EFFECTS OF FARMYARD MANURE AND A BACTERIAL FERTILIZER ON THE PHOSPHORUS AND POTASSIUM CONTENT OF GRAPE LEAVES

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Abstract

A field experiment in a vineyard was conducted to investigate the effects of farmyard manure and a bacterial fertilizer (EM-1) on the nutrient uptake of grape. Farmyard manure and bacterial fertilizer (EM-1) were applied in early spring of 2010 at rate of 500 kg/600m^2 and with dose of 32l/ha, respectively. The study was conducted on sandy soil in the randomized block design with 3 treatments and 3 replications. Grape leaves (of Pannónia Kincse) from the experimental area were collected and were analysed on June and August, 2010 and 2011, respectively. Nutrient contents of leaves were determined. In this paper we summarised the effects of organic fertilizers on the phosphorus and potassium content of grape leaves.

According to our results it can be stated that both farmyard manure and bacterial ferilizer (EM-1) had effects on the potassium, phosphorus contents of grape leaves.

Keywords: farmyard manure, bacterial fertilizer, nutrient, grape

INTRODUCTION

Organic fertilization is one of the oldest methods of soil cultivation. Every possible type of organic manuring has got vital importance for soil fertility preservation (Petróczki, 2004). The nutrient content of organic manures can vary widely depending their source and moisture content. Organic manures play key roles in terms of maintaining or improving soil fertility, soil organic matter and plant nutrition through the direct and indirect effects on microbial activity and nutrient availability (Clark et al., 1998; Haynes et al., 1995).

Use of farmyard manure is a good and old alternative method for plant nutrition for increasing crop production by enhancing soil productivity Dawson and Kelling, 2002; Fraser et al., 1994).

Use of microbial preparations for enhancement of plant production is becoming a new practice in many countries (Rodriguez & Fraga, 1999; Higa, 1994). Bacterial fertilizers contain different microorganisms, such as nitrogen fixing and phosphates solubilizing microorganisms. They have the ability to fix nitrogen from the air and to solubilize phosphate minerals and so make nitrogen and phosphorus available to plants. Biofertilizers may increase the soil microbial sources, improve crop nutrition conditions, may accelerate the decomposition of organic wastes, increase the availability of mineral nutrients, can dissolve soil phosphorus, potassium, can increase the nitrogen content of soil and may enhance the activities of beneficial micro-organisms.

Results of different studies with microbial inoculants have been highly variable. According to many researchers microbial inoculants are promising components of integrated nutrient management systems, other investigators have found less expressed effects of applied biofertilizer (Richardson, 2001; Wu et al., 2005; Hegedus et al., 2008; Schenk & Müller, 2009; Kincses et al. 2008).

The objective of this study was to examine the effects of farmyard manure and a commercially available bacterial fertilizer (EM-1) on phosphorus and potassium uptake of grape for two years.

MATERIAL AND METHOD

A field experiment was set up in a vineyard in 2010. Experimental soil was sandy soil, some properties of soil are included in Table 1.

Table 1. Characteristics of the experimental soil

$pH_{(CaCl2)}$	6.22
K_A	30
Hu %	2.0
AL-P_2O_5 (mg kg^{-1})	1603 mg/kg
AL-K_2O (mg kg^{-1})	202.3 mg/kg

K_A: Plasticity index according to Arany

The variety of grape was "Pannónia Kincse". Farmyard manure was applied on 18th March 2010, at the rate of 500kg/600m^2. Bacterial fertilizer was applied also in that time with dose of 32l/ha. The experiment was arranged in a randomized design with three treatments (1/ unfertilized control; 2/ farmyard manure; 3/ EM-1 bacterial fertilizer) and three replicates.

The applied bacterial fertilizer was a commercially distributed biofertilizer in Hungary, EM-1, which contains different species that belong to for example *Azotobacter croococcum*, *Bacillus megatherium* soil bacteria, microelements, heteroauxin, gibberelin, vitamin B.

For elemental analysis, plant leaves were collected four times: on 27th June, 2010; on 27th August, 2010; on 22nd June, 2011 and on 30th August, 2011, respectively. Leaves samples after drying at 50C° were digested by H_2SO_4-H_2O_2 and by HNO_3-H_2O_2 methods. Total phosphorus content of plant was determined by vanadate-molybdate method given by Olsen & Sommers (1982). Potassium content of plant was analysed by atomic emission spectrophotometry.

Analysis of variance (one-way ANOVA) was carried out on the data in order to provide a statistical comparison between the treatment means. The least significant difference (LSD) test (P=0.05) was used to detect differences between means.

RESULTS AND DISSCUSIONS

Phosphorus content of grape leaves

The phosphorus content of leaves measured in 2010 and in 2011 ranged between 0.24-0.42% (Figure 1.).

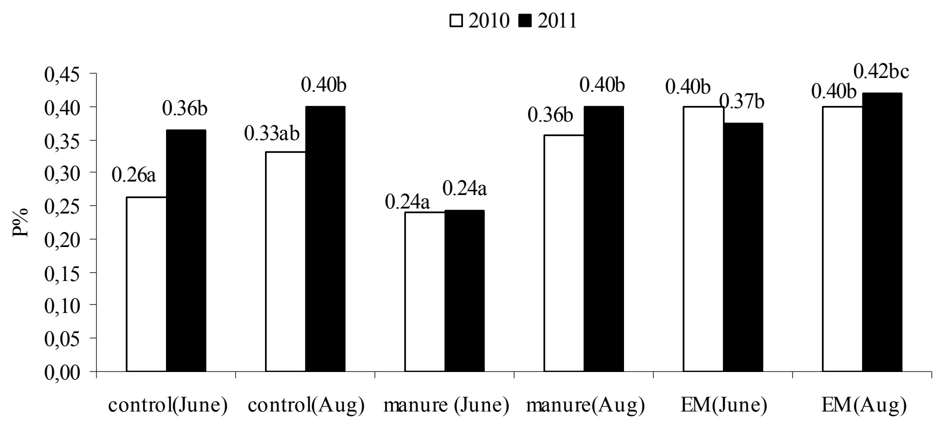

Fig. 1 The phosphorus content of the leaves in 2010 and in 2011 ($LSD_{5\%}$=0.06)

The phosphorus content of grape leaves was higher in August than in June in both experimental years.

In June 2010 the phosphorus content of leaves did not differ in the farmyard manure and control treatments. The farmyard manure contains not dirrect available phosphorus to plant, the P can become available after mineralisation. EM-1 bacterial fertilizer increased the phosphorus content of leaves and this effect appeared already in June 2010.

Phosphorus content of leaves measured in August 2010 were higher in the farmyard treatment and bacterial treatment compared to control. The bacterial fertilizer caused higher increment of phosphorus compared to farmyard.

P of leaves measured in the second year of the fertilizers applications (in 2011) were a little bit higher than in the first year (in 2010).

In June 2011 the P of leaves were the lowest in the farmyard treatment. The reason of this might be the dilution effect (Jarrell & Beverly, 1981). In the bacterial fertilizer treatment there was not any significant difference in the P content of leaves compared to control.

In August 2011 the phosphorus content of leaves were almost the same in all treatments, only in the EM-1 bacterial fertilizer treatment was a little bit higher, than the value of control.

Potassium content of grape leaves

The potassium content of leaves ranged between 1.59-2.37 % (Figure 2.).

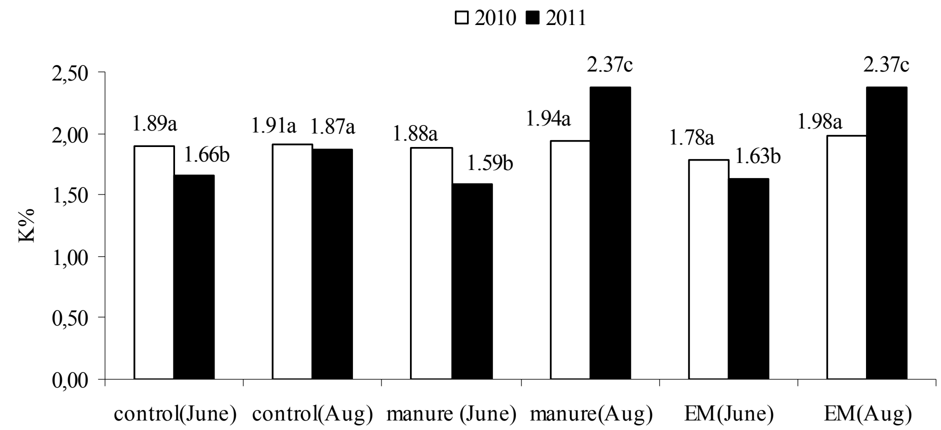

Fig. 2 The potassium content of the leaves in 2010 and in 2011 as a function of different treatments ($LSD_{5\%}$=0.152)

In 2010 there were not any significant effects of treatments on these values. The potassium content of leaves measured in June 2010 was a little bit lower than in August 2010.

In June 2011, either farmyard manure or bacterial fertilizer did not altered the potassium content of leaves compared the control, but in August 2011 both organic fertilizer treatments had significant increasing effects on the leaves K. The increasing effect of manure might be because of its mineralization during two years, and EM-1 bacterial fertilizer effect might be because this product contains different microorganisms which might help dissolve potassium.

CONCLUSIONS

On the bases of our results it can be concluded, that farmyard manure and EM-1 bacterial fertilizer had significant effects both on the P and the K contents of grapes leaves.

Increasing effect of farmyard manure was significant in the first experimental year in August on the phosphorus content of leaves, but increased potassium content of leaves appeared only in the second year (in August) after the manure application.

The EM-1 bacterial fertilizer increased the P content of leaves in the first year and the potassium content in the second year after fertilizer application.

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