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RESEARCH REGARDING ASPECTS OF MORPHOLOGY, PHYSIOLOGY, PRODUCTION AND ECONOMIC EFFICIENCY FOR SOME PULSES (PEAS, BEANS, SOYBEANS, CHICKPEAS) IN THE PEDO-CLIMATIC CONDITIONS OF CÂMPIA CRIŞURILOR – ARAD

[1*]Ovidiu Costică Ungureanu, [2]Elena Ungureanu, [1]Iulian Stana, [3,5]Viviane Beatrice Bota, [4]Florin Marinescu, [1,5]Violeta Turcuş.

[1] Universitatea de Vest „V. Goldiş" din Arad;
[2]Universitatea de Ştiinţe Agricole şi Medicină Veterinară ,,Ion Ionescu de la Brad" din Iaşi;
[3]Asociația Terra Nobillis Arad
[4]Stațiunea de Cercetare-Dezvoltare pentru Creșterea Bovinelor din Arad.
[5] Academia Română, Institutul Naţional de Cercetări Economice „Costin C. Kiriţescu", Centrul de Economie Montană CE-MONT

ABSTRACT: This study presents some morphological, physiological, production and economical efficiency aspects for 4 species of pulses (peas, beans, chickpeas and soybeans) in the pedo-climatic conditions of Câmpia Crişurilor, Arad county, with the purpose of expanding these crops, giving that pulses represent an essential source of proteins. A bifactorial experiment was run with 4 species of pulses in normal and irrigated conditions, 5 times. The experimental variants are: V1 – Nicoleta type peas – unirrigated; V2 – Nicoleta type peas - irrigated; V3 – Avans type beans - unirrigated; V4 – Avans type beans - irrigated; V5 – Rodin type chickpeas - unirrigated; V6 – Rodin type chickpeas – irrigated; V7 – Daciana type soybeans– unirrigated; V8 – Daciana type soybeans – irrigated. The plant`s size, weight of 1000 beans, seed production, proteins and fats, as well as the percentage content of proteins and fats from the beans were evaluated. The recorded data shows that Câmpia Crişurilor area is suitable for growing pulses (peas, beans, chickpeas and soybeans) in optimum conditions.

Keywords: peas, beans, soybeans, soybeans, chickpeas, economic efficiency

INTRODUCTION:

The importance of pulses stands in the beans high content of proteins, which gives them a high nutritional value. The proteic content of pulses exceeds by 2 – 4 times that of cereals. The ratio between crude protein and nonproteic compounds is: 1/1,7 for soybeans; 1/2,8 for peas; etc. (Muntean L.S. and colab., 2001).

Pulses represent both food and feed packed with proteins. To be noted also the high protein value of some beans, equivalent to that of animal origin, containing essential amino acids. The proteins from pulses have a high digestibility rate (around 90%) and doesn`t form uric acids (like some animal proteins), of which accumulation in the body can be harmful. The nutritional value for pulses like peas, beans, chickpeas and soybeans is given by the content in carbohydrates, vitamins, minerals and other nutrients which, alongside other proteins and fats, completes the value of these crops.

Stand alone or in a mixture, fresh or dry, pulses can be successfully used for animal feeding. Harvested early and leaving the soil rich in nutrients, the peas, beans, chickpeas and soybeans make one of the most valuable precursor plants for crop rotation (David. Ghe. and colab., 2011).

Soybeans (*Glycine hispida* max.) make up the primary source for cheap, valuable proteins and quality oil, for which the demands constantly rise. Its value and universal use is due to the high content of essential amino acids, comparable to those of animal origins.

The protein content in soybeans is 2 - 3 times larger than in cereals, and 1,5 - 2 times larger than in meat, fish and eggs. A significant mention is that the fat content in soybeans can be from 17 up to 25%. The oil extracted from its beans has great nutritional value, is semi-siccative, and places first in the world production of edible oils. The groats left from the oil extraction make a valuable feed in the preparation of feed concentrates. Soybeans contain various macroelements (phosphorus, calcium, magnesium, potassium, sulfur etc.), microelements (iron, copper, aluminum, nickel, iodine etc.) and vitamins (A1, B1, B2, D, E, C, and K), of great importance for the body. Soybean cultivation has an ecologic impact due to its contribution to soil fertilization, structural composition and, as a result, to a reduction in the use of chemical fertilizers that pollute the environment. After a soybean culture, the soil accumulates 80 – 100 kg organic nitrogen on account of symbiotic bacteria that form on the roots and collect the nitrogen from the atmosphere.

Given the high quality of the beans and pods in their technical condition, beans (*Phaseolus vulgaris* L.) are also highly demanded in alimentation. Bean selection is directed towards the creation of field varieties and garden varieties. The value of beans is determined by the increased protein content – 23-25%, starch- 48-55%, and fats – 2.0%. The protein is rich in essential amino acids and great for human diet. It contains up to 3 times more lysine than cereals. Field beans are cultivated for their seeds, and garden beans

Correspondence: Ungureanu Ovidiu Costica, Vasile Goldis Western University, Faculty of Medicine, Biology Departament, Str. Liviu Rebreanu, No 91-93, Arad, Romania, E-mail: ovidiu.c.ungureanu@gmail.com

are intended for green beans production and their use for human diet and preservation.

Peas (*Pisum sativum* L.) are an ancient crop with extensive ecological and production potential, cultivated for their seeds in the majority of countries around the globe. Peas seeds are used as food, in the processing industry and as feed. Seeds value reside in the high content of proteins – 27,8%, starch – 43,2% and fats – 1,2%, cherished for their biochemical content (Muntean L.S. and colab., 2001).

Chickpeas (*Cicer arientinum* L.), along with other legumes and cereals, have brought an essential contribution, vital and economical, in the formation of humankind and civilizations, being cultivated from ancient times for medicinal purposes. It is wide spread in Asia, India and Mediterranean area agriculture due to its increased adaptability, stable harvest, severe drought and high temperatures resistance, disease and pest tolerance; It doesn't fall off during maturation and can be harvested mechanically (Ungureanu O. and colab., 2012).

With all the challenges presented and considering the worldwide protein demands, the areas cultivated with pulses are far too reduced.

Globally, pulses were cultivated on around 170 millions ha. In 2005, worldwide, the areas cultivated with the primary pulses were: : 91,3 millions ha with soybeans; 26,7 millions ha with beans; 25,2 millions ha with peanuts; 6,5 millions ha with peas; 11,2 millions ha with chickpeas: 4,0 millions ha with lentils etc (FAO, 2005).

In our country, the areas cultivated with pulses were of 596,8 thousands ha in 1985, of 98,8 thousands ha in 2001 and of 262 thousands ha in 2005.

The primary pulses: peas, beans, soybeans, chickpeas, plants for which productive varieties are created, and meet favorable conditions in our country, still require to be extended in crop cultures, helping, as a result and to a large extent, to ensure the protein requirement, and oil in the case of soybeans.

MATERIALS AND METHODS:

For our experiments, the following materials were used:

– alluvial soil with the following characteristics: pH = 7 – 7,5; Humus = 3,1 – 3,9%; Argil = 33 – 35%; Groundwater depth = 50 – 60 cm; mobile phosphorus = 13,44 mg/100g soil; total Nitrogen = 0,16 – 0,18 mg/100g soil;

– plots with 20 m^2 surface, L = 10m, W = 2m, protection space with a width of 3m, 2m space between repetitions, 0,5m rows between variants;

– *Pisum sativum* L. seeds, of Nicoleta type peas, created at I.N.C.D.A. Fundulea;

– *Phaseolus vulgaris* L. seeds, of Avans type beans, created at I.C.C.P.T. Fundulea;

– *Cicer arietinum* L. seeds, of Rodin type chickpeas, created at S.C.D.A. Teleorman;

– *Glycine hispida max* L. seeds, of Daciana type soybeans, created at I.C.C.P.T. Fundulea;

Soil works consisted of:

– autumn plowing at 25 cm depth, smoothened and kept free of weeds up until winter;

– disking with a harrow in springtime and preparing the germination layer with a combine harvester at 4 – 5 cm depth;

– sowing during spring, at 4 – 5 cm depth, and seeding season was depending on minimum germination temperature for each species;

– during the vegetation periods, the plots were kept clean of weeds by specific care works.

Two waterings were applied, with 200m^3/ha/watering; first watering during the appearance of the first flowers, and second during the appearance of the first bean pods.

Fertilization was made during the preparation of the germination layer with NPK complex fertilizer: N = 50 kg/ha, P = 45 kg/ha, and K = 40 kg/ha.

A bifactorial experiment was made with 4 species of pulses, in normal and irrigated conditions, in 5 rounds. The following experimental variants were used (pulses species with and without irrigation): V1 – Nicoleta type peas – unirrigated; V2 – Nicoleta type peas - irrigated; V3 – Avans type beans - unirrigated; V4 – Avans type beans - irrigated; V5 – Rodin type chickpeas - unirrigated; V6 – Rodin type chickpeas – irrigated; V7 – Daciana type soybeans– unirrigated; V8 – Daciana type soybeans – irrigated.

RESULTS AND DISCUTIONS:

Climatic conditions in Arad 2017

The temperature conditions, rainfalls, nebulosity and relative humidity didn't register big differences compared to the multiannual media. The temperatures from April-May-June, slightly higher than usual, correlated with the lack of rainfall in March and 3rd ten-days period of May and June, have affected the crops that are sensible to these climatic factors. During the period in which the beans fill up, a lack of humidity was recorded but also a rise in temperature, which led to a drop in water and thermal comfort with implications in the plants growth and development for the unirrigated variants of peas, beans and soybeans (Figure 1).

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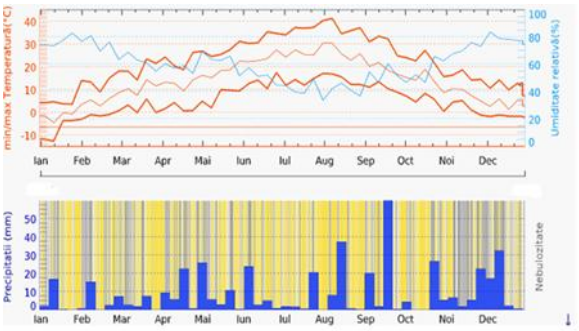

Fig. 1. Average value of temperatures and rainfalls, January-December, 2017, Arad
Source: https://www.meteoblue.com- Arhiva meteo Arad, istis.ro/image/data/download/catalog-oficial/CATALOG_2016.pdf.

Applying a cultivation technology recommended by specialists for each species of pulses has highlighted the growth in normal conditions for the 4 types of plants taken into study. Plant sizes remained between the growth limits mentioned by the improvers of the respective types, growth sizes of 18 - 20 cm were observed for the irrigated plants compared to the unirrigated ones. An exception from these sizes were noted in the case of chickpeas, where the height of irrigated plants was with only 4,8 cm bigger than those of unirrigated plants, proving that chickpeas have a higher resistance to drought than peas, beans and soybeans (Table 1).

Tab. 1.
The influence of pedo-climatic conditions and irrigation over the plant size of peas, beans, chickpeas and soybeans

Species/ type	Variant	Size (cm)	Difference (cm)
Peas Nicoleta	Unirrigated (mt)	62	-
	Irrigated	75,4	**20**
Beans Avans	Unirrigated (mt)	50,2	-
	Irrigated	68,6	**18,4**
Chickpeas Rodin	Unirrigated (mt)	67	-
	Irrigated	71,8	**4,8**
Soybeans Daciana	Unirrigated (mt)	95	-
	Irrigated	113	**18,0**

The two waterings during the vegetation period, once before the blooming and second before the fructification, had a positive influence over the plants growth and development, a fact shown in the seed production reported to the surface unit. To be noted that the beans had the smallest production (1474 kg/ha) when unirrigated, and soybeans had the biggest production (3040, 8 kg/ha) when irrigated. Applying the two waterings has underlined the peas and soybeans, with production increases of over 1000 kg/ha, and the chickpeas, for which the production increase was insignificant, of only 162 kg/ha (Table 2).

Tab. 2.
The influence of pedo-climatic conditions and irrigation over the production of beans for peas, beans, chickpeas and soybeans

Species/ type	Variant	Production (kg/ha)	Difference (kg/ha)
Peas Nicoleta	Unirrigated (mt)	1706	-
	Irrigated	2718	**1012**
Beans Avans	Unirrigated (mt)	1474	-
	Irrigated	2096,4	**622,4**
Chickpeas Rodin	Unirrigated (mt)	2198	-
	Irrigated	2360	**162**
Soybeans Daciana	Unirrigated (mt)	2014,8	
	Irrigated	3040,8	**1026**

Thousand grain weight (TGW) of seeds from the 4 species cultivated had average values between 167,2 g and 309,4 g. To be noted that soybean reacted very well to irrigation, the thousand grain weight was with 30 g more than for the unirrigated crop. On the opposite side were the chickpeas, where the difference in TGW between the irrigated and unirrigated crop was only 13,6 g. The two waterings have led to TGW increases of 5 – 18% compared to the crops where they weren't applied (Table 3).

Tab. 3.
The influence of pedo-climatic conditions and irrigation over the thousand grain weight for peas, beans, chickpeas and soybeans

Species/ type	Variant	TGW (g)	Difference (g)
Peas Nicoleta	Unirrigated (mt)	254,2	-
	Irrigated	274,2	**20,0**
Beans Avans	Unirrigated (mt)	231,0	-
	Irrigated	253,0	**22,0**
Chickpeas Rodin	Unirrigated (mt)	295,8	-
	Irrigated	309,4	**13,6**
Soybeans Daciana	Unirrigated (mt)	167,2	
	Irrigated	197,2	**30,0**

The studies made over the seeds of the 4 cultivated species show a big production of vegetal proteins that these pulses can make in the climate and soil conditions from Arad. It is worth mentioning that for the irrigated soybeans crop, 1145,8 kg of protein per surface unit were obtained. Chickpeas drought resistance was accentuated by the small difference in protein, 14,2 kg/ha, obtained for the irrigated crop, compared to the unirrigated one (Table 4).

Tab. 4.
The influence of pedo-climatic conditions and irrigation over the production of proteins for peas, beans, chickpeas and soybeans

Species/ type	Variant	Proteins (kg/ha)	Difference (kg/ha)
Peas Nicoleta	Unirrigated (mt)	442	-
	Irrigated	652,4	**210,4**
Beans Avans	Unirrigated (mt)	350,8	-
	Irrigated	466,2	**115,4**
Chickpeas Rodin	Unirrigated (mt)	596,2	-
	Irrigated	610,4	**14,2**
Soybeans Daciana	Unirrigated (mt)	763	
	Irrigated	1145,8	**364,6**

The bean protein percentage was smaller for the irrigated crops than for unirrigated crops for the all 4 species of pulses taken into study. In the case of peas crop, the percentage difference between the two variants analysed was the biggest, while in the case of chickpeas crop was the smallest. To be noted the high protein content (38,78%) for the soybeans variant in which the two waterings were not applied (Table 5).

Tab. 5.
The influence of pedo-climatic conditions and irrigation over the protein content in peas, beans, chickpeas and soybeans

Species/ type	Variant	Proteins %	Difference %
Peas Nicoleta	Unirrigated (mt)	25,91	-
	Irrigated	24,00	**-1,91**
Beans Avans	Unirrigated (mt)	23,92	-
	Irrigated	22,26	**-1,54**
Chickpeas Rodin	Unirrigated (mt)	27,14	-
	Irrigated	25,86	**-1,28**
Soybeans Daciana	Unirrigated (mt)	38,78	-
	Irrigated	37,16	**-1,62**

Given the high fat content of soybeans, this plant is significantly deffered by the rest of the pulses in terms of production (426,8 – 613,0 kg/ha). The small fat content of beans and peas, regardless of the cultivation technology, doesn't diminish their diet importance. The irrigated variant of chickpeas hasn't shown significant difference to the unirrigated variant, the 3,2 kg protein increase is not enough to justify the introduction of this technological step in the cultivation of this valuable plant (Table 6).

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Tab. 6.
The influence of pedo-climatic conditions and irrigation over the fat production in peas, beans, chickpeas and soybeans

Species/ type	Variant	Proteins (kg/ha)	Difference (kg/ha)
Peas Nicoleta	Unirrigated (mt)	23,71	-
	Irrigated	38,27	**14,48**
Beans Avans	Unirrigated (mt)	25,64	-
	Irrigated	37,48	**11,84**
Chickpeas Rodin	Unirrigated (mt)	142,2	-
	Irrigated	145,4	**3,20**
Soybeans Daciana	Unirrigated (mt)	426,8	
	Irrigated	613,0	**186,20**

In terms of percent, it is noticeable that for the peas and beans, the fat content, although insignificant, it was greater for the irrigated variants, while for chickpeas and soybeans, it had a smaller value. The limits for the fat percentage contained by the beans of the 4 species of pulses, show the possibility of their cultivation on these lands (Table 7).

Tab. 7.
The influence of pedo-climatic conditions and irrigation over the fat content in peas, beans, chickpeas and soybeans

Species/ type	Variant	Fats %	Difference %
Peas Nicoleta	Unirrigated (mt)	1,39	-
	Irrigated	1,41	**0,02**
Beans Avans	Unirrigated (mt)	1,74	-
	Irrigated	1,79	**0,05**
Chickpeas Rodin	Unirrigated (mt)	6,48	-
	Irrigated	6,16	**-0,32**
Soybeans Daciana	Unirrigated (mt)	21,2	-
	Irrigated	20,2	**-1,00**

Analyzing from an economic perspective the behavior of these 4 species of pulses (peas, beans, chickpeas and soybeans) in the pedo-climatic conditions from Arad area, it can be stated that they were efficient, incomes being set between 481,1 RON/ha (soybeans - unirrigated crop) and 3493 RON/ha (chickpeas – unirrigated crop). The best results were obtained for the chickpeas crop variants, where the incomes were of 2780 RON/ha (irrigated crop) and 3493 RON/ha (unirrigated crop). To be noted the behavior of Nicoleta peas and Avans beans types, which in irrigated conditions brought incomes of 2015 RON/ha and 1957,4 RON/ha, respectively. The weakest results were obtained for the variants of unirrigated soybeans and peas, with incomes of only 481,1 RON/ha and 756 RON/ha, respectively (Table 8).

Tab. 8.
The influence of pedo-climatic conditions and irrigation over the economic efficiency of peas, beans, chickpeas and soybeans

Species/ type	Variant	Producţion (kg/ha)	Price (lei/kg)	Production value (RON/ha)	Production cost (RON/ha)	Income (RON/ha)
Peas Nicoleta	Unirrigated	1706	2,5	4265	3500	**765**
	Irrigated	2718	2,5	6795	4780	**2015**
	Difference	1012	-	6795	4780	**1250**
Beans Avans	Unirrigated	1474	3,5	5159	4100	**1059**
	Irrigated	2096,4	3,5	7337,4	5380	**1957,4**
	Difference	622,4	-	1000	1280	**898,4**
Chickpeas Rodin	Unirrigated	2198	3,5	7693	4200	**3493**
	Irrigated	2360	3,5	8260	5480	**2780**
	Difference	162	-	1000	1280	**713**
Soybeans Daciana	Unirrigated	2014,8	2,1	4231,1	3750	**481,1**
	Irrigated	3040,8	2,1	6385,7	5030	**1355,7**
	Difference	1026	-	2154,6	1280	**874,6**

CONCLUSIONS:

The cultivation of the 4 species of pulses (peas, beans, chickpeas and soybeans) in the climate and soil conditions of Arad, has led to some morphological characters and valuable productivity elements for all the irrigated experimental variants.

Increased productions were obtained from all 4 species of pulses for which, in the vegetation period, two waterings were applied, with a boost in the case of soybeans, where the seed quantity related to surface unit was of 3040,8 kg/ha.

In unirrigated conditions, chickpeas obtained the best results, with a production of 2098 kg/ha, which emphasizes the plant's resistance to lack of water correlated with high temperatures.

Bean protein and fats contents were smaller for the irrigated variants compared to unirrigated ones, except for peas and beans, for which the content in fats was higher when waterings were applied.

The best results, from an economic point of view was obtained from unirrigated chickpeas crops, with an income of 3493 RON/ha, and irrigated crops, with income of 2780 RON/ha, followed by peas (irrigated) with 2015 RON/ha and beans (irrigated) with 1957,4 RON/ha.

The most inefficient variants of crops were unirrigated soybeans, with income of 481,1 RON/ha, and unirrigated peas with income of 756 RON/ha.

REFERENCES:

Bîlteanu Ghe., Salontai Al., Vasilică C., Bârnaure V., Borcean I., Fitotehnie, Ed. Didactică și Pedagogică, București, 1991.

Borcean I., Borcean A., Cultura și protecția plantelor leguminoase cultivate pentru boabe, Ed. de Vest, 2003.

David. Ghe., Borcean A., Cereale și leguminoase pentru boabe, Ed. Eurobit, Timișoara, 2011.

Dobrotă C., Fiziologia Plantelor, Ed. Risoprint, Cluj-Napoca, 2013.

Giosan N. și colab., Soia, Ed. Academiei, București, 1986.

Ionescu D. și colab., Cultura leguminoaselor pentru boabe, Ed. Agro-Silvică, București, 1967.

Muntean L.S., Borcean I., Axinte M., Roman Ghe.V., Fitotehnie, Ed. Ion Ionescu de la Brad, ISBN:973-8014-45-X, Iași, 2001.

Şinon Alina, Mazărea-Tehnologia de cultivare în Transilvania, Agricultura Transilvană, Buletin informativ, nr. 22, Ed. Eladesing-Turda, 2015.

Ungureanu O., Axinte M., Ungureanu G., Ungureanu E., Năutul, Ed.Pim, ISBN 978-606-13-0804-0, Iași, 2012.

Zamfirescu N., Bazele biologice ale producșiei vegetale, Ed. Ceres, București, 1977.

https://www.meteoblue.com- Arhiva meteo Arad.

istis.ro/image/data/download/catalog-oficial/CATALOG_2016.pdf.