Succession of crops in fitossanidade and crop productivity of potato (*Solanum tuberosum* L.)

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Abstract

The study was conducted in the experimental area of Department of Agronomy, campus Cedeteg of the State University Center West, Guarapuava - PR. It aimed to evaluate the productivity and classification of tubers and the severity and incidence of scab on the potato crop in succession crops of vetch (Vicia sativa L.), oat (Avena strigosa L.), wheat (Triticum aestivum L.), radish (Raphanus sativus L.) and fallow area. It was observed that the productivity and the diameter of the tubers were not affected by treatments. The cultivation of oat as predecessor increases the severity of common scab (Streptomyces spp), and fallow and culture of vetch as predecessor caused an increase in severity of silver scab (Helminthosporium solani Dur. e Mont.).

Key words: land cover, scab, tuber size

Introduction

The potato (Solanum tuberosum L.), Solanaceae, is originally from the Andes and ranks fourth in volume of world food production, exceeded only by wheat, rice and corn (LOPES and BUSO, 1997), considered the third largest food source for humanity (FILGUEIRA, 1993), is a major diet in many countries.

The potato crop is of fundamental importance to Brazil, where it is grown about 140 hectares per year (JOUKHADAR, 2006). It was observed a reduction in planted area in the country in the last decade, despite the increase in productivity per area. This was mainly due to the professionalization of producers in search of economic viability and sustainability of agriculture by increasing the amount of inputs used as fertilizer, increased planting of scale and better quality health, physiological and genetic seed potatoes, not been widely studied soil quality as a basis for the efficiency of the inputs used.

The addition of organic residues in the soil causes an increase in total porosity and macroporosity, which facilitates the movement of air and water, reduces soil compaction and soil density, increasing the infiltration of clay soils and improves the penetration of the root crops, being an important factor for the development of the potato plant. Derpsch (1993) mentions that the rotation of crops and green manures influence the infiltration of water, soil conservation and provide better returns on the profitability of production, when the rotation is integrated into no-till compared to conventional tillage. Another important indicator is the stability of aggregates in water, whereas a major impact with the addition of organic waste to the soil is to improve this parameter, which indicates changes in aeration, water drainage and root growth. For Pereira and Daniels (2003) for potatoes, not compacted soils and well structured are key to development and good training of tubers.

Significant changes are occurring in relation to care about the environment and maintenance of natural resources, with high questioning over the loss of soil erosion and the need for further mobilization in soil preparation. The minimum tillage is placed in an intermediate position to conventional tillage. The minimum tillage and direct seeding are called conservation tillage that aim to save energy, provide soil stability, reduce erosion and make it sustainable. The insconstância of the effect of disease is considered one of the greatest impediments to the full use of conservation tillage (FONTES, 2007).

In the potato crop, especially in other countries, there is the concernment about reducing soil degradation that can partly be achieved through the preparation with fewer machine operations.

Crop rotation is regarded as a key factor to be considered in planning crop production of potatoes. Besides principles of soil fertility and soil structure, are associated to this management factor plant characteristics, due to some cultures leave crop residue on their possible sources of inoculum, in accordance with measurements of soil and climate

occurring, can transfer to the tubers diseases with potential rates of incidence and severity, requiring larger volumes of pesticide application during the cycle and increasing production costs and reducing productivity and quality of potato production.

As the potatoes grow well in soils exceptionally porous, presenting critical rate of oxygen diffusion above the average found for other crops, and the O2 consumption by the root system 5 to 100 times higher than in other plants Regassi et al. (2007), stress that it is expected to grasses grown before potatoes, can benefit the culture with wider diffusion of oxygen. Boller and Prediger (2001) observed that some crops cultivated before the planting of potatoes can significantly influence the tuber yield. For climates Cfb, Cfa and other classified as subtropical climate and warm climate, as in south Brazil, crop rotation in general will involve species of ground cover in winter to the development of potato crops in the spring and summer. However, due to be considered a nomadic crop, migrating to areas of cultivation and escaping of an inoculum of fungal and bacterial diseases, it is also common cultivation in succession to land. As the culture is highly affected by the occurrence of diseases, especially those that affect the productivity and external quality of the tubers, it is vital to develop research to reduce the pressure from pathogens on culture, and the assessment of a succession of crops and rotation crops important factors to be known, therefore, enable new and more appropriate forms of management for field culture.

Menezes e Silva (2003) point out that the crop rotation and addition of organic wastes of animal origin to the soil are important alternatives to optimize the addition of nutrients in the soil and thus leverage the answers in terms of production and fitossianidade potato.

Taking into account the great response of potato to the use of inputs, geographic areas limited to exploration and decreased productivity after using this system of soil management, it is vital to the profitability and sustainability of potato new processes of land use, seeking alternatives that optimize the inputs used without compromising future crops that will use resources provided by the soil. In this context, the objective was to evaluate the yield and grading of tubers and the severity and incidence of common scab (*Streptomyces* spp.) and silver scab (*Helminthosporium solani* Dur. e Mont) in succession to different types of winter crops.

Materials and methods

The study was conducted in the experimental area of Department of Agronomy, Campus Cedeteg State University Center West - Unicentro in Guarapuava - PR, 25 ° 23'36 "N, 51 ° 27'19" W, altitude of about 1025m, and regional climate classified as Cfb - mesothermal humid subtropical, according to the methodology Koeppen. Climatic data for the period were obtained from the meteorological station Unicentro located near the experimental area.

The local soil is characteristic of the region being classified as Latossolo Bruno Distroférrico (Embrapa, 2006). Chemical analysis conducted in April 2008 presented the following data (0-20 cm layer) pH (CaCl2) 4.6; MO: 44.3 mg dm-3, P (Mehlich): 1.2 mg dm -3, K2O: 0.13 cmol dm-3, Ca: 2.0 cmol dm-3, Mg: 2.0 cmol dm-3, B: 0.25 mg dm-3, Fe: 49.8 mg dm -3, Cu: 1.0 mg dm-3; Mn: 30.2 mg dm-3, Zn: 1.4 mg dm-3.

The five treatments consisted of soil cover in the predecessor period of the potatoes cultivation, four species used as cover crops and fallow in winter, being: T1-Wheat (150 kg seed ha-1), T2-radish (30 kg seed ha-1) T3-Control (fallow), T4-black oat (110 kg seed ha-1), T5-vetch (70 kg seed ha-1). The fertilizer used prior to planting of cover crops was 200 kg ha-1 NPK 4-20-20 formula, including fallow, distributed 60 days before sowing.

The deployment of the treatments was held on July 10th, 2008, and on December 09th all plots were desiccated. The planting of the potato crop was held on December 23rd, 2008, using the cultivar Ágata, now widely cultivated in Brazil. The seed used was Generation 01 and tubers class II (45 to 55 mm).

Prior to planting the preparation and new soil preparation was done, considering the methodology used by producers usually more tecnificados in the region, which included distribution of limestone (3.5 T ha-1) and operations of the 1st gradagem, rotary tiller, 2nd gradagem and plow for montagem de camalhões. To plant the seed potatoes were distributed by hand at a depth of approximately 10

cm spacing between rows of 0.8 cm and between plants of 0.25 m with a planting density of 50,000 tubers per hectare. The fertilizer used in the furrow was 3.5 ton ha-1 of NPK 4-14-8. After the distribution of tubers in the furrows a fungicide with active ingredient (ai) Pencycuron and insecticide (ai) Chlorpyrifos was applied to prevent the tubers during early development.

The experimental design was completely randomized with five treatments and four replications. The experimental unit was 4 rows of 4 m long spaced 0.8 m constituting a total area of 16m2. The evaluations were conducted in two meters of each of the two main lines of the plot. It was evaluated the productivity and classification of tubers according to the size and incidence and severity of common scab (*Streptomyces* spp.) and silver scab (Helminthosporium solani Dur. And Mont.) on the tubers. The characteristics related to the symptoms in relation to the severity and incidence were divided into superior and higher, indicating the occurrence of symptoms in rough spot or depression, respectively. Statistical analysis was performed by analysis of variance and comparison test of mediums by Tukey test with 95% probability.

The classification of the tubers was carried out according to the diameter classes of Decree No. 69 MAP February 21st 2005 and scab assessment was performed according to the methodology proposed by Reifschneider (1987) e Azevedo (1997). Statistical analysis was performed by analysis of variance and comparison test of mediums.

During the development cycle of the plants preventive and curative pesticides were applied,

Figure 1. Temperature and rainfall during the development cycle of the potato crop in the period December/2008 to March/2009 in Guarapuava-PR.

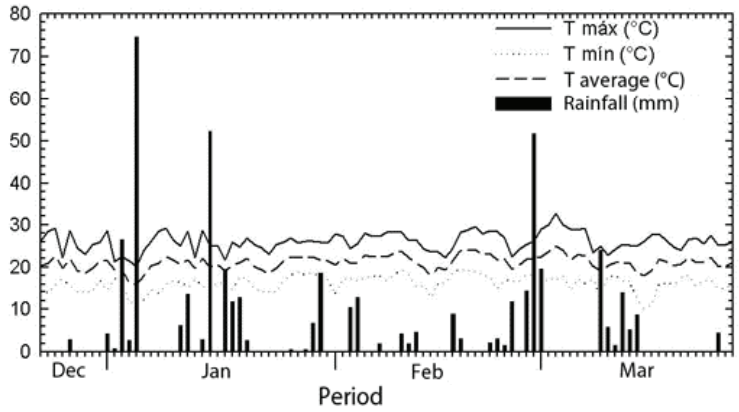

Table 1. Active ingredient products (fungicides, insecticides and herbicides) applied during the development cycle of the potato.

	Product (active ingredient) - dosage (ha-1)*								
	Clorpirifós	**Pencycuron**	**Paraquat**	**Mancozeb**	**Metamidofós**	**Lambda-Cialotrina**	**Alfa-Cipermetrina**	**Metribuzim**	**Carbaril**
	1,5 L	**4 Kg**	**1,5 L**	**3 Kg**	**100 mL**	**150 mL**	**100 mL**	**1,5 L**	**100 mL**
Month	**Date of application**								
December	23	23	10	-	-	-	-	-	-
January	10	-	-	13, 16, 19, 24, 30	14, 20	16, 24, 30	-	29	
February	-	-	-	2, 4, 6, 10, 13, 16, 18, 22, 24, 27	2, 6, 22	4, 13, 16, 24	10	-	18
March	-	-	27	3, 6, 11, 18, 20, 23, 25	6, 23	3, 11, 20, 25	-	-	18

** Determination of corresponding commercial product.*

considering the major fungal diseases and insects that cause damage to crops and selective herbicides (Table 1), (i.a) Paraquat was used as a herbicide pre-planting and as desiccant culture (at 95 days after planting - DAP) in order to standardize the completion of the development cycle of the crop for later harvest, which was held on April 12th, 2009 at 110 DAP.

Results and discussion

Figure 1 presents the data on the behavior of temperature and rainfall during the crop cycle. It appears that the average temperature oscillated around 20 ° C, which tends to show lower temperature from the month of March, being this variation considered normal for the temperature in the region, according to Ayoade (1996). The monthly rainfall values were between 150 and 200 mm, within normal limits for the period, however, the distribution of rainfall was not uniform, and in the second fortnight of January and the first of March the reduction moisture soil may have caused water stress to the culture and affected the yield and quality of tubers.

The results of productivity and classification of tubers considering the diameter are presented in Table 2. There were no statistically significant differences in the evaluation of production and classification of tubers. The statistics similarities of the results are important information because it indicates that the potato can be grown in rotation with other crops without harming productivity, which in many cases, can facilitate the planning of the production system. However, it is appropriate that this information is evaluated carefully, as in other studies there were significant effects of previous crops on yield, and as Boller and Prediger (2001) who found higher yields of tubers in potato crops in cultivation

Figure 2. Evaluation of the incidence and severity of different forms of occurrence of scab (Streptomyces spp.) in potato tubers. (Averages followed by same letter do not differ by Tukey test at 5% probability).

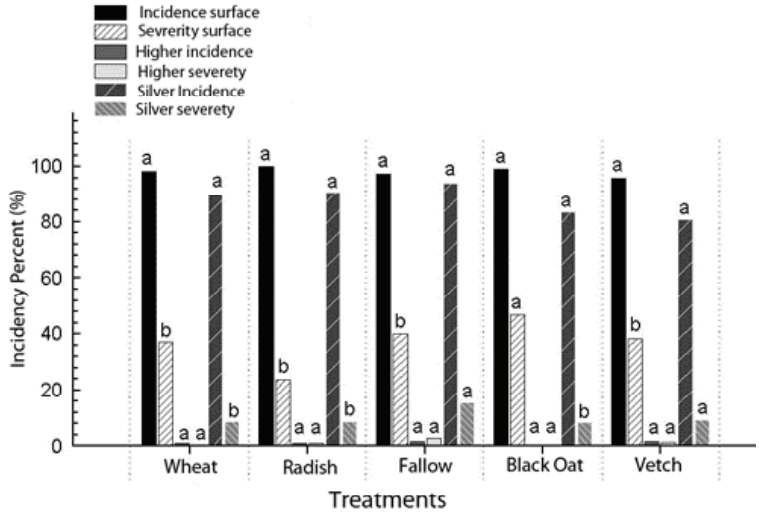

Table 2. Productivity and percentages of different sizes of potato tubers in different treatments.

Covers	Productivity (Kg ha-1)	Diameter of Tuber			
		> 55 mm	45-55 mm	33-45 mm	< 33 mm
Wheat	42869,53 a	63 a	27,38 a	9,32 a	0,28 a
Radish	43113,28 a	58,46 a	34,23 a	7,09 a	0,19 a
Fallow	45921,87 a	50,70 a	38,04 a	11,07 a	0,17 a
Black Oat	45598,67 a	56,51 a	31,98 a	11,26 a	0,22 a
Vetch	41854,68 a	58,44 a	33,74 a	7,47 a	0,32 a

Means followed by the same letter in column do not differ by Tukey test at 5% probability of error.

after the rye (grass) than with radish. In this regard Regassi (2007) describe the biomass of grasses tend to increase soil oxygen diffusion, satisfying the high demand of potato crop.

It should be considered, however, that there are changes to approximate production of 4,000 kg ha-1, and, although these differences were not identified by conventional statistics, the tendency is to lower production when the crop is held in common vetch.

To evaluate the diameter of the tubers was found that 57.42% were prepared in the> 55 mm, 33.38% between 45-55 mm, 9.24% between 33-45 mm, being observed an extremely low number of tubers in class less than 33 mm in diameter. The average yield of the crop was 43.871Kg ha-1. The fallow tended to greater value yield, however, regarding the classification of the tubers, the tendency was to concentrate more tubers in class of the size between 45 and 55 mm in comparison with other treatments that tended to focus more on the> 55 mm.

Figure 2 presents the results of treatment in relation to the sanity of tubers. It was evaluated the incidence and severity of different forms of occurrence of scab (Streptomyces spp.) in the tubers. Differences were observed between the culture of oat (*Avena strigosa*) in relation to other cultures, the aspect of severity of common scab in the superficial lesion. This result is extremely important considering the suppressive effects of scab on the commercial aspects of the infected tubers, as reported by Fisher et al. (2003). This result confirms the views of many bataticultores from Paraná, who suspect of greater scabies infection of potato crops in succession to oats.

For the evaluation of silver scab (*Helminthosporium solani* Dur. And Mont.) it was observed a higher incidence of severity in the treatments with fallow and cultivation of vetch, indicating that other predecessors cultures used helped to control this pathogen. There were no differences between treatments for the other evaluated parameters, as incidence of superficial symptoms, and incidence and severity of symptoms of high common scab, and incidence of silver scab.

In relation to sanity, considering the occurrence of both common scab and silver scab causes the damage that greatly reduce the economic value of the tubers results indicate that among the treatments, it should be avoided growing potatoes in the fallow or in rotation oats or vetch, with preference being given preference to the succession of crops of wheat or radish.

Conclusions

For better sanity of tubers considering the occurrence of common scab and silver scab, it should be avoided cultivation of potato in the fallow or in rotation with oats or vetch, with preference for growing in succession to wheat or radish.

The productivity per area of tubers and the classification according to the diameter are little affected characteristics by the cultivation of potato in common vetch, oats, wheat, radish or fallow area.

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