PHYTOSANITARY STUDY OF PEA CROP PROTECTION FROM *FUSARIUM* ROOT ROT DEPENDING ON THE PRECURSOR

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Abstract. *The article presents the phytosanitary rationale of pea crop protection from Fusarium root rot depending on the precursor in Yashkinsky district of the Kemerovo region. It was revealed that pea variety Yamal regionalized in the Kemerovo region and taken as the standard is affected by root rot to a greater extent for crops (19.0%) than for Phytosanitary precursor such as a rape (10.0%). Variety Salamanca has not damage above 11.0% respectively for all precursors. The maximum grain yield was obtained from variety Salamanca for precursor such as annual grasses (rapeseed). The yield was 2.2 t / ha by 0.7 t / ha more than for recognized variety Yamal. As a result of the above it is clear that the choice of variety and the precursor is of great importance in phytosanitary rationale of pea crops protection from Fusarium root rot.*

Key words: *crop protection, Fusarium, phytosanitary study, variety Salamanca, variety Yamal*

INTRODUCTION

Loss of agricultural products from pests in Russia is 25.0-27.0% annually. At the present time it is managed to prevent up to 60.0-70.0% of the possible yield losses due to the use of chemical plant protection products that leads to an increase in pesticide load on the biosphere of Kuzbass [1, 2, 3]. This problem has become global and in connection with which there is a growing interest in phytosanitary technologies of pea cultivation where the organization of production and plant protection strategy is aimed at reducing the use of pesticides which will reduce their negative impact on the environment [4, 5].

Deficiency of protein feed in this country and also in the Kemerovo region is the most important problem. It is one of the reasons hindering the further enhancement of livestock productivity. To increase the production of vegetable protein it is necessary to increase the number of sown areas, to introduce promising new high-yielding varieties of peas, as well as to use culture on phytosanitary precursors in crop rotation [5].

Pea due to its high food and fodder qualities plays a main role in the production of vegetable protein. Pea varieties regionalized in Kemerovo region are highly susceptible to diseases and are damaged by pests and also have low yields of grain and green mass. Major losses of pea crop from pests and diseases make up 20.0% and more annually [5].

Many cultures can be precursors for peas. An important requirement in choosing a precursor is the high level of site supply and purity from weeds. Rape, winter and row crops may be phytosanitary precursors. It is not right to sow peas after leguminous crops and legumes. They accumulate soil infection of *Fusarium* root rot which is dangerous for peas [5]. Development of *Fusarium* root rot in pea crops in the Kemerovo region is interconnected with the introduction of phytosanitary technology elements in the agricultural production. Sowing of peas on phytosanitary predecessors reduces the negative environmental situation in the region and affects the yield increase [6, 7]. By now some experimental data of pea cultivation on a variety of predecessors are accumulated. However, research on the effectiveness of the phytosanitary rationale of pea crop protection from *Fusarium* root rot depending from predecessor was not carried out although the science and practice require a more in-depth study of this issue.

Based on the above, the purpose of our research was to give the phytosanitary rationale of pea crop protection from *Fusarium* root rot depending on the precursor. In accordance with the purpose there were identified the following objectives: study the effect of predecessors on reducing the pea plant damage from *Fusarium* root rot as part of phytosanitary cultivation technology; study of influence of predecessors on yield of pea varieties; calculation of economic efficiency depending on the predecessor as part of phytosanitary technology.

MATERIAL AND METHODS

A pilot research was carried out in 2012-2014 on the experimental field of the industrial and agricultural cooperative «Litvinovsky» in Yashkino district of Kemerovo region. Experience described in this work was carried out on plot with dark-gray forest soil. The content of humus was 7.8 % indicating average fertility, pH was 5.5 (weak acidic soil), the degree of base saturation was high (88.0 %), the pea supply by potassium was 131 mg/kg of soil, by phosphorus was 105 mg/kg (high), nitrogen – 5,1 mg/kg of soil (average). Data are favorable for pea growing.

Immunological study of pea on resistance to root rot and seasonal dynamics of pathogen was carried out according to the «Methodical instructions to study the grain legume crops» [8], methods of A. M. OVCHINNIKOVA, R. M. ANDRYUKHINA [1980, 1985]. The varieties of peas such as Yamal (standard), Salamanca were used as the investigated objects. Predecessors: annual grasses (rapeseed) and grain crops. Varieties of peas depending of Fusarium root rot damage were evaluated in the germination phase, phase of 3 leaves and the inflorescence phase. The plant was visually inspected and the development of the disease was determined. The subsequent accounting was carried out in the phase of filling the beans. We dug up to 30 plants of each variety and in the laboratory determined the degree of Fusarium root rot development on the scale shown in Table 1 and the following formula:

$$R = \frac{\sum(a * b)}{N * K} * 100\%, \qquad (1)$$

where R is the percentage of the disease development; Σ (a x b) is the sum of products of the number of plants per corresponding damage score; N is total number of taking into account plants or individual organs; K is the highest score of accounting scale.

Table 1

Assessment scale of the sustainability of peas to root rots and disease progression

Damage	Assessment on a 6-point scale			Immunological characteristics
	score	leaves, stems, beans,% development disease	seeds, % damage	
Demage	0	0	0	I
Very weak	1	1-10	1-2	HR
Weak	2	11-25	3-5	R
Average	3	26-50	6-10	MS
Strong	4	51-75	11-20	S
Very strong	5	76-100	more than 21	VS

Note: I - immune, HR - highly resistant, R - resistant, MS – medium-susceptible, S - susceptible, VS – very susceptible.

RESULTS AND DISCUSSIONS

Experimental study of the phytosanitary state of pea crops in 2012-2014 in Yashkinsky district of the Kemerovo region showed that soil harmful organism such as Fusarium root rot was found on epiphytotiological classification relating to soil-air-seed infection. Rhizictoniose rot which refers to the same infection and typical soil infection were rarely met. Their species composition was defined. Fusarium root rot pathogens are fungi of genus *Fusarium* Link., *Fusarium oxysporum* Schlecht. f. sp. pisi. Linford., *Fusarium solani* (Mart.) App. Wr. sp. *pisi*, *Fusarium avenaceum* (Fr.) Sac. The damage of pea crops started in the seed sprouts seed in places of primary roots occurrence. Later the root neck and the base of the stem were damaged. As a result 1.0% of seedlings perished. Disease developed in also on mature plants, which prematurely turned yellow and dried out.

Experimental research has shown that regionalized in the Kemerovo region pea variety Yamal (standard) was affected by *Fusarium* root rot pathogens to a greater extent on crops (19.0%). Minimal damage was noted on annual grasses predecessor such as rape (10.0%) (Table 2.).

Table 2

Damage of pea crops by Fusarium root rot in the phase of milk ripeness of grain depending on the precursor, Yashkinsky district of Kemerovo region, 2012-2014,%

№	Variety	Damage of plants,%	Damage, % in samples				Average for the variety, %
			1	2	3	4	
Predecessor – annual grasses (rape)							
2	Yamal (standard)	21.0	10.0	10.0	10.0	10.0	10.0
1	Salamanca	26.0	7.0	7.0	7.0	7.0	7.0
Predecessor – cereals							
1	Yamal (standard)	46.0	26.0	10.0	10.0	30.0	19.0
2	Salamanca	31.0	17.0	14.0	10.0	3.0	11.0

The damage of variety Salamanca for all predecessors is not above 11.0%. It is just minor deviations from the standard. Thus it is clearly seen that the choice of the predecessor is essential in pea sowing.

2012-2014 was unfavorable period for the growth and development of pea crops. There was high humidity at low temperatures. Pea made beans but the top continued to grow forming new inflorescences, blossomed and made new beans. As a result the ripening process was slowed down, there were a lot of unripe peas in pods. On the 14th of June in 2014 there was a heavy downpour with hail and strong winds that affected yields. Data of basic elements of yield structure is shown in Table 3.

Analyzing the basic elements of the pea crop structure, we note that the variety Yamal (standard) has the same number of surviving plants to harvesting on both predecessors such as 99 pcs./m².

Table 3

Structure elements of pea crop yield depending on the precursor, Yashkinsky region of Kemerovo region, 2012-2014

Predecessor	Variety	Survivor plants for harvesting, pcs./m ²	Number of beans on 1 plant	Weight of seeds from 1 plants, g	Mass of 1000 seeds, g	Producti-vity, t/ha
Annual grasses	Yamal (standard)	99	9	1.46	168.4	1.5
	Salamanca	103	10	1.65	303.0	2.2
Grain crops	Yamal (standard)	99	9	1.52	174.6	1.51
	Salamanca	103	10	1.63	242.6	1.7
HCP_{05}						0.35

The variety of Salamanca has 103 pcs./m² of surviving plants both on annual grasses and grain precursor. The maximum grain yield was obtained from variety Salamanca on annual grasses predecessor (rapeseed), which amounted to 2.2 t/ha. It is 0.7 t/ha more than regionalized variety Yamal taken as standard has. Data for economic efficiency are shown in Table 4.

Table 4

Economic efficiency of spring pea cultivation, Yashkinsky region Kemerovo region, 2012-2014

№	Indicators	Variety	
		Yamal (standard)	Salamanca
1	Yield (t/ha)	1.5	2.2
2	Production cost (rub.)	13500	19800
3	Cost of 1 ha (rub.)	7769	8205
4	Net income (rub.)	5731	11595
5	Cost price (rub.)	5179	3729
6	Rrofitability (rub.)	74	141

When calculating the economic efficiency of cultivation of spring peas on annual grasses predecessor we identified variety Salamanca having profitability level of 141.0% and the level of net income of 11595 rubles / ha. Variety of spring pea Salamanca exceeds harvest of Yamal, adopted as a standard by 0.7 t / ha.

The influence of factors (varieties, precursors, years) on the development of *Fusarium* root rot is different. At the same time varieties and precursors regulate the development of *Fusarium* root rot. The combined share of their influence was 95.5% at HCP_{05} - 0.35.

Productivity analysis revealed that the maximum grain yield was obtained from variety Salamanca on predecessor such as annual grasses – 2.2 t / ha. A clear correlation in the number of grains and the number of surviving to harvest plants per unit area depending on the predecessor was not found. It was revealed that the variety Salamanca was dominant on annual grasses predecessor (rapeseed) with the level of profitability of 141.0% and the level of net income of 11595 rubles / ha.

CONCLUSIONS

It was found that a variety of pea Yamal (standard) was damaged by root rot to a greater extent on crops (19.0%) than on the precursor such as annual grasses (10.0%). Variety Salamanca was damaged not above 11.0% on all precursors.

It was found that the maximum grain yield was obtained from variety Salamanca on annual grasses predecessor (rapeseed), which amounted to 2.2 t / ha by 0.7 t / ha more than regionalized variety Yamal taken as standard.

It was established that in the calculation of economic efficiency of spring pea cultivation on annual grasses predecessor the variety Salamanca was dominant with the level of profitability of 141.0% and the level of net income of 11595 rubles / ha.

Elements of phytosanitary technology of pea cultivation in the conditions of the Kemerovo region were developed. They create favorable conditions for the formation of healthy plants and they are unfavorable for the life of *Fusarium* root rot pathogens. These elements are based on the introduction of phytosanitary precursors in the production and are environmentally safe.

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