Symbiotic nitrogen fixation in vegetables in dependence on doses and application methods of nitrogen and phosphorus fertilisers

Lucian Halmagean, Simona Crisan

Original scientific paper

"Aurel Vlaicu" University of Arad, Faculty of Food Engineering, Tourism and Environmental Protection, Arad, Elena Drăgoi street, No. 2, 310330,Romania, (e-mail: simo_crisan@yahoo.com)

Abstract

The researches that had been done, regarded the obtained effects in symbiosis developing due bio-fertilizers like Biotrofin, in function of nitrogen fertilizer doses level and apllication condition and by "starter" phosphorus appliance.

Key words: symbiosis, bacterial product, bio-fertilizer

Introduction

The symbiotically process suppose a very delicate equilibrium installation, which depend by numbered endogenous and exogenous factors that will condition the evolution and the system efficiency. In the category of the endogenous factors are contained the ones who are acting directly or indirectly in the fixation process. All act in a close dependence with a secondary factor, but who had a major limitative role in ATP generation, reducing the electrons donators and ammoniac assimilation, meaning the photosynthesis process.

Material and methods

The bacterial product used for experimentations in the Arad agro ecological area, area representative for the western side of the country, between 1999 and 2004 for sowing garden bean cultures is called Biotrofin (obtained in ASAS microbiological laboratories). Biotrofin bio-fertilizer has two living components: first a nitrogen fixating bacteria, that gets its nitrogen from the atmosphere and a second bacteria, *Bacillus megaterium* that by phosphates solubilization balances the soil's content in nitrogen, phosphorus and potassium.

Experimentations carried out on sowing garden bean cultures followed the effects of the Biotrofin bio-fertilizer in relation with the dose and means of application of the nitrogen and phosphorus fertilizers.

Experimentations were three factorial structured, disposed on field in randomized blocks, with four repetitions, using Valja variety and dimensioning the fields at 15 sq m.

During plant vegetation period, definitive observations and determinations were carried out regarding the intensity of the symbiotic processes that was correlated with the yield indices of the plants. Data processing was carried out using the variation analysis method applied to the randomized blocks, in each year and for three factorial experimentations carried out over more years and in the same location.

Results and discussion

The aim of our researches was to establish the effects on the symbiotic processes due to Biotrofin treatments (10 l/ha), in concordance with the doses and means of application of the nitrogen-based fertilizers along with phosphorus application in Starter system. The general guidance data regarding the variability of the results from the entire range of experimentations prove indubitably the heterogeneity of the compared variations (Table no. 3).

Regarding the medium yields during experimentation cycles, one can see that the optimal variation is the one that combines the bacterisation with a 30-60 kg/ha nitrogen fertilization (NH_4NO_3) applied at flower budding stage on a base of phosphorus application through Starter method. The optimal variation from an economical point of view, having a yield only 40 kg seeds less than the maximal yield (2,931 t/ha) is obtained by using bacterisation and phosphorus fertilization in Starter system on an overall half nitrogen fertilization (30 kg/ha) by using urea – $CO(NH_2)_2$ – at flower budding stage.

Phosphorus application in Starter system is an alternative backed up by the results from both experimental and economical point of view, which point out its influence comparing with the other involved factors. Biotrofin bio-fertilization is a highly efficient method, being confirmed by the maximum yield level obtained during the experimentation comparing with the immediate effects of the other factors (2,838 t/ha compared with 2,636 t/ha), with a total yield increase of 7,7%.

For nitrogen fertilization correlated with phosphorus, average data obtained point out the stimulating effect of the urea used during vegetation period, at flower budding, on a background of phosphorus application in Starter system. This is the situation in which the high yield level is obtained with an obvious economy if we take into consideration the quantities used for both fertilizers.

Nitrogen applied during vegetation stages, especially as urea, correlated with the bacterisation on phosphorus mediated base, is stimulating the symbiotic processes with noticeable effects on the total yield. It is noticeable how the yield icreases attributed to bacterisation slowly diminish with the increase of nitrogen doses but in a lower degree when applied during vegetation stages. Bacterisation correlated with phosphorus on nitrogen mediated base points out the positive economical effect when the fertilizations are carried out in Starter system. Regarding the complex interactions that occur on a basis of phosphorus and nitrogen fertilizations as well as bacterisation treatments, the most favorable effects on the total yield for the sowing garden bean are obtained when combining super phosphate fertilization in Starter system, nitrogen fertilization using ammonia nitrate and urea in doses of 60 kg/ha applied at flower budding stage and bacterial treatments.

Table 1. Specific increases of sowing garden bean yield for seeds own to phosphorus and nitrogen fertilizationsand bacterial treatment at the seeding moment and during vegetation (1999-2004)

Factor	Year			1999-2004				kg a.s/ kg seed
	2002	2003	2004	t/ha	%	d.s t/ha	v.c %	
Average effect of phosphorus (mediated nitrogen and bacterisation)								
Super phosphate (300 kg/ha)	2,746	2,555	2,917	2,740	100	0,181	6,611	9,1
Super phosphate Starter (80 kg/ha)	2,749	2,509	2,943	2,734	99,8	0,217	7,953	34,2
Yield average increase: 21,6 kg seed/kg P_2O_5								
Average effect of bacterisation (mediated nitrogen and phosphorus)								
Unbacterised	2,645	2,438	2,824	2,636	100	0,193	7,329	-
Bacterised	2,850	2,627	3,037	2,838	107,7	0,205	7,233	20,2
Yield average increase: 10,1 kg seed/kg Biotrofin								
Average effect of nitrogen (mediated phosphorus and bacterisation)								
NO	2,471	2,209	2,670	2,450	100	0,231	9,437	-
N_{30}-NH_4NO_3 (at seeding moment)	2,666	2,439	2,861	2,655	108,4	0,211	7,954	6,8
N_{30}-NH_4NO_3 (at flower budding stage)	2,728	2,509	2,909	2,715	110,8	0,200	7,377	8,8
N_{30}-$CO(NH_2)_2$ (at flower budding stage)	2,766	2,546	2,952	2,755	112,4	0,203	7,378	11,2
N_{60}-NH_4NO_3 (at seeding moment)	2,790	2,675	2,914	2,793	114,0	0,120	4,280	5,7
N_{30}-NH_4NO_3 (at seeding stage) N_{30}-$CO(NH_2)_2$ (at flower budding stage)	2,848	2,625	3,018	2,830	115,5	0,197	6,964	6,3
N_{60}-NH_4NO_3 (at flower budding stage)	2,832	2,623	3,047	2,834	115,7	0,212	7,481	6,4
N_{60}-$CO(NH_2)_2$ (at flower budding stage)	2,878	2,631	3,068	2,859	116,7	0,219	7,664	6,8
Yield average increase: 7,4 kg seed/kg nitrogen								

Table 2. Interaction's effect of super phosphate and seeds' treatment with bacterial products on sowing garden bean production (1999-2004)

A-Basic fertilization B-Bacterial treatment	A_1 - Super phosphate 300 kg (autumn)				A_2 – Super phosphate 80 kg Starter				$A_2 - A_1$	
	t/ha	%	Dif t/ha	S	t/ha	%	Dif t/ha	S	Dif t/ha	S
B_1-unbacterised	2,650	100	-	-	2,621	100	Mt_1	-	-0,029	oo
B_2-bacterised	2,830	107,8	0,180	xxx	2,846	108,6	0,225	xxx	0,016	
A Average	2,740	100	-		2,734	99,8	-0,006		-0,016	
DL5% (t/ha)				0,026					0,020	
DL1% (t/ha)				0,037					0,028	
DL0,1% (t/ha)				0,052					0,042	

Conclusions

Phosphorus and nitrogen fertilization on the base of bacterial treatment with Biotrofin bio-fertilizer (10 l/ha) show a maximal increase of the yield for the garden bean when the treatments are carried out using a combination between the fertilization with super phosphate in Starter system (80 kg/ha), nitrogen fertilization using urea (60 kg/ha) applied at flower budding stage and bacterial treatment.

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Table 3. The effects of the interactions between phosphorus fertilization, nitrogen fertilization and bacterial treatments on the seeds production for garden bean (1999-2004)

Nitrogen fertilizers (C)	A_1 – super-phosphate (300 kg/ha)						A_2 – super-phosphate (80 kg/ha) "Starter"						Average C		
	B_1 - unbacterised			B_1 - unbacterised			B_1 - unbacterised			B_2 - bacterised			t/ha	D (t/ha)	S
	t/ha	D (t/ha)	S	t/ha	D (t/ha)	S	t/ha	D (t/ha)	S	t/ha	D (t/ha)	S			
C_1-N_0 (Mt)	2,183	-	-	2,716	0,533	xxx	2,153	-0,030	-	2,748	0,565	xxx	2,450	Mt	-
C_2-N_{30} (NH_4NO_3 at sowing)	2,586	-	-	2,762	0,176	xxx	2,498	-0,088	o	2,776	0,190	xxx	2,660	0,210	xxx
C_3-N_{30} (NH_4NO_3 at flowering)	2,621	-	-	2,811	0,190	xxx	2,601	-0,020	-	2,828	0,207	xxx	2,715	0,265	xxx
C_4-N_{30} ($CO(NH_2)_2$ at flowering)	2,640	-	-	2,856	0,216	xxx	2,636	-0,004	-	2,887	0,247	xxx	2,755	0,305	xxx
C_5-N_{60} (NH_4NO_3 at sowing)	2,766	-	-	2,847	0,081	x	2,728	-0,038	-	2,828	0,062	-	2,792	0,342	xxx
C_6-N_{60} (30 kg NH_4NO_3 at sowing and 30 kg $CO(NH_2)_2$ at flowering)	2,801	-	-	2,870	0,069	-	2,790	-0,011	-	2,861	0,060	-	2,831	0,381	xxx
C_7-N_{60} (NH_4NO_3 at flowering)	2,790	-	-	2,876	0,086	x	2,762	-0,028	-	2,908	0,118	xx	2,834	0,384	xxx
C_8-N_{60} ($CO(NH_2)_2$ at flowering)	2,810	-	-	2,898	0,088	x	2,798	-0,012	-	2,931	0,121	xx	2,859	0,409	xxx
Average		2,650			2,830			2,621			2,846		2,737	-	-

Super-phosphate (A)	2,740	2,734
%	100	99,8
Dif (t/ha)	Mt	-0,006
Significance	-	-

Bacterial treatment (B)	2,636	2,838	DL	A	B	C	CxAxB	BxAxC	AxBxC
%	100	107,7	5%	0,010	0,017	0,039	0,077	0,078	0,076
D (t/ha)	Mt	0,203	1%	0,015	0,024	0,052	0,102	0,104	0,100
Significance	-	xxx	0,1%	0,024	0,035	0,067	0,131	0,134	0,130