The Influence of Soil Properties on Grain Production in Spring Forage Pea Crop

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Abstract

Forage pea (*Pisum arvense f. aestivale*), also known as field pea, is one of the important species cultivated in our country for the feed of several animal species, due to the remarkable content of the grains in proteins, calcium, vitamins, but also in other essential elements for animal nutrition. Also, together with oats, it forms the spring mash, which is well-known for its high fodder quality. The research carried out during three experimental years, in the climate and soil conditions of the Arad Plain, regarding the cultivation of spring forage pea, highlighted the importance of soil fertility, as well as the importance of the water from precipitation during winter and growth period. Among the three experimental years (2020, 2021 and 2022), the best results regarding grain production were recorded by the spring forage pea variety Salamanca with determined growth, in the year of 2021, on a cambic chernozem, low carbonate, medium loam/medium loam clay type of soil, when the grain production exceeded 4.800 kg/ha, STAS grains. The same genetic material (Salamanca variety), cultivated under identical technological conditions, on a weakly stagnoglazed vertosoil, medium loam clay/dusty-clay type of soil, achieved a significantly lower grain production, of less than 4.000 kg/ha. It is remarkable that, in the all three years of spring forage pea cultivation, the grain production obtained on the cambic chernozem type of soil exceeded, each time, the value of 4.000 kg/ha, while, in the case of the vertosoil, every year recorded a production below the value of 4.000 kg/ha, making soil fertility as one of the most determinant factors for production of this significant legume crop.

Keywords: pea, production, soil, variety.

1. Introduction

In the context of increasingly obvious climate changes and amid the intensification of the desertification of agricultural lands in many parts of our country known for their good soil fertility, the expansion of the areas occupied by green crops, especially legumes, appears as an action to preserve the agricultural potential of Romania [1, 2].

Land desertification is one of the most obvious consequences of climate change, largely due to prolonged drought periods affecting many of our countries' steppe and silvo-steppe areas. At the same time, uncontrolled land clearing, as well as soil erosion caused by intensive farming systems, can also be identified as direct causes of this phenomenon. It is estimated that, in the coming years, in the absence of specific measures to combat land desertification, the situation may change for worse, affecting more and more important agricultural areas of our country [1-3].

Considered as one of the most beneficial green crops, forage pea cultivation presents multiple advantages for the practice of agriculture, both from an ecological, economical and qualitative perspective (valuable feed for many species of animals due to its remarkable content of the grains

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in proteins, calcium, vitamins, but also in other essential elements) [4-7].

Part of the Fabaceae family, *Pisum arvense* has a particular agronomic importance, due to the fact that it is a good precursor plant for most agricultural crops, releasing the land early, leaving it clean of weeds and plant debris and enriched in organic matter and nitrogen. Also, forage pea is considered as one of the most important species for nitrogen fixation, the research proving that the remaining quantity of nitrogen in the soil after this crop, is significant [6-9].

At the same time, the cultivation of this species presents a series of advantages in terms of soil structure, preserving sufficient moisture for a qualitative and early ploughing [8, 10].

As we previously mentioned, the species is used successfully in animal feed, especially by using the mature grains as such in the feed of sheep and goats or by introducing them into the composition of combined fodder recipes for feeding various categories of animals raised in an industrial system, such as: chickens for meat, hens for eggs, young pigs or pigs for fattening, as well as cattle for fattening [5, 7, 11, 12].

The spring forage pea (*Pisum arvense f. aestivale*) originates in the Mediterranean region and was brought to Romania as crop after the year 1700, in Transylvania. It then reached other agricultural areas and has been used for livestock feeding ever since [5, 7].

In time, this species and crop form has been used mainly for creating the spring mash when combined with straw cereals (oat, rye, barley, or triticale).

At present, spring forage pea cultivation has gained more interest for farmers, both as pure crops, as well as for forming the spring mash, due to its many benefits and good economical value.

2. Materials and methods

For the research developed during the three experimental years of 2020, 2021 and 2022, we used the genetic material of spring forage pea named Salamanca variety, developed by the Saaten Union Romania company, which is known among the farmers from the West part of Romania, for its exceptional properties, such as:

- Medium vegetation period;
- Height of the plant - medium to tall;
- First pea-pod is inserted not very low and thus, using the harvester is possible without any loss;
- Particular resilience to falling and bending;
- Can be successfully grown in all areas favourable to pea culture in Romania;
- Large constant productions with a guaranteed profit for farmers.

Also, regarding the results obtained it is important to highlight the role played by the main technological elements, as it follows:

1. Precursor plant in crop rotation was winter wheat;
2. Fertilization implied the application of chemical fertilizers in doses of 50 kg/ha P_2O_5 and 40 kg/ha K_2O;
3. The soil works were the following: during fall - basic ploughing and works with the combinatory for soil preparation, and during the spring - surface works with the combinatory for seedbed preparation;
4. Seeding took place in early March, in rows 12.5cm apart, with a seeding density of 75 germinable grains/sqm., by the use of a seed quantity of 220 kg/ha;
5. The digging depth was 4cm on vertisol soil and 5cm on black soil;
6. The maintenance works were spreading Pulsar herbicide 0.8 l/ha, applied during the vegetative phase, particularly for fighting annual weeds, fungicide Ortiva 1 l/ha against diseases, and insecticide Karis 0.05 l/ha for fighting pea weevil.

The research took place on two different soils from the point of view of their physical and chemical properties, in the Arad Plain, on a cambic chernozem type of soil, which can be found on higher terrain and on a weakly stagnoglazed vertosoil, medium loam clay/dusty-clay type of soil found on the lower terrain, both located on the territory of Zimandu Nou Commune, Arad County (Figure 1) [13, 14].

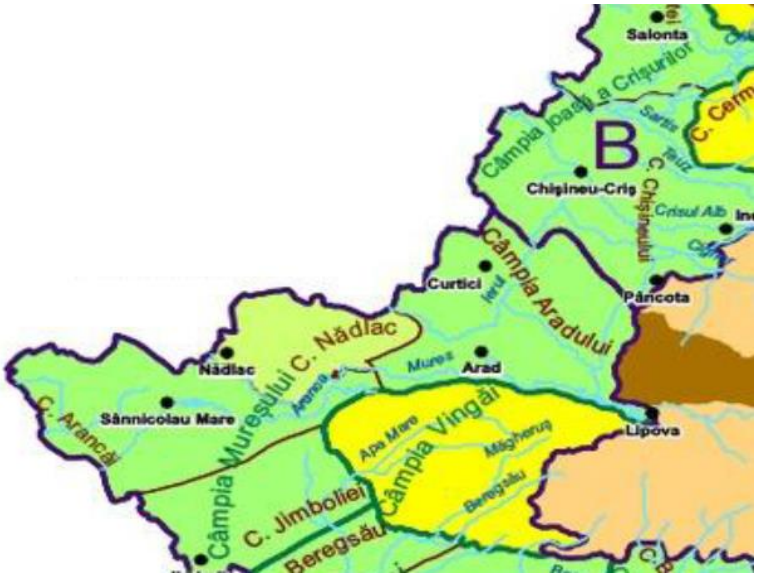

Figure 1. Arad Plain part of the West Plain of Romania (our own adaptation after Badea L., Posea G, 1984)

The main properties of the two analyzed soils (according to OSPA Arad) are presented below.

Among the properties of cambic chernozem, the most significant are the following:

- Ground water located 5-10 m deep;
- Medium clay/medium loam texture;
- Field capacity has medium to high values in the first 50 cm;
- Reaction of soil in the low-acidic to low-alkaline range;
- High values of the humus reserve in the first 50 cm [15].

Among the physical, hydro-physical and chemical properties of the analyzed vertosoil, the following were found:

- Medium clay/medium loam texture;
- Field capacity has high values in the first 85 cm;
- Soil reaction is low-acidic in the first 200 cm;
- High values of the humus reserve in the first 50 cm [15].

The main objective of the research during the reference period (2020-2022) followed the behaviour manner in connection to the production capacity of the Salamanca spring forage pea variety, which was grown on the two soils that vary in texture and fertility degree, given the climatic conditions of the Arad Plain.

The purpose of the research was the identification of the elements that would lead to obtaining higher spring forage pea grain production.

Thus, single-factor experiences were organized in each agricultural year, on the two types of soil, the Salamanca dynamic-growth variety being cultivated under identical conditions as regards the used agricultural technology.

The results obtain can offer an overview regarding grain production of the researched spring forage pea variety for farmers interested in the cultivation of this species, especially farmers from the West Plain of Romania, with lands with the same types of soils or similar pedological conditions.

3. Results and discussion

In Table 1 are presented the results of grain productions in the 2020, 2021, and 2022 agricultural years, which were obtained by the Salamanca spring forage pea variety, given the conditions of the Arad Plain. After analyzing the crop data registered in the agricultural year of 2020, we can notice the fact that the value of the mean grain production obtained from the Salamanca spring forage pea variety on the cambic chernozem type of soil was 4723 kg/ha, which surpassed the average of versions by 729 kg/ha. In percentages, this meant a value of 118%. On a weekly stagnoglazed vertosoil type of soil, the production was 546 kg/ha below the general average of versions, which was 3448 kg/ha.

The climatic conditions and the average temperature and precipitation in the vegetative phase months were quite favourable to the crops (except for the month of April when under 10 l/sqm. precipitation were registered, but over 43 l/sqm. were recorded in March and 145 l/sqm. in June).

Table 1. Production results of the Salamanca variety in the three agricultural years researched

Crop years	Cultivated variety	Soil type	Grain production (kg/ha)	Difference to the annual production mean (kg/ha)	Difference to the general mean of versions (kg/ha)	Difference to the general mean of versions (%)
2020	Salamanca	Cambic chernozem	4723	637	729	118
		weakly stagnoglazed vertosoil	3448	637	546	86
	Annual production mean		4086		92	102
2021	Salamanca	Cambic chernozem	4834	606	842	121
		weakly stagnoglazed vertosoil	3622	606	372	91
	Annual production mean		4228		234	106
2022	Salamanca	Cambic chernozem	4216	547	225	106
		weakly stagnoglazed vertosoil	3121	547	873	78
	Annual production mean		3669		325	92
General average of versions in the period of the 2020-2022 cultivation years (kg/ha)			3994			100%

This made the grain productions on the two soils to be quite high, an important matter being recorded in favour of the first version, of 1274 kg/ha.

The average of productions obtained from the two cultivated variants was 4086 kg/ha, by just 2% over the general average, which was 92 kg/ha.

The grain productions for year 2021 were higher than those in the previous year, being registered a mean of 4228 kg/ha, which is 6% more by comparison to the average of versions, that being 243 kg/ha as quantity. From the point of view of low precipitation, the year had a good start and continued in May with 77.9 l/sqm. These matters had an important contribution to the growth of plants and to fructification, next to the temperature that was within the multiannual values. All these climatic conditions led to obtaining particularly large productions on the cambic chernozem (4834 kg/ha) and on the weakly stagnoglazed vertosoil soil, of 3622 kg/ha.

The difference by comparison to the general average production in the version cultivated on the type of soil with high fertility, which was chernozem, was 842 kg/ha, meaning over 21%.

The first half of year 2022 was deemed to have low precipitation, considerably under the multiannual values. However, given these conditions, for the spring forage pea crop a significant part was played by precipitation in the month of May (57.4 l/sqm), which compensated the deficit from the previous months and helped with the formation and filling of peas. Thus, the mean production of the two versions was 3669 kg/ha, 325 kg/ha under the general average, which was 8%. In the conditions indicated above, the lowest average grain production was registered, too, in the version of cultivating the Salamanca variety on the vertosoil type of soil (3121 kg/ha), the difference of the general average being -12%.

4. Conclusions

The climatic and soil conditions in the Arad Plain, the area where the research unfolded, are favourable to the spring forage pea crop, even without irrigation, conditioned by the seeding during the optimal period, which is early March, thus that the plants can take advantage of the water accumulated during the winter months.

Cultivating the Salamanca variety proved to be a good choice because the crop results on the two types of soil were high. A significant increase was registered on the more fertile soil, the cambic chernozem, with a mean production of 1194 kg/ha.

The effect of fixed nitrogen that remained in the soil after the spring forage pea crop, for the following crop, was significant.

The general average production of all the analyzed versions was close to 4000 kg/ha and 3994 kg/ha state-set standard grain, respectively, which would lead to a very big profit for the farmers if adequately sold.

Among the three experimental years, the best climatic conditions for the spring forage pea crop were registered in the agricultural year of 2021, while the agricultural year of 2022 had the worst climatic conditions.

References

1. Feier-David, S. R., Mateoc-Sîrb, N., Implementarea politicilor agricole și de mediu în România în contextul dezvoltării durabile, Ed. Eurobit, Timișoara, 2020, pp. 42-50
2. https://www.lumeasatului.ro/articole-revista/agrotehnica/7977-masuri-de-prevenire-a-fenomenului-de-desertificare.html
3. Pîrșan, P., Okros, A., Note de curs. Concepte și principii în agricultura ecologică, Ed. Agroprint, Timișoara, 2018, pp. 5-10
4. Dragomir, N., Peţ, I., Dragomir, C., Proca, S., Tehnologia de cultivare a leguminoaselor furajere perene, Ed. Waldpress, Timișoara, 2003, pp. 12
5. Dragomir, N., Curs Producerea și conservarea furajelor, Ed. Eurobit, Timișoara, 2005, pp. 301-305
6. IMBREA, F., Tehnologii Integrate. Vol I. Cereale și leguminoase pentru boabe, Ed. Eurobit, Timișoara, 2014, pp. 211-217
7. Cojocariu, L., Producerea furajelor, Ed. Solness, Timișoara, 2005, pp. 229-231
8. Peț, I., Agricultură general - note de curs, Ed. Eurobit, Timișoara, 2021
9. Peț, I., Feier-David, S. R., Producerea și conservarea furajelor - Lucrări practice, Ed. Eurobit, 2021, pp. 146-147
10. Peț, I., Feier-David, S. R., Agricultură generală - ciet de lucrări practice, Ed. Agroprint, Timișoara, 2021, pp. 45
11. https://ecohorti.ro/productia-de-mazare/
12. https://agrointel.ro/42431/mazare-furajera-pret-tehnologie-de-cultivare/
13. Țărău, D., Rogobete, G., Dicu, D. D., Solurile din Vestul României - caracterizare, evaluare, ameliorare, Ed. Eurobit, Timișoara, 2016, pp. 874
14. Țărău, D., Rogobete, G., Grozav, A., Dicu, D. D., Solurile din Sud-Vestul României, Ed. Eurobit, Timișoara, 2018, pp. 61
15. O.S.P.A. Arad archive