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INFLUENCE OF THE PREVIOUS CROP AND SOIL FERTILITY ON POTATO YIELD

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Abstract. A crop rotation system has consists of various benefits such as reducing soil erosion and increasing fertility and crop yield. The experiment was conducted on the irrigation field of the formal potato seed multiplier Company “Elite seed” from 2015 to 2018. The main purpose of the research is to multiply the types of crops that are part of the potato rotation, to improve the structure, to investigate and determine the effect of the crops grown in rotation on the physical, chemical, and biological quality of the soil and how well they are to the next crop, and to solve the problems of crop development. Four types of potato rotations were included in the study, and in increasing seed potato yield and soil fertility green manure fallow — potato — wheat rotation or green manure had better benefits than other rotations (green manure plowing in the field in July). Soil samples were taken from 0-20 cm depth before the planting and after the harvest of potatoes each year. According to the results of the soil analysis of the experimental field, the humus content of the green manure fallow soil increased by an average of 0.35% with an improvement from another previous crop. Moreover, in the soil of green manure fallow the amount of nitrogen easily used by plants was 0.3-0.8 mg/kg (spring), which had a good effect on the yield of the potato crop planted the following year. The result of the experiment shows that the use of green manure fallow as a rotation with potatoes will improve the yield and quality of potatoes, therefore, this method is highly recommended in the future.

Keywords: field, sample, content, green manure fallow, tuber

Introduction

Potato has an important role as a food source since it produces more food per unit area per unit of time than conventional cereal crops and thereby holds promise for food for the fast-growing human population.

Potato (*Solanum tuberosum* L.) is most important food crop in Mongolia. Due to increasing potato production areas, it is required to improve the quality of potato seed material. But, poor quality of seed potatoes is a major yield-reducing factor in potato production.

Potato is a crop that uses soil fertility intensively. Planting in the same field for many years in a row can cause major problems such as disease and pests during the growing season, yield reduction, and poor-quality potatoes.

According to the research of the Soil Agrochemical Laboratory of the Institute of Plant Agricultural and Science in Darkhan-Uul province, the nitrogen supply of 46.0 thousand/ha area was 68.3%, the phosphorus supply was 46.0%, and the potassium supply was 70.5% (Mongolia). It has been shown that it is necessary to reduce and use rotations which increase the variety of cultivated plants.

In recent years, crop rotation is one of the Eco-friendly methods.

Materials and methods

The experiment was conducted on the irrigation field of the formal potato seed multiplier company “Elite seed” in Khushaat sum of Selenge province (Photo 1).

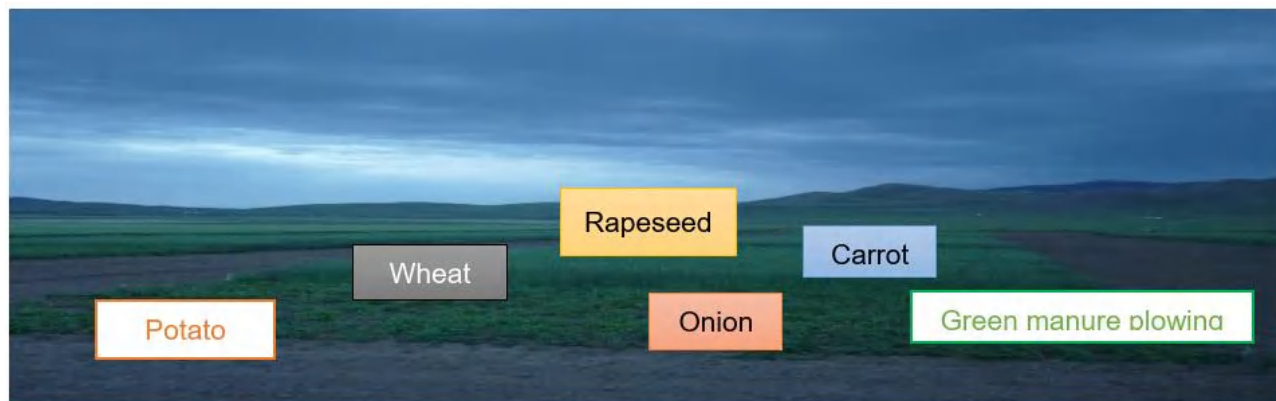


Photo 1. Field of experience

The four different crop rotation has three systems. The experimental field was 140m² per plot, with three replications following potato planted preceding wheat, rapeseed, green manure fallow, carrot, and onion.

Types of potato rotation:

1. Wheat – Potato –Wheat (W-Po-W)/
2. Green manure fallow (Peas + Buckwheat rice mix) – Potato – Wheat (GMF-Po-W).
3. Rapeseed – Potato – Wheat (Rs-Po-W).
4. Onion – Potato – Carrot (O-Po-C).

A mixed soil sample of 0-20 cm was taken from each plot of the experimental area, and the basic agrochemical parameters were determined by the Soil Agrochemical Laboratory of the Institute of Plant Agricultural and Science. Among them: soil humus was determined by the Turing method, nitrate nitrogen by the Disulfaphenol method, mobile phosphorus by the Michigan method, exchangeable potassium by a flame photometer, and soil environment by a potentiometer.

The yield was calculated as each replicate's average number and weight of tubers from 10 plants. By dividing the total number and weight of tubers by the number of measured plants, the index of one bush was obtained, and the yield of 1 ha was calculated based on the yield of one bush.

Research result

According to the research, when the soil samples were analyzed before planting potatoes, the content of humus, nitrogen, phosphorus, and potassium was not the same due to the previous cultivation, but the GMF-P-W rotation was superior in terms of overall soil fertility and biochemical parameters. According to the results of the soil analysis conducted after harvesting potatoes, there was a slight increase in humus, and a decrease in nitrogen, phosphorus, and potassium content.

The average results of 2015-2018 for soil humus and agrochemical plant are shown (in Figure 1).

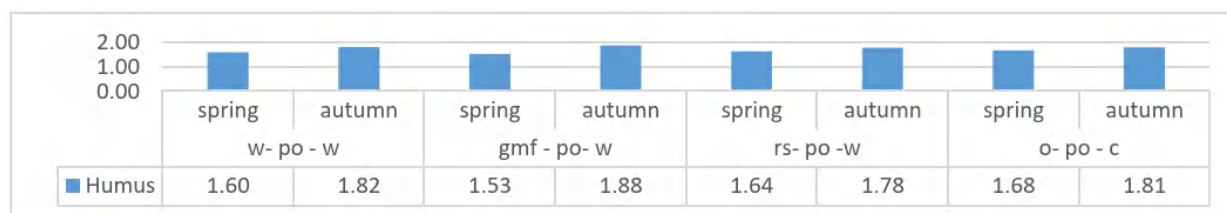


Figure 1. Amount of humus in soil, %

It is a good thing that soil humus increased by 0.23% from 1.53 to 1.68% in spring and from 1.78 to 1.88% in autumn due to previous crops.

Soil analysis samples taken before and after potato planting in onion fields showed an average increase of 0.13% in humus content and an average increase of 0.35% in green manure fallow. Green manure fallow enriched the soil with the highest amount of humus compared to the other alternatives, as was observed in the results of the soil analysis and during the study.

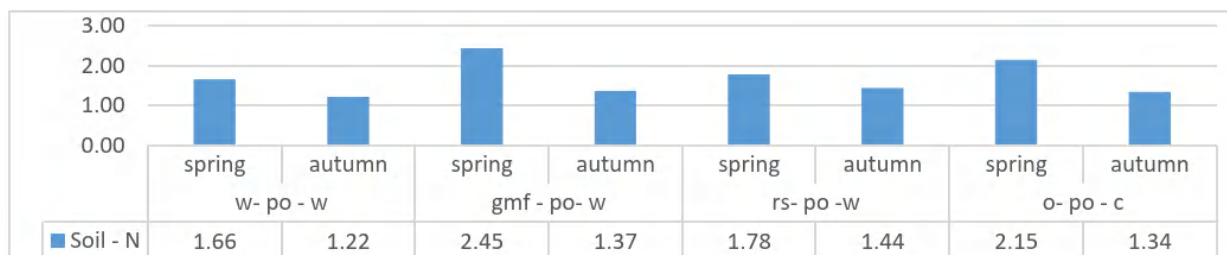


Figure 2. Amount of soil nitrogen content, mg/kg

According to the result of soil nitrogen content in spring and autumn samples taken from potato fields planted with various previous crops, it decreased to 1.66-2.45 mg/kg before potato planting and 1.22-1.44 mg/kg in autumn. From this, approximately 0.73 mg of nitrogen was taken from the soil per 1 kg of soil during the growing period of the potato.

Potato crops planted after rapeseed had the lowest use of 0.34 mg/kg nitrogen, and green manure fallow crops used 1.1 mg/kg nitrogen. It indicates that the amount of soil nitrogen, which can be easily used by plants, was high in the 0-20 cm depth of the soil after following with green manure fallow, which creates the possibility to have a good effect on the growth and yield of crops planted in the next year.

The amount of phosphorus used by potato plants grown in each rotation was determined in spring and autumn in soil samples. According to the results of the analysis, potatoes planted after wheat used 0.05 mg/100 g or less than other versions, and potatoes planted after rapeseed used 0.45 mg of phosphorus from 100 g of soil during the growth period.

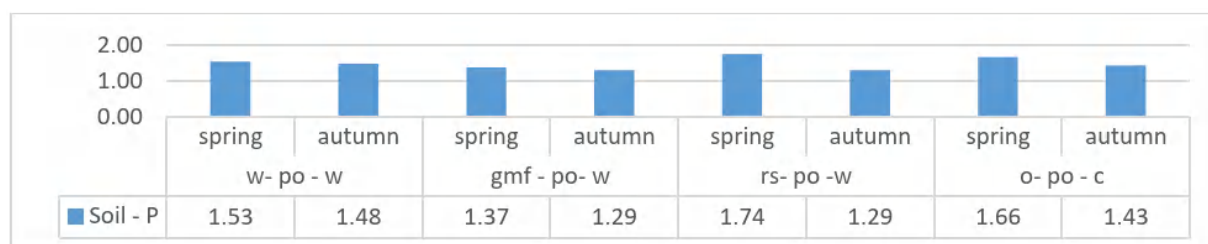


Figure 3. Amount of soil phosphorus content, mg/ 100 g

It was found that the potassium content in the field soil was 6.00-6.88 mg/100 g in the spring, and decreased to 4.12-4.40 mg/100 g after the harvest. Potatoes use a lot of potassium during the growing season which has an important effect on soil fertility. After planting green manure fallow and rapeseed in, soil exchange was used more, therefore contributing to the increase in yield. Figure 4 shows that the least potassium (1.62 mg/100 g) was used for planting potatoes in the field planted with wheat for 2 consecutive years.

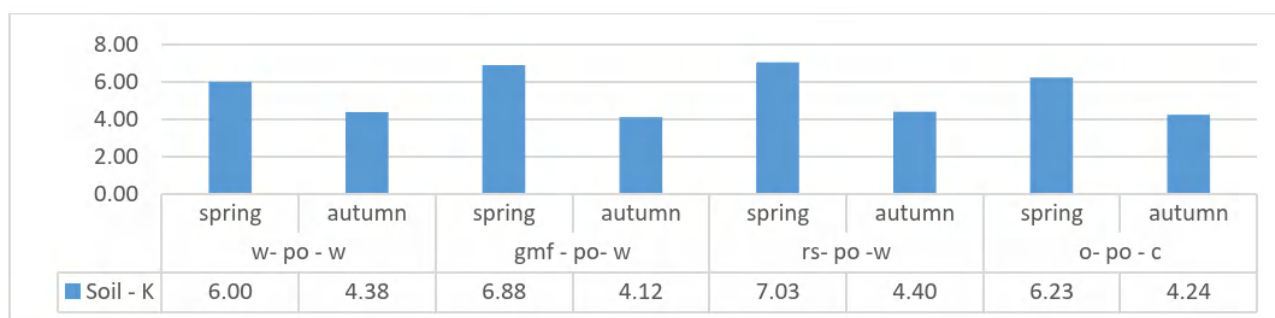


Figure 4. Amount of soil potassium content, mg/100 g

Dr. R. Baljinnyam has clearly written in his work that potato cultivation intensively uses potassium during the development of vegetative organs, especially during flowering and tuber formation [1-13].

Tables 1 and 2 show the changes in the yield and biochemical parameters of potatoes planted after various types of cultivation, depending on the rotation involved in potato cultivation.

Table 1. Yields of potatoes

№	Type crop rotation	Yield per bush		Number of bulbs per tuber	Yield t/ha
		Number of tubers	weight, g		
1	W – Po – W	7.2	558.2	79.3	22.9
2	O – Po – C	8.5	655.1	78.3	27.2
3	GMF – Po – W	9.1	896.7	101.5	36.5
4	Rs – Po – W	7.2	631.4	88.2	26.0

According to a 4-year study of potato crop rotation, after green manure fallow is planted potato yields 36.5 t/ha, which is 9.3-13.6 t/ha better than potato yield after planting other plants. The potato crop planted after wheat had the lowest yield. The number of tubers per bush of potato planted after types crop rotation was 7.2-9.1 bushels, while potatoes planted after green manure fallow planted of potato yield 0.6-1.9 tubers more than other plants.

Discussion

According to the results of our research, green manure fallow-potato-wheat with legumes not only improves the biochemistry of tubers, and soil fertility, has a positive effect on humus content and physical properties, but also increases the yield, which is similar to the results of other researchers.

As can be seen from the above mathematical processing, the yield of potato crops grown indifferent previous crop is significantly different from each other, the p value is less than 0.05.

Conclusions

1. Green manure fallow increases the nitrogen content in the soil layer where the roots of the plants are located, which can be easily used by the plants and has a good effect on the growth and yield of the next year's crops.

2. Green manure fallow – Potato – Wheat rotation in high-yielding green manure for potato harvested 9.3-13.6 t/ha better potato yield than other rotations.

3. The rotations involving potato cultivation improved the soil fertility and had a good effect on the yield increase. In addition, green manure fallow-potato-wheat rotation was superior to other rotations in terms of soil fertility, tuber biochemical quality, and yield.

References

- [1] Amarsanaa B. Soil fertility management. UB, 2015.
- [2] Ariuntsetseg D. Effects of tillage and rotation on soil fertility regeneration. UB, 2022.
- [3] Baljinnyam R. Selection of potato previous crops and improvement of soil cultivation systems in the central cropping region // Thesis for the degree of associate doctor of agricultural sciences. p.119. UB, 1992.
- [5] Batsukh B., Myagmarsuren Ya. Experiment methods. Darkhan, 2008.
- [6] Bayarsaikhan B. Effect of fertilizers on the soil fertility and wheat yield, quality // Thesis for the degree of associate doctor of agricultural sciences. UB, 2019.
- [7] Davaa L. Effect of soil cultivation and crop rotation on soil biological activity // Thesis for the degree of associate doctor of agricultural sciences. UB. 2006.
- [8] Gereltuya P., Ninjmaa O., Saranchimeg B. Efficacy of green manure following and microorganisms on yield of potato seed // Science report, Darkhan, 2018.
- [9] Mijiddorj J. Agriculture for soil protection. Darkhan, 2012.
- [10] Otgonbaatar I., Altangerel U., Turmandakh T., Nyamjav S. Effect of crop rotation on improving soil fertility in irrigated potato fields" Agricultural Development of Mongolia. 2016 // Proceedings of the Research-Industrial Conference. UB. 2016.
- [11] Ochir J., Dorj B., Boldsaikhan O. Effect of legumes on soil fertility. Agriculture Development of Mongolia. 2016 // Proceedings of the Research-Industrial Conference. UB. 2016.
- [12] Tsermaa D., etc., report on the scientific and technological project on the topic of "New rotation and advanced technology to improve soil fertility" [manuscript]. UB, 2005.
- [13] Enkhtuya B. "Soil science". Darkhan – Uul, 2008.