RESEARCH ON THE EVOLUTION OF THE NUMBER OF NODOSITIES DEVELOPED IN SOY UNDER THE EFFECT OF INOCULATION AND OF FERTILISATION WITH NITROGEN ON TWO SOIL TYPES

CERCETĂRI PRIVIND EVOLUȚIA NUMĂRULUI DE NODOZITĂȚI LA SOIA ÎN FUNCȚIE DE EFECTUL INOCULĂRII ŞI AL FERTILIZĂRII CU AZOT PE DOUĂ TIPURI DE SOL

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Abstract. *During the trial cycle 2003-2005, we studied the effect of inoculation or of fertilization with nitrogen (N_0, N_{30}, and N_{60}) on the number of nodosities developed by soy on two types of soil: cambic chernozem and brown luvic. On both soil types in the variants inoculated, the number of nodosities was significantly larger than in the control variants. The nitrogen dose N_{30} applied before sowing resulted in an increase of the number of nodosities on the brown luvic soil; on the cambic chernozem there were no significant differences compared to the control (N0). The N60 dose resulted in the development of a significantly smaller number of nodosities on both soil types.*

Rezumat: *Intr-un ciclu experimental de trei ani 2003-2005, am studiat efectul inoculării şi al fertilizării cu azot (N_0, N_{30}, si N_{60}) asupra numărului de nodozităţi la soia pe două tipuri de sol: cernoziom cambic şi brun luvic. In funcţie de tipul de sol în variantele inoculate, numărul de nodozităţi a fost foarte semnificativ comparativ cu varianta martor. Azotul aplicat in doză de N30 a influenţat numărul de nodozităţi pe solul brun luvic, pe solul de tip cernoziom cambic nu s-au înregistrat diferenţe semnificative faţă de varianta martor N0.. La doza de N60 rezultatele au fost semnificative pe ambele tipuri de sol.*

Key words: soy, *nitrogen dose, number of nodosities, and soil type*
Cuvinte cheie*: soia, doza de azot, număr de nodozităţi, tip de sol*

INTRODUCTION

Setting and functioning nitrogen fixing symbioses are inhibited by the high mineral nitrogen levels in the soil. Some trial results show that applying nitrogen in small amounts can enhance the development of nodosities and the fixation of nitrogen (Kimon et al., 1985).

Nitrogen nutrition in legumes is controlled by two enzymatic systems:

- reductosic nitrate for the metabolizing of mineral nitrogen;
- nitrogenasic nitrate for the metabolizing of fixed biological nitrogen.

The opinion according to which the two nutritions are antagonistic and succeed each other during the vegetation period was disputed by Ohoton (1987) who, as a result of trials, claims that the two nutritions in soy are not completely antagonistic. He concludes that maximum yield in soy are when developing optimal conditions for reductosic and nitrogenasic nitrate activity, which can lead to applying fertilizers when plants need them, but during periods of time and at doses that do not inhibit fixation.

Popescu (1980) reaches the conclusion according to which nitrogenasic nutrition is more sensitive to unfavourable factors compared to reductosic nitrate nutrition. Beginning of nitrogenase occurs later, pointing out the fact that during the first vegetation periods nitrogen nutrition is done from other sources (seeds, soil, etc.).

Soil, particularly through its acidity, has a complex depressive effect on symbiotic

systems, which can be explained through its direct action doubled by a series of collateral effects (Lie, 1974).

In this paper, we aim at presenting the evolution of the number of nodosities as an expression of beginning and functioning of symbiosis in soy on a neutral soil and on an acid soil, when fertilized with progressive nitrogen doses.

MATERIAL AND METHOD

Research was carried out at the Didactic Station in Timisoara and in Recas, during the trial cycle 2003-2005.

The soil in Timisoara was a cambic chernozem, strongly gleyed, and low decarbonated.

Soil reaction is neutral between 0 and 35 cm, and low alkaline between 40 and 80 cm.

Humus supply is medium, and so is nitrogen supply, while potassium supply is good.

In Recas, the soil type was brown luvic, low pseudo-gleyed.

The soil is acid between 0 and 35 cm, and low acid between 35 and 80 cm.

The soil has a poor supply of humus and nitrogen, and a good supply of phosphorus and potassium.

The trial was a bi-factorial one.

Factor A – inoculation variants with two graduations:

a1 – control;

a2 – inoculated.

Factor B – nitrogen fertilization variants with three graduations:

b1 – N_0;

b2 – N_{30};

b3 – N_{60}.

Nitrogen fertilization was done before sowing.

Basic fertilization was done with $P_{70}K_{40}$.

Establishing the number of nodosities was done during the following stages:

- vegetation 3 (V3) – appearance of the third nodosity of the stem;
- reproduction 4 (R4) – plants with pods 2 cm long.

From the point of view of the climate, the years 2003 and 2004 were less favourable for soy because, mainly, of the high temperatures during the summer doubled by drought, but the year 2005 was more favourable.

RESULTS AND DISCUSSIONS

The type of soil has significant effects on the development and functioning of symbiosis. Tables 1 and 2 show that the number of nodosities on the brown luvic soil is significantly smaller in both vegetation stages compared to the number of nodosities on the cambic chernozem, which confirms the depressive effect of soil acidity on the symbiosis.

On the cambic chernozem in Timisoara, in the stage V3 inoculation of the soy seeds resulted in an increase of the number of nodosities developed with 50% on the average on the three agri-funds, a difference that is very significant (Table 3).

Applying nitrogen fertilizers in doses of 30 kg/ha induced no significant difference whatsoever in the number of nodosities compared to the control variant.

At the level of N_{60}, there was a very significant decrease of the number of nodosities developed because of the repressive effect of the concentration of the mineral nitrogen in the soil on the development of the symbiosis.

On the brown luvic soil, in the stage V3 (Table 4), there was a very significant increase of the number of nodosities by applying 30 kg/ha of nitrogen. Nitrogen fertilizers resulted in a better development of the plants when treated with N_0. Taking into account the naturally poor supply with nitrogen of this soil, it is out of question to develop in the soil a nitrogen concentration that inhibits the development of the symbiosis.

Table 1

Type of soil	No. nod./pl	%	Difference	Significance
Chernozem cambic	7.2	100	Mt	
Brown luvic	3.9	184	3.3	000

DL 5%=0.54 1%=0.79 0.1%=1.10

Number of nodositie registered in the stage V_3

Table 2

Number of nodositie registered in the stage R_4

Type of soil	No. nod./pl	%	Difference	Significance
Chernozem cambic	11.2	100		
Brown luvic	6.2	55	-5.0	000

DL 5%=0.84 1%=1.35 0.1%=1.98

Table 3

Number of nodositie registered in the stage V_3 in Timisoara

A factor Inoculated variants	B Factor Nitrogen variants(N kg/ha)			Average Factor A			
	0	30	60	No. nod./pl	%	Diff.	Significance
Control	6.2	6.5	4.7	5.8	100	Mt	
Inoculated	9.8	10.7	5.8	8.7	150	2.9	xxx

Average Factor B			
No. nod./pl	8.0	8.6	5.2
%	100.0	107.0	65.0
Difference	Mt	0.6	-2.8
Significance			000

DL	A	B
5%	0.52	0.39
1%	1.07	0.55
0.1%	1.46	0.78

The evolution of symbioses shows that, in the conditions of the cambic chernozem, the positive effect of inoculation on the number of nodosities per plant is constant until stage R4 (Table 5).

As for the effect of nitrogen fertilization, it is similar to that recorded in stage V3.

In Recas, on the brown luvic soil, the number of nodosities in stage R4 (Table 6) was influenced by the trial factors as in stage V3.

The effect of inoculation was an increase with 43% of the number of nodosities per plant.

At the level of the dose of N_{30}, the number of nodosities was larger (23%) than in the N_0 variant, but it decreased compared to the control with 43%.

Table 4

Number of nodositie registered in the stage R_4 at Recas

A factor Inoculated variants	B Factor Nitrogen variants(N kg/ha)			Average Factor A			
	0	30	60	No. nod./pl	%	Diff.	Significance
Control	5.2	6.3	3.8	5.1	100	Mt	
Inoculated	7.9	9.8	3.7	7.3	143	2.2	xxx

Average Factor B			
No. nod./pl	6.5	8.0	3.7
%	100	123	57
Difference	Mt	1.5	-2.8
Significance		xxx	000

DL	A	B
5%	0.55	0.47
1%	0.81	0.66
0.1%	1.01	0.92

Table 5

Number of nodositie registered in the stage R_4 at Timisoara

A factor Inoculated variants	B Factor Nitrogen variants(N kg/ha)			Average Factor A			
	0	30	60	No. nod./pl	%	Diff.	Significance
Control	9.4	10.6	7.3	9.1	100	Mt	
Inoculated	15.3	14.6	10.3	13.4	147	4.3	xxx

Average Factor B			
No. nod./pl	12.3	12.6	8.8
%	100	102	71
Difference	Mt	0.3	-3.5
Significance		xxx	000

DL	A	B
5%	0.83	0.59
1%	1.07	0.88
0.1%	1.44	1.12

Table 6

Number of nodositie registered in the stage V_3 at Recas

A factor Inoculated variants	B Factor Nitrogen variants(N kg/ha)			Average Factor A			
	0	30	60	No. nod./pl	%	Diff.	Significance
Control	3.1	4.2	2.8	3.3	100	Mt	
Inoculated	4.7	5.9	3.0	4.5	136	1.2	xxx

Average Factor B			
No. nod./pl	3.9	5.0	2.9
%	100	130	74
Difference	Mt	1.1	-1.0
Significance		xxx	000

DL	A	B
5%	0.61	0.53
1%	079	0.69
0.1%	1.07	1.02

CONCLUSIONS

1. Brown luvic soil is less favourable to the development of symbiosis in soy compared to cambic chernozem, mainly because of its acidity.
2. Inoculating soy seeds with bacterial preparations is a technological measure that results in a significant increase of the number of nodosities developed by the soy plants.
3. Fertilising before sowing with nitrogen in doses of 30 kg/ha on the cambic chernozem did not influence the number of nodosities developed by the soy plants.
4. On the brown luvic soil, fertilizing with N_{30} resulted in a significant increase of the number of nodosities.
5. The dose of N_{60} resulted on both soil types in a significant decrease of the nodosities developed.

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