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Short Communication

Evaluation of rajmash (*Phaseolus vulgaris* L.) genotypes in mid-altitudes of North-Western Himalayas

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In north-western Himalayas, rajmash (*Phaseolus vulgaris* L.) is generally grown as *kharif* crop. For Uttaranchal hills, the last rajmash variety 'VL Rajma 63' was released in 1978, and is the only option with the farmers other than local varieties. Farmers generally grow local landraces which are indeterminate type but determinate ones are also available. During 2002-03, Uttaranchal produced 6,382 metric ton of rajmash from an area of 4, 11 8 ha with productivity of 8.92 q/ha. Uttaranchal is a pulse deficit state as it produces only 0.31 lakh tonnes of pulses which is only 11.69 per cent of its total requirement of 2.65 lakh tonnes [1]. Increase in pulse productivity is one option to bridge the production gap in pulses. The climatic conditions vary greatly over years, thus the understanding of genetic parameters should be studied over years. The present investigation was undertaken to understand the contribution of various characters to yield in rajmash under mid-altitudes of north-west Himalayas over years.

Thirteen rajmash genotypes (Table 1) were evaluated from 2001 to 2003 during *kharif* season at mid-altitudes at Hawalbagh farm (Latitude: 29^{O}-36'N; Longitude: 79^{O}-40'E and Altitude: 1250 amsl) of North West Himalayas. The experimental plot consisted of four rows sown in a randomized block design. The distance between rows was 30 cm while distance between plants within a row was 10 cm. The experiment was sown during first fortnight of July every year, the normal planting time of rajmash in hills of Uttaranchal.

The data were recorded on five competitive plants in each replication for seed yield, pods/plant, pod length (cm) and plant height (cm) while data on seed yield, vegetative period and days to 50% maturity were recorded on plot basis. The duration of vegetative phase was calculated from the date of sowing till flower initiation. The data were analyzed as per Dewey and Lu [2] for direct and indirect effects through path analysis over years using seed yield as dependent variable.

In the present investigation, correlation coefficients were computed pooled over three years, 2001-2003 (Table 2). The results indicated a significant positive association of yield with seeds/pod, pods/plant, pod length and days to maturity while significantly negative association with plant height. Dhimam [3] also reported that seed yield was positively correlated with number of nodules, number of pods and pod length, but negatively correlated with plant height in dry bean. Seeds/pod was significantly and positively associated with all the traits except plant height. Plant height is inversely related to seeds/pod and pods/plant. Pods/plant was also significantly and positively associated with pod length and days to maturity. The duration of vegetative phase was significantly associated with seeds/pod, pod length and days to maturity, indicating that increased vegetative phase in rajmash was related to increased seeds/pod, pod length and days to maturity.

Partitioning of correlation coefficients into direct and indirect effects revealed that days to maturity, seeds/pod, pod length and pods/plant had a positive contribution to yield while shorter vegetative phase had a negative contribution to yield (Table 3). Pod length was found to be the most important character contributing to yield in dry bean [3]. Pods/plant, pod length, seeds/pod and 100-seed weight contributed appreciable higher genetic gain for yield through simultaneous selection in rajmash [4].

The pattern of indirect contribution of various traits towards yield (Table 3) indicated pods/plant, maturity days and pod length were contributing indirectly towards yield through seeds/pod. None of the traits are sufficiently indirectly contributing through either pods/plant or pod length. Days to maturity is negatively contributing through negative direct vegetative period. On the other hand,

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Table 1. Details of rajmash experimental materials

S. No.	Genotype	Parentage	Developing centre	Seed colour
1	VRJ 121	PI 339401 × L 60	VPKAS, Almora	White
2	VRJ 122	PI 339401 × PI 339482	VPKAS, Almora	White
3	VRJ 123	VL 63 × VL 65	VPKAS, Almora	Red with dark red patches
4	VRJ 128	PI 339401 × Jawala	VPKAS, Almora	White
5	VRJ 133	VL 63 × VL 65	VPKAS, Almora	Brownish red with red patches
6	VRJ 138	VL 63 × Jawala	VPKAS, Almora	Red with dark red patches
7	VRJ 141	VL 63 × VL 64	VPKAS, Almora	Red with dark red patches
8	VRJ 142	VL 63 × VL 65	VPKAS, Almora	White
9	VRJ 144	PI 339401 × EC 9160	VPKAS, Almora	White
10	VRJ 147	VL 63 × VL 64	VPKAS, Almora	Red with dark red patches
11	VL 64	Local introduction	VPKAS, Almora	Brownish red
12	VL Rajma 63	Selection from local germplasm	VPKAS, Almora	Light red with deep red patches
13	IPR 96-4	Selection from local germplasm	IIPR, Kanpur	Dark red with white patches

Table 2. Phenotypic correlations among different traits in rajmash pooled over three years (2001 to 2003) at Hawalbagh

Trait	Pods/ plant	Pod length	Plant height	Vegeta-tive period	Days to maturity	Yield
Seeds/pod	0.493**	0.357**	–0.236*	0.208*	0.389**	0.563**
Pods/plant		0.411**	–0.260**	0.067	0.301**	0.509**
Pod length			–0.069	0.196*	0.181	0.344**
Plant height				0.166	0.094	–0.226*
Vegetative period					0.551**	–0.031
Days to maturity						0.488**

*P<0.05; **P<0.01

positively correlated with seeds/pod, pod length and maturity days. Direct effect of days to maturity towards yield was maximum while that of vegetative phase was minimum and negative towards yield. Seed colour preference for rajmash in hills is primarily for red with dark red patches or without patches. However, rajmash genotypes with other seed colours (white, brownish red) are also available on limited scale. Beside colour, farmers also look for better cooking quality. Therefore, promising genotypes with red or brownish red seeds with good cooking quality need to be identified/developed for Uttaranchal hills.

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Table 3. Partitioning of phenotypic correlations into direct (bold) and indirect effects in rajmash pooled over three years (2001 to 2003) at Hawalbagh

Trait	Seeds/pod	Pods/plant	Pod length	Plant height	Vegetative period	Days to maturity
Seeds/pod	**0.290**	0.143	0.104	–0.068	0.060	0.113
Pods/plant	0.070	**0.142**	0.058	–0.037	0.010	0.043
Pod length	0.057	0.065	**0.159**	–0.011	0.031	0.029
Plant height	0.022	0.024	0.006	**–0.092**	–0.015	–0.009
Vegetative period	–0.086	–0.028	–0.081	–0.069	**–0.414**	–0.228
Days to maturity	0.210	0.162	0.098	–0.051	0.298	**0.540**
Yield (r)	0.563**	0.509**	0.344**	–0.226*	–0.030	0.488**

*P≤0.05; **P≤0.01

seeds/pod, pods/plant and vegetative period were indirectly contributing to yield through days to maturity. 100-seed weight, number of branches/plant, number of pods/plant, number of seeds/pod, plant spread and plant height jointly contribute 82.9 per cent towards yield [5]. The characters used in our study explained 35.7 per cent of variation which may be due to high fluctuations in climatic conditions over years. The coefficient of determination was fairly high in the present investigation (0.587).

Hence, it is concluded that yield is positively associated with yield components like seeds/pod, pods/plant and pod length; as well as with days to maturity. The duration of vegetative phase was also

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