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EFFECTS OF PROCESSING MELIORATIVE TILLAGE ON THE SOILS WITH HEAVY MECHANICAL TYPE IN MAIZE PRODUCTION

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SUMMARY

Soils with heavy mechanical type of composition demand a cultivation system that ensures preservation of natural potential and fertility resources. This system must also prevent degrading processes and ensure an optimal water flow within the soil, with an optimal usage of energy and labor. This paper presents the results of the application of the machines and tools for new technologies in maize production. We analyzed the influence of meliorative tillage and effect of conventional tillage systems on maize production.

Keywords: tillage, grain yield, drainage plough, vibrating subsoiler, energy

INTRODUCTION

Soils with heavy mechanical texture - soils HMT require processing system that ensures conservation of natural resources of fertility and prevents soil degradation processes, especially in terms of optimization of energy use, action and water.

A large number of researchers who have studied this type of soil [10, 20, 27], point out that soil HMT possess a number of specific characteristics, especially the unfavorable physical and water-air properties [16, 18, 23]. Because of the wide distribution this type of soil, there is a need to modify existing methods of treatment, with a combination of existing and new technologies in the production process the most important crops [3, 6, 7].

Heavy soils demand adequate tillage practice, which can preserve natural fertility potentials and restrain degradation processes in soil [17]. The preservation of soil bio-system, regulation of water and air regime, moisture conservation, as well as rational energy utilization and production level of heavy soils must be provided by tillage machinery [21].

The effective tillage practice gives opportunity to correct negative physical and water features, increasing soil fertility and crops yield. The different tillage systems also influence the conservation of N [22], loosing N via leaching and de-nitrification [15] and N uptake by plants. The aim of this study was to investigate the effects of meliorative tillage on growth and yield

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of sunflower, maize and wheat, as well as change of N content in soil, under rainfed conditions on a calcareous clay chernozem type of soil.

Researches with a new processing techniques that are applied to soil HMT [8, 9], are aimed at repairing the possibility of unfavorable physical and hydro-physical properties, in order to raise fertility of these soils, and crop yields [11, 12]. Bearing in mind that in Serbia we have more than 400,000 ha of soil HMT and approximately 1 million hectares of degraded soil in different ways, this kind of researches are important and useful from the standpoint of science, and even more from the point of using this research into practice.

MATERIALS AND METHODS

The experiment was set up at the Krnješevci experimental field of the Maize Research Institute (44°54`N latitude, 20°08`E longitude), on a calcareous clay chernozem type of soil, under rainfed conditions during 2011. A parcel of 10 ha was sowed with maize. Half of the parcel was divided in two subplots: treatment (where meliorative tillage (MT) during 2010.) and control (conventional tillage (CT) during 2010.). All other cultivation practices were identical for each subplot. The previous crop for corn was wheat.

Meliorative tillage (MT) consists of mole drainage and sub-soiling. Mole drainage was performed with the drainage plough DP-4, resulting in drainage canals on the depth of 60-80 cm, 5 m apart. Subsoiling was done with the vibrating subsoiler VR 5/7, which consists of 5 working organs 60 cm apart, operating 50 cm deep.

On the control plot conventional tillage (CT) was applied. Plowing was carried out by using a rotary plough „Lemken EuroPal 8“, at a depth of 30-35 cm.

Maize (*ZP-360 Ultra*) was sowed on April 28th 2010., with sowing density 58,300 plants per hectare. The 150 kg ha^{-1} of Ammonium nitrate (34% N) and 140 kg ha^{-1} of Urea (46% N) were applied before sowing maize.

The soil was sampled for analysis to determine N content at the beginning and at the end of vegetation. The samples were taken from three layers of effective rhizosphere zone: 0-30 cm, 30-60 cm, and from 60-90 cm layers. Average samples were used to determine the ammonium (NH4) and nitrate (NO3) from 1 M NaCl + 0.1 M $CaCl_2$ extracts by the method of [24]. Their sum was expressed as the mineral N. Maize was harvested on September 23rd 2011. The yield was determined by taking five representative samples from area of 1 square meter.

RESULTS AND DISCUSSION

Distribution of rainfall during 2010. is shown in Fig. 1, while the average monthly temperature is shown in Fig. 2.

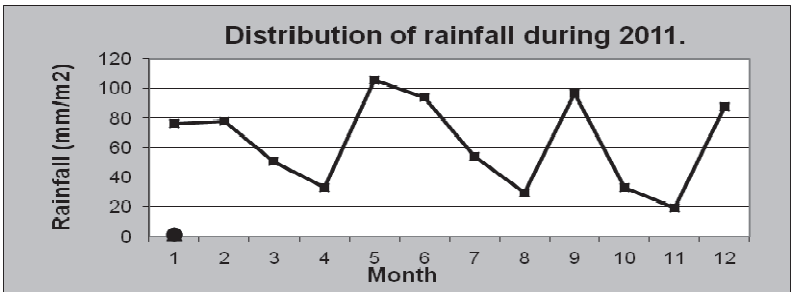

Fig. 1. Distribution of rainfall during 2011.

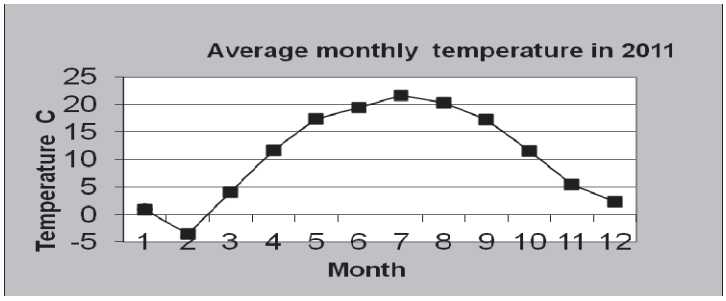

Fig. 2. Average monthly temperature in 2011.

Content of available N in soil had decreasing trend during vegetation, as was expected, in all treatment subplots.

Significant decrease of N content, from sowing period, could be observed after phase I for (Table 1.), irrespectively to relatively high N loss from sowing to phase I, which is connected to proximity of fertilizer application [13, 25].

When N quantity consumed by plants [5] is also taken into consideration, it could be pointed out that total N deprivation by leaching and evaporation was higher in the control plot, which is in accordance with results of [22].

Tab. 1. The changes of available N content in soil, influenced by meliorative tillage and convetional tillage in maize production

Depth (cm)	Treatment (MT)				Control (CT)			
	Phase I - (may 2011)							
	vlaga (%)	NO3 (kg ha^{-1})	NH4 (kg ha^{-1})	Ntot (kg ha^{-1})	vlaga (%)	NO3 (kg ha^{-1})	NH4 (kg ha^{-1})	Ntot (kg ha^{-1})
0-30	13.6	66.4	59.7	126.2	12.0	47.7	71.9	119.6
30-60	13.9	107.1	136.5	243.6	12.7	96.2	85.1	181.3
60-90	18.3	17.3	50.6	67.9	15.0	70.2	99.0	169.2
Av. / Sum	15.3	190.9	246.8	437.7	13.3	214.1	256.0	470.1
	Phase II - (june 2011)							
0-30	19.2	172.2	3.5	175.7	20.3	179.9	53.4	233.3
30-60	19.1	73.1	3.8	76.9	19.0	77.8	9.0	86.8
60-90	18.2	82.2	3.3	85.5	18.6	90.2	16.6	106.7
Av. / Sum	18.8	327.5	10.5	338.0	19.3	347.9	79.0	426.9
	Phase III - (july 2011)							
0-30	18.3	91.8	2.8	94.6	17.1	102.2	4.0	106.2
30-60	17.2	83.9	2.1	86.0	17.5	57.0	2.6	59.6
60-90	17,1	92.7	4.9	97.6	17.0	92.3	0.0	92.3
Av. / Sum	17.5	268.4	9.8	278.2	17.2	251.5	6.6	258.0
	Phase IV - (august 2011)							
0-30	15.4	119.2	19.1	138.3	15.2	85.1	19.7	104.8
30-60	15.4	52.2	5.8	58.0	15.5	47.8	9.2	57.0
60-90	16.2	30.5	5.4	35.9	15.3	47.1	4.8	52.0
Av. / Sum	15.7	202.0	30.2	232.2	15.3	180.0	33.8	213.8
Grain y. (tha^{-1})	7,08				6,38			

The meliorative tillage didn't affect N content significantly [1, 16, 19, 26]. The higher N output

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by plants, leaching and evaporation were observed in control plot (448.1 kg ha^{-1}), during vegetative period, which is about 24.3% higher, compared to treatment plot.

Grain yield was higher in treatment 9.9%. The results of this reserch indicate that reducing soil compaction have positive influence on N uptake and higher grain yield [14]. The same statement can be confirmed from the results achieved in this research. No significant influence of moisture or N content on yield of breeding cultivars has been observed during the research. Nevertheless, the achieved yields were significantly different between treatment and control plot. These results suggest that research have to be extended to more influential factors on the yield, not just the humidity and the presence of N.A. wider study of this issue will continue in the future.

CONCLUSION

According to our data, land reclamation tillage, applied on calcareous clay chernozem type of soil under rainfed conditions, during this research, the higher N output by plants, leaching and evaporation were observed in the control plot. The observed situation, together with higher grain yield, obtained in treatment could be explained by better N utilization from soil and its lesser deprivation during vegetation. The research also points to better use of moisture by plants in stressful periods in terms of reclamation processing, resulting in higher yields compared to the control plot.

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