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EFFECT OF AGROTECHNICAL MEASURES ON THE AGROPHYSICAL PROPERTIES OF THE SOIL.

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Abstract. A 3-year study results in the typical sierozem soils of Samarkand Province, Uzbekistan revealed that soil tillage to 30-35 cm depth has reduced the number of biennial and perennial weeds in the winter wheat field for 30 -40 %, soil compaction – for 0.08 g cm^{-3}, increased soil porosity for 1.5-2.0%,water infiltration for 6-hours – for 87-101m^3, ha^{-1}, and improved soil microbial activity. Grain yield of winter wheat during the study years ranged from 5.94 to 6.26 t ha^{-1}.

Keywords: winter wheat, soil tillage depth, weed infestation, soil bulk density, soil porosity, water infiltration.

INTRODUCTION

It is known that weeds in wheat fields adversely affect the crop yields, soil fertility and the environment. However, the weeds are found not only in the wheat fields but also in other agricultural fields. Similarly to other agricultural crops, the weeds consume soil nutrients and amounts of adsorbed nutrients are substantial. Almost all weed species are nitrophilic (nitrogen demanding), intensively grow and develop in the soils with good nutrients suppl y. In its turn, due to cultivation of winter wheat for bread and bakery products and with the aim to provide sufficient nitrogen nutrition to the crop the nitrogen fertilizer rates are applied in the winter wheat fields for 2 -fold higher than phosphorus and for 3-fold more than potassium fertilizer. This also creates favourable conditions for rapid growth of various weeds in the wheat fields and increases their harmful effects on the environment [2,6].

Application of appropriate agrotechnological measures for cereals production is one important factor to increase grain production and yields of winter wheat. This task includes inculcation of intensive grain production technologies, efficiently use of irrigation water, fertilizers and other chemicals, environment safety and protection of cereal crops from various diseases, pests and weeds [7,8].

Proper soil preparation for seeding is an important agrotechnological method for achieving high yields of crops with early harvest of the yield. Soil tillage depth is differentiated depending of soil type, plow layer, compaction and weed infestation in the field. Particularly, soil tillage depth in the light sierozem soils of the Andijan region and fertile soils of the Surkhandarya region is 35-40 cm, in Tashkent, Samarkand, Sirdarya, Kashkadarya, Bukhara Provinces and Republic of Karakalpakstan – 30 cm and in the Khorezm region – 32-35 cm [1]. The research results also showed efficiency of usage of two-tiered plow which results in

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reduction of weeds in the agricultural field s for 2-3 times.

Grain yields of winter wheat in some fields of the Zarafshan oasis, Uzbekistan are ranging from 3.0 to 3.5 t ha^{-1}. The low grain yields are due to agrotechnical and chemical measures still not well developed for the winter wheat in this area. Hence, the aim of our study was an investigation of influence of soil tillage depths on soil: (i) aggregates, (ii) bulk density and porosity, (iii) water infiltration and (iv) microbial activity.

MATERIALS AND METHODS

A field experiment with winter wheat cultivar Nota for investigation of influence of the soil tillage depths of 20-25; 25-30; 30-35 and 35-40 cm on agrophysical properties typical sierozem soil was carried out in farmer's field located in Taylok district of Samarkand Province, Uzbekistan . The experiment was three replicated with plot area each of 480 m^2.

The typical sierozem soil was non-saline and humus content in the top 0-25 cm soil layer was 11.1 g kg^{-1}, total nitrogen - 1.3 g kg^{-1}, total phosphorus - 1.3 g kg-1, total potassium - 23.4 g kg-1, NO_3-N - 14 mg kg^{-1}, available phosphorus - 17 mg kg^{-1} and exchangeable potassium - 224 mg kg^{-1}. The soil pH was 7.1.

Winter wheat received $N_{200}P_{140}K_{100}$ kg $ha^{-1}$of mineral fertilizer and application timing of the fertilizer were as following: 70 % of P-fertilizer and full rate of K-fertilizer were applied before soil till, 20 % of N - fertilizer and 30 % of P-fertilizer were incorporated in soil at planting. Remaining 80 % of N-fertilizer was applied in two splits: at tillering and shooting growth stages of the crop.

Phenological observations, biometric measurements and yield determinations were conducted according to field experimentation methods [3, 4] on delineated model plants in the area of 1 m2 in each treatment and replication of the experiment. Standard procedures [5] were applied for determination of soil water physical and agrophysical properties (dry and wet sieving, water infiltration, bulk density and porosity).

RESULTS AND DISCUSSION

Our study results showed the efficiency of soil tillage depth against weed infestation in the wheat field. In that, soil tillage depth has primarily influenced soil aggregation, i.e. aggregates with size of 0.25 mm and l ess. Amount of soil aggregates of <0.25 mm in the 0-25 and 25-50 soil layers before winter wheat planting was ranging from 27.4 to 30.9 % and 25.4 to 28.9 % respectively while it ranged from 26.7 to 30.9 in the 0-25 cm soil layer and 23.5 to 29.2% in 25-50 cm soil layer under soil tillage to 20-25; 25-30; 30-35 and 35-40 cm depths. Amount of water-stable aggregates in the plowing layer of soil was 24.1 % at end of wheat season under soil till to 20 -25 cm (control). Compared to the control treatment the water-stable aggregates decreased for 3.9; 8.4 and 7.0 % under soil tillage to 25-30; 30-35 and 35-40 cm depths respectively.

Deepening of soil till improved soil bulk density (BD) and porosity. Averaged for three study years the BD and specific density (SD) of soil solid phase were ranging accordingly from 1.30 to 1.33 g cm^{-3} and 2.67 to 2.71 g cm^{-3} before planting and 1.38 to 1.35 g cm^{-3} and 2.67 to 2.66 g cm^{-3} at the end of the wheat season under soil till to 20-25 cm depth. The BD and SD in the top 0-25 soil layer ranged from 1.28 to 1.29 g cm^{-3} and 2.68 to 2.70 g cm^{-3} under soil till to 30-35 cm depth and from 1.28 to 1.31 g cm^{-3} and 2.67 to 2.68 g cm^{-3} under

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soil till to 35-40 cm depth. The parameters for the same soil layer at the end of the wheat season were ranging from 1.29 to 1.30 g cm^{-3} and 2.63 to 2.70 g cm^{-3} under soil till to 30-35 cm depth and 1.31-1.34 and 2.68-2.70 g cm^{-3} under soil till to 35-40 cm depth.

Soil tillage depths as a measure against weed infestation in the wheat field positively impacted on soil porosity (SP). The SP in the 0-25 cm soil layer at wheat planting ranged from 50.9 to 51.4 % under soil till to 20 -25 cm depth and soil till to 30-35 cm increased the SP from 0.8 to 1.5 %. Improved SP positively influenced water infiltration. Impact of soil tillage on water infiltration was observed not only at planting but also close to harvest of winter wheat. Water infiltration for the first three hours of measurements at harvest was 312; 357; 366 and 379 m^3 ha^{-1} under soil tillage to 20-25; 25-30; 30-35 and 35-40 cm respectively (Table 1).

Table 1

Influence of soil tillage depths on water infiltration (2015-2017)

Measurements	Soil depth (cm)							
	20-25		25-30		30-35		35-40	
	Time of measurement							
	1	2	1	2	1	2	1	2
----------Water infiltration (m3 ha-1) ----------								
In 1-hour	148	119	154	135	163	139	161	144
In 2-hours	131	102	137	127	142	127	148	131
In 3-hours	105	91	115	95	125	100	132	104
Total for 1-3 hours	383	312	405	357	430	366	441	379
In 4-hours	92	75	100	82	109	92	110	93
In 5-hours	83	62	92	71	95	78	101	83
In 6-hours	76	54	82	62	88	69	90	73
Total for 4-6 hours	251	191	274	214	291	239	302	249
Grand total for 6 hours	634	503	680	571	722	605	743	628

Note: 1 – before planting; 2 – before harvest.

Water infiltration, however, for the second three hours of the measurement was reduced accordingly up to 191; 214; 239 and 249 m3 ha^{-1} under soil tillage to 20-25; 25-30; 30-35 and 35-40 cm. It could be explained by the followings: soil crumbling in the winter wheat field due to the effects of precipitation and irrigation water; infill of soil capillaries by the clayey fractions transported by irrigation water and soil compaction due to irrigations. In general, water infiltration for 6-hours measured at planting and harvest was 722 and 743 m^3 ha^{-1} and 605 and 628 m^3 ha^{-1} accordingly under soil tillage to 30-35 and 35-40 cm depths applied as a measure against weed infestation in the winter wheat field. Compared to soil tillage to 25 -30 and 20-25 cm, the water infiltration under soil tillage to 30-35 and 35-40 cm depths was higher for

87-109 and 45-63 m^3 ha^{-1} and 101-125 and 34-57 m^3 ha^{-1} respectively. Thus, soil tillage to 30-35 and 35-40 cm depths improved water infiltration and created conditions for evenly moistening of soil. Hence, improved water holding capacity of soil under soil till to 30-35 and 35-40 cm depths resulted in better growth and development of winter wheat.

Soil tillage to different depth has also influenced the soil microbial activity. Compared to soil tillage of 20-25 cm depth, the number of bacteria was increased for 1.1 to 2.0 million, actinomycete - 0.9 to 1.9 thousand, fungi - 2.2 to 3.6 thousand, penicilla and aspergilla - 2.1 to 2.7 and 3.0 to 4.1 % respectively.

CONCLUSIONS

A 3-year study results in the typical sierozem soils of Samarkand Province, Uzbekistan revealed that properly researched soil tillage depth (30-35 cm) has reduced the number of biennial and perennial weeds in the winter wheat field for 30 to 40 %, soil compaction – for 0.08 g cm-3, increased soil porosity for 1.5 to 2.0 %, water infiltration for 6-hours – for 87-101 m3 ha-1 and improved the soil microbial activity. Winter wheat grown under these conditions was producing 5.94 to 6.26 t ha-1 of grain yields during the study years.

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