THE DEFICIT OF ROOTLETLESS SEGREGATES IN *PHARBITIS NIL*

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Rootletless (*rl*) is a recessive gene which affects the root system of *Pharbitis Nil*. The form made its appearance by mutation under the writer's observation (IMAI 1931). Since the rootletless seedlings have no rootlets during their early growth after germination, only a few crooked ones being developed afterwards, the plants grow slowly. Therefore, even full-grown plants can easily be pulled up by the hand, owing to the poor development of their root system. The seedlings generally have cotyledons with shallow lobing. These cotyledons are frequently abnormal in number, as shown in Table 1.

TABLE 1

Variation in the number of cotyledons of rootletless seedlings.

Num. of cotyledons	1	2	3	4	Total
Frequency	2	204	77	9	292

The abnormal seedlings having syn-, tri- and quadri-cotyledons amount to 30.1 percent, which is very small for standard, normal seedlings. Another remarkable thing about rootletless segregates is their deficit in the hybrid progeny, the recessive ratio being quite low. A summary of F_2 from hybrids, obtained by the crossing of the rootletless with the normal, is given in Table 2.

TABLE 2

F_2 derived by crossing rootletless with normal.

Cross	+	*rl*	Total	+ / *rl*
RL × KN	302	57	359	5.30
RL × A24	426	68	494	6.26
RL × ID	182	30	212	5.11
RL × D108	195	33	228	5.91
Total	1105	188	1293	5.88

Instead of a 3:1 ratio as expected, the normal segregates outnumbered

the rootletless 5.88 times. The deficit in the recessives is so considerable that it cannot well be ignored. Backcrossing experiments made in reciprocal ways, however, revealed the cause of the deficit, the numerical data being given in Table 3.

TABLE 3

Backcross; (RL×ID) ×RL and RL× (RL×ID).

Backcross	+	*rl*	Total	+ / *rl*
(+×*rl*)×*rl*	158	154	312	1.03
rl×(+×*rl*)	221	104	325	2.13

The difference exhibited between reciprocal backcrosses is remarkable. Notwithstanding that the deficit in the rootletless is evident in the backcross when F_1 was the staminate parent, it vanishes in its reciprocal mating when F_1 was the pistillate parent in the backcross. This fact brings to attention the different chances for fertilization occurring between pollen carrying the gene normal and those carrying the gene rootletless, the chances of the former's occurring being more than twice as often as the latter. Adopting the gametic proportion of 2.13:1.00 in the certation, the theoretical F_2 ratio is calculated to be 5.26:1.00, which nearly coincides with the observed ratio. Experiments were attempted in order to verify the certation occurring between pollen carrying the different genes, following the methods devised by CORRENS (1917) and HELIBERT-NILSSON (1920). The results obtained are summarized in Table 4.

TABLE 4

Certation experiments for rootletless.

Experiment	+	*rl*	Total	+ / *rl*
Control	148	69	217	2.14
Exp. A	127	90	217	1.41
Exp. B	140	53	193	2.64

To eliminate experimental errors as much as possible, these experiments were conducted during the same season and with pollen from the same F_1 plants. The control was the usual backcross, pollinating F_1 gemetes on the rootletless stigmas, where certation might possibly occur. Experiment A was the same backcross, except that only a small quantity of pollen was applied. For control, pollen from an anther were applied to a stigma; whereas, in Experiment A, only from one-third to one-half of the quantity of pollen used for the control was applied. In Experiment B, pollination was made as control, and after 4–5 hours the styles were cut off with a knife at their base,

1mm. above the ovaries. By this operation, the pollen that are growing tardily with their pollen-tubes may be excluded from fertilization. Under these circumstances, the deficit of the rootletless segregates may become smaller in Expeiment A by affording a greater chance for the fertilization of the pollen carrying the gene rootletless, whereas it may become larger in Experiment B by giving less chances for their fertilization. The actual results confirm these expectations, proving that the certation occurs between the pollen carrying the different genes. Considerable deficit of recessive segregates have been reported at times in the genetic literature of *Pharbitis Nil*, some of which do not seem to be due merely to their low viability; for instance, the case of the pear reported by MIYAKE and IMAI (1927), which it may be necessary to test by critical experiments.

To ascertain whether the predisposition to deficit of rootletless is due to the gene rootletless itself or to another physiological gene, a series of F_3 families was examined with respect to their segregating ratios, a summary of the results of these observations being given in Table 5.

TABLE 5

Summarized F_3 data derived from cross RL×ID.

Character of F_2	Num. of families	+	*rl*	Total	+ / *rl*
Normal	55	5590	—	5590	—
	72	6929	809	7738	7.79
Rootletless	20	—	908	908	—

Count was made at the seedling bed a little later than usual, therefore the increase of deficit seems at least to be due in part to the fact of lateness in counting, owing to the low viability of rootletless seedlings. In Table 6 is distributed the F_2 frequencies according to the magnitude of the normal segregates as compared with the rootletless ones.

TABLE 6

Distribution of F_2 of cross RL×ID, according to the magnitude of normal segregates compared with rootletless ones.

Magnitude	×2	×4	×6	×8	×10	×12	×14	×16	×18	×20	×22	Total
Frequency	0	7	14	15	15	4	4	5	6	2	0	72

If the predisposition to deficit of rootletless is due to another linked or independent gene, we should expect some families in which segregation occurs in a 3:1 or a $3<1$ ratio. However, we had no such families, the one showing

× 3.77 being the lowest in magnitude. The slow pollen-tube growth seems, therefore, to be due to manifold effects of the gene rootletless itself.

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