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SUPPLIES OF MOISTURE FOR CORN PER APPLICATION OF MINERAL FERTILIZERS AND DIRECT SOWING

The effect of fertilizers on supplies moisture for maize for direct sowing and conventional tillage was researched. Supplies of moisture during the growing season of the crop did not significantly differ in variants, but the efficiency of their use increased in a direct proportion to the norm of mineral fertilizers. Thus, on the formation of 1 g of dry matter was used 324 g of the soil water in the control variant. At the same time application of $N_{120}P_{100}K_{100}Mg_{60}$ it was 218 g. However, delay of the plants growing in the early stages for direct sowing the yield was lower at 0,69-0,90 t/ha compared with traditional tillage and grain moisture was higher at 0,22-3,02 %.

Keywords: mineral fertilizers, maize, supplies of moisture, direct sowing (without tillage), traditional tillage

Introduction. There is a warming trend in Earth climate. It was established that over the last 100 years temperature increased for 0.5 °C [6]. Corresponding increase in continental climate type is peculiar to the conditions of modern Ukraine. In this regard it is important rationally use soil moisture and improve crops productivity level. Zero tillage and direct sowing are effective technologies for this tasks solution, which is confirmed by the results of foreign and Ukrainian scholars [3].

Zero tillage technology minimizes mechanical impact on the soil surface layer and moisture evaporation decreases. According to Cherepanov [7], losses during this physical process for the growing season crops were 41 mm that was for 150 mm less compared to the same figure for the traditional cultivation. Introduction of direct sowing infiltration of water increased nearly for 3 times [2]. Soil plowing destroys the system of soil capillaries that contributes to the rapid rainfall absorption. It should be noted that the lack of "plowing sole" contributes to raising the capillary moisture from the lower layers to the upper.

Direct sowing reduction of evaporation, increase of infiltration capacity and the possibility of "underground irrigation" promotes better moisture availability of the plant. Collares et al. [9], Streck et al. [10] found that the difference between productive moisture content by conventional and zero tillage systems can reach 36-45 % in favor to the traditional one. Bulygin S. [1] and A. Pikovsky [5] pointed out that the biggest difference between the performance characteristics of the soil layer was for 0-20 cm layer. Scientists explain this phenomenon by decrease of surface temperature by plant residues in areas with zero cultivation technique application.

It is necessary to study the effect of fertilizers on soil moisture availability for crops, particularly for maize, for effective implementation of direct sowing technology into production.

The aim of the research was to study the effect of different norms of fertilizers on moisture availability for maize for direct sowing compared to the traditional cultivation. *Object of study* - moisture reserves in dark Greyzem Haplic soil. *Subject of research* – moisture usage during the growing season of maize and moisture accumulation in 0-100 cm layer.

Materials and methods. Researches of estimation of the use of different rates of fertilizers at the direct sowing of corn were conducted during 2011 – 2012 years in experience of department of agricultural chemistry and quality of plant-grower in the name of Dushechkin of National University of Life and Environmental Sciences of Ukraine in the farm of the Boryspil district of the Kyiv region.

Area of registration plot – 100 m², the repeated of experience is 3-multiple. The hybrid of Emilio F1 (originator – KWS) was grown on the experienced field.

Soil of the experienced area – darkly-grey, which was characterized by the weak-acidic reaction of the ground solution, higher maintenance of mineral connections of nitrogen, high degree of available phosphorus and potassium and middle of exchange a calcium and magnesium.

The direct sowing carried out by the special seeder SuperWalter W1770. Conventional tillage of soil compared to the experience for determination of efficiency of direct sowing. It is consisted of next operations: disking (10-12 cm), autumn ploughing (25-27 cm), preseed cultivating (10-12 cm), sowing (4-5 cm).

Standard fertilizers were used in researches: ammonium nitrate, ammophos, potassium chlorous, sulfate of magnesium. In a control variant not top-dressed. The rates of mineral fertilizers grew from N₃₀P₂₅K₂₅ Mg₁₅ to N₁₂₀P₁₀₀K₁₀₀Mg₆₀. The selection of standards of plants of corn, realization of the biometrical measuring and laboratory analysis is carried out in accordance with existent methodologies [11].

Research results. There was a positive impact of the technology on the water regime of dark Greyzem Haplic in the first years of application of direct sowing of maize. So, in shooting phase, amount of moisture in the 0-20 cm layer were higher for 11-26 % compared to the conventional tillage that is indicated in table 1. This phenomenon was due to the positive impact of direct sowing crop residues on the soil surface.

In the phase of 9 – 10 leaves for direct sowing, moisture content in 0 - 100 cm layer was higher for 6.48 – 21.0 % compared to the traditional cultivation. This trend has contributed to the optimization of maize moisture availability in the critical period (between phases of panicle throwing and flowering) [4]. It should be noted that the direct sowing amount of moisture in one meter layer in application variants of mineral fertilizers were higher for 9 – 18 mm compared to control levels. The reason was increase of the maize leave index from 3.89 to 4.62 in variants with fertilizers that changed the field climate significantly.

Table 1

Fertilizers influence on direct sowing maize moisture availability in dark Greyzem Haplic in 2011 – 2012

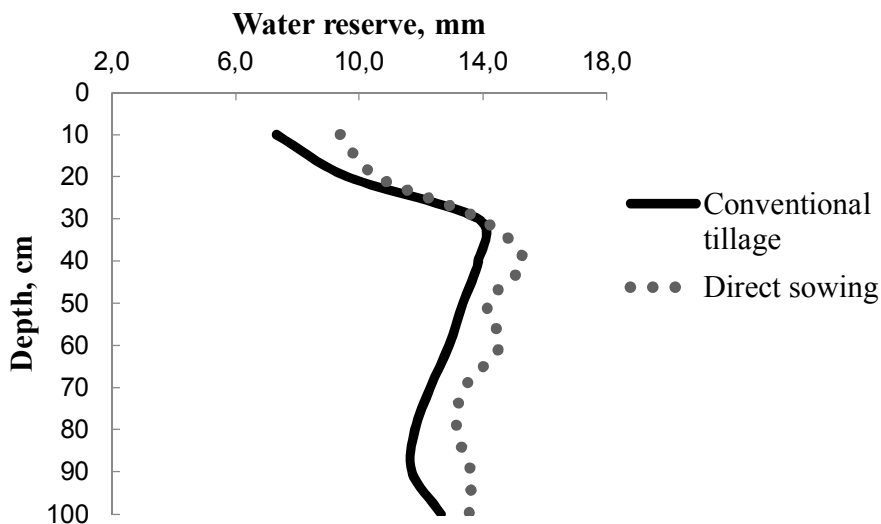
Experiment variant	Moisture availability in 0-20 cm layer (shooting phase)		Moisture availability in 0-100 cm (phase of 9-10 leaves)		Moisture usage for period of vegetation, t/ha			Dry biomass, π /ha	Water usage coefficient**	
	mm	% to CT*	mm	% to CT	From accumulated in soil	From rainoff	total		g/g	% to CT
Control (without fertilizers)	29,0	+26,4	117	+6,48	555	3307	3862	11,9	324	+16,6
N ₃₀ P ₂₅ K ₂₅ Mg ₁₅	29,2	+15,4	126	+6,81	550		3857	13,7	281	+13,0
N ₆₀ P ₅₀ K ₅₀ Mg ₃₀	29,2	+22,0	135	+18,9	517		3823	15,6	246	+13,1
N ₉₀ P ₇₅ K ₇₅ Mg ₄₅	28,2	+22,4	133	+21,0	590		3896	15,8	247	+23,7
N ₁₂₀ P ₁₀₀ K ₁₀₀ Mg ₆₀	27,5	+11,3	132	+15,9	563		3870	17,8	218	+18,5

% to CT* – index change comparing to the same with conventional tillage (CT)

Water usage coefficient* – moisture g/g of dry matter

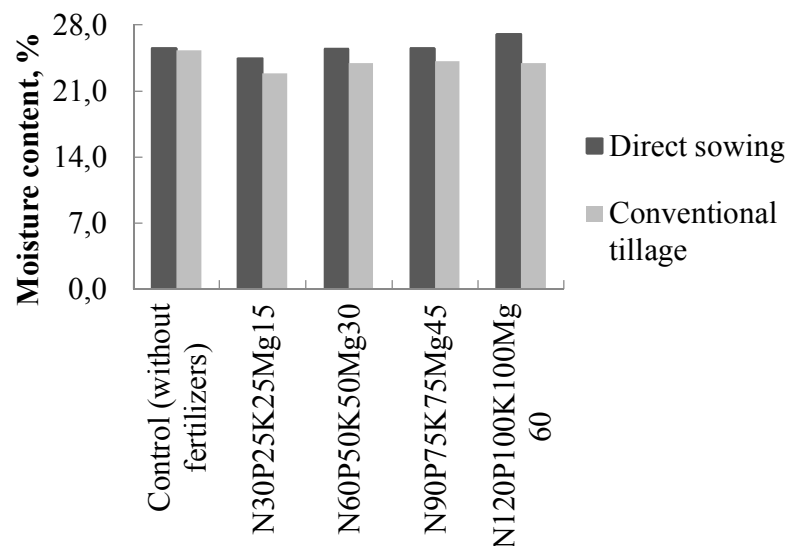
It was established that soil moisture usage for direct sowing did not differ significantly in the experiment variant, and its usage effectiveness was inversely proportional to the norms of mineral fertilizers. It was used 324 g of water for the formation of 1 g of dry matter in control variant. In the variant with application of $N_{120}P_{100}K_{100}Mg_{60}$ amount of used water for the formation of 1g of dry matter was 218. This means that fertilizers significantly increased content of colloid-bound water amount in plant leaves that resulted by reduction of transpiration intensity. Optimization of plants nutritions contributed to the productivity growth of photosynthesis and, consequently, accumulation of dry matter was more intensive than moisture loses. Scientists who have studied impact of fertilizers and cultivation methods on the above parameters got similar patterns in their experiments [8].

The variation of moisture reserves in soil profile indicates that the difference between the figures for direct sowing and conventional tillage was essential in all meter layer (pic. 1). This pattern was observed at the beginning and in the middle of maize growing season. In particular, the phase of 9 – 10 leaves for direct sowing moisture reserves were for 1.4 times higher in the layer 0 – 100 cm than in traditional cultivation. Gradually phase of technical maturity indicators aligned.



Pic. 1. Dependence of water reserves (mm) in soil meter layer in 9-10 leaves phase with inputs of $N_{120}P_{100}K_{100}Mg_{60}$ and different tillage methods

Despite of some optimal parameters of the water regime by direct sowing, yield capacity was lower for 0.30 - 0.93 t/ha than for conventional tillage. The reasons for this were several other factors, including increased soil density and slow warming of the surface layer in spring. In the conditions of soil physical parameters deterioration, maize plants were significantly behind in growth and development resulting later phase of technical maturity than traditionally cultivated plants. As a result, grain moisture was higher for direct sowing that is indicated in picture 2.



Pic. 2 Dependence of grain humidity on amount of fertilizers and soil cultivation methods

Conclusions. Water treatment of dark Greyzem Haplic soil optimized after application of direct sowing, particularly in the 0-20 cm layer in the shooting phase and in the meter layer – during flowering. Mineral fertilization effected more efficient usage of soil moisture. However, the grain moisture by direct sowing was higher compared to the traditionally cultivated, and yield capacity was lower.

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Анотація

Бикін А. В., Тарасенко О. В.

Вологозабезпечення рослин кукурудзи за внесення мінеральних добрив і прямої сівби

Досліджено вплив мінеральних добрив на вологозабезпечення рослин кукурудзи за прямої сівби і традиційного обробітку ґрунту. Запаси вологи протягом вегетації культури за цих умов істотно не відрізнялися, проте ефективність їх використання зростала прямо пропорційно до норми мінеральних добрив. Так, у контролі на формування 1 г сухої речовини рослинами використовувалося 324 г води, а за внесення $N_{120}P_{100}K_{100}Mg_{60}$ цей показник становив 218 г. Однак через затримку росту рослин на початкових етапах за прямої сівби урожайність була істотно нижчою на 0,69 – 0,90 т/га, ніж за оранки, а вологість зерна – вищою на 0,22 – 3,02 %.

Ключові слова: мінеральні добрива, кукурудза на зерно, запаси вологи, пряма сівба, традиційний обробіток ґрунту

Аннотация

Быкин А. В., Тарасенко А. В.

Влагообеспеченность растений кукурузы при внесении минеральных удобрений и прямом посеве

Исследовано влияние минеральных удобрений на влагообеспеченность растений кукурузы при прямом посеве и традиционной обработке почвы. Запасы влаги в течение вегетации культуры в этих условиях существенно не отличались, однако эффективность их использования возрастала прямо пропорционально к норме минеральных удобрений. Так, на контроле на формирование 1 г сухого вещества использовалось 324 г влаги. В свою очередь, при внесении $N_{120}P_{100}K_{100}Mg_{60}$ этот показатель составлял 218. Однако из-за задержки роста растений на начальных этапах при прямом посеве урожайность была ниже на 0,69 – 0,90 т/га по сравнению с традиционной обработкой, а влажность зерна – выше на 0,22 – 3,02 %.

Ключевые слова: минеральные удобрения, кукуруза на зерно, запасы влаги, прямой посев (без обработки), традиционная обработка почвы