

INFLUENCE OF THE ROTATION TYPES ON THE POTATO DISEASES GROWING IN IRRIGATED AREAS

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Abstract

In irrigated areas, crop rotation is especially important to reduce the potato diseases. Place the rotation correctly, increasing the number of rotations also the crop species are the key to increase crop yields and to reducing potato diseases. To study the spread and development of potato disease 5 variants of 2,3,4-square-meter rotations were used. We carried out with 3 repetitions, each field was 140m², the study area was totally 1.1 hectares.

In irrigated potato crop rotation types, the prevalence of phytophthora disease was 3.3% in 4-crop rotation areas, it means it was 1.0-3.0 less than in 2- and 3-crop rotation areas, and the prevalence of alternariosis was 2.5% in rapeseed, 2.3% in Green fallow, which was 1.5-2.0% lower than in wheat rotations. Depending on the pre planting crops and the number of rotations, the incidence of the disease decreases significantly and the yield increases by 2.7-14.2 tones/ ha.

Keywords: Potato, rotation, disease, Phytophthora, Alternariosis

Introduction

Due to climate change and global warming, as well as the change of precipitation distribution, the annual crop yields vary in Mongolia. Therefore, the need for irrigated agriculture to achieve sustainable high yields is increasing, also the use of irrigation in potato cultivation is increasing in our country.

According to the survey, there are 234.0 thousand hectares of land in our country which have a suitable soil and sufficient water supply for irrigated agriculture. In 2016, an irrigation system with an irrigation capacity of 54.0 thousand hectares were used, but 82.8 percent is used annually []. The main threat to irrigated potato fields is the spread of diseases such as late blight and alternariosis. The use of green manure in rotation system is necessary for increasing yield, decreasing diseases, protect the soil structure and soil fertility in irrigated potato field.

The purpose of the study

The purpose of this work is to improve the quality of irrigated potato crop and to select the optimal potato rotation system to reduce the incidence of diseases. In order to reach our purpose, we carried out following subtasks.

1. Estimation of disease development and spread during potato growth in all rotation types.
2. Pre-select the appropriate plants in rotations for irrigated potato crops.

Research methods

The study was carried out in the irrigated area of “Elite-Ur” LLC, located in Khushaat soum, Selenge province, in 2014-2019. French-made 2IE straight-line sprinkler were used.

During the growing season, the disease was identified by their characters at the stage of flowering. Phytophthora was evaluated with a score of 6 points and alternariosis with a score of 5 points, respectively. The spread and the development of disease were determined by A.E.Chumakov's method.

Rotation crop types

A. Planting in two fields

1. Potatoes - Wheat

B. Three-crop rotation fields

1. Potato - Wheat - Wheat
2. Potatoes - Wheat – Green fallow (peas + oats)
3. Potatoes - Wheat - Rapeseed

B. Four-crop rotation fields

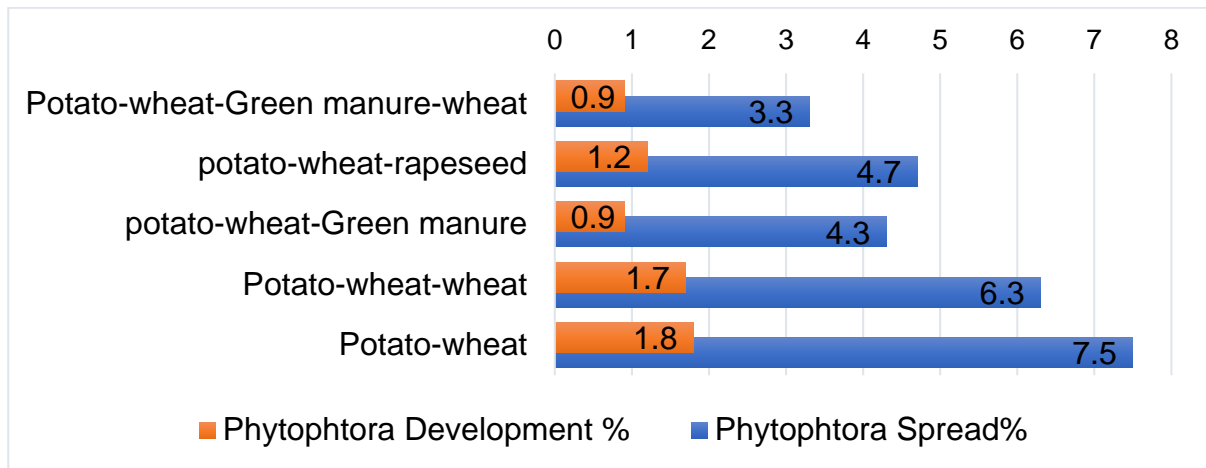
- a. Potatoes - Wheat - Green fallow (Pea + oat mixture) - Wheat

Research result

The spread and development of diseases on the stem and leaves of potato were studied in 2, 3, and 4 fields by comparing the effects of different cropping types at the end.

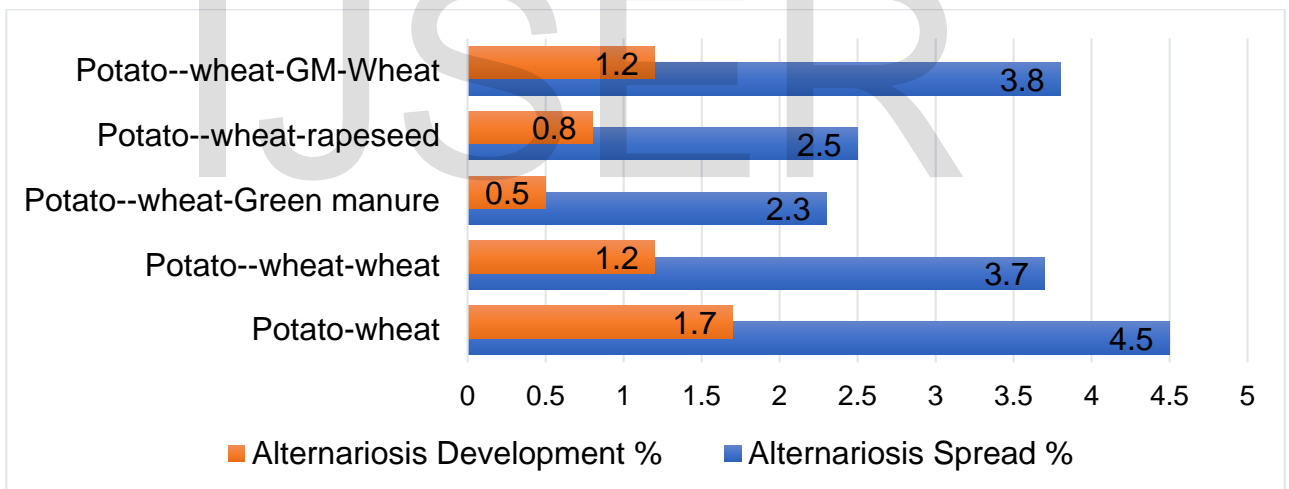
Effect of Rotation system on potato stem and leaf disease

Researcher B.Dondov found that the distribution of phytophthora during the growing season of potato in Mongolia depends on the moisture and heat coefficient of the year. When the moisture and heat coefficient (MHC) of the growing season is less than 0.6, phytophthora disease does not occur at all, when MHC is 0.7-1.0, it is low, and when MHC is 1.0-1.3, it is moderately above 1.4, and the spread of the disease increases [5].



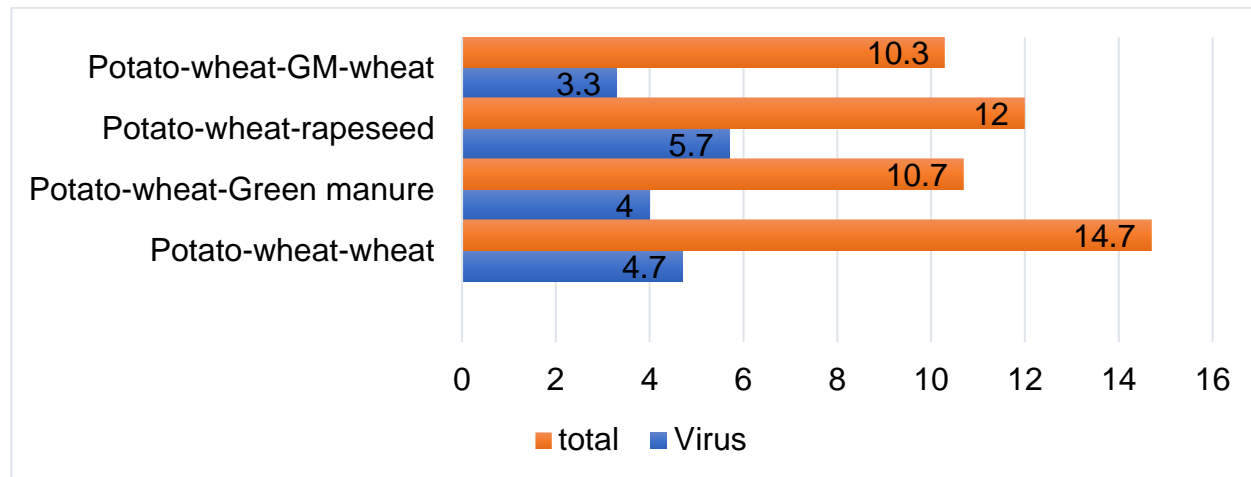
Graphic 1. The spread and development of Phytophthora disease

The prevalence of phytophthora in the rotation system sectors is 3.3-7.5%, development 0.9-1.8%. The prevalence of phytophthora was 7.5% in the 2-field rotation involving potatoes and wheat, and 6.3-4.3% or 1.2-2.2% lower than in the 3-field rotation. The prevalence of phytophthora disease in the 4-site rotation was 3.3%, which is 4.2% lower than in the 2-site rotation, and 1.0-3.0 less than in the 3-site rotation. As the rotation number increases the incidence decreases. Shown in Graphic 1.



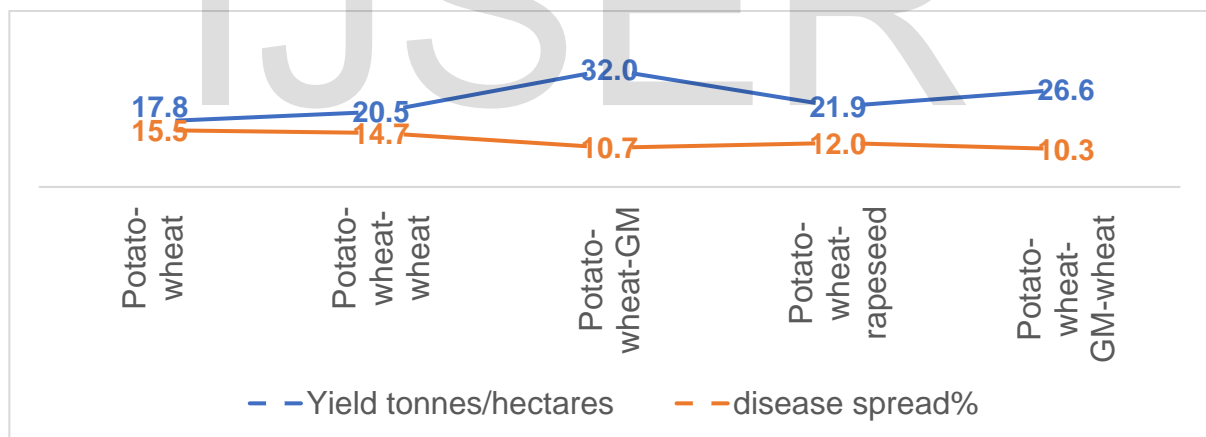
Graphic 2. The spread and development of Alternaria disease

The prevalence of alternariosis in the Rotation system was between 2.3-4.5%, the development rate was 0.5-1.7%, and the prevalence of alternariosis is 2.3-2.5% in 3-field rotation type involving green fallow and rapeseed. In other 2 and 4 crops rotation fields the incidence was 3.7-4.5 %, the higher result, indicating that the preliminary crop types effects on the rotation. The result was shown in Graphic 2.



Graphic 3. Total disease compared to viral disease

According to Spaare's study (1993) the potato yield decreases 20-78 % by L virus, 14-90% by Y virus, 38-46% by A virus, 9-50% by M virus, 0-23% by S virus, 0-57% by X virus, respectively. In potato rotation the virus disease is about 3.3-5.7 % and covers 22.6-47.5% of the total disease. The two and three field rotation type including potato and wheat, the disease prevalence was 15.5-14.7%, in three field including green fallow and rapeseed, it was 10.7-12.0% and for the four field rotation type including potato, wheat, green fallow the prevalence was 10.3 %. From this result we can show that the disease decreases while the rotation number increases. Graph 3.



Graphic 4. Comparison between the disease spread and yield

In the irrigated potato field the high yield and low disease prevalence indicated in the field including green manure. This shows that increasing the rotation number and rotation crop numbers are the key factor for high yield and low diseases.

Discussion

Because potatoes are biologically less competitive with weeds in their early stages of growth, weeds need to be controlled by prevention, proper tillage, planting technology, rotation type and selection of rotation crops that are appropriate to the characteristics of the weeds. The use of Green fallow in the rotation in potato field has many advantages, such as protecting soil fertility, biological control of diseases, pests

and weeds, increasing yields, improving crop quality and producing ecologically healthy products.

Conclusion

In the rotation, the prevalence of phytophthora was 3.3% in four rotation type field, it means 4.2% lower than the two rotation type field, and 1.0-3.0 less than the three rotation field, which decreased by increasing the number of rotations.

The prevalence of alternariosis was 3.8-4.5% in wheat, while the prevalence in rapeseed was 2.5% and 2.3% in Green fallow rotation type, depending from the pre planting crops.

In order to reduce the incidence of diseases in irrigated areas and increase yields, it is especially important to increase the crop structure, lengthen the rotation in the system, and replace it with green fallow.

References

1. Batsukh.B, Myagmarsuren. Ya, "Experimental methodologies", Darkhan, 2008
2. Davaadorj.G, Turmandakh.T "Potato", Ulaanbaatar, 2011
3. Mijiddorj.J, "Soil conversation", Darkhan, 2012
4. Ninjmaa.O "Methods for protecting seed material from disease during virus-free potato seed multiplication", doctoral dissertation for agricultural science, Darkhan, 2001
5. Nyamjav.S "Improving the quality of seed tubers by improving the primary seed multiplication of virus-free potatoes" doctoral dissertation for agricultural science, Ulaanbaatar, 2013
6. Results of potato research, Ulaanbaatar, 2011