ABSTRACT

Keywords: cultivar, density, mulching, planting distances

The research carried out in order to draw up the doctoral thesis entitled „**Research on the use of intensive methods in the rhubarb (*Rheum rhabarbarum* L.) crop**" was done between 2013-2016 within the vegetable growing experimental field and laboratory of the Faculty of Horticulture of Iași.

The goal of the doctoral thesis was to evaluate the possibility of intensive cultivation technology of rhubarb (Rheum rhabarbarum L.), using important intensive methods for the vegetable practice.

To achieve this goal, we have established the following major objectives:
1. The study of natural conditions comparative with plant requirements
2. Determining the best distances between plants for rhubarb crop
3. Study of the cultivar effect on total yield of rhubarb
4. Study of the planting distances effect on total yield of rhubarb
5. Study of the mulching effect on total yield of rhubarb
6. Study of factors combinations studied individual effect on total yield of rhubarb

In order to achieve the goal and the objectives proposed, two distinctive experiments have been carried out: one, of a monofactorial type and the second, of a trifactorial type. In the first experiment, the monofactorial type, four planting distances were studied using a rhubarb cultivar of Victoria variety. The four variants were:

V_1 – 0,75 x 1,00 m
V_2 – 1,00 x 1,00 m
V_3 – 1,25 x 1,00 m
V_4 – 1,50 x 1,00 m.

The second experiment, the trifactorial type (3A x 2B x 4C) was organized in a device of subdivided plots with 24 variants, in three repetitions. Factor A was represented by the cultivar, factor B - the planting distance, and factor C - the mulching method.

A factor – the cultivar (variety) had three graduations:

a_1 = Glaskin's perpetual;
a_2 = Local population;
a_3 = Victoria

B factor – the planting distance had two graduations:

$b_1 = 0,75$ x $1,00$ m;

$b_2 = 1,00$ x $1,00$ m.

C factor – the mulching type had four graduations:

$c_1 =$ straw;

$c_2 =$ black polyethylene film of 15 μ;

$c_3 =$ black polyethylene film of 30 μ;

$c_4 =$ unmulched.

The doctoral thesis includes a number of six chapters, being devided into two parts.

Part I - The current knowledge on the rhubarb crop. It includes two chapters:

- Chapter 1. The importance of rhubarb crop

- Chapter 2. Current status of research regarding technological factors cultivar, density and mulch at the rhubarb crop

Part II – Results of own research. This includes a number of four chapters:

- Chapter 3. The goal, objectives of the research. Material used and general work method

- Chapter 4. Research concerning influence of density factor at rhubarb crop

- Chapter 5. Research concerning influence of cultivar, density, mulch and theier combinations on rhubarb yield

- Chapter 6. General conclusions and recommendations

The bibliography includes a number of 153 specialty titles, both from our country and abrod.

The first part of the paper is made up of two chapters including general informations regarding the thesis topic's current stage. On drawing these chapters, documentary studies were conducted, using different sources: Vegetable growing textbooks, books and treaties, journals, scientific articles, doctoral thesis along with a number of recent web informations.

The first chapter of the thesis reveals the importance of the rhubarb crop, focusing on a range of issues such as: the feeding and therapeutic importance, the agrotechnical, social and economic importance, as well as the description of the cultivar assortment.

The second chapter is structured in three subchapters and contains general information, from specialized literature, regarding the current status of research on technological factors considered in the study: the cultivar, density and mulching.

The second part of the thesis includes four chapters, having a 70 % share, and represents the author's contribution regarding the research theme.

The third chapter deals with the goal and objectives of the thesis, the researches materials and methods, as well as the environmental, organizational and institutional conditions.

The used biological material represented by a Local population of rhubarb,

Glaskin's perpetual cultivar and Victoria variety.

General research methods used to achieve the proposed objective were *observation* and *experiment* (Jităreanu, 1999).

Experimental data were properly processed using statistical and mathematical methods recommended by experimental technique: statistical grouping, comparison, statistical calculation and some specific parameters (arithmetic mean, standard deviation, etc.). Yield data were processed by the algorithm for ANOVA (analysis of variance) using Fisher's exact test, Student's t test and the least significant differences (LSD) for three levels of confidence: LSD 5% (P = 95%), LSD 1% (P = 99 %) and LSD 0.1% (P = 99.9%).

The study of natural environment is presented in a separate section (subchapter 3.4.). From this subchapter results the following:

• The experimental field shows a relatively flat land, with a chernozem soil type, favorable for horticulture and vegetable crops.

• Precipitations regime shows that they are unevenly distributed during the year and during the growing season.

• It is appreciated that exist favorable natural conditions of framework, technical and organizational framework for performing the proposed researches in the doctoral thesis, but in some years (for example, 2015) the dryness is a major risk factor.

In **the fourth chapter**, the results of the author's own research are presented, in summary. Since the paper required the interpretation of a multitude of interdisciplinary data, their ordering was attempted, in order to facilitate the highlighting of generally valid influences on the four planting distances, so that afterwards, an analysis of the influence of technological factors for the best two densities was carried out. In this chapter we distinguish results regarding:

- the density of culture optimizing
- the influence of density factor on staggering of yield
- the influence of density factor on dynamic of yield
- the influence of density factor on amount yield

Regarding the experimental results concerning the staggering of the yield, the yields recorded at two weeks are ranging from 1.10 t/ha, for the variant with 1,50 x 1,00 m (V_4) planting distance, in the 1.06-15.06 period, to 17.30 t/ha, for the variant 0,75 x 1,00 m (V_1) planting distance, value registered in the 16.05-31.05 period.

The highest yields were registered in the 16.05-31.05 period, with a yield of 17.30 t/ha, for the 0,75 x 1,00 m (V_1) planting distance, 16.56 t/ha, for the 1,00 x 1,00 m (V_2) planting distance, 6.24 t/ha, for the 1,25 x 1,00 m (V_3) planting distance and 5.29 t/ha for the variant with 1,50 x 1,00 m (V_4) planting distance.

The lowest yields were registered in the 1.06-15.06 period, the yield resulted from the 1,50 x 1,00 m (V_4) planting distance being of 1.10 t/ha, followed by the 1,25 x 1,00 m (V_3) planting distance, with a total yield of 2.52 t/ha. In the case of the Victoria variety planting at 1,00 x 1,00 m (V_2) planting distance, the amount of yield in the 1.06-15.06

period was of 2.56 t/ha, while the variant with 0,75 x 1,00 m (V_1) planting distance registered a yield of 3.93 t/ha.

Regarding the experimental results on the dynamics of the yield, the average yield for the three years, registered at the last harvest (15.06), as well as the multiannual total yield, ranged from 17.53 t/ha, in the case of 1,50 x 1,00 m (V_4) planting distance, to 45.71 t/ha, for 0,75 x 1,00 m (V_1) planting distance, compared with the experimental average which was of 31.70 t/ha. For the 1,00 x 1,00 m (V_2) planting distance, the average yield accumulated over the three years was of 42.85 t/ha, while for the 1,25 x 1,00 m (V_3) planting distance there was achieved an average yield of 20.69 t/ha.

Regarding the experimental results concerning the quantity of the yield, the average yield over the three years ranged widely from 17.53 t/ha, in the case of the 1,50 x 1,00 m (V_4) planting distance, to 45.71 t/ha, for the 0,75 x 1,00 m (V_1) planting distance, compared with the experimental average of 31.70 t/ha.

The fifth chapter includes the results of the influence of the cultivar, density, mulching factors and their combinations on yield.

Regarding the influence of the cultivar factor, for the 2014-2016 experimental period, the total yield varied from 28.48 t/ha, in the case of Glaskin's perpetual variety, to 39.89 t/ha, for the Victoria cultivar, compared with the experimental average of 34.01 t/ha. Regarding the total yield of the Local population, it was of 33.70 t/ha. The Victoria cultivar obtained a significant yield rise of 4.85 t/ha, compared with the experimental average, while the Glaskin's perpetual variety performed a very significant negative difference (-6.53 t/ha), compared with the experimental average.

Regarding the influence of the density factor, for the 2014-2016 years, the total yield varied from 31.01 t/ha, for varieties with 10.000 plants/ha density, to 37.01 t/ha, in the case of 13.330 plants/ha density, compared to experimental average of 34.01 t/ha. The differences from the experimental average, show that the 0,75 x 1,00 m planting distance performed a significantly distinct production rise, of 3.00 t/ha, compared with the 1,00 x 1,00 m planting distance, which recorded significant distinctly negative differences, respectively of -3.00 t/ha.

Regarding the influence of the mulching factor, for the three years included in the study, the total yield ranged from 29.23 t/ha, in the case of mulching with black polyethylene film of 30 μ, to 39.76 t/ha, in the situation of straw mulching, compared with the experimental average of 34.01 t/ha. The unmulched variant, just like the mulched variant with black polyethylene film of 15 μ, have obtained an average yield of 37.62 t/ha, respectively of 29.44 t/ha. Regarding the influence of the type of the mulch on the total yield of rhubarb, for the three experimental years, two variants stand by positive yield results, very significant compared with the experimental average: the straw mulching, with a production rise of 4.75 compared with the experimental average, and the unmulched crop with a production rise of 2.61 t/ha compared with the experimental average.

In the case of cultivar x planting distances interplay, the highest average yield was

4

obtained by the Victoria x 0,75 x 1,00 m (a_3b_1) planting distance combination, with a total yield of 42.69 t/ha, compared with the experimental average of 34.01 t/ha. The combination between Glaskin's perpetual cultivar, planted at 0,75 x 1,00 m (a_2b_1), was ranked second, with a yield of 37.16 t/ha, with a significantly distinct production increase of 3.15 t/ha, compared with the experimental average, followed by the Victoria x 1,00 x 1,00 m planting distance (a_3b_2) combination, with a medium average of 37.03 t/ha, respectively an increase in production significantly distinct of 3.02 t/ha compared with the experimental average. The weakest variant, from the point of view of yield, was the Glaskin's perpetual with 1,00 x 1,00 m (a_1b_2) planting distance combination, which resulted in an average yield of 25.76 t/ha.

Regarding the influence of the combination between cultivar and mulching method, the average yield of rhubarb crop for the three years of study ranged between 20.24 t/ha, for mulching with black polyethylene film of 30 μ of Glaskin's perpetual (a_1c_3) cultivar, and 45.02 t/ha, registered by the Victoria variety, mulched with straw (a_3c_1), while the experimental average was of 34.01 t/ha.

Very significant positive differences compared with the experimental average were obtained in the case of the following combinations of factors: the Victoria cultivar, mulched with straw (a_3c_1), the unmulched Victoria (a_3c_4), Glaskin's perpetual, unmulched (a_2c_4) and Glaskins perpetual, mulched with straw (a_2c_1), with a production increases of 11.01 t/ha, 9.88 t/ha, 4.26 t/ha, respectively 4.21 t/ha, compared with the experimental average. We may remark four very significant differences compared with the experimental average, namely: Glaskin's perpetual cultivar, mulched with black polyethylene film of 30 μ (a_1c_3), Glaskin's perpetual, mulched with black polyethylene film of 15 μ (a_1c_2), Local population cultivar mulched with black polyethylene film of 15 μ (a_2c_2) and Glaskin's perpetual, unmulched (a_1c_4), with differences of -13.77 t/ha, -7.08 t/ha, -7.08 t/ha, respectively -3,32 t/ha compared with the experimental average.

Regarding the influence of the density x mulch combination, the total yield on rhubarb crop ranged from 24.94 t/ha, in the case of 1,00 x 1,00 m planting distance and mulching with black polyethylene film of 15 μ (b_2c_2), to 41.97 t/ha, for 0,75 x 1,00 m planting distance and mulching with straw (b_1c_1), compared with the experimental average of 34.01 t/ha. The best yields were obtained for the 0,75 x 1,00 m planting distance and mulching with straw (b_1c_1), respectively unmulching (b_1c_4), with an average yield of 41.97 t/ha, respectively 40.46 t/ha. The lowest yields were obtained in the case of 1,00 x 1,00 m planting distance and mulching with black polyethylene film of 15 μ (b_2c_2), respectively black polyethylene film of 30 μ (b_2c_3), with an experimental average of 24.94 t/ha, respectively 26.78 t/ha.

Regarding the influence of the cultivar x density x mulch combination, the total yields on rhubarb crop ranged from 19.67 t/ha, for the Glaskin's perpetual variety planted at 1,00 x 1,00 m distance and mulched with black polyethylene film of 30 μ ($a_1b_2c_3$), to 46.61 t/ha, in the case of the Victoria cultivar, planted at 0,75 x 1,00 m and mulched with straw ($a_3b_1c_1$), compared with the experimental average of 34.01 t/ha.

The 0,75 x 1,00 m planting distance, along with the Victoria variety and straw mulching, respectively the unmulched variant caused very significant yield increases of 12.60 t/ha, respectively of 11.14 t/ha compared with the experimental average, which was 34.01 t/ha, while the 1,00 x 1,00 m planting distance, along with the Local population and Glaskin's perpetual variety, mulched with black polyethylene film of 30 μ, caused a very significant negative difference of -14.34 t/ha, respectively -13.21 t/ha, compared with the experimental average.

The results confirm the achievement of the goal and objectives that have been set out, the results of the research carried out within the present doctoral thesis representing both a practical and theoretical contribution, regarding the use of intensive methods for the rhubarb crop (*Rheum rhabarbarum* L.). A large part of the results that were obtained along the years have been published in scientific papers indexed in international databases.