THE ROLE AND IMPORTANCE OF TEMPORARY GRASSLAND IN CROP ROTATION SYSTEMS

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Abstract

The solution for a continuous increase of the requirements for food resources, both in terms of quantity and quality, can be done by expanding cultivated areas, increasing the soil fertility, high yields per unit area, but the most important alternative is implementation of the higher technological measures. Conventional farming system causes the rapid growth of production through the use of numerous works for seedbed preparing, with short rotations, increasing amounts of fertilizers and pesticides, all with negative repercussions on the physical-chemical state of the soil and in the same way on the environment quality.To remedy these inconveniences was resorted to practicing the sustainable agriculture systems. The sustainable agriculture has emerged as an alternative to conventional agriculture or intensive, with the main components: crop rotation and crop structure, use in optimal doses of chemical fertilizers combined with the organic, soil works etc. All these are intended to increase and maintain the soil fertility for a longer period, environmental protection, biodiversity conservation, protecting and stimulating the activity of microorganisms, useful flora and fauna, restoration and protection of natural landscape quality etc. Crop rotation is the most important component of agricultural systems that contribute to meeting these requirements. By introducing crop rotation are eliminated most of the problems caused by intensive use of land and biodiversity loss, deteriorating the physicochemical and the biological soil characteristics, ambient pollution etc. Establishing a more diverse structures of crops, in the crop rotation with species and varieties adapted to specific regional conditions and specific technology application, improves the sustainability of the farming system.

Keywords: temporary grassland, crop rotation, sustainable agriculture

INTRODUCTION

The introduction in the cropping rotation of the surfaces with complex mixture of perennial grasses and legumes improves soil physical, chemical and biological soil properties, protects the soil against

erosion, creating as a result the favorable conditions for plant growth, involving production increases. Grasses and perennial legumes from floristic composition of temporary grassland have a very important role in improving the soil properties, increasing the content of organic and inorganic substances, getting a stable soil structure, improves system of water and air and develops intense biological activity. It also recorded significant increases of humus soluble aggregates, P_2O_5 and K_2 0.In the crop rotation with temporary grassland has also been a rise in the concentration of organic carbon and total nitrogen and also there is a limit to decrease the pH.

Legumes in the mixture have the appropriation to enrich the soil with atmospheric nitrogen as a result of symbiosis, with nitrogen-fixing bacteria (150-200 kg/ha/year).

In the rotation, the crops following temporary grassland, find the most favorable conditions for growth and development, achieving higher production, both quantitatively and qualitatively.

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MATERIAL AND METHOD

In the experimental field of Fagaras Depression were cultivated the crops suitable to these areas, using the following rotation:

- Temporary grassland (perennial grasses + legumes);
- Potato;
- Spring wheat;
- Fodder turnip;
- Silage maize.

Figure 1 shows the location of crops scheme under experimental device.

G 4	P	S W	S M	F T		F T	S W	P	G 1	S M		S M	G 1	S W	P	F T	2014
G 3	F T	P	S W	S M		S M	P	S W	F T	G 4		G 1	P	S M	F T	SW	201
G 2	G 2	G 2	G 3	G 2		S W	F T	S M	P	G 3		P	S M	F T	S W	G 1	2012
G 1	G 1	G 1	G 2	G 1		G 1	G 1	G 1	G 1	G 2		G 4	G 1	G 1	G 1	G 1	201
A 1	A 2	A 3	A 4	A 5		B 1	B 2	B 3	B 4	B 5		C 1	C 2	C 3	C 4	C 5	
BLOCK 1						BLOCK 2						BLOCK 3					

Legend: P - potato; G 1 – temporary grassland in 1st year;
FT-forage turnip; G 2 - temporary grassland in 2nd year
SW - spring wheat; G 3 - temporary grassland in 3rd year;
SM - silage maize; G 4 - temporary grassland in 4th year.

Fig.1. Cultural history of experimental field

To determine the characteristics of the climate from Fagaras Depression- Brasov County, have been used data from the meteorological station Fagaras, belonging to the National Meteorological Administration, the only serving territory. The Fagaras station is located at latitude $45^{0}50^{l}$ N, longitude $24^{0}56^{l}$ E and altitude of 428 m above sea level.

It was found that the year 2013 - 2014 was a farming year with hydric stress, the growing season being a thermal regime moderately compared to the previous year and low precipitation, both during in winter and the growing season, which contributed the crop developing in the harsh conditions and a decreasing in average productivity per hectare.

RESULTS AND DISCUSSIONS

a. Economic aspects to specific crops of the Fagaras zone, in rotation with a complex mixture of grassland perennial grasses and forage legumes

a.1 Economic aspects of the complex mixture of grassland perennial grasses and legumes

The data obtained during experiments shows the yields of DM/ha for each rotation. In the year that the grass mixture was cultivated after spring wheat (A1) to a NPK fertilizer rate of 100-100-100 kg/ha, in 2013 and 50-50-50, in 2012 and 2014, it has obtained an average annual output of 13,85 t DM/ha, achieving an estimated income of 7.617* lei/ha. Potato crop is also a good precursory crop for the mixture of grassland perennial grasses and legumes, the land remains clean after harvesting it. At a fertilizer rate of N100P100K100, in the year of establishment 2013 and N50P50K50, next year 2014 (C1) were achieved an average 12,29 t DM/ha, with an estimated income of 6.760* lei/ha.

Average production level at all alternatives ranged from 7,93 to 13,85 t DM/ha, with estimated incomes, between 4361-7617* lei/ha, values that recommend a profitable crop in the area.

(* The average annual price of complex mixture of perennial grasses with legumes was considered 0,55 lei/kg DM).

a.2 Economic aspects of the potato crop

The experimental results highlight that silage maize and the temporary grassland are good precursory for potato in Fagaras area.

The highest yields were obtained in variants of rotation (A2, B3, C4), within temporary grassland was followed by a hoeing plants (silage maize, forage turnip) and a uniformity crops (spring wheat).

The lowest yields, of 11,47 and 13,97 t/ha, were obtained in 2012, because the 2012 agricultural year was characterized by a deficient rainfall during June-September, that associated with high temperatures in summer generated a particularly excessive drought. Another cause was the low levels of fertilization of N50P50K50 kg/ha.

One advantage of using the rotational temporary grassland system, in 2013, after two years, is the low degree of weed infestation compared to other preceding crops. On average, in the three years of rotation after different precursory crops, potato provides an estimated income of 17.644* lei/ha.

(* The average annual price of potatoes was considered by 0,60 lei/kg).

a.3 Economic aspects of the spring wheat crop

According to the experimental results, the first crop rotation cycle of 2012, spring wheat crop has had production of 3.318-3.700 kg/ha, on all variants with precursory the temporary grassland.

In 2013, in all variants the yields were lower than those of 2012 and 2014, differences ranging from 306-1.959 kg/ha, due to spring weather conditions which resulted in a lower establishment of spring wheat crop which led to a density at harvest of 220 heads/m^2 A4 variant, 194 heads/m^2, variant B3 and 235 heads/m^2, variant C5.

The medium annual yields of spring wheat crop are 2.368 (2013), 3.509 (2012) and 3.452 kg/ha (2014), the estimate incomes obtained are, averaged over three years of rotation, of 2.363* lei/ha, relatively small, but it is recommended its use in crop rotation in a situation where cannot work the land in autumn and cannot sow winter wheat or rye, allowing a better time sharing of the labor on the farm, especially since it is a complete mechanized crop.

(* The annual average price of spring wheat was considered 0,76 lei/kg).

a.4 Economic aspects of the forage turnip crop

From the experimental data it results that for forage turnip the best precursory represents temporary grassland, which provides an increase of 14 % in the same year 2013 and 34 % in 2014, when in crop rotation, sown grassland is before preceding crop, compared to other rotation made in the same years, under a low fertilization of N50P50K50 kg/ha, in 2014.

Notably that in 2013, in alternative with precursory sown grassland (A2), in addition to relatively high production of roots, the crop weeding degree was 8 %, compared with 19 % for the above mentioned rotation.

Averages of annual root production were 38,25 (2013) and 50,68 t roots/ha.

The estimated income average realized from the crop, in the rotation of two years, is 15.563* lei/ha, except derived income from secondary production (leaves etc.), a

profitable crop with a high feeding value.

(* The annual average price of forage turnip was considered 350 lei/t).

a.5 Economic aspects of the silage maize crop

The experimental data shows that silage maize production in 2012, at a fertilization N50P50K50 kg/ha, ranged from 8,95 (B3) and 10,10 t/ha (C2), due to the spring weather conditions of this year, large temperature fluctuations between day and night, thermal amplitude being 33,9 ^{o}C in April, with monthly minimum -5,2 ^{o}C (on April 2nd) and the maximum of 28,7 ^{o}C (29th to 30th April), that affected significantly the maize crop. Also, during July-August coincided with the highest soil water deficit caused by lack of rainfall.

The phenomenon has been amplified by high sunshine duration and the average of monthly temperatures. Under fertilization rate of N100P100K100 (2013) the production ranged between 50,81 and 64,51 t/ha, the maximum being obtained from variant with sown grassland as previous crop, two years of existence.

The average of estimated annual income, during the two years of rotation, 2013 and 2014 (N50P50K50), with climatic conditions closely to multiannual average, after different precedent crops is 5.670* lei/ha and it is a suitable crop for mixed farming in Fagaras, in addition that is a completely mechanized crop, indispensable within dairy cows farms.

(* The annual average price of silage maize was considered 120 lei/t).

b. The evolution of soil physical and chemical indicators of temporary grassland crop rotation

The sustainable use of soil under conditions of significant changes in terms of ownership, technical equipment, production destination, price fluctuations, demand for agricultural products, requirements related to environmental protection, it was attempted finding the specific technological solutions for the studied area.

Crop rotation is an important link of agricultural technologies contributing to constant productions over time. For this purpose, have initiated experiences in Depression Fagaras, was introduced in the crop rotation a complex mixture of grasses with legumes on an initial agro fond N100, P100, K100, reducing half in the coming years.

Physical-chemical evolution in the studied experimental field was positive in terms that the soil answered to chosen technological solution. The greater inputs from the first year of experimentation, were reflected in agrochemical indices measured, as the yields obtained. Further reduction of the amount of fertilizer also has reflected its index values measured. Also, it was observed that doses N50, P50, K50,

consistently applied with improvement effect that the complex mixture of grasses with forage legumes has on soil have led to an increased production of crops in rotation and a slight improvement in soil structure indices.

For each determined element have observed the following:

- soil reaction (pH) in Fagaras experimental field is characterized by a uniformity across the field and very little variation from one year to another, this stability is attributed to the administration of calcareous amendments in the first year of experimentation;
- content of total nitrogen (Nt %) recorded an increasing;
- organic matter content (C_t * 1,72 %) increased (because of fresh plant debris) in experimental field;
- phosphorus content (P_{AL} ppm) registered a growth trend in experimental field;
- mobile potassium content (K_{AL}, ppm) decreased. It is recommended to increase the dosage of potassium;
- hydrostatic aggregates number (AH) increased modestly, growth can be attributed to the assortment of selected crops. The degree of dispersion of structural aggregates (D) shows a downward trend;
- structural instability index (IS) shows a modest decrease in the experimental fields It notes, as a general trend, improvement in soil structure in the analyzed field.

Also, it may notice a modest improvement in the supply of nutrients from the soil. An exception is the potassium content available for the plants, which suffered a decrease in time.

The effects of introducing the temporary grassland in rotation were poorly distinguishable from the physico-chemical parameters analyzed, producing the significant changes over a period of time.

Importantly is this slight improvement as a sustainable land use.

If to this soil quality improvement it adds the production increases achieved by crops and environmental benefits, it can be said that the chosen technological solution can be successfully recommended to farmers from the studied area.

CONCLUSIONS

The research conducted before and during the trials revealed that the introduction in the crop rotation system of sown grassland with mixtures of perennial grasses and forage legumes have substantially improved the physical and biochemical properties of soil, creating favorable conditions for other crops in the rotation, highlighting the following advantages:

- symbiotic nitrogen fixation (bioazot) up to 150-200 kg/ha/year and a rezidual biomass at the end of the growing season of 5-6 t/ha;
- soil carbon sequestration;
- reducing the nutrients leaching from the soil;
- improved utilization of rain water;
- shading the soil (decrease the evapo-transpiration);
- soil aeration;
- weed control;
- pest and disease control;
- ensuring low cost in crop rotation as a result of lower amounts of chemical fertilizers;
- improve the use of soil nutrients;
- lighter cultivation systems;
- reduced requirements for plant protection.

REFERENCES

1. Ailincăi C. *et al.* (1997) Cercetări privind evoluţia principalilor insuşiri fizico-chimice ale solului sub influienţa sistemului de cultură şi a eroziunii de suprafaţă.
2. Avrămescu E. *et al.* (2014) Rolul pajiştii semănate în asolament din zona colinară a Moldovei.
3. Dumitrescu N. *et al.* (1979) Pajişti degradate de eroziune şi ameliorarea lor. Ed. Ceres, Bucureşti;
4. Frame J. (1992) Improved Grassland management – Farming Press Books, UK.
5. Mocanu V., Hermenean I. (2008) Tehnologii pentru mecanizarea cu inputuri minime a lucrărilor de întreţinere şi îmbunătăţire a pajiştilor. Editura Universităţii Transilvania din Braşov.
6. Mocanu V. *et al.* (2008) Ecological and economical technology for mechanization of grassland improvement works. Proceedings of the 22nd General Meeting of the European Grassland Federation ,,Biodiversity and Animal Feed – Future Challenges for Grassland Production, Uppsala, Suedia, 9-12 June 2008.
7.*** 2013, Raport ştiinţific şi tehnic privind realizarea etapei a IV-a a Proiectului Valorificarea Multifuncţionalităţii Pajiştilor În Contextul Dezvoltării Durabile A Agriculturii Şi Protecţiei Mediului, Arhiva Icdp Braşov.

8.*** 2013, Raport ştiinţific şi tehnic privind realizarea etapei a V-a a Proiectului Valorificarea Multifuncţionalităţii Pajiştilor În Contextul Dezvoltării Durabile A Agriculturii Şi Protecţiei Mediului, Arhiva Icdp Braşov.
9.***2014 Raport ştiinţific şi tehnic privind realizarea etapei a VI-a a Proiectului Valorificarea Multifuncţionalităţii Pajiştilor În Contextul Dezvoltării Durabile A Agriculturii Şi Protecţiei Mediului, Arhiva Icdp Braşov.
10.***2014 Raport ştiinţific şi tehnic privind realizarea etapei a VII-a a Proiectului Valorificarea Multifuncţionalităţii Pajiştilor În Contextul Dezvoltării Durabile A Agriculturii Şi Protecţiei Mediului, Arhiva Icdp Braşov.