ABSTRACT

Keywords: setting up time, bean, intercropping, trellising system

In our country, the runner bean (*Phaseolus coccineus* L.) is a well known species, but only occupies small areas, being especially common in the rural population gardens, where is considered the same as the climbing garden bean (P. vulgaris L.) and confused with it. Although it found favorable conditions for cultivation, as demonstrated by the wide spread in all regions, the species did not establish itself in culture as one of economic importance, probably because of the lower economic efficiency, low attractiveness of the climbing forms of beans, which are less suitable for mechanization, the lack of improved assortment, yields that vary from one year to another, the lack of a well defined and/or modern cultivation technology etc. The crop is profitable if an appropriate technology is used, in close correlation with the biological and, especially, environmental features (Popa, 2010).

Through the study of literature and through the acquired experience in our country, the secret of this crop is ensuring cultivation conditions which meet the requirements of the plant, that prefers a cool and humid climate, but higher threshold of 10-12^{0}C temperature. This is confirmed by the results of this species culture in England, the Netherlands, China, Spain, which are cultivating runner bean under conditions that satisfy the requirements of the plant and achieve extremely high yields, both as pods (60-80 t/ha) and as dry grains (4-5 t / ha). In these circumstances, we might question if it can become competitive and what are the ways and means of achieving this competitiveness.

In conclusion, the technological factors complexity and their contribution on the quality and the quantity of runner bean yield, as well as the ecological diversity from the areas of culture, reveal the great importance of an adequate technology and also the need of its permanent improvement, through scientific research activities.

In these circumstances, *the goal* of the thesis is to optimize some technological sequences in order to develop an adequate technology for runner bean cultivation (*Phaseolus coccineus* L.) under the NE of Romania conditions.

The thesis is structured in two parts and eight chapters.

Part I – The current knowledge includes two chapters:

- Chapter I – Studies on the biological and ecological features of runner bean (*Phaseolus coccineus* L.)

- Chapter II – Knowledge about runner bean (*Phaseolus coccineus L.*) cultivation technology

Part II – Results of own research, includes five chapters:

- Chapter III – Goal, objectives, biological material and general research methodology

- Chapter IV – Study of the natural, organizational and institutional environment where researches were made

- Chapter V – Results regarding experimental factors influence on plants' growth and development and on yield

- Chapter VI – Results regarding influence of the technological variants on photosynthetic pigments content and biochemical components

- Chapter VII – Economic efficiency assessment of studied technological variants

- Chapter VIII – General conclusions and recommendations

The bibliography includes a number of 242 bibliographic references, both from Romania and abroad.

The first part of the thesis consists of two chapters and contains general information, from the specialized literature on the current state of knowledge on runner bean.

The first chapter is structured in four subchapters which present morphological, physiological, ecological and allelopathic features of runner bean.

The second chapter is divided into two subchapters and presents the knowledge of the runner bean cultivation technology, namely, the main technological cultivation links of this species and the technological alternatives where it can be cultivated, respectively, the pure crop system and intercropping system.

The second part of the thesis consists of six chapters and represents my own contribution, based on the research activity.

Chapter III presents the goal, objectives, biological material and general research methodology.

The goal of the thesis is to optimize some technological sequences in order to develop an adequate technology for runner bean cultivation (*Phaseolus coccineus* L.) under the NE of Romania conditions.

To achieve this purpose, the following general objectives were established:

1. Study of the experimental years meteorological conditions effect on crop and yield.

2. Study of setting up time effect on crop and yield.

3. Establishment of some schemes and densities in pure culture system.

4. Establishment of some association schemes in intercropping system.

5. Study of the cultivation systems technological factors effect on photosynthetic pigments.

6. Determination of the influence of the cultivation systems technological factors on biochemical components of yield.

7. Economic efficiency assessment of studied technological variants.

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

Experimental factors and their graduations were:

- Factor A – *the setting up time*, with three graduations: a_1 = 1.05; a_2 = 15.05; a_3 = 30.05.

- Factor B – *the trellising system*, with two graduations: b_1 = pure culture system; b_2 = intercropping.

- Factor C – *schemes and densities* (within the two cultivation systems), with six graduations: c_1 = pure culture, palis on trellis, with individual string, with double rows, having a density of 7,14 plants/m^2; c_2 = pure culture, palis on trellis, with individual string, with a single row, having a density of 5,0 plants/m^2; c_3 = pure culture, palis on trellis, with synthetic net with a single row, having a density of 5,0 plants/m^2; c_4 = intercropping with common maize, on a single row, with a density of 5,0 runner bean plants/m^2; c_5 = intercropping with sunflower, on a single row, with a density of 5,0 runner bean plants/m^2; c_6 = intercropping with Jerusalem artichoke, on a single row, with a density of 5,0 runner bean plants/m^2.

In all variants, the runner bean crop was established by sowing directly into the nests of two plants. Experimental factors location, as well as their graduations, was carried out in device plots.

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%).

Chapter IV contains four subchapters and presents the study of the natural, organizational and institutional environment where research was made.

Research was carried out in the "Vasile Adamachi" farm of U.A.S.V.M., farm which disposes, both territorially and administratively, of all necessary amenities to achieve the objectives proposed in the thesis.

Chapter V presents results regarding experimental factors influence on plants growth and development and on yield.

Regarding the phenological characterization, the period from sowing to emergence was about seven to ten days, the period from emergence to appearance of the first real trifoliate leaves was around six to seven days, the period from emergence to the first flowers was about 32 -35 days, the period from emergence to the first pod was about 67-70 days, the period from emergence to seed maturation was around 115-120 days and the period from emergence to the end of the vegetation period was around 130-137 days.

The number of pods per plant ranged from 6-17, with an average of 13 pods/plant. The lowest number of pods/plant was recorded for variant c_6 (6), and the highest number in variant c_3 (17).

The pods size ranged, in length, from 13.5 to 14 cm with an average of 13.7 cm. The greatest length (14 cm) was recorded in the variant c_1. The largest width was recorded at c_3 variant (1.8 cm), with an average of 1.6 cm.

The number of seeds in pods had an average value of 2-4, the lowest number of seeds in pods being recorded in the variant c_6 (2-3).

The runner bean grain size, measured by the length of the longest axis, ranged between 22 and 23 mm, with an average of 23 mm. The seeds width ranged from 13 to 14 mm, with an average of 14 mm.

The weight of 1000 grains (MMB) varied between 976.63 and 1238.33 g. The highest value was obtained for variant c_3, and the lowest in variant c_6. The experimental mean had a value of 1072.5 g. Changes in runner bean seeds weight is due, mainly, to variable genetic potential for this character.

Regarding the influence of setting up time on the runner bean yield (dry grain), in 2013, the largest amount of yield was obtained in 15.05 setting up time (2912 kg/ha) and the lowest in 01.05 setting up time (2162 kg/ha); in 2014, the largest amount of yield was obtained in 15.05 setting up time (3119 kg/ha) and the lowest in 01.05 setting up time (2591 kg/ha); in 2015, the largest amount of yield was obtained in 15.05 setting up time (3058 kg/ha) and the lowest in 01.05 setting up time (1993 kg/ha).

Regarding the influence of the trellising system on the runner bean yield (dry grain), in 2013, the largest yield was carried out under the system of pure crop (3080 kg/ha) compared to the intercropping system (1949 kg/ha); in 2014, also, the highest yield was achieved in pure culture system (3281 kg/ha), unlike intercropping system (2420 kg/ha); in 2015, the yield in the pure culture system (2891 kg/ha) was higher than that obtained in inercropping system (2104 kg/ha).

Regarding the influence of schemes and densities on the runner bean yield (dry grain), in 2013, the largest yield was obtained by variant c_3 (3325 kg/ha) and the lowest yield by variant c_6 (789 kg/ha); in 2014, the highest yield was achieved in the variant c_2 (3610 kg/ha) and lowest in the variant c_6 (1684 kg/ha); in 2015, the highest yield was obtained by variant c_2 (3170 kg/ha) and the lowest yield by variant c_6 (1189 kg/ha).

Regarding the yield results obtained from the interaction of experimental factors, the largest yield was obtained in 15.05.2014 setting up time (3119 kg/ha) and the lowest in 1.05.2015 setting up time (1993 kg/ha); on the system trellising, the greatest amount of crop was obtained in pure culture in the year 2014 (3281 kg/ha) and the lowest in intercropping system, in 2013 (1949 kg/ha); also, the greatest amount of crop was obtained by variant c_2 (3610 kg/ha) in 2014, and the lowest, the variant c_6 (789 kg/ha) in 2013.

As a general conclusion, the setting up time in which the best results were obtained was 15.05, the trellising system in which the largest quantity of yield was obtained was the pure culture system and the scheme and the density where the best results of yield were obtained was

c_2 respectively pure culture, palis on trellis, with individual string, with a single row, having a density of 5,0 plants/m^2.

Chapter VI refers to the research results on the influence of the technological variants on photosynthetic pigments content and biochemical components.

The obtained results regarding the photosynthetic pigments show that, in the case of intercropping system, the plants have a higher chlorophyll concentrations than those grown in pure culture system. In this case, the shading contributes to increasing the concentration of chlorophyll in the leaves, as a result of starting of an adjustment mechanism of plants to low light intensity.

The grain yield decrease under the influence of shading can be explained by the lack of storage organs, respectively, by the reducing number of pods/plant and not by the photosynthetic activity.

The results on the chemical composition of runner bean dried grains showed that this was not obviously influenced by studied technological alternatives.

The dry matter ranged, as a percentage of fresh substance, from 88.04 (c_6) to 88.90 (c_5), with a mean of 88,73%; crude ash, as a percentage of dry matter, ranged from 4.82 (c_3) to 5.47 % (c_6), with a mean of 5,04%; organic substances ranged from 93.82 (c_6) to 95.56 (c_4), with a mean of 94,98%; crude protein ranged from 22.65 % (c_6) to 25.47 %(c_3), with a mean of 23.66 %; crude fat ranged from 1.91 % (c_6) to 2,16 % (c_4), with a mean of 2.05%; crude fibre ranged from 5.41 (c_4) to 5.81 (c_5), with a mean of 5.66 %; non - nitrogenous extractive substances ranged from 62.11 % (c_3) to 64.92 % (c_4), with a mean of 63.62%.

Chapter VII refers to the economic efficiency assessment of studied technological variants.

Comparing the six experimental variants, the highest cost of production is for variant c_1 (8611.4 lei) and the lowest for variant c_5 (4083.6 lei); in the same time, the highest rate of return has been performed in the variant c_5 (144.9%), and the lowest in the variant c_6 (6.7%).

In the last chapter, namely **Chapter VIII**, the general conclusions of the thesis are presented, which shows that the established objectives have been entirely met. Thus, technical solutions have been detached, according to which the factors that have been taken into account can be optimized.

The recommendations are clearly drawn, according to the best experimental variants the results revealed.

Thus, after the achieved research, we can say that the runner bean is a species that deserves more interest from growers and also for researchers.