



RESULTS OF USING GREEN FALLOW ON IRRIGATED SOIL TO ENHANCE THE FERTILITY OF SOIL

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ABSTRACT

In our country average precipitation is annually 250-300 mm, and when we assuming that we need 22, 0-30,2 mm precipitation for getting 1 centner of wheat and thus means it is sufficient for 7-10 centner yield. For more yield use irrigation systems to provide the fields with enough water and humidity is important issue. Cultivation using rotation is not only for producing high yields but also it is important for stabilizing and improving the soil fertility like the first condition of the soil. Beside destroyed through wind and water the nutrient layer of the soil degraded by agricultural activities and the fertility of the soil is decreased by yield. The USSR researchers stated that grains reduced 0.5-1.0 tons of soil humus annually and increase with 0.3-0.4 tons each year, while other crops are decreasing 1.5-3.0 times more than the grain cultivation. In irrigation conditions, the soil particles with 0.25-10 mm in diameter at the layer of 0-20 cm in rotation of potatoes increased after harvesting, and compared with other types the rotation with green fallow shows 0.8-1.4% more results. At 0 to 20 cm depth of the soil the humus content was increased by 0.06-0.31%, the rotation with green fallow was about 0.03-0.25% greater than the other types.

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INTRODUCTION

Nowadays climate is changed rapidly and the global warming affects to the precipitation thus results different amount of grain yield year by year. Therefore it is necessary to use irrigation in agriculture land to get high percent of yield. In our country average precipitation is annually 250-300 mm, and when we assuming that we need 22,0-30,2 mm precipitation for getting 1 centner of wheat and thus means it is sufficient for 7-10 centner yield. For more yield use irrigation systems to provide the fields with enough water and humidity is important issue. Use the irrigation field properly the rotation and the cultivation field of the crops are important and it enhance the fertility of the soil and improve the soil structure. Cultivation using rotation is not only for producing high yields but also it is important for stabilizing and improving the soil fertility like the first condition of the soil.

In recent years most potato growers and farmers using 2-3 fields /without irrigation system/such as potato-wheat, potato-fallow-wheat, and for irrigated farming potato-wheat rotation are used. According to the researchers growing potatoes using rotation over 2-3 years has shown that the spread of fungus and bacterial diseases increased through soil. In addition, potato has a weak root system and cultivated with widespread lines so it is convenient to make harboring, shingling, and hill the potato plant. Following the potato cultivation technology and using more techniques during the plant growth period, the organic decomposition of the soil will be activated, the mineralization process will rapidly occur, the soil fertility is reduced, and the soil structure is disturbed, so it is necessary to follow methods with short-term improvement of soil fertility for growing crops.

Research purpose

The purpose of this research work is to ensure the economically viable rotation system for potato cultivation in irrigated field which will protect the soil fertility and to reduce the risk of plant diseases and harm of weeds.

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The tasks are the following. Including

- Determine the impact of different types of rotation for soil fertility in irrigated field.
- Determine the impact of various types of rotation in irrigated fields, with the effects of potato disease, pest infestation, and soil drainage.
- Compare the rotation types in irrigated fields and select economically viable method.

Research field, version and diagram

The experimental study was conducted in irrigated field of "Elit Ur" Co. Ltd located in Khushaat soum, Selenge a imag using potato, grain, green fallow, rape, carrot and onion in 2-4 field with 6 rotation types and 3 replicates totally 54 field were chosen by randomly. One field area- 140 m² (10 x 14), total area- 1.3 hectare, circular strip 0,52 ha, experimental field totally- 0,78 ha.

Rotation types used in the research work

- **Field of rotation**
 - Potato – Wheat /P-W/
- **Field of rotation**
 - Potato –wheat–wheat /P-W-W/
 - Potato -wheat- green fallow/GF/ (Peas + mixed rye) /P-W-GF/
- Potato - wheat- Rape /P-W-R/
 - Potatoes - Carrots – Onions /P-C-O/
- **Field of rotation**
 - Potatoes - wheat – green fallow (Peas + Mixed rye) – Wheat /P-W-GF-W/

Agro techniques

- Cultivate the wheat Buryatski ostistivariety with 3,5 million/ha in 4-6 cm deep on 25th May using SN-16 seed machine.
- Sterilize Gala potato variety with 400 gr/tonnes Maxim /fungicide/ and making the cultivation with 60-80 gr tubers in 10-12cm in depth, 75 cm between lines, 30 cm between plants on 26th May using "Grimme" "GL-34T" seed machine.
- Pea and mixed rye were cultivated with 150+70 kg/ha in 5-6 cm deep using SN-16 seed machine on 25th May and were harvested in 25th July. Small cuttings were used for green fallow.
- Rapula variety of rape was cultivated with 4-6 kg/ha in 2-3 cm deep on 25th May using SN-16 seed machine.
- Shantene variety of yellow carrot was cultivated with 4.5 kg/ha, in 2-3 cm deep 30 cm between lines on 27th May.
- Onion were cultivated with bulbs, 30 cm between lines, 10 cm between plants, in 4-5 cm deep with 800 kg/ha on 26th May.

RESEARCH RESULT

Effect of rotation on soil aggregate structure

The micro structure of soil is around 0,05-0,25 mm, and the macro structure is around 0,25-10 mm in diameter.



Pic 1. Peas + mixed rye



Pic 2. During cultivation

From these the 1-3 mm particles are the most convenient structure for agriculture. If the 0,25-10 mm structure amount is higher than 80 percent in the upper soil it is good soil structure, 65-80 percent means middle, 50-60 percent belongs to nonstructural soil. Before the experiment these particles amount was 94-96 percent, and after the experiment it was 9,5-97,8 percent. Thus the soil structure was good. From the result we can see that the soil aggregate structure is increased after harvesting with 1,5-2,9 percent in 2-4 field of rotation compared to the cultivation time and the P-W-GF was 0,8-1,4 percent more than the other types.

Rotation effect on soil organic residues

Soil fertility depends from the amount of organic matter and the decomposition of the organic substance /consist of upper and under part of plants / deposited by microorganisms. Organic residues play a key role in humification process, nutrient enhancement, microbial life and activity, improve the soil-physical and chemical properties and soil fertility. Plant organic residues remain in the soil depends from the soil type, which crop is planted in previous year and weather conditions of the year. Researchers supposed that in convenient condition about 20-33% of the organic residue in soil converted to humus. Therefore, it is necessary to reduce the soil fertility loss and increase the accumulation of organic substances in green fallow. The results shows that the amount of organic residues in top of the soil / 0-40 cm/depends from the type of plant, that cultivated in previous year on the rotation. For example, the types including plants with short germination stages, high massive plants give less organic matters in the

soil, or plants contains organic residues which are decomposed more rapidly shows the result that the organic amount is decreased after the harvesting stage. Plants that contains more fibers decomposed more slowly and thus the P-W-W rotation field the organic amount were increased during harvesting in autumn.

The humus content was increased by 0.06-0.31% in 0 to 20 cm deep of the soil. Particularly, rotation including leguminous plant the soil humus is increased by 0.24-0.31%. Consequently, the cultivation of leguminous crops in the irrigated area should be followed and thus results a stable yield without disturbing soil fertility.

Table 1. Soil aggregate structure on 0-20 cm, % 2014-2016

№	Rotation type	Type	Aggregate structure 0,25-10 mm		Difference % /+ -/
			Spring	Autumn	
1	2 field	P-W	94.1	96.3	2.1
		P-W-W	94.0	95.5	1.5
		P-W-GF	94.5	97.4	2.9
		P-W-R	94.4	96.3	1.9
2	3 field	P-C-O	95.6	97.7	2.0
3	4 field	P-W-GF-W	96.0	97.8	1.8

Table 2. Organic residues in soil/0-40cm/, c/ha

№	Rotation type	Type	Organic matters in 0-40 cm depth c/ha	
			Spring	Autumn
1	2 field	P-W	179.9	160.8
		P-W-W	142.3	163.2
		P-W-GF	123.8	115.6
2	3 field	P-W-R	175.4	129.5
		P-C-O	162.6	123.4
3	4 field	P-W-GF-W	144.3	116.9

Table 3. Soil humus amount in 0-20 cm deep Xt, % 2014-2016

№	Rotation type	Type	Amount of humus in 0-20cm deep, %		
			Spring	Autumn	Difference % /+ -/
1	2 field	P-W	1.72	1.78	0.06
		P-W-W	1.73	1.85	0.12
		P-W-GF	1.76	2.07	0.31
		P-W-R	1.78	1.99	0.21
2	3 field	P-C-O	1.87	2.03	0.16
3	4 field	P-W-GF-W	1.81	2.05	0.24

Table 4. Yield of green mass of green fallow, c/ha, 2014-2016

№	Rotation type	Year	Plant height /cm/	Plant number/pcs/			Plant number /pcs/	Wet weight /gr/			Wet weight /gr/
				P	MR	XY		P	MR	XY	
1	3 field	2014	113.3	47.3	70.6	4	122	775	1921.6	21.6	2718.3
		2015	67.3	32	58.6	12.6	103.3	260	440	23.3	723.3
		2016	133.3	42.6	40	17.3	110.6	3013.3	1370.6	403.3	4754
		Average		104.6	40.6	58.4	11.3	111.9	1349.4	1244	149.3
2	4 field	2014	116	45.6	59.3	6.6	111.6	850	1670	33.3	2553.3
		2015	66	24.6	63.3	14.6	102.6	266.6	426.6	30	723.3
		2016	136.6	49.3	26.6	10.6	87.3	2333.3	1000	270	3603.3
		Average		106.2	39.8	49.7	10.6	110.5	1149.9	1032.3	111.1

Impact of rotation on soil composting

The physical and chemical properties depends from the soil humus and also it is the main indicator. Beside destroyed through wind and water the nutrient layer of the soil degraded by agricultural activities and the fertility of the soil is decreased by yield. The USSR researcher stated that grains reduced 0.5-1.0 tons of soil humus annually and increase with 0.3-0.4 tons each year, while other crops are decreasing 1.5-3.0 times more than the grain cultivation. If the Soil humus is decreased the physical properties of soil will degrade, biological activity and nutrient supply and fertility decreases.

Yield of green mass of green fallow

Potatoes provide less amount of organic residues in the soil, gives more yields, and the soil structure greatly destroyed caused by mechanical processing and thus affects decreasing the organic matters.

Therefore from the result we can see that the green fallow is useful in rotation system. Pea and mixed rye cultivated in rotation field of P-W-GF and the average height was 104.6 cm and gives 27.3 C / ha yield, and for P-W-GF-W the average height was 106.2 cm, gives 22.9 c/ha yield.



Pic 3. Experimental field



Pic 4. Sampling

Table 5. Rotation effect for crop yield C/ha 2014-2016

Nº	Rotation type	Type	Yield c/ha
1	2 field	P-W	101.6
		P-W-W	93.6
		P-W-GF	124.9
2	3 field	P-W-R	96.8
3	4 Field	P-C-O	80.5

The rotation types gives around 80.5-124.9 c / ha yield and the yield with Green fallow (T-W-GF) gives 23.3-44.4 c / ha more yields compared to other types.

Conclusion

- In irrigation conditions, the soil particles with 0.25-10 mm in diameter at the layer of 0-20 cm in rotation of potatoes increased after harvesting, and compared with other types the rotation with green fallow shows 0.8-1.4% more results.
- The amount of organic residues in 0-40 cm depths of the soil is decreasing after harvesting, depending on the crop type and plants cultivated in previous year.
- At 0 to 20 cm depth of the soil the humus content was increased by 0.06-0.31%, the rotation with green fallow was about 0.03-0.25% greater than the other types.

- Mixture of pea and rye were 104.6-106.2 cm tall before used in soil and gave 22.9-27.3 c / ha green mass yields.
- The rotational fields give averages of 80.5-124.9 c / ha in three years and the green fallow yield was the highest, 23.3-44.4 c / hectare.

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