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PATH ANALYSIS IN MASH (*VIGNA MUNGO* L.)

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Abstract

Studies regarding correlation and path coefficient in 48 local genotypes of mash (*Vigna mungo* L.) were undertaken to find out important traits contributing towards grain yield. Observations were taken on days to maturity, plant height, branches per plant, pods per plant, pod length, seeds per pod, 100-seed weight, biological yield per plant, harvest index and grain yield per plant. All the characters had positive correlation with grain yield per plant. It was significant with pods per plant and biological yield per plant. Path analysis revealed that branches per plant, pod length, harvest index and biological yield per plant had positive direct effects on grain yield. Biological yield and harvest index may be exploited in selecting high yielding cultivars in mash.

Introduction

Improvement in yield is based on simultaneous selection for the desirable yield components in crop plants. Dewey & Lu (1959) demonstrated the validity of path analysis in effective plant selection that results in selection of desirable genotypes. The high pod bearing bold seeded genotypes may produce high grain yield (Tomar *et al*., 1973; Malik *et al*., 1983). Most of the yield contributing characters except days to maturity, primary branches per plant and clusters per plant were considered important for improvement by Malhotra *et al*., (1974). Yield contributing characters like pods per plant, 100-seed weight and seeds per pod qualify the indices for selection of genotypes in breeding programme of mash (Rani & Rao, 1981). The maximum relative selection efficiency was observed for branches per plant in mungbean by Malik *et al.,* (1983) whereas Khalid *et al*., (1984) suggested selection on the basis of branches per plant, pod length and 100-seed weight. Malik *et al*., (1987) reported biological yield as major yield contributing character and negative direct effects of days to maturity, branches per plant, pods per plant, seeds per pod and 100-seed weight.

Varietal differences with respect to harvest index have been reported in peas (Donald, 1962), in several drybeans (Wallace & Munger, 1966), in chickpea (Lal, 1967) and in lentil (Singh, 1977). Little work on mash has been conducted in this respect. The present studies were, thus conducted to find out the best physiologically efficient genotype contributing towards grain yield in mash (*Vigna mungo* L.).

Materials and Methods

Forty eight genotypes/varieties of mash (*Vigna mungo* L.), belonging to local origin were grown in a randomized complete block design with 4 replications, in the experimental fields of National Agricultural Research Centre, Islamabad during Summer, 1988. Six rows of 5 m length were planted by keeping 30 and 10 cm spacings between and within rows, respectively. Recommended cultural practices were followed. At maturity, the data were recorded for plant height (cm), branches per plant, pods per plant, pod length (cm), seeds per pod, 100-seed weight (g), biological yield per plant (g), harvest index and grain yield per plant (g) on 10 competitive plants selected randomly. Besides days to 90% maturity were recorded on plot basis. Harvest index was computed as ratio between grain yield per plant and biological yield per plant. The average data were subjected to the standard statistical techniques for analysis of variance to test the level of significance among the genotypes for different characters under study (Steel & Torrie, 1960). Heritability estimates were calculated with the help of genotypic and phenotypic variances. Correlations and path coefficients were computed by using the methods of Al-Jiburi *et al.,* (1958) and Dewey & Lu (1959). The significance of genotypic correlation coefficient was tested with the help of standard error as suggested by Reeve (1955).

Results and Discussion

The means, analysis of variance and heritability in broad sense are presented in Table 1. Analysis of variance revealed highly significant differences among genotypes/varieties for all the characters under study. High heritability estimates in broad sense were observed for all the characters except harvest index where it was low. High heritability for yield and yield components had also been reported by Khalid *et al.,* (1984) and Malik *et al.,* (1987) in mungbean.

Correlation Coefficient: The results regarding genotypic, phenotypic and environmental correlation coefficients given in the Table 2 revealed that the genotypic correlations were higher than phenotypic ones for most of the characters. The environmental correlation coefficients were negligible in most cases, indicating low environmental influence. All references in the text hereafter refer to genotypic correlations.

The correlation coefficient of yield was positive with all the characters. It was highly significant with pods per plant and biological yield per plant only. Significantly positive correlation of yield with yield contributing characters viz., plant height, pods per plant, pod length and 100-seed weight had already been reported by Rani & Rao (1981) in blackgram. In mungbean, Tomar *et al.,* (1973) Khalid *et al.,* (1984) observed positive correlation of yield with yield components, whereas Malik *et al.,* (1987) showed negative correlation of yield with days to maturity, pod length and 100-seed weight. Similarly, Malhotra *et al.,* (1974) reported positive association of yield with days to maturity, plant height, pods per plant and pod length, whereas negative with 100-seed weight. Days to maturity was positively correlated with all the characters studied indicating higher yield potential of late maturing genotypes. Similar results

Table 1. Means and analysis of variance for yield and yield components in 49 genotypes of mash (*Vigna mungo* L.)

S. No.	Genotype/ variety	X 1	X 2	X 3	X 4	X 5	X 6	X 7	X 8	X 9	Y
1-	S 10	78.75	34.60	8.25	33.35	5.05	7.21	4.68	26.48	28.77	6.74
2-	S 24	75.00	25.54	10.25	32.80	4.21	6.07	4.73	31.45	18.27	5.61
3-	S 55	78.50	26.80	6.00	35.60	4.60	5.42	4.18	24.49	25.31	6.24
4-	S 56	75.00	27.45	7.15	17.13	4.25	6.17	4.87	36.39	18.32	6.68
5-	S 58	66.75	20.70	7.38	30.88	4.21	5.80	4.63	27.19	17.69	4.83
6-	S 118	78.75	31.03	6.43	38.40	4.79	6.84	4.37	28.77	23.93	6.86
7-	S 132	61.50	19.00	6.33	23.40	4.29	5.92	4.34	27.57	13.57	3.58
8-	S 136	70.00	22.45	8.77	32.63	4.19	6.67	4.39	33.67	18.36	6.15
9-	S 155	63.25	20.00	7.33	22.15	3.92	5.92	4.36	34.47	13.76	4.69
10-	S 164	64.00	20.85	6.13	23.78	4.19	6.34	4.23	27.31	14.07	3.84
11-	S 175	66.50	21.15	6.93	24.58	4.28	6.25	4.97	34.84	14.24	4.96
12-	S 210	75.25	24.85	9.45	37.67	4.29	6.00	4.11	31.67	21.59	6.69
13-	S 211	74.75	29.18	10.85	41.45	4.87	7.00	4.31	35.23	22.71	7.93
14-	S 220	79.00	25.70	9.10	33.25	4.42	6.50	4.55	28.36	21.26	5.90
15-	S 221	78.75	25.40	8.60	36.65	4.38	6.58	4.30	34.52	22.30	7.74
16-	S 222	74.75	25.40	7.95	38.40	4.13	5.50	4.49	32.72	21.59	7.01
17-	S 234	60.75	20.50	7.15	24.93	4.32	6.14	3.96	30.32	14.08	4.23
18-	S 239	63.50	19.05	6.30	19.15	4.11	5.50	4.32	27.11	10.65	2.90
19-	S 242	73.75	25.55	5.80	45.48	4.79	5.93	4.23	22.98	25.37	5.85
20-	S 250-I	76.75	24.45	8.10	45.40	4.04	5.17	5.01	34.47	27.51	9.47
21-	S 250-II	74.75	23.20	7.35	22.35	4.17	5.65	4.34	34.82	12.11	4.25
22-	S 327	79.00	24.53	9.30	44.00	4.45	7.00	4.33	29.20	23.88	6.96
23-	S 275	79.50	31.28	10.40	36.18	4.17	5.92	4.30	29.71	22.46	6.52
24-	S 290	59.75	21.65	6.63	26.75	4.36	5.59	4.07	27.28	16.24	4.36
25-	S 291	60.75	20.15	7.10	28.00	4.09	6.42	4.26	33.05	14.11	4.56
26-	S 297	62.50	18.20	5.27	28.97	4.02	6.08	4.32	29.77	16.11	4.63
27-	S 300	60.00	20.55	7.33	29.50	4.21	6.00	3.86	27.81	15.28	4.51
28-	S 326	59.50	20.25	7.65	28.95	4.33	5.14	3.74	28.52	14.38	4.12
29-	S 332	61.25	20.20	7.90	25.75	4.01	6.75	4.01	28.92	14.37	4.22
30-	S 338	60.25	20.70	7.65	29.05	4.24	5.92	4.25	30.35	15.00	4.50
31-	S 341	60.75	20.20	6.65	25.15	3.95	5.75	4.05	28.06	13.10	3.67
32-	S 381	79.50	28.10	8.70	34.15	4.69	6.67	4.78	32.94	21.78	7.17
33-	S 399	71.50	24.50	7.00	24.78	3.99	6.67	4.69	24.65	17.60	4.32
34-	S 479	61.25	18.40	6.45	23.93	3.96	6.75	4.00	32.41	12.93	4.16
35-	S 564	66.00	21.45	7.20	27.68	4.03	5.50	4.71	32.82	14.18	4.65
36-	AARI-113	74.50	35.53	9.98	25.55	4.37	6.70	4.50	29.46	18.92	5.57

(Table 1 Contd.)

S. No.	Genotype/ variety	X 1	X 2	X 3	X 4	X 5	X 6	X 7	X 8	X 9	Y
37-	AARI-114	77.50	30.08	7.90	24.03	4.29	5.77	4.52	32.18	12.07	3.79
38-	AARI-191	72.25	19.80	7.18	21.05	4.13	6.69	4.04	28.09	13.72	3.88
39-	AARI-118	80.50	27.15	9.98	25.60	4.63	6.17	4.92	34.63	15.21	5.98
40-	MM 5-60	79.00	37.20	8.98	22.15	5.00	6.73	4.32	28.92	14.59	4.53
41-	MM 49-6	80.75	19.50	5.68	15.55	3.96	5.85	4.30	38.00	9.73	3.69
42-	MM 12-24	83.25	24.85	8.05	26.90	4.33	6.77	4.05	36.39	14.96	5.44
43-	MM 6-48	76.75	21.45	6.02	18.00	3.96	6.27	4.41	35.70	12.31	4.46
44-	MM 33-40	71.50	22.75	6.08	18.55	4.54	6.35	4.97	35.01	11.79	4.14
45-	Mash 59	83.50	28.20	6.83	26.00	4.59	6.50	3.93	32.46	14.56	4.73
46-	Mash 216	85.00	34.10	10.35	30.20	4.50	7.15	4.04	27.36	16.82	4.57
47-	Mash 48	70.75	23.00	9.58	33.18	4.29	5.75	4.26	26.04	14.02	4.30
48-	Mash 80	79.00	26.58	10.10	38.35	4.07	6.04	4.44	27.11	21.62	5.79
		**	**	**	**	**	** **	**		**	**
MS(V)		245.64	91.65	8.56	222.11	0.32	1.09	0.38	52.53	82.67	7.53
		*	**					*			
MS (R)		5.50	7.01	1.14	10.16	0.01	0.09	0.07	4.88	6.34	0.35
MS (E)		1.61	1.35	0.57	10.13	0.02	0.08	0.02	15.56	4.80	0.38
SE		0.63	0.58	0.38	1.59	0.07	0.15	0.07	1.97	1.10	0.31
Heritability		0.97	0.94	0.78	0.84	0.79	0.75	0.80	0.37	0.80	0.82

X 1- Days to maturity X 2- Plant height (cm)
X 3- Branches per plant X 4- Pods per plant
X 5- Pod length (cm) X 6- Seeds per pod
X 7- 100-seed weight (g) X 8- Harvest index (% age)
X 9- Biological yield per plant (g) Y - Grain yield per plant (g)

** Highly significant * Significant

have been reported by Malhotra *et al.,* (1987) and Malik *et al.,* (1987) in mungbean. Plant height was positively correlated with all the characters except with harvest index where it was negative. These results are in close agreement with Malhotra *et al.,* (1974) and Malik *et al.,* (1987) except with pod length and 100-seed weight where they did not agree. Branches per plant was positively correlated with all the characters. Pods per plant and pod length were positively associated with all the characters except with harvest index where it was negatively correlated. Pods per plant had significant correlation with biological and grain yield which could be considered important yield contributing character. The positive association of pods per plant with other yield

Table 2. Genotypic, phenotypic and environmental correlation co-efficient among yield and yield components in 48 genotypes of mash (*Vigna mungo* L.)

	X 2	X 3	X 4	X 5	X 6	X 7	X 8	X 9	Y
	**								
X 1 rG	0.7224	0.4667	0.2846	0.4597	0.3490	0.3026	0.2440	0.4491	0.5263
	**	**		**	*			**	**
rP	0.6894	0.4008	0.2580	0.4036	0.2977	0.2690	0.1662	0.3983	0.4770
rE	-0.0842	-0.0746	0.0089	-0.0059	-0.0068	0.0218	0.1506	0.0174	0.0752
X 2 rG		0.5923	0.3016	0.7112	0.4302	0.2276	-0.1104	0.5093	0.4693
		**	*	**	**			**	**
rP		0.5257	0.2832	0.6340	0.3828	0.2025	-0.0563	0.4636	0.4417
rE		0.1627	0.1553	0.1752	0.1771	0.0421	0.0486	0.1945	0.2781
X 3 rG			0.4657	0.2831	0.3181	0.1367	0.0540	0.3920	0.4877
			**					*	**
rP			0.3754	0.2271	0.2409	0.1100	0.0363	0.3350	0.4210
rE			-0.0054	0.0221	-0.0083	0.0100	0.0194	0.1210	0.1534
								**	**
X 4 rG				0.3531	0.0259	0.0372	-0.3254	0.9032	0.7834
				*				**	**
rP				0.2908	0.0200	0.0221	-0.1839	0.7767	0.6852
rE				0.0151	-0.0029	-0.0473	-0.0059	0.1991	0.1975
X 5 rG					0.4223	0.0917	-0.2294	0.4713	0.3848
					**			**	**
rP					0.3826	0.0881	-0.1257	0.3912	0.3279
rE					0.2505	0.0742	-0.0030	0.0758	0.0873
X 6 rG						-0.0240	0.0567	0.1487	0.1633
rP						-0.0007	0.0119	0.1465	0.1429
rE						0.0802	-0.0455	0.1402	0.0692
X 7 rG							0.4144	0.2344	0.4030
									*
rP							0.1638	0.2213	0.3275
rE							-0.1775	0.1682	-0.0016
X 8 rG								-0.2134	0.1877
								*	

(Table 2 Contd.)

	X 2	X 3	X 4	X 5	X 6	X 7	X 8	X 9	Y
rP								-0.2928	0.2751
								**	**
rE								-0.5000	0.5165
									**
X 9 rG									0.9105
									**
rP									0.8004
									*
rE									0.3200

X 1- Days to maturity X 2- Plant height (cm)
X 3- Branches per plant X 4- Pods per plant
X 5- Pod length (cm) X 6- Seeds per pod
X 7- 100-seed weight (g) X 8- Harvest index (% age)
X 9- Biological yield per plant (g) Y - Grain yield per plant (g)

rG, rP and rE are genotypic, phenotypic and environmental correlation coefficients, respectively.

** Significant P > 0.01 * Significant P > 0.05
( ) Non-significant

components had been reported by Malhotra *et al.,* (1974) and Khalid *et al.,* (1984) except with pod length and 100-seed weight where they contradicted. Seeds per pod had positive correlation with all the characters except with 100-seed weight where it was negative. Seed weight was positively correlated with all other characters except with seeds per pod as already mentioned. Biological had negative effect on accumulating efficient bio-mass into grain yield and vegetative parts. The varieties with high biological yield and low grain yield attained low harvest index. Similar findings have been reported by Malik *et al.,* (1981) in chickpea and Malik *et al.,* (1986) in mungbean. The negative associations of character pairs like 100-seed weight vs seeds per pod and harvest index vs pods per plant are likely to impose problem in combining these important yield components in one genotype. Suitable recombinations might be obtained through biparental mating, mutation breeding or diallel selective mating by breaking undesirable linkages.

Path coefficient analysis: The genotypic correlation coefficients were further partitioned into direct and indirect effects by various yield contributing characters and

Table 3. Direct (highlighted) and indirect effects of yield and yield components in 48 genotypes of mash (*Vigna mungo* L.)

	X 1	X 2	X 3	X 4	X 5	X 6	X 7	X 8	X 9	rG
X1	-0.0136	-0.1615	0.1198	-0.0931	0.0485	-0.0215	-0.0053	0.0855	0.5675	0.5263
X2	-0.0098	-0.2236	0.1520	-0.0986	0.0750	-0.0265	-0.0040	-0.0387	0.6435	0.4693
X3	-0.0063	-0.1324	0.2567	-0.1523	0.0298	-0.0196	-0.0025	0.0189	0.4953	0.4877
X4	-0.0039	-0.0674	0.1195	-0.3170	0.0372	-0.0016	-0.0006	-0.1141	1.1413	0.7834
X5	-0.0063	-0.1590	0.0727	-0.1155	0.1054	-0.0260	-0.0016	-0.0804	0.5955	0.3848
X6	-0.0047	-0.0962	0.0816	-0.0085	0.0445	-0.0615	0.0004	0.0199	0.1878	0.1633
X7	-0.0042	-0.0509	0.0351	-0.0122	0.0097	0.0015	-0.0175	0.1452	0.2961	0.4030
X8	-0.0033	0.0247	0.0138	0.1064	-0.0242	-0.0035	-0.0072	0.3503	-0.2696	0.1877
X9	-0.0061	-0.1139	0.1006	-0.2953	0.0497	-0.0091	-0.0041	-0.0748	1.2636	0.9105

X 1- Days to maturity X 2- Plant height (cm)
X 3- Branches per plant X 4- Pods per plant
X 5- Pod length (cm) X 6- Seeds per pod
X 7- 100-seed weight (g) X 8- Harvest index (% age)
X 9- Biological yield per plant (g) rG - Genotypic correlation with grain yield per plant

presented in Table 3. It is evident that biological yield per plant, harvest index, branches per plant and pod length contributed positive direct effects towards grain yield. The contribution by important characters was mainly through biological yield and branches per plant in most cases. The improvement through pods per plant and 100-seed weight may be utilized via biological yield and branches per plant as pods per plant and 100-seed weight had been considered important yield contributing parameters in most of the legumes (Tomar *et al.*, 1973; Malhotra *et al.*, 1987; Rani & Rao, 1981; Khalid *et al.*, 1984). The direct effect of days to maturity, plant height, pods per plant, seeds per pod and 100-seed weight were negative. Malik *et al.*, (1987) also reported negative direct effects of days to maturity, branches per plant, pods per plant, seeds per pod and 100- seed weight, and thus concluded plant height and biological yield more important for improving grain yield in mungbean. Most of the earlier investigators reported positive direct effects of pods per plant except Malik *et al.,* (1987) who are in agreement with the present findings. The contradiction in results mainly depends on the breeding material and environments under which the experiment was conducted.

In the present investigation where a considerable portion of available local mash genetic stock was utilized, branches per plant, pod length, harvest index and biological yield per plant were found to be most important yield components contributed towards grain yield mainly via biological yield alongwith its maximum direct effect towards grain yield, therefore, the selection should be based on biological yield with a close consideration of branches and harvest index for further improvement in local mash.

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