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BIBLIOGRAPHIC STUDY OF THE IMPACT OF FERTILISATION ON PERMANENT GRASSLAND

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Abstract: This work inset to highlight the important role particularly in the context of grasslands is the population explosion actual. In today, world population reached about 7 billion people and the feeding problem has become increasingly problematic. This paper is intended to be a focus of recent research conducted by Romanian and foreign researchers who emphasize the importance of organic fertilization on production recorded on permanent grassland and improve their floristic composition. Work is a meticulous analysis of the results obtained by researchers from around the world on different types of permanent grassland in different conditions of temperature and precipitation. *Research carried out shows that it has special role in increasing production of organic fertilizers permanent grassland. The substantial amounts of manure of manure applied on grassland may influence the species composition .The organic inputs are associated with the importation of seeds with poor ecological and forager value Rumex sp and the smothering of the sward by manure. Also, the effect of sward covering by manure is similar with the scene created by litter accumulation (PLANTUREUX et al., 2005). After DJUKIC et al., (2008) the manure applied on grassland determinates changes in the floristic composition involving a higher percentage of legumes in comparison with other species and grasses. The floristic composition studies need long time researches, as in the case of biodiversity, to provide sustainable results (DJUKIC et al., 2008). In a permanent grassland agro-ecosystem the floristic composition varied depending on substances flow, soil nutrients availability and climatic conditions (MOISUC et all 2001). Application of organic fertilizers in a rational way contributes to changes in permanent pasture floristic composition, in the sense of increasing the valuable plants participation in economic terms.*

Key words: *meadow, grassland, floristic composition, fertilization*

DISTRIBUTION OF GRASSLANDS

Worldwide and in Romania, grasslands are the largest ecosystem on Earth, reaching an estimate 52,500,000 ha (WORLD RESOURCES INSTITUTE, 2000), an area about two times larger than that covered by arable lands.

Different sources estimate in different ways the natural areas covered by grasslands. Thus, HAUSER (1996) estimates that grasslands cover a fifth of the Earth's land, while WHITE et al. (2000) consider that, Greenland and the Antarctic put aside, grasslands cover 40% of the lands.

The authors of "GRASSLAND ECOSYSTEM PROFILE" (2001) claim that the global area covered by grasslands is estimate to about 41-56,000,000 km² covering 31-43% of the lands.

According to the same source, the difference between the values presented is due to the fact that some researchers include in this category the tundra and the shrubbery.

According to the Statistic Yearbook of Romania, the area of permanent grasslands is 4,937,600 ha (3,424,000 ha of grasslands and 1,513,000 ha of haymaking fields); their share of the total area is 23.1% in grasslands and 10.2% in haymaking fields, with arable land sharing 63.3% of the national agricultural area (9,398,500 ha).

The importance and relevance of fertilizing the grasslands lie in the principle of restoring nutrients exported through the harvested crop, a concept developed by Bossingaul and founded by Justus von Liebig in the 19th century; it refers to the fact that crops consume nutrients from the soil to develop the crop thus depleting the soil from nutrients that are removed with the crop which results in a decrease of soil fertility. Hence the idea of recovering soil nutrients.

Fertilisation practices have ancestral origins: Homer (850 B.C.) mentioned that Ulysses, while reaching Troy, was recognised by his dog who was playing on a pile of animal manure taken out of the stable by the slaves and spread on the field to get better crops (FARDEAU et COLOMB, 2001).

Applying fertilizers on the grasslands is the main method of improving grassland quality: it has been practiced from times immemorial.

Through fertilisation, we stimulate plant development, grasses growth and recovery after grazing or mowing, and we change the floristic composition, favouring the development of high economic value; we also destroy inferior species and most of the weeds.

Unlike agricultural cultures (agro-eco-systems), where fertilizers are applied on certain plants, in grasslands fertilizers are applied on phyto-coenoses in which different species react in different ways to fertilization, which asks for different application. When fertilized properly, there is improvement of the floristic composition, while in improper fertilization; there is multiplication of the weeds and, therefore, a decrease of the share of useful plants (SAMFIRA et MOISUC, 2007).

Animal manure is a complex product resulted from the aerobic and anaerobic fermentation of a mixture of consistent and liquid animal wastes with different vegetal wastes (straw, tendrils, dry leaves, sawdust) used as support. It is the most used organic fertilizer.

According to SALA (2008), there are four types of animal manure depending on the fermentation state:

- fresh or little fermented animal manure: the support is made up of straw whose colour and consistency are unchanged while the aqueous extract is yellowish;
- demi-fermented animal manure: the straw are brown-blackish, breakable and it weighs 10-30% less than fresh animal manure;
- well fermented animal manure: the straw are not easy to identify, the material is blackish in colour, and it weighs 50% of the initial weight, while the slurry is colourless;
- putrid animal manure: the material is earth-like, and it weighs 25% of the initial weight (Sala, 2008).

IMPACT OF ORGANIC FERTILISATION ON PERMANENT GRASSLAND PRODUCTION

The numerous researches show that applying fertilisers on grasslands is justified economically since, on the average, 1 kg of active element results in an increase of 80-100 kg of green matter. This economic productivity is also strengthened by the fact that from 1 ton of dried matter we can extract 20-21 kg of N, 6-8 kg of P_2O_5, 20-21kg of K_2O and 10-14 kg of CaO.

As a conclusion, we can say that fertilising grasslands results, on the average, in a twofold to threefold increase of the yield (SAMFIRA et MOISUC, 2007).

According to SCHWARTZ et al. (2005) nitrogen accumulation on permanent natural grasslands can reach 10 t of N/ha^{-1}.

Due to the complex improving role of organic fertilizers on the physical, chemical, and trophic characteristics of the soils, we can get important yield increases.

They claim that by fertilizing the grasslands with animal manure, whose effect lasts over 3-4 years, yield increases have a mean of 70% over the 4 years (://www.afaceri-agricole.net/2011/03/gunoiul-de-grajd/ 11/15/2011).

They recommend animal manure to be applied on grasslands because this is a complex organic fertilizer that enriches the soil with nutrients, microelements, microorganisms, etc. For instance, applying a mean rate of 30 t/ha animal manure results in 150 kg of nitrogen, 60 kg of phosphorus, 180 kg of potassium, 90 kg of calcium and over 7,000 kg of organic matter. The lower phosphorus content asks for a supplement of 25-30 kg of this element to be incorporated into the soil.

The optimal time to apply animal manure on grasslands is in the fall, after the grazing cycle is over, but it can also be applied during this period of time (when there is no rain or snow, when the soil is dried or frozen), as well as during winter, when the time is proper.

If we apply animal manure, there are increases of 10% compared to spring fertilisation; there is also the advantage of longer periods of transportation and that precipitations carry the nutrients deeper into the soil. By spring time, there will be no more unpleasant smell and the forage will be well eaten by the animals.

Animal manure remanence duration is 4-5 years depending on the rate applied, on the fertiliser quality, and on the grassland floristic composition. The highest increases in yield are in the 1st year, but it decreases steadily from one year to another (SAMFIRA et MOISUC, 2007).

Though applying animal manure has great effects on the grassland, its use is limited by the amounts available, by the lack of means of transportation, by the difficulty of spreading it, and by the discomfort of the people who have to do it.

Besides the fact that the entire amount of animal manure should be valorised, we can also avoid the risk of environmental pollution caused by the storage in the near vicinity of the stables of such huge amounts. While accumulating large amounts of animal manure, minerals are washed away and distributed in excess on the land and in the water close to the animal farms resulting in nitrate and nitrite pollution.

From an economic point of view, fertilising with animal manure is extremely advantageous, the only expenses being related to transportation and to spreading.

Besides its direct action on grassland plant nutrition, animal manure improves thermal regime and soil aeration, increases soil water holding capacity, and intensifies microorganism activity in the soil.

Even if we cannot incorporate animal manure into the soil on grasslands, it contributes to the increase and changing of phyto-coenosis and its efficiency depends on soil and climate conditions, on floristic composition, and on grassland type, being higher in moist areas and on grasslands with valuable dominant species.

Because it cannot be incorporated into the soil, they recommend grassland fertilisation with fermented and demi-fermented animal manure. As for the fertilisation rate, fertilising with 20 t/ha equals about 300 kg of ammonia nitrate and 200 t/ha of Superphosphate (SAMUIL, 2009).

The impact of animal manure on permanent grasslands in Romania has been studied under very different conditions and on different types of grasslands. All the studies, with no exception, pointed out the positive impact of animal manure on grassland productivity.

Ever since the first trials of PAVEL et al. (1962) on the grasslands of *Nardus stricta* in the Parang basin it has been shown that there are increases in yield when fertilized with animal manure of 182%, 223%, and 289%, respectively, in rates of 10, 20, and 30 t/ha of animal manure, respectively.

There has also been a change of floristic composition, i.e. a decrease of the share of the species *Nardus stricta* from 64% to 21% and an increase of the share of the species *Trifolium repens* of up to 20%.

The rates applied varied between wide limits, i.e. between 20 t/ha and 40 t/ha and even up to 60 t/ha. The amount applied depends on the grassland floristic composition and on its state of decay, on the amount of animal manure available.

Thus, on degraded grasslands such as those of *Nardus stricta* it is recommendable to apply 40-60 t/ha of animal manure if we need to get important changes in the soil trophism that result in a radical improvement of the floristic composition and, therefore, in a considerable increase of the yield. On other grasslands such as those of *Festuca rubra*, *Agrostis tenuis*, and *Trisetum flavescens*, the recommended rates are 20-30 t/ha of animal manure.

Stable slurry is a liquid organic fertiliser proper for grassland fertilisation. It can be easily applied on the grasslands where it infiltrates in the soil layer which makes nutrients readily assailable.

Stable slurry is rich in nitrogen, which makes its application in rates too high and alone (with no phosphorus) result in the occurrence and proliferation of nitrophilous species such as *Rumex sp.*, *Heracleum sp.* together with a decrease of the share of legumes.

Yield increases obtained through stable slurry application are high. Research shows that for 1 kg of nitrogen from slurry there is an increase of 60 kg of hay.

Optimal rate of application is 150-200 hl/ha, containing 40-50 kg of nitrogen, 60-80 kg of K_2O and 1.5-2 kg of P_2O_5. Low phosphorus content requires a supplementary fertilisation with 150-200 kg of superphosphate per ha.

Trial carried out by CIORTEA et al. (2000, 2002, 2004) on mountain grasslands show that fertilising increases the share of gramineae both when mowing and when grazing, while the share of legumes increases slightly when grazing if we apply increased rates of nitrogen on haymaking fields (SAMFIRA et MOISUC, 2007).

After Farrugia et al., (2008) the higher fertilization inputs associated with grass cutting for hay has increased the plot homogeneity and reduced the vegetation diversity

The organic fertilization with manure is very important on these weak productive soils with low humus content (JEANGROS et al., 2003; RYSER et. al., 2001).

The result obtained by BENGTSSON et al., (2005) suggest that the difference between organic and conventional farming is more pronounced in studies performed at a small scale that do not take the surrounding landscape into account. This is indicating that farming practice only partly explains the variation in species richness and abundance in agricultural landscapes

HOLE et al., (2005) shows that despite the pressing need for long-term, system level studies of biodiversity response to organic management at the landscape scale, the available evidences indicate that organic farming could play a significant role in increasing biodiversity across lowland farmland in Europe.

The results obtained by JEANNERET et al., 2007 show that biodiversity scores increased from low intensive grassland (fertilized with solid manure) to extensive grasslands.

The research developed by JONASON et al., 2011 show that the main effect of the organic farming on grassland from Sweden took place immediately after transition. The results regarding the biodiversity show that the researches on grassland organic fertilization need to be developed in a long term experiences, because the immediate results aren´t constant, they varying from a year to another.

Without the nutritive elements income, big productions ca not be obtained on these soil types, and the investments made for grasslands establishment would become unprofitable. The required fertilization is explained by the high consume of nutritive elements extracted from soil by the forage plants compassing these grasslands

An effective practice to increase productivity is intensification or fertilizing (VANTU et al. 2009).

EFFECT OF FERTILISATION ON PERMANENT GRASSLAND FLORISTIC COMPOSITION

The substantial amounts of manure of manure applied on grassland may influence the species composition .The organic inputs are associated with the importation of seeds with poor ecological and forager value *Rumex sp* and the smothering of the sward by manure. Also, the effect of sward covering by manure is similar with the scene created by litter accumulation (PLANTUREUX et al., 2005).

Manure fertilization contributes to grasslands phyto-diversity, while spring overgrazing or frequent mowing are disadvantageous (NETTIER et al., 2010).

Questions remain as to what level of organic fertilization optimally maintains the phyto-diversity of meadows. With regard to the effectiveness of organic fertilizer and their impact on plant species composition of meadows there are divergent opinions (SZEWCZYK et al., 2010)

Organic fertilization and rational use of fertilizers can produce substantial increases in the production and biodiversity, and in food quality improvement (VANTU et al., 2008).

Grassland floristic composition is an extremely clear indicator of its forage value. Fertilisation has a strong impact on grassland floristic composition. In any type of grassland, applying fertilisers rationally results in an improvement of the floristic composition decreasing the share of invaluable species and increasing the share of the valuable ones (SAMFIRA et MOISUC, 2007).

In the Central part of Apuseni Mountains, fertilization by manure is the most important component of traditional management that means to increase the biomass yield, species diversity and identity of the cultural landscape maintenance in this area **(**ROTAR, 2010).

Another possibility is the transformation of the meadows to extensive or intensive pastures, in order to decrease the workload. This transformation usually causes significant changes in floristic composition and interspecific relationships relationship, depending on grazing animals and to the way in which the grazing is conducted (LUDVIKOVA et al., 2009, SEITHER et al., 2010).

These practices cause significant reductions in the floristic composition and diversity of mountain meadows (PACURAR et al., 2004, ROTAR et al., 2010, STYBNAROVA et al., 2009).

After DJUKIC et al., (2008) the manure applied on grassland determinates changes in the floristic composition involving a higher percentage of legumes in comparison with other species and grasses.

The floristic composition studies need long time researches, as in the case of biodiversity, to provide sustainable results (DJUKIC et al., 2008).

In a permanent grassland agro-ecosystem the floristic composition varied depending on substances flow, soil nutrients availability and climatic conditions (MOISUC et all 2001).

On the floristic composition of forages will depend it´s quality and the satisfaction of nutritive necessities of animals in relantionship with the final quality of row matter (AMMAERMAN et al 1995)

CONCLUSIONS

The research on the organic fertilization on grasslands is necessary to be realized in long time experiences because the date obtained in the first years of fertilization can determinate the appearance of unsustainable data that can be very different from a year to another.

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