INHERITANCE OF PUBESCENCE IN PHARBITIS NIL

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The stem of the common strains of *Pharbitis Nil* (the Japanese morning glory) is more or less silver gray in color in reflected light, on account of the somewhat dense hairs growing downward on its surface. In one of my pedigrees, no. 65, the development of the hairs on the stem is very poor, however, and the stem which grows out in the autumn is almost free of hairs. Because of this condition the stem and the foliage of the strain are of vivid color. Roughly speaking, the strain may be said to have a smooth stem.

Crossing this strain with the hairy normals, I obtained F_1 plants having a hairy stem, and they gave rise to the F_2 offspring composed of the hairy and the smooth stems in nearly the usual ratio. With these results, we may assume that the smooth stems which are produced breed true to type in the subsequent generation. Some of the F_3 families of these smooth stems, however, gave unexpected results, segregating into smooth and hairy stems. Thus the hairy condition behaves either as a dominant or a recessive to the smoothness in the descendants of the same cross.

The smooth condition is commonly found to be recessive to the hairy state in many different species of plants. According to Miss SAUNDERS (2), and MIYAKE and IMAI (1), however, the hair of the stem in the foxglove is transmitted as a recessive allelomorph to the so-called smoothness. The smooth stem in this plant is not entirely or nearly free from hairs, only the upper flowering part of the stem being almost smooth. In *Pharbites Nil* the relative development of hairs on the stem is represented in a manner somewhat similar to that of *Digitalis*, but the genetic behavior is more complicated, on account of the occurrence of a dominant hairy stem.

Experimental results

The F_1 plants obtained by crossing a smooth stemmed strain (65) and two hairy stemmed specimens (326 and 220) had quite hairy stems; their reciprocal matings gave no different results. Table I gives the results obtained in raising the F_2 offspring.

TABLE I

Cross	Hairy stem	Smooth stem	Total
65×326.......	93	30	123
65×220.......	141	25	166
Total..........	234	55	289
Expected (13.3)	234.81	54.19	289

TABLE II

F_3 DATA OF CROSS 65×326

Character of F_2	Pedigree number	Hairy stem	Smooth stem	Total
Hairy stem	Total of 38 pedigrees	1153		1153
	33	19	6	25
	36	19	7	26
	41	?	?	(101)
	42	11	3	14
	43	12	3	15
	46	11	7	18
	47	23	8	31
	49	38	6	44
	54	7	4	11
	57	42	14	56
	61	18	9	27
	62	29	14	43
	66	43	11	54
	67	18	6	24
	69	4	1	5
	71	6	4	10
	Total	300	103	403
Smooth stem	Total of 8 pedigrees		236	236
	28	13	29	42
	29	5	10	15
	30	2	8	10
	31	22	62	84
	34	7	19	26
	37	1	6	7
	39	1	3	4
	40	4	12	16
	63	4	11	15
	70	5	14	19
	73	4	8	12
	Total	68	182	250
	Expected	62.5	187.5	250

The segregating number is not very far from the simplest ratio of 3:1, and we might think that the case is one of monohybrid inheritance, but the case is not so simple when the F_3 data are examined. The actual segregation may be a modified dihybrid ratio of 13:3, the former having hairy stems and the latter smooth ones. The F_3 results obtained from a cross, 65×326, are shown in table II.

Offspring of hairy stemmed F_2.—Roughly speaking, the results of the hairy stemmed F_2 are divided into two classes, the one breeding true and the other segregating into hairy and smooth stems. The segregating number in total nearly corresponds with that calculated on the basis of 3:1. Theoretically, however, the average proportion must be $3>1$, as will be shown in the next section.

Offspring of smooth stemmed F_2.—The F_3 families of the smooth stemmed F_2 are equally divided into two types, those breeding pure and those producing hairy stems. Now we have a case of reversal segregation, namely, the segregating smooth stems produce the hairy stems. The segregating hairy stems are in the proportion of 27 per cent of the total number, consequently the case may be considered as practically 3:1 segregation.

Discussion

In summing up, the results obtained by the cross 65×326 may be shown graphically as follows:

P	F_1	F_2		F_3
Hairy stem		76% Hairy stem	70%	100% Hairy stem
			30%	74% Hairy stem 26% Smooth stem
×	100% Hairy stem			
Smooth stem		24% Smooth stem	42%	100% Smooth stem
			58%	73% Smooth stem 27% Hairy stem

The dominant nature of the hairy condition can be learned by the fact that the F_1 plants all had hairy stems, and they produced smooth stems in about one-fourth of the total F_2. Some smooth stemmed F_2 plants, however, produced offspring consisting of the smooth and the hairy stems in the proportion of 3:1. The result shows entirely reverse behavior in the segregation of the similar characters.

Now let us assume two allelomorphic pairs of factors in relation to the development of the hair on the stem: (1) H_s, h_s.–H_s inhibits the production of hairs on the stem, while its recessive factor h_s is responsible for the hairy stem; (2) H_h, h_h.–H_h acts as an inhibitor to H_s, making the stem hairy.

Then the genetic composition of the parental hairy stems should be $h_sh_sH_hH_h$, while the smooth partner is considered to be $H_sH_sh_hh_h$. In the consideration of the former composition two alternatives may be offered, $H_sH_sH_hH_h$ or $h_sh_sh_hh_h$, but neither of them can be thought of as the actual case, since the F_1 plants must have a double heterozygotic constitution. The free combinations of the factors in the F_2 generation should give:

Reference	Genetic composition	Its ratio	Character	Its ratio
A	$H_sH_sH_hH_h$	1	Hairy stem	13
	$H_sh_sH_hH_h$	2		
	$h_sh_sH_hH_h$	1		
	$h_sh_sH_hh_h$	2		
	$h_sh_sh_hh_h$	1		
B	$H_sH_sH_hh_h$	2		
	$H_sh_sH_hh_h$	4		
C	$H_sH_sh_hh_h$	1	Smooth stem	3
D	$H_sh_sh_hh_h$	2		

The ratio of the hairy and the smooth stems is 13:3. With such an expected ratio as a basis, the observed and the theoretical numbers approximately corresponded, as was shown in the bottom line of the F_2 table. Out of seven hairy F_2 genotypes, five grouped in *A* should phenotypically breed true to the hairy stem, whatever their constitution may be. The remaining two types grouped in *B*, however, should produce segregating families; the one, single heterozygotic type, will produce hairy and smooth stems in the ratio of 3:1; while the other, double heterozygotic type, may give the two forms in the proportion of 13:3. The two types of ratio, 3:1 and 13:3, are not so different that they can always be distinguished easily one from the other with the numbers which were observed. Those families which produced some smooth stems are then considered to be composed of two types of segregation; so the ratio in the total number should be $3>1$, but not 3:1. The actual ratio, however, was nearly 3:1, not $3>1$. This unexpected result may be partly accounted for at least by the difficulty of distinguishing between the two forms. Although in the majority of the cases the classification was not hard, it was sometimes difficult. The extreme case is exhibited in family 41, of which I failed to take reliable records as to the segregating characters. Such difficult conditions for identification seem to admit of some qualifications in judging the data. Out of two smooth stemmed F_2 genotypes one (*C*) should phenotypically breed true to the smooth stem, while the other (*D*) will produce smooth and hairy stems in the ratio of 3:1. These expectations coincided nearly with the actual data.

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