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Short Note

Stability analysis for seed yield and related traits in buckwheats (*Fagopyrum* species)

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Abstract

Joint regression analysis over four environments in eight genetically diverse buckwheat (*tataricum* and *esculentum* sp.) genotypes during *kharif* seasons of 2001-2004 at Sangla (distt. Kinnaur) indicated the presence of genotype x environment interaction for all the traits studied. Based on stability parameters, no genotype was stable for plant height and seed yield. Genotypes Sangla B-1, PRB-1 along with the local cultivars i.e. Kuppa and Kamroo were highly stable for days to maturity and 100-seed weight. For seed yield, genotypes Sangla B-1 and Himpriya adapted for high yielding environments, whereas genotypes VL Ugal-7, OC-2, PRB-1 and KBB-3 showed suitability for low yielding environments. Sangla B-1 exhibited high mean performance for most of the traits, rendering its cultivation in Kinnaur district of Himachal Pradesh.

Key words: Buckwheat, G x E interaction, stability parameters.

The buckwheats i.e. sweet (*Fagopyrum esculentum* L. Moench.) and bitter (*Fagopyrum tataricum* L. Gaertn.) are a rich source of lysine content along with other amino acids which the common cereal crops lack. It is an important catch crop taken after green pea in the high altitude, dry temperate regions with comparatively low rainfall under the neglected agriculture conditions of Himachal Pradesh. The cultivation of this crop has seen a conspicuous decline mainly due to the lack of awareness of its complementary nutritive value and non-availability of suitable high yielding varieties. To promote the cultivation of this crop, quick varietal improvement is one of the important criteria. The flowers and green leaves are used for the extraction of rutin, a flavinoid, which is used for preparing medicines (Joshi and Paroda, 1991). Inspite having great importance, very little has been done to exploit the genetic potential of the crop in the recent past in Himachal Pradesh (Joshi and Rana, 1995). Considering the scanty information on the identification of the stable genotypes, the present study was conducted to determine the amount of genotype x environment interaction among the promising selections of *esculentum* and *tataricum* species.

The experimental material consisted of eight diverse genotypes of buckwheat raised in randomized block design during the summer seasons of 2001-2004 at Mountain Agriculture Research and Extension Centre, Sangla (2680m above mean sea level) in district Kinnaur. All the genotypes except for OC-2 (*esculentum* species) belonged to *tataricum* species. The experiments were conducted in randomized block design with three replications and each genotype was grown in $8m^2$ plot. Data were recorded on ten randomly taken plants for days to 50% flowering, plant height (cm), days to maturity, 100-seed weight (g) and seed yield (q/ha). Stability parameters for different characters were computed using the regression approach of Eberhart and Russell (1966).

Pooled analysis of variance (Table 1) revealed significant differences among the genotypes suggesting the presence of variability among genotypes. The mean squares due to environments were also significant for all the traits except for days to 50% flowering and 100-seed weight indicating that different environments played a major role in bringing variation among the genotypes. The mean squares due to genotype x environment interaction were also significant for all the traits indicating differential response of genotypes to different environments. Highly significant means squares due to environment (linear) indicated considerable differences among environments and their predominant effects on all the traits except for 100-seed weight. Similar findings were reported by earlier workers (Dhiman *et al.*, 2002 and Dhiman and Chahota,

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2003). Pooled deviations were significant for all the traits except for days to 50% flowering and 100-seed weight indicating the importance of non-linear component in the manifestation of genotype x environment interaction for the significant traits. The genotype x environment interaction (linear) was significant for plant height, 100-seed weight and seed yield emphasizing the importance of linear effects in the prediction of these traits with some reliance under different environments. Sharma and Lata (2003) also obtained similar results for these traits. However, for the unpredictable traits, prediction can be made by considering the stability parameters of individual genotypes.

Table 1. Joint regression analysis of variance for different traits over environments in buckwheat

Source	df	Days to 50% flowering	Plant height (cm)	Days to maturity	100-seed weight (g)	Seed yield (q/ha)
Genotypes	7	262.84*	2946.59*	543.72*	0.13*	202.59*
Environments	3	31.26	393.17*	73.18*	0.01	12.39*
Genotype x Environment	21	27.21*	278.22*	53.79*	0.01*	19.02*
Environment + (Genotype x Environment)	24	11.85*	130.30*	24.84*	0.001	7.10*
Environment (linear)	1	93.79^{+}	1179.59^{+}	219.51^{+}	0.002	37.16^{+}
Genotype x Environment (linear)	7	13.71	204.70^{+}	17.51	0.002^{+}	13.58^{+}
Pooled deviation (non-linear)	16	5.91	32.18*	15.88*	0.001	2.39*
Pooled error	56	3.36	3.31	2.74	0.001	34.19

*P≥0.05; $^{+}$ P≥0.05

Estimates of stability parameters (Table 2) revealed that none of the genotypes were found to be stable for plant height and seed yield indicating their unsuitability to the fluctuating environments. For days to 50% flowering, genotypes Himpriya, VL Ugal-7, Sangla B-1, Kuppa Local and Kamroo Local exhibited high stability. Similarly, genotypes Sangla B-1, PRB-1 along with the local genotypes Kuppa and Kamroo were highly stable for days to maturity and 100-seed weight, whereas based on mean performance, Sangla B-1 was the earliest in maturity having maximum seed weight. For 100-seed weight, all the genotypes except for Himpriya and OC-2 were highly stable. Thus, the genotypes exhibiting high stability can be recommended for all the environments. Genotype OC-2 showed below average stability (b<1) for days to maturity and 100-seed weight indicating suitability for low yielding environments. For plant height and seed yield, genotypes Sangla B-1 and Himpriya showed above average stability (b>1) indicating suitability to better yielding environments. Sangla B-1 also showed the highest mean seed yield over environments. Genotypes VL Ugal-7, OC-2, PRB-1 and KBB-3 for seed yield, and genotypes VL Ugal-7, PRB-1 and Kamroo Local for plant height were found to be least responsive indicating their suitability for low yielding environments.

Based on the mean performance and stability parameters, it can be concluded that genotype Sangla B-1 alongwith one or more yield contributing traits may be recommended for cultivation in district Kinnaur and adjoining areas of Himachal Pradesh.

Table 2. Individual regression analysis and estimates of stability parameters for different characters in buckwheat

Genotype	Days to 50% flowering			Plant height (cm)			Days to maturity			100-seed weight (g)			Seed yield (q/ha)		
	x	b	S^2d	x	b	S^2d	x	b	S^2d	x	b	S^2d	x	b	S^2d
Himpriya	67.25	-0.16 ± 0.87	8.69	147.66	2.18* ± 0.44	29.04*	131.67	0.11 ± 1.28	44.86*	2.45	-0.33 ± 3.51	0.003*	13.66	2.63* ± 0.47	1.04
VL Ugal-7	43.25	1.14 ± 0.25	0.71	73.37	0.03* ± 0.21	6.31	103.50	0.41 ± 1.38	52.19*	2.35	0.46 ± 1.86	0.001	2.65	0.01* ± 0.19	0.19
Sangla B-1	61.50	0.83 ± 0.35	1.47	149.60	2.64* ± 0.44	28.14*	101.17	0.73 ± 0.42	4.88	2.75	-0.22 ± 0.68	0.0001	25.24	3.62* ± 1.15	6.14*
OC-2	55.58	2.65 ± 1.17	16.09*	129.25	0.51 ± 0.43	27.27*	112.33	-0.06* ± 0.26	1.85	2.41	-1.20* ± 0.34	0.0001	12.04	-0.30* ± 0.59	1.60*
PRB-1	63.42	1.63 ± 0.97	11.10*	103.72	-0.75* ± 0.78	90.05*	132.17	1.65 ± 0.38	3.95	2.68	-1.11 ± 1.69	0.0006	6.48	-0.25* ± 0.56	1.45*
KBB-3	62.58	-0.65* ± 0.20	0.48	151.85	12.03* ± 0.33	16.28*	109.00	1.88 ± 0.61	10.28*	2.60	1.45 ± 1.03	0.0002	20.27	-0.84* ± 0.52	1.25*
Kuppa local	65.42	0.64 ± 0.69	5.64	128.29	0.97 ± 0.62	56.02*	111.92	1.45 ± 0.27	2.05	2.46	1.33 ± 2.33	0.001	14.72	0.39 ± 0.67	2.07*
Kamroo local	51.75	1.91 ± 0.51	3.08	111.90	0.41* ± 0.18	4.31	118.75	1.85 ± 0.51	7.01	2.19	1.79 ± 1.11	0.0003	14.12	2.74 ± 1.07	5.36*
Grand mean	58.84			124.45			115.19			2.49			13.65		
CD (5%)	5.10			6.24			5.74			0.05			1.39		

*P≥0.05

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