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Inheritance and linkage of leaf colour and plant pubescence in lentil (*Lens culinaris* Medik.)

M. E. Hoque[1], S. K. Mishra, Yogesh Kumar, Rajesh Kumar, S. M. S. Tomar and B. Sharma

Division of Genetics, Indian Agricultural Research Institute, New Delhi 110 012

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Abstract

Inheritance of leaf colour and plant pubescence in lentil (*Lens culinaris* Medik.) was studied using six and three crosses, respectively. Observation on 1037 F_2 plants for leaf colour revealed a segregation ratio of 3 (dark green): 1 (light green). The F_3 family data also fitted well to the ratio of 1 (dark green): 2 (segregating): 1 (light green) leaf colour. Individual 1735 F_2 plants were observed for plant pubescence which segregated in the ratio of 3 (pubescent): 1 (non-pubescent). The F_3 family data showed a ratio of 1 (pubescent): 2 (segregating): 1 (non-pubescent). The results revealed the involvement of single dominant gene for both the characters and gene symbols *Dgl* and *Pub* are proposed for them. Joint segregation analysis resulted in a significant, χ^2 L value for these loci indicating their linkage with a map distance of 29.66 ± 0.012 in Kosambi Unit.

Key words: Lentil, inheritance, linkage, leaf colour, plant pubescence

Introduction

Lentil (*Lens culinaris* Medik.) is one of the oldest food legume crops and grown in almost all parts of the world. This crop is valued as a high protein source and for its residues, which are used for animal feeding. The straw and pod walls have high feed value for cattles. Genotypes with both dark green and light green foliage are available in lentil. Mishra *et al.* [1] reported that the light green foliage turns yellow towards maturity and leaves drop-off during crop maturation. In contrast, the dark green foliage is more persistent and remain green even at the advanced stage of crop growth. The genotype with dark green foliage do not shed leaves early. So, it is desired to develop lentil varieties with dark green foliage for high yield potential. Pubescence is an important morphological trait as it is often associated with resistance to biotic and abiotic stresses [2]. However, literature reveals no information on inheritance and linkage of leaf colour and plant pubescence in lentil. Therefore, the present investigation was carried out to study the inheritance and linkage of these two traits.

Materials and methods

From a large collection of lentil germplasm maintained in the Division of Genetics, Indian Agricultural Research Institute (IARI), New Delhi, six and four genotypes were used to study the inheritance of plant pubescence and leaf colour, respectively. The experimental materials comprised Sehore 74-3, L 830, L 263 and L 7360 which had dark green leaf and pubescent plant. The strain Precoz and MC 6 have light green foliage with non-pubescent plant type. The crosses were made during *rabi* 1998-99 at IARI, New Delhi. The F_1 seeds were sown in the National Phytotron Facility at IARI, New Delhi for advancing the generation. The F_2 plants were raised in winter 1999-2000 at IARI, New Delhi, keeping a 50 cm spacing between rows and 25 cm from plant to plant. The observation on leaf colour was recorded at the time of pod filling to physiological maturity of pod, i.e., at 75-85 days after sowing. Presence or absence of pubescence was recorded at 35-40 days after sowing. It was observed that the pubescence was present on the entire plant parts like leaf, stem, peduncle and pod. Non-pubescent or glaborous type of plants have almost clean and smooth surface for all plant parts. To study the inheritance of each trait, χ^2 was estimated by using standard formula. Linkage was detected based on joint segregation analysis [3]. Recombination fraction was calculated as suggested by Kosambi [4].

Results and discussion

Leaf colour. Inheritance of leaf colour was studied in 3 crosses (Table 1) involving 4 genotypes (Precoz, Sehore 74-3, L 830 and L 7360). The F_1 plants of all the crosses showed dark green leaf indicating the dominance of dark green leaf over light green leaf. The F_2 population of 111 to 519 plants segregated in the ratio of 3 (dark green) : 1 (light green) (χ^2 = 0.003

[1]Present address : Department of Plant Breeding, BARI, Ghazipur 1701, Bangladesh

Table 1. F_2 Segregation for green leaf colour in lentil

Crosses	F_1 phenotype	F_2 segregation			χ^2 (3:1)	d.f.	P value
		Dark green	Light green	Total			
Light green x dark green							
Precoz x Sehore 74-3	Dark green	376	143	519	1.804	1	0.184
Precoz x L 830	Dark green	83	28	111	0.003	1	0.958
Dark green x light green							
L 7360 x Precoz	Dark green	316	91	407	1.514	1	0.222
Pooled over 3 crosses		775	262	1037	0.038	1	0.862
Heterogeneity		-	-	-	3.283	2	0.302

Table 2. F_2 segregation for plant pubescence in lentil

Crosses	F_1 phenotype	F_2 segregation			χ^2 (3:1)	d.f.	P value
		Pubescent	Non-pubescent	Total			
Non-pubescent x pubescent							
Precoz x Sehore 74-3	Pubescent	378	141	519	1.300	1	0.260
Precoz x L 830	Pubescent	77	34	111	1.877	1	0.177
MC 6 x L 830	Pubescent	178	50	228	1.146	1	0.287
MC 6 x L 263	Pubescent	209	64	273	0.352	1	0.567
Pubescent x non-pubescent							
L 7360 x Precoz	Pubescent	284	114	398	2.817	1	0.095
Schore 74-3 x MC 6	Pubescent	159	47	206	0.524	1	0.477
Pooled over 6 crosses	-	1285	450	1735	0.811	1	0.384
Heterogeneity	-	-	-	-	7.205	5	0.008

to 1.804). The pooled data of all the crosses revealed 1037 F_2 plants to segregate in the same ratio (χ^2 0.038), indicating leaf colour to be controlled by a single dominant gene.

Plant pubescence : Six crosses were made including two reciprocals to study the inheritance of plant pubescence in lentil (Table 2). The F_1 of all the crosses produced plants with pubescence indicating the dominance of pubescence over non-pubescence. The F_2 population of all the crosses segregated in the ratio of 3 (pubescent) : 1 (non-pubescent) (χ^2 = 0.352 to 2.817). The pooled data over all the crosses revealed 1735 F_2 plants to segregate monogenically (χ^2 = 0.81 1), suggesting single dominant gene control for plant pubescence.

F_3 family analysis : The classification of F_2 plants based on the behaviour of their progenies in F_3 rows is more reliable than that based on only the F_2 data.

Table 3. Segregation for green leaf colour in F_3 families in lentil crosses

Crosses	No. of families	No. of plants in each family	Dark green families	No. of segregating families	Light green families	Segregation ratio in F_3 families	d.f.	χ^2 value	P value
Precoz x Sehore 74-3	40	34	7	26	7	1:2:1	2	3.60	0.060
Precoz x L 830	40	39	7	24	9	1:2:1	2	1.80	0.185
L 7360 x Precoz	40	36	13	19	8	1:2:1	2	1.35	0.251

Table 4. Segregation for plant pubescence in F_3 families in lentil crosses

Crosses	No. of families	No. of plant in each family	Pubescent families	No. of segregating families	Non-pubescent families	Segregation ratio in F_3 families	d.f.	χ^2 value	P value
Precoz x Sehore 74-3	40	33	6	22	12	1:2:1	2	2.20	0.147
Precoz x L 830	40	38	7	20	13	1:2:1	2	1.80	0.185
L 7360 x Precoz	40	31	12	17	11	1:2:1	2	0.95	0.340
Sehere 74-3 x MC 6	40	32	8	19	13	1:2:1	2	1.35	0.251

Table 5. Joint F_2 segregation of the genes '*Pub*' controlling plant pubescence and '*Dgl*'controlling leaf colour in lentil

Cross	F_2 segregation					Chi-Square			P (Linkage)	RF %	S.E.	Map dis. Kosambi unit
	Pub Dgl	*Pub dgl*	*pub Dgl*	*pub dgl*	Total	Locus 1 (3:1)	Locus 2 (3:1)	Joint seg.				
Precoz x Sehore 74-3	326	50	62	81	519	1.300	1.804	110.674	<0.0001	23.80	0.0219	25.88
Precoz x L 830	69	14	10	18	111	1.877	0.003	25.306	<0.0001	23.41	0.0470	25.38
L 7360 x Precoz	253	63	44	47	407	2.817	1.514	34.404	<0.0001	31.01	0.0285	36.26
Pooled analysis (1 df)	648	127	116	146	1037	0.038	1.157	162.893	<0.0001	26.61	0.0126	29.66
Heterogeneity (1 df)	-	-	-	-	1037	5.956	2.164	7.491	0.008	-	-	-

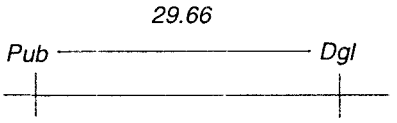
Note : '*Pub*' or '*pub*' indicates pubescent or non-pubescent phenotypes
'*Dgl*' or '*dgl*' indicates dark green or light green phenotypes

The F_3 families were grown to confirm the results obtained from F_2 populations. The F_3 data fitted well into 1 (dark green) : 2 (segregating) : 1 (light green) for leaf colour (Table 3). A 1:2:1 segregation ratio was also observed for pubescence (Table 4).

Mishra *et al.* [1] reported the dark green leaf to be controlled by a single dominant gene and proposed the gene symbol, *Dgl* for dark green leaf. The homozygous (*Dgl Dgl*) and heterozygous (*Dgl dgl*) plants have dark green foliage. The light green foliage will be produced under homozygous recessive (*dgl dgl*) condition.

Emami [5] observed peduncle pubescence to be governed by a single dominant gene. Vandenberg [6] mentioned pod pubescence also controlled by a single dominant gene. However, Emami [5] and Vandenberg [6] used different gene symbols for pubescence in separate parts of pubescent plants. As it has been mentioned in the Material and Methods that the plant which was pubescent for leaf was also pubescent for stem, peduncle and pod. There was no genotype with pubescence on only one part, leaf, stem, peduncle or pod. It may be safely assumed that a single gene is responsible for pubescence trait in lentil. The gene symbol, '*Pub*' is proposed for this trait. The dominant homozygous (*Pub Pub*) or heterozygous (*Pub pub*) have pubescent plant and homozygous recessive (*pub pub*) genotypes produce glaborous plant.

Linkage was studied between the gene pairs *Pub-Dgl* based on the analysis of three crosses having 1037 F_2 plants. Significant χ^2 L values were observed in each cross as well as in pooled analysis (Table 5). Map distances in Kosambi unit, ranged from 25.38 ± 0.0470 to 36.26 ± 0.0285. The average map distance based on pooled analysis was 29.66 ± 0.0126. On the basis of recombination fraction and map distance, the loci can be assigned as follows :



References

1. **Mishra S. K., Rajesh Kumar and Yogesh Kumar.** 2001. Inheritance of foliage colour in lentil. Abstract National Symposium on Pulses for Sustainable Agriculture and Nutritional Security, April 17-19, 2001, New Delhi.

2. **Kole C. R., Teutonico, Mengistu A., Williams P. H. and Osborn T. C.** 1996. Molecular mapping of a locus conrolling resistance to *Albugo candida* in *Brassica rapa*. Phytopathology, **86**: 367-369.

3. **Mather K.** 1951. The Measurement of Linkage in Heredity. John Willey of Sons, New York.

4. **Kosambi D. D.** 1943. The estimation of map units from recombination values. *Ann. Eugen. Lond.*, **12**:172-175.

5. **Emami M. K.** 1996. Genetic Mapping in Lentil (*Lens culinaris* Medik.). Ph. D. Thesis, Indian Agricultural Research Institute, New Delhi.

6. **Vandenberg A.** 1987. Inheritance and Linkage of Several Quantitative Traits in Lentil. Ph. D. Thesis, University of Saskachewan, Saskatoon, Canada. C. F. Tahir, M.C., J. Simon and F.J. Muehibaurer, 1993, Gene map of lentil: a review, Lens Newsletter, **20**: 3-10.