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NITROGEN, PHOSPHORUS AND POTASSIUM BALANCE OF ALFALFA CROPPING IN CONDITIONS OF DIFFERENT NUTRITION INTENSITY LEVEL

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Summary

Research of the alfalfa, PALAVA variety, were solved in the polyfactorial stationary field trial at the Research Institute of Agroecology Michalovce – at experimental basis Vysoká nad Uhom over the years 1996 - 1998. The doses of nutrients were calculated at two different nutrition levels (V1, V2), the no-fertilized control (V3) were included too. At the evaluation of total balance, we were calculated with nutrient consumption and utilised amount of N from the mineral and inorganic fertilizers and soil resources, also. The evaluation shows, that balance is expressive negative. The alfalfa hay yield was achieved following amounts of N- content under different variants of nutrition level: V1 – 1064,13 kg. ha^{-1} , V2 – 970,70 kg. ha^{-1} and V3 – 796,27 kg. ha^{-1}. The values of the negative balance were increased upon the nutrition intensity. The evaluation of total balance of P – contents, which we calculated likewise as in N – case, was more temperate in comparison with N – balance. During three utility years, following amounts was comprised, under different variants of fertilizing: V1 – 102,78 kg. ha^{-1}, V2 – 94,80 kg. ha^{-1} and V3 – 91,84 kg. ha^{-1}. The values of negative balance as well as N – case increased by the nutrition intensity level. The total balance of K – contents were negative, too. This one was more temperate essentially (4,5 times more temperate) in comparison with N – balance, however, 4,5 times higher in comparison with P – balance. The yield of alfalfa was succeded following amounts of K contents, under different variants of fertilizing: V1 – 480,08 kg. ha^{-1}, V2 – 444,80 kg. ha^{-1} and V3 – 462,15 kg. ha^{-1}. The values of negative balance was the highest upon the most intensive variant of nutrition, likewise in N and P – cases, but the lowest values were in variant V2.

***Key words*:** alfalfa, nutrient balance, nutrition intensity level, nitrogen, phosphorus, potassium

Introduction

Growing of any crops, especially these ones that are economically important, isn't possible without intensification factors, that ensure adequate fertility and their needed qualitative indexes. At the same time it is necessary to take into account their availability in the relationship to the economy and environment. At growing the most common intensification measure is using fertilizers, in a new conception at the co-operation of a year effect (CIHACEK 1993, HANNAWAY and SHULER 1993, RAUN et al. 1999). These questions are studied by many authors in our country as well as abroad. Especially nitrogen is emphasised as very mobile nutrient, but also some other nutrients and agrotechnical measures (ANDREAS 1996, BURMESTER 1991, ALLEN and ENTZ, 1994, HORN and NEMETH 1991).
The aim of this work is to evaluate fertilizing and to check rationality by the influence of environment.

Material and methods

Research of the alfalfa, PALAVA variety, were solved in polyfactorial stationary field trial at the Research Institute of Agroecology Michalovce – at experimental basis Vysoká nad Uhom over the years 1996 - 1998. The base is situated in the central part of East Slovak Lowland. Field trials were stood on Eutric fluvisol, without irrigation.
The crop stands was established by spring sowing, the sowing rate: 7 million of germinating grains per hectare. The direct forecrop of the alfalfa rape was winter wheat.
Soil conditions: Eutric fluvisol (EF) - is a middle soil, sandy – loam up to loamy soil. The topsoil has bean shaped structure. According to tests made in autumn 1997 followed characteristics were found out: average C_{org} contents 2,073%; $pH_{(KCl)}$ 7,14; H_o (bulk soil density) 1532 kg.m^{-3}; P 41,85%; cont. part. I. cat. (clay content) over 30%; $CaCO_3$ 0,28%; average "S" value 24,1 mmol.100g^{-1}; "T" value 24,9 mmol.100g^{-1}; "V" value 96,72%. Nutrient supply N- 0,130%; P- 47,7 mg.1000g^{-1}; K- 153 mg.1000 g^{-1}; Mg- 122 mg.1000g^{-1}.
Nutrient contents of soil samples was evaluated by using special methods: N-contents by colorimetric analysis; P- contents by EGNER method; K- contents by SCHACHTSCHABEL method.
Climate conditions: The East Slovak Lowland is situated in the warm, semidry to dry area with the average annual air temperature 9,0 °C, the average air temperature in the growing season is 15,2 °C. Annual total precipitation is 557 mm, in the growing season it is 397 mm.
Characteristic of years over the trial: 1996 – temperature expressively under normal, precipitation moderate above normal; 1997 – temperature in normal, precipitation gently under normal; 1998 – temperature expressively under normal, precipitation expressively under normal.
The information about basic climate values were acquired at the station of the Slovak Hydro-meteorological Institute that is situated near the field stationary. The detailed meteorological characteristics of the region were published by TÓTH (1998).

The nutrition (Table.1) was followed in three variants under different intensity (including no-fertilized control) in four repetitions. Mineral fertilizers were fully applied before sowing and heavy scuffler was used. The doses of nutrients were calculated at two different nutrition level, the no-fertilized control were included too.

Table 1: The nutrition intensity according to variants (kg.ha^{-1})

Variant – nutrient	N	P	K
V1 (fertilizing at level 15 t)	30*	36	115
V2 (fertilizing at level 12 t)	30*	32	102
V3 (no-fertilized control)	-	-	-

*...application of nitrogen only in the 1st utility year (1996)

Tillage treatment: The basic and foresowing soil tillage was made by machines and tools common used. We were used the **conventional agrotechnics:** after forecrop harvest we made autumn plough – depth 220-240 mm. The next autumn operation was a ploughed field treatment by hard harrows. At spring soil bed preparation we used middle harrows. The sowing depth was 20-25 mm. At every soil treatment variant we used a roller after sowing.
Herbicides application: Herbicides were applied postemergently: Basagran 600 + Aminex Pur (2,5 l.ha^{-1} + 1,0 l.ha^{-1}), but only on stands in the 1st utility year before first cutting.
The size of variants: 5 m x 10 m, number of repetitions: 4
Nutrient contents of alfalfa dry matter was evaluated by using special methods: N- contents by KJELDAHL method; P-contents by colorimetric analysis; K-contents by spectrophotometric analysis.
At nutrient balance we calculated with N-exhaustion of 50% from soil and equally from mineral fertilizers, P-exhaustion of 13% from soil and 20% from mineral fertilizers, K- exhaustion of 60% from mineral fertilizers.

Results and discussion

The purpose of the polyfactorial stationary field trial was found out the selected chemical parameters, which review is part of the valuable tables. In the field trial conventional variant of agrotechnics and three variants of nutrition were observed. According to information about temporal course of basic nutrition regime and the others watching parameters, expressing as empiric values, it's evident, that these were very different (Table 2).

Table 2: Contents of nutrients over the three utility years and over the year of stand liquidation, according to followed nutrition variants

Nutrition	V1	V2	V3	V1	V2	V3
Year	N (NH_4+) (mg.kg^{-1})			P (mg.kg^{-1})		
1996	10.16	12.13	10.30	52.00	48.60	10.10
1997	9.16	9.06	9.59	49.30	51.20	14.20
1998	11.03	10.90	10.52	55.80	53.60	13.70
1999	9.30	9.84	9.62	52.30	54.30	15.30
	N (NO_3-) (mg.kg^{-1})			K (mg.kg^{-1})		
1996	4.15	3.62	4.05	176.00	173.80	121.00
1997	2.19	3.08	2.89	180.60	183.10	130.80
1998	4.19	3.32	3.84	176.30	178.90	133.80
1999	3.93	4.06	3.62	180.60	189.30	140.30

Evaluation shows, that nutrition balance is expressive negative. The crop yield of alfalfa was explained following amount of N- contents under different variants of fertilizing: V1 – 1064,13 kg. ha^{-1} , V2 – 970,70 kg. ha^{-1} and V3 – 796,27 kg. ha^{-1}. Table 3 represents time development of nutrient balance of total nutrient contents as empiric values.

The negative balance of N (inorg.) contents was ascertained. The values of negative balance were increased under different nutrition intensity level. Evaluation of total balance of P – contents calculated likewise as in N – case confirmed, that correlation was more temperate in comparison with N – balance. During three utility years following amounts of P were recorded: V1 – 102,78 kg. ha^{-1}, V2 – 94,80 kg. ha^{-1} and V3 – 91,84 kg. ha^{-1}. The values of negative P- balance as well as in N – case were increased under raising of nutrition intensity level.
The total balance of K – contents was negative, also. This one was more temperate essentially (4,5 times more temperate) in comparison with N – balance, however, 4,5 times higher in comparison with P – balance. The alfalfa yield explained following amounts of K contents during three utility years, under different variants of fertilizing: V1 – 480,08 kg. ha^{-1}, V2 – 444,80 kg. ha^{-1} and V3 – 462,15 kg. ha^{-1}. The values of negative balance was the highest under the most intensive variant of nutrition likewise in N and P – cases, but the lowest values were in variant V2.
This investigation can be explained by mighty developed radical system and competence of alfalfa to draw nutrients from more inaccessible forms and by presence of nitrogenous bacteria, also (CIHACEK, 1993; KUNCL ET AL., 1995). The

negative balance of phosphorus and potassium we gave to be connected with competence of alfalfa to draw these nutrients from deeper forms, especially on intensive nutrition variants (BURMESTER ET AL., 1991).

Table 3: Time development of pure nutrient balance N, P, K f (t) = ∑ P f (H) + ∑ P f (Hz) - ∑ P f (Ys)

Nutrition variant	V1	V2	V3
Utility year	N (inorg) (kg.ha^{-1})		
I. (1996)	-315,26	-310,53	-268,12
II. (1997)	-415,57	-354,74	-293,81
III. (1998)	333,30	-305,43	-234,34
Total	-398,53	-971,7	-797,27
Utility year	P (kg.ha^{-1})		
I. (1996)	-30,70	-31,34	-30,81
II. (1997)	-40,94	-34,49	-34,01
III. (1998)	-31,14	-28,97	-27,02
Total	-103,78	-95,8	-92,84
Utility year	K (kg.ha^{-1})		
I. (1996)	-144,15	-147,54	-155,88
II. (1997)	-189,60	-161,66	-169,03
III. (1998)	-146,33	-135,60	-137,24
Total	-481,08	-445,8	-463,15

Used symbols: ∑ P f (H) – function of mineral fertilizers use, ∑ P f (Hz) – function of inorganic fertilizers use, ∑ P f (Ys) – function of nutrients exhausted by yield, f (t) – time function

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