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Effect of some herbicides on the growth of two Drechslera species

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Effect of auxinlike herbicides on growth of *Drechslera sorokiniana* and *D. teres* in vitro was investigated. All herbicides in high concentrations inhibited mycelial growth, sporulation and germination of conidia.

INTRODUCTION

Plant pathogenic fungi are sensitive to different chemicals applied in agriculture. Most herbicides are not inactive to fungi. Some of them stimulate other inhibit their development, while growth regulators such as 2,4-D, MCPA, dicamba or mecoprop are considered as less active ones.

Hitherto investigations on the effect of herbicides on the cereal fungi have concentrated on *Drechslera sorokiniana* (Sacc.) Subramanian et P. C. Jain. The results have not been explicit. Richardson (1957) found decrease of root infestation of barley sprayed by 2,4-D. Archangielska (1982) and Gawrilova (1979) noticed, that 2,4-D protected wheat and at 0,25-1 µg/g concentration increased its resistance to *D. sorokiniana* and *Fusarium*, whereas Hsia and Christensen (1951) observed the increase of susceptibility of wheat to diseases caused by *Drechslera*. According to these authors *D. sorokiniana*, cultured on the medium containing 2,4-D showed higher pathogenicity. Hodges (1977) noticed that the effect of 2,4-D, dicamba and mecoprop on the growth and development of mycelium and spore germination of this fungus in vitro is similar to the effect of growth regulators on higher plants.

The aim of this paper was to investigate the side effects of a few herbicides applied commonly in agricultural practice on two species of *Drechslera* in vitro.

MATERIALS AND METHODS

Three strains of two species isolated from spring barley: *Drechslera sorokiniana* (Sacc.) Subram. et Jain and *Drechslera teres* (Sacc.) Shoemaker and four herbicides: "Aminopielik D" (36 % aminic salt of 2,4-D and 2,8 % aminic salt of dicamba), "Chwastox D" (14,5 % sodic salt of MCPA and 1,6 % sodic salt of dicamba), "Chwastox M" (9 % sodic salt of MCPA and 10 % sodic salt of mecoprop), "Chwastox płynny" (17 % sodic salt of MCPA) were investigated.

Examination of fungi colonies rate growth was carried out on potato-glucose agar with herbicides at six concentrations: 1, 10, 50, 100, 500, 1000 µg/g in terms of active substance (B u r g i e ł, 1984). The control was the medium without herbicides. Inoculum 5 mm in diameter, taken from peripheral part of one week old monosporic culture was placed on solidified medium on Petri dishes 90 mm in diameter. The experiment was carried out in three replications.

Measurements of linear growth of mycelium were taken every 48 hours until the total cover of the controlled dishes. Then the morphology of colonies was described and microscopic examinations were carried out. The structure and size of mycelium cells (50 elements from each replication) were analyzed in preparations.

14 day old *D. sorokiniana* culture in 0,25 l conical flasks on potato-glucose medium, about 10 mm thick with addition of herbicides at concentrations mentioned above were used for measurement of sporulation intensity. 30 ml of sterile distilled water was poured into flasks and they were shaken on a mechanical shaker for half an hour, applying such a frequency of shaking as not to damage the agar. Then the number of conidia was counted in 1 ml of suspension by hemocytometer and converted for the whole colony.

Besides, drops of spore suspention from each flask were placed on glasses in a wet camera at 21°C. After 24 hours germination of 50 spores from each combination was estimated according to F i s h l' s scale and then an index of germination was calculated (B u r g i e ł, 1984).

Additional experiments concerned a direct effect of preparations on spore germination. Fungi cultures on potato-glucose medium without herbicides were used for this purpose. Spores were washed out from the surface of 14 days old fungi colonies by solutions at above mentioned concentrations. Suspense drops were placed on glasses in a wet camera at 21°C. After 24 hours spore germination was estimated according to the presented method.

The examination of spores only involved *D. sorokiniana* because of difficulties with obtaining sufficient amount of well developed *D. teres* spores as the mentioned fungus produced spores very poorly in artificial cultures.

The values presented in figures represent an average for a given species because of the lack of significant differences in the reaction of particular strains of the examined fungi species to herbicides.

RESULTS

The applied herbicides generally restricted the growth of *D. teres* mycelium and that of *D. sorokiniana* (Fig. 1). Inhibitional activity of all preparations increased with their amount above 10 µg s.a./g of medium. The highest concentration caused a complete inhibition of mycelial growth. "Aminopielik D" was an exception. Small doses (1 and 10 µg s.a./g of medium) also inhibited the fungi growth, but their dependence on the concentration were not explicit. Attention should be paid to the lack of *D. teres* reaction to "Aminopielik D" and "Chwastox D", applied at above mentioned concentrations.

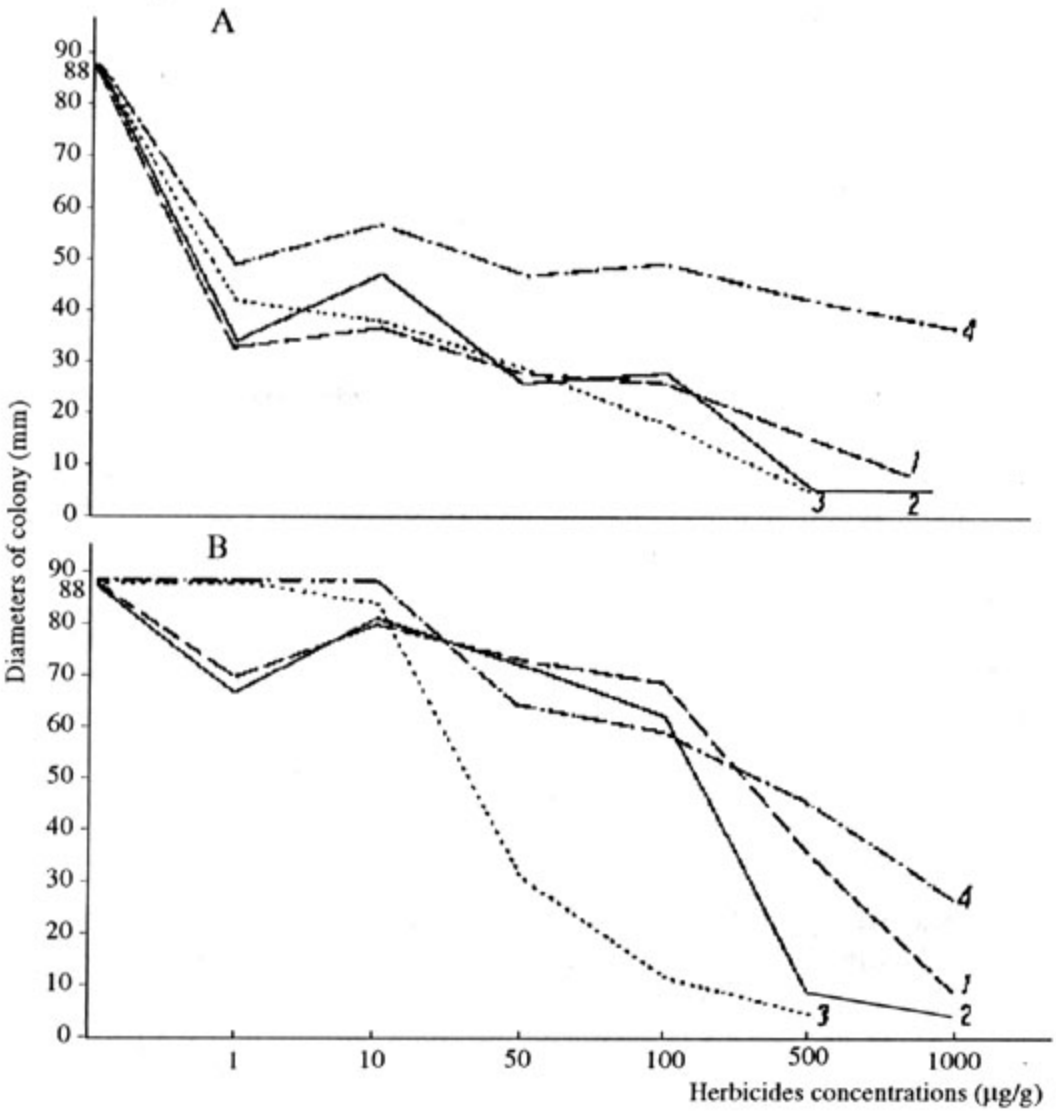

Fig. 1. Mycelial growth of *Drechslera sorokiniana* (A) and *D. teres* (B) according to the type and concentration of herbicides
1 – "Chwastox płynny" (in liquid) 30, 2 – "Chwastox M", 3 – "Chwastox D", 4 – "Aminopielik D"

Control *D. sorokiniana* colonies (Fig. 2 A) had smooth silky surface, well shaped edges. Aerial mycelium was olive-black and the bottom part was nearly black. Fungi colonies looked similar on "Chwastox M" and "Chwastox płynny" media at all concentrations and on the two other at lower concentrations. At "Aminopielik D" concentration of 1000 μg s.a./g (Fig. 2 B) the edge of a colony was wavy, low and on the medium containing "Chwastox D" in amount of 100 μg s.a./g the edge was raised and swollen significantly.

D. teres colonies in control series (Fig. 2 C) had a regular edge, woolen surface, olive-grey colour covered by light-grey, flaky mycelium conglomerations and the bottom part was olive-black. At lower concentrations of herbicides fungi colonies did not differ from the control ones whereas at the highest concentrations they were light-grey with olive shade especially on the medium containing "Chwastox D" (Fig. 2 D).

D. sorokiniana mycelium cells on media with herbicides were usually shorter than in the control (Fig. 3 A) and in some combinations they were also wider. "Chwastox D" in 50 and 100 μg s.a./g doses had a particular effect: cells were twice as wide as in the control and were rounded and swollen (Fig. 2 E).

The influence of herbicides on *D. teres* was not so significant, however the increase of the cell width and degenerative changes in protoplasm, particuraly at higher concentrations were observed.

D. sorokiniana colonies cultured with addition of "Chwastox D" at 1 and 10 μg s.a./g concentrations and "Chwastox M" at 1 μg s.a./g produced spores more abundantly than in the control (Fig. 4). At 1 μg s.a./g the number of spores was twice as high as in the control. The two other herbicides decreased the intensity of spore production at all concentrations. In the doses above 50 μg s.a./g all the preparations inhibited spore production. A complete lack of sporulation was observed for most herbicides at 500 μg s.a./g concentration. Few spores were only observed at this doses in a combination with "Chwastox płynny".

The index of *D. sorokiniana* spore germination taken from the colonies cultured on the media with herbicides was generally close to the control (Fig. 5 A). The index only decreased by about 40 and 60 % on the medium with "Chwastox D" and "Chwastox M" at 1 μg s.a./g concentration due to the great number of non germinating spores. Germ tubes developed normally and they did not show any deformations and growth inhibition in all combinations of the experiment irrespective of the kind and dose of preparation.

Solutions of all preparations inhibited *D. sorokiniana* spore germination (Fig. 5 B). "Chwastox D" and "Chwastox M" were not the most toxic. Even the lowest dose of these preparations inhibited germination, whereas "Chwastox D" at 500 μg s.a./g and "Chwastox M" at 1000 μg s.a./g did not permit spore germination at all. Strong effect of "Aminopielik D" and "Chwastox płynny" was observed at above 10 μg s.a./g but even at higher concentration the preparations did not inhibit spore germination totally. In most cases there was a growth restriction of germ tubes and at higher concentrations they branched in an abnormal way and curled creating conglomerations of balls.

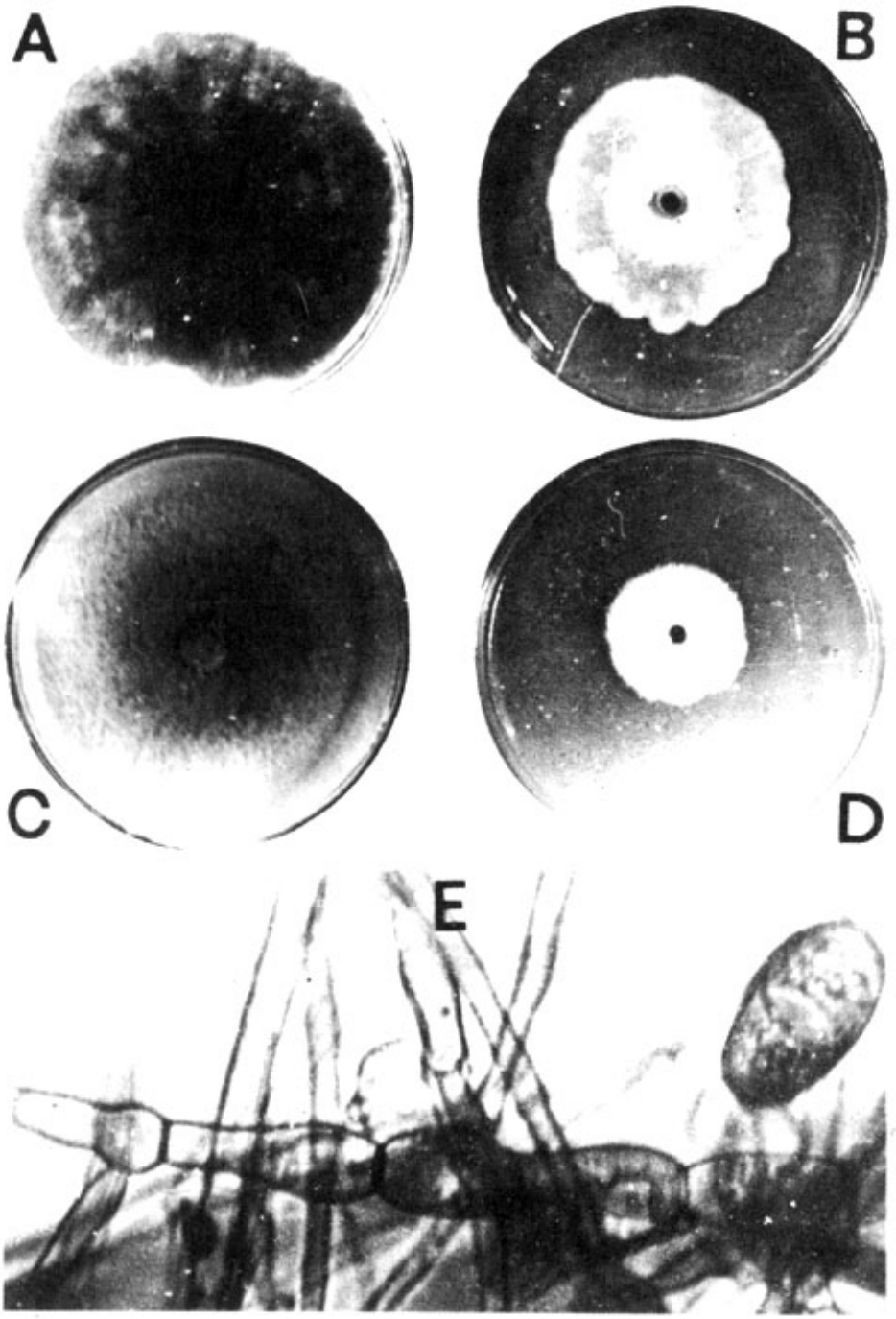

Fig. 2. Colonies of *D. sorokiniana* (A) and *D. teres* (C) on medium without herbicides; colony of *D. sorokiniana* on medium with "Aminopielik D" (B) at concentration 1000 µg s.a./g;colony of *D. teres* on medium with "Chwastox D" (D) at concentration 100 µg s.a./g; distorted mycelial cells of *D. sorokiniana* on medium with "Chwastox D" at concentration 100 µg s.a./g (E)

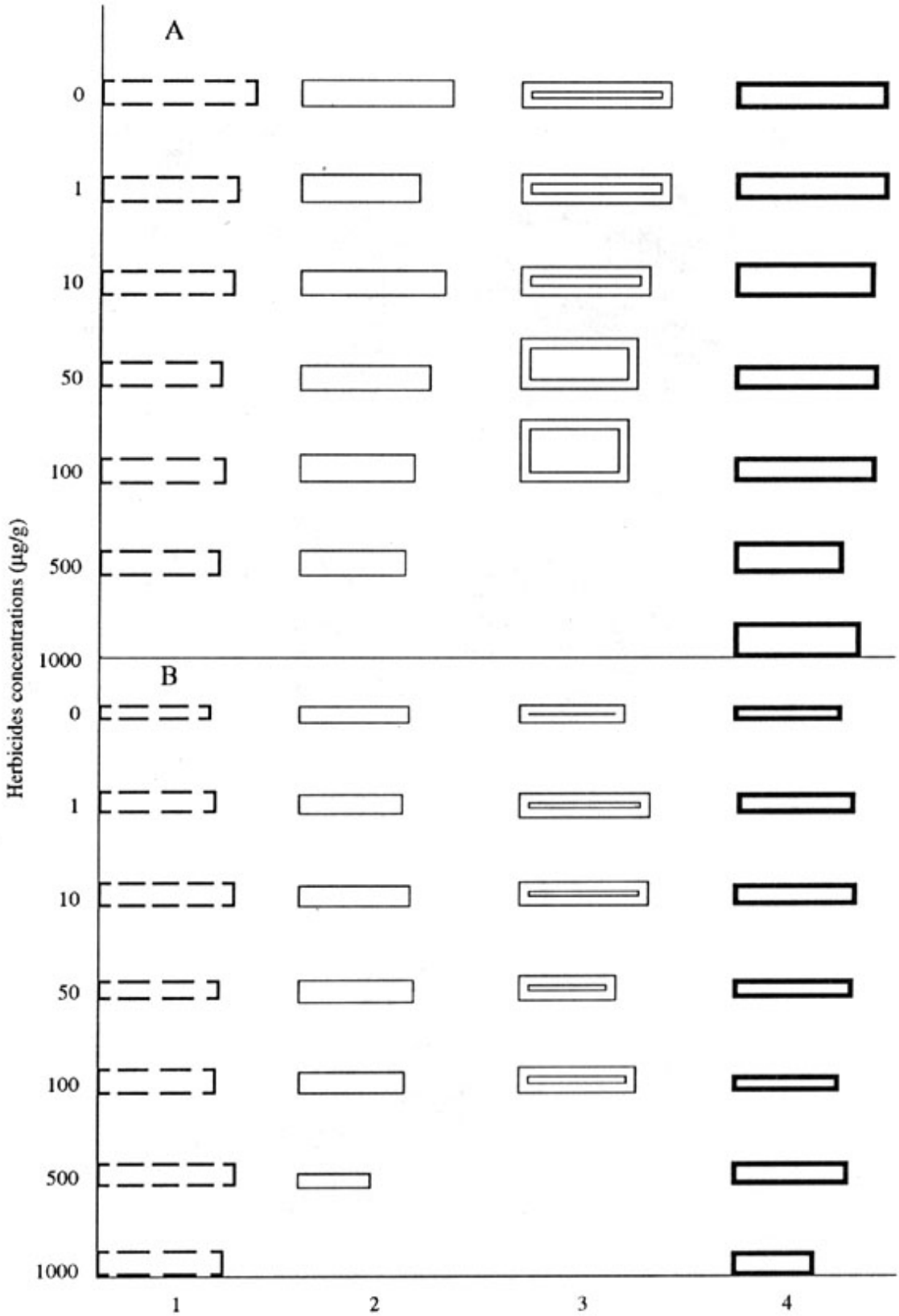

Fig. 3. Size of mycelial cells of *D. sorokiniana* (A) and *D. teres* (B) according to the type and concentration of herbicides

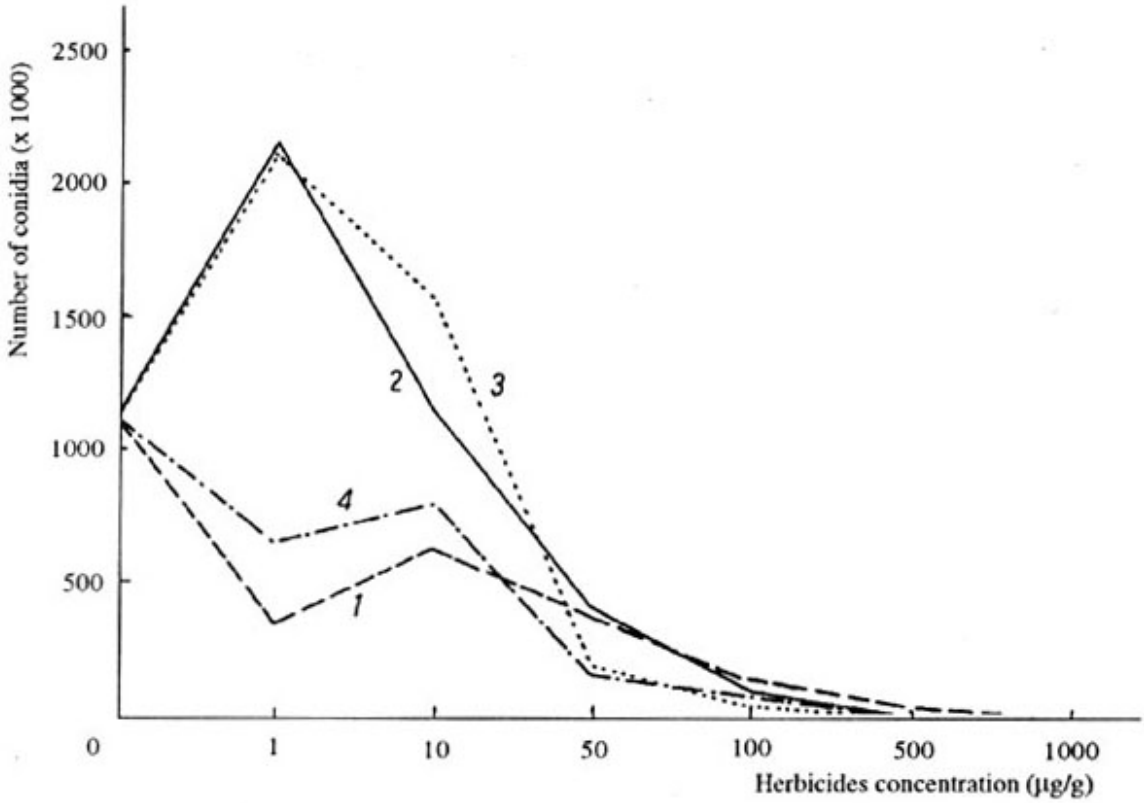

Fig. 4. Intensity of sporulation of *D. sorokiniana* according to the type and concentration of herbicides
1 – "Chwastox płynny" (in liquid), 2 – "Chwastox M", 3 – "Chwastox D", 4 – "Aminopielik D"

DISCUSSION

In the present investigations "Aminopielik D" containing 2,4-D and dicamba showed the weakest fungistatic activity in all doses. The results obtained by Hodges (1977) show that 2,4-D, applied in an acid form, inhibited *D. sorokiniana* mycelium growth. Other authors (Bever, Slife, 1948; Chappel, Miller, 1956; Richardson, 1957) who used aminic salts and sodic salts of 2,4-D did not find any effect or any inhibitory effect of this substance on mycelium development. However, Hsia and Christensen (1951) who applied aminic salt 2,4-D at 100 and 1000 µg/g observed its stimulating effect on the mycelium growth of *Drechslera sorokiniana*. Jacenko (1972) showed fungistatic effect of sodic and aminic salts of 2,4-D and dicamba on *Fusarium* fungi.

The above presented divergences of the results obtained by the mentioned authors and in our investigations may be due to some reasons. First the 2,4-D was applied in different forms as acid, sodic and aminic salts. Second, is the usage of two- component herbicides in the experiments in the case of which there may be a synergic effect of components other than active substance applied separately, in pure form.

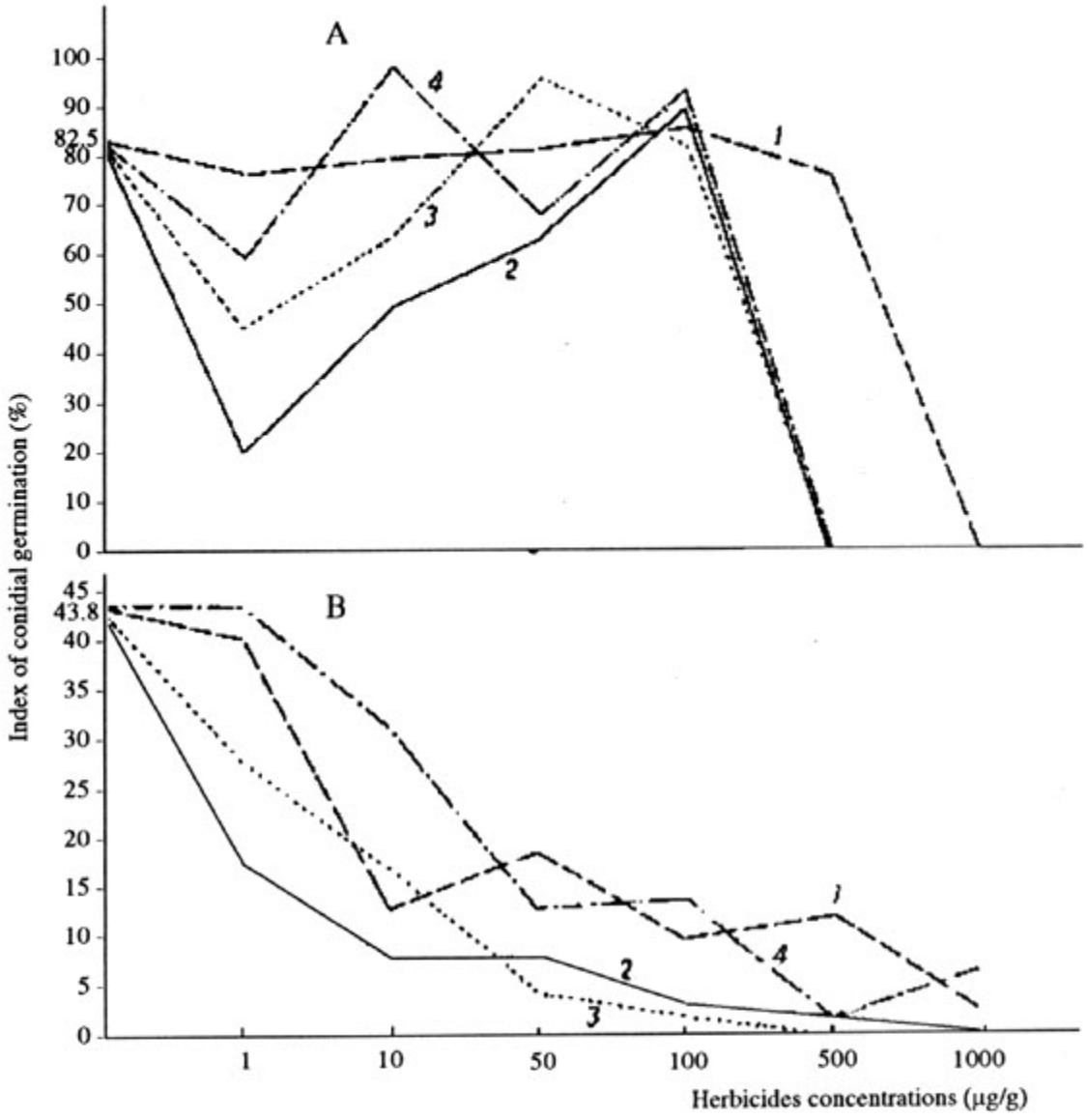

Fig. 5. Conidial germination of *D. sorokiniana*
A – according to the type and concentration of herbicides in medium; B – in different solutions of herbicides
1 – "Chwastox płynny" (in liquid), 2 – "Chwastox M", 3 – "Chwastox D", 4 – "Aminopielik D"

In experiment the weak effect of "Aminopielik D" on both fungi and the lack of influence of "Chwastox D" on *D. teres* growth at low concentrations may be caused by the presence of dicamba as a component of active substance of these preparations. In experiments concluded by H o d g e s (1977) the dicamba, used in a pure form, stimulated *D. sorokiniana* mycelium growth. According to this author a similar effect was caused by mecoprop at concentrations below 1000 µg/g. This not been proved in the present experiments because "Chwastox M" containing among others

mecoprop belonged to preparations having the strongest effect.

The obtained results concerning the stronger effect of higher herbicides concentrations on *Drechslera* growth are in accordance with the oppinions of the following authors: Hodges (1977), Bever and Slife (1948), Chappel and Miller (1956), Richardson (1957) and Burgieł (1984) who examined fungi belonging to other groups.

Hodges (1977) observed a significant inhibitory effect of only 2,4-D and dicamba at higher concentrations, which were added to the medium, on the intensity of *D. sorokiniana* sporulation. 2,4-D in doses 1–100 µg/g stimulated sporulation. However, mecoprop at 1–1000 µg/g limited spore production of this fungus significantly. Burgieł (1984) observed a strong, negative effect of "Chwastox płynny"on *Fusarium avenaceum* and *F. culmorum* macroconidia germination at higher concentrations. In the present experiments this preparation as well as "Aminopielik D" were the weakest.

The examined herbicides in field conditions are used at concentration 1000–2000 µg s.a./g depending on the preparation. In the present experiments, carried out in vitro, the highest dose approximate field concentrations, caused a total inhibition of mycelium growth and the restriction of spore germination in most cases. It is necessary to investigate whether the influence of herbicides on examined fungi developing on a host plant is also very strong.

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