Tobacco Science, 1982, 26-32, p. 121-123, ISSN. 0082-4523.pdf

GENETICS OF ASSOCIATED WHITE FLOWER AND WHITE SEED CHARACTERS IN *NICOTIANA TABACUM* L.

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Cultivars of *Nicotiana tabacum* L. normally have pink flowers and brown seeds. A white flowered and white seeded mutant occurred in a cultivar known as Jayalakshmi (JL). These associated mutant characters were recessive to pink flower and brown seed colours in F_1 progenies. F_2 populations of crosses involving JL with three normal cultivars gave segregation ratios of 15 pink flowered, brown seeded; 1 white flowered, white seeded plants. Testcross populations gave 3:1 ratios. In a fourth cross (16/103 xJL), ratios of 3:1 in F_2 and 1:1 in the testcross were obtained. Results show that the white flower and white seed characters are governed by duplicate recessive genes. Of the four varieties used in crosses with JL, three had both genes in dominant condition, whereas in the fourth cultivar (16/103) one of the genes seems to exist in the mutated condition. The duplicate recessive genes are designated as wfs_1 and wfs_2 for white flower and white seed.

Additional key words: *Nicotiana tabacum*, spontaneous mutation, white flower and white seed, duplicate genes.

INTRODUCTION

Cultivars of *Nicotiana tabacum* L. normally have pink flowers and brown seeds. Other flower colours such as red, carmine, and white are not uncommon. Seed coat colour may vary from tan to dark brown. White flower (corolla) colour was reported to be recessive to all coloured forms. Red and carmine are dominant to pink corolla colour. Monogenic, digenic and trigenic segregations for corolla colour were reported earlier (1, 4, 5, 7, 8, 10, 11).

The flue-cured cultivar called Jayalakshmi (JL) has white flowers and cream coloured seeds (termed white seeds for convenience, **Fig. 1)**; presumably a result of spontaneous mutation(s). It is akin to other local cultivars like SP Cross, CTRI Special and FCV Special in having light green leaves and creamy stem colour at maturity. Origin of this white seeded cultivar, time of occurrence of mutation and its isolation are not known. Genetics of the associated white flower and white seed characters are reported here.

MATERIALS AND METHODS

The white flowered and white seeded cultivar, JL, was crossed with four flue-cured, pink flowered and brown seeded cultivars, viz., SP Cross, CTRI Special, TMVRR2a and 16/103, the latter two being dark green types. Reciprocal crosses were made only with SP Cross. The F_1s were raised during 1979-80 and self-pollinated. Also, each F_1 was backcrossed to the parents. The F_2 and backcross populations were grown in 1980-81 and scored for flower and seed colours. Seed size, seed weight and percent oil content of the mutant seed were

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Contribution received September 16, 1981. Tob. Sci. XXVI: 121-123, 1982.

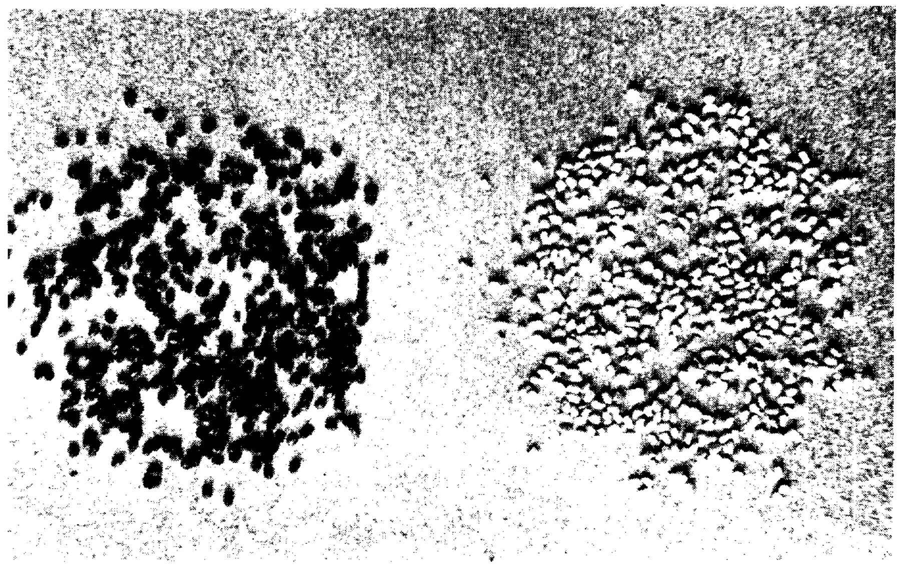


Fig. 1. Normal brown and mutant white seed of *N. tabacum* L.

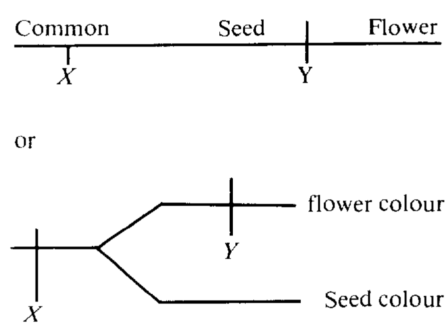
recorded. Germinability of white seeds was tested in petri dishes. JL was also crossed with three other white flowered but brown seeded *N. tabacum* mutants viz., Virginia Gold, Delcrest and DR.1 and the three F_1s were grown in 1980-81 season.

RESULTS AND DISCUSSION

The creamy stem colour of JL at maturity is allelic to that of SP Cross and CTRI Special. Seedlings of JL are similar to those of green cast cultivars though somewhat lighter green and become pale yellow under nitrogen deficiency. The plants progressively turn from lighter green to yellow as they approach maturity. More leaves (4 to 5) come for harvest at each priming compared to green cultivars (2 to 3). Stem remains green till flowering time and turns progressively creamy on exposure to sun after harvest of and at maturity. JL differs from yellow burley, in that, burley stem and mid-ribs appear creamy even from early stages of growth. There were no differences in seed size, weight and germinability of the mutant seeds compared to normal brown seeds. The oil content of white seeds was lower (25%) than that of brown seeds (28%). There was no difference in the refractive index of oil (1.4774 for white seed and 1.4773 for brown seed).

All the F_1 progenies had pink flowers and brown seeds showing that the white flower and white seed traits are recessive. There were no reciprocal differences. The frequencies of different phenotypic classes in the F_2, BCP_1 and BCP_2 populations of the four crosses are given in **Table 1.** There are only two classes of plants: (a) pink flowered with brown seeds and (b) white flowered with white seeds. Absence of recombinant types indicates that the white flower and white seed characters are governed by the same mutation. The frequencies of plants in the two classes of the first three crosses **(Table 1)** fit well, in general, to the assumed ratios of 15 : 1 in F_2 and 3: 1 in the testcross, indicating involvement of duplicate genes; the double recessive controlling white flower and white seed characters. Dominant duplicate genes are present in SP Cross, CTRI Special and TMVRR2a. The frequencies of plants of the fourth cross (16/103 x JL) suggest a single gene diffrence between the cultivars. It appears that one of the genes in 16/103 is in the dominant condition while the other gene mutated. Existence of one of the duplicate genes in mutated condition in *N. tabacum* cultivars was reported earlier for other characters by Stines and Mann (12) and Aycock (2).

F_1s of JL with the three white flowered but brown seeded cultivars had pink flowers and brown seeds showing that the loci concerned in the two types are different. The present results suggest that the locus for the white flowered and white seeded mutation is in the common biochemical pathway for pigments of corolla and seed coat colour. The existence of white flowered mutants with brown seeds allows assumption of the following simple mutational steps in the pathway (s):



Differences in the tissues and time of appearance of pigments in flowers and seeds make the bifurcated pathway more plausible. Mutation at step *X* results in plants with white flower and white seed colour, whereas mutation at step *Y* results only in white flower colour. Reports of mutations giving only white seed coat colour in *N. tabacum* are not known to the authors. However, Boortzev (3) reported simple recessive white seed mutant in *N. rustica*.

In *N. tabacum*, an amphidiploid, several characters such as white burley (6), humped calyx (9) and persistant corolla (9) were governed by duplicate loci, presumably one locus in each of the two genomes. The present one involving white flower and white seed characters is another instance. The recessive duplicate genes are designated as wfs_1 and wfs_2 for white flower and white seed.

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Table 1. Frequencies of phenotypic classes for flower and seed colour.

Cross/population	Assumed phenotypic ratio	Number of plants with pink flower and brown seed	Number of plants with white flower and white seed	P
1. SP Cross x JL				
(a) F_2	15:1	314	20	0.80-0.90
(b) F_1 x SP Cross	1:0	101	0	
(c) F_1 x JL	3:1	73	29	0.30-0.50
2. CTRI Special x JL				
(a) F_2	15:1	234	9	0.10-0.20
(b) F_1xCTRI Special	1:0	96	0	
(c) F_1x JL	3:1	73	26	0.70-0.80
3. TMVRR 2a x JL				
(a) F_2	15:1	311	24	0.30-0.50
(b) F_1x TMVRR 2a	1:0	104	0	
(c) F_1 x JL	3:1	77	24	0.70-0.80
4. 16/103 x JL				
(a) F_2	3:1	264	70	0.50-0.10
(b) F_1 x 16/103	1:0	97	0	
(c) F_1 x JL	1:1	64	38	0.01-0.02

ACKNOWLEDGEMENTS

Grateful thanks are due to Dr. N.C. Gopalachari, Director, Central Tobacco Research Institute, for providing facilities. The authors express their appreciation to Dr. M. K. Chakraborty, former Head of the Division of Biochemistry, Technology and Plant Nutrition for kindly arranging the analysis of oil content of white and brown seeds and to Mr. K. Appa Rao for supplying seeds of two white flowered varieties.

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