

SWOT ANALYSIS OF RUNNER BEAN (*Phaseolus coccineus* L.) CULTIVATION IN INTERCROPPING SYSTEM

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Abstract

This paper presents the SWOT analysis of a runner bean crop (*Phaseolus coccineus* L.) in intercropping system, using maize, sunflower and Jerusalem artichokes as associated plants, in the conditions of North-Eastern Romania. Runner bean can be cultivated in several crop systems, associated or interleaved, depending on the area, traditions, technical possibilities etc. Runner bean cultivation interspersed with maize is traditionally the best known, but it may be successfully done with sunflower or Jerusalem artichoke, whose stem is also the support system for the runner bean plants. The SWOT analysis shows, as a main advantage, the fact that runner bean is a species with a high level of rusticity and a higher ecological plasticity than the common bean (*Phaseolus vulgaris* L.), due to higher resistance or tolerance to pathogens. Grown in intercropping system, it benefits from an improved microclimate, close to environmental requirements. A weak point is the competition for the elements that are necessary for the growth and development of plants, which interleaving is performed with. As an opportunity, runner bean cultivation in intercropping system can increase quality and quantity of production. Among threats, the adverse weather conditions which may compromise the crop are highlighted. In conclusion, intercropping system can be adopted with good results for runner bean cultivation in the conditions of North-Eastern Romania.

Key words: intercalated crops, strengths, opportunities, threats, weaknesses

Originally from South America, the runner bean species (*Phaseolus coccineus* L.) is very less known and researched in Romania. The previous studies (Hamburdă S.B. et al, 2014; Munteanu N., 2006, Munteanu N. et al, 2007a, b; Munteanu N. et al, 2013; Popa L.D. et al, 2006, Popa L.D., 2010) revealed the great diversity of existing populations in the collection of the University of Agricultural Sciences and Veterinary Medicine Iași (UASVM). However, the species has not been imposed in culture as a species of economic importance, probably due to reduced attractiveness for the climbing form, less suitable for mechanization, yields that vary from year to year, lack of modern and/or standardized cultivation technologies.

One of the most popular systems in our country is that in which runner bean is (like the climbing common bean - *Phaseolus vulgaris* L. var. *communis*) grown in maize, in nests, supported on individual poles or on maize plants (Hamburdă et al., 2013).

Following the intercalation system (intercropping) with maize, without prop, the idea was generated to perform other intercropping systems, in which this is done with other crops such as sunflower (*Helianthus annuus* L.) and

Jerusalem artichoke or earth apple (*Helianthus tuberosus* L.).

A first idea of achieving runner bean intercropping system with maize, sunflower and Jerusalem artichoke has been implemented at the UASVM Iași in 2012-2013 (Hamburdă S.B. et al, 2013).

Intercropping can be viewed as a practice to increase crop production, as is the culture of runner bean. Intercropping is influenced by a number of agrotechnical practices, which is the secret of success of this cultivation system: plant density, date of crops establishment, available resources and spatial arrangement (Mazaheri D. et al, 2006).

The purpose of this paper is to present a SWOT analysis on a runner bean crop in intercropping system using maize, sunflowers and Jerusalem artichoke as interleaved plants, given the North-Eastern Romania conditions.

Cultivation of this species, by vobule growing assortments, known exclusively in Romania, is conditioned, among other things, by finding a support system which is cheap, easy to perform and which improves environmental conditions by the arranging of plants in the crop. Searching solutions to this problem, different

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cultivation systems have been generated, under more or less elaborated conditions, depending on the area, traditions, technical feasibility etc.

SWOT analysis (S - Strengths, W - Weaknesses, O - Opportunities, T - Threats) was used, which is a tool for formulating selection and strategy. The method is used for business, usually. Any successful business is based on the strengths, correcting the weaknesses, exploiting the opportunities and taking measures against external threats.

SWOT analysis, as a transdisciplinary method, is less known in the vegetable growing research area, regarding cultivation technologies. For the present study, we believe that this method is a scientific way that highlights the factors that may decrease the production and through which production can be increased, both quantitatively and qualitatively, in terms of economic efficiency.

MATERIAL AND METHOD

In accordance with the purpose and objectives of the research, the experiment was placed in the experimental field of vegetable growing department within the "V. Adamachi" farm of UASVM Iași, in 2013-2014.

The biological material used to establish the experience consisted of runner bean seeds, maize seeds, sunflower seeds and tubers of Jerusalem artichoke.

Plant cultivation was conducted in accordance with the emerging technology rules of consulted literature (Axinte *et al.*, 2006, Popa, 2010, Ruști, 2007, Stan *et al.*, 2003). The culture was established on well leveled ground; the soil is cambic chernozem, well-stocked in nutrients, with an organic matter content of 3.2-3.4% and a pH of 6.5-6.8. Care works were those recommended by the specialized literature (Axinte *et al.*, 2006, Stan *et al.*, 2003).

The experimental device was made of randomized blocks with three repetitions. Four different variants of plant interleaving were used (figure 1). Row spacing was one meter and the distance between plants in the row was 25 cm for V₁, V₂ and V₃ variants and 40 cm for the V₄ variant (figure 2, figure 3, figure 4).

Variant			
V ₁	V ₂	V ₃	V ₄
1:1	1:2	1:3	2:1
■	■	■	⊗
⊗	■	■	■
■	⊗	■	⊗
⊗	■	⊗	■
■	■	■	■
⊗	⊗	■	⊗
■	■	■	⊗
⊗	■	⊗	■
⊗ - runner bean plant			
■ - interleaved plant			

Figure 1. The arrangement of the plants in the field

In the case of runner bean intercalation with sunflower, the leaves were removed from the sunflower stems as it grew, leaving two to three leaves around the capitula, to maintain vegetation. The purpose of this operation was to not shadow the runner bean plants too much (fig. 4).



Figure 2. Runner bean – intercropping with maize (original photo)



Figure 3. Runner bean - intercropping with Jerusalem artichoke (original photo)



Figure 4. Runner bean – intercropping with sunflower (original photo)

In the present experiment, biometric observations and measurements were conducted, showing the state of the vegetation, plant phenology and production results. Amid these observations and determinations, strengths, weaknesses, opportunities and threats of growing runner bean in intercropping system were analyzed.

To perform SWOT analysis, eight steps were followed, namely: goal setting; documentation regarding the current situation of runner bean cultivated in intercropping system; enumeration of strengths; enumeration of weaknesses; enumeration of the potential opportunities; enumeration of the potential threats; setting priorities; developing a strategy to address the problems in the SWOT analysis.

RESULTS AND DISCUSSION

Objective – SWOT analysis efficiency resulting from opportunities to learn how and where it can make a runner bean crop in intercropping system, under the conditions of the North-Eastern Romania, economically efficient.

Analysis of the current situation of intercropping highlights the fact that, in this area, there are no registered researches on this issue, runner beans being a species which is understudied. Different cases are known, with no systematic evidence, especially without records of achievements in crops and yields.

Strengths

Runner bean is a species with a high level of rusticity and ecological plasticity, higher than common bean (*Phaseolus vulgaris* L.), due to higher resistance or tolerance to pathogens. Being a cool and humid climate species, cultivated in intercropping system, it benefits from a microclimate formed by the arrangement of plants near optimal environmental requirements.

At the same time, the intercropping system reduces the number of damaging insect populations and, due to the diversity of plants, a large number of useful insects is drawn; reduces crops diseases; reduces the number of weeds through allelopathy or competition; increases or maintains organic matter content; more efficient use of farm land; diversified cropping patterns in a single season; improves the microclimate in agricultural ecosystem etc.

Given the high cost of support systems for runner beans, the stems of associated plants are favorable means for crop growth and development.

Residues from cropping plants are extremely valuable as a silo, both qualitatively and quantitatively. Growing runner beans at the same time with interleaved plants in intercropping system enables the collection and use of their

mixture directly to the feed (legumes compensate protein, while cereals provide carbohydrates), or may be collected separately for individual use.

Growing runner bean in intercropping system can increase the quality and quantity of production. If one of the crops would be compromised, the other could provide income. Among the considered options, the most effective, in terms of quality and quantity, were variant V₄, followed by variants V₁, V₂ and V₃.

Weaknesses

A weak point is the competition for items necessary for interspersed plant growth and development. This can be corrected by enriching soil nutrients, especially during critical growing stages.

The greatest obstacle to the adoption of an interleaved system is conceptualization of growing crops, the method of fertilization, the method of combating pests and diseases and, in particular, the collection method.

Another flaw is the inadequate density of the plants. Given the vastness of cultures and different possible combinations of climate and soil conditions, it is possible to generalize the recommendations in this direction. It is recommended to take into account five different aspects to achieve a successful intercropping: (1) detailed planning; (2) seeding at the optimal age of each culture; (3) adequate fertilization in the optimal period; (4) effective control of weeds and pests and (5) a harvest without losses.

From the conducted research, for the V₂ and V₃ variants, runner bean crop has not developed properly due to the insufficient light factor. This can be remedied by increasing the distance between plants in the row. Among the analyzed variants, the lowest results were obtained for the V₃ variant, followed by V₂.

Opportunities

As an opportunity, runner beans can be grown as an ornamental plant, in addition to its great food value. Lately, there is a particular focus on achieving a healthy and decorative garden at the same time. Also, there are efforts in achieving mixed gardens, in which vegetables and flowers associate harmoniously, taking into account the allelopathy relations.

Threats

Adverse weather conditions can compromise the culture. This is a real threat because cosmic factors can not be controlled. Also, another risk of ruining cultures is the improper association of species, without taking into account the allelopathy relations.

CONCLUSIONS

Intercropping success depends on thorough planning and thorough knowledge of the botanical, ecological and technological particularities of the associated species, especially habitus, root morphology, requirements for water and nutrients.

Following the research, it results that intercropping system can be successfully adopted for runner bean cultivation in the conditions of North-Eastern Romania, but more laborious researches are necessary.

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