STUDY OF THE EFFECT OF 'RENI' ON THE QUALITY AND PRODUCTIVITY OF GARDEN PEAS

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ABSTRACT

The effect of two substances with regulatory effect – RENI and RENI A on the quality and productivity of peas were studied. The experimental work was carried out in 2005-2006 on the territory of the town of Alexandroupolis, Greece. Wrinkled-seed garden peas of Vyatovo cultivar was an object of the study. The experiment was set by the plot method in four repetitions, the plot area being 6,4 m^2. The plants were grown by the technology adopted for pea production.

The experimental variants were the following: 1. Control; 2. Treated with RENI; 3. Treated with RENI A.

Pre-sowing treatment with nitrogen at the rate of 3,3 kg/da, applied as ammonium nitrate and with phosphorus (P_2O_5) at the rate of 5 kg/da, applied as triple superphosphate was carried out. Treatment with RENI substances was conducted at the stage of bud formation and at the beginning of flowering. The applied rate of 200 ml/da was determined in our previous studies.

It was found out that treatment with RENI had a positive effect on the dry matter accumulation and the carbohydrate exchange dynamics in peas of Vyatovo cultivar. Thus, the unfavourable environmental conditions could be compensated and a produce of better technological features and taste qualities could be obtained.

Treatment with RENI brought about the improvement of the biological value of the proteins by increasing the total amount of the essential amino acids and changing the ratio between essential and total amino acids in favour of the essential ones.

Treatment with RENI increased the molybdenum content in the pea grain and it is a prerequisite for replacing the pre-sowing treatment with molybdenum chemicals.

KEY WORDS: garden peas, carbohydrate exchange dynamics, amino acids, proteins, quality, yield, RENI.

РЕЗЮМЕ

Изпитани са нови средства (РЕНИ и РЕНИ А) върху някои качествени показатели, определящи биологичната стойност на зърното, неговите вкусови и технологични качества.

Установено е, че третирането с РЕНИ влияе благоприятно върху натрупването на сухо вещество и динамиката на въглехидратния обмен при грах сорт "Вятово". По този начин могат да се компенсират неблагоприятните фактори на околната среда и да се получи продукция с по-добри технологични и вкусови качества.

Третирането с РЕНИ подобрява биологичната стойност на белтъците – увеличава се общото количество на незаменимите аминокиселини и се променя съотношението на незаменими аминокиселини – общи аминокиселини в полза на незаменимите.

Третирането с РЕНИ увеличава съдържанието на молибден в зърното на граха и може да замени предпосевното им третиране с молибденови препарати.

Ключови думи: зелен грах, динамика на въглехидратния обмен, биологична стойност на белтъка, РЕНИ, нитрогеназа

INTRODUCTION

The effectiveness of the biological nitrogen fixation is directly related to the activity of the nitrogenated enzymatic complex and to the enzymes participating in the absorption of the ammonium cations produced. However, problems such as regulation with microelements, phytohormones, cofactors and other growth regulators, as well as of biosynthesis and the activity of those and other enzymes connected with nitrogen fixation in garden peas and their effect on the quality of grain concerning dry matter content, starch-sugar ratio, protein content and its biological value have not yet been studied thoroughly.

It is known that nitrogenase (EC 1.7.99.2) is a molybdenum-containing enzyme and the deficiency of molybdenum negatively affected its activity [6, 2]. The induction of the enzymatic activities of the nitrogenase was caused not only by the molybdenum but also by the cytokinins, humic acids, ascorbic acid, glucose, sucrose, etc. [1, 5]. On the other hand, the enzymatic activity related to the absorption of ammonia was influenced by magnesium and manganese cations and it was closely dependent on the nitrogenase activity [5].

Based on the above stated, it could be concluded that it is important for the pea production rate and agrotechnology, that reaching the optimal ripeness and quality could be regulated along with using different cultivars [8], also by applying growth regulators.

The RENI substances used in the present study are combinations of the microelements molybdenum, manganese, magnesium, at different ratios and compositions (from 0,1 % to 0,00015 % for the microelement), [10]. In RENI A there is an additional component cobalt used at the same concentrations. The effect is realized by increasing the activity of the major enzymatic systems related to nitrogen metabolism: nitrogenase (EC – 1.7.99.2), nitratereductase (EC – 1.6.6.2), glutaminesynthetase (EC – 6.3.1.2), asparagine synthetase (EC – 6.3.1.1), etc. They are suitable for leaf application and they have proven their efficiency for decreasing the nitrate content in vegetables and in other crops [10, 11], for increasing the antioxidant qualities of grapes, its quality and yield [7, 12], for increasing the yields and the protein content in vetch [4].

We intended to elaborate on those studies by using RENI and to further develop effective substances on the same basis (RENI A), with a view of improving the quality and productivity of garden peas.

AIM

The aim of the present study was to establish the possibilities of applying the new RENI substances for increasing the efficiency of the nitrogen exchange, obtaining higher yields and improving the quality of garden peas.

MATERIAL AND METHODS

The experimental work was carried out in 2005-2006 on the agricultural land of the city of Alexandroupolis, Greece. Wrinkled-seed garden peas of Vyatovo cultivar was the object of the study. The experiment was set by the plot method in four repetitions, the plot area being 6,4 m^2. The peas were sown manually in four rows (10/20/40/20/10) with an inter-row distance of 5 cm. The plants were grown following the adopted technology for pea production.

The experimental variants were as follows: 1. Control; 2. Treated with RENI; 3. Treated with RENI A.

Pre-sowing treatment with nitrogen at the rate of 3,3 kg/da, applied as ammonium nitrate and with phosphorus (P_2O_5) at the rate of 5 kg/da, applied as triple superphosphate, was carried out. Treatment with RENI and RENI A was carried out at the stage of bud formation and at the beginning of flowering. The applied rate of 200 ml/da was determined in our previous studies.

The following parameters of the garden pea grain were reported: absolute dry weight determined by the weight method, crude protein content – by Keldal, proteinogenic amino acids after hydrolysis with 6n HCl and aminoanalyzer A-200 Knauer type, starch content – polarmetrically, content of total sugars by the methods of Hagedorn-Jensen [3]. The element content in the pea grain was also determined by atomic emission spectrophotometer after dissolving the compounds with nitric and perchloric acids.

During the experimental period, the parameters had similar changes due to which the average data of the two-year period were presented.

RESULTS AND DISCUSSION

The degree of ripeness of the pea grains is determined most precisely by analyzing the dry matter content [8]. Standard canned foods from wrinkled-seed peas are produced when the dry matter content is within 21-25 % [9].

The variants of Vyatovo cultivar treated with RENI and RENI A had a lower dry matter content and a lower starch content compared to the control, which corresponded to the higher total sugar content (Table 1). It showed that RENI affected positively the carbohydrate exchange dynamics and the dry matter accumulation in peas, which extended the period for reaching technological ripeness.

Table 1. Dry matter content, carbohydrates (total sugars, starch and cellulose) and crude protein in garden pea grain, cv. Vyatovo, (% to absolute dry matter)

Variant	Dry matter (%)	Starch (%)	Cellulose (%)	Total sugars (%)	Crude protein (%)
Control	20,16	10,45	9,65	10,12	27,93
RENI	18,60	9,33	8,78	14,56	30,68
RENI A	19,90	9.22	8.85	10,87	24,25

Table 2. Contents of total and essential amino acids in garden pea grain, cv. Vyatovo, (% to absolute dry matter)

Amino acid	Control	RENI	RENI A
1.Lysine	1.61	1.78	1.62
2.Histidine	0,62	0,71	0.65
3.Arginine	2,76	3,35	2.78
4.Asparaginic acid	2,74	2,79	2.76
5.Threonine	1.20	1.49	1.19
6.Serine	1,31	1,31	1.36
7.Glutamic acid	4,09	4,35	4.09
8.Proline	1,07	1,17	1.00
9.Glycine	0,98	1,00	1.00
10.Alanine	1,43	1,75	1.48
11.Cysteine	0,15	0,16	0.15
12.Valine	1.03	1.14	1.05
13.Methionine	0.02	0.03	0.02
14.Isoleucine	0.80	1.03	0.83
15.Leucine	1.75	2.06	1.74
16.Tyrozine	0,65	0,68	0.66
17.Phenylalanine	1.05	1.19	1.00
TOTAL	23,26	25,99	23,39

Table 3. Contents of elements in garden pea grain, cv. Vyatovo, (mg/kg to absolute dry matter)

Variant	Ca	Mg	Fe	Cu	Zn	Mn	Mo
Control	1278	1392	55,8	9,87	46,0	11,8	1,30
RENI	1012	1279	55,0	13,30	39,4	11,0	3,92
RENI A	1010	1256	54,9	13,26	41,2	11,5	3,85

Table 4. Grain yield, kg/da

Variants	Average yield kg/da	% to control
Control	358.8	100.00
RENI	432.3	120.50
RENI A	429.9	119.82
LSD 5 %	*38.78*	
1 %	*58.72*	
0.1%	*94.33*	

It is considered that the grain of the wrinkled-seed pea cultivars has inferior taste and poorer technological characteristics when the starch-sugars ratio exceeded one. The studied samples showed significant differences between the treated pea plants and the control. In the control variant the starch-sugars ratio was 1:1, whereas in the variants treated with RENI the starch-sugars ratio was 1:1,5 in favour of the sugars. This parameter together with the dry matter content were the most significant in determining the technological quality of peas and the suitability for canning.

Peas belong to the leguminous plants rich in proteins and containing significant amounts of cellulose in comparison with the other vegetables. The cellulose is localized primarily in the pericarp. Treatment with RENI reduced the cellulose content, increasing the crude protein content by 2.5 % (Table 1).

Proteins in peas, which is a leguminous crop, have insufficient amounts of the sulfur containing amino acids – methionine and cystine. On the other hand, pea grain is quite rich in arginine, which has important functions in the human organism.

Our contribution to the scientific data consisted in finding out that treatment of peas with RENI increased the arginine content in the pea grain to the highest possible degree – by 36 % as compared to the rest of the proteinogenic amino acids.

The total amount of the 17 examined proteinogenic amino acids was increased by 11,7 % after treatment with the above mentioned substances, the content of the essential amino acids being increased by 16,9 % and that of the total amino acids by 9,3 %. The higher ratio of essential amino acids to the total ones gave the reason to conclude that, as a result of treating the pea plants with RENI, proteins of well balanced amino acid content and of higher biological value were obtained. Treatment with RENI led to changes in the share of the protein fractions expressed in increasing the share of albumin and globulin fractions, which were rich in essential amino acids. The hypothesis was confirmed by facts known in literature that the changes in the amount of the amino acids in the fraction itself was genetically controlled and it could be hardly changed, whereas the protein fraction ratio could be easily altered by external factors.

Treatments with RENI substances increased the molybdenum content in the pea grain thrice (Table 3). The increased endogenous molybdenum content in the pea grain enhanced germination, shooting and better initial growth habits of the sown seeds. Pre-sowing treatment of the leguminous seeds with molybdenum containing chemicals is a common practice.

Positive results were expected about the initial growth habits of the pea seeds treated with RENI and RENI A, thus eliminating the need of the molybdenum treatment.

Table 4 shows that RENI substances had a positive effect on the garden pea productivity. The effect of the applied treatment was measured by the yield increase, which was by 73,5 kg/da of grain (20,5 %) in average for RENI and by 71,1 kg/da (19,82 %) for RENI A, respectively. Those results were statistically significant at LSD – 1 %.

The analysis of those data led to the conclusion that the studied substances RENI and RENI A had positive effects on the productivity of garden peas, Vyatovo cultivar.

Taking into account the already mentioned advantages related to the favourable effect of those substances on the yield obtained, their influence on dry matter accumulation, the carbohydrate exchange dynamics and the quality of the amino acid content, the application of the two substances could be recommended in the production practice.

CONCLUSIONS

Treatment with RENI had a favourable effect on the accumulation of dry matter and the carbohydrate exchange dynamics in garden peas of Vyatovo cultivar.

Thus the unfavourable environmental factors could be compensated for and a produce of better technological and taste qualities could be obtained.

Treatment with RENI improved the biological value of the proteins – the total amount of the essential amino acids increased and the ratio between the essential and total amino acids changed in favour of the essential ones.

Treatment with RENI increased the molybdenum content in the pea grain and it could replace the pre-sowing treatment with molybdenum-containing chemicals.

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