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Research Article

Participatory Varietal Selection (PVS) - a client oriented breeding approach in mung bean (*Vigna radiata* L.)

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Abstract
Participatory variety selection in mung bean was carried out at Rice Research Station, Tirur. Twenty two mung bean cultures were raised in three replications with check varieties Co (Gg) 7 and VBN (Gg) 3 and farmers were involved in selection process at Research Station. Among the cultures raised, sixteen cultures were selected based on yield and scores given by the farmers. The sixteen promising cultures identified were screened for Mung bean Yellow Mosaic Virus resistance in hot spot and thirteen cultures were categorized as resistant and moderately resistant. Mother trials (*i.e*) researcher managed replicated trial was laid out with the above thirteen cultures along with check varieties. From mother trial six cultures *viz*., TMGG 11007, TMGG 11018, TMGG 11034, TMGG 11035, TMGG11038 and TMGG 11042 were identified for baby trials. From baby trials, three promising cultures *viz.*, TMGG 11034, TMGG 11007 and TMGG 11042 were identified based on farmers preference.

Key words
Mung bean, yield, Yellow Mosaic Virus, Participatory variety selection, farmers preference

Introduction

Green gram or mung bean (*Vigna radiata* L.) is the third most important pulse crop after chickpea and pigeonpea grown and consumed in India. It is a good source of proteins and minerals and its protein quality is similar to or better than other legumes. In addition, mung bean is also known for its easy digestibility and non-flatulence behaviour. It also improves soil fertility through biological nitrogen fixation and is, therefore, used in crop rotations, mixed cropping and alley cropping systems (Heuzé *et al*., 2015). India is the primary green gram producer and contributes to about 75 per cent of the world pulses production. In India, it is grown in an area of 3.44 million hectares with annual production of 1.54 million tons and average productivity of 461 kg / ha (nfsm.gov.in 2016). The productivity of pulse crops including green gram is low because of several biotic and abiotic constraints. Among the several biotic constraints for mungbean production, Mungbean Yellow Mosaic Virus (MYMV) disease occupies prime position and is the most destructive and devastating viral disease. Development of high yielding, virus resistant variety is the most efficient approach to alleviate the occurrence of MYMV disease and to increase the productivity (Mohan *et al*., 2014).

Generally, plant breeders develop and release varieties that are most productive under ideal conditions; often they are not suitable for marginal farm conditions. Farmers are the end users of a variety so the decision by the farmers while judging the variety should be taken into consideration to make the varietal choice more effective for its widespread adoption (Najeeb *et al*., 2018). The varieties tested only on station evaluation trials without taking the data from the farmers' fields by not including farmers as partners for variety evaluation are the reasons of low adoption of varieties. Rajula Shanthy (2010) reported the feasibility of conducting on — farm research in participatory mode and the success thereof in Sugarcane. More varieties need to be developed with farmer participation to help increase production across the diversity of challenging environments.

Farmer's Participatory Varietal Selection is a way to overcome the limitations of conventional breeding by offering farmers the possibility to choose in their own environment, the varieties that better suit their needs and conditions (Ceccarelli and Grando, 2007). Since PVS facilitates development of varieties suitable for farmers' interests, the objective of the present study is to explore farmers' acceptance criteria and preferences in identifying high yielding, MYMV resistant mung bean cultivars.

Materials and Methods

New crosses were made by crossing the high yielding but susceptible green gram cultivars such as Co 6, Co GG 936, VBN 2, ML 682 and VBN 2 with MYMV resistant green gram donors *viz*., ML 99, UPM-02-18, Annur 1, Barimung 5, VC 615713-70P and TM 96-2. The F_1 hybrids developed were evaluated in order to fix true hybrids. Promising single plants were selected from segregating generations for further evaluation. The advanced breeding lines were obtained after attaining uniformity.

A total of twenty two green gram advanced breeding lines developed were raised in three replications at Rice Research Station, Tirur with two check varieties Co (Gg) 7 and VBN (Gg) 3. Each entry was raised in $5m^2$ plot with the spacing of 30 x 10 cm. At the time of maturity of the above trial, farmers were involved in selection programme at Research station and score sheet was given to each farmer. Based on scores, the promising cultures were identified.

The promising cultures identified were raised in hot spot area for MYMV disease (Ponboli village of Tirunelveli district, Tamil Nadu) and screened for MYMV resistance. Disease incidence was recorded periodically and Percentage Disease Incidence (PDI) was worked out using the formula

$$\text{Percentage Disease Incidence (PDI)} = \frac{\textit{Number of Plants infected in a row}}{\textit{Total number of plants in a row}} \times 100$$

The genotypes were categorized using (0-5) arbitrary scale as

Disease Scale	Percent Infection	Category	Reaction group
0	No plants showing any symptoms	Immune	I
1	Less than 1% plants exhibiting symptoms	Resistant	R
3	1-10 % plants exhibiting symptoms	Moderately Resistant	MR
5	11-20 % plants exhibiting symptoms	Moderately Susceptible	MS
7	21-50% plants exhibiting symptoms	Susceptible	S
9	50 % and more plants exhibiting symptoms	Highly Susceptible	HS

Four farmers in four different villages were identified and mother trials (*i.e*) researcher managed replicated trial were laid out with the selected cultures along with check varieties. The cultures were raised in three replications in the plot size of 3 m^2 adopting the spacing of 30 x 10 cm. At maturity, farmers in the nearby areas in each village were invited and asked to select superior cultures in the field based on their requirements and give their impressions about choice of the culture. The information were pooled to find out the general preferences of farmers.

Baby trials were laid out with the selected promising entries in five locations in at least five villages in Tiruvallur districts. Farmers were asked not to change their normal cultural practices. The entire trial was managed by them from sowing to harvesting. Technical advice about new technologies such as seed treatment, foliar spray during flowering was given. Field day and group discussions were arranged. Promising entries were identified with farmer's preferred data.

Results and Discussions

Mungbean Yellow Mosaic Virus (MYMV) is the most destructive and devastating viral disease and causes yield loss upto 80%. Evolution of resistant varieties with high yield potential is the most feasible and durable solution of controlling MYMV disease and getting higher productivity. Participatory Varietal Selection (PVS) trials, which are conducted on-farm and under the complete management of farmers provide information about the performance of new varieties under the real conditions faced by farmers. The farmers' role is a primary interest in PVS as they are the targeted end-users and they are sources of local knowledge, there is greater likelihood of farmers adopting the new variety (Rahman *et al*., 2015).

In the present investigation, a total of twenty two green gram advanced breeding lines developed were raised in three replications at Rice Research Station, Tirur with two check varieties Co (Gg) 7 and VBN (Gg) 3. Farmers were involved in selection at Research station at the time of maturity based on their duration, plant type, pod length, no. of pods / plant, pod bearing nature, grain traits such as size, colour, luster and marketability. Grain Yield / plot were recorded in all the entries. Among the twenty two green gram cultures raised, sixteen cultures were selected based on yield and score. Sixteen cultures out yielded the check varieties Co (Gg) 7 and VBN (Gg) 3 by recording more than 10 % yield increase (Table 1). The yield increase ranges from 12.4 % to 46.1 %. Maximum yield of

1312 kg/ha was recorded by the culture TMGG 11034 (Co GG 936 / Co 6) followed by TMGG 11007 (Co 6 / ML 99) and TMGG 11042 (Co 6 / TM 96-2) (1250 kg/ha).

The sixteen promising cultures identified were raised in hot spot area for YMV disease (Ponboli village of Tirunelveli district, Tamil Nadu) and screened for YMV resistance. Percentage Disease Incidence (PDI) was worked out and cultures were categorized. Among the sixteen cultures, thirteen cultures were categorized under resistant / Moderately resistant categories at hot spot area Table 2. The cultures TMGG 11007, TMGG 11018, TMGG 11034, TMGG 11035, TMGG 11038 and TMGG 11042 were grouped under resistant (Disease scale <1) and the cultures TMGG 11003, TMGG 11004, TMGG 11010, TMGG 11019, TMGG 11027, TMGG 11033 and TMGG 11040 were categorized under moderately resistant. The remaining three cultivars were grouped as moderately susceptible (Fig .1).

Four farmers in four different villages were identified and mother trials (*i.e*) researcher managed replicated trial were laid out with the above thirteen cultures along with check varieties. The details of farmers involved in selection process.

S. No	Farmer name	Village
1.	Mr. Deivasigamani	Poorivakkam, Thiruvallur Dt
2.	Mr. Varadhan	Baluchettichatram, Kanchipuram Dt.,
3.	Mr.Delli Babu	Attrambakkam, Thiruvallur Dt
4.	Mr. Raman	Ekkadu Kilambakkam,Thiruvallur Dt

At maturity, farmers in the nearby areas in each village were invited and asked to select superior cultures in the field based on their requirements. The information were pooled to find out the general preferences of farmers. Farmers preferred early maturity (55-60 days), more number pods / plant, pods at top of the plant (for mechanical harvesting), determinate / semi determinate type (1 or 2 pickings), medium sized, bright green, shiny seeds. Farmers were interested in a wide range of traits (*i.e*) of combination of traits. From the pooled information and scores (Table. 3) sub set of six cultures *viz*., TMGG 11007, TMGG 11018, TMGG 11034, TMGG 11035, TMGG 11038 and TMGG 11042 were identified for baby trials.

Baby trials were laid out with the above six promising entries in five locations in the villages Attrambakkam, Kilambakkam, Poorivakkam, Kalambakkam and Pudumavillangai in Tiruvallur districts. Farmers were asked not to change their normal cultural practices. Technical advice about new technologies such as seed treatment, foliar spray during flowering was given. Group discussions before and after harvest was carried out on all aspects of the test entries including market value and storability. Similar studies was carried out by Mbeyagala *et al*., 2017 for assessing farmers' preference in eleven mung bean genotypes and identified six traits through group discussions as the most preferred traits by farmers in selecting the best mungbean genotypes. The traits were yield, overall performance, seed size, seed colour, marketability and early maturity. From the baby trials laid out, three promising cultures *viz.*, TMGG 11034, TMGG 11 007 and TMGG 11042 were identified based on farmers preference.

Special features of the promising cultures identified:Three promising cultures identified from this study *viz*., TMGG 11034 (Co GG 936 / Co 6), , TMGG 11007 ((Co 6 / ML 99) and TMGG 11042 (Co 6 / TM 96-2) are early maturing (58-62 days), high yielding with more no of top bearing pods and MYMV resistant. All the three cultures are suitable for both *Kharif* and *Rabi* seasons. The culture TMGG 11042 has lengthy pods with bold seeds (5g/100 seeds) and synchronized maturity.

TMGG 11034

TMGG 11007

TMGG 11042

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Table 1. Entries identified under Consultative Participatory Varietal Selection

Entries	Cross combination	Plot yield (Kg)				Yield (kg/ha)	% increase over check Co (Gg) 7
		RI	RII	RIII	Mean		
TMGG 11003	Co 6 / ML 99	4.50	4.17	4.15	4.27	1187	32.2
TMGG 11004	Co 6 / ML 99	4.32	3.94	3.67	3.97	1104	22.9
TMGG 11007	Co 6 / ML 99	4.86	4.79	3.86	4.50	1250	39.6
TMGG 11010	Co 6 / ML 99	3.85	3.49	4.13	3.82	1062	18.3
TMGG 11017	Co 6 /UPM-02-18/VBN 2	3.74	3.65	3.68	3.69	1025	12.4
TMGG 11018	Co 6 /UPM-02-18/VBN 2	4.00	3.77	4.37	4.05	1124	25.2
TMGG 11019	Co 6 /UPM-02-18/VBN 2	4.34	4.26	3.76	4.12	1145	27.5
TMGG 11025	Co 6 / Co GG 936	3.60	4.14	4.19	3.97	1104	22.9
TMGG 11027	Co 6 / Co GG 936	3.81	3.53	3.92	3.75	1042	16.0
TMGG 11033	Co GG 936 / Co 6	3.72	4.20	3.78	3.90	1083	20.6
TMGG 11034	Co GG 936 / Co 6	4.72	5.05	4.39	4.72	1312	46.1
TMGG 11035	Co GG 936 / Co 6	4.56	4.20	4.06	4.27	1187	32.2
TMGG 11036	VBN 2/ Annur 1	3.33	3.82	3.66	3.60	1000	11.4
TMGG 11038	ML 682/ Barimung 5	3.38	3.93	3.71	3.68	1021	13.7
TMGG 11040	VBN 2 / VC615713-70P	3.60	4.02	3.41	3.68	1021	13.7
TMGG 11042	Co 6 / TM 96-2	4.86	4.79	3.86	4.50	1250	39.6
Co (Gg) 7		3.05	3.27	3.38	3.23	898	
VBN (Gg)3		3.05	2.53	2.85	2.81	780	

SEd = 0.04 CD(0.05) = 0.08 CV % = 9.1

Table 2. Screening of promising lines for MYMV resistance in hot spot location

Genotype	PDI	Category
TMGG 11003	3.3	Moderately Resistant
TMGG 11004	1.7	Moderately Resistant
TMGG 11007	0.3	Resistant
TMGG 11010	2.3	Moderately Resistant
TMGG 11017	18.3	Moderately Susceptible
TMGG 11018	0.8	Resistant
TMGG 110 19	1.5	Moderately Resistant
TMGG 11025	15.9	Moderately Susceptible
TMGG 11027	4.9	Moderately Resistant
TMGG 11033	1.6	Moderately Resistant
TMGG 110 34	0.5	Resistant
TMGG 110 35	0.9	Resistant
TMGG 11036	12.7	Moderately Susceptible
TMGG 11038	0.8	Resistant
TMGG 11040	6.5	Moderately Resistant
TMGG 11042	0.5	Resistant

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Table 3. Scores given by the farmers in Mother trials

Characters	TMGG 11003	TMGG11 004	TMGG11 007	TMGG11 010	TMGG 11018	TMGG11 019	TMGG11 027	TMGG11 033	TMGG 11034	TMGG 11035	TMGG11 038	TMGG11 040	TMGG 11042
Duration	II	II	I	I	II	II	I	II	I	I	I	II	I
Plant type	II	I	I	I	II	I	III	III	I	I	I	III	I
Position of pods	III	II	I	II	II	II	II	II	II	II	I	II	I
Pods length	II	I	I	I	I	I	III	III	I	I	II	II	I
No. of pods / plant	II	I	I	I	I	I	III	II	I	I	I	II	II
No. of grains / pod	II	I	I	I	I	I	II	II	I	II	I	III	I
Grain size	II	II	II	II	II	I	III	I	I	II	II	II	I
Colour & lusture	I	I	I	I	I	II	II	II	I	I	I	II	I
Resistance to YMV	II	I	I	I	I	II	II	II	I	I	I	II	I

Note: I – Most preferred
II – Moderately preferred
III – Least preferred

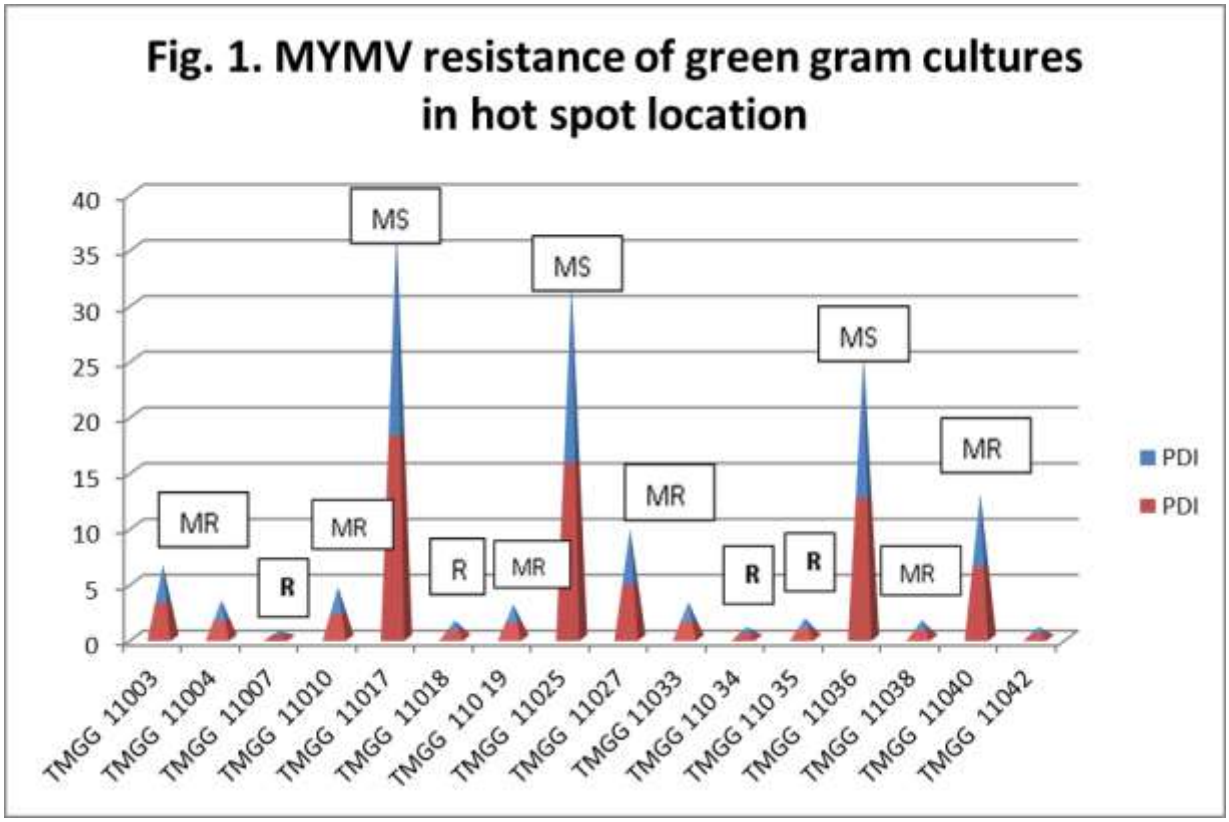
Fig. 1. MYMV resistance of green gram cultures in hot spot location
40
35
30
25
20
15
10
5
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TMGG 11003
TMGG 11004
TMGG 11007
TMGG 11010
TMGG 11017
TMGG 11018
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