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New High Yielding Mung Bean Variety Phule Chetak for Maharashtra

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ABSTRACT

Background: Mung bean is one of the important pulse crop requiring low inputs. The productivity of *kharif* mung bean is very low. The present improved varieties have lower yield potential and disease susceptibility. There is a need to develop high yielding varieties combined with early to mid synchronous maturity, better quality and resistance/tolerance to major pests and diseases.

Methods: The green gram *var.* Phule Chetak was developed by pedigree selection method from a cross between SML-668 X Naval at Oilseeds Research Station, MPKV, Jalgaon. It was tested over several locations and environments for its stability performance.

Result: The results indicated a significant improvement in yield level under field conditions. The new variety Phule Chetak reported an average yield of 1003 kg/ha which is 26.96%, 36.46%, 29.42%, 21.72%, 17.58% and 13.21 per cent higher than the check varieties Vaibhav, BPMR-145, AKM-8802, BM-2002-1, BM-2003-2 and Utkarsha respectively. It is bold seeded having early maturity, moderately resistant to major diseases like powdery mildew, mungbean yellow mosaic virus under field conditions. Considering its consistent performance, the mung bean genotype PM-707-5 has been released for cultivation in the *kharif* season for Maharashtra under the name of Phule Chetak in Joint Agresco during 29-30 October, 2020 held at Dr PDKV, Akola.

Key words: Multilocation trials, Mung bean, Phule chetak, Yield.

INTRODUCTION

Mung bean (*Vigna radiata* L.) is an important pulse crop in India cultivated over a wide range of agro-climatic zones of the country. It belongs to the family *Leguminoceae* (Fabaceae) and has originated from India and Central Asia. This crop is grown in all the seasons, however maximum area is under *kharif* cultivation where intercropping with sorghum, pearl millet, maize, cotton, castor, pigeon pea *etc.* is very popular (Anonymous, 2020). Due to its short duration, it has proved to be an ideal crop for catch cropping, intercropping and relay cropping. Mung bean is an excellent source of high quality protein. It is consumed in different ways as *dal, halwa* which is very nutritious. Sprouted whole mung bean is used in South India for preparing curry or savory dish. The seeds are boiled whole or after splitting and eaten as *dal* or ground to prepare *balls, bari, pakori* and *papad etc.* It is also recommended as a medicinal diet in cases of flatulence and to the sick. Ascorbic acid (Vitamin C) is synthesized in sprouted seeds of mung bean. The amount of riboflavin and thiamine also increases during seed sprouting. As it is a leguminous crop it has the capacity to fix atmospheric nitrogen through symbiotic nitrogen fixation. It is also used as a green manure crop. It also provides an excellent green fodder to the animals.

In India, many factors are responsible for improper growth and low yields of green gram. Out of that use of old varieties, imbalanced application of fertilizers and inadequate planting distance are some of the major factors, which adversely affect the growth of green gram (Patil *et al.*, 1985). Inclusion of only quality seed of improved varieties in its cultivation leads to increase of 15-20% seed yield. Availability of quality seed of improved variety at a reasonable price to the door of potential growers is still a big challenge. Because apart from the genetic constitution, a number of physiological, biochemical and lack of required packages of practices during the critical stages of crop growth have found to be some of the yield barriers of mung bean (Ahlawat and Rana, 2002). Timely sowing at the proper spacing along with application of recommended doses of fertilizer, microbial inoculants and boron foliar spray have been found to ameliorate such bottlenecks to a considerable extent in pulses (Vakeswaran *et al.*, 2016).

In India the major mung bean growing states are Maharashtra, Andhra Pradesh, Rajasthan, Orissa and Bihar. In Maharashtra it is the second important *kharif* pulse crop grown after pigeon pea. Mung bean is cultivated on an area of 3.95 lakh hectares producing 1.44 lakh tones with an average productivity of 365 kg per hectare in Maharashtra (Anonymous, 2021). However the present yield potential of improved varieties is not enough to attract the farmers, which is further aggravated by disease susceptibility. Therefore, there is a need to develop high yielding variety combined

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with early to mid late synchronous maturity, better quality and resistance/tolerance to major pests and diseases.

With this object in view, hybridization programme was undertaken at the Oilseeds Research Station, Jalgaon under Mahatma Phule Krishi Vidyapeeth, Rahuri. A cross between diverse parents *viz*., SML-668 and Naval resulted in isolation of promising culture Phule M-707-5. The culture Phule M-707-5 was entered in the mung bean Regional varietal trial during 2010 and State Multilocation varietal trial during 2011 to 2019.

MATERIALS AND METHODS

The green gram promising *var.* Phule Chetak (PM-707-5) was developed by pedigree selection method from a cross between SML-668 X Naval at Oilseeds Research Station, Mahatma Phule Krishi Vidyapeeth, Jalgaon. This selected genotype has been screened for higher yield with pest and disease resistance in F_1 to F_5 generations. The genotype was studied for its yield and ancillary characteristics in station trials, multi-location as well as AICRP trials during 2012 to 2019 in *kharif* seasons (Table 1). It was tested for several locations and environments for its stability performance. The variety was evaluated in a randomized block design with 3 replications in university/state trials and in AICRP trials with checks. The variety Phule Chetak and existing released varieties were evaluated for their yield performance under field conditions. At maturity the yield and yield attributing characteristics were recorded. The statistical analysis was carried out according to Panse and Sukhatme (1985). The candidate variety was evaluated for its reaction to major diseases under endemic conditions during 2017 to 2019 *kharif* seasons.

Crop management

Right after sowing, the experimental plots were taken care regularly at every growth stage interval until pods matured. Weeding was done manually. Plant protection measures were applied as and when required. The various morphological observations were recorded at proper stage till harvest.

RESULTS AND DISCUSSION

The evaluation of Phule Chetak (PM-707-5) was done in *kharif* season through station and multi-location trials for eight years during 2012 to 2019 in 40 trials and performance of the genotype Phule Chetak was recorded on various traits. It was revealed that seed yield was 986 kg /ha in *kharif* which is 27.55, 34.15, 27.23, 19.66, 15.59 and 11.29 per cent higher than the check varieties *viz.* Vaibhav, BPMR-145, AKM-8802, BM-2002-1, BM-2003-2 and Utkarsha respectively (Table 1).

The genotype Phule Chetak (PM-707-5) was tested in co-ordinated trials under AICRP project in *kharif* for one year. Performance of Phule Chetak (PM-707-5) in these trials was also superior over the corresponding checks.

Taking into account best performance of Phule Chetak (PM-707-5) in *kharif* multilocation trials as well as co-ordinated trials, it was released for Maharashtra state for cultivation for farmers in *kharif* season.

Table 1: Summary of yield performance of phule chetak (PM-707-5) in station, multilocation and IVT trials over checks (*Kharif* 2012-2019).

Trial	Year	No. of trials	PM-707-5	Vaibhav	BPMR-145	AKM-8802	BM-2002-1	BM-2003-2	Utkarsha
SSYET	2012	1	1275	969	-	-	-	-	-
LSYET*	2013	1	290	287					
RVT	2014	2	527	360	-	-	-	-	-
Pooled weighted mean of station trials (03)		04	776	563	-	-	-	-	-
Per cent increase over			-	37.83					
SMVT	2015	5	966	651	526	576	622	666	-
	2016	7	1076	826	857	825	908	932	975
	2017	8	914	756	734	801	869	895	859
	2018	9	958	759	701	738	834	831	738
	2019	8	1100	913	797	871	822	883	1000
Pooled weighted mean of multilocation trials (37)		37	1003 (37) 1008 (32)	790	735	775	824	853	886 (32)
Per cent increase over				26.95	36.45	29.38	21.63	17.55	13.86
Overall pooled weighted mean of station and SMVT trials (40)		40	986	773	735	775	824	853	886
Per cent increase over			-	27.55	34.15	27.23	19.66	15.59	11.29
IVT	2018	24	885	-	-	717	-	-	-
Per cent increase over			-	-	-	23.43			

Note: *Data of station trial (Jalgaon 2013) was excluded while calculating Weighted pooled mean due to low yield level below state average.

Performance of phule chetak (PM-707-5) in station trials

Phule Chetak (PM-707-5) was tested in station trials for three years at Oilseeds Research Station, MPKV, Jalgaon during *kharif* 2012-13 to 2014-15 (Anonymous, 2015). Phule Chetak recorded 776 kg/ha seed yield when compared with check variety Vaibhav (563 kg/ha), which was 37.83 per cent higher over check (Table 1).

Performance of Phule Chetak (PM-707-5) in multi-location trials

The multilocation trials were conducted at 37 locations during *kharif* 2015-16 to 2019-20. On the basis of mean performance for five years Phule Chetak (PM-707-5) gave 1003 kg/ha seed yield as against check varieties *viz*., Vaibhav (790 kg/ha), BPMR-145 (735 kg/ha), AKM-8802 (775 kg/ha), BM-2002-1 (824 kg/ha), BM-2003-2 (853 kg/ha) and Utkarsha (886 kg/ha) with a percentage increase of 26.95, 36.45, 29.38, 21.63, 17.55 and 13.86 per cent respectively (Table 1).

Performance of Phule Chetak (PM-707-5) in AICRP trials

The genotype Phule Chetak (PM-707-5) was tested in AICRP IVT (2018-19) all over India. The overall mean performance for one year in 24 trials showed that Phule Chetak (PM-707-5) recorded 885 kg/ha grain yield which was 23.43 per cent increase over the check variety AKM-8802 (717 kg/ha) (Table 1) (Anonymous, 2019).

Overall performance of Phule Chetak (PM-707-5) in station and multilocation trials

The genotype Phule Chetak (PM-707-5) was tested in total 40 trials comprising of 3 station trials and 37 multilocation trials in *kharif* season during 2012-13 to 2019-20. The overall mean performance for eight years in 40 trials reported that Phule Chetak (PM-707-5) recorded higher grain yield of 986 kg/ha as against check varieties *viz*., Vaibhav (773 kg/ha), BPMR-145 (735 kg /ha), AKM-8802 (775 kg/ha), BM-2002-1 (824 kg/ha), BM-2003-2 (853 kg/ha) and Utkarsha (886 kg/ha) with percentage increase of 27.55, 34.15, 27.23, 19.66, 15.59 and 11.29 per cent respectively (Table 1).

Performance of Phule Chetak (PM-707-5) in agronomic trial

The genotype Phule Chetak (PM-707-5) was tested for Agronomic performance at Oilseeds Research Station, MPKV, Jalgaon during 2019-20 under rainfed condition (Table 2) (Anonymous, 2020).

Effect of variety

The results revealed that the variety PM-707-5 recorded significantly higher number of pods per plant (21.28), number of grains per pod (13.90), test weight (4.83 g), grain weight per plant (4.72 g), grain yield (942 kg ha^{-1}) and haulm yield (2172 kg ha^{-1}) over the check variety Vaibhav (18.80, 12.52, 3.86 g, 3.92 g, 787 kg ha^{-1} and 2002 kg ha^{-1}, respectively). The same variety PM-707-5 also recorded the maximum net returns Rs. 38095 ha^{-1} and a B:C ratio of 2.19. However, both the varieties did not show any significant effect on growth parameters like plant stand, plant height, plant spread and number of branches.

Table 2: Crop production technology: Agronomy trial conducted at Jalgaon during *kharif* 2019. Effect of variety, spacing and fertilizer dose on seed yield, GMR, NMR and B:C ratio in mungbean.

Treatment	Initial plant stand	Final plant stand	Plant height (cm)	Plant spread (cm)	No. of branches/ plant	No. of pods/ plant	No. of grains/ pod	100 grain weight	Grain weight/ plant	Grain yield (kg/ha)	Haulm yield (kg/ha)	Gross monetary returns (Rs/ha)	Net monetary returns (Rs/ha)	B: C ratio
Variety (V)														
PM-707-5 (V_1)	273	258	85.25	11.50	4.43	21.28	13.90	4.83	4.72	942	2157	70011	38095	2.19
Vaibhav (V_2)	272	255	83.00	11.48	4.10	18.80	12.52	3.86	3.92	787	2002	58884	26969	1.85
SEm±	1.03	1.10	0.89	0.15	0.12	0.32	0.16	0.08	0.09	20.97	35.19	1434	1434	0.04
CD at 5%	NS	NS	NS	NS	NS	0.97	0.50	0.25	0.28	63.62	106.75	4351	4351	0.14
Spacing (S)														
30 × 10 cm (S_1)	328	312	88.42	11.37	4.30	20.50	13.03	4.26	4.30	889	2118	66268	34518	2.09
45 × 10 cm (S_2)	218	202	79.83	11.62	4.23	19.58	13.38	4.44	4.33	839	2041	62627	30546	1.95
SEm±	1.03	1.10	0.89	0.15	0.12	0.32	0.16	0.08	0.09	20.97	35.19	1434	1434	0.04
CD at 5%	3.14	3.35	2.70	0.45	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Fertilizer dose (F)														
100% RDF (F_1)	272	256	83.42	11.27	4.20	19.85	13.00	4.26	4.27	855	2049	63724	32028	2.01
125% RDF (F_2)	273	258	84.83	11.72	4.33	20.23	13.42	4.44	4.36	874	2110	65171	33036	2.03
SEm±	1.03	1.10	0.89	0.15	0.12	0.32	0.16	0.08	0.09	20.97	35.19	1434	1434	0.04
CD at 5%	NS	NS	1.70	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Effect of spacing

The growth attributes like initial and final plant stand (328, 312), plant height (88 cm) and number of branches (4.30) were recorded significantly higher under normal spacing 30 × 10 cm over broader spacing of 45 × 10 cm (218, 202, 80 cm, 4.23, respectively). But the plant spread at broader spacing (11.62 cm) recorded significantly higher than normal spacing (11.37 cm). However, all the yield attributes and economics shown non significant effect at varying levels of spacing.

Effect of fertilizer dose

Application of fertilizer doses (100% RDF and 125% RDF) to the green gram did not produce any significant effect on growth and yield attributes except at 125% of RDF recorded significantly higher plant height (85 cm) over 100% RDF (83 cm).

Reaction to major diseases

The candidate variety was tested at various locations under AICRP *viz.,* Raipur, Badnapur, Vamban, Akola, Berhampur, Dholi, Pantnagar, Lam, Sagar and SK Nagar against major diseases of mung bean. In 0-5 scale, the powdery mildew disease score in the variety Phule Chetak (PM-707-5) ranged from 1 to 2 as compared to check varieties 1 to 4. In 0-9 scale, the cercospora leaf spot disease score in this variety was in the range from 2 to 9 as compared to checks 3 to 9 and for mung bean yellow mosaic virus disease it ranged 1 to 3 as against 1 to 3 in checks. Also the stem rot disease percentage was ranged from 1.67 to 9.23% as compared to check varieties. Considering the overall performance, Phule Chetak (PM-707-5) has high level of resistance to powdery mildew, Cercospora Leaf Spot and mung bean yellow mosaic virus (Table 3a and 3b).

Ancillary characters of phule chetak (PM-707-5)

The ancillary data is reported in Table 4. The candidate variety Phule Chetak requires on an average 39.2 days for 50% flowering and 69.2 days for maturity. The no. of pods per plant (24.60) is less than Vaibhav, BPMR-145, BM-2003-2, AKM-8802 and Utkarsha, The mean plant height (56.84 cm) is less than Vaibhav, BM-2002-1, BPMR-145, BM-2003-2 and AKM-8802. The no. of branches per plant (3.68) is higher than all check varieties except Utkarsha. The no. of seeds per pod (13.20) is better than check varieties AKM-8802

Table 3a: Screening of PM-707-5 genotype against major diseases of mungbean at various locations under AICRP (*Kharif* 2018).

Diseases	Locations	PM-707-5	BM-4	AKM-8802	Kopergaon
Powdery mildew (0-5 scale)	Raipur	1.0	3.0	3.0	3.0
	Badnapur	2.0	1.0	1.0	1.0
	Vamban	1.0	3.0	0.0	1.0
	Akola	2.0	4.0	4.0	3.0
	Reaction	R	R	R	R
Cercospora leaf spot (0-9 scale)	Berhampur	4.0	5.0	6.0	7.0
	Dholi	2.0	3.0	3.0	3.0
	Pantnagar	4.0	9.0	6.0	5.0
	Lam	9.0	9.0	9.0	9.0
	Reaction	R	R	R	R
Mungbean yellow mosaic virus	Raipur	1.0	1.0	1.0	1.0
(MYMV) (0-9 scale)	Berhampur	1.0	1.0	1.0	1.0
	Sagar	2.0	3.0	3.0	3.0
	SK Nagar	1.0	3.0	2.0	1.0
	Badnapur	3.0	2.0	2.0	3.0
	Reaction	MR	MR	MR	MR

Source: Annual Report on MULLaRP- ICAR-IIPR, Kanpur 2018-19.

Table 3b: Reaction of PM-707-5 to major diseases recorded at Jalgaon under field conditions (*Kharif* 2017-19).

Diseases	Year	PM-707-5	Vaibhav	BPMR-145	Kopergaon
Powdery mildew (0-5 scale)	2017	23.31 (MR)	17.75 (MR)	21.54 (MR)	60.40 (S)
	2018	8.50 (R)	19.50 (MR)	7.70 (R)	69.50 (HS)
	2019	9.12 (R)	13.52 (MR)	12.76 (MR)	70.0 (HS)
Mean		13.64 (MR)	16.91 (MR)	13.98 (MR)	66.63 (HS)
Reaction		(MR)	(MR)	(MR)	(HS)
Cercospora leaf spot (0-5 scale)	2017	19.97 (MR)	62.51 (S)	25.64 (M.S)	65.00 (S)
	2018	12.50 (MR)	28.00 (MR)	15.50 (MR)	78.00 (HS)
	2019	17.08 (MR)	12.69 (MR)	20.46 (MR)	77.00 (HS)
Mean		16.51 (MR)	34.40 (MS)	20.53 (MR)	73.33 (HS)
Reaction		(MR)	(MS)	(MR)	(HS)

Table 4: Ancillary observations of phule chetak (PM-707-5) in comparison with checks.

Year	PM-707-5	Vaibhav	BM-2002-1	BPMR-145	BM-2003-2	AKM-8802	Utkarsha
Days to 50% flowering	39.2	41.0	40.0	40.4	39.2	38.8	39.0
Days to maturity	69.2	68.8	69.6	68.0	68.4	68.0	68.75
Plant height (cm)	56.84	57.30	68.24	61.26	59.64	57.26	44.10
No. of branches/plant	3.68	3.50	3.54	3.44	3.56	3.56	3.75
No. of pods/plant	24.60	27.42	22.92	25.62	28.00	28.02	24.87
100 seed weight (g)	4.77	3.61	4.58	4.65	4.61	4.11	4.22
No. of seeds/pod	13.20	13.66	14.20	13.70	13.58	13.08	11.36

Note: Figures in brackets indicate number of observations.

Table 5: Quality parameters of mungbean genotypes grown at Oilseeds Research Station, MPKV, Jalgaon.

Genotype	Milling quality				Cooking period (Min.)
	Clean dal (%)	Broken dal (%)	Churi + Gota (%)	Husk + whole seeds	
Phule Chetak (PM-707-5)	76.4	3.0	4.1	16.5	08
Vaibhav (C)	74.9	2.6	3.8	18.7	10
BM-2003-2 (C)	76.8	3.1	5.8	14.3	09
AKM-8802 (C)	75.7	2.6	5.3	16.4	12
Utkarsha (C)	76.2	3.6	4.2	16.1	11

Table 6: Nutritional quality of mungbean genotype phule chetak (PM-707-5).

Genotype	Nitrogen %	Dry seed protein %	Germinated seed protein %	Methionine %
Phule chetak (PM-707-5)	4.10	25.60	21.88	0.58
Vaibhav (C)	4.21	26.31	20.85	0.43
BM-2003-2 (C)	4.04	25.22	21.47	0.52
AKM-8802 (C)	3.78	23.62	20.56	0.46
Utkarsha (C)	4.02	25.14	20.89	0.55

- Total protein content was estimated by Micro Kjeldhal method.
- Methionine content was estimated by Spectrophotometric analysis done by Lowery method.

and Utkarsha. The 100 seed weight (4.77) is maximum amongst all varieties including checks.

Quality parameters

The genotype Phule Chetak (PM-707-5) was tested for different quality parameters *viz*; clean dal, broken dal, churi, gota, husk, cooking period. Overall this genotype contains 76.4 per cent clean dal, 3% broken dal having 4.1 per cent churi + gota and 16.5 husk + whole seeds. It is superior in cooking period (08 min) required than the check varieties (Table 5).

The genotype Phule Chetak (PM-707-5) was also tested for different nutritional quality parameters. This genotype contains 4.10 per cent nitrogen, 25.60% dry seed protein and 21.88 per cent germinated seed protein. It is superior in methionine (0.58%) content as compared to the check varieties (Table 6).

CONCLUSION

The new variety Phule Chetak developed at Oilseeds Research Station, MPKV, Jalgaon reported an average yield of 1003 kg/ha which is 26.96%, 36.46%, 29.42%, 21.72%, 17.58% and 13.21 per cent higher than the check varieties Vaibhav, BPMR-145, AKM-8802, BM-2002-1, BM-2003-2 and Utkarsha respectively. The leaves are dark green, stem is green coloured with pubescence. It is bold seeded having early maturity, moderately resistant to major diseases like powdery mildew, mungbean yellow mosaic virus under field conditions. Considering consistent performance, the mung bean genotype PM-707-5 has been released for cultivation in the *kharif* season for Maharashtra under the name of Phule Chetak by Varietal Release Committee in Joint Agresco during 29-30 October, 2020 held at Dr PDKV, Akola and State Seed Sub Committee meeting held by video conference on 2nd September, 2021 (Anonymous, 2021).

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