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Breeding for Improved Seed Yield in Mungbean

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Abstract

Disease resistant mungbean variety NIAB MUNG 92 showed tremendous impact for increasing the area and production of the country demonstrating genetic manipulation of economic traits. Large seed size and earliness had been introgressed into otherwise adapted genetic background. A series of high yielding elite lines having improved morpho-physiological characteristics had been developed. Out of these, NM 92 has been approved as NIAB MUNG 92 in November,1996 by the Punjab Seed Council for general cultivation in the province. The present paper reports the developmental history of NM 92 and its adoption by the growers to achieve sustainable mungbean production.

Introduction

Seed yield in mungbean is the product of number of plants per unit area, number of pods per plant, number of seeds per pod, and their weight. Seed yield will increase if an increase in one of the yield components is not associated with the decrease in others (Poehlman, 1991). Large seed size is an important yield component in Asian Vegetable Research and Development Centre (AVRDC) Thailand accessions (Tickoo *et al.*, 1988). In Pakistan, exotic large seeded germplasm is unadaptive in the major Kharif season due to its susceptibility to mungbean yellow mosaic virus and pod shattering at maturity.

Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad, Pakistan, with the objectives of evolving large seeded, high yielding and short duration varieties, started hybridization between an indigenous small seeded germplasm and an exotic large seeded AVRDC accessions. Vigorous selection in the segregating generations yielded a series of large seeded, short duration and high yielding elite lines. Out of these, NM 92 was approved as NIAB MUNG 92 in November, 1996 by the Punjab Seed Council for general cultivation in the province. The present study describes its evolutionary history and yield stability in the major mungbean growing areas in the province of the Punjab.

Materials and Methods

The experimental material comprised of NM 36 (derivative of a cross between local cv 6601 and exotic AVRDC accession VC 1973A) and an AVRDC accession VC 2768B. Single and reciprocal crosses (Boling *et al.*, 1961) were made during summer 1987. An F_1 generation was raised during spring, 1988 in such a planting geometry that hybrids were covered on both the sides by their respective parents. At maturity, individual plants in each cross combination were harvested and threshed manually. Following pedigree method, F_2 populations along with their respective parents were raised in single row, 4 m long spaced 0.3 m while maintaining a distance of 0.1 m between plants. Spreader rows of susceptible cultivar Mung Kabuli were grown after every tenth row for creation of natural epiphytotic environments. Progeny rows from F_3 and F_4 selected plants were grown with the same planting pattern to study their breeding behavior for important plant characteristics. True breeding progenies showing disease resistance, earliness, short stature, and high bearings, were bulked for further evaluation. Out of these, six lines along with parents/standards were studied in randomized complete block design with three replications in the preliminary yield trials at NIAB Farm, Faisalabad, during summer, 1991. One of the high yielding lines, NM 92 along with parents/standard checks was field evaluated during 1992-94 for yield performance at NIAB Farm as well as in the major mungbean growing areas in the Punjab province. Data on morpho-physiological traits and seed yield were recorded and were analyzed statistically (Singh and Chaudhry, 1979). Disease scoring for mungbean yellow mosaic virus and Cercospora leaf spot were carriedout in the segregating population as well as true breeding lines (Shukla *et al.*, 1978; and Mew *et al.*,1975).

Results and Discussion

NM 92 was evaluated in different yield trials at Nuclear Institute for Agriculture and Biology, Faisalabad, and in an adaptation trials in the major mungbean growing areas in the Punjab. The results are discussed hereafter.

Station Yield Trials: In Summer 1991, NM 92 produced significantly the highest seed yield of 2548 kg ha^{-1} (Table 1). NM 51 yielded 1918 kg ha^{-1} whereas NM 121-25 produced 1436 kg ha^{-1}. In 1992, NM 92 gave 2189 kg ha^{-1} seed yield as compared to 1687 kg ha^{-1} of NM 51. In 1993 and 1994, NM 92 surpassed again in seed yield by producing 2252 Kg ha^{-1} and 1668 kg ha^{-1}. NM 92 gave 2164 kg ha^{-1} seed yield on mean basis of four summer seasons. Yield increase percentage of NM 92 over NM 36, NM 121-25 and NM 51 was 51, 69 and 35 per cent respectively. An exotic AVRDC accession VC 2768B fails to thrive and hence did not produce seed yield.

In spring, seed yield trend was similar to summer. NM 92 gave the highest seed yield on overall basis. NM 92 produced 36, 37, 51, and 27 per cent higher over NM 36, VC 2768B, NM 121-25 and NM 51 respectively.

Table 1: Performance of NIAB MUNG 92 in yield trials laidout at NIAB, Faisalabad

	Line/variety					LSD	
	NM 92	NM 36	VC 2768B*	NM121-25	NM 51	5%	1%
1991							
Summer	2548	1619	-	1436	1918	224	304
Spring	1564	1448	1416	1344	1448	113	153
1992							
Summer	2189	1599	-	1436	1687	132	184
Spring	1531	1344	1374	1195	1365	78	105
1993							
Summer	2252	1630	-	1512	1761	129	177
Spring	1517	1142	1392	1123	1237	88	122
1994							
Summer	1668	885	-	741	1068	150	208
Mean							
Summer	2164	1433	-	1281	1609		
Spring	1537	1311	1394	1221	1350		
Yield increase (%)							
Summer	-	51.00	-	68.93	34.49		
Spring	-	17.23	10.25	25.94	13.80		
Overall							
Mean	1896	1381	1394	1255	1498		
Increase (%)	-	3729	36.01	51.07	26.56		

* Exotic parent did not thrive in summer

Table 2: Performance of NIAB MUNG 92 in an adaptation trials laidout in the major mungbean growing areas in Punjab

Line/variety	1992 Av. 4 site	1993 Av. 6 site	1994 Av. 6 site	Mean	Increase (%)
NM 92	1218	1566	1292	1359	-
NM 93	848	-	-	848	60.0
NM 51	1027	1327	907	1096	24.0
NM 121-25	1037	1112	927	1025	33.0
LSD (5%)	243	48	251		
(1%)	-	68	-		

Table 3: Morpho-physiological characters of NIAB MUNG 92 as compared to parents and standard checks

Line/variety	Days to matur	Plant height (cm)	1000-seed wt (g)	Harvest index (%)
NM 92	60.46c	52.66c	55.83a	39.36a
NM 36	73.70a	80.70a	48.60b	28.95b
NM 51	70.20b	76.36b	45.06c	28.55b
NM 121-25	74.43a	79.06ab	31.30d	23.80c

Table 4: Reaction of NIAB MUNG 92 to mungbean yellow mosaic virus and Cercospora leaf spot diseases

Line/variety	1991		1992		1993	
	Infection (%)	Rating	Infection (%)	Rating	Infection (%)	Rating
NM 92	3*	HR	2	HR	4	HR
	1**	HR	1	HR	2	HR
NM 96	8	R	6	R	7	R
	26	T	30	T	27	MT
VC 2768B	95	HS	92	HS	92	HS
	1	R	1	HR	3	HR
NM 121-25	20	MR	10	MR	18	MR
	31	MS	34	MS	51	S
NM 51	4	HR	3	HR	3	HR
	27	T	30	T	43	S

*Mungbean yellow mosaic virus; ** Cercospora leaf spot

Adaptation Yield Trials: NM 92 on an average of four sites produced 1218 kg ha^{-1} seed yield in 1992. Similar trend of superior yield performance of NM 92 was observed during 1993 and 1994 (Table 2). NM 92 produced 24% and 33% higher yield as compared to NM 51 and NM 121-25 respectively. On overall mean yield performance basis, NM 92 produced seed yield of 1359 kg ha^{-1} followed by NM 51 (1096 kg ha^{-1}).

Morpho-physiological traits of NM 92 as compared to other varieties are shown in table 3. Significant differences for all the traits were observed. NM 36 and NM 121-25 took maximum days to mature while NM 92 showed significant earliness in maturity. NM 36 and NM 51 showed nonsignificant differences for plant height. NM 92 had significantly the least plant height. NM 92 had shown significant improvement in seed size and harvest index.

Breeding mungbean at Nuclear Institute for Agriculture and Biology involves crosses between well adapted, small seeded varieties with exotic germplasm having large seed size. The improvement programme has resulted in the development of a series of elite lines possessing high yield potential, large seed size, earliness and disease resistance. In Pakistan, there is preference for short duration varieties suitable for intensive cropping pattern. In the present investigation, NM 92 took significantly minimum days to mature. Induction of earliness in mungbean was earlier reported (Imrie *et al.*, 1988). Improvement of seed size in NM 92 appears to be due to selection pressure for larger seed size in the segregating generations and an accumulation of recessive genes with an additive effects (Sen and Murty, 1960). Improved photosynthesis/ translocation efficiency along with other desired compromise of yield components had probably caused increase in seed yield.

Disease Resistance: NM 92 showed high degree of resistance to MYMV (Table 4). NM 51 and NM 121-25 showed highly resistant and moderately resistant reaction respectively. An exotic parent VC 2768B showed highly susceptible reaction. NM 92 exhibited high degree of resistance against CLS whereas exotic parent VC 2768B had high resistance. NM 36, a maternal parent showed tolerant to moderately tolerant reaction (Table 4). NM 121-25 showed moderately susceptible reaction. Identification of sources of resistance and utilization of resistance in breeding disease resistant varieties appear to be an appropriate strategy to control the disease. Several sources of resistance against mungbean yellow mosaic virus and Cercospora leaf spot diseases have been reported (Singh, 1982; Fernandez and Shanmugasundaram, 1988). Utilization of large seed size and disease resistant exotic germplasm in the crosses with locally well adapted small seeded varieties had yielded phenologically altered germplasm having desirable level of disease resistance, seed size and seed yield components in the present investigation. In the sequel, an elite line NM 92 based upon superb yield performance, earliness, large seed size, and disease resistance, has been approved as NIAB MUNG 92 in Nov. 1996 by the Punjab seed council for general cultivation in the province. Acreage under NIAB MUNG 92 planting reached to 51 per cent (Ali *et al.*, 1997), indicating its yield superiority over other varieties. The faster rate of adoption of NIAB MUNG 92 appeared to be rapid due to its desirable phenological and ideotypic development. It is expected that its cultivation will further help to maintain and sustain seed yield on the farmers' field, thus bringing an increase in area and production of mungbean in the country.

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