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Stability Parameters of Mung Strains in Southern Punjab

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Three genotypes of mung (*Vigna radiata*) i.e. BRM-188, BRM-195 and BRM-202 along with two check varieties (NM-92 and NM-98) were evaluated at five different locations (i.e. Bahawalpur, Multan, Vehari, Khanewal and Dera Ghazi Khan) in Southern Punjab for two consecutive years (2001 and 2002). The genotype BRM-195 was found to be the most stable genotype across a variety of location/environment with regression coefficient (bi) of 1.062 and dispersion (Sd^2) of 0.052 followed by BRM-188 and BRM-202. The genotype BRM-195 performed better across all the locations (3056 Kg ha^{-1}) by producing 46.2 and 60% higher yield than the check varieties i.e. NM-92 and NM-98, respectively. The genotype BRM-195 was being evaluated as a candidate variety in National Uniform Mung Yield Trials by the Coordinator Pulses, National Agricultural Research Centre, Islamabad, for its release for general cultivation in the Southern Punjab.

Key words: Mung genotypes, Stability, Locations, Grain yield.

Introduction

Pulses are the rich sources of protein and essential amino acids, particularly the lysine (cereals are low in lysine). Pulses are also highly nutritious and generally contain high percentage of protein, carbohydrate and vitamins. These are the cheapest source of protein in the indigenous diet. Protein contents range from 20.8 to 33.1%. Their seeds contain twice or thrice as high percentage of protein as cereals and 70% of the world's protein comes directly from vegetable sources (Akhtar *et al* 2003). These are the natural supplements to cereals; cereal-pulse combination thus supports the idea of **"Dal & Roti"** of Pakistani diet. It is an established fact that pulse protein is normally cheaper than the animal protein mostly obtained from meat, milk, poultry and fish.

Mungbean (green gram) (*Vigna radiata* L. Wnezck) is an important pulse crop in Asia, particularly in the Indian subcontinent and South-East Asia. This crop is generally suitable for multiple-cropping systems, enabling better use of land. Mung is rich in easily digestible protein and iron (Akhtar *et al* 2003). It grows rapidly until harvest. More clusters, more seed per pod and high seed-weight form an ideal plant type. Its seed-color is green and black.

In Pakistan, mung crop was cultivated on an area of 215.8 and 239.2 thousand acres with a production of 102 and 115.4 thousand tons, respectively, during 2001-02 (Anon 2002). Average yield was 472 and 482 Kg ha^{-1} in Punjab and Pakistan, respectively. Due to its low average yield, the plant breeders aimed at for the development of new mung cultivars that may possess improved/wider yield stability in a variety of environments. It is essential and a reported fact that the evolution of a new cultivar normally takes about 10-12 years and needs a lot of funds to develop it. For this purpose, various statistical methods have been proposed to determine the stability of a new cultivar. Most commonly used method is the joint regression analysis for yield stability (Eberhart and Russel 1966; Arain and Siddiqi 1977). According to Eberhart and Russell (1966), the regression coefficient (bi) and the average quadratic departure from the regression line (Sd^2) are the two mathematical indices for the assessment of stability parameters. Genotypes with high bi and Sd^2 react readily to changes in the environment and possess considerable variability, while cultivars with bi<1.00 and an Sd^2 near to zero react weakly to changes in growing conditions and are considered to be stable in yield (Finlay and Wilkinson 1963). According to Finlay and Wilkinson (1963), genotype with bi near to 1.00 and a high mean yield were regarded as being well adapted to all environments at growing conditions. The objective of the present studies was to assess the yield stability of newly developed mung strains (BRM-188, BRM-195 and BRM-202) in comparison with the check varieties (NM-92 and NM-98) under the local growing conditions.

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Materials and Methods

Three genotypes of mungbean (*Vigna radiata*) i.e. BRM-188, BRM-195 and BRM-202 developed at the Regional Agricultural Research Institute, Bahawalpur along with two check varieties (NM-92 and NM-98) were evaluated at five different locations (i.e. Bahawalpur, Multan, Vehari, Khanewal and Dera Ghazi Khan) in the Punjab Province for two consecutive years

Table 1
Analysis of variance of the grain yield data

Sources	df	Mean squares	F value	Probability
Replications	3	2278880.1	17.6	0.000
Locations (E)	4	12064032.8	93.2	0.000
Genotypes (G)	4	2032101.5	15.7	0.000
ExG	16	280955.1	2.2	0.010
Error	72	129492.5		

Table 2
Yield (Kg ha^{-1}) performance of mung varieties at 5 locations during the years 2001 and 2002

Varieties	BWP	Multan	Vehari	Khanewal	D.G.Khan	AV.
			Year 2001			
BRM-195	3315	3068	2950	3200	3192	3145a
BRM-188	2538	2358	2100	2669	2645	2462b
BRM-202	1482	1385	1679	1725	1319	1518d
NM-92 (check)	1895	1968	2035	1628	1754	1856c
NM-98 (check)	1628	1857	1588	1905	1547	1705c
			Year 2002			
BRM-195	3182	2713	3008	3042	2885	2966a
BRM-188	2580	2445	2710	2800	2740	2655b
BRM-202	2255	2085	2100	1972	2318	2146d
NM-92 (check)	2448	2267	2123	2295	2492	2325c
NM-98 (check)	2076	1965	2325	2100	2109	2115d

Table 3
Yield (Kg ha^{-1}) performance of mung varieties during the years 2001 and 2002 (average of 5 locations)

Genotypes	2001	2002	Av. (2 years)	% ± over checks	
				NM-92	NM-98
BRM-195	3145a	2966a	3056a	+46.2	+60.0
BRM-188	2462b	2655b	2559b	+22.4	+33.9
BRM-202	1518d	2146d	1833d	-12.4	-05.0
NM-92 (check)	1856c	2325c	2091c	-	-
NM-98 (check)	1705c	2115d	1910d	-	-

Table 4
Stability parameters

Genotypes	Regression coefficient (bi)	Dispersion (Sd^2)
BRM-188	1.054	0.049
BRM-202	1.201	0.457
BRM-195	1.062	0.052
NM-92 (check)	0.990	0.060
NM-98 (check)	0.692	0.242

2001 and 2002. The experiments were laid out according to Randomized Complete Block Design with four replications at each site during each year. Seed beds were prepared by two deep ploughings followed by plankings and use of rotavator. Six rows each of 5 meter length per genotype were sown. Row to row distance was kept as 30 cm. Normal inputs like fertilizer (1 bag DAP per acre before sowing), weedicides (1.5 litres Stomp per acre before sowing) and two irrigations were applied during the growing period. All the cultural practices were carried out during the growth period. At maturity, the central

Table 5

Consolidated results of mung national uniform yield trial-kharif-2002 [yield (Kg ha^{-1})] received from coordinator pulses, NARC, Islamabad

Code/ Source	Genotype	L 1	L 2	L 3	L 4	L 5	L 6	L 7	L 8	L 9	L 10	L 11	L 12	L 13	Av.
A / L5	98 cmg 003	1143.28	1493.25	270.36	1346.80	1085.50	776.66	507.70	554	303.72	455.62	92.67	229.90	1136.33	722.75
B / L5	98 cmg 016	1424.75	1484.50	422.91	1825.20	935.20	740.18	566.43	525	177.92	390.31	74.13	214.87	885.08	743.58
C / L5	98 cmg 018	535.15	1267.25	169.93	1863.16	1235.80	964.31	458.35	417	119.54	441.27	13.90	213.76	1311.81	693.17
D / L1	NM-1	1848.70	2204.75	411.44	2123.68	1091.07	847.90	533.41	551	266.88	416.88	90.35	136.94	709.60	864.05
E / L1	NM-2	1261.43	1527.75	353.06	2173.60	1040.97	672.41	409.36	421	235.61	394.78	76.45	252.73	1066.48	760.43
F / L10	SM-1	1310.08	1675.25	329.43	1561.56	1002.00	846.16	352.37	498	317.12	422.97	55.60	183.14	936.86	730.08
G / L4	C1/94-4-19	774.93	1805.50	575.11	1675.96	812.73	886.13	453.14	404	265.49	370.71	67.18	278.89	983.77	719.50
H / L4	C2/94-4-42	1150.23	1163.00	225.88	1883.96	779.33	740.18	472.60	432	319.70	396.71	74.13	281.12	859.72	675.27
I / L2	BRM-188	201.55	1336.75	399.63	1520.48	578.93	482.33	456.62	624	123.02	403.78	55.60	197.06	854.16	556.45
J / L2	BRM-195	378.78	2065.75	561.91	1431.56	775.07	505.61	505.61	639	93.13	391.87	39.38	90.18	698.48	628.34
K / L2	BRM-202	225.88	1415.00	212.32	1366.56	578.93	496.93	507.35	412	11.20	370.50	18.53	124.36	940.34	521.68
L / L14	Mung-1	847.90	1527.50	412.83	1517.43	935.20	834.00	454.53	593	132.05	379.29	57.92	308.95	854.50	687.32
M / L14	Mung-6	1098.10	2006.75	539.67	1789.84	912.93	617.59	518.47	407	218.93	333.31	23.17	22.67	860.06	745.58
N / L15	L1P5/5/89	427.43	1267.25	386.07	1538.68	979.73	796.47	419.09	545	401.78	443.20	121.93	157.54	954.93	647.62
O / L13	NCM-209	656.78	1510.50	555.31	1146.60	1030.03	1002.54	421.17	417	182.79	421.82	23.17	194.28	1240.23	684.78
P / L13	VC3960 A88	1078.68	1475.75	356.19	1437.80	990.87	667.20	413.53	418	311.36	449.38	74.13	212.09	955.97	680.76
Q / L13	VC3960 A89	1282.28	1369.50	747.13	1622.92	996.43	959.10	443.41	414	344.03	365.92	125.10	165.89	1134.24	766.92
R Check	NM-92	639.40	1267.25	348.20	2014.48	1024.27	948.68	377.73	417	321.09	362.13	64.87	214.32	882.65	683.23
S Check	NM-92	1120.69	1484.25	501.79	2249.52	796.03	990.38	324.91	419	398.24	356.77	143.63	228.23	944.16	765.97

Locations

L1	NIAB, Jhang Road, Faisalabad
L2	Regional Agricultural Research Institute, Bahawalpur
L3	Agricultural Research Institute, Dera Ismail Khan
L4	Arid Zone Research Institute, Bhakkar
L5	Barani Agricultural Research Institute (BARI), Chakwal
L6	KARINA, Juglote, Gilgit
L7	Pulses Research Station, Tando Jam
L8	RRI, Dokri, Sindh
L9	Agricultural Research Station, Ahmad Wala Karak
L10	Agricultural Research Station, Mingora, Swat
L11	Barani Agricultural Research Station, Jarma, Kohat
L12	Barani Agricultural Research Station, Fateh Jang
L13	NARC, Islamabad
L14	AARI, Jhang Road, Faisalabad (Trial rejected due to disease)
L15	Nuclear Institute of Agriculture (NIA), Tando Jam, Sindh

four rows of 4 meter length were harvested for grain yield determination. The data were subjected to stability analysis according to the method of Eberhart and Russell (1966).

Results and Discussion

Analysis of variance of the data for grain yield is given in Table 1, which revealed that genotypes (G), locations (environments) (E) and G x E interaction mean squares were highly significant ($P < 0.01$) for grain yield. Average grain yield (Kg ha^{-1}) of various genotypes over years and across the locations is presented in Tables 2-3. These data revealed that the genotype BRM-195 yielded the highest (3056 Kg ha^{-1}) followed by BRM-188 (2559 Kg ha^{-1}) and check NM-92 (2091 Kg ha^{-1}) at all the five locations. The genotype BRM-195 gave 46.2 and 60% higher yield than the check varieties NM-92 and NM-98, respectively. The genotype BRM-202 yielded less than both the checks. Mean yield over all locations ranged from 1833 to 3056 Kg ha^{-1}. The regression of genotype mean yield on the environmental index resulted in regression coefficient (bi) ranging from 0.692 in NM-98 to 1.054 in BRM-188 (Table 4), which means that BRM-195 (bi=1.062) was generally adapted to all environments.

The other better performing genotypes were BRM-188 and NM-92. These genotypes had regression coefficient (bi) values near to unity and had comparatively higher yield than the grand mean yield (1675 Kg ha^{-1}) over all the locations. This shows that these were less responsive to environmental changes and generally adapted to all the environments. The genotypes BRM-202 and NM-98 had the highest value of Sd^2 compared to other genotypes which means that these genotypes were less stable (Eberhart and Russell 1966). Arain and Siddiqi (1977), Sial *et al* (1999), Shindin and Lokteva (2000), Akhtar *et al* (2001) and Hussain *et al* (2002) have reported similar results.

The stable line i.e. BRM-195 is being tested in National Uniform Mung Yield Trial for its release for general cultivation in the southern Punjab. During 2002, BRM-195 yielded 2066 kg ha^{-1} in the National Trial at Bahawalpur compared with 1267 and 1484 kg ha^{-1} of the check varieties NM-92 and NM-98. BRM-195 also out yielded the check varieties NM-92 and NM-98 at Dera Ismail Khan and Mangora in NWFP and Tandojam and Dokri in the Sindh province (Table 5).

In the light of the present results, it is suggested that a new variety of any crop must not be released/approved for general cultivation until and unless it is tested across different locations of the province/country.

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