RESEARCH REGARDING THE IMPROVEMENT OF THE TECHNOLOGY IN THE CULTURE OF THE ECOLOGICAL SPINACH GROWN IN THE SOLARIUMS

Cărbunar Mihai*, Vidican Iuliana Teodora*, Todea Viorel, Cărbunar Mihaela***

*University of Oradea, Faculty of EnvironmentalProtection, 26 Gen. Magheru St., 410048, Oradea, Romania, e-mail: carbunar@yahoo.com
**University of AgriculturalSciencesandVeterinary Medicine, 3-5 Manastur St., 400372 Cluj-Napoca, Romania,

Abstract

Organic farming aims to increase the quality and quantity of production, and minimize the negative effects of agriculture. Spinach, a vegetable whose leaves are edible, is rich in vitamins and mineral salts and highly appreciated by consumers. The present research aims to establish an optimum density, using more distances between rows. The ecological culture was established in the solarium, with variants and repetitions. The results showed that both increasing and decreasing the distance between rows led to a decrease in production. The quality of production has shown that an increase in density leads to a decrease in quality, and a decrease in density up to certain limits has the effect of a qualitative increase.

Key words: spinach, density, production

INTRODUCTION

Organic farming aims to harmonize the dynamic interactions between soil, plants, animals and humans or, in other words, between the ecological, economic and social supply of agro-ecosystems and human needs for food, clothing and housing. Being a type of sustainable agriculture (Toncea, 1999), the purpose of organic farming can be expressed through a mini - max type function: maximizing yields and minimizing the negative side effects of agricultural activities (Toncea, 1997, 1999).

As a rule, agricultural systems are constantly moving and changing, their evolution following a path whose final coordinates are different from the initial ones (Toncea and Alecu, 1999).

Spinach, a dioecious plant, very resistant to low temperatures, is cultivated for its leaves, eaten raw, but especially cooked in various forms. According to FAOSTAT (FAO) data from 2012-2013, China produces 91% (21 067 800 t) of world spinach production, followed by the US with 1% (336 200 t).

Spinach is known for its high iron content, it also has high levels of provitamin A, vitamin B9, vitamin K, vitamin C and antioxidant compounds, with health protection effects.

With 23 calories per 100 g of product, spinach is a low-calorie vegetable, but it is a good source of minerals and trace elements: it contains a lot of iron, magnesium, calcium, potassium, copper, zinc, iodine, selenium.

Contrary to a persistent legend, spinach is not the best source of dietary iron. The iron content of spinach was greatly overestimated in the 19th century. According to Aprifel com. (Agency for Fruit and Vegetable Research and Information) spinach contains 2.14 mg / 100g. Spinach iron is also much better absorbed by the body when accompanied by a source of vitamin (N. Lowry), for example with lemon juice. Spinach also contains a large amount of oxalic acid that inhibits iron uptake.

Spinach is rich in nitrates that turn into nitrites through bacteria in the mouth. These nitrites are involved in vasodilation and blood thinning, which improves blood flow to certain areas of the brain that, over time, are less perfused.

A daily dose of spinach can prevent dementia and cognitive decline by improving this cerebral blood flow (Tennille D. Presley et al.).

MATERIAL AND METHOD

In order to reach the proposed objectives, in the autumn of 2017 (November) a comparative competition culture was established, with six variants in three repetitions, in a micro-vegetable farm, certified ecologically. The location of the mono factorial experience was made in a solarium 50 m long, 10 m wide and 4.5 m high. The variation of the variants in the experience was done according to the method of the subdivided blocks. The statistical processing of the experimental data was done by analyzing the variance.

The biological material was represented by the spinach variety Géantd'hiver, a productive, cold-resistant variety (ecologically certified seed).

The experimental variants targeted different densities materialized by different distances between rows, the distance between plants in a row was the same (7 cm, made by thinning).

Experimental variants:

V1 Mt. - the distance between rows of 15 cm
V2- the distance between rows of 10 cm
V3- the distance between rows of 20 cm
V4- the distance between rows of 25 cm
V5- the distance between rows of 30 cm
V6- the distance between rows of 35 cm

RESULTS AND DISCUSSION

The technology applied in the experimental culture was the ecological technology of spinach culture. In spring 2018, three leaf crops were made. The analysis of the total spinach production is presented in table 1. Even if it is an ecological culture, it is observed that the total production approaches some variants of the solarium productions in the conventional culture. As mentioned the distance between rows in the control variant was 15cm, and at V2 an even higher density was tried, respectively 10cm. This variant was the only one that recorded a leaf production below the control production level. In relative production this meant 80.46% of the production of variant V1. The difference was provided statistically, negative distinctly significant. To this small production is also added the smaller size of the leaves which resulted in a lower yield at harvest.

The variant with the largest production of spinach leaves, was V4 at which the distance between the rows was 25 cm. Compared with the control, this variant registered a production increase of 77.09%, in absolute production meaning over 10 t / ha. The difference from the witness was statistically assured, very significant positive. The high production of leaves shows that in this variant the nutrition space was well balanced, each plant benefited from sufficient light, harvesting easily.

The next variant with high leaf production was V2.This version yielded 2.05 kg / m^2 in absolute production, more by 0.74 kg / m2 than the control variant. The difference was ensured statistically, positive very significant. The greater distance between the rows allowed the plants to develop bigger, heavier leaves, but at m^2 the production did not reach the production level from V4. In the case of V3, the production increase compared to V1 was 32.82%, this difference was statistically assured, very significant positive.

Table 1

Spinach production Husasău de Tinca 2018

Cr. no.	**Variant**	**Absolute production of spinach kg/m^2**	**Relative production of spinach %**	**± d kg/m^2**	**Signifi cance**
1	V1 Mt.	1,31	100,00	0,00	-
2	V2	1,03	80,46	-0,28	oo
3	V3	1,74	132,82	+0,43	xxx
4	V4	2,32	177,09	+1,01	xxx
5	V5	2,05	156,48	+0.74	xxx
6	V6	1,57	119,84	+0,26	xx

LSD 5%=0,15 LSD 1%=0,22 LSD 0,1%=0,31

The greater the distance between rows (35 cm) from the V6 variant, marked an increase in the production of leaves, but not as large as in the other variants. Thus, 1.56 kg / m^2 was harvested more by 0.26 kg / m^2 than in the case of the control. The difference was statistically assured, positive distinctly significant.

Table 2

The quality of spinach production Husasău de Tinca 2018

Nr crt.	Variant	Total production	Cal.extra from total		Cal.I from total		Cal. II from total	
			Kg/m^2	%	Kg/m^2	%	Kg/m^2	%
1	V1 Mt.	1,31	0,67	51,14	0,34	25,95	0,30	22,90
2	V2	1,03	0,48	46,60	0,23	22,33	0,32	31,06
3	V3	1,74	0,93	53,44	0,59	33,90	0,22	12,64
4	V4	2,32	1,68	72,41	0,47	20,25	0,17	7,32
5	V5	2,05	1,75	85,36	0,21	10,24	0,09	4,39
6	V6	1,57	1,12	71,33	0,23	14,64	0,22	14,01

An important parameter that was then analyzed was the quality of spinach leaves harvested from all variants and repetitions. Table 2 presents the quality of leaf production for each variant, divided into the three qualitative stages. The qualitative production was expressed both in kg / m2 and in% of total production for each variant and quality step. Regarding the extra quality, it can be seen that, except for the V2 variant, all the variants registered over 50% of the total production. The too small distance between the rows, so a higher density from the V2 variant, did not bring a higher quality, making only 46.60% of the total production. The highest production of extra quality was obtained by the V5 variant, where 85.36% of the total production, represented by the leaves of spinach of superior quality.

The production of spinach of the first quality, had values between 10.24% in the variant V5 and 33.90 in V3. Regarding the leaves of the second quality, it registered values between 4.39% in v5 and 31.06% in the V2 variant.

CONCLUSIONS

The researches regarding the establishment of an optimum density at the ecological culture of the spinach cultivated in the solariums, allowed to draw some conclusions.

1. The density of spinach plants, realized by the distance between rows and between plants in a row, influences both the production and the quality of the leaves.

2. The best distance between the rows is 25cm from the V4 variant, which has achieved a production of 2.32 kg / m2 and a production increase over the control of over 70%.

3. Several plants per unit area, respectively a distance between rows of 10 cm, from variant V2, do not generate a higher production. Only 1.3 kg / m2 was the amount of leaves harvested from this variant.

4. The decrease in density, that is to say 30cm and 35cm between the rows of the V5 and V6 variants, led to the decrease of the production, to 2.05 kg / m2 respectively 1.57 kg / m2 to V6.

5. The high density caused not only a small production but also a lower quality. This happened at V2, where the production of extra quality reached only 46.60 di total production.

6. With a percentage of 85.36% extra quality leaves, the V5 variant obtained the best quality among the analyzed variants.

REFERENCES

1. Apahidean Al. S., Apahidean M., 2001, Legumicultură specială. Ed. Academic Pres, Cluj-Napoca
2. Căzăceanu I., Georgescu, m., Zavoi A., 1982, Ameliorarea plantelor Horticole și tehnică experimentală. Ed. Didactică și Pedagogică, București.
3. Cantliffe D. J.,. Phantac S. C, 1974, Nitrate acumulation in greenhous evegetable crops.". Canadian Journal of Plant Science,vol.54, p. 783-788.
4. Ciofu Ruxandra și colab., 2004, Tratat de legumicultură, Ed. Ceres, București.
5. Choux CI., Foury CI., 1994, Productionslegumieres vol. I-III, Lavoisier, TEC/DOC, Paris.
6. Davidescu D., Davidescu V.,, 1992, Agrochimia Horticolă. Ed. academiei, București
7. Dumitrescu M. și colab., 1998, Producerea legumelor. Ed. Ceres, București.
8. Horgoş A., 1999, Legumicultură specială. Ed. Mirton, Timișoara.
9. Indrea D. și colab., 1983, Legumicultură. Ed. Didactică și Pedagogică, București.
10. Lăzureanu A. și colab.., 1998, Agrotehnică. Ed. Risoprint, Cluj –Napoca.
11. Maier I., 1969, Cultura legumelor. Ed. Agro-silvică, București.
12. Palageşiu I. și colab., 2000, Entomologie agricolă și horticolă. Ed. Mirton, Timișoara.
13. Popescu Gh., 2001, Patologia plantelor horticole. Ed. Eurobit, Timișoara.
14. Popescu V., 1996, Legumicultură. Vol.I. Ed. Ceres, București.
15. Popescu V., Horgoş A., 2003, Tratat de legumicultură. Ed. Ceres, București.
16. Renaud V., Duduet Ch., 1988, Le potager par lesmethodesnaturelles.
17. Stan T. N., Stan N. T., 1999, Legumicultură, Vol.I., Ed. Ion Ionescu de la Brad, Iași.

18. Voican V., 1972, Efectul intensității luminii asupra creșterii și dezvoltării asupra unor specii legumicole.
19. Anuarul F.A.O. – 2012, 2013
20. www.bio-romania.org
21. www.greenpeace.org
22. www.ecomagazin.ro/info/agricultura-ecologica-2/
23. https://kokopelli-semences.fr