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RESEARCH PAPER

Correlation analysis in advanced breeding lines of grasspea for yield and its attributing character with neurotoxin ODAP content

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ABSTRACT

Eighteen advanced breeding lines with their five parents were evaluated for their yield and yield attributing characters, protein and β-ODAP (β-*N*-oxalyl-L-α, β-diaminopropionic acid) at different growth stages. The correlations between traits were investigated and, positiveand significant correlations were found among seed yield,number of seeds/plant and number of pods/plant. β-ODAP content at different stage shows no and negative correlation with seed yield and protein content.Seed protein content shows negative or no correlation with seed yield and β-ODAP at different growth stage. Therefore, it can be said that development of higher yielding grasspea lines with low β-ODAP and high protein content is possible.

Key Words : Advanced breeding lines, Grasspea, Yield, Neurotoxin, ODAP

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Grasspea is a dual purpose annual legume crop grown for human consumption as pulse and for animal consumption as forage and seed. Grass pea is a one of the preferred legume crop in poor and arid areas because of its outstanding tolerance of dry or flooding conditions, disease resistance, and high yield potential. It can easily grow in different soil types and at high altitudes (Tiwari and Campbell, 1996a and b). *L. sativus* grows with as little as 250 mm of annual precipitation and it is typically the last surviving plant in drought times (Tekele-Haimanot *et al.*, 1990 and White *et al.*, 2002).It has high protein content and high fibre content in hull (ADF>55%) (4). It seeds have good protein content (relatively rich in lysine) and a high level of polyunsaturated fatty acids (Chinnasamy *et al.*, 2005). Grass pea foliage and seeds make valuable forage. They can be used fresh, dried as hay or made into silage (Emile *et al*., 2008 and Yadav and Bejiga, 2006).

Besides the obvious advantages, *L. sativus* seeds contain a major anti-nutritional compound namely β-N-oxalyl-L-α,β-diaminopropionic acid (β-ODAP) (Zhao *et al.*, 1999 and Wang *et al.*, 2000), which, if consumed in large quantities for prolonged periods (3 to 4 month),can cause irreversible disease known as 'lathyrism' or 'neurolathyrism', that is paralysis of the lower limbs (Spencer *et al.*, 1986 and Yan *et al.*, 2006).Although attempts had been made by many lathyrus endemic countries to ban the production of grasspea and its

substitution by alternative crops to combat lathyrism but it failed to be practical with farmers (Tadesse *et al.*, 1997) due to its many advantages over other crops such as its ability to tolerate drought, ease of planting, less cost of production, ability to maintain soil fertility and its resistance to disease and weeds (Spencer and Palmer, 1989). Therefore, breeding of grass pea strains with zero/ low ODAP is proposed as a long lasting and dependable solution to combat the menace of lathyrism and to exploit the immense potentials of this hardy legume (Campbell, 1988).In order to this purpose breeding programmes are in progress worldwide to improve genotypes combining high yield, high protein content and low or zeroneurotoxin content (ODAP) (Bozzini, 1997; Siddique and Hanbury, 1998 and Hanbury *et al.*, 2000) because seeds having less than 0.2 per cent ODAP are safe for consumption (Abd El Moneim *et al.*, 1999).

For this purpose an experiment was carried out to investigate correlation between yield attributing characters and ODAP and protein quality traits of grass pea. The present paper elucidates the interrelationship of factors influencing grain yield of advanced breeding lines and quality characters.

RESEARCH METHODOLOGY

Plant material and field trials :

Eighteen advanced lines with their five parents (listed in Table A) were grown during *Rabi* 2013-14 in Randomized Complete Block Design (RBD) with three replications in plot size of 4×0.45 m^2 at row spacing of 30 cm apart. The observations were recorded on five plant basis in each plot in each replication. These observations were averaged and then subjected to statistical analysis.

Determination of ODAP contain :

ODAP in dry seeds and dry leaf was estimated by using the OPT suggested by Briggs *et al.*, 1983). 0.5 g grinded powdered (40 mesh) sample was aliquated by shaking for 45 minutes with 10 ml of 60 per cent ethanol and then centrifuged at 4000 rpm for 15 minutes.

Table A : Details of the genotypes used in the study

Sr. No.	Genotype	Generation	Source
1.	Mahateora	Parent	AICPIR, MULLARP, IGKV, Raipur
2.	Prateek	Parent	AICPIR, MULLARP, IGKV, Raipur
3.	Pusa 24	Parent	IARI, New Delhi
4.	Ratan	Parent	IARI, New Delhi
5.	RLS 3004	Parent	IGKV, Raipur
6.	Ratan × Mahateora	F_7	AICPIR, MULLARP, IGKV, Raipur
7.	Ratan × Pusa-24	F_7	AICPIR, MULLARP, IGKV, Raipur
8.	Prateek × RLS-3004	F_7	AICPIR, MULLARP, IGKV, Raipur
9.	Pusa-24 × RLS-3004	F_7	AICPIR, MULLARP, IGKV, Raipur
10.	Ratan × RLS-3004	F_7	AICPIR, MULLARP, IGKV, Raipur
11.	Prateek × Pusa-24	F_7	AICPIR, MULLARP, IGKV, Raipur
12.	Mahateora × Ratan	F_7	AICPIR, MULLARP, IGKV, Raipur
13.	Ratan × Prateek	F_7	AICPIR, MULLARP, IGKV, Raipur
14.	Prateek × Ratan	F_6	AICPIR, MULLARP, IGKV, Raipur
15.	Pusa-24 × Mahateora	F_6	AICPIR, MULLARP, IGKV, Raipur
16.	Pusa-24 × Prateek	F_6	AICPIR, MULLARP, IGKV, Raipur
17.	Mahateora × RLS-3004	F_6	AICPIR, MULLARP, IGKV, Raipur
18.	Prateek × Mahateora	F_6	AICPIR, MULLARP, IGKV, Raipur
19.	Prateek × RLS- 3004	F_5	AICPIR, MULLARP, IGKV, Raipur
20.	Prateek × Ratan	F_5	AICPIR, MULLARP, IGKV, Raipur
21.	Ratan × Mahateora	F_5	AICPIR, MULLARP, IGKV, Raipur
22.	Pusa 24 × Prateek	F_5	AICPIR, MULLARP, IGKV, Raipur
23.	RLS- 3004 × Prateek	F_5	AICPIR, MULLARP, IGKV, Raipur

Table 1 : Correlation analysis in advanced breeding lines of grasspea

Ch.No.	Characters	1	2	3	4	5	6	7	8	9
1.	No. of pods plant^{-1}	1.000	0.898**	0.621**	-0.203	0.248	-0.016	0.086	-0.463*	-0.574**
2.	No. of seeds plant^{-1}	0.835**	1.000	0.689**	-0.166	0.415*	0.024	0.176	-0.616**	-0.681**
3.	Seed yield plant^{-1} (g)	0.570**	0.652**	1.000	-0.210	0.880**	-0.029	-0.003	-0.265	-0.262
4.	100 seed weight (g)	-0.073	-0.067	-0.107	1.000	0.243	-0.124	-0.506*	0.374	0.353
5.	Harvest Index (%)	0.185	0.317	0.749**	-0.198	1.000	0.017	0.072	-0.203	0.004
6.	Seed protein content (%)	0.001	0.026	-0.047	-0.135	-0.044	1.000	0.027	0.083	0.087
7.	ODAP at flowering stage	0.035	0.134	0.020	-0.248	0.066	0.078	1.000	0.237	-0.027
8.	ODAP at pod filling stage	-0.423*	-0.607	-0.255	0.221	-0.165	0.065	-0.165	1.000	0.990**
9.	ODAP in seed	-0.467*	-0.537	0.220	0.144	-0.056	0.102	-0.035	0.784**	1.000

* and ** indicate significance of values at P=0.05 and 0.01, respectively

Supernatant (2 ml) was hydrolyzed with aqueous potassium hydroxide solution (3N, 4 ml) for 30 minutes.After cooling, 0.25 ml supernatant of the hydrolyzed extract was taken for each sample and 0.75 ml double distilled water and 2 ml OPT reagent was added to it the sample were then incubated at 37^{0}C-38 ^{0}C for two hours. A bright yellow colour was developed. The absorbance was measured at 425 nm using Systronic Spectrometer.

Estimation of protein content in dry seeds :

The nitrogen content was determined by Microkjeldhal method using Gerhart digestion and distillation model (VAO-30).The estimated nitrogen value of replicated sample was converted into protein per cent by multiplying factor 6.25 of pulse protein.

RESULTS AND REMONSTRATION

Correlation analysis indicated that there are significant associations between the investigated traits (Table 1). Seed yield significantly ($p< 0.01$) and positively correlated with harvest index, number of seed per plant and number of pods per plant. Correlations between β-ODAP content at three different stage, seed yield and protein were negative or no significant.

Grass pea is mainly cultivated for its seed but it contents neurotoxin compound so, in all the world, the major target of grass pea breeding is reducing β-ODAP content in the seed. The correlation analysis showed that there is negative or no significant association between β-ODAP and yield traits. The correlation of β-ODAP content at different growth stage with yield and yield correlated traits suchas number of pods /plant, number of seeds per plant and hundred seed weight were significant and negative. This result may be promising to improve new varieties with high yielding and low β-ODAP content.Same results were reported by Talukdar (2009), Firkre *et al.* (2011). However, Cocks *et al.* (2000) who reported a negative relationship between β-ODAP concentration and the total amount of β-ODAP in the plant (total seed weight xβ-ODAP concentration), proposed that low toxin concentration in plant with high seed yielding were caused by toxin dilution. So, the negative and significant correlation between β-ODAP and yield should be taken into consideration with this aspect by the breeders. The association between β-ODAP and protein content was not significant. Similar results were reported by Tadesse and Bekele (2003); Mustafa *et al.* (2007) and Sammour *et al.* (2007). According to same authors, lack of correlation between the β-ODAP and protein indicates that β-ODAP is synthesized and stored independent of protein content.

REFERENCES

Abd El Moneim, A.M., Dorrestein, B. Van, Baum, M. and Mulugeta, W. (1999). Role of ICARDA in improving the nutritional quality and yield potential of grass pea (*Lathyrus sativus*) for subsistence farmers in developing countries: CGIAR-wide conference on Agriculture Nutrition, pp. 5-6.

Bozzini, A. (1997). Utilizzazione di germoplasma in alcune leguminose da granella presso il C.R. Casaccia dell' ENEA. Atti 3rd National Congress Biodiversità: tecnologie-qualità, Reggio Calabria (Italy) 16- 17 June 1997. pp. 107-121.

Briggs, C.J., Pareno, N. and Campbell, C.G. (1983). Physio-chemical assessment of *Lathyrus* species for neurotoxin agent, β-N Oxalyl-L-α–β-diaminopropionic acid. *Plantamedica*., **47** : 188-190.

Campbell, C.G. (1988). Improvement of Lathyrus sativus, in: P.S. Spencer (Ed.), The Grasspeas Threat and Promise. Proceedings of the International Network for Improvement of Lathyrus sativus and Erradication of Lathyrism (INILSEL) workshop, London, May 1988, Third World Medical Research Foundation, New York, 1988, pp. 139-146.

Campbell, C.G. (1997). Grass pea: *Lathyrus sativus* L. International Plant Genetic Resources Institute (IPGRI), Rome; Italy, 92p.

Chinnasamy, G., Bal, A.K. and McKenzie, D.B. (2005). Fatty acid composition of grass pea (*Lathyrus sativus* L.) seeds Lathyrus Lathyrism. *Newsletter*, **4**: 2-4.

Cocks, P., Siddique, K. and Hanbury, C. (2000). Lathyrus. A new grain legume:A report for the rural industries Research and development corporation. Rural Industries Research and Development Corporation.

Emile, J.C., Dias, F.J., Al-Rifai, M., Roy, P le and Faverdin, P. (2008). Triticale and mixtures silage for feeding dairy cows. In: Grassland Science in Europe, Volume 13, Biodiversity and animal feed: future challenges for grassland production. Proceedings of the 22nd General meeting of the European grassland Federation, Uppsala, Sweden, 9-12 June 2008 pp. 804-806.

Fikre, Asnake, Tesgera, Negwo, Kuo, Yu-Haey, Lambein, Femand and Ahmed, Seid (2011). Climatic, edaphic and altitudinal factors affecting yield and toxicity of *Lathyus sativus* grown at five locations in Ethiopia. *Food & Chem. Toxicol.*, **49**(3) : 623-630.

Hanbury, C.D., White, C.L., Mullan, B.P. and Siddique, K.H.M. (2000). A review of the potential of *Lathyrus sativus* L. and *L. cicera* L. grain for use as animal feed. *Anim. Feed Sci. Technol.*, **87** : 1-27.

Mekasha, Y., Tegegne, A., Yami, A., Umunna, N.N. and Nsahai, I.V. (2003). Effect of supplementation of grass hay with non-conventional agro-industrial by-product on rumen fermentation characteristics and microbial nitrogen supply in rams. *Small Rumin. Res.*, **50** : 141-151.

Mustafa, A.E.M.A., Badr, S., Taher, W. and Sammour, R.H.A. (2007). Evaluation of *Lathyrus* spp. germplasm, for quality traits. *J. Biol. Sci.*, **7**(8) : 1339-1346.

Sammour, Reda H., Mustafa, Abd El-Zahar, Badr, Salwa and Tahr, Walla (2007). Genetic variability of quality traits in Lathyrus spp.Germplasm. *Actaagriculturae Slovenia*, **90** : 33-43.

Siddique, K.H.M. and Hanbury, C.D. (1998). The introduction, evaluation and utilization of *Lathyrus* germplasm in Australia. In*:* Mathur PN, Ramanatha RV and Arora RK (editors). Lathyrus genetic resources network. IPGRI, New Delhi, India. pp. 42-45.

Spencer, P.S., Ludolph, A., Dawivedi, M.P., Roy, D.N., Hugon, J. and Shaumburg, H.H. (1986). Evidence for role of the neuro-excitatory amino acid BOAA. *Lancet*, **2** : 1066-1067.

Spencer, P.S. and Palmer, V. (1989). Lathyrus sativus and lathyrism research: A global experience in applied neurotoxicology, in: Lathyrus and Lathyrism Newsletter, Third World Medical Research Foundation, New York, pp. 1-8.

Tadesse, W. and Bekele, E. (2003). Variation and association of morphological and biochemical characters in grass pea (*Lathyrus sativus* L.). *Euphytica*, **130** : 315-324.

Tadesse, W., Wollelie, M. and Yohannes, D. (1997). Identification of alternativecrops for grass pea, in: R. Teklehaimanot, F. Lambein (Eds.), Lathyrus and lathyrism: A Decade of Progress, University of Ghent, Belgium, 1997, pp. 12–15.

Talukdar, D. (2009). Association of seed yield components along with seed neurotoxin content in different varieties and induced mutant lines of grasspea (*Lathyus sativus* L.). *Internat. J. Plant Sci.*, **4**(2) : 378-380.

Tekele-Haimanot, R., Kidane Y., Wuhib, E., Kalissa, A., Alemu, T., Zein, Z.A. and Spencer, P.S. (1990). Lathyrism in rural Northwestern Ethiopia: a highly prevalent neurotoxic disorder. *Internat. J. Epidemiol.*, **19** : 664-672.

Tiwari, K.R. and Campbell, C.G. (1996a). Inheritance of seed weight in grasspea (*Lathyrus sativus* L.).*FABIS Newslett.*, **38**/**39** : 30-33.

Tiwari, K.R. and Campbell, C.G. (1996b). Inheritance of neurotoxin (ODAP) content, flower and seed coat colour in grass pea (*Lathyrus sativus* L.). *Euphytica*, **91**: 195-203.

Wang, F., Chen, X., Chen, Q., Qin, X.C. and Li, Z.X. (2000). Determination of neurotoxin 3-*N*-oxalyl-2,3-diaminopropionic acid and non-protein amino acids in *Lathyrus sativus* by precolumnderivatization with 1- fluoro-2,4-dinitrobenzene. *J. Chromatogr.*, **883** : 113-118.

White, C.L., Hanbury, C.D., Young, P., Phillips, N., Wiese, S.C., Milton, B., Davidson, R.H., Siddique, H.M. and Harris, D. (2002). The nutritional value of Lathyrus cicera and *Lupinus angustifolius* grain for sheep. *Anim. Feed Sci. Technol.*, **99**: 45-64.

Yadav, S.S. and Bejiga, G. (2006). *Lathyrus sativus* L.. In: Brink, M. ; Belay, G. (Eds). PROTA 1: Cerels and pulses/Cereals et legumes secs. (CD-ROM). PROTA, Wageingen, Pays Bas.

Yan, Z.Y., Spencer, P.S., Li, Z.X., Liang, Y.M., Wang, Y.F., Wang, C.Y. and Li, F.M. (2006). *Lathyrus sativus* (grass pea and its neurotoxin ODAP. *Phytochemistry*, **67** : 107-121.

Zhao, L., Chen, X.G., Hu, Z.D., Li, Q.F., Chen, Q. and Li, Z.X. (1999). Analysis of β-*N*oxalyl- L-α,β- diaminopropionic acid and homoarginine in *Lathyrus sativus* by capillary zone electrophoresis. *J. Chromatogr.*, **857** : 295- 302.

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