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Exotic mungbean (*Vigna radiata* L. Wilczek) germplasm: Its utilization through conventional breeding approach

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ABSTRACT

Improved mungbean (*Vigna radiata* (L.) Wilczek) germplasm having high yield potential and large seed size developed at the Asian Vegetable Research and Development Centre (AVRDC), Taiwan was crossed with indigenous material from Pakistan. F_1 seeds from single plants in each cross combination were collected to raise F_2 populations for selection by pedigree method. Succeeding generations were grown for the selection of desirable recombinants having resistance to mungbean yellow mosaic virus (MYMV), large seed size, higher number of pods per plant and grain yield. Plant progeny rows were raised, true breeding selections were bulked, and evaluated for yield potential and other desirable plant characteristics. Out of these, NIAB Mung 92 (NM 92) has been released as a commercial variety based on its high yield performance, large seed size, resistance to MYMV, synchronous maturity with non-shattering pods, and improved plant type. A number of other elite lines developed through this breeding approach may prove a useful source of potential genes for other economic traits for future breeding.

Key words: Mungbean, seed size, grain yield, introgression, *Vigna radiata*

INTRODUCTION

Grain yield is a physiologically complex trait and is influenced by many genes which control synthesis, translocation and storage of assimilates, plant growth and development (Poehlman 1991). In mungbean (*Vigna radiata* (L.) Wilczek), seed yield is the product of number of plants per unit area, number of pods per plant, number of seeds per pod and seed weight per pod. The large seed size not only contributes to yield directly, but also has greater consumer preference. One thousand seed weight showed positive correlation and high direct effect on seed yield in mungbean but was highly influenced by number of pods per plant, days to maturity and plant height (Khattak *et al.* 1995). The small seed size showed dominance over large seed size with predominantly additive gene action (Imrie *et al.* 1985). The Asian Vegetable Research and Development Centre (AVRDC), Taiwan has succeeded in developing high yielding and large seeded mungbean lines. In Pakistan, exotic germplasm including AVRDC material has shown poor adaptation in major mungbean growing season (summer) due to its susceptibility to mungbean yellow mosaic virus (MYMV). However, some lines have resistance against Cercospora leaf spot (CLS) and have large seed size (50 - 70 g per 1000 seeds). In spring season, these large seeded genotypes suffer from pod shattering at maturity and necessitate many hand pickings making it an uneconomical crop.

Indigenous mungbean germplasm of Pakistan is small seeded and has inherent MYMV resistance. To develop genotypes combining large seed of exotic cultivars with MYMV resistance of local material, a hybridization programme was initiated at the Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad, Pakistan. This programme has resulted in the development of a number of elite lines having desirable degree of resistance to MYMV alongwith large seed size (45 - 52 g per 1000 seeds). Of these lines, NM51 and NM54 were released in 1990 as commercial mungbean varieties. For further pyramiding seed size and grain yield, MYMV resistant large seeded variety NM36 was crossed with promising AVRDC material. The performance of selected lines in this programme and of the high yielding, short duration and disease resistant variety NM92 are presented in this paper.

MATERIALS AND METHODS

Large seeded true breeding lines from AVRDC, VC 1560D, VC 2768B, and VC 3726 (Boling *et al.* 1961) were crossed with NM36 as the maternal parent (a

Abbreviations: AVRDC - Asian Vegetable Research and Development, Centre, Taiwan, CLS - Cercospora leaf spot; MYMV - mungbean yellow mosaic virus derivative of var. 6601 x VC 1973A), which has medium seed size (48 g per 1000 seeds) and resistance to MYMV. Four single crosses were raised during spring 1987 and 1988. The seeds of twenty five single plants in each cross were manually harvested and threshed, and were advanced by pedigree breeding method. F_2 populations (2500 plants of each cross) along with parents, and susceptible (to MYMV) checks were grown during summer 1988 under natural epiphytotic conditions for screening against MYMV. Single plant selections were made on the basis of resistance to MYMV, large seed size and improved plant yield in the segregating populations. The F_3 and F_4 generations were raised as plant progeny rows during spring 1989 and summer 1989 respectively. Twenty five true breeding lines possessing desirable economic traits and resistance to MYMV and CLS diseases were selected in F_5. These lines were evaluated in yield screening nurseries during summer 1990 and 1991. Out of these, ten selected lines along with female parent (NM36) and standard check NM51 were evaluated for yield performance in randomized complete block design with four replications during summer 1992 to 1995 at NIAB, Faisalabad. Thereafter, one of the promising breeding lines NM92 along with standard checks was evaluated in multi-locational trials in the major mungbean growing areas at 17 locations (5 in 1992 and 6 each in 1993 and 1994). Each entry consisted of six rows of 5 m length spaced 0.3 m apart, and plant to plant distance of 0.1 m within a row. The MYMV incidence was assessed visually according to the intensity of the virus on the test entries, and scored as suggested by Shukla *et al.* (1978). Maturity date was recorded when 90% of the pods reached maturity. Seed yield of plants was measured from first node to the top of the stem. One thousand seeds, taken randomly from a bulk sample of each replication were counted and weighed. Harvest index was calculated as the ratio of grain yield to biomass yield. Analysis of variance of yield data was performed and means were compared using Duncan's New Multiple Range Test (DMRT).

Table 1: Seed yield and yield related traits of twenty five advanced mung bean lines at NIAB, Faisalabad (1990 and 1991)

Selection	Cross Combination	Maturity, days	Plant height, cm	Reaction to MYMV[1]	1000 seed wt., g	Seed yield, kg ha^{-1}
1	NM36xVC2768B	67	52	R	55	2052 a
2	,,	68	55	R	55	2040 ab
3	NM36xVC2768A	66	53	R	56	1981 abc
4	,,	65	51	R	56	1978 abc
5	,,	65	62	R	52	1917 abcd
6	NM36xVC3726	68	59	R	54	1833 abcde
7	NM36xVC2768B	69	63	MR	48	1807 abcde
8	NM36xVC2768A	68	61	MR	53	1801 abcde
9	,,	66	60	MR	51	1753 abcde
10	NM36xVC3726	69	58	MR	51	1747 abced
11	NM36xVC2768B	69	67	R	59	1727 abcde
12	NM36xVC3726	66	51	MR	50	1712 abcde
13	,,	65	50	MR	51	1675 abcde
14	NM36xVC2768A	68	53	MR	52	1671 abcde
15	NM36xVC1560D	66	59	R	51	1649 bcde
16	NM36xVC2768B	64	56	R	51	1630 cde
17	NM36xVC1560D	70	66	MR	55	1610 cde
18	,,	68	58	R	53	1602 cde
19	NM36xVC2768B	65	54	R	51	1591 cde
20	,,	69	59	MR	54	1562 de
21	NM36xVC3726	67	58	R	51	1535 de
22	NM36xVC2768B	67	59	MR	60	1514 e
23	NM36xVC1560D	67	53	MR	52	1510 e
24	NM36xVC2768B	66	58	R	55	1508 e
25	NM36xVC3726	67	61	MR	41	1445 e
NM36	Parent	65	65	MR	48	1577 de
NM51	Standard	67	70	R	49	1692 abcde

[1] R - Resistant, MR - Moderately resistant

Table 2. Mean seed yield and yield related traits of high yielding, large seeded, and disease resistant mungbean elite lines at NIAB, Faisalabad (1992-1995)

Genotype	Maturity, days	Plant height, cm	1000 seed weight g	Harvest index, %	Reaction to MYMV	Grain yield, kg ha^{-1}
1	66	62	56	32	R	1919 a
2	66	69	51	33	MR	1915 a
3	68	69	51	32	R	1882 ab
4	70	67	53	30	R	1839 bc
5	71	70	50	31	MR	1841 b
6	69	70	52	30	R	1834 bc
7	70	69	54	35	R	1832 bc
8	70	65	52	30	R	1726 cd
9	71	78	49	27	MR	1682 d
10	70	66	53	34	R	1675 d
NM36	77	83	48	20	MR	1327 e
NM51	73	88	45	22	R	1701 d
VC2768A	75	72	43	12	HS	561 f

Table 3. Mean yield performance (kg ha^{-1}) in multilocational trials laid out in major mungbean growing areas in Punjab Province, Pakistan.

Genotype/ Standard check	1992	1993	1994	Overall mean
NM92	1218 a	1566a	1292 a	1359 a
NM51 (Standard)	1027 ab	1354 b	907 b	1096 b
NM121-25(Standard)	1037 ab	1112 c	929 b	1026 b

RESULTS AND DISCUSSION

Plant height, days to maturity, reaction to MYMV, 1000 seed weight and grain yield of twenty five advanced mungbean lines in yield screening nurseries are presented in Table 1. Selection no 1 out yielded all the other lines but the differences among genotypes 1 to 14 and standard check NM51 were non-significant. Genotype 22 showed the highest 1000 seed weight (60 g per 1000 seeds). The genotypes did not show sufficient variation for days to maturity and showed resistant or moderately resistant reaction to MYMV.

Based on high yield potential, large seed size, early maturity, and resistance to disease, ten genotypes were evaluated in comparison with parent and standard check during 1992 to 1995 at NIAB, Faisalabad (Table 2). Non-significant differences in seed yield were observed among genotypes 1, 2 and 3. Genotype 1 showed the highest 1000 seed weight (56 g), matured in 66 days, and showed resistance to MYMV. This genotype (named as NM92) producing the highest grain yield along with other desirable economic traits, was evaluated in multi-locational trials laid-out in the major mungbean growing areas in the province of Punjab during 1992-1994 (Table 3). NM92 gave significantly the highest yields in 1993 and 1994. On overall basis, NM92 showed superb performance (1359 kg ha^{-1}). Due to high yield potential, short duration, uniform maturity, and improved plant type along with desirable degree of resistance against MYMV, NM92 was released in 1996 for general cultivation in the Punjab province.

Introgression of genes among hybridizing parents has been well established (Tickoo *et al.* 1988), and this process has culminated in the development of germplasm possessing desirable agronomic and economic traits (Anishetty and Moss 1988). The mungbean material developed through conventional breeding at NIAB may prove a useful source of potential genes for seed size, harvest index, short stature, earliness with determinate plant growth habit, and resistance to MYMV in the future crop improvement programmes.

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