

INFLUENCE OF BASIC TILLAGE DEPTH ON SOIL HUMIDITY RESOURCES AND SUNFLOWER YIELDS

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Abstract

In the period 2002-2005 it was studied the effect of the soil ploughing depth for sunflower on soil humidity regulation and yields. It was tested two ploughing tillad on depth 23-25 cm and 31-33 cm. The results present that the deeper ploughing on 31-33 cm increases total water supplay quantity of water productivity in soil and yields of sunflower. The effect of ploughing tillage on depth 31-33 cm with respect to water productivity continues to flowering phase. Yields are increased with 165 kg/da.

Key words: sunflower, soil tillage, soil humidity.

INTRODUCTION

A lot of researches are made in regards to the soil moisture under the influence of the tilth. The results obtained are highly controversial due to the soil differences, the technological production and the purposes of the researches (Borisov and Simeonov, 1979; Borisova and Dimitrov, 1996; Shopov et al., 1965, Kluchnov, 1986, Baumhardt et al., 1993; Yoo and Touchton, 1989). The results are mostly in regards to the moisture containment in weight percentage. There are very few researches that give a perspective about the total and productive moisture stock in the tilth layer and under the tilth layer (Borisova and Nikolova, 2006; Saldzhiev and Stoilova, 2007; Stoimenov et al., 2007).

The purpose of the research was to determine the impact of the basic tillage depth on the moisture reserve, the amendment of the total water reserve and the productive moisture throughout the vegetation of the sunflower and their impact on the level of yield.

MATERIALS AND METHODS

In a field test held in the field of the Field Crops Institute Chirpan it was studied the influence of two types of basic tillage depth (23-25 and 31-33 cm) over the moisture reserve and the amendment of the quality of the productive moisture during the vegetation

of the sunflower. The culture was grown in non-irrigated conditions in Pellic vertisols with humus horizon-70-115 cm, humus content of 3.5-3.7 %. The soil is of heavy mechanical constitution with mainly clay fraction of 65%, low in moving nitrogen and well stocked with potassium. The approximate weight of the plowing layer is 2.45 g and the bulk density of the layer from 0 to 50 cm varies between 1.24-1.28 g/cm³. The wilting humidity point is between 19.5-22.5 %. FMC for layer 0-50 cm was 34.2 %, 51-100 cm was 31.6 % and 101-200 cm-28.7 %. The soil moisture was determined by the weight method at 100 cm depth. The total water supply was determined by the percentage of moisture and the bulk density. The productive moisture was calculated by the difference from the total water supply and the quantitative productive moisture. These indicators are determined during the basic phases of the development of the sunflower – germination, fifth-eight leave, budding forming of the disk, flowering and ripening. The dates of the reading of the moisture reserve are as follows: 17.03, 17.04, 17.05, 17.06, 7.07, 17.07 and 17.08. The sowing was in the period 20-25.03. The yields is equated to 10 % moisture of the seeds. The sum of the temperatures during the experimental period is within the norms. The rainfall during the vegetation period is described in Table 1.

Table 1. Raifall distribution in vegetation period of sunflower

Years	Mounths						Sum
	IV	V	VI	VII	VIII	IX	
2002	66.6	28.9	17.2	176.4	35.4	49.7	374.2
2003	55.1	73.1	33.2	105.6	10.3	27.9	305.2
2004	17.6	93.3	135.8	36.8	72.8	39.5	395.8
2005	18.1	50.1	72.5	158.1	51.6	91.8	442.2
2006	67.2	19.2	32.9	66.6	48.6	39.9	274.4
2002-06	44.9	52.9	58.3	108.8	43.7	49.8	358.4
1928-07	44.9	62.4	65.7	54.0	41.5	34.4	302.9

In 2006 was reported considerably lower rainfall, 2003 is equal to the average yearly, and the rest three years 2002, 2004 and 2005 are with considerably higher rainfall. Despite the overall ascertainment, the distribution of the rainfall is not even during the most important phase for the sunflower – flowering – start of filling the seeds. In 2002, from 10-25 July there was no rainfall and the disks were small in diameter which led to lower yield. The excessive rainfall during this period had little impact over the sunflower. In July 2004 and 2005 there was no considerable rainfall for 22 days – from 1/07 until 22/07 for the first, and from 15/07 until 05/08 for the second. Due to the good water reserve from the previous month the drought did not led to considerable decrease of the yield. 2006 was considerably low in rainfall and with drought from 15/07 – 06/08. The best year for the sunflower was 2003, when there was considerably even rainfall.

RESULTS AND DISCUSSIONS

The data for the influence of the tillage depth over the water reserve of the soil, gathered before sowing are shown in Table 2. The analysis shows that for tillage depth of 31-33 cm average for the period, there is considerably high water reserve in the layer 0-30 cm and 0-50 cm. For the horizons 0-10 cm and 0-20 cm the total reserve, as well as the quantity of the productive moisture, at both depths is equal. Early the most variable results in the quality moisture are in the layer 0-10 cm. The growth and development of the sunflower during the vegetation is implemented with different content of productive moisture in the soil and depends on the depth of the basic tillage (Table 3). Average for the period, there

are no big differences in the content of productive moisture in the layers 0-10 and 10-20 cm. This can be explained with the excessive rainfalls during the months of April, May and June in 2002, 2003 and 2004, which equalized the content of the total water reserve of the soil in these layers. Because of the better physical condition of the soil and the creation of more powerful water-accumulating layer during plowing in 31-33 cm, the productive moisture for the layers 0-30 and 0-50 cm is higher than this during plowing in 23-25 cm with respectively 5 m³/ha in phase 5-8 leaves and 2 m³/ha in the buttoning phase (total for the layer 0-30 cm). For the soil layer 0-50 cm for the phases mentioned above the differences are 17 m³/ha and 10 m³/ha respectively. During the period between the phases buttoning-flowering there is fast gaining of biomass and the plants grew in height with 1 cm daily average. During this period the quantity of the absorbable moisture is used up, as well as this in the in the 50-100 cm layer. Regarding this, it is safe to say that the impact of the plowing is exhausted in the "beginning of the flowering" phase. The productive moist in the layer 0-30 cm then decreases to 2-3 cm³/ha and the yield depends only on the quantities and distribution of the summer rainfalls. The higher content of productive moisture in the layers 0-30 and 0-50 cm leads to accumulating of larger biomass, forming of more seeds in the disks. The formation of the yield to great extend depends on the rainfall quantities during the summer months. In three of the cases (2002, 2003 and 2005) we have demonstrated higher yield when the basic tillage is deeper – Table 3. In two of the years there is no prove but, average for the multi-annual period with the deeper tillage variant there is higher yield with 16.5 kg/ha or 57%.

Table 2. Water supply for sunflower pre-sowing time (mm)

Soil layer, cm	2002		2003		2004		2005		2006		Average	
	TWS	WP	TWS	WP	TWS	WP	TWS	WP	TWS	WP	TWS	WP
Tillage of 23-25 cm depth												
0-10	33	10	27	5	29	6	29	7	40	17	32	9
10-20	36	11	35	10	36	11	36	11	39	14	36	11
20-30	39	13	38	12	38	12	38	12	42	16	39	13
0-30	108	34	100	27	103	29	103	30	121	47	107	33
0-50	187	63	182	59	181	57	185	62	211	87	189	66
0-100	370	120	404	155	380	130	407	158	431	181	399	149
Tillage of 23-25 cm depth												
0-10	36	14	28	6	29	6	28	6	40	17	32	10
10-20	38	13	38	12	36	11	37	12	40	15	38	13
20-30	39	13	41	15	40	14	39	13	45	19	41	15
0-30	113	40	107	33	105	31	104	31	125	51	111	38
0-50	192	68	190	66	188	64	190	65	220	96	196	72
0-100	386	136	420	170	396	146	411	161	472	192	411	161

TWS-total water supply; WP-water productivity

Table 3. Yield of sunflower (kg/da) on the period 2002-2006

Depth of plowing (cm)	Years					Average		
	2002	2003	2004	2005	2006	mg/da	D	%
23-25 cm	160.7	384.5	345.4	305.3	242.5	287.7	-	100
31-33 cm	192.1***	406.7***	339.1	327.4***	255.8	304.2	16.5***	105.7
GD	5.0%	6.4	9.6	7.7	11.8	14.0	10.0	3.5
	1.0%	8.6	12.8	10.2	15.8	18.7	13.3	4.6
	0.1%	11.2	16.8	13.4	20.7	24.5	17.3	6.0

CONCLUSIONS

The tillage with depth 31-33 cm for the sunflower improves the physical condition of the soil, which results in better water reserve in the soil, compared to the tillage with depth 23-25 cm. The deeper tillage increases the quantity of productive moisture in the soil, and the effects are limited in the phase of mass flowering of the sunflower. These better conditions help the higher average yield of the plants – 16.5 kg/da more.

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