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*Short Communication*

# Inheritance of flower and stipule characters in different induced mutant lines of grass pea (*Lathyrus sativus* L.)

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Induced mutagenesis has been used as a valuable tool to create genetic variability in grass pea [1, 2]. In recent years, a number of morphological mutations and their pattern of inheritance have been studied [3-6]. Among different morphological traits, flower colour is considered as an important parameter for classification in grass pea [7, 8]. Perusal of literature, however, cites limited information regarding the mode of inheritance of flower colour in grass pea [9-12]. On the other hand, reports on inheritance of stipule colour and its orientation against stem in grass pea are lacking, although transmission patterns of presence or absence and different modifications in shapes of stipule were reported earlier [13]. The present authors carried out an extensive investigations on mode of inheritance of flower and stipule characters in different induced mutant lines and mother cultivar BioR-231; a brief description of which is presented in this communication.

Five induced mutant lines *viz.* four flower colours - pale violet, reddish-purple, white and blue patched white, isolated from 150Gy, 200Gy, 300Gy and 350Gy gamma ray irradiated progenies respectively and another mutant line (250Gy) showing blackish-purple colour and perpendicular orientation of stipule along with their mother control cultivar BioR-23 1 manifesting blue colour of flower and green stipule with parallel orientation were used in the present study (Figs. 1-6, 14, 15). Barring blue-patched white flower mutant, detected in MI generation, all the other mutants were isolated from $M_2$ progenies (rabi 1998). All the five mutant lines were selfed up to $M_5$ generation (rabi 2002) and found to be true breeding. Inheritance of colour (blue vs. pale violet vs. reddish-purple vs. blue-patched white vs. white) of flower, stipule (green vs. blackish-purple) and its orientation (parallel vs. perpendicular) were studied in $F_1$, $F_2$ and backcross progenies obtained from different intercrosses (including reciprocals) among parents during rabi 2002-2006. Chi-square test was applied to test the goodness of fit for the expected genetic ratio.

*Inheritance of flower colour.* Mode of transmission of five different flower colour *viz.* blue, reddish-purple, blue-patched white, white and pale violet was studied in $F_1$, $F_2$ and corresponding back cross progenies of different cross combinations (Table 1). Segregation patterns revealed complete monogenic dominance (3:1 in $F_2$ and 1:1 in test cross) of blue colour over blue-patched white and white and also of blue patched white to white. These results we're in agreement with monogenic complete dominance of coloured flowers over colourless or white in different intervarietal crosses in grass pea, although inhibitory (13 blue : 3white) and supplementary (9blue:3pink:4white) types of gene interactions had also been reported [9-12].

Modification of flower colour to blue patched reddish-purple was observed in all $F_1$ plants obtained from the cross between blue flowered control and a mutant showing reddish-purple colour of flower (Fig. 7). $F_2$ (1 blue: 2 blue patched reddish-purple:1 reddish-purple) and backcross segregations (1 blue/reddish purple :1 blue patched reddish purple) suggested existence of co-dominance between the alleles governing blue and reddish-purple colour of flowers. On the other hand, intermediate pink and bluish pink colouration in petals appeared in the $F_1$s of the crosses reddish-purple x white and reddish-purple x blue patched-white, respectively (Table 1). Subsequent segregations fitting well to 1 reddish-purple : 2pink :1 white in case of former and 1 reddish-purple :2bluish pink :1 blue-patched white in the latter cross in $F_2$ and


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**Figs. 1-15. (1) Control plant with blue colour of flower; (2) Blue and reddish purple flower; (3) Mutant plant with reddish purple flower; (4) A twig with pale violet flower; (5) Blue patched white flower; (6) White flower; (7) Flowering twig with blue patched reddish purple; (8) Pink flower; (9-10) Close view of pink and bluish pink flower; (11) Plant with light blue coloured flower; (12) Pinkish purple flower on twig; (13) Its close view and (14-15) Stipule of control and mutant plant, respectively.**

1:1 in corresponding backcrosses indicated monogenic control of the traits with incomplete dominance of reddish-purple over white as well as over blue patched-white colour of flower (Figs. 8-10).

It is thus evident that different flower colour modifications of the blue flower inherited monogenically involving a series of multiple alleles, proposed as $B^+$, $B^{rp}$, $B^{bp}$ and $B^w$ for blue, reddish-purple, blue-patched white and white colour of flower respectively where $B^+$ is completely dominant over $B^{bp}$ and $B^w$ but co-dominant to $B^{rp}$ which showed incomplete dominance over $B^{bp}$ and $B^w$. $B^{bp}$, on the other hand was completely dominant over $B^w$. Possibility of involvement of multiple alleles in governing flower colour in grass pea was also reported in different accessions [14].

Peculiar type of inheritance, for flower colour however, was observed in the crosses (a) pale/violet flowered mutant x blue flowered control and (b) pale violet x reddish-purple flowered mutant. $F_1$ plants showed completely different colour of flower in both crosses; light blue in the former case and pinkish-purple in the latter (Figs. 11-13). In $F_2$, segregation of light blue: blue : pale violet: white in cross (a) and pinkish-purple: reddish-purple: pink: pale violet: white in cross (b) fitted closely with 9:3:3:1 and 9:1:2:3:1, respectively. Backcrosses of $F_1$ x control plants and $F_2$ x pale violet flowered mutant in cross (a) yielded light blue: blue and light blue: pale violet in 1:1 segregation ratios in both cases. On the other hand in cross (b), $F_1$ x reddish-purple and $F_1$ x pale violet flowered mutant gave rise to 2 pinkish-purple: 1 pink: 1 reddish-purple and 1 pinkish-purple: 1 pale violet segregation, respectively (Table 1). Occurrence of two new phenorypes in the $F_1$ progenies was rather rare but interesting and comparable with the inheritance

**Table 1.** Segregation of flower colour, stipule colour and orientation in different mutant lines of control cv. BipR-231 in grass pea (*Lathyrus sativus* L.)

| Cross | $F_1$ phenotype | Segregations in $F_2$ and backcross generations | Expected ratio | $c^2$ | P |
|---|---|---|---|---|---|
| Blue x white | Blue | 86 blue: 25 white | 3:1 | 0.36 | 20.50-0.70 |
| $F_1$ x white | - | 21 blue: 18 white | 1:1 | 0.23 | 0.50-0.70 |
| Blue x reddish purple (RP) | Blue patched reddish purple (BPRP) | 29 blue: 56 BPRP: 25 RP | 1:2:1 | 0.33 | 0.70-0.90 |
| $F_1$ x blue | - | 26 blue: 19 BPRP | 1:1 | 1.09 | 0.20-0.30 |
| $F_1$ x RP | - | 27 BPRP: 20RP | 1:1 | 1.042 | 0.30-0.50 |
| RP x white | Pink | 27 RP: 54 pink: 2 1 white | 1:2:1 | 1.05 | 0.50-0.70 |
| $F_1$ x RP | - | 18RP:20pink | 1:1 | 0.105 | 0.70-0.90 |
| $F_1$ x white | - | 33 white: 29 pink | 1:1 | 0.258 | 0.50-0.70 |
| Blue x BPW | Blue | 109 blue: 30 BPW | 3:1 | 0.865 | 0.30-0.50 |
| $F_1$ x BPW | - | 29 blue: 22 BPW | 1:1 | 0.960 | 0.50-0.70 |
| BPW x white | BPW | 51 BPW: 15 white | 3:1 | 0.182 | 0.50-0.70 |
| $F_1$ x white | - | 17 BPW: 12 white | 1:1 | 0.862 | 0.30-0.50 |
| RP x BPW | Bluish pink | 19 RP: 24 BPW: 41 bluish-pink | 1:2:1 | 0.643 | 0.70-0.90 |
| $F_1$ x BPW | - | 12 BPW: 10 bluish-pink | 1:1 | 0.181 | 0.50-0.70 |
| $F_1$ x RP | - | 14 RP: 11 bluish-pink | 1 : 1 | 0.360 | 0.50-0.70 |
| Blue x pale violet (Pv) | Light blue | 107 light blue: 37 blue: 29 pale-violet: 11 white | 9:3:3:1 | 1.198 | 0.70-0.90 |
| $F_1$ x Pv | - | 29 light blue: 33 pale-violet | 1:1 | 0.258 | 0.50-0.70 |
| $F_1$ x Blue | - | 19 light blue: 28 blue | 1:1 | 1.723 | 0.10-0.20 |
| RP x Pv | Pinkish purple | 89 pinkish-purple: 10 RP:13 pink: 30 pv:09 white | 9:1:2:3:1 | 1.31 | 0.70-0.90 |
| $F_1$ x Pv | - | 13 pinkish-purple : 1 7 pale violet | 1:1 | 0.534 | 0.30-0.50 |
| $F_1$ x RP | - | 21 pinkish-purple: 10RP:09 pink | 2:1:1 | 0.15 | 0.90-0.95 |
| Pale violet x white | Pale violet | 41 pale violet: 13 white | 3:1 | 0.025 | 0.80-0.90 |
| $F_1$ x white | - | 11 pale violet: 08 white | 1:1 | 0.474 | 0.30-0.50 |
| *Stipule colour and orientation* | | | | | |
| Green (control) x blackish-purple (mutant) | green | 47 green : 33 blackish-purple | 9.7 | 0.203 | 0.50-0.70 |
| $F_1$ x blackish-purple | - | 18 green : 46 blackish-purple | 1:3 | 0.337 | 0.50-0.70 |
| Parallel (control) x perpendicular (mutant) | parallel | 290 parallel : 95 perpendicular | 3:1 | 0.021 | 0.80-0.90 |
| $F_1$ x mutant | - | 81 parallel : 77 perpendicular | 1:1 | 0.101 | 0.70-0.90 |

of comb character in fowl [15]. These ratios are different from the simple Mendelian dihybrid ratio because Mendelian segregation represents four combinations of two pairs of characters while in these two crosses, four phenotypes of the same character have been/ manifested. When both the genes ($B^{+}/B^{rp}$ and *Pv* controlling blue/reddish purple and pale violet respectively) are present in dominant form ($B^{+}/B^{rp}$-*Pv*-) their products interacted to give a unique colour of flower but in combination with *pv*, $B^{+}$ produced parental phenotypes of blue flower ($B^{+}$-*pvpv*) in cross(a) and $B^{rp}$ gave reddish-purple ($B^{rp}$-*pvpv*) in cross (b). In recessive form of both the genes ($B^{w}B^{w}$*pvpv*), colourless or white flower appeared. Due to incomplete dominance of reddish-purple over white, pink phenorypes appeared in cross (b). Similar mode of segregation with different flower colour in $F_1$ and $F_2$ was also reported earlier in lentil [16].

*Transmission of colour and orientation of stipule*

Appearance of green and blackish-purple colour of stipules in 47 and 33 plants in $F_2$ and in 18 and 46 plants in back cross progeny of $F_1$ x blackish purple stipule mutant closely fitting with 9:7 and 1:3 ratios respectively suggested that the trait was digenically inherited and the two non-allelic genes (proposed as $St^{G}$ and $St^{Bp}$) in their dominant form ($St^{G}$-$St^{Bp}$-) complemented with each other to produce green colour. Absence of dominant allele of any of the 2 genes ($St^{G}$-$St^{bp}$ $St^{bp}$/$St^{g}St^{g}St^{Bp}$-) produced blackish-purple colour as neither $St^{G}$ nor $St^{Bp}$ gene can produce green colour in stipule by its own (Table 1).

Parallel orientation of stipules was found to be completely dominant over perpendicular orientation in all the $F_1$ plants. Segregation of parallel vs. perpendicular orientation showing good fit to 3:1 in $F_2$ and 1:1 in test cross progenies suggested that the trait was regulated by a single pair of gene, proposed as *Par-par* for parallel and perpendicular orientation of stipules respectively (Table 1).

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