

MORPHOLOGICAL STUDIES ON THE HIGHLY NODULATING MUTANT *nod-3* AND ITS PARENT VARIETY 'RONDO'

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After inoculation with *Rhizobium leguminosarum*, the nodulation behavior of mutant *nod-3* contrasts sharply with the behavior of the wild type. The mutant persistently nodulates in the presence of high amounts of nitrate as well as nodulating abundantly on nitrogen-free aerated liquid medium (1). Taproot length of *nod-3* plants after nodulation was found to be much shorter than that of cv 'Rondo'. To investigate whether this difference in taproot length is a result of the abundant nodulation or a direct effect of the mutation, the root and shoot morphology of nodule-free seedlings of both genotypes, cultured on nitrogen-free aerated liquid medium (3), have been investigated during the first three weeks after sowing.

No clear differences between the two genotypes were noted in the period immediately following germination. Seedlings were examined 9, 13, 17, and 22 days after sowing (Table 1). The shoot, taproot, and total root length (taproot + all lateral roots) of mutant *nod-3* were much shorter than that of the wildtype cv Rondo. The number of primary lateral roots was essentially the same in both genotypes, whereas the number of secondary lateral roots, the first ones appearing about 14 days after sowing, was much higher in the mutant. The distance between the root tip and the point at which lateral roots first appear on the taproot as well as on the primary lateral roots is shorter in the mutant. Therefore, notwithstanding the differences in root length, the number of primary lateral roots per cm of the rooted part of the taproot is the same in three-week-old seedlings of both genotypes (Rondo 2.5 and *nod-3* 2.7). The number of secondary lateral roots per cm of the rooted part of the primary lateral roots clearly were different (cv Rondo 2.3 and *nod-3* 7.0).

Comparable differences were observed when seedlings of both genotypes were nodulated after inoculation with *Rhizobium leguminosarum* (data not shown). However, in this case also the number of secondary lateral roots per primary lateral root was higher in three-week-old seedlings of the mutant (Rondo: 5.2 and *nod-3*: 8.6) but the difference was smaller than under nodule-free conditions (Table 1, B2). This decreased number of secondary lateral roots in nodulated mutant plants is directly connected with a relatively high number of nodules present on such primary lateral roots (2).

All these observations indicate that the root morphology and shoot length of mutant *nod-3* also differs from that of the wildtype when nodules are absent. After crossing mutant *nod-3* with wildtype, no recombination between persistent nodulation and an altered root morphology of the mutant was observed in an F2 population of over one hundred plants, suggesting that we are dealing with pleiotropic characters.

The altered root morphology and shoot length of mutant nod-3 as well as its persistent nodulation could be caused by a changed hormonal makeup or balance of the plant. Investigations have been started to determine auxin and cytokinin levels in seedlings of both genotypes with the view to discover the basis for the difference in behavior. Preliminary observations indicated that in young root systems of nod-3 plants contain a higher amount of indole acetic acid.

1. Jacobsen, E. and H. Nijdam. 1983. PNL 16:31-32.
2. Jacobsen, E. and W. J. Feenstra. 1984. Plant Sci. Letters 33:337-344.
3. Jacobsen, E. 1984. Plant and Soil. (In press.)

Table 1. Root morphology and shoot length of uninoculated seedlings of mutant nod-3 and cv Rondo during the first three weeks after sowing.

	Days after sowing							
	9		13		17		22	
	Rondo	nod-3	Rondo	nod-3	Rondo	nod-3	Rondo	nod-3
Length (mm) of:								
Taproot	80	57	209	205	261	247	367	289
Total root system	216	110	1164	955	2078	1331	4603	3864
Shoot	30	23	54	54	89	61	105	85
Number of:								
Primary lateral roots	12.9	8.0	29.5	32.9	43.2	41.1	68.8	68.3
Secondary lateral roots per primary lateral root	-	-	-	-	0.5	1.7	5.6	14.1
Distance in mm between root tip and appearance of lateral roots:								
On tap root	58	50	127	119	100	89	92	33
On primary lateral roots	-	-	-	-	54	52	68	42