

INFLUENCE OF TRICHODERMIN-BL ON THE DECREASE OF FIBER FLAX INFECTION BY DISEASES AND THE IMPROVEMENT OF ITS PRODUCTION QUALITY

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Abstract: *Fusarium avenaceum*, *F. oxysporum*, *Alternaria alternata*, *Botrytis cinerea*, *Rhizoctonia solani*, *Mucor* sp., *Aspergillus niger*, *Penicillium* spp. were the most often isolated species from fiber seeds. The antagonistic action of *Trichoderma lignorum* T 13–82 in relation to seed contaminants was evaluated. The use of Trichodermin-BL, based on that antagonist, applied as pre-sowing seed treatment and on growing plants decrease diseases incidence. The application of Trichodermin-BL improved a set of biometrical and physiological parameters during crop vegetation, increased the yield and raised flax fiber quality.

Key words: flax, fungi, seeds, *Trichoderma lignorum*, Trichodermin-BL, disease control, yield

INTRODUCTION

In the global practice of plant protection at present the priority comes with the preparations of polyfunctional prescription which protect against the diseases, improving the ecological condition of germination zone, stimulating plant growth and development (Kudryavcev 2004). To such preparations refer bio-preparations based on high active strains of *Trichoderma* spp. The potential of antagonists as plant protection products is rather high: they optimize crop germination zone, restrict the pathogenic microflora and increase plant resistance to unfavorable factors (Harman 2000; Pietr 1997; Weindling 1932).

The most harmful fiber flax diseases in all flax sowing regions of Belarus are: pasmo (*Fusarium* spp.), flax septoriossis (*Septoria linicola* Speg. Garras), *Rhizoctonia* red rot (*R. solani* Kühn.), anthracnose (*Colletotrichum lini* Manns et Boll), bacterio-

sis (*Clostridium* spp.) (Semenov et al. 1980; Starostina et al. 2003). As main fiber flax disease agents are seed-borne, pre-sowing seed treatment is a compulsory technique in the technology of the crop growing. Considering that flax fiber and seeds are used for getting fabric with the special hygienic and antiseptic properties, medicinal preparations, food oil, high demands in relation to the ecological purity are brought forward the raw material. The use of biological preparations is one of the main elements of modern technologies of phytosanitary optimization of agrobiocoenoses.

MATERIALS AND METHODS

Trials were carried out under laboratory and field conditions of the Republican Unitary Company "Institute of Plant Protection" National Academy of Sciences (NAS) of Belarus and the Republican Unitary Company (RUC) "Flax Institute National Academy of Sciences of Belarus".

Antagonist fungi *Trichoderma lignorum*, strain T 13–82 and seeds contaminants of flax culture: *Fusarium avenaceum* (Fr.) Sacc., *Fusarium oxysporum* (Schlecht.) Snyd. et Hans., *Alternaria alternata* (Fr.) Keissl., *Botrytis cinerea* Pers., *Rhizoctonia solani* Kühn., *Mucor*, *Aspergillus niger* Tiegh., *Penicillium* spp. were used. To support cultures the agarized nutritive media: wort-agar and Chapek were applied (Aristovskaya et al. 1962). The antagonistic activity of *Trichoderma* spp. was evaluated by cross colonies method (Tarunina and Maslova 1979). To diagnose the diseases and identify the isolated phytopathogens methods used were applied (Bilaj et al. 1988; Semenov et al. 1980; Khokhryakov et al. 2003).

Field trials were carried out in the experimental field of the RUC "Flax Research Institute NAS of Belarus" according to methods of Dospekhov (1979). In field trials medium – ripening, high-growth, blue-flowered fiber flax cv E-68 was used. There were four repetitions with plot size 25 m² and planting rate – 22 mln of germinated seeds per hectare. Method of planting: narrow-rowed. Previous crop – winter triticale.

Based on the strain T 13–82 the biopreparation Trichodermin-BL was manufactured. The product was prepared on a loose grain substrate.

The scheme included: the 1st variant – Trichodermin-BL (pre-sowing treatment, 5 kg/t); the 2nd variant – Trichodermin-BL (pre-sowing treatment – 5 kg/t, spraying at the beginning of quick growth stage, 20 kg/ha); the 3rd variant – Vitavax 200 FF (1.5 kg/t) – standard (pre-sowing treatment); the 4th variant – control (without treatment).

During plant vegetation the phytosanitary monitoring (spread and development of diseases were taken into account), the phenological observations, the plant stand density and height were evaluated. After harvest the yield structure, flax stock and fiber quality were determined.

RESULTS AND DISCUSSION

Based on the results of phytoexamination of flax seeds it was determined that their contamination by fungi depended on tested cultivars. Mycological analyse of 12 flax cultivars showed that seed contamination fluctuated from 9 to 87%.

An average seed contamination by phytoinfection for the studied varieties was 53%. Among them the proportion of fungal agents was 73.6%, whereas bacterial – 26.4%. It is marked that among contaminants the phytopathogenic and saprophytic fungi were prevalent. *Fusarium. avenaceum*, *F. oxysporum*, *A. alternata*, *B. cinerea*, *R. solani*, *Mucor* sp., *A. niger*, *Penicillium* spp. dominated among isolates obtained.

The analysis of results of antagonistic action of *T. lignorum* in relation to seed contaminants showed that the inhibition of micromycetes growth was 57.5% on the third day of the combined cultivation and 85.7% on the 7-th day (Table 1). A high antagonistic action of *T. lignorum* T 13-82 is marked in relation to *A. niger*, *F. avenaceum* isolate 2-1 and *F. avenaceum* isolate 1-2.

Table1. *In vitro* influence of *Trichoderma lignorum* T 13-82 on the growth of flax pathogens

Pathogens	Inhibition of growth in % after days	
	3	7
<i>Alternaria alternata</i> isolate-2	26.4	2.8
<i>Aspergillus niger</i>	27.0	44.2
<i>Botrytis cinerea</i> isolate 8-1	8.7	0
<i>Fusarium avenaceum</i> isolate 1-2	57.5	85.7
<i>Fusarium avenaceum</i> isolate 2-1	53.8	71.7
<i>Fusarium oxysporum</i>	0	21.9

The phytosanitary monitoring showed that the main fiber flax diseases in 2004 were wilt caused by *F. avenaceum* and *F. oxysporum*, flax septoriosis (*Polyspora lini*) and anthracnose (*C. lini*). In the less degree the plants were infected by *Clostridium* sp.

The records of flax infection by diseases carried out at the beginning of yellow ripeness stage showed that Trichodermin-BL application effectively kept back the spread of fusariosis and septoriosis. In the variants with the pre-sowing treatment by the biopreparation and in combination of pre-sowing treatment with spraying during vegetation, flax fusariosis occurred on 4–6% of plants whereas in the control on 14% (Table 2). Flax septoriosis spread in the variants with biopreparation has made 11–16% (in the control – 21%). The efficiency of Trichodermin-BL was at the standard – a chemical preparation Vitavax 200 FF (1.5l/t) level.

Table 2. Influence of Trichodermin-BL spread (in %) of fiber flax cv E-68 diseases at the beginning of yellow ripeness stage

Trial variants	Spread (in %)		
	fusariosis	septoriosis	anthracnose
Trichodermin-BL (pre-sowing treatment)	6	16	3
Trichodermin-BL (pre-sowing treatment, single treatment during vegetation)	4	11	1
Vitavax 200 FF (1.5l/t) standard	2	14	4
Control	14	21	2
SED ₀₅	6.8	4.9	5.7

The analysis of biometric and physiological parameters of fiber flax at the beginning of quick growth stage showed that the application of Trichodermin-BL promoted the increase of a set of both parameters during crop vegetation. In the variants with its application crude and dry plant biomass, crude and dry stem biomass, dry and crude substance of leaves has increased.

The positive influence of Trichodermin-BL on flax seed productivity was marked. The mathematically reliable seed yield increased in relation to control. In the variant with two times application of the product (pre-sowing treatment, single spraying during vegetation) seed yield has made 8.3 cwt/ha (in the control 7.3 cwt/ha).

The complex application of Trichodermin-BL by seed treatment with the subsequent plant spraying during quick growth influenced positively flax production yield. Two times application of a biopreparation provided flax straw yield increase 7.2 cwt/ha, flax stock – 5.8 cwt/ha, total fiber 3.4 cwt/ha, long fiber 2.7 cwt/ha (Table 3).

Table 3. Influence of Trichodermin-BL on yield and economic parameters of flax production

Trial variants	Straw yield, cwt/ha	Flax stock yield, cwt/ha	Fiber			Fiber No.
			total	long		
			cwt/ha	cwt/ha	%	
Trichodermin-BL (pre-sowing treatment)	62.8	50.3	21.3	18.9	37.5	12
Trichodermin-BL (pre-sowing treatment, single spraying during vegetation)	64.3	51.5	22.8	20.0	38.8	12
Vitavax 200 FF (1.5l/t) – standard	58.0	46.4	19.1	17.9	38.5	12
Control	57.1	45.7	19.4	17.3	37.9	11
SED _{0.5}	2.7	2.2	1.1	0.90	0.96	–

Trichodermin-BL application along with the favourable conditions of flax retting and well-timed flax harvest, dew retting of flax straw, turning about and lifting of the obtained flax stock gave an opportunity to get rather high fiber quality. In the variants with the biopreparation application the number of the obtained fiber flax (No. 12) was higher than the control one (No. 11).

CONCLUSIONS

Flax seeds are the source of different pathogens and they are infected during vegetation time (Weindling 1932). That is why the decrease of an infection load is actual not only at pre-sowing treatment stage but during vegetation. Our trials showed the antagonist *T. lignorum* T-13-82 renders a biological activity in relation to the main pathogenetic and saprophytic contaminants of flax seeds.

The pre-sowing seed treatment by Trichodermin-BL and the additional application of the preparation during crop vegetation decreased the phytopathological load. Besides, the use of the biopreparation of a polyfunctional action pro-

moted the stimulating effect – facilitated yield increase and the improvement of flax production quality.

In spite of a separate lack of weather conditions coincidence with the biological flax needs at the cost of a biopreparation Trichodermin-BL application plant infection by diseases was decreased, good yield and high quality of fiber flax was obtained.

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POLISH SUMMARY

WPŁYW PREPARATU TRICHODERMIN-BL NA OGRANICZENIE ZACHOROWALNOŚCI LNU I POPRAWĘ JAKOŚCI JEGO PRODUKCJI

Fusarium avenaceum, *F. oxysporum*, *Alternaria alternata*, *Botrytis cinerea*, *Rhizoctonia solani*, *Mucor* sp., *Aspergillus niger*, *Penicillium* spp. (łacińskie nazwy patogenów, jak w streszczeniu angielskim) są gatunkami najczęściej izolowanymi z nasion lnu. W niniejszej pracy oceniano antagonizm *Trichoderma lignorum* T 13–82 w stosunku do powyższych mikroorganizmów. Zastosowanie preparatu Trichodermin-BL, opartego na tym antagoniście, jako zabieg przedsięwzięty dla nasion oraz już w czasie wzrostu roślin, zmniejsza ich

zachorowalność. Użycie środka poprawia także parametry biometryczne i fizjologiczne uprawy podczas jej wegetacji podwyższając plon oraz jakość włókna lnianego.