Influence of corn on soil fertility in crop rotation systems "winter wheat + re-sowing + cotton"

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1. Introduction

Crop rotation is the basis of agriculture in agriculture and plays an important role in improving soil fertility, improving the efficiency of agrotechnical and reclamation measures, increasing the yield of cotton, wheat, food, fodder and other crops, and is an important tool in maintaining soil fertility subject to wind and irrigation erosion.

Growing crops according to a crop rotation system is one of the main aspects of science-based farming. In modern conditions, in the era of farmers who have land plots and develop other promising forms of agriculture, the scientific foundations of crop rotation, maintenance of soil fertility, and pest and weed control must be strictly implemented(Azimov B. and et. al. 1995).

First of all, before planting a crop, it is necessary to pay attention to the health of the field soil, soil fertility - can it give the desired crop from the planted crop, what crop was planted here before, how much of it was produced, how many nutrients were taken out of the soil (Massino I.V. and et. al. 1989) .

It should be noted that as a result of the reforms carried out in the agrarian sector of the republic in recent years, a new farming system was created, instead of the existing green fields and large arrays of cotton-alfalfa crop rotations, crop rotation and alternating sowing patterns of grain + cotton, grain + cotton + fodder were introduced, grain + re-crops + cotton. As a result, the monopoly of cotton in agricultural technology was terminated, and winter wheat began to be sown on 32-35% of the total area of irrigated agriculture, and cotton on 43-45%.

However, this new scheme of irrigated agriculture also gives rise to the problem of maintaining, restoring and increasing its fertility on all types of soil, which shows that the role of cotton in maintaining, restoring and increasing soil fertility is insufficient even in the main and repeated plantings (Eraliev D. and et. al. 1998).

In order to restore and increase the lost soil fertility, it is necessary to focus as much as possible on repeated crops planted on winter wheat, and to choose legumes that correspond to winter wheat as a predecessor crop and increase soil fertility and are a nutritious feed for livestock. These crops include legumes such as mung beans, cowpeas,

soybeans, lentils, peas and beans. According to scientific studies conducted to determine the impact of these crops on soil fertility and yields in new crop rotation schemes, cotton with a short rotation of winter wheat + mung bean, winter wheat + sorghum and root residues, and then sown mung bean - leaves 80 -85 kg / ha of nitrogen .

The scheme of crop rotation winter wheat + repeated crops + cotton was also studied in our studies, carried out in the conditions of meadow gray and light gray soils of the Ferghana Valley(Arabadjiev S.D. and et. al. 1981).

An increase in the rate of nitrogen fertilizers by 400-500 kg/ha did not lead to an increase in cotton yield. Even now, in some farms, even with a high rate of application of nitrogen fertilizers, there is no increase in yield, which depends on soil fertility and the correct implementation of other agrotechnical measures.

According to the experiment carried out in various soil and climatic conditions of Uzbekistan, the largest increase in the cotton yield was obtained when nitrogen, phosphorus and potassium were added in a ratio of 1:0.7:0.5. However, with the constant use of mineral fertilizers, even in these proportions, it is observed that the yield of cotton does not always increase, and in some cases decreases.

It should be noted that the effective rates of mineral fertilizer application for corn, intermediate crops for 3 years after alfalfa in the cotton crop rotation have been determined. However, there is not enough scientific research on cotton fertilization depending on the sowing of root and crop residues, the remaining sown repeated crops after winter wheat(Ilin V.B. and et. al. 1989).

Table 1

<table>
<tr><td rowspan="2">Option order</td><td colspan="3">Experience system</td></tr>
<tr><td>2015-2018</td><td>2016-2018</td><td>2017-2019</td></tr>
<tr><td></td><td>Fertilizer rates in winter wheat, kg/ha</td><td>Fertilizer rates in repeated crops, kg/ha</td><td>Fertilizer rates in cotton, kg/ha</td></tr>
<tr><td>1</td><td rowspan="3">N-200, R-140, K-100</td><td rowspan="3">Control (no fertilizer, no crop)</td><td>N-150, R-105, K-75</td></tr>
<tr><td>2</td><td>N-200, R-140, K-100</td></tr>
<tr><td>3</td><td>N-250, R-175, K-125</td></tr>
<tr><td>4</td><td rowspan="3">N-200, R-140, K-100</td><td rowspan="3">Corn,
N-200, R-140, K-100</td><td>N-150, R-105, K-75</td></tr>
<tr><td>5</td><td>N-200, R-140, K-100</td></tr>
<tr><td>6</td><td>N-250, R-175, K-125</td></tr>
<tr><td>7</td><td rowspan="3">N-200, R-140, K-100</td><td rowspan="3">Beans,
N-75, R-75, K-50</td><td>N-150, R-105, K-75</td></tr>
<tr><td>8</td><td>N-200, R-140, K-100</td></tr>
<tr><td>9</td><td>N-250, R-175, K-125</td></tr>
<tr><td>10</td><td>N-200, R-140, K-100</td><td>Soybean</td><td>N-150, R-105, K-75</td></tr>
</table>

11		N-50, R-75, K-50	N-200, R-140, K-100
12			N-250, R-175, K-125

So, we sowed corn, beans and soybeans from repeated crops after winter wheat and conducted field experiments in the conditions of meadow gray and light gray soils of the Ferghana Valley in order to determine the optimal rates of mineral fertilizers for cotton, depending on the root and crop residues left them.

The scheme of experiments is presented in table 1. With a crop rotation scheme of 1: 1, 3 crops were harvested in 2 years. To do this, winter wheat was sown every year in a new field, followed by re-sowing and cotton after them, in the year cotton was sown in field 1, winter wheat was sown in field 2, and so on.

2. Materials and methods

In table. 2 shows the initial agrochemical characteristics of the soil of the experimental fields. That is, the mobile amount of nutrients in meadow-serozem soils is close to the average supply (according to the fields of research), and in light-serozem soils their undersupply is observed(Khozanovich M.A. 1958).

In the years of research, the yield of winter wheat and straw on meadow-serozem soils is 64.1-70.4 in relation to the experimental fields; 63.8-72.3 and 65.2-73.5 c/ha, on light gray soils 48.1-59.7 c/ha; 50.4-60.8; It amounted to 52.3-60.3 q/ha.

Table 2. Initial agrochemical properties of soils (0-30 cm), yield of grain and straw, amount of stubble and root residues before sowing winter wheat.

Indicators	On meadow-serozem			On light gray earth		
	Field 1	Field 2	Field 3	Field 1	Field 2	Field 3
Compost, %	1,28/0,85	1,30/0,820	1,36/0,910	0,766/0,250	0,760/0,280	0,760/0,210
Nitrogen, %	0,120/0,105	0,13/0,120	0,135/0,110	0,064/0,32	0,070/0,38	0,70/0,40
Phosphorus, %	0,79/0,60	0,80/0,70	0,85/0,05	0,135/0,100	0,138/0,98	1,340/0,110
Potassium, %	-	-	-	1,88	1,90	1,85
N-NO_3 mg/kg	22,3/9,5	23,5/10,1	25,3/12,1	8,21/5,6	9,25/5,8	8,90/6,1
R_2O_5 mg/kg	25,2/12,1	26,1/13,1	27,1/14,2	13,2/5,1	14,1/6,8	13,2/7,1
K_2O mg/kg	228/120	230/120	222/130	202/90	200/85	210/95
Wheat grain yield, quintal/ha	64,1	63,8	65,2	48,4	50,4	52,3
Straw yield, quintal/ha	70,4	72,3	73,5	59,7	60,8	60,3
Harvest	14,0	14,5	15,1	12,5	12,2	10,9

residues, quintal/ha						
Root residues, quintal/ha	18,1	19,0	19,8	16,1	16,0	16,8

Note: 0-30 cm in the numerator, 30-50 cm of soil layers in the denominator.

So, in conditions of light gray soils, the yield of grain and straw is proportionally 16.0-10.7, compared with meadow gray soils, from N-200, P2O5-350, K2O-50 kg of fertilizers used for winter wheat; lower values of 13.4-11.5 and 13.1-13.2 q/ha were obtained. 14.0-18.1 proportionally on the experimental fields, the remains of the stem and roots of winter wheat; 14.5-1(.0; 15.1-19.8 c/ha (meadow-gray), 12.5-16.1; 12.2-16.0; 10.9-16.8 c/ha ha (light gray earth), which, under the influence of these indicators, had an impact on the growth and development of repeated crops planted after it(Nematov U. M., 2022).

In our experiments, scientific data on the germination of corn after winter wheat, depending on soil conditions, are presented in Table 3.

Note that during the years of research, corn was sown on June 28-July 1; June 24 - July 2; from 20 to 28 June. in proportion to soil types(Nematov U. M 2018).

Corn planted on June 28 on meadow-serozem soils, the germination of corn seeds after 4 days was 39.8%, after 6 days - 67.5%, after 8 days - 95.9%. Similar data were obtained in the experiments carried out on the 2nd and 3rd fields in subsequent years, and these figures respectively amounted to 38.5; 68.9; 96.5 and 35.8; 67.6; 94.5%.

During the years of research on light gray soils, corn was sown later, in 2016 it was found that after 4 days 32.1% of the seeds germinated, after 6 days - 62.8%, after 8 days - 65.9%. In subsequent years, these figures amounted to 35.1; 61.3; 88.4 and 35.0; 62.8; 91.3%.

It should be noted that during the years of research, the germination of corn on light gray soils over the observation period was 10.0; 8.1; 3.2% less compared to meadow gray soils, which depends on the physical properties of the soil(Isashov A. and et. al. 2015).

Since corn is sown for grain in the studies, it is desirable that the planting density be almost the same over the years. These figures are 68.1; 64.8 and 64.2 thousand/ha at the beginning of the growing season in proportion by years on meadow-serozem soils; and at the end of the growing season it was equal to 62.1; 60.1 and 59.8 thousand/ha. And in light gray soils 61.2; 60.5; 62.3 and 59.8; 58.2; 58.4 thousand/ha respectively. On average for 3 years it was 65.7-60.8 and 61.3-58.8 thousand/ha in proportion to soil types. the density of standing between the repetitions of subsequent variants of cotton differed by only 1-2 thousand/ha, which indicates a methodologically correct experiment(Anvarjon, I. and et. al. 2021).

According to the data obtained over the years of research on the growth and development of corn on meadow-serozem soils, depending on soil types (Table 4), the average plant height in observations made on July 19 was 11.8; 13.4 and 12.8 cm, August 20 88.4 ;; 90.8 and 85.4 cm, and on September 19 145.1; 148.2 and 144.5 cm, and the number of leaves in these periods was proportionally equal to 3.3; 3.8; 3.0 and 8.4; 8.9; 8.0 and 13.8;

15.1; 12.0 units In the last observation, the number of cobs was 1.0 pieces in all three years of the study. At the end of the growing season, the height of corn was 188.1-195.2 cm, the number of leaves was 14.8-16.1 pieces, the number of cobs was 1.0-1.1 pieces(Isashov, A. and et. al. 2018).

The number of grains in 1 cob, considered the most important, is 468.1 in proportion to the years of research; 490.1 and 460.1 grains, and the mass of grain in 1 cob is 85.1; 88.2 and 83.1 g, weight of 1000 grains 168.1; 180.1 and 160.2 g. At 3 years old, the average number of grains was 472.7, the weight of grain in 1 cob was 85.4 g, the weight of 1000 grains was 169.4 g

3. Results and discussion

Таблица 3 Всхожесть кукурузы (%) и фактическая густота стояния (тыс./га)

Years	On grassy gray soils			Actual standing density, thousand/ha		On light gray soils			Actual standing density, thousand/ha	
	number of germinated plants			At the beginning of the growing season	At the end of the growing season	number of germinated plants			At the beginning of the growing season	At the end of the growing season
	2.07	4.07	6.07			5.07	7.07	9.07		
2016	39,8	67,5	95,9	68,1	62,1	32,1	62,8	85,9	61,2	59,8
	28.06	30.06	2.07			4.07	6.07	8.07		
2017	38,5	68,9	96,5	64,8	60,5	35,1	61,3	88,4	60,5	58,2
	24.06	26.06	28.06			2.07	4.07	6.07		
2018	35,8	67,6	94,5	64,2	59,8	35,0	62,8	91,3	62,3	58,4
Average				65,7	60,8				61,3	58,8

It should be noted that indicators close to the above were also obtained on light gray soils. At the same time, the yield of corn at the end of the application period is 186.1 in proportion to the years of research; 190.2 and 185.7 cm, number of leaves 14.8; 15.1 and 13.5 pcs., the number of cobs - 1.0 pcs. These indicators are 2.0 compared with those in meadow-serozem soils; 5.0 and 4.4 cm, 1.0; It is less by 1.0 and 0.7 units, as well as by 0.3 units. This shows that the growth and development of corn in both soil conditions in the fields were almost the same(Карабаев, А. Н. and et. al. 2020).

But, as mentioned above, the most important indicators - 22.5 grains in 1 cob, 2.8 g of grain mass in 1 cob and 2.6 g of grain mass in 1000 grains decreased over 3 years, which led to a decrease in yield (Table 4).).

Data on the yield of grain and green mass of corn planted after winter wheat as a re-crop in the years of research are presented in Table. 5. Under the conditions of 2016, the grain yield by repetition in proportion to soil types was 37.8; 39.1; 38.1; 37.4 and 36.5; 36.4; 36.7; 40.0 t/ha, and on average 38.1 and 37.4 t/ha.

Table 4. Growth and development of corn

years	19.07		20.08		19.09			At the end of the validity period			Number of grains in a sprout, pcs.	Mass of grain in a sprout, g	Weight of 1000 grains, g
	Height, cm	Number of leaves, pcs.	Height, cm	Number of leaves, pcs.	Height, cm	Number of leaves, pcs.	Number of days, pcs	Height, cm	Number of shutters, pcs.	Number of days, pcs			
meadow-serozem soils													
2016	11,8	3,3	88,4	8,4	145,1	13,1	1,0	188,1	15,8	1,0	468,1	85,1	168,1
2017	13,4	3,8	90,8	8,9	148,2	15,1	1,0	195,2	16,1	1,1	490,1	88,2	180,1
2018	12,8	3,0	85,4	8,0	144,5	12,0	1,0	190,1	14,8	1,0	460,1	83,1	160,2
Average											472,7	85,4	179,7
light gray soils													
2016	11,0	3,1	80,1	7,8	135,1	13,1	1,0	186,5	14,8	1,0	450,5	83,1	160,1
2017	12,8	3,4	90,2	8,0	145,1	14,1	1,0	190,2	15,1	1,0	470,2	84,2	172,1
2018	11,0	3,2	81,5	7,8	138,1	13,0	1,0	185,7	13,5	1,0	430,1	81,3	168,2
Average													

Table 5. Grain yield and green mass of corn, centner/ha

Годы	Grain output by repetitions					green mass output
	I	II	III	IV	Average	
meadow-serozem soils						
2016	27,8	39,1	38,1	37,4	38,1	280,4
2017	39,0	40,1	39,8	40,7	39,9	300,1
2018	36,5	37,1	36,5	37,1	36,8	270,2
Average					38,2	283,5
On light gray soils						
2016	36,5	36,4	36,7	40,0	37,4	270,5
2017	38,0	38,9	39,1	36,8	38,3	280,5
2018	34,5	35,1	36,1	40,3	36,5	26,1
Average					37,4	270,3

The average yield of green mass of corn on meadow gray soils is 283.5 t/ha for 3 years, on light gray soils - 270.5 t/ha 280.5 and 260.1 centners per hectare, averaging 270.1 centners /ha, which on average for 3 years was 13.2 centners/ha less compared to meadow-serozem soils(Ermatova, D. E. and et. al. 2021).

Thus, the possibility of sowing corn as a re-crop after winter wheat in the conditions of meadow-serozem and light-serozem soils of the Ferghana Valley has been proved(Abdulkhakov, F. and et. al. 2022).

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