistant
3	15-25 per cent of plants showing symptoms	Moderately susceptible
4	25-50 per cent of plants showing symptoms	Susceptible
5	> 50 per cent of plants showing symptoms	Highly susceptible

**Table 2: Field screening of cowpea genotypes against BCMV during *Kharif* 2013 and 2014**

Sl. No.	Genotypes	Disease incidence (%)		Average	Disease score	*Reaction type
		2013	2014			
1	C-152	50	60	55.00	5	HS
2	KBC-2	5	10	7.50	2	MR
3	NBC-1	00	00	0.00	0	I
4	FTC-27	10	20	15.00	3	MS
5	GC-3	30	15	22.50	3	MS
6	IC 2196	00	00	0.00	0	I
7	IC 2815	00	00	0.00	0	I
8	IC 2918	00	00	0.00	0	I
9	IC 5969	10	00	5.00	1	R
10	IC 7832	5	5	5.00	1	R
11	1C 8966	00	00	0.00	0	I
12	1C 9833	10	10	10.00	2	MR
13	IC 10810	00	00	0.00	0	I
14	IC 19775	40	20	30.00	4	S
15	IC 19778	5	00	2.50	1	R
16	IC 19786-I	20	15	17.50	3	MS
17	IC 19797	20	25	22.50	3	MS
18	IC 20451	30	25	27.50	4	S
19	IC 20456	5	5	5.00	1	R
20	IC 20477	10	5	7.50	2	MR
21	IC 20504	0	15	7.50	2	MR
22	1C 20514	5	00	2.50	1	R
23	1C 20523	5	10	7.50	2	MR
24	IC 20526	5	00	2.50	1	R
25	IC 20575	10	25	17.50	3	MS
26	IC 20645	00	00	0.00	0	I
27	IC 20659	25	20	22.50	3	MS
28	IC 20720	5	5	5.00	1	R
29	IC 22637	10	5	7.50	2	MR
30	IC 26029	5	25	15.00	2	MR
31	IC 26048	5	5	5.00	1	R
32	IC 39870	10	40	25.00	3	MS
33	1C 39896	00	15	7.50	2	MR
34	1C 39911	45	20	32.50	4	S

Table 2: Cont.....

Sl. No.	Genotypes	Disease incidence (%)		Average	Disease score	*Reaction type
		2013	2014			
35	IC 39916	00	00	0.00	0	I
36	IC 39921	35	20	27.50	4	S
37	IC 39922	5	5	5.00	1	R
38	IC 39945	0	5	2.50	1	R
39	IC 39947	00	00	0.00	0	I
40	IC 52092	30	15	22.50	3	MS
41	IC 52094	10	25	17.50	3	MS
42	IC 52105	00	00	0.00	0	I
43	IC 52107-A	00	10	5.00	1	R
44	1C 52110	00	00	0.00	0	I
45	1C 52118	10	5	7.50	2	MR
46	IC 52128	20	0	10.00	2	MR
47	IC 102826	35	30	32.50	4	S
48	IC 199702	5	5	5.00	1	R
49	IC 201079	00	00	0.00	0	I
50	IC 201095	00	00	0.00	0	I
51	IC 202705	15	5	10.00	2	MR
52	IC 202707	10	20	15.00	2	MR
53	IC 202709	30	5	17.50	3	MS
54	IC 202711	30	25	27.50	4	S
55	1C 202717	25	20	22.50	3	MS
56	1C 202718	10	15	12.50	2	MR
57	IC 202720	5	0	2.50	1	R
58	1C 202730	25	30	27.50	4	S
59	1C 202762	0	30	15.00	2	MR
60	IC 202775	10	10	10.00	2	MR
61	1C 202779	5	5	5.00	1	R
62	1C 202782	0	0	0.00	0	I
63	IC 202791	0	10	5.00	1	R
64	IC 202806	10	25	12.50	3	MS
65	IC 202827	5	15	10.00	2	MR
66	1C 202829	10	10	10.00	2	MR
67	1C 202848	10	30	20.00	3	MS
68	IC 202891	00	00	0.00	0	I
69	1C 202926	10	5	7.50	2	MR
70	IC 204103	30	50	40.00	4	S
71	1C 206240	10	20	15.00	2	MR
72	1C 214751	5	10	7.50	2	MR
73	IC 214753	10	5	7.50	2	MR
74	1C 214757	5	20	12.50	2	MR
75	1C 214833	5	0	2.50	1	R
76	IC 214834	40	5	22.50	3	MS
77	IC 219489	15	20	17.50	3	MS
78	IC 219550	10	10	10.00	2	MR
79	IC 219592	40	40	40.00	4	S
80	IC 219594	5	20	12.50	2	MR
81	IC 219871	00	00	0.00	0	I
82	IC 219872	40	30	35.00	4	S
83	IC 243501	40	80	60.00	5	HS
84	IC 249132	0	30	15.00	3	MS
85	IC 249133	10	10	10.00	2	MR
86	IC 249140	30	10	20.00	3	MS
87	IC 249141	10	40	25.00	3	MS
88	IC 249584	30	20	25.00	3	MS
89	IC 249586	5	40	22.50	3	MS
90	IC 249588	5	10	7.50	2	MR
91	IC 249591	5	10	7.50	2	MR
92	IC 253270	5	5	5.00	1	R
93	IC 253275	25	0	12.50	2	MR
94	IC 253288	20	10	15.00	2	MR
95	IC 254430	5	0	2.50	1	R
96	IC 259024	40	0	20.00	2	MR
97	IC 259043	10	25	17.50	3	MS
98	IC 259061	20	15	17.50	3	MS
99	IC 259078	40	40	40.00	4	S
100	V-5	00	00	0.00	0	I

**Table 3: Screening of cowpea genotypes against BCMV under artificial conditions**

Sl. No.	Genotypes	Disease incidence (%)			Average	Disease score	Disease reaction
		R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>			
1	C-152	40	70	70	60.00	5	HS
2	KBC-2	30	30	40	33.33	4	S
3	NBC-1	0	0	10	03.33	1	R
4	FTC-27	30	0	20	16.66	3	MS
5	GC-3	20	20	30	23.33	3	MS
6	IC 2196	0	0	10	03.33	1	R
7	IC 2815	10	0	0	03.33	1	R
8	IC 2918	0	0	10	03.33	1	R
9	IC 5969	20	10	0	10.00	2	MR
10	IC 7832	10	10	20	13.33	2	MR
11	1C 8966	0	0	0	00.00	0	I
12	1C 9833	0	20	10	13.33	2	MR
13	IC 10810	0	0	10	03.33	1	R
14	IC 19775	30	30	30	30.00	4	S
15	IC 19778	30	30	30	30.00	4	S
16	IC 19786-I	20	20	20	20.00	3	MS
17	IC 19797	50	40	70	53.33	5	HS
18	IC 20451	40	60	80	60.00	5	HS
19	IC 20456	20	20	10	16.66	2	MR
20	IC 20477	30	20	0	16.66	2	MR
21	IC 20504	10	10	20	13.33	2	MR
22	1C 20514	10	10	10	10.00	2	MR
23	1C 20523	0	10	0	03.33	1	R
24	IC 20526	0	0	20	06.66	2	MR
25	IC 20575	0	10	10	06.66	2	MR
26	IC 20645	0	0	10	03.33	1	R
27	IC 20659	0	10	0	03.33	1	R
28	IC 20720	20	40	80	46.66	4	S
29	IC 22637	40	30	20	30.00	4	S
30	IC 26029	10	20	10	16.66	3	MS
31	IC 26048	10	10	10	10.00	2	MR
32	IC 39870	10	10	0	06.66	2	MR
33	1C 39896	10	10	10	10.00	2	MR
34	1C 39911	40	30	60	50.00	5	HS
35	IC 39916	10	10	10	10.00	2	MR
36	IC 39921	10	0	10	06.66	2	MR
37	IC 39922	0	10	10	06.66	2	MR
38	IC 39945	10	10	10	10.00	2	MR
39	IC 39947	10	0	0	03.33	1	R
40	IC 52092	40	30	0	23.33	3	MS
41	IC 52094	00	20	30	16.66	3	MS
42	IC 52105	10	10	10	10.00	2	MR
43	IC 52107-A	0	0	30	10.00	2	MR
44	1C 52110	0	20	10	13.33	2	MR
45	1C 52118	20	0	10	10.00	2	MR
46	IC 52128	0	10	10	06.66	2	MR
47	IC 102826	30	40	30	33.33	4	S
48	IC 199702	50	30	30	36.66	4	S
49	IC 201079	0	0	10	03.33	1	R
50	IC 201095	0	10	0	03.33	1	R
51	IC 202705	30	40	0	23.33	3	MS
52	IC 202707	30	10	30	23.33	3	MS
53	IC 202709	20	0	10	16.66	3	MS
54	IC 202711	20	20	40	26.66	4	S
55	1C 202717	70	50	60	60.00	5	HS
56	1C 202718	20	20	20	20.00	3	MS
57	IC 202720	0	10	0	03.33	1	R
58	1C 202730	40	60	70	56.66	5	HS
59	1C 202762	20	20	20	20.00	3	MS
60	IC 202775	30	40	30	33.33	4	S
61	1C 202779	30	20	0	16.66	3	MS
62	1C 202782	0	0	0	0.00	0	I
63	IC 202791	0	0	10	03.33	1	R

Table 3: Cont.....

Sl. No.	Genotypes	Disease incidence (%)			Average	Disease score	Disease reaction
		R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>			
64	IC 202806	50	40	70	53.33	5	HS
65	IC 202827	20	20	30	23.33	3	MS
66	1C 202829	10	40	20	23.33	3	MS
67	1C 202848	40	40	10	30.00	4	S
68	IC 202891	10	20	10	13.33	2	MR
69	1C 202926	20	20	20	20.00	3	MS
70	IC 204103	60	70	60	63.33	5	HS
71	1C 206240	30	30	30	30.00	4	S
72	1C 214751	20	20	0	13.33	2	MR
73	IC 214753	20	10	10	13.33	2	MR
74	1C 214757	0	30	10	13.33	2	MR
75	1C 214833	0	0	10	03.33	1	R
76	IC 214834	40	50	10	33.33	4	S
77	IC 219489	0	30	30	20.00	3	MS
78	IC 219550	10	10	40	20.00	3	MS
79	IC 219592	40	50	80	56.66	5	HS
80	IC 219594	30	40	30	33.33	4	S
81	IC 219871	0	0	30	10.00	2	MR
82	IC 219872	30	40	60	43.33	4	S
83	IC 243501	60	70	60	63.33	5	HS
84	IC 249132	30	10	30	23.33	3	MS
85	IC 249133	10	10	50	23.33	3	MS
86	IC 249140	40	40	40	40.00	4	S
87	IC 249141	30	30	40	33.33	4	S
88	IC 249584	40	50	10	46.66	4	S
89	IC 249586	20	60	40	40.00	4	S
90	IC 249588	0	0	20	06.66	2	MR
91	IC 249594	20	0	30	16.66	3	MS
92	IC 253270	0	0	10	03.33	1	R
93	IC 253275	0	0	30	10.00	2	MR
94	IC 253288	0	20	10	13.33	2	MR
95	IC 254430	10	0	0	03.33	1	R
96	IC 259024	0	10	10	6.66	2	MR
97	IC 259043	20	50	30	33.33	4	MS
98	IC 259061	10	10	30	13.33	2	MR
99	IC 259078	30	40	30	33.33	4	S
100	V-5	0	0	0	00.00	0	I

\*Reaction types: I: Immune; R: Resistant; MR: Moderately resistant; MS: Moderately susceptible; S: Susceptible; HS: Highly susceptible

field condition, among the 100 genotypes screened, 16 genotypes showed immune reaction, 17 genotypes showed resistant reaction, 34 genotypes showed moderately resistant reaction, 21 genotypes moderately susceptible reaction, 10 genotypes showed susceptible reaction and 2 genotypes were showed highly susceptible reaction. In these studies the highest per cent of disease incidence (60%) was observed in IC-243501. Results are presented in the Table 4.

However, the results of 100 genotypes screened under artificial condition against BCMV (Table 5). Among the 100 genotypes screened, 3 genotypes showed immune reaction, 17 genotypes showed resistant reaction, 30 genotypes showed moderately resistant reaction, 21 genotypes moderately susceptible reaction, 19 genotypes susceptible reaction and 10 genotypes were showed highly susceptible reaction. In these studies the highest per cent of disease incidence (63.33%) was observed in IC-204103 and IC-243501. Among all genotypes IC-8966, V-5 and IC-202782 showed immune reaction both in field and artificial condition.

These results presented were in accordance with several workers Bhati *et al.* (1987), Gumedzoe *et al.* (1990), Sahoo

and Hota (1991), Gubba (1994). Bashir *et al.* (2000) and Bashir and Ahmed (2002) identified the resistance in cowpea against black eye cowpea mosaic virus. Two hundred cowpea germplasm accessions were evaluated against black eye cowpea mosaic virus (BICMV), under greenhouse conditions by sap inoculation method.

Suly and Providentii (1995) noted five multiple virus resistant common bean breeding lines. The *phaseolus vulgaris* breeding lines sp6c, sp17b, sp61, sp180d, sp377d were derived from a cross between Great northern 1140; B21 carries resistance to BCMV, BYMV and black eye cowpea mosaic potyvirus (BICMV).

Sharma *et al.* (2008) evaluated 397 common bean accessions of diverse origin through artificial screening revealed the presence of effective sources of resistance against bean common mosaic virus strains present in Himachal Pradesh of India. 21 accessions were found resistance to NL1n and NL7n strains of BCMV.

Genotypes grouped as immune and resistant category under both in field and artificial condition would be utilized as donors

**Table 4: Grouping of cowpea genotypes based on their reaction against BCMV under field condition.**

Reaction type	Number of genotypes	Genotypes
Immune	16	NBC-1, IC 2196, IC 2918, IC 2815, IC 10810, IC 20645, IC 39916, IC 39947, IC 52110, IC 201079, IC 201095, IC 8966, V-5, 202782, 202891, IC 219872
Resistant	17	IC 5969, IC 7832, IC 19778, IC 20456, IC 20514, IC 20720, IC 26048, IC 39922, IC 39945, IC 52107-I, IC 199702, IC 202720, IC 202779, IC 202791, IC 214833, IC 253270, IC 254430
Moderately resistant	34	KBC-2, IC 9833, IC 20477, IC 20504, IC 20523, IC 22637, IC 26029, IC 39896, IC 52118, IC 52128, IC 202705, IC 202707, IC 202718, IC 202762, IC 202775, IC 202827, IC 202829, IC 202926, IC 206240, IC 214751, IC 214753, IC 214757, IC 219550, IC 219594, IC 249133, IC 249588, IC 249591, IC 253275, IC 253288, IC 259024
Moderately susceptible	21	FTC-27, GC-3, IC 19786-I, IC 19797, IC 20575, IC 20659, IC 39870, IC 52092, IC 52094, IC 202709, IC 202717, IC 202806, IC 202848, IC 214834, IC 2194489, IC 249132, IC 259043, IC 259061, IC 249140, IC 249141, IC 249584, IC 249586
Susceptible	10	IC 19775, IC 20451, IC 39921, IC 102826, IC 202711, IC 202730, IC 204103, IC 219592, IC 219872, IC 259078
Highly susceptible	02	C-152, IC 243501

**Table 5: Grouping of cowpea genotypes based on their reaction against BCMV under artificial condition**

Reaction	Number of genotypes	Genotypes
Immune	03	IC 8966, V-5, 202782
Resistant	17	NBC-1, IC 2196, IC 2918, IC 2815, IC 10810, IC 20523, IC 20645, IC 20659, IC 39916, IC 39947, IC 201079, IC 201095, IC 202720, IC 202791, IC 214833, IC 253270, IC 254430
Moderately resistant	30	IC 5969, IC 7832, IC 9833, IC 20456, IC 20477, IC 20504, IC 20514, IC 20526, IC 20575, IC 26048, IC 39870, IC 39896, IC 39921, IC 39922, IC 39945, IC 52105, IC 52107-A, IC 52110, IC 52118, IC 52128, IC 202891, IC 214751, IC 214753, IC 214757, IC 219871, IC 249588, IC 253275, IC 253288, IC 259024, IC 259061
Moderately susceptible	21	FTC-27, GC-3, IC 19786-I, IC 26029, IC 52092, IC 52094, IC 202705, IC 202707, IC 202709, IC 202718, IC 202762, IC 202779, IC 202827, IC 202829, IC 202926, IC 219489, IC 219550, IC 249132, IC 249133, IC 249594, IC 259043
Susceptible	19	KBC-2, IC 19775, IC 19778, IC 20720, IC 22637, IC 102826, IC 199702, IC 202711, IC 202775, IC 202848, IC 206240, IC 214834, IC 219594, IC 219872, IC 249140, IC 249141, IC 249584, IC 249586, IC 259078
Highly susceptible	10	C-152, IC 19797, IC 20451, IC 39911, IC 202717, IC 202730, 202806, IC 204103, IC 219592, IC 243501

to develop BCMV resistant lines. In addition, these genotypes will be screened through SSR linked markers against BCMV to confirm resistance.

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