

STABILITY OF NEUROTOXIN CONTENT IN *KHESARI*

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Khesari (*Lathyrus sativus* L.) is cultivated in India on about two million hectares producing one million tonnes of protein-rich grain and more than a million tonnes of fodder. Bihar and Madhya Pradesh together account for about 80% of the *khesari* area, while the rest is distributed over West Bengal, Orissa, Gujarat, Uttar Pradesh and Maharashtra. *Khesari* can grow under conditions where other crops totally fail. Recent studies suggest that *khesari* benefits succeeding nonleguminous crops, perhaps even more than gram, in terms of biologically fixed nitrogen.

However, the continuous use of this pulse for long periods is known to result in lathyrism, a non-reversible paralysis of lower limbs, in human beings. This detrimental effect is due to the presence of a neurotoxin identified as β -N-Oxalyl- α -B-diaminopropionic acid (BOAA; Rao, Adiga and Sarma, 1964). Work has been in progress at the Division of Genetics, IARI, to develop varieties with low content of the neurotoxin and several such lines have been identified (Jain, Somayajulu and Barat, 1974).

The object of this study was to evaluate the behaviour of such low-neurotoxin varieties in different environments.

MATERIALS AND METHODS

The material comprised 15 strains (Table 1), including Local (which varied at different locations), grown at 6 locations. The seed obtained from these 6 locations was analysed for BOAA content (mg/100 gm) at the National Institute of Nutrition, Hyderabad and for protein content at the Genetics Division, IARI, New Delhi.

RESULTS

The BOAA content (mg/100 gm), protein content and seed yield (in q./ha) in the six environments are given in Table 1. It is seen that 'LSD-1', 'LSD-2', 'LSD-3', 'LSD-4', 'LSD-5', 'LSD-6' and 'Pusa 24' have lower BOAA content than the general mean (442). The local, which varied from location to location, had a mean of 515. The highest overall BOAA content is in the variety 'S. 220', to the extent of 576. This strain is white-flowered and white-

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TABLE I
Average BOAA content (mg/100gm) at 6 locations, mean yield (qls/ha) and % protein content of 15 strains of khesari

Genotypes	BOAA (mg/100 gm)						Mean grain yield in ql/ha	Mean protein content (percent)	
	Pusa	Delhi	Sirsa	Karnal	Kanpur	Tanchla			
Pusa -24	248.5	331.0	486.5	517.5	409.0	435.0	405	11.2	30.97
LSD - 1	222.5	201.5	140.0	367.5	142.5	393.0	245	11.3	30.75
LSD - 2	228.0	528.0	419.0	497.0	346.5	538.0	426	10.5	30.86
LSD - 3	527.5	238.0	250.5	300.0	352.0	300.0	328	11.4	30.50
LSD - 4	445.0	183.0	228.0	217.5	191.5	259.0	254	11.2	30.58
LSD - 5	227.5	621.0	388.0	517.5	124.5	662.0	423	10.3	30.76
LSD - 6	548.5	279.5	103.5	346.6	181.0	311.0	295	10.5	29.25
PS - 1	631.5	610.5	424.5	429.5	420.0	549.0	511	12.0	27.57
PS - 6	466.0	528.5	466.0	543.5	393.5	497.0	483	11.6	27.87
P 10-1	600.5	559.0	579.5	517.5	429.0	621.0	551	10.8	28.75
P -396	538.0	631.5	476.0	512.5	414.0	621.0	532	13.1	27.04
S. 121	652.0	610.5	460.5	481.5	429.5	528.0	527	10.5	29.05
S. 220	880.0	538.5	471.0	476.0	554.0	538.0	576	10.8	30.29
K. H-1	558.5	620.5	523.0	497.0	484.5	704.0	565	11.5	28.29
Local	590.0	558.5	367.5	496.5	372.5	518.0	515	11.0	28.34
Environ-Index	48.6	26.9	-56.8	5.9	-92.4	68.3			

Grand Mean=442.4 (BOAA), 10.0 (grain yield) and 29.6 (% protein) C. D. (5%) BOAA content, 125.3.

seeded where as all other strains are blue-flowered and light-brown seeded. Other strains with high BOAA values are 'K.H. 1' (565), 'P. 10-1' (551), 'P. 396' (532), 'S. 121' (527), 'P.S. 1' (511) and 'P.S. 6' (483). The strains with low overall mean BOAA values are 'Pusa-24' (405), 'LSD-3' (328), 'LSD-6' (295) and 'LSD-1' (245). However, it is to be noted that high values are recorded for 'Pusa-24' at Karnal (517.5) and Sirsa (486.5), for 'LSD-3' (527.5) and 'LSD-6' (548.5) at Delhi and 'LSD-1' at Tanchha (393).

TABLE 2
Analysis of variance for BOAA content

Source	D.F.	M.S.
Varieties	14	78428.78*
E (L)	1	293235.88**
V × E (L)	14	9313.22
Pooled Devs.	60	10218.72*
Pooled error	70	6844.40@

*Significant at $P=0.05$; **Significant at $P=0.01$; @ Pooled error was estimated from 5 locations whose replicated data was available.

TABLE 3
Stability parameters for BOAA content

Genotype	Mean	Reg. (b) on EI	s ² _d
Pusa-24	404.58	0.61	10725.76
LSD-1	244.50	1.22	7872.85
LSD-2	426.08	0.45	17374.19
LSD-3	328.00	0.38	13315.50
LSD-4	254.00	0.75	9079.38
LSD-5	423.41	2.16	35614.06
LSD-6	295.00	1.77	13886.36
PS-1	510.83	1.23	4697.23
PS-6	483.25	0.53	2011.08
P10-1	551.08	0.86	2416.25
P-396	532.16	1.18	2040.82
S-121	527.00	1.07	4047.69
S-220	576.25	0.95	24764.78
KH-1	564.58	1.03	3646.80

Mean BOAA content of local checks: 514.8 mg/100 gm.

The seed yield data (Table 1) revealed that centres like Pusa, Sirsa and Kanpur had better crop as compared to other centres. Though P. 396 yielded 13.14 q./ha (mean yield), its BOAA content was among the highest (621), next to K.H. 1 (704). All other varieties seemed to be at par for yield, including Local. With regard to protein content, 'Pusa-24' had the highest value of 30.97 followed by 'LSD-3' (30.58). Other strains with higher protein values than the local are 'LSD-1', 'LSD-2', 'LSD-4', 'LSD-5', 'LSD-6', 'S. 220' and 'S. 121'.

Analysis of variance for BOAA content (Table 2) showed that there were significant differences between the varieties for this character. The environments also differed significantly. The response slopes for the different genotypes were not significantly different but there was considerable scattering of the points around the response lines. The three stability parameters, mean, b and s^2_d in respect of the 15 genotypes are in Table 3.

DISCUSSION

The major breeding objective in *khesari* has been to evolve strains with low-neurotoxin content, otherwise at par with local cultivars. It is seen that all LSD strains and 'Pusa-24' have such a lower BOAA content. A most interesting observation is that BOAA content of the same genotype varied in different environments and that there are significant differences among environments for BOAA content. The linear component of the $G \times E$ interaction is not, however, significant. But the deviations about the linear regression, as measured by pooled deviation, were marked. It will be difficult, therefore, to predict genotype performance across environments.

Locations such as Pusa, Karnal and Tancha are high BOAA environments. Strain LSD. 1 maintained its low rank for BOAA at Pusa (222.5), Sirsa (140.0), Karnal (367.5) and Tanchha (393). Similar is the case with 'LSD-3', 'LSD-4', 'LSD-6' and 'Pusa-24'. Hence, these lines deserve preference over other varieties for cultivation even in high BOAA environments. The existence of such variation underscores the need for testing the low BOAA lines extensively in the areas of proposed release before they are finally recommended to the cultivators.

All strains are at par with each other, including the locals, for seed yield. With regard to protein content, 'Pusa-24' showed the highest value followed by 'LSD-3'. A number of other low-BOAA strains also have higher protein percentage as compared to locals.

SUMMARY

A set of low-neurotoxin (BOAA) varieties of *Lathyrus sativus* was tested in six environments. The varieties as well as environments differed significantly. Though env. \times var. linear component was not significant, pooled deviations were.

significant. Because of the existence of such instability, rigorous testing of low-neurotoxin varieties in the areas of proposed release would appear essential.

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