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ENERGY BALANCE AND SUSTAINABLE AGRICULTURE

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Summary

Ffour different crop production systems were evaluated at the Experimental station of Slovak Agricultural University In Nitra-Dolná Malanta, during 1994 – 2000. From comparison of energy balance parameters(total energy input, energy output of dry matter of plant biomass, an energy gain and efficiency) resulted that the highest energy inputs are by single cropping system of maize. By using this method we defined the energy flow with aim – to reduce energy consumption. The four crop sequences cropping system saved 39% of total energy consumption and works with higher energy efficiency(9.97 %). For acceptable energy input and energy efficiency we recommende more diverse crop rotation than double crop sequences .

Keywords: energy balance, cropping systems, crop management practice

Introduction

Food production systems must be environmentally sustainable and their products must be accesseble and safe.The yield production and input of direct and indirect fossil energy and its agri-environmental causalities is especially important in view of the ongoing EU accession proces. Purposeful assert of saving energy consumption requires analysing of cropping technologies and their impact and sustainability(Pospišil, Vilček,2000). Present cropping technologies are energy and economical demanding with comparison to price of agricultural products.The basic tillage systems have a big share of total energy input into Agricultural systems (Pospišil,Macák,1999). Sustainable agricultural practices are under scrutiny by researches and producers. The advanced agricultural production system requires to solve many questions with direct impact on crop production and environment like reducing fossil energy (Rumpel,1992). In addition to stable yield production - account of energy balance is required for assessment of fossil energy saving technologies (Hančárová,1989).
Material and Methods
The objective of this study was to evaluate productivity of four cropping systems with focus on cash crops and to design cropping technology with aims: to produce foodstuff of nutritional quality and sufficient quantity and to reduce the use of fossil energy in agricultural practice. The experimental site is located at the Experimental station of Slovak Agricultural University in Nitra - Dolná Malanta. During 1994 – 2000 years,
three fertilization and tillage treatments in four agricultural systems have been studied.
The crop rotation treatments were as follows: single cropped – maize rotation, double cropped - maize for corn – spring barley rotation, three crop rotation - maize for corn – common pea – winter wheat rotation, four crop rotation – maize for corn – spring barley – common pea – winter wheat
Three basic tillage treatment were:
B1 – conventional cultivation mouldboard plough tillage to a depth 0.3 m (maize), moldboard plough tillage to a depth 0.2 m and surface cultivation of topsoil (winter wheat, barley, common pea)
B2 - offset disc ploughing(0.15 deep) and combined cultivator
B3 – reduced cultivation – shallov loosening (winter wheat, barley, common pea), twice times shallov loosening(maize)
Each tillage treatments had three fertilizing levels:
O – zero level without organic or inorganic fertilization, respectively

PH – balanced fertilizing to the designed yield level, specifically to the crop
PZ – incorporating all above-ground plant material and crop residues as a source of organic matter and inorganic fertilizer for the balance equilibrium level.
Common pest and disease control practices were applied. For weed control were used both herbicides and stick harrow. In common pea herbicides only. Energy balance was calculated according to Preininger(1987) in gigajoule(GJ). Plots for tillage system were implemented in a split plot design. Plots were divided into subplots(11 x 40 m) non randomized within main plots and were subjected to fertilization treatments with four replication.

Results and discussion

The examples of the of basic energy balance factors assessment in total, during 1994 – 2000 years in the investigated agricultural systems under dics ploughingh and inorganic fertilizers only are shown in the table.

The comparison of some energy balance factors by growing maize for corn,common pea, winter wheat and barley in four crop sequences with interaction of B2 PH treatments, average for 1994 – 2000, H.Malanta.

Crop rotation	energy input GJ ha^{-1}	energy output GJ ha^{-1}	energy gain GJ ha^{-1}	energy efficiency in %
Single cropped	33.87	230.95	197.08	6.81
Double cropped	21.61	190.09	168.48	8.79
Three crops rotation	22.93	215.01	192.08	9.37
Four crop rotation	20.66	206.07	185.41	9.97

The highest total energy input, which comprises human and technological work and part of operating inputs – fertilizers, seeds, pesticides,fuel , have been noted in single crop system(maize for corn). The growing system of four crop rotation demands– only 20.66 GJ per hectare. The lower energy input in more diverse crop management system saved 39% of total energy consumption .The highest output of energy and total mass of plant material produced maize for corn like single crop, the less output of energy has been noted in double crop system (maize/ barley rotation). The highes efficiency of fossil energy transformation was in four crop rotation(common pea/ winter wheat/ maize/ barley rotation). On the basis of seven year trial we suggest that the most effective agricultural system of transformation of direct and indirect energy is four crop rotation , with declination of effectivity by three crop sequences - double cropped - single cropped. The industrial agriculture production being maintained by large amounts of external input that results in "waste problems " for the surroundings. Industrial agriculture also utilises non-renewable resources to a greater extend than that which is returned (Šarapatka et al., 1999). The analysis of crop production systems and designing of crop management systems towards sustainable agriculture is a big challenge for agricultural science in transition period of Slovakia. During this seven year trial we noted the highest energy efficiency with lower energy input in four crop sequences due to benefit of more sustainable cropping technology. The energy evaluation of different crop management practices or more specifically crop production practices belongs to the group of exact methods for assessment of energy consumption and energy balance. Significant differences in energy efficiency between single crop technology and double crop technology with comparison to four crop sequences have increased values - 46.4% or 15%, respectively. The accurate assessment of energy input – output system, energy gain, and efficiency lead to identify more energy consumption crop management process for determination of critical uses of farm inputs.

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INFLUENCE OF PASTURE ON THE SUCCESSION AND BIODIVERSITY IN THE NATIONAL PARK MALÁ FATRA

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Summary

The experimental pasture area Strungový príslop (110 ha) is situated on the territory of The National Park Malá Fatra on the altitude 1,150 m. The pasture vegetation was formed by the association *Agrosti-Festuceum rubrae* with up to 56 species. In the lower part the animals relaxed after the free grazing, and spent the nights on the area of 0.5 ha. After their long-lasting stay on the stand the soil was eutrophised and the above-ground biomass was badly ruderalised. The amounts of nitrogen and potassium were three times higher than the values of the control group. They varied from 2,680 to 4,928 mg.kg^{-1} in case of nitrogen and from 165 to 527 mg.kg^{-1} in case of potassium. Changes in the soil and destruction of turf by trampling of the cattle caused the gradual regressive succession of the original phytocoenosis. The group of ruderal weeds *Rumicetum obtusifolii* with the dominance of *Rumex obtusifolius* (27.2%) was formed on the area. There were from 12 to 27 species in the ground cover. The empty spaces comprised up to 29%. The replace of the young cattle by the flock of sheep (450 – 500) with at least 5 goats is proposed to affect by their grazing the top parts of *Rumex obtusifolius*. The areal application of the herbicide Roundup-Bioaktiv (3 l.ha^{-1}) and following reseeding of *Dactylis glomerata* and *Trifolium repens* is most advantageous to form the cover of vegetation and to draw the redundant nutrients from the soil. Other species will gradually appear in the cover and the richness of the plant species in the vegetation will rise.

Key words: National Park Malá Fatra, young cattle, grazing, euthrophisation, revitalization

Introduction

Ground cover belongs to the most rich European ecosystems as far as the number of species is concerned. They are the source of the plant species, natural resources of the country and their biodiversity is the highest on the agricultural land. Their ecological stability is relatively high. Their appearance and existence depends on the farming activity of people (mowing and grazing). If young cattle relax and spend the night, or stay for a longer time on one stand, the soil of the pasture ground cover is eutrophised and above-ground biomass ruderalised under the influence of excrements (Novák 1992).
Grass ground cover in the area of The National Park Malá Fatra belongs among the valuable biotops, and from the point of view of the occurrence of the species it belongs among the irreplaceable ecosystems. Except for the productive function the soil-protective, water-management, bio-homeostatic, landscape-engineering, recreational and medicare, esthetical and cultural functions are most important in these conditions. These functions stress the protection of soil against erosion, preservation of genofond of vegetation and animal communities and their species.

Material and methods

Experimental pasture area Strungový príslop (110 ha) is situated in The National Park Malá Fatra on the altitude 1,150 m, on the north-east incline, not far from Malý Rozsutec, in the cadastraly zone of the co-operative farm Párnica.
The purposes of the ecologically aimed pasture experiment (1999 – 2000) were to detect negative influences of the grazing of young cattle (175 heads) on the pasture turf, to evaluate the changes of the floristic composition of the grass, and on the base of the results to propose the way of revitalisation, keeping the rules of ecological farming. The cattle was situated on the night stand in the period from 15 May to 15 October during several years. Soil-forming substrate was formed by crystalline core with granitoid parent rock, upper layer is formed by medium heavy- heavy, podzolized-podzolic, brown forest and unproductive land. The samples of soil were taken in the autumn period from the depth of 100 – 200 mm to set the total nitrogen (N_t) by Kjeldahl, available P by Schachtschable, available K by Egner, humus by titration (Tjurin) and pH/KCl.
Floristic analyses were made in the spring and autumn periods by the method of projective dominance by Klapp (1965), using the exact squares (0.01m^2) in 4 repeatings. From the floristic records ecological characteristic was calculated - (medium number of nitrogen M.No.N), and value of quality (valuation of vegetation V_v) according to the forage value by Klapp et al. (1953).