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LATHYRUS GERMPLASM EVALUATION AND CULTIVATION IN PAKISTAN

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ABSTRACT

Fifteen improved, low toxin grasspea (*Lathyrus sativus* L.) genotypes received from the International Centre for Agricultural research in the Dry Areas (ICARDA), Aleppo, Syria and a local check were tested for winter season (2006-07) in the rainfed conditions of National Agriculture research Centre (NARC), Islamabad. Aim of the study was to select the promising genotypes that would give high seed yield with low neurotoxin oxalyl-diamino-propionic acid (ODAP) content. Data on maturity days, plant height, biological yield, grain yield, 100-kernel weight, and harvest index were collected. The genotype Sel. 190 gave the highest grain yield 1265 kg ha^{-1} and significantly outperformed other genotypes. It was followed by the genotypes Sel.387, Sel. 390 and Sel. 736.

Key-words: *Lathyrus*, genotype, cultivation, screening, Pakistan.

INTRODUCTION

Grasspea/chickling vetch locally called *desi mattar* is an important cool-season annual legume belonging to the family Fabaceae and the tribe Vicieae (Biswas and Biswas, 1997). In Pakistan, it is cultivated mainly in the upper parts of Sindh (Larkana, Shikarpur, and Sukkur districts) on the residual moisture of rice crop. Grasspea seed is broadcast in the rice field when water is still standing in the field or the soil is very wet. After seed sowing, rice crop is harvested and grasspea is allowed to grow on the same land without additional water. Furthermore, it is also grown along the river bank in Sindh and southern Punjab on the fresh deposits of alluvial soil where moisture conditions are comparatively better than the adjoining up lying areas. It is best adapted to medium to heavy texture soils where the annual rainfall ranges between 300 and 650 mm (Siddique *et al.*, 2006). It is mainly used as green fodder for the livestock but is also used as a food legume for human consumption (Zahid and Khan, 1996). The chemical composition of seed shows high crude protein concentration and low level of cholesterol (Senatore and Basso, 1994).

Despite its potential under rainfed area and high protein for food and feed, it contains a neurotoxin - oxalyl-diamino-propionic acid (ODAP), which is known to cause "*lathyrism"*, hence its cultivation is restricted in particular area of Sindh where farmers have low choice. The grain, if consumed over a period of more than three months, causes non-remitting and irreversible spastic paraplegia (paralysis of lower limbs) in humans, called lathyrism, for which no cure has been yet discovered (Khawaja, 1996). For solving problem of human lathyrism and making the grasspea an important crop for the marginal areas, we need to introduce zero or low toxin (<0.02 percent ODAP) varieties that are safe for human consumption. ICARDA has developed bold seeded genotypes with low ODAP content. The cultivation of such varieties will not only reduce the risk of *lathyrism* but will also help to alleviate the economic conditions of the local farmers as a result of improved yield and quality of this hardy crop that needs minimum inputs.

MATERIALS AND METHODS

Fifteen elite grasspea genotypes with low ODAP were received from ICARDA, Aleppo, Syria during 2006. Experiment was conducted to evaluate potential differences in yield response of these genotypes along with a local check in the sub-humid, sub-tropical climate of National Agricultural Research Centre (NARC), Islamabad during 2006-07. Plots measuring 1.2 x 4 m (4.8 m^2) with four rows $plot^{-1}$ were sown manually using single row hand drill on first day of November during the winter season 2006-07. Seeding was done at 30 cm row spacing at a rate of 200 seeds $plot^{-1}$ corresponding to interplant distance of 10 cm. A randomized complete block design (RCBD) with three replications was used for the experiment. Experiment was conducted on separate but adjacent sites, where cereal and legume crops had been grown for the last many years. Soil fertility conditions and plant density was normal. Sowing was done on the residual soil moisture of fall rains 2006.

Soil of the experimental area was clay loam, deep, and slightl alkaline with pH 8.0, low in organic matter (0.5 percent) and deficient in N (0.042 percent) and P (5.4 ppm) except for available K (78.5 ppm) (Qamar, 1997). The rainfall received during the study period was also recorded for the winter season 2006-07 is given in Table 1 below:

Table 1. Monthly rainfall received during the study period (2006-07).

Month	**Rainfall mm**
October 2006	35.07
November 2006	14.89
December 2006	124.40
January 2007	Nil
February 2007	93.56
March 2007	178.99
April 2007	3.02
May 2007	57.76
Total:	**507.69**

Source: Agricultural Meteorological Data Record, Water Resources Research Institute (WRRI), NARC, Islamabad

At maturity, data on plant height, maturity days, grain yield, biological yield, and 100-kernel weight were recorded. Three plants were randomly sampled from each plot at maturity and the height was measured in cm with the help of meter rod from soil surface to the final growing point. Biological yield was determined by harvesting crop manually at maturity from each plot and the harvested above-ground stuff (grain + straw) was weighed in the field just after harvesting of the crop and expressed as kg ha^{-1}. Grains were separated from the harvested stuff of each plot and calculated on kg ha^{-1} basis. Hundred grains were randomly separated from the harvested stuff of each plot and weighed in gram for recording 100-kernel weight. Harvest Index (HI) was expressed as percentage of ratio between grain yield and biological yield.

Data were subjected to analysis of variance using RCB design with three replications and 16 *Lathyrus* genotypes for different plant characters with the help of computer software 'MSTAT-C' (Bricker, 1991). Fisher's Least Significant Difference (*LSD*) was applied for comparing genotype means. The promising genotypes were identified on the basis of significant differences in grain yield, biological yield, and resistance to diseases/abiotic stresses.

RESULTS AND DISCUSSION

The results of analysis of variance showed significant differences among all the genotypes for all the characters under this study (Table 2). The introduced genotypes took 132 to 148 mean days to attain 50 % flowering while the local check took only 139 days indicating that the most of introduced genotypes are comparatively late maturing than that of the local one. The genotype Sel 736 produced the mean tallest plants (112 cm) followed by the genotypes Sel 554, Sel. 387 and Sel. 554 whereas the lowest plant height was observed in the local check and Sel. B111. The highest biological yield was given by the genotypes Sel. 736 followed by Sel 387 and Sel 554. The genotype Sel. 190 gave the maximum grain yield followed by Sel.390 and Sel 587. The highest % H.I of Sel 190 further confirms its higher grain yield production compared with other genotypes. Karadag *et al.,* (2004) reported that the biological yield and seed yield of 11 grasspea lines ranged 4566 to 6858 and 1029 to 1681 kg ha^{-1}, respectively under the rainfed conditions of semi arid regions of Turkey. The grain yield of 20 grasspea cultivars varied from 320 to 3000 kg ha^{-1} over different environments in Ethiopia (Tadesse, 2003).

The apparent greater response in the 100-kernel weight of genotype Sel 736 (15.3g) compared to other genotypes indicated that its seed size is prominently large enough than that of the other genotypes. Tay *et al.*, (2004) reported mean 100-seed weight of 30 g for Luanco-INIA a new large seed Chilean grasspea cultivar, which can be increased up to 35 g in the favourable environment. So, the 100-kernel weight of genotype Sel 736 is quite reasonable and potential exists to improve it further. Although the genotype SEL 190 performed outstandingly in other characters but its HI percentage was little bit lower than that of the other genotypes suggesting it has relatively moderate physiological efficiency for converting dry matter into final grain yield.

Table 2. International Grasspea Adaptation Trial 2006-07.

Sl. #	Entry	First Day	Plant Height (cm)	Biological Yield (kg ha^{-1})	G. Yield (kg ha^{-1})	100 KW (g)	H.I. %
1	Sel 190	132^{d}	85^{bcde}	3958^{ef}	1265^{a}	8.0^{ef}	31.9
2	Sel 288	145^{ab}	95^{b}	3958^{ef}	611^{defg}	8.6^{cde}	15.4
3	Sel 289	148^{a}	87^{bcde}	3819^{efg}	491^{fg}	9.3^{cd}	12.8
4	Sel 290	144^{ab}	79^{cde}	3819^{efg}	540^{efg}	8.6^{cde}	14.1
5	Sel 299	144^{ab}	96^{b}	4097^{def}	727^{cdef}	7.0^{f}	17.7
6	Sel 387	143^{ab}	97^{ab}	5139^{b}	762^{bcde}	9.6^{c}	14.8
7	Sel 390	143^{ab}	88^{bcd}	4792^{bcd}	966^{b}	8.3^{de}	20.1
8	Sel 449	145^{ab}	91^{bc}	4375^{cde}	721^{cdef}	9.6^{c}	16.4
9	Sel 554	144^{ab}	98^{ab}	5139^{b}	400^{g}	13.3^{b}	7.7
10	Sel 587	143^{ab}	86^{bcde}	3819^{efg}	882^{bc}	8.3^{de}	23.0
11	Sel 736	146^{ab}	112^{a}	6736^{a}	429^{g}	15.3^{a}	6.3
12	Sel B111	133^{cd}	72^{e}	3472^{fg}	727^{cdef}	8.0^{ef}	20.9
13	Sel B222	139^{bc}	76^{de}	3542^{fg}	810^{bcd}	8.3^{de}	22.8
14	SelETH1/299	147^{a}	94^{bc}	5069^{bc}	582^{defg}	9.0^{cde}	11.4
15	Sel 521/B1	140^{b}	89^{bcd}	4097^{def}	747^{bcde}	9.0^{cde}	18.2
16	Local check	139^{bc}	72^{e}	3194^{g}	804^{bcd}	5.6^{g}	25.1
	Mean	142	88	4314	716	9.1	16.5
	Std Mean	16.78	85	191394	20367	0.593	-
	LSD(0.05)	6.83	15.46	729.5	238	1.284	-

* = Standard error of the mean.

Rao *et al.*, (2005) reported that the higher level of production gives grasspea greater potential as a forage plant in the southern Great Plains. Grasspea can be grown under conditions of water stress, which many other crops cannot withstand and can therefore, successfully be introduced in rangelands for forage purposes (Khawaja, 1996). Being cool-season active plant, it can provide green forage for the livestock during winter when local flora becomes dried. Keeping in view the high biological yield of 6736 kg ha^{-1}, the genotype Sel 736 is suggested to be tested in the rangelands of Pothwar area as a potential forage plant.

A number of fungal, bacterial, nematicidal, and viral diseases have been associated with grasspea crop all over the world but a very little work has been done on the pathological aspect of this crop in Pakistan (Khan *et al.*, 1996). However, no disease was recorded during the year of the study suggesting that the tested genotypes were resistant to pest attack. Although germplasm of the tested genotypes came from the nursery having low neurotoxin stock but it is suggested to test ODAP content of the high yielding genotypes Sel 190, Sel 387, Sel 390 and Sel. 736 before releasing variety from these genotypes for cultivation in Pakistan.

Conclusion

Since genotype Sel 190 performed outstandingly among all the genotypes and it was followed by the genotypes Sel 387, Sel 390 and Sel 736 hence these have been selected for further testing at the Quaid-e-Awam Agricultural Research Institute (QAARI), Larkana a representative experimental site for grasspea testing in the province of Sindh.

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