Pak. J. Bot., 35(5): 763-770, 2003.

BREEDING MUNGBEAN (*VIGNA RADIATA* (L.) WILCZEK) GENOTYPES FOR THE AGRO CLIMATIC CONDITIONS OF NWFP

G. S. S. KHATTAK, R. ZAMIR, T. MUHAMMAD AND S. A. SHAH

Nuclear Institute for Food and Agriculture (NIFA), Tarnab, Peshawar, Pakistan.

Abstract

Mungbean advanced lines derived through hybridization from different cross. Combinations and the released varieties have been evaluated at NIFA, Peshawar for some important agronomic traits and screened for Mungbean Yellow Mosaic Virus (MYMV) during kharif season 2002. The genotypes/varieties have shown highly significant genetic variability for the studied traits. The high yielding mungbean recombinants have shown 1603 to 2443 kg/ha yield, large seed size (40.8-55.6 g/1000 seed weight) and MYMV rating from resistant to highly resistant. The days to flowering and physiological maturity of the recombinants were found in range from 30-52 days and 64-93 days, respectively. The genotypes, which took less than 70 days for physiological maturity, were NFM-3-3, NFM-6-2, NFM-6-5, NFM-7-3, NFM-7-6, NFM-7-13, NFM-8-1, NFM-8-2, NFM-8-22 and NM 92. The short stature genotypes (below 50 cm) were NFM-7-3, NFM-12-15 and NFM-12-16. The genotypes NFM-6-2, NFM-7-6, NFM-12-9, NFM-12-12, NFM-12-14, NFM-12-15, NFM-13-2 and NFM-13-4 have produced more than 2.0 tones yield per acre. The genotypes NFM-7-3, NFM-8-22, NFM-12-9, NFM-12-18 and NM 54 exhibited seed size above 55g/1000 seed weight. The genetic variability in the newly developed mungbean genotypes for physiological maturity, plant height, seed size and seed yield reported in this paper could be used directly to evolve mungbean variety or to incorporate these traits in other genotypes through hybridization for the improvement of this crop in the province.

Introduction

Mungbean is the major kharif pulse crop grown in Pakistan. It can be easily cultivated on relatively light soils, marginal for cereal cultivation. The mungbean growing areas have relatively poor infrastructure with farmers having below average resources and house hold inventories. All other crops of this season cannot compete with mungbean in these areas due to less return to the growers. Presently no other research institute is engaged in the mungbean improvement work in NWFP. There is, however, a great potential for the increasing mungbean production in the country through breeding/introducing mungbean genotypes suitable for the major mungbean growing areas, and as an intercrop in orchards and sugarcane in this province. Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad has evolved high yielding mungbean varieties (Ali *et al*., 1997) for the mungbean growing areas of the Punjab but they are not performing well in NWFP due to different agro-climatic conditions.

The mungbean released varieties and the advanced lines derived from different cross combinations have been evaluated at NIFA, Peshawar for some important agronomic traits and screened for Mungbean Yellow Mosaic Virus (MYMV) during kharif season 2002. The development of high yielding mungbean recombinants through hybridization between local and exotic germplasm and their evaluation has been described in this paper.

Materials and Methods

The exotic (VC 3726, VC 1971A, VC 1560D, VC 1482C and Pusa Baisakhi) and local mungbean genotypes (NM 36, NM 92, NM 93, Blackmung and 6601) were hybridized in various cross combinations (Tables 1-3) at Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad during kharif season 1998 following the crossing technique of Khattak *et al.* (1998). The F_1 generation of these crosses was planted during summer 1999 and the hybrid plants were harvested individually. The F_2 populations of each cross were raised as plant progeny rows for selecting high yielding recombinants with resistance to MYMV during kharif 1999. Mung Kabuli, a highly susceptible check for MYMV was used as spreader and planted after each five rows to intensify MYMV inocula from natural sources. Chemical spray was avoided so as to maintain the natural population of whitefly (*Bemisia tabaci*) in the experimental field. The high yielding and MYMV resistant plants were selected. The generation of the selected recombinants was advanced to confirm their breeding behaviour/genetic stability for the desired traits.

The selected true breeding recombinants and the released mungbean varieties were evaluated for yield and some important agronomic traits in replicated yield trials at Nuclear Institute for Food and Agriculture (NIFA), Peshawar during kharif 2002. The trials were conducted in three replications with 6 rows per treatment in each replication and row length was maintained 4 meter. The plant-to-plant and row-to-row space was maintained 10 cm and 30 cm respectively. The data were recorded as follows:

Days to flowering: Days from sowing to the initiation of flower on 50 % plants of a genotype (in a plot) in each replication.

Days to maturity: Days from sowing to 90 % pods maturity on all plants of a genotype (in a plot) in each replication.

Plant height (cm): Average of the 10 plants height per replication recorded from base of the plant to the top peduncle on the main branch.

Thousand seeds' weight (g): Three random samples of 1000 seeds from a genotype per replication were weighed.

Seed yield kg/ha: The seed weight of the middle 4 harvested rows of a genotype in each replication was recorded in g and kg/ha calculated.

The recorded data of the above mentioned parameters were subjected to analysis of variance (Steel & Torrie, 1980). All the calculations were performed through microcomputer program MSTAT-C (Michigan State University and Agricultural University of Norway).

The true breeding recombinants and varieties were also screened for MYMV in screening nursery with two replications having 4 rows for each treatment per replication with 4-meter row length. Mung Kabuli, a highly susceptible check for MYMV was used as spreader and planted after each entry to intensify MYMV inocula from natural sources. Chemical spray was also avoided here so as to maintain the natural population of whitefly (*Bemisia tabaci*) in the experimental field. The MYMV percent infection was recorded on individual plant basis 4 weeks after sowing when 100 % plants of the susceptible check (mung kabuli) were completely infected with MYMV. The mean disease score of each entry was calculated as (infection rate x frequency)/total number of plants. The percent MYMV infection was converted to disease score and disease reaction according to the MYMV disease score scale (0-8) reported by Malik (1992).

Table 1. Performance of mungbean advanced lines in yield trial during kharif 2002 at NIFA, Peshawar.

Entry	Parentage	Days to flowering	Days to maturity	Plant height (cm)	1000 Seeds' weight (g)	Reaction to MYMV	Yield kg/ha
NFM-3-3	VC 3726 x NM 36	32	65	62	53.6	R	1188
NFM-6-1	VC 1971A x NM 92	30	72	56	54.8	MR	1520
NFM-6-2	VC 1971A x NM 92	30	65	59	53.4	R	2227
NFM-6-5	VC 1971A x NM 92	29	65	53	53.4	R	1303
NFM-7-3	VC 1560D x NM 92	30	64	49	55.2	R	1297
NFM-7-6	VC 1560D x NM 92	30	64	59	50.6	R	2020
NFM-7-13	VC 1560D x NM 92	36	64	56	52.0	R	1523
NFM-8-1	NM 93 x NM 92	32	64	53	54.4	R	1383
NFM-8-2	NM 93 x NM 92	36	64	51	53.8	R	1410
NFM-8-22	NM 93 x NM 92	39	64	61	55.8	R	1367
NFM-11-3	NM 92 x Blackmung	39	71	50	47.6	R	1090
NFM-11-4	NM 92 x Blackmung	42	71	51	45.6	R	793
NM 92 (Check)	VC 2768B x NM 36	40	71	58	53.0	HR	1570
NM 98 (Check	NM 20-21 x VC 1482E	45	80	69	38.0	R	1547
SE		3.06	2.16	3.21	1.12	-	13.24
LSD 5 % level		3.05	0.74	1.10	0.38	-	60

Table 2. Performance of mungbean advanced lines in yield trial during kharif 2002 at NIFA, Peshawar.

Entry	Parentage	Days to flowering	Days to maturity	Plant height (cm)	1000 Seeds' weight (g)	Reaction to MYMV	Yield kg/ha
NFM-12-3	VC 1482C x NM 92	42	73	65	52.4	R	2017
NFM-12-5	VC 1482C x NM 92	40	75	62	53.6	R	747
NFM-12-6	VC 1482C x NM 92	41	71	52	51.0	R	767
NFM-12-7	VC 1482C x NM 92	40	72	62	50.8	MR	850
NFM-12-8	VC 1482C x NM 92	43	71	51	45.2	R	1063
NFM-12-9	VC 1482C x NM 92	42	80	82	57.6	R	2210
NFM-12-10	VC 1482C x NM 92	43	83	92	45.8	MR	1907
NFM-12-11	VC 1482C x NM 92	47	82	83	47.0	R	1840
NFM-12-12	VC 1482C x NM 92	42	76	72	51.6	R	2100
NFM-12-13	VC 1482C x NM 92	42	76	79	47.2	R	1507
NFM-12-14	VC 1482C x NM 92	43	73	78	52.8	R	2003
NFM-12-15	VC 1482C x NM 92	40	70	47	46.4	R	2117
NFM-12-16	VC 1482C x NM 92	44	70	49	53.4	R	1740
NFM-12-17	VC 1482C x NM 92	42	70	54	48.0	R	1143
NFM-12-18	VC 1482C x NM 92	40	70	50	55.0	R	1603
NM 92 (Check)	VC 2768B x NM 36	41	71	60	52.8	HR	1510
NM 98 (Check)	NM 20-21 x VC 1482E	45	82	73	38.7	R	1480
SE		1.92	2.62	5.50	0.95	-	17.47
LSD 5 % level		0.67	0.91	1.91	0.33	-	50

Table 3. Performance of mungbean advanced lines in yield trial during kharif 2002 at NIFA, Peshawar.

Entry	Parentage	Days to flowering	Days to maturity	Plant height (cm)	1000 Seeds' weight (g)	Reaction to MYMV	Yield kg/ha
NFM-13-1	6601 x NM 92	41	76	63	47.6	MR	1770
NFM-13-2	6601 x NM 92	43	83	84	47.0	R	2400
NFM-13-4	6601 x NM 92	43	81	78	46.8	R	2103
NFM-13-8	6601 x NM 92	52	93	92	33.4	R	1320
NFM-14-3	NM 92 x Pusa Baisakhi	42	82	64	40.8	MR	1500
NFM-14-5	NM 92 x Pusa Baisakhi	43	77	61	53.4	R	1267
NFM-14-6	NM 92 x Pusa Baisakhi	41	78	64	45.8	R	1473
NFM-14-7	NM 92 x Pusa Baisakhi	42	79	60	47.6	R	1180
NFM-14-12	NM 92 x Pusa Baisakhi	43	83	76	50.6	R	1480
NFM-14-19	NM 92 x Pusa Baisakhi	52	80	95	42.0	R	2443
NM 92 (Check)	VC 2768B x NM 36	40	69	57	53.2	HR	1555
NM 98 (Check)	NM 20-21 x VC 1482E	47	81	71	38.8	R	1500
SE		4.49	6.79	7.93	0.98	-	20.06
LSD 5 % level		1.53	2.32	2.70	0.34	-	58

Table 4. Performance of mungbean varieties in yield trial during kharif 2002 at NIFA, Peshawar.

Variety	Evolving station/centre	Days to flowering	Days to maturity	Plant height (cm)	1000 Seeds' weight (g)	*Reaction to MYMV	Yield kg/ha
6601	[a]AARI, Faisalabad	52	93	102	34.8	T	1020
NM 28	[b]NIAB, Faisalabad	45	83	90	33.2	T	703
NM 13-1	[b]NIAB, Faisalabad	44	79	65	38.4	MR	787
NM 19-19	[b]NIAB, Faisalabad	43	76	68	32.0	MR	730
NM 20-21	[b]NIAB, Faisalabad	45	83	69	35.2	MR	723
NM 121-25	[b]NIAB, Faisalabad	48	90	95	30.6	MR	735
NM 51	[b]NIAB, Faisalabad	47	79	91	40.8	R	1210
NM 54	[b]NIAB, Faisalabad	44	77	68	56.0	MR	1350
NM 92	[b]NIAB, Faisalabad	39	69	60	53.4	HR	1420
NM 98	[b]NIAB, Faisalabad	44	80	75	38.6	R	1370
Mung-88	[c]ARS, Bahawalpur	47	90	104	30.6	MT	1053
Chakwal-97	[c]ARS, Chakwal	50	89	120	31.6	MT	710
AEM-96	[d]NIA, Tandojam	51	90	115	28.4	MT	753
ML-5	India	45	86	78	33.0	T	1107
SE		6.38	6.94	4.55	1.20	-	18.87
LSD 5 % level		2.19	2.38	1.56	0.41	-	55

[a]Ayub Agriculture Research Institute, [b]Nuclear Institute for Agriculture and Biology, [c]Agriculture Research Station, [d]Nuclear Institute for Agriculture
*MYMV disease Score

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

Results and Discussion

The mungbean-advanced lines derived from eight different cross combinations have shown highly significant differences for seed yield (Tables 1-3). Similarly the released mungbean varieties have shown highly significant variability for seed yield (Table 4). In case of recombinants, the days to flowering and physiological maturity ranged from 30 to 52 days and 64 to 93 days respectively. The plant height ranged from 47 to 95 cm while the values for 1000 seed weight from 33.4 to 55.8 g. The reaction to MYMV was resistant to highly resistant. The recombinants NFM-6-2, NFM-7-6, NFM-12-3, NFM-12-9, NFM-12-10, NFM-12-11, NFM-12-12, NFM-12-14, NFM-12-15, NFM-12-16, NFM-12-18, NFM-13-1, NFM-13-2, NFM-13-4 and NFM-14-19 have shown significantly higher seed yield than the standard checks NM 92 and NM 98. The varieties NM 51, NM 54, NM 92 and NM 98 have produced higher seed yield than the rest of the evaluated mungbean varieties (Table 4). The variety NM 54 had the large seed size (56 g/1000 seed weight) whereas the variety NM 92 took minimum days to maturity and exhibited short stature. These two varieties could be used in hybridization programme or in mutation breeding for their distinctive traits to develop high yielding mungbean genotypes suitable for the agro-climatic conditions of NWFP.

The high yielding mungbean varieties are not determinate in true sense (Tickoo *et al.*, 1996). The existing mungbean germplasm have shown some genetic variability for the determinate growth habit and synchrony in pods maturity but lacks the clear-cut demarcation between the vegetative and reproductive growth. The recombinants with early maturity and short stature could be further evaluated and exploited for synchrony in pod maturity and determinate growth habit. The mungbean genotypes with improved synchrony in pod maturity and determinate growth habit could be recommended for intercroping in orchards and sugar cane (Khattak *et al.*, 2002a, b). The selection for such traits would be beneficial in latter generation due to the predominant additive nature of inheritance of the synchrony in pod maturity and determinate growth habit in mungbean (Khattak *et al.*, 2001a, b, c, d). Seed size is the least sensitive trait for environmental fluctuations in addition to the main yield-contributing factor in mungbean (Khattak *et al.*, 1995, 1997, 1999a, b). The high yielding recombinants with large seed size will produce stable yield compared to the genotypes with mall seed size. The main contributing factor in small seeded genotypes is the large number of pods, which is very sensitive trait in fluctuating environment in mungbean (Khattak *et al.*, 2001e). The MYMV resistance in mungbean is controlled to be a major recessive gene and the modifying genes influence the degree of MYMV resistance/susceptibility (Khattak *et al.*, 1999c, 2000). Accumulation of more favourable modifying genes (responsible for MYMV resistance) in a genotype is required to develop mungbean genotype with high resistance to MYMV disease. The recombinants/varieties with high resistance to MYMV are recommended as a local parent when the alien gene of large seed size is required to transfer from exotic mungbean germplasm.

The adaptation and stability evaluation of the developed recombinants in multilocation and National Uniform Yield Trials would help to select the outstanding mungbean genotype for evolving as a mungbean variety for general cultivation in the major mungbean growing areas in NWFP. The recommendations/suggestions would help in more strengthening the mungbean-breeding programs in the province.

References

Ali, M., I.A. Malik, H.M. Sabir and B. Ahmad. 1997. The Mungbean Green Revolution in Pakistan. Technical Bulletin No. 24. AVRDC. Shanhua, Taiwan, ROC.

Khattak, G.S.S, M.A. Haq, M. Ashraf and G.R. Tahir. 1999a.Genetic variability and correlation studies in mungbean (*Vigna radiata* (L.) Wilczek). *Surinaree J. Sci. Technol.*, 6: 65-69.

Khattak, G.S.S., M.A. Haq, M. Ashraf and M. Irfaq. 1999b. Yield and yield components in mungbean (*Vigna radiata* (L.) Wilczek). *Songklanakarin J. Sci. Technol.*, 21: 387-391.

Khattak, G.S.S., M.A. Haq, S.A. Rana, P. Srinives and M. Ashraf. 1999c. Inheritance of resistance to mungbean yellow mosaic virus (MYMV) in mungbean (*Vigna radiata* (L.) Wilczek). *Thai J. Agric Sci.*, 32: 49-54.

Khattak, G.S.S., M.A. Haq, S.A. Rana, T. Elahi and P. Srinives. 1998. An efficient technique for crossing mungbean (*Vigna radiata* (L.) Wilczek). *Thai J. Agric. Sci.*, 31: 577-582.

Khattak, G.S.S., M.A. Haq, M. Ashraf and T. Elahi. 2000. Genetics of mungbean yellow mosaic virus (MYMV) in mungbean (*Vigna radiata* (L.) Wilczek). *J. Genetic Breed.*, 54: 237-243.

Khattak, G.S.S., M.A. Haq, M. Ashraf and A. Jabbar. 2001a. Heterosis for synchrony in pods maturity and determinate growth habit in mungbean (*Vigna radiata* (L.) Wilczek). *Surinaree J. Sci. Technol.*, 8: 1-7.

Khattak, G.S.S., M.A. Haq, M. Ashraf and G.R. Tahir. 2001b. Genetic basis of synchrony in pod maturity in mungbean (*Vigna radiata* (L.) Wilczek). *Kasetsart J. (Nat. Sci.)*, 35: 1-7.

Khattak, G.S.S., M.A. Haq, M. Ashraf, G.R. Tahir and E.U.K. Marwat. 2001c. Detection of epistasis, and estimation of additive and dominance components of genetic variation for synchrony in pod maturity in mungbean (*Vigna radiata* (L.) Wilczek). *Field Crops Res.*, 72: 211-219.

Khattak, G.S.S., M.A. Haq, M. Ashraf and P. Srinives. 2001d. Combining ability in mungbean (*Vigna radiata* (L.) Wilczek) II Traits Related to Indetermination. *Korean J. Crop Sci.*, 46(5): 424-427.

Khattak, G.S.S., M.A. Haq, M. Ashraf and T. McNeilly. 2001e. Genetic basis of variation of yield, and yield components in mungbean (*Vigna radiata* (L.) Wilczek). *Hereditas*, 134: 211-217.

Khattak, G.S.S., M.A. Haq, M. Ashraf and Said Hassan. 2002a. Detection of epistasis, and estimation of additive and dominance components of genetic variation for determinate growth habit in mungbean (*Vigna radiata* (L.) Wilczek). *J. Genetic Breed.*, 56: 1-7.

Khattak, G.S.S., M.A. Haq, M. Ashraf and Said Hassan. 2002b. Yield and yield components at various flowers flushes in mungbean (*Vigna radiata* (L.) Wilczek). *Breed. Sci.*, 52: 61-63.

Khattak, G.S.S., P. Srinives and D.H. Kim. 1995. Yield partitioning in high yielding mungbean (*Vigna radiata* (L.) Wilczek). *Kasetsart J. (Nat. Sci.)*, 29: 494-497.

Khattak, G.S.S., Razi-ud-Din, F. Hanan and R. Ahmad. 1997. Genetic analysis of some quantitative character in mungbean. *Sarhad J. Agric.*, 13: 371-376.

Malik, I.A. 1992. Breeding for resistance to MYMV and its vector in Pakistan. *In*: S. K. Green and D.H. Kim (Eds.). Mungbean Yellow Mosaic Disease. *Proceed. International Workshop.* AVRDC, Bangkok, Thailand, p. 41-53.

Steel, R.G.D and J.H. Torrie. 1980. *Principles and Procedures of Statistics*. McGraw Hill, N.Y.

Tickoo, J.L., Gajraj, R. Matho and C. Manji. 1996. Plant type in mungbean (*Vigna radiata* (L.) wilczek). *In*: A.N. Asthana and D.H. Kim (Ed.). *Proc. Recent Adv. Mungbean Res.*, Indian Soc. Pulses Res. Kanpur, India, p. 197-213.