ISSN: 2287-688X

Annals of
Plant Sciences

Volume 11, Issue 01 (2022) pp. 4705-4711

Research Article

Influence of Leguminous and Fodder Crops on Soil Agrophysical Properties and Crop Yields

Dr. Shakhobiddin M. Turdimetov[1] and Zarkum Rakhimov[2]

[1]*PhD, Associate Professor, Head of Soil Science Department Gulistan State University,*
[2]*Master's degree student, Gulistan State University.*

Abstract

The article describes the data obtained on the improvement of soil agrophysical properties and increase crop yields through the planting of legumes and fodder crops. Changes in volume mass and porosity were detected before planting and after harvest of plants such as peas, vetch, esparto, alfalfa. The decrease in soil density was in the variant where more alfalfa was planted, with 0.07 and 0.08 g / cm3, respectively, in the 0-30 cm and 30-50 cm layers.Results were also obtained on changes in the yields of cotton and winter wheat after planting these crops. . According to the results, the yield of cotton in the planted variant of vica increased by 2.6%, while the yield of winter wheat increased by 14.3%.

Keywords: *legumes, fodder crops, peas, vetch, esparto, alfalfa, soil volume mass, specific gravity, porosity, cotton, winter wheat*

Introduction

Numerous scientific data have been obtained on the use of various crops to improve soil properties. Most of the results obtained indicate an improvement in soil properties and an increase in the yield of crops planted after these plants.

F.Rasulova, B.Khalikov (2019) studied the change in the volume and weight of the soil in the system of vegetable-grain rotation. According to the results of the experiment, it was found that soybean from repeated crops reduces the soil by 0.02-0.03 g / cm^3 relative to moss and by 0.05-0.06 g / cm^3 relative to corn. K.A.Nikulchev, E. V.Banetskaya (2020) experimented with changing the agrophysical properties of the soil under the conditions of shade monoculture and crop rotation. According to the experimental results, the soil volume weight under monoculture was 1.25 g / cm^3, 1.22 after barley and 1.19 g / cm^3 after corn.

In the experiments of D.Kutlimuratova (2020), 20 t / ha of manure was applied, and the volume of soil in the 0-30 cm layer was 0.05 cm in the 0-30 cm layer compared to the winter wheat (monoculture) variant. Decreased to -0.08 g / cm^3.

Usmanov, T.Ostanakulov (2021) studied the effect of siderates planted on two different terms on the physical properties of the soil. The proportion of macroaggregates greater than 0.25 mm was 3.0–9.8% higher than the control in the 0–30 cm layer when summer sideration was applied.

V. I. Turusov, O. A. Bogatyx, N. V. Dronova, E. A. Balyunova, R. V. The Salnikovs (2021) studied the effect of past crops on soil volume weight. In the control variant, this figure was 1.0 g / cm^3, while the lowest value was in the planted variant of gorox-autumn wheat + autumn vica, the volume weight was 0.83 to 1.0 g / cm^3.

A.M. Grebennikov (2020) studied the effect of a mixture of different siderate crops on the agrophysical properties of the soil. In all variants, the bulk density of the soil was found to be better than the control variant. In

***Corresponding Author:**
Dr. Shakhobiddin M. Turdimetov;
DOI: http://dx.doi.org/10.21746/aps.2022.11.01.18

particular, in the case of payza (Japanese millet) + sunflower, the decrease in volume mass in the tillage layer was 0.07 g / cm^3, and the increase in grain yield was 2.6 ts / ha.

A.M.Berzin, V.A.Polosina (2018) found experimentally that it is possible to improve soil moisture capacity by planting siderate crops. As a result of the increase in soil moisture capacity by planting siderate crops, it was found that the yield of spring wheat increased to 3.7 ts / ha compared to the control option.

V.B. Tsiribko, A. M.Ustinova, N. N.Tsibulkos (2019) believe that one of the most effective ways to improve the agrophysical properties of the soil is the sowing of intermediate crops. By planting these crops, the density of the soil can be reduced to 0.07-0.25 g / cm^3, and the porosity can be increased to 2-9%.

\S.A. Linkov, A.S. Zakaraev (2016) conducted experiments to determine changes in agrophysical properties of the soil and an increase in the yield of sunflower when using different crops as siderate crops. When using buckwheat as a siderate crop compared to the control option, the bulk density of the soil was at a minimum of 1.08 g / cm^3. The yield of sunflower in this variant was also high.

T. Ostanakulov, Sh. Jabborov, O. Muratov (2020) studied the effect of past crops: winter wheat, cabbage, green peas on the yield of two varieties of tomatoes planted as a secondary crop. The yield of tomatoes in the variant planted after green peas was 26.5-30.1 t / ha, and 4.0-4.8 t / ha more than in the variant sown with winter wheat.

In the experiments of R. Aripov, A. Buriev, M. Makhsudova (2021), the yield of winter wheat sown after peas, mosh and rapeseed was 10.1-11.9-11.6 ts / ha higher than the control. According to the authors, the main reason for this is the enrichment of plant roots and stumps, as well as the soil with biological nitrogen.

A.N. Babichev (2010) studied the effect of intermediate and siderate crops on the yield and productivity of vegetable crops. In the variant planted with siderate and intermediate crops, it was found that the yield of potato crop was high. It is noted that this is due to the fact that the soil is enriched with organic matter due to the presence of plant residues in the soil, as a result of good phytosanitary conditions reduces the likelihood of disease.

A.V.Akinchin, A.S.Fedorov (2020) studied the importance of siderate crops on the yield of corn planted for grain. Siderate crops used white mustard, buckwheat, soy. In the control variant, the grain yield of corn was 6.5 t / ha, after white mustard the yield was less variable, and in the buckwheat variant it was increased to 7.3 t / ha.

V.A.Shadskix, V.E.Kijaeva, L.G.Romanova, O.L.Rasskazova (2018), I.F.Kargin, A.A.Zubarev, N.N.Ivanova (2018), M. Degu, A.Melese, W.Tena (2019), V.M.Novikov (2012), O.Tomashova, N.Osenniy, A.Ilyin, L.Veselova (2020) O.A.Tsyuk, S.P.Tanchyk, V.I. Kyrylyuk, T.V.Shevchenko (2018)[, Sh.M. Turdimetov (2021;2020) provided information on changes in agrophysical and agrochemical properties of soil through the sowing of legumes and fodder crops.

Research methods

In our experiments, we studied the effect of legumes and fodder crops on the density and porosity of the soil, which is one of the general physical properties of the soil. Although these indicators change rapidly, they are important for soil fertility and crop yields.

Results and discussions

Recent studies suggest the introduction of correction factors based on these indicators when assessing soil fertility.

Taking into account the data in Table 1, the volume mass of the soil in the 0-30 cm layer after planting the pea crop, the decrease in density was 0.03 g / cm^3. In the 30–50 cm layer, the soil density decreased from 1.37 to 1.33 g / cm^3. After planting the sainfoin crop, the density of the soil in the 0-30 cm layer decreased to 0.03 g / cm^3, while in the 30-50 cm layer it decreased to 0.06 g / cm^3. In the

variant where Vika was planted, the decrease in soil density in the 0-30 and 30-50 cm layers had the same rate. Almost the same result was observed in the variant in which water weed was planted.

Table 1-Variation of soil volume mass by sowing legumes and fodder crops

Crops	Layer thickness	Volume weight, g / cm³		Change in density, g / cm³
		Before planting crops	Before planting the next crop	
Peas	0-30	1,33	1,3	0,03
	30-50	1,37	1,33	0,04
Esparto	0-30	1,27	1,24	0,03
	30-50	1,35	1,29	0,06
vetch,	0-30	1,32	1,27	0,05
	30-50	1,38	1,33	0,05
Alfalfa	0-30	1,36	1,29	0,07
	30-50	1,38	1,3	0,08
Sudan weed	0-30	1,29	1,24	0,05
	30-50	1,35	1,29	0,06

The decrease in soil density was in the variant where more alfalfa was planted, with 0.07 and 0.08 g / cm³ in the 0-30 cm and 30-50 cm layers, respectively.

Soil porosity is an indicator that depends on the specific gravity and volume weight of the soil and is one of the most important indicators among soil properties. It was calculated using a generally accepted method to determine soil porosity. The specific gravity of the soil is around 2.69-2.72 g / cm³, and the indicator that has the greatest effect on soil porosity is its volume weight.

Considering the data in Table 1, the volume mass of the soil in the 0–30 cm layer after planting the pea crop was a decrease in density of 0.03 g / cm³. In the 30–50 cm layer, the soil density decreased from 1.37 to 1.33 g / cm³. After planting the sainfoin crop, the density of the soil in the 0-30 cm layer decreased to 0.03 g / cm³, while in the 30-50 cm layer it decreased to 0.06 g / cm³. In the variant where Vika was planted, the decrease in soil density in the 0-30 and 30-50 cm layers had the same rate. Almost the same result was observed in the variant in which water weed was planted.

Table 2-Change of soil porosity by sowing legumes and fodder crops

Crops	Layer thickness	Porosity, %		Variation of porosity, %
		Before planting crops	Before planting the next crop	
Peas	0-30	50,6	51,7	1,1
	30-50	49,4	50,9	1,5
Esparto	0-30	52,8	53,9	1,1
	30-50	50,2	52,4	2,2
Vetch	0-30	50,9	52,8	1,9
	30-50	49,1	50,9	1,8
Alfalfa	0-30	49,4	52,0	2,6
	30-50	49,1	52,0	3,0
Sudan weed	0-30	52,0	53,9	1,9
	30-50	50,2	52,4	2,2

The change in soil porosity through legumes and fodder crops was carried out in accordance with the change in the bulk mass of the soil. After the pea crop was harvested,

the increase in porosity was 1.1% in the 0-30 cm layer and 1.5% in the 30-50 cm layer. The increase in porosity corresponds to a layer of 30-50 cm of soil after planting alfalfa, the increase in porosity was 3.0%. In the variant in which the vica crop was planted, the decrease in volume mass at both depths was almost uniform.

The effect of legumes and fodder crops on the agrophysical and agrochemical properties of the soil in any case was found to be improved compared to the pre-planting condition of these crops.

Impact of legumes and fodder crops on cotton and winter wheat yields

Legumes and fodder crops have a positive effect on the growth and development of subsequent crops as a result of improving the agrophysical and agrochemical properties of soils. In the end, it leads to an increase in the yield of crops planted after these crops, on which much information has been obtained.

In our experiments, an increase in soil fertility and crop yields was observed due to improved agrophysical and agrochemical properties of leguminous cereals and fodder crops (Tables 3, 4).

Table 3-Changes in the yield of cotton by planting legumes and fodder crops

№	Experiment options	Yield by years, ts / ha			Average yield, ts / ha	In relation to control,±
		Peas				
		2006 y.	2007 y.	2008 y.		
1	Control-without planting	28,8	29,2	27,7	28,6	
2	After sowing the crop	30,9	33,8	29,5	31,4	2,8
vetch						
		2014	**2015**	**2016**		
3	Control-without planting	29,6	32,4	30,5	30,8	
4	After sowing the crop	31,3	33,8	29,8	31,6	0,8
Esparto						
		2012	**2013**	**2014**		
5	Control-without planting	28,3	26,2	27,8	27,4	
6	After sowing the crop	30,3	29,4	29,8	29,8	2,4
Alfalfa						
		2018	**2019**	**2020**		
7	Control-without planting	29,6	32,6	31,2	31,1	
8	After sowing the crop	32,3	35,6	34,4	34,1	3,0
Sudan weed						
		2018	**2019**	**2020**		
9	Control-without planting	30,3	30,3	31,8	30,8	
10	After sowing the crop	32,3	31,5	32,8	32,2	1,4

If we pay attention to the data in the table, it was observed that the yield of cotton increased after planting all the options. However, it was observed that the yield of cotton planted after pea and alfalfa crops increased significantly.

An increase in winter wheat yields after planting legumes and fodder crops was also studied (Table 4).

From Table 4, it was found that the effect of legumes and fodder crops on the winter wheat crop was slightly different from the effect of the cotton crop. This effect was especially noticeable under the conditions under which the vica plant was planted. In cotton-plant, the yield increased by 2.6% compared to the uncultivated variant, while in winter wheat the yield increased by 14.3%.

Table 4-Changes in the yield of winter wheat by sowing legumes and fodder crops

№	Experiment options	Yield by years, ts / ha			Average yield, ts / ha	In relation to control, ±
		Peas				
		2006 y.	2007 y.	2008 y.		
1	Control-without planting	34,56	47,04	44,04	41,88	
2	After sowing the crop	43,08	53,76	47,4	48,08	6,2
		vetch				
		2014	2015	2016		
3	Control-without planting	47,52	49,68	48,6	48,6	
4	After sowing the crop	55,56	56,16	54,96	55,56	6,96
Esparto						
		2012	2013	2014		
5	Control-without planting	41,16	38,64	42,96	40,92	
6	After sowing the crop	48,36	43,68	47,16	46,4	5,48
Alfalfa						
		2018	2019	2020		
7	Control-without planting	42,72	42,72	47,04	44,16	
8	After sowing the crop	50,76	46,32	56,88	51,32	7,16
Sudan weed						
		2018	2019	2020		
9	Control-without planting	43,56	42,36	45,36	43,76	
10	After sowing the crop	48,36	45	47,76	47,04	3,28

Conclusion

This figure is appropriate, in the pea plant, 9,8 % and 14,8 %, 8.75% and 13.4% in esparto, 9.6% and 16.2% in alfalfa, 4.5% and 7.5% in Sudan weed.

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Source of support: Nil; **Conflict of interest:** Nil.

Cite this article as:
Turdimetov, M.S. and Rakhimov, Z. "Influence of Leguminous and Fodder Crops on Soil Agrophysical Properties and Crop Yields." *Annals of Plant Sciences.*11.1 (2022): pp. 4705-4711.

DOI: http://dx.doi.org/10.21746/aps.2022.11.1.18