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Original Research Article

RELEASE OF NEW HIGH YIELDING MUNGBEAN VARIETY BAHAWALPUR-MUNG-17; SUITABLE FOR PUNJAB ESPECIALLY IN SOUTHERN PUNJAB (PAKISTAN)

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Abstract *Bahawalpur-Mung-17 was developed through a cross between VC-3726 an exotic line received from AVRDC, Thailand, and NM-36 which was a locally advanced line with the bold grain. Bahawalpur-Mung-17 was tested in a series of experiments for production technology and yield performance at the Regional Agricultural Research Institute, Bahawalpur and farmers' fields in Yazman, Rahim Yar Khan, Hasilpur, Bahawalpur with average yield of 1465 Kg ha-1 coupled with N:P: K dose at the rate of 23:34:25 Kg/ha gave maximum yield when planted in row-to-row distance of 45cm apart. Bahawalpur-Mung-17 yielded among all candidate lines included in the National Uniform Yield Trial (NUYT)-2013 and 2014 with an average yield of 1020 and 1028 Kg ha-1 respectively at 15 locations across the country, with the highest grain yield of 1380 Kg ha-1 at AZRI-Bahawalpur during 2013 and 2475 Kg/ha at NIAB-FSD. Bahawalpur-Mung-17 outclassed, among 18 candidate lines in 2013 and 14 candidate lines in 2014 across the country, and stood on top of the victory stand. Punjab Seed Council approved it for general cultivation in Punjab. Bahawalpur-Mung-17 gave 26 % more yield than check NM-2011 in 2013 and has 8.43 % more yield and potential than best check AZRI MUNG-2006 and NM-2011 and showed moderately resistant to disease Mungbean Yellow Mosaic Virus (MYMV) at maturity, morphologically different from existing mung bean varieties (light green) and drought resistant.*

Keywords: *Bahwalpur-Mung-17; Mode of Resistance; MYMV; High Yielder; Morphology*

Introduction

Mung-Bean [*Vigna radiata* (L.) Wilczek], is a native vegetable legume and one of the most important pulse crops in Pakistan. It is rich in dietary protein and poor in fatty compounds (Relyea, 2024). Nowadays, this mung bean protein has great popularity due to its use in the food industry because of its huge amount of nutritional value and other functional properties. Its protein has the potential to compete with the proteins of other plant-based products, meat protein, and other types of nutritional proteins. Thus it is considered a high-quality plant protein resource (Abbas et al., 2024; Awan et al., 2024; Feng et al., 2024; Rasheed et al., 2024). Mung bean protein has great importance for human life due to its bioactivity, anti-diabetic, antioxidant, and anti-cancer activity (Huang et al., 2024). Pulses are mainly grown in Punjab, near about 85% of the Pulses in Pakistan are grown in Punjab, and the remaining 15% are grown in other areas of Pakistan. However, its average yield compared to other international countries is very low (Junaid and Gokce, 2024; Vanzetti et al., 2017). The main reason for low yield in Pakistan is due to biotic and abiotic factors, among abiotic factors i.e. MYMV, and drought is a serious issue of low yield of Pakistan (Abhishek et al., 2024; Haider et al., 2023; Islam et al., 2024). According to the economic survey of Pakistan, the total production of Mungbean in Pakistan 2022-23 and 2023-24 is 135,000 Tons and 153,000 Tons respectively (Economic survey of Pakistan 2022-24) while domestic consumption in Pakistan is 5Kg per person annually less than developed countries but its production is enhanced by the more availability of pulses crops but it's consumption should be increase due to its anti-oxidant and anti-diabetic activity and used for the maintenance of cardiovascular disease (Malik et al., 2024a; Malik et al., 2024b; Malik et al., 2024c;

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Venkidasamy et al., 2019). To overcome this gap the Pakistan Government has to spend a large amount of foreign exchange. Now it was the need of time to develop such a variety to overcome the gap between production and demand, so a hybridization program was initiated and a variety named Bahawalpur-Mung-17 was developed to boost up the existing production of the pulses crop.

Materials and Methods

Bahawalpur-Mung-17 was developed through the method of hybridization attempted involving an exotic genotype VC-3726, high yield potential in adaptability in the Agro-climatic conditions of Pakistan and susceptible to MYMV, and local Mungbean genotype NM-36; short stature, and resistant to MYMV were hybridized at Regional Agricultural Research Institute, Bahawalpur following the crossing technique of (Khattak et al., 1998). This institute is located in Punjab, Pakistan with latitude and longitude of 29.35° N and 71.69° E respectively. The soil used for the experiment was sandy loam with organic matter, nitrogen, and phosphorus. The summer season remained very harsh due to its semi-arid climate with uncertain rains during monsoon. The location of the experiment is 117-118m above sea level. The average temperature of Bahawalpur during summer and winter is 46 °C and 4 °C respectively. The relative humidity of the site varies from 58% to 78%. The annual rainfall in this city is 143mm per year (Waseem and Breuste, 2023) which was very low because in this area a low amount of precipitation and relative humidity occurred. F_1 generation of the cross was planted in 2003 and the hybrid plant was harvested individually. The F_2 population was raised as plant progeny rows for selecting high-yielding recombinants with resistance to MYMV during Kharif 2004. Chemical spray was avoided to minimize the natural population of white fly (*Bemisia tabaci*) in the experimental area. The high-yielding and MYMV-resistant plants were selected. Generation of the selected recombinants was advanced to confirm its breeding behavior oblique genetic stability for desired traits, MYMV screening during. The layout for these trials was a Randomized Complete Block Design (RCBD) followed by Salinas Ruíz et al. (2024) with plant-to-plant and root-to-root spacing was 10 and 30 cm respectively. The row was four meters long and the number of rows in preliminary yield trials was 4, and in all other trials 6 rows per plot per replication. The yield trial data were analyzed according to Steel et al. (1997).

Results

The variety Bahawalpur-Mung-17 was studied in replicated preliminary yield trials, regular, advanced trials, adaptation trials, and zonal trials from 2008-2013. Single Row Hand Drill (SRHD) was used for sowing purposes. For comparison, two commercial cultivars were used as a check in every experiment. Lastly, the candidate line was tested in the National Uniform Yield Trials (NUYT). These trials were managed independently by the National Coordinator of Legumes. Pakistan Agriculture Research Council, Islamabad at 11 locations in 2013 and 11 locations in 2014 throughout the country. Whereases, crop management practices sowing time, soil, and climatic conditions varied in all the experimental locations of Pakistan. The experimental data of every individual location was collected in averaged and then converted for evaluation to Kg ha^{-1}. Furthermore, statistical techniques were used for comparison. All necessary measures from hybridization to final approval of Bahawalpur-Mung-17 are represented in Table 1.

Table No.1: Trials and time of growing

Sr. No.	Trial/Generation	Year
1	F_0	2002 cross attempted
2	F_1	2003
3	F_2	2004
4	F_3	2005
5	F_4	2006
6	F_5	2007
7	Preliminary yield trial	2008
8	Regular trial	2009
9	Advance trial	2010
10	Zonal trial	2011
11	Adaptation trial	2012
12	Adaptation trial	2013
13	NUYT	2013
14	NUYT	2014

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Table 2a: PRELIMINARY YIELD TRIAL 2008

Sr. No.	V. Code	Yield (kg/ha)
1	BAHAWALPUR-MUNG-17	1615
2	CH MUNG-06	1068
3	AZRI MUNG-06	1042

* Strain BAHAWALPUR-MUNG-17 gave highest yield than best check CH MUNG-06 with a % increase of 51.21 %

Table 2b: REGULAR YIELD TRIAL 2009

Sr. No.	V. Code	Yield (kg/ha)
1	BAHAWALPUR-MUNG-17	1350
2	CH MUNG-06	1180
3	AZRI MUNG-06	1150

* Strain BAHAWALPUR-MUNG-17 gave highest yield than best check CH MUNG-06 with a % increase of 14.40 %

Table 2c: ADVANCE YIELD TRIAL 2010

Sr. No.	V. Code	Yield (kg/ha)
1	BAHAWALPUR-MUNG-17	555
2	CH MUNG-06	370
3	AZRI MUNG-06	416

* BAHAWALPUR-MUNG-17 gave highest yield than best check AZRI MUNG-06 with a % increase of 33.41 %

Table 2d: ZONAL YIELD TRIAL 2011

Sr. No.	V. code	YIELD (kg/ha)				Average
		Yazman	Rahim yar khan	Hasilpur	Bahawalpur	
1	BAHAWALPUR-MUNG-17	1065	1250	1180	1590	1271.25
2	AZRI MUNG-06	990	1270	1030	1480	1192.50

* BAHAWALPUR-MUNG-17 gave highest yield than best check AZRI MUNG-06 with a % increase of 6.60 %

Table 2e: MUNGBEAN ADAPTATION YIELD TRIAL AT RARI, BAHAWALPUR 2012

Sr. No.	V. Code	Description	Yield (kg/ha)
1	BAHAWALPUR-MUNG-17	Strain	1655
2	AZRI MUNG-06	Check	1458
3	CH.MUNG-2006	Check	1644

* Strain BAHAWALPUR-MUNG-17 gave highest yield than best check CH MUNG-06 with a % increase of 0.66 %

Soil Chemistry Studies

The fertilizer (NPK) requirement for the variety was studied for two years (2014-15) and presented in Table No.3. From the results, it is obvious that Bahawalpur-Mung-17 gave the highest yield (1465 Kg/ha) when fertilized with 23:34:25 Kg NPK ha^{-1} respectively. So, it is evident from the experiment that the variety is responsive to fertilizers.

Table 3: Fertilizer Requirements for Bahawalpur-Mung-17 for the year 2014 & 2015

Sr. No.	TREATMENT (N-P-K Kg/ha)	GRAIN YIELD Kg/ha		
		2014	2015	AVERAGE
1	0-0-0	550	632	591
2	0-34-25	1020	1115	1068
3	12-34-25	1185	1367	1276
4	**23-34-25**	**1460**	**1470**	**1465**
5	36-34-25	1490	1525	1508
6	23-0-25	960	1149	1055

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7	23-23-25	1210	1299	1255
8	23-46-25	1520	1504	1512
9	23-34-0	1290	1381	1336
10	23-34-12	1415	1472	1444
11	23-34-36	1480	1497	1489
		LSD: 117	**LSD: 151**	**LSD: 134**

* Recommended dose of NPK for BAHAWALPUR-MUNG-17 is 23-34-25 kg/ha

Agronomical Studies

Weedicide studies showed that the maximum yield of the variety Bahawalpur-Mung-17 gave 1404 Kg/ha was obtained where Pendimethalin was applied as a pre-emergence herbicide to control all types of weeds in the variety (Table No.4).

Table 4: EFFICACY OF WEEDICIDE AND WEED CONTROL PRACTICES IN MUNGBEAN 2015 SEED GRAIN YIELD Kg/ha FOR STRAIN BAHAWALPUR-MUNG-17

PRACTICE	MEAN
Control	697 e
Hand weeding	1065 d
Pendimethalin	1458 a
Dual gold	1273 c
Halt	1366 b
Quizlofop	1361 b

LSD at 0.05: 81.72

Entomological and Plant Pathological Studies

The response of the Bahawalpur-Mung-17 variety revealed that the candidate variety shows the highest population of white flies as compared to checks as shown in Table No.5. Whereas pathological studies revealed that the candidate variety showed more resistance against the disease MYMV than the control varieties (Table 6a & 6b).

Table 5: AVERAGE POPULATION OF WHITE FLY PER LEAF

Variety/strain	Kharif 2011	Kharif 2012	Kharif 2013	Avg. of three years
BAHAWALPUR-MUNG-17	2.78	3.40	5.70	3.96
CH MUNG-06	2.19	2.63	4.10	2.97
AZRI MUNG-06	1.78	2.32	3.20	2.43

* Results of three years show the highest population of white fly on BAHAWALPUR-MUNG-17 as compared to checks

Table 6a: STUDIES OF MYMV ON THE STRAIN BAHAWALPUR-MUNG-17 in year 2015

Sr. No.	V. CODE	DISEASE (MYMV) % AGE	STATUS
1	BAHAWALPUR-MUNG-17	15 %	RESISTANT
2	NM-11 (CHECK)	70 – 80 %	HIGHLY SUSCEPTIBLE
3	PIGEON PEA	70 %	-DO-
4	MASH(susceptible check)	80 %	-DO-

Table 6b: STUDIES OF MYMV ON THE STRAIN BAHAWALPUR-MUNG-17 2016

Sr. No.	V. CODE	DISEASE (MYMV) % AGE	STATUS
1	BAHAWALPUR-MUNG-17	15 – 20 %	RESISTANT
2	MASH (CHECK)	80 %	HIGHLY SUSCEPTIBLE

Summary the Station and Out-Stations Trial

Table 7: MUNGBEAN NATIONAL UNIFORM YIELD TRIAL 2013

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Sr. No.	NARC, ISLAMABAD	AARI, FSD	NIAB, FSD	AZRI, BHK	AZRI, BWP	BARI, CHK	ARI, SWAT	AZRI, D.G.K	BARS, FATEH JANG	ARI, SARIAB	RARI, BWP	MEAN
BAHAWALPUR-MUNG-17	500	978	2031	264	**1380**	1160	953	634	688	475	2153	1020
NM-11	467	786	1781	249	1022	1167	822	205	580	459	1389	812

CV = 13.93 %

***** Bahawalpur-Mung-17 gave 26 % more yield than check NM-2011

Table 8: MUNGBEAN NATIONAL UNIFORM YIELD TRIAL 2014

SR. NO.	NARC, ISLAMABAD	BARI, CHK	BARS, FATEH JANG	NIAB, FSD	AZRI, BHK	NIFA, PESHAWAR	AARI, FSD	ARI, SWAT	RARI, BWP	ARS, KARAK	AZRI, BWP	MEAN
BAHAWALPUR-MUNG-17	710	486	872	**2475**	323	1684	740	622	1458	1055	885	1028
AZRI MUNG-06	620	555	601	2114	403	1639	381	551	1285	1000	1282	948
NM-2011	533	569	326	2820	548	1479	510	337	1285	815	890	919
NM-06	487	604	644	2058	317	1549	514	661	1702	916	779	930

CV: 20.01 %

* The BAHAWALPUR-MUNG-17 gave about 8.43 % more yield than best check AZRI MUNG-2006

Table 9: SUMMARY OF YIELD TRIALS OF THE STRAIN BAHAWALPUR-MUNG-17

V. CODE	NAME OF THE TRIAL							
	Preliminary (2008)	Regular (2009)	Advance (2010)	Zonal (2011)	Adaptation		NUYT	
					2012	(2013)	2013	2014
BAHAWALPUR-MUNG-17	1615	1350	555	1271	1655	1051	1020	1028
CH MUNG.06	1068	1180	370	-	1644	915	-	-
AZRI MUNG.06	1042	1150	416	1193	1458	-	-	948
NM-11	-	-	-		-	688	812	919
NM.06	-	-	-		-	-	-	930
% increase over best check	51.21 %	14.40 %	33.41 %	6.53 %	0.66 %	14.86 %	25.61 %	8.43 %

Discussions

Ayub Agricultural Research Institute (AARI), Faisalabad, has evolved several high-yielding Mungbean varieties through hybridization using AVRDC germplasm for Punjab (Ali et al., 1997). These varieties can't perform well in Punjab due to variations in Agro-climatic conditions (Khattak et al., 2008). The newly evolved variety Bahawalpur-Mung-17 by RARI, Bahawalpur showed improvement by enhancing the seed size, decline in plant height, stiff stem, and earliness in maturity by a margin of about 10 days with a comparison of other standard varieties. The bold seed size in mung bean is the major contributing factor to the yield of Mungbean (Khattak et al., 2006; Khattak et al.,

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All authors contributed equally.

Conflict of interest

There is no conflict of interest among the authors of the manuscript.