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Research Article

High Yielding Mungbean [Vigna radiata (L.) Wilczek] Variety "NIFA Mung-2017"

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Abstract

National yield of mungbean is low as compared to other countries, mainly due to shortage of commercial mungbean varieties. To address this issue, an exotic Mungbean Yellow Mosaic Virus (MYMV) susceptible accession VC 1973A and a local MYMV resistant genotype NM 92 were crossed (VC 1973A x NM 92) at the experimental field of the Nuclear Institute for Food and Agriculture (NIFA), Peshawar during kharif 2004. Selection for best recombinant lines based on high yield (more pods per plant), resistance to MYMV, semi erect plant type in early segregating populations, and genetic stability in F_2 - F_5 generations for the desired traits was carried-out from 2005 to 2010. The high yielding recombinant "NFM-6-5" along with other advanced lines and local standard variety "Ramzan" were screened for MYMV resistance, and tested for seed yield and other related components in various yield trials i.e. preliminary, advanced, multi-locations and National Uniform Yield trials from 2011-2015. Results revealed that recombinant "NFM-6-5" produced up to 2283 kg ha^{-1} seed yield in replicated yield trials with 25-30% higher seed yield compared to the check variety "Ramzan" in various yield trials. More number of pods per plant and large seed size are the main primary yield contributing components in NIFA Mung-2017 (recombinant "NFM-6-5"). NIFA Mung - 2017 is a promising variety with different genetic background from earlier mungbean varieties. Khyber Pakhtunkhwa Provincial Seed Council approved the recombinant "NFM-6-5" as a commercial variety with name "NIFA Mung-2017" for general cultivation in Khyber Pakhtunkhwa (KP) on 19th September 2017.

Keywords: Disease resistance; Mungbean; NIFA Mung-2017; Seed yield; Variety; Yield components

Introduction

Mungbean (*Vigna radiata* L. Wilczek) is a warm season crop cultivated on fields with poor fertility which do not support season's cereal and cash crops in Pakistan. Thus, these crops are unable to compete with mungbean on these resource-poor soils due to meager financial returns to the farmers. Since pulses are grown on marginal fields in rainfed areas, grain yield is therefore the most important parameter for its growers. Like other smallholding farmers, pulses

growers take only in to consideration the high seed yield of new cultivars [1, 2]. For enhancing pulses productivity, a continuous inflow of improved and competitive varieties is the primary requirement to substitute the old ones. Benefits from new varieties with improved yield potential can be realized through rapid delivery of these varieties to farmers [3, 4].

Mungbean improvement programs are being carried-out in the Khyber Pakhtunkhwa (KP) and six commercial cultivars i.e., "Karak Mung-1" in 2003, "Swat Mung" in 2004, Ramzan in 2005 [5], Dera Mung in 2009, Inqilab Mung in 2013 and Sona Mung in 2014 have so far been approved in KP for general cultivation. The per unit mungbean yield increase (from 358 kg ha^{-1} in 1947 to 776 kg ha^{-1} in 2015) is mainly the result of the development of improved mungbean varieties with yield potential [6]. In current and near future scenario, development of varieties with high seed yield seems to be the practical solution to increase mungbean production in the country. There exists a reasonable potential to increase both area and production through evolution of mungbean varieties with better seed yield potential and suitability for key mungbean growing areas in Pakistan. The new mungbean variety "NIFA Mung-2017" has been developed through classical hybridization technique by crossing indigenous and exotic genotypes. Based on its different genetic background compared with earlier mungbean varieties in KP, NIFA Mung – 2017 is one of the practical options for harvesting high yields.

The current manuscript describes the development of new mungbean variety "NIFA Mung-2017".

Materials and methods

Experimental materials and field trials

An exotic Mungbean Yellow Mosaic Virus (MYMV) susceptible accession "VC 1973A" received from World Vegetable Centre, Taiwan and a local MYMV resistant genotype "NM 92" were crossed (VC 1973A x NM 92) at the research farm of Nuclear Institute for Food and Agriculture (NIFA), Peshawar in kharif 2004 following an efficient crossing technique [7].

F_1 generation was raised in summer 2005 and individually harvested and bagged all recombinant plants. F_2 population was subsequently raised in kharif 2006. VC 1560D (a highly MYMV susceptible check) was used as spreader in segregating population/screening nurseries. Single plants were selected on the basis of desired criteria i.e. high yield, better plant type and disease resistance. The selected plant material was further tested in advanced generations for confirmation of breeding behavior/genetic stability of the above-mentioned traits from 2006 - 2010.

During 2011 – 2015, fifteen recombinant lines finally selected from the generations mentioned above, were tested for yield and related traits along with local and national check in various yield trials i.e. preliminary, advanced, multi-locations and National Uniform Yield trials. Yield performance experiments were conducted in "Randomized Complete Block Design (RCBD)" keeping 10 cm and 30 cm distance between plants and rows, respectively. Each plot in each experiment was replicated thrice keeping 4 m row length. Preliminary yield trials were sown in four rows, whereas advanced lines yield trials were sown in six rows. Disease reaction data was recorded as reported by Khan et al. [8].

Statistical analysis

Analysis of Variance (ANOVA) for yield trials was worked out using standard procedure [9], and means were compared using Least Significant Difference (LSD) test at 5% probability level.

Based on high yield potential, disease resistance and different genetic background, recombinant line "NFM-6-5 was finally

selected, and its breeding history with proposed name "NIFA Mung – 2017" in chronological order is depicted in (Table 1).

Table 1. Breeding history of NIFA Mung-2017

S #	Year	Filial Generation. /Trial	Remarks
1	Kharif 2004	F_0	NM 92 and VC 1973A were crossed
2	Summer 2005	F_1	All recombinant plants were harvested
3	Kharif 2006	F_2	MYMV resistant and high yielding single plant selections
4	Kharif 2007	F_3	Confirmation of breeding behavior and single plant selections
5	Kharif 2008-2010	F_4/F_5	Generation advancement, screening for disease and single lines with high yield were selected
6	Kharif 2011-2015	Evaluation in yield trials	NFM-6-5 was tested in various mandatory yield trials and screened for MYMV in screening nurseries

Results and discussion

Results of replicated/non-replicated yield trials are shown in (Table 2-11). First, in preliminary yield trials conducted during kharif 2011 and 2012, NFM-6-5 produced statistically significant and higher grain yield of 1708 and 1830 kg ha^{-1}, respectively compared with check variety 'Ramzan' (1140 kg ha^{-1} and 1333 kg ha^{-1}, respectively) (Table 2 & 3). Second in advanced lines yield trials planted during kharif 2014 and 2015, NFM-6-5 gave statistically significant and higher grain yields of 1986 kg ha^{-1} and 1744 kg ha^{-1}, respectively than Ramzan (1378 kg ha^{-1} and 1158 kg ha^{-1}, respectively) (Table 4 & 5). Moreover, NFM-6-5 produced statistically significant higher grain yields of 2283 kg ha^{-1} and 833 kg ha^{-1} at Arid Zone Agriculture Research Centre (AZRC), D. I. Khan compared to the standard check variety Ramzan (1824 kg ha^{-1} and 667 kg ha^{-1}) in adaptation yield trials planted in kharif 2014 and 2015, respectively (Table 6). NFM-6-5 showed 25% increase in seed yield over check variety Ramzan on the basis of average seed yield of two years. Similarly, in adaptation yield trial conducted at Agricultural Research Station (ARS), Karak during 2014, NFM-6-5 exhibited significantly the highest seed yield of 834 kg ha^{-1} with 30% increase in seed yield over Ramzan (Table 7). In non-replicated yield trial planted on farmer's field at Parachinar, Kuram during 2014 and 2015, NFM-6-5 produced the highest averaged grain yield of 1339 kg ha^{-1} as compared to other entries as well as the check variety Ramzan (Table 8). The results of National Uniform Yield trials planted at different location across the country are shown in (Table 9 & 10). The grain yield of NFM-6-5 was 889 kg ha^{-1} and 929 kg ha^{-1} compared to check variety (NM-2011) grain yield of 812 kg ha^{-1} and 919 kg ha^{-1} during 2013 and 2014, respectively. A substantial number of new mungbean varieties with high grain yield potential in Punjab and few in KP have been developed through irradiation as well as hybridization for the respective agro-climatic conditions **[10, 11]**. Our results also showed that NIFA Mung-2017 (recombinant "NFM-6-5") produced higher seed yield in all replicated and non-replicated yield trials as compared to the local as well as national check varieties. High yield potential is one of the important traits for a commercial variety to be acceptable in market **[12]**.

Table 2. Results of preliminary yield trial planted in kharif 2011 at NIFA, Peshawar

Entry	Parentage	Days to flowering	Days to maturity	Plant height (cm)	1000 grains' weight (g)	Yield (kg ha^{-1})
NFM-3-3	VC 3726 x NM 36	45	70	68	53	1007
NFM-6-5	VC 1973A x NM 92	40	68	67	52	1708
NFM-7-6	VC 1560D x NM 92	44	70	63	52	1052
NFM-7-13	-do-	38	68	58	53	1130
NFM-8-1	NM 93 x NM 92	39	66	61	54	1354
NFM-8-22	-do-	41	66	61	55	952
NFM-11-3	NM 92 x B. mung	44	69	62	52	1046
NFM-12-3	VC 1482C x N M92	45	69	68	46	829
NFM-12-6	-do-	42	71	66	46	1248
NFM-12-7	-do-	43	70	71	49	1047
NFM-13-1	6601 x NM 92	40	69	64	48	1135
NFM-13-8	6601 x NM 92	46	72	72	40	541
NFM-14-3	NM 92 x P. Baisaki	42	66	67	53	951
NFM-14-5	-do-	47	69	60	38	750
NFM-14-6	-do-	41	66	57	46	800
Ramzan (Check)	VC 1482C x NM 92	39	70	65	50	1140
CV		0.51	0.75	1.02	0.64	14.79
LSD 5%		1.05	1.53	2.09	1.30	50.63

Table 3. Results of preliminary yield trial planted in kharif 2012 at NIFA, Peshawar

Entry	Parentage	Days to flowering	Days to maturity	Plant height (cm)	1000 seed weight (g)	Yield (kg ha^{-1})
NFM-3-3	VC 3726 x NM 36	39	79	69	51	1806
NFM-6-5	VC 1973A x NM 92	37	76	69	49	1830
NFM-7-6	VC 1560D x NM 92	36	75	65	50	1642
NFM-7-13	-do-	38	77	67	53	1410
NFM-8-1	NM 93 x NM 92	35	76	71	48	1656
NFM-8-22	-do-	39	76	68	54	1642
NFM-11-3	NM 92 x B. mung	37	75	61	51	1760
NFM-12-3	VC 1482C x NM92	37	77	62	44	1333
NFM-12-6	-do-	38	75	65	56	1524
NFM-12-7	-do-	38	76	69	46	1358
NFM-13-1	6601 x NM 92	37	76	69	56	1688
NFM-13-8	-do-	39	79	70	34	1111
NFM-14-3	NM 92 x P. Baisaki	37	74	63	50	1622
NFM-14-5	-do-	40	75	66	36	1507
NFM-14-6	-do-	36	77	63	44	1583
Ramzan (Check)	VC 1482C x NM 92	38	76	62	47	1333
CV		0.49	0.82	1.69	0.85	14.65
LSD 5% level		1.90	2.21	6.34	0.61	167.84

Table 4. Results of advanced lines yield trial planted in kharif 2014 at NIFA, Peshawar

Entry	Parentage	Days to flowering	Days to maturity	Plant height (cm)	1000 seed weight (g)	Yield (kg ha^{-1})
NFM-3-3	VC 3726 x NM 36	32	88	83	51	2014
NFM-6-5	VC 1973A x NM 92	34	85	79	49	1986
NFM-7-6	VC 1560D x NM 92	33	90	78	55	2028
NFM-8-1	NM 93 x NM 92	32	90	74	53	1924
NFM-8-22	NM 93 x NM 92	34	89	80	54	2035
NFM-11-3	NM 92 x B. mung	33	90	85	49	2143
NFM-12-6	VC 1482C x NM 92	34	90	59	43	2028
NFM-13-1	6601 x NM 92	33	90	68	43	1983
NFM-14-3	NM 92 x P. Baisaki	32	91	75	49	1896
NFM-14-6	-do-	33	90	52	45	1819
Ramzan (Check)	VC 1482C x NM 92	34	90	70	44	1378
CV		1.4	1.6	3.7	2.1	10.5
LSD 5%		2.8	5.8	6.8	4.6	225

Table 5. Results of advanced lines yield trial planted in kharif 2015 at NIFA, Peshawar

Entry	Parentage	Days to flowering	Days to maturity	Plant height (cm)	1000 seed weight (g)	Yield (kg ha^{-1})
NFM-3-3	VC 3726 x NM 36	43	89	83	57	1600
NFM-6-5	VC 1973A x NM 92	45	79	78	48	1744
NFM-7-6	VC 1560D x NM 92	43	87	86	53	1167
NFM-8-1	NM 93 x NM 92	42	75	84	53	1597
NFM-8-22	NM 93 x NM 92	44	90	89	56	1678
NFM-11-3	NM 92 x B. mung	48	89	94	52	878
NFM-12-6	VC 1482C x NM 92	46	90	84	44	1206
NFM-13-1	6601 x NM 92	45	91	94	46	894
NFM-14-3	NM 92 x P. Baisaki	44	90	85	47	1172
NFM-14-6	-do-	45	79	89	47	1197
NFM-14-7	-do-	45	91	94	48	844
NFM-5-63-1	VC 1482E x NM 92	47	91	94	49	911
NFM-5-63-2	-do-	46	89	88	52	1606
NFM-5-63-3	-do-	46	91	93	51	1736
NFM-5-63-5	-do-	46	90	97	56	1356
Ramzan (Check)	VC 1482C x NM 92	48	81	69	46	1158
CV		3.1	3.5	5.2	3.2	7.0
LSD 5% level		4.2	6.1	6.9	4.8	152

Table 6. Results of adaptation yield trial planted at AZRC, D. I. Khan in kharif 2014 & 2015

Entry	Parentage	Days to flowering	Days to maturity	Plant height (cm)	Yield Kg ha^{-1}			% increase over check
					2014	2015	Ave.	
NFM-5-36-24	VC 1482C x NM 92	43	76	76	1988	767	1378	11
NFM-5-36-26	VC 1482C x NM 92	43	76	71	1979	774	1377	11
NFM-6-5	VC 1973A x NM 92	44	79	76	2283	833	1558	25
NFM-92-2-8	Mutant from NM 92	42	75	76	1819	778	1299	4
NFM-92-2-31	Mutant from NM 92	42	75	76	2247	712	1480	19
Ramzan (Check)	VC 1482C x NM 92	44	77	70	1824	667	1246	-
CV		1.7	1.8	3.7	19.2	15.5		
LSD (5%)		2.4	4.8	5.8	215	145		

Table 7. Results of adaptation yield trial planted at Karak in kharif 2014

Entry	Parentage	Days to flowering	Days to maturity	Plant height (cm)	Yield Kg ha^{-1}	% increase over check
NFM-5-36-24	VC 1482C x NM 92	46	66	36	628	-
NFM-5-36-26	VC 1482C x NM 92	45	66	31	566	-
NFM-6-5	VC 1973A x NM 92	48	71	36	834	30
NFM-92-2-8	Mutant from NM 92	45	65	36	528	-
NFM-92-2-31	Mutant from NM 92	43	64	36	642	0.5
Ramzan (Check)	VC 1482C x NM 92	47	69	30	639	
CV		1.3	1.4	3.2	14.5	
LSD (5%)		2.2	4.5	4.1	138	

Table 8. Results of adaptation yield trial planted on farmer's field at Parachinar, Kuram Agency in kharif 2014 & 2015

Entry	Parentage	Days to maturity	Plant height (cm)	Yield Kg ha^{-1}			% increase over check
				2014	2015	Ave.	
NFM-5-36-24	VC 1482C x NM 92	72	76	950	1467	1209	6
NFM-5-36-26	VC 1482C x NM 92	70	72	1070	1346	1208	6
NFM-6-5	VC 1973A x NM 92	75	78	1175	1502	1339	17
NFM-92-2-8	Mutant from NM 92	71	70	812	910	861	-
NFM-92-2-31	Mutant from NM 92	75	63	835	1087	961	-
Ramzan (Check)	VC 1482C x NM 92	74	68	1020	1260	1140	

Table 9. Results of Mungbean National Uniform Yield Trial planted across the country in kharif 2013

Entry Name	Locations (Yield kg ha^{-1})											Average
	1	2	3	4	5	6	7	8	9	10	11	
NIFA MUNG-1	472	843	1677	267	604	1083	1094	156	549	495	1354	781
NIFA MUNG-2	388	736	1587	274	1073	1167	911	237	642	613	1493	829
NIFA MUNG-3	635	663	1698	290	1136	1236	944	318	559	561	1736	889
V1/08009	624	901	1441	278	972	1076	993	537	642	560	1736	887
V2/07009	553	763	1531	283	1248	931	817	523	705	528	2222	918

V3/07006	299	658	1861	261	1464	1063	922	380	531	596	1979	910
BRM-311	500	978	2031	264	1380	1160	953	634	688	475	2153	1020
NM-9	656	656	1618	265	992	1194	938	284	819	543	1545	865
NM-12	736	674	1931	336	853	1264	1117	926	649	584	2153	1020
NM-13	573	668	1951	319	1581	1063	900	376	740	588	2014	979
Dera AZRI-01	813	664	1556	285	1124	1146	819	527	688	482	2431	958
NCM-257-10	748	656	545	268	756	597	1088	193	590	472	1632	686
NCM-252-10	604	703	1177	288	907	1132	1057	251	625	518	2049	846
AZ-MH-1	649	734	1667	249	991	903	994	467	740	442	1875	883
AZ-MH-2	681	776	1500	256	1005	903	944	191	642	536	2188	875
NM-2011 (Check)	467	786	1781	249	1022	1167	822	205	580	459	1389	812

Locations

Location code	Location	Location code	Location
1	NARC, Islamabad	7	ARI (North) Mingora, Swat
2	AARI, Faisalabad	8	AZRI, D. I. Khan
3	NIAB, Faisalabad	9	BARS, Fateh Jang
4	AZRI, Bhakkar	10	ARI, Sariab, Quetta
5	AZRI, Bahawalpur	11	RARI, Bahawalpur
6	BARI, Chakwal		

Table 10. Results of Mungbean National Uniform Yield Trial planted across the country in kharif 2014

Entry Name	Locations (Yield kg ha^{-1})											Average
	1	2	3	4	5	6	7	8	9	10	11	
BRM-311	710	486	872	2475	323	1684	740	622	1458	1055	885	1028
NCM-257-10	763	556	611	1742	229	1885	383	588	1389	703	821	879
NCM-252-10	862	521	486	2006	403	1892	389	768	1025	787	913	914
NIFA MUNG-1	527	514	274	1756	569	1899	548	456	1024	833	783	835
NIFA MUNG-2	567	563	375	1591	667	1795	500	547	1389	759	1200	905
NIFA MUNG-3	710	576	306	2214	560	1625	489	740	1181	926	891	929
V1/07008	477	452	552	3142	565	1493	621	535	764	1148	786	958
V2/07006	554	340	499	1953	576	1535	806	695	1563	861	902	935
V3/08009	716	479	649	2119	672	1431	622	346	1458	1047	1044	962
NM-14	607	465	475	2717	715	1549	507	422	903	1166	835	942
NM-12	539	562	482	2183	493	1565	563	388	1493	907	1051	930
NM-13	426	451	399	1997	524	1601	528	467	1667	926	903	899
NM-15	399	563	677	1978	470	1556	307	373	798	903	1265	844
09TM-11	512	583	688	2092	242	1570	614	667	798	1083	1008	896
AZ-MH-1	546	438	285	2469	367	1545	615	631	1285	833	990	909
AZ-MH-4	632	521	403	2128	395	1583	489	526	1250	991	1000	901
AZ-MY	470	576	650	2386	329	1625	601	544	1250	861	1014	937
NM-2011 (Check)	533	569	326	2820	548	1479	510	337	1285	815	890	919

Locations

Location code	Location	Location code	Location
1	NARC, Islamabad	7	AARI, Faisalabad
2	BARI, Chakwal	8	ARI (North) Mingora, Swat
3	BARS, Fateh Jang	9	RARI, Bahawalpur
4	NIAB, Faisalabad	10	ARS, Karak
5	AZRI, Bhakkar	11	AZRI, Bahawalpur
6	NIFA, Peshawar		

Results of disease (MYMV) reaction analysis of NFM-6-5 in comparison with parents and standards conducted during 2008, 2009 and 2011 at NIFA, Peshawar are presented in (Table 11) using 0-8 scale (Table 12). The results showed that NFM-6-5 was consistently resistant to MYMV disease, whereas one of the parents (VC 1973A) was consistently highly susceptible to MYMV disease. Resistance to MYMV coupled with high grain yield makes NIFA Mung-2017 (NFM-6-5) a promising commercial variety for the mungbean growing areas of the KP, as resistance to disease(s) occurring under prevailing environmental conditions is the key to protection of potential yield and success of a given crop's commercial variety. MYMV resistance is the result of accumulation of more favorable modifying genes in an individual genotype **[13],** and the different genetic back ground of NIFA Mung-2017 hints about accumulation of such genes in this variety.

Table 11. Results of disease reaction analysis carried out in kharif 2008, 2009 and 2011

Entry	Mungbean Yellow Mosaic Virus disease rating during								
	2008 at NIFA, Peshawar			2009 at NIFA, Peshawar			2011 at NIFA, Peshawar		
	% Infection	Score	Rating	% Infection	Score	Rating	% Infection	Score	Rating
NFM-5-36-24	7.1	2	R	6.9	2	R	7.4	2	R
NFM-5-36-26	6.8	2	R	7.8	2	R	7.2	2	R
NFM-6-5	6.5	2	R	7.6	2	R	7.3	2	R
NFM-92-2-8	4.3	1	HR	4.5	1	HR	4.4	1	HR
NFM-92-2-31	4.6	1	HR	4.2	1	HR	4.2	1	HR
NM 92 (Local parent)	4.2	1	HR	4.5	1	HR	4.3	1	HR
VC 1973A (Exotic parent)	95.6	8	HS	97.4	8	HS	96.7	8	HS
Ramzan (Check)	7.1	2	R	6.7	2	R	6.8	2	R

R: Resistant; HR: Highly resistant; HS: Highly susceptible, Mungbean Yellow Mosaic Virus (MYMV) disease Score

Table 12. Scale for Mungbean Yellow Mosaic Virus disease reaction analysis

Plant parts infected/disease (%)	Score	Disease reaction	Plant parts infected/disease (%)	Score	Disease reaction
No infection	0	Immune (I)	31-40	5	Moderately tolerant (MT)
1-5	1	Highly resistant (HR)	41-50	6	Moderately susceptible (MS)
6-10	2	Resistant (R)	51-80	7	Susceptible (S)
11-20	3	Moderately resistant (MR)	81-100	8	Highly susceptible (HS)
21-30	4	Tolerant (T)			

Results of useful agronomic traits and yield components of NIFA Mung-2017 (NFM-6-5) are depicted in (Table 13). NIFA Mung-2017 showed more pods and clusters per plant, higher harvest index (%), and grain yield (kg ha^{-1}) compared to the check variety Ramzan. In addition, NIFA Mung-2017 showed higher 1000 seeds weight of 49 g compared to check variety Ramzan, indicating that these individual components are important constituents of crop yield, and therefore contribute positively to the final

grain yield [14-17]. Our results show that NIFA Mung-2017 (NFM-6-5) exhibited higher and favorably comparable yield components which resulted in increase in final grain yield that surpassed the check variety as well as parents. NIFA Mung-2017 also showed reasonable harvest index (Table 13) indicating an inherent potential of this variety for carrying out efficient photosynthesis through enhanced biomass and therefore producing and channeling more photosynthates towards healthy grain formation and filling, as these traits are known to have positive correlation with the grain yield [18, 19].

Table 13. Results of agronomic and other traits analysis

Characters	NIFA Mung-2017	Ramzan	NM 92	VC 1973A
Days to flowering (50%)	37±4	35±3	35±4	Fail to thrive in Kharif due to MYMV attack and inadaptability in Pakistan
Days to maturity (90 %)	78±5	77±6	73±5	
Plant height (cm)	73±6	69±6	68±8	
Pods plant^{-1}	37±4	24±5	21±4	
Seed pod^{-1}	10±1	10±1	9±2	
Pod length (cm)	10±2	10±1	9±2	
Clusters plant^{-1}	18±3	11±3	10±2	
Branches plant^{-1}	2±1	2±1	1±1	
Harvest Index (%)	35±6	34±5	33±6	
Seed yield (kg ha^{-1})	2000±150	1215±145	1101±165	
1000 seed weight (g)	49±2	47±1	50±2	55±1
Seed protein content (%)	24 ±0.3	24±0.3	24±0.2	24±0.3
Reaction to MYMV	R	R	R	HS

Conclusion

The recombinant NFM-6-5 was approved for general cultivation with name "NIFA Mung-2017" in KP on the basis of high yield with its different genetic background, and good plant type by the Provincial Seed Council in its 37th meeting held on 19th September 2017 at Peshawar.

Authors' contributions

Conceived and designed the experiments: GSS Khattak & I Saeed, Performed the experiments: I Saeed, M Abbas, G Ullah & M Ibrar, Analyzed the data: I Saeed & M Abbas, Contributed materials/ analysis/ tools: GSS Khattak & I Saeed, Wrote the paper: GSS Khattak & I Saeed.

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