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Research Article

Gamma ray Induced Light-orange Flower Mutant in Groundnut (*Arachis hypogaea* L.) and its inheritance

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Abstract:
A dwarf mutant plant having small leaves and light-orange flower was identified in the M_2 generation from gamma ray treated groundnut cultivar VRI 2. The mutant bred true in successive generations. An investigation was made to know the genetics of light-orange flower in groundnut mutant. The Spanish bunch cultivar VRI 2 having orange flower was crossed with the light-orange flower mutant. The F_1 plants exhibited orange flower indicating that the orange colour is governed by dominant gene. However, the F_2 population segregated as 3 orange: 1 light-orange flower indicating the light-orange flower trait is governed by a single recessive gene.

Keywords: Groundnut, mutation, gamma rays, flower colour.

Introduction

Mutation breeding is a potent genetic tool to generate new gene recombination by using either physical (gamma radiation) or chemical (ethyl methane sulphonate and methyl methane sulphonate) mutagens. Mutation breeding helps to break the undesirable linkages associated with pod and kernel features. Though mutation breeding is tedious and involves huge resources, its role in releasing the hidden genetic variability is significant as evidenced by the release of several high yielding cultivars worldwide. The present investigation was made to study the inheritance of flower colour mutant. Comparative morphological characteristic features of the induced mutant along with the control are also described in this paper.

Material and Methods

The Spanish bunch cultivar VRI 2 (any ref. for VRI 2)was irradiated with two doses of 200 Gy and 300 Gy of gamma rays. The treated seeds were raised as M_1 generation during post-rainy season 2007-08 at the New Farm of Regional Research Station, Vriddhachalam, Cuddalore District, Tamil Nadu by adopting a spacing of 30 x 30 cm^2 to allow the plants to produce as many number of pods. All the survived M_1 plants were harvested on a single plant basis and forwarded as M_2 progeny rows during rainy season 2008. The M_2 population was evaluated with a spacing of 30 x 10 cm^2. A dwarf, small leaf, light-orange colour flower mutant was identified in one of the progeny rows from 300 Gy dose. The selected mutant was raised as M_3 progeny during post-rainy season 2008-09. All the plants in the progenies were uniform and produced light-orange coloured flowers indicating the true to type. The true breeding nature was observed till M_5 generation. In order to investigate the genetics of light-orange colour flower, the cultivar VRI 2 was crossed with light-orange colour flower mutant during rainy season 2010. The resultant F_1 hybrids were raised during post-rainy season 2010-11. All the F_1 plants were harvested individually and raised as F_2 progenies during rainy season 2011. The observation on flower colour was recorded on both the parents and F_1's. The F_2 population was also observed for the colour of flower. The data was analysed for the light-orange colour flower trait to determine the mode of inheritance by $\chi 2$ test .

Results and Discussion

Description of the light-orange flower mutant: Light-orange flower mutant is a dwarf type plant. It has erect growth habit with sequential flowering as observed in the control cultivar VRI 2 (Table 1). Sparse hairiness is observed in the stem with no pigmentation. Leaf colour is usually green in colour with obovate leaves covered with sparse hairs. Inflorescence is compound type with 2 to 4 flowers borne on the axils of cataphylls or foliage leaves. The standard petal colour is light orange with usual standard, wing and keel petals. The pod has slight beak with shallow constriction and moderate reticulation. The mutant possessed rose colour testa.

The mean plant height is 37.35 cm and 23.56 cm respectively during rainy and post-rainy seasons while control recorded a mean plant height of 41.45 cm (Table 2). Number of primaries is more or less similar in both the seasons (5.58 and 5.26). However, number of secondaries is much higher in *kharif* and *rabi*/summer seasons (14.33 and 13.23). The leaflet length and width is greatly reduced to half of the control cultivar. Number of seeds per pod is more or less equal in both mutant and control. Mean pod length is 2.02 cm and 1.79 cm respectively during *kharif* and *rabi*/summer seasons. However the control registered a mean length of 2.66 cm. Similarly mean pod width is also reduced to 0.837 cm and 0.805 cm in both the seasons. Mean kernel length in both the seasons is 0.908 and 0.826 cm respectively which is much smaller than the control (1.34 cm). Kernel width also followed similar trend. Mean hundred kernel weight observed during both the seasons are 24.42 and 23.81 g, which is one half of the control cultivar. However, there is not much difference with respect to the shelling outturn. Mean pod yield is lesser in mutant (9.895 and 6.016 g in *kharif* and *rabi*/summer seasons) and higher in control (25.23 g). The oil content of the mutant is 46.5 and 47.3 per cent during *kharif* and *rabi*/summer seasons. For rust and late leaf spot reaction, the mutant recorded a mean grade of 6.0 and 6.0 respectively during *kharif* season; while the reaction is 5.0 and 6.0 during *rabi*/summer season.

Genetics of light-orange flower colour mutant: Mode of inheritance of corolla colour was studied by crossing VRI 2 (orange colour flower) with light-orange flower mutant . All the plants in F_1 generation of the cross were with orange colour flowers, indicating dominant nature of the orange colour. The F_2 population however segregated in the ratio of 3 orange: 1 light-orange, indicating mutant trait is governed by single recessive gene (Table 3). Badigannavar (2007) also found light-orange colour mutant which was under the control of single recessive gene. However, Dwivedi *et al*. (1996) studied the segregation for flower colour in the progeny of the light-orange flowered plants in the cross ICGV 86694 X NCAc 2821. The cross followed inconsistent segregation behavior which was due to either a position effect caused by breakage and fusion of chromosomes or the activity of an unstable genetic element associated with the alleles producing light-orange flower phenotypes. Desale *et al*. (1986) studied the genetics of faint orange colour flower by crossing with the cultivar JL 24 which is having orange flowers. The F_2 and F_3 generation indicated that flower colour was controlled by a single recessive gene designated as *oflr*. However, the ratio need to be confirmed through the test cross.

References:

Badigannavar, A.M. 2007. Inheritance of flower colour mutant in groundnut. *Indian J. Genet.,* **67** (3): 266-267.

Desale, S.C., Bhapkar, D.G. and Thombre, M.V. 1986. Inheritance of faint orange flower colour in groundnut. *J. Oilseeds Res.,* **3**: 135-136.

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Table 1. Morphological description of light-orange flower mutant and its parent VRI 2 in groundnut

Name of the trait		Specification
Growth habit	:	Erect
Branching pattern	:	Sequential
Stem hairiness	:	Sparse
Stem pigmentation	:	Absent
Leaf colour	:	Green
Leaflet shape	:	Obovate
Hairiness on young leaf	:	Medium
Hairiness on mature leaf	:	Sparse
Inflorescence type	:	Compound
Peg colour	:	Absent
Standard petal colour	:	**Light Orange**
Pod beak	:	Slight
Pod constriction	:	Shallow
Pod reticulation	:	Moderate
Seed colour	:	Rose
Secondary seed coat colour	:	Rose

Table 2. Performance of groundnut light-orange flower mutant for certain quantitative characteristics during rainy and post-rainy seasons.

Characters	Light-orange flower mutant		Control (VRI 2)	
	rainy season	post rainy season	rainy season	post rainy season
	Mean ± S.E	Mean ± S.E	Mean ± S.E	Mean ± S.E
Days to maturity	100.2±0.0	96.2±0.2	102.3 ± 0.4	99.1±0.0
Plant height (cm)	37.35±1.0	23.563±0.6	41.45 ± 1.6	36.42±1.1
Number of primaries	5.58±0.1	5.266±0.2	6.1 ± 0.5	5.7±0.1
Number of secondaries	14.33±1.1	13.233±1.1	6.0 ± 1.6	5.2±1.1
Number of flowers/inflorescence	2.33±0.0	2.533±0.1	2.6 ± 0.1	2.25±0.1
Leaflet length (cm)	2.3±0.0	2.437±0.0	4.562 ± 0.1	4.658±0.0
Leaflet width (cm)	1.104±0.0	1.217±0.0	2.207 ± 0.0	2.316±0.0
Length/Width ratio	1.962±0.0	2.014±0.0	2.089 ± 0.0	2.165±0.0
Number of seeds per pod	1.9±0.1	1.933±0.0	1.8 ± 0.1	1.946±0.0
Pod length (cm)	2.029±0.0	1.791±0.0	2.66 ± 0.0	2.358±0.0
Pod width (cm)	0.837±0.0	0.805±0.0	1.15 ± 0.0	1.01±0.0
Seed length (cm)	0.908±0.0	0.826±0.0	1.34 ± 0.0	1.12±0.0
Seed width (cm)	0.662±0.0	0.6±0.0	0.735 ±0.0	0.711±0.0
100 seed weight (g)	24.42±0.1	23.81±0.1	47.44 ± 0.4	45.87±0.1
Shelling per cent	74.012±0.9	72.33±0.3	72.43 ± 0.5	70.22±0.6
Pod yield (g/plant)	9.895±0.6	6.016±0.3	25.23±3.8	23.11±0.4
Oil content (%)	46.5	47.3	49.6	49.9
Reaction to rust (1-9 scale)	6.0	5.0	8.0	8.0
Reaction to late leaf spot (1-9 scale)	6.0	6.0	8.0	8.0

Table 3. Segregation for flower colour in a F_2 population of groundnut.

S.No.	Plant character / crosses	$P_1 \times P_2$	F_1 Phenotypes	F_2 observations		χ^2 ratio	χ^2 Value	P value
				Orange	Light-orange			
1.	**Flower colour** VRI 2 X Light-orange colour flower mutant	Orange X Light-orange	Orange	135	31	3:1	2.656	0.10-0.05

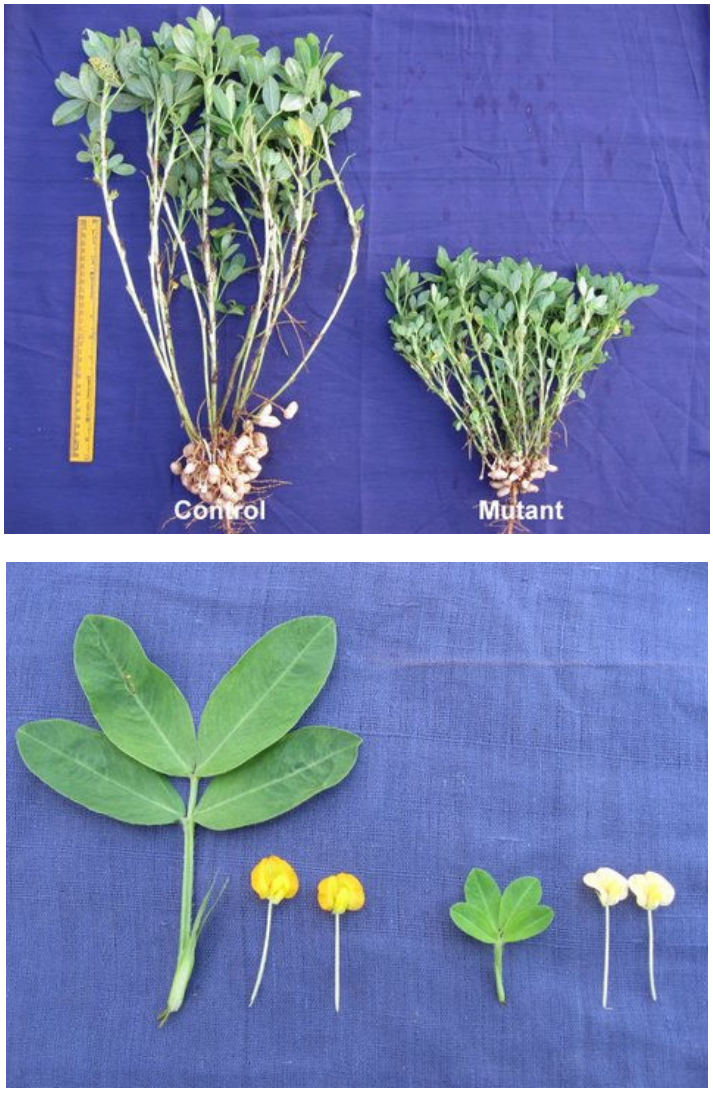

Fig 1. Light-orange flower mutant in groundnut