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An induced fasciated mutant in grasspea (*Lathyrus sativus* L.)

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Abstract

A fasciated mutant characterized by broadened stem, small narrow leaves and pods reduced in size, arranged in line on the node of the upper part of the stem was identified in M3 generation in grasspea (*Lathyrus sativus* L.) cv. P27 following 250 Gy gamma rays treatment. The flattened stem of the shoot apex appeared like a cluster of closely fused branches. The mutant was fertile and had less number of primary and secondary branches, reduced pod and seed size, low yield and delayed maturity as compared to parental cultivar. Bc_1 and F_2 segregation showed that fasciation was controlled by a single recessive gene. Distinctive features of fasciation have been described. This is a first report of induced fasciated mutant in *Lathyrus sativus* L.

Key words : Grasspea, induced mutations, fasciation, inheritance.

Introduction

Stem fasciation is a morphological abnormality known to create heritable change as a result of spontaneous or induced mutations. Spontaneous mutants with fasciation have been reported in several leguminous crops including pea [1], pigeonpea [2], mungbean [3], soybean [4], chickpea [5] and lupin [6]. Induced fasciated mutants have also been reported in pea [7], chickpea [8] and lentil [9, 10]. Though, mutants with fasciation were shown to have little or no practical value [3], it can serve as a valuable genetic resource and benefit crop improvement programmes. Fasciated mutants were found higher yielding than their parental cultivars in lentil [10] and pea [11]. These mutants have also been used for producing recombinants in pea [7, 12-14] and soybean [15, 16].

This is the first report on an induced fasciated mutant in grasspea (khesari). The mode of inheritance, morphological and agronomic features of fasciation in grasspea mutant have been described and discussed.

Materials and methods

Dry seeds of uniform size and shape with 10 per cent moisture of grasspea improved cultivar P27 were treated with gamma rays and ethyl methane sulphonate (EMS) for induction of mutations. The gamma rays doses were 50, 100, 150, 200, 250, 300, 350 and 400 Gy. Seeds presoaked in water for 6 hrs were treated with EMS 0.5 and 1.0 per cent aqueous solution for 2 and 4 hrs. Seeds of individual M_1 plants in all the treatments including control were harvested separately and grown as single plant progenies. Spectrum of morphological mutations such as plant type, plant growth habit, leaf, pod size and chlorophyll mutations were scored in M_2 generation. Non-segregating M_2 plant progenies were carried forward to M_3 and observations for macro and micro mutations were recorded. The fasciated mutant was observed in 250 Gy gamma rays treatment in M_3 generation.

The fasciated mutant (FM) was crossed with P27 a parental cultivar and LSD6 using mutant as pollen parent. All the F_1 plants were found to be normal, comparable to improved cultivars involved in crosses. The F_1s were selfed to produce F_2 seeds and also backcrossed with fasciated mutant to produce Bc_1. Four populations (Bc_1 and F_2 two each) thus obtained, were grown under normal field conditions and observations were recorded on individual plants. Chi-square test was employed to test the goodness of fit for the segregation ratios.

Results and discussion

A mutant with fasciation was isolated in M3 generation (in the progeny of normal looking M_2 plant) from 250 Gy gamma rays treatment. The mutant showed distinctive morphological and developmental features from the parental cultivar. In the early stages of plant growth stem was normal. However, during the later stages when plant enters reproductive phase, the main stem in the upper part (15-20 cm) progressively develops

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a broad, strap-like flattened structure. The shoot appeared like a cluster of closely fused branches (Fig. 1). The width of flattened stem varied between plants and ranges between 1.5 to 2.8 cm which otherwise ranges between 0.3 to 0.5 cm. The flattened stem were carrying many leaves and flower buds arranged in a line on the node of fasciated stem. At the apex, many small leaves were giving appearance like "a cluster or bunchy top".

Fig. 1. A fasciated mutant

The fasciated mutant had reduced number of primary and secondary branches with normal reproductive organs. The fasciated stem was generally longer with very few secondary branches. In general, height of the mutated plants was less than height of parental cultivar. The fasciation was also found to have adversely affected yield attributes. The fasciated plants had reduced number of pods per plant, reduced pod and seed size, reduced number of seeds per pod and reduced grain yield per plant. Comparative features of the fasciated mutant and parental cultivar P27 are presented in Table 1.

So far no fasciation has been reported in grasspea. The fasciated mutants of chickpea, spontaneous [5] and induced [8] were also found to be inferior in yield and late maturing compared to parental cultivars. Similarly, the fasciated mutants reported in pigeonpea [2, 17] and mungbean [3] were agronomically inferior to parental cultivars.

Table 1. Distinguishing features of fasciated mutant and parental variety P27

Characters	Fasciated mutant	Parental variety P27
Days to flowering	71.3 ± 2.10	69.9 ± 2.00
Days to maturity	153.4 ± 1.98	147.1 ± 1.97
Plant height (cm)	58.2 ± 1.62	69.3 ± 1.54
Number of primary branches	3.6 ± 0.05	5.1 ± 0.05
Number of pods/ plant	46.7 ± 1.70	68.6 ± 2.10
Pod length (cm)	2.8 ± 0.30	3.34 ± 0.25
Number of seeds/ pod	2.42 ± 0.18	2.93 ± 0.15
100 seed weight (g)	9.76 ± 0.19	13.71 ± 0.14
Grain yield/ plant (g)	11.03 ± 0.68	27.98 ± 0.84

Gottshalk and Hussein [13] obtained fasciated pea mutants with increased number of pods per plant, synchronous maturity and increased grain yield. The harvest index in fasciated mutant increased with simultaneous increase in grain yield as well as total biological yield. Fasciated mutants have been used for developing promising recombinants in pea [7, 12-14], soybean [15, 16] and lentil [10].

All F_1 plants from both the crosses, P27 × FM and LSD6 × FM, had normal plant growth habit. Segregation for fasciation was studied in first backcross Bc_1 and F_2 generation. Segregation of normal and fasciated plants was confirming to 1:1 ratio in Bc_1 populations and F_2 showing good fit for the 3:1 ratio (Table 2). The segregation pattern in both, Bc_1, and F2 populations indicate that a single recessive gene control stem fasciation in *Latliyrus*. A single recessive gene inheritance has also been reported in pea [1], pigeonpea [2, 17], soybean [4], lentil [10] and chickpea [5, 8]. However, expression of fasciation in pea appears to be more complex. Gottschalk [7] showed that alleles at three loci were responsible for fasciation in four induced mutants and one spontaneous mutant in pea with each gene confirming a different type of fasciation.

Table 2. Segregation for fasciation in Bc_1 and F_2 generation

Cross combinations	Segregation			χ^2
	Normal	Fasciated	Total	
(P27 × Fasciated mutant) Bc_1	45	39	84	0.297
(LSD6 × Fasciated mutant) Bc_1	32	30	62	0.016
Pooled Bc_1	77	69	146	0.335
(P27 × Fasciated mutant) F_2	266	85	351	0.056
(LSD6 × Fasciated mutant) F_2	238	76	314	0.067
Pooled F_2	504	161	665	0.090

An evaluation of fasciated mutants showed that fasciation adversely affect characters of economic significance, particularly number of primary branches, number of pods per plant, number of seeds per pod, seed size and in turn grain yield. Therefore, fasciation is unlikely to be of direct use in *Lathyrus* improvement. However, these mutants may be used in hybridization to develop recombinant genotypes showing promise. Fasciation, is easily observable morphological trait, can be used as genetic marker in linkage studies along with isozymes and molecular markers.

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