INHERITANCE OF HYPOCOTYL COLOUR AND PUBESCENCE IN MUNGBEAN (*VIGNA RADIATA* (L.) WILCZEK)

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Abstract

The mode of inheritance of seedling color and plant pubescence was studied in two crosses among three parents, which differed for these traits. The results have revealed that purple seedling color was dominant over green seedling color and pubescence was dominant over nonpubescence. These two traits segregated independently of each other may be used as morphological markers individually for different genetic studies and to estimate the rate of out-crossing in mungbean.

Introduction

The identification of genetic markers and study of their inheritance pattern is of considerable significance in hybridization and genetic studies. In mungbean, hypocotyl color is either purple or green (no pigmentation) and may be used as a genetic marker at the seedling stage. The purple coloration in hypocotyl and various parts of the mungbean plant generally result from the presence of a class of water-soluble pigments or anthocyanins [3]. The absence of anthocyanin results in a green hypocotyl color in the mungbean. The presence or absence of pubescence of the mungbean plant can easily be detected at the late seedling stage. An attempt was made to study the inheritance and linkage between these two characters. The information obtained may help to use these morphological markers for screening mungbean segregating populations at an early seedling stage, to estimate the rate of outcrossing and for the identification of F_1 hybrid plant and variety.

Keywords: Mungbean; Hypocotyl; Pubescence; Dominant; Recessive; Inheritance

Materials and Methods

Three mungbean genotypes viz., NM 92, 6601 (purple hypocotyl color and pubescence), VC 1560D (green hypocotyl color and no pubescence) and their crosses were used in the present study. The experimental material, consisting of F_1, F_2, F_3 and backcrosses, was planted at the Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad, Pakistan during the summer of 1997. The material was planted in rows 30 cm apart and planted to plant spacing of 10 cm. Data were recorded for the number of plants with purple hypocotyl, green hypocotyl, hairy and non-hairy plants for the inheritance studies of hypocotyl color and pubescence. For the linkage studies of hypocotyl color and pubescence, plants were counted on the basis of purple hypocotyl with hairy, purple hypocotyl with non-hairy, green hypocotyl with hairy and green hypocotyl with non-hairy plants. All the plants in F_1, backcrosses, and sufficient plants in the segregating generations were counted for hypocotyl color and pubescence and tested for goodness-of-fit, using χ^2 test. A sufficient number of plants (sixty from each population) were randomly selected from F_2 for raising F_3 progenies.

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Table 1. Inheritance of green and purple hypocotyl color in mungbean using F_1, F_2, F_3 and backcross generations

Cross combinations	Generation	Expected ratio	Purple hypocotyl plants	Green hypocotyl plants	Segregating plants	Total plants	χ^2	P
VC1560D×NM92	F_1	–	All	–	–	70	–	–
NM92×VC1560D	F_1	–	All	–	–	76	–	–
VC1560D×NM92	F_2	3:1	885	292	–	1177	0.023	0.80-0.90
VC1560D×NM92	F_3	1:2:1	15	13	32	60	0.4	0.50-0.70
F_1×VC1560D	BC_1	1:1	39	32	–	71	0.690	0.30-0.50
F_1×NM92	BC_2	–	68	–	–	68	–	–
VC1560D×Var.6601	F_1	–	All	–	–	71	–	–
Var.6601×VC1560D	F_1	–	All	–	–	73	–	–
VC1560D×Var.6601	F_2	3:1	891	270	–	1161	1.883	0.10-0.20
VC1560D×Var.6601	F_3	1:2:1	17	16	27	60	0.634	0.30-0.50
F_1×VC1560D	BC_1	1:1	39	33	–	72	0.5	0.30-0.50
F_1×Var.6601	BC_2	–	75	–	–	75	–	–

Table 2. Inheritance of plant pubescence in mungbean using F_1, F_2, F_3 and backcross generations

Cross combinations	Generation	Expected ratio	Hairy plants	Non-hairy plants	Segregating plants	Total plants	χ^2	P
VC1560D×NM92	F_1	–	All	–	–	60	–	–
NM92×VC1560D	F_1	–	All	–	–	60	–	–
VC1560D×NM92	F_2	3:1	421	125	–	546	1.291	0.20-0.30
VC1560D×NM92	F_3	1:2:1	16	12	32	60	0.8	0.30-0.50
F_1×VC1560D	BC_1	1:1	21	19	–	40	0.1	0.70-0.80
F_1×NM92	BC_2	–	All	–	–	40	–	–
VC1560D×Var.6601	F_1	–	All	71	–	71	–	–
Var.6601×VC1560D	F_1	–	All	73	–	73	–	–
VC1560D×Var.6601	F_2	3:1	311	89	–	400	1.613	0.20-0.30
VC1560D×Var.6601	F_3	1:2:1	16	14	30	60	0.134	0.70-0.80
F_1×VC1560D	BC_1	1:1	26	22	–	48	0.333	0.50-0.70

Table 3. Joint segregation of hypocotyl color and plant pubescence in mungbean using F_2 and backcross generations

Cross combinations	Generation	Expected ratio	Purple and Hairy	Purple and Non-hairy	Green and Hairy	Green and Non-hairy	Total	χ^2	P
(VC1560D×NM92)×VC1560D	BC_1	1:1:1:1	9	10	12	9	40	0.6	0.30-0.50
(VC1560D×NM92)×NM92	BC_2	–	All	–	–	–	40	–	–
VC1560D×NM92	F_2	9:3:3:1	314	95	107	30	546	1.393	0.20-0.30
(VC1560D×Var.6601)×VC1560D	BC_1	1:1:1:1	14	12	12	10	48	0.667	0.30-0.50
(VC1560D×Var.6601)×Var.6601	BC_2	–	All	–	–	–	40	–	–
VC1560D×Var.6601	F_2	9:3:3:1	219	82	75	24	400	0.853	0.30-0.50

Results and Discussion

Inheritance of Hypocotyl Color

The data for the inheritance of hypocotyl color has been presented in Table 1. The F_1 and reciprocals showed the purple hypocotyl color indicating the involvement of only nuclear genes in the inheritance of hypocotyl color. This also indicated that the purple hypocotyl color is dominant over green hypocotyl color. The F_2 ratio of 3 purple: 1 green, showed the monogenic dominant behavior of purple hypocotyl color. The test crosses in both combinations showed 1:1 ratio confirming the dominance behavior of purple hypocotyl color. A total of 60 families in F_3 (randomly selected from F_2) showed a good fit with 1 purple: 2 segregated: 1 green ratio, and also confirmed the monogenic dominant behavior of purple hypocotyl color. Thakur *et al.* [5], Virk and Verma [6], Swindell and Poehlman [4] and Dwivedi and Singh [1] have also reported single dominant gene inheritance for hypocotyl anthocyanin pigmentation in mungbean while Yadav [7] reported that in the mutant of mungbean cultivar T41 two dominant genes are responsible for the inheritance of anthocyanin pigmentation.

Inheritance of Pubescence

The data regarding the inheritance of pubescence on mungbean plant are presented in Table 2. The presence of pubescence in F_1 and reciprocals indicated the absence of cytoplasmic effect in the inheritance of this trait. The F_2 population segregated in a ratio of 3 hairy: 1 non-hairy plants. The F_3 families (60 randomly selected plants from F_2) showed a ratio of 1 hairy: 2 segregated: 1 non-hairy lines. The results clearly indicated the monogenic dominant behavior of presence of pubescence in mungbean. The test cross ratio of 1 hairy: 1 non-hairy also confirmed the dominant behavior of pubescence over non-pubescence. The dense pubescence has been reported monogenic dominant over medium-dense by Murty and Patel [2].

Joint Segregation of Hypocotyl Color and Pubescence

The joint segregation studies of hypocotyl color and pubescence are presented in Table 3. The results obtained gave a good fit to the expectation of 1 purple hairy: 1 purple non-hairy: 1 green hairy: 1 green non-hairy ratios in test crosses and 9 purple hairy: 3 purple non-hairy: 3 green hairy: 1 green non-hairy ratios in F_2 populations. These results indicated that the hypocotyl color and pubescence have segregated independently.

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