Control of Seedling Diseases of Sugar Beets With Dexon and Dexon-PCNB Mixture[1]

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Seedling diseases or root rots are of considerable importance in the growing of sugar beets, especially in heavy irrigated soils in Montana. Investigations showed (5)[3] that the following fungi are involved in the complex of seedling diseases of beets in Montana: *Aphanomyces, Pythium, Rhizoctonia, Phoma, Fusarium* and some others. However, evidence indicates that *Aphanomyces cochlioides* probably is the most important pathogen of young sugar beets in heavy soils.

In an attempt to control these diseases, several soil and seed treatments have been investigated with sugar beets since 1939 at the Huntley Branch Station and also in the greenhouse in Bozeman using soil from the Huntley Station (1, 2, 3, 4). In general, seed treatments were found to be only slightly beneficial in controlling seedling diseases of beets. However, soil treatments with fertilizers were found to be of great importance in controlling these diseases. Sugar beets planted in soil well fertilized with manure, nitrogen and phosphorus always had only small amounts of seedling disease as compared to those grown in soil poor in nutrients and organic matter.

New interest in this work arose recently when the Chemagro Corporation introduced a new seed and soil fungicide called Dexon (p-dimethylaminobenzenediazo sodium sulfonate) which has demonstrated an ability to protect plants from a damping-off root rot complex involving species of *Pythium, Aphanomyces*, and *Phytophthora* fungi. It was suggested by Chemagro that if *Rhizoctonia* was also involved in the complex, the addition of PCNB (pentachloronitrobenzene) would control that pathogen also. In testing the above-mentioned compounds for control of seedling diseases of sugar beets, several greenhouse tests were conducted in Bozeman, Montana, using heavy Huntley soil. Soil flats were planted with segmented seeds of The Great Western Sugar Company's variety GW359.

Experimental Procedure

In some tests the soil was not sterilized and was either inoculated with *Aphanomyces* or not inoculated. In the other tests, soil was sterilized and inoculated either with *Aphanomyces* or *Rhizoctonia* alone or with a combination of these fungi.

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[3] Numbers in parentheses refer to literature cited.

Results and Discussion

The results presented in Table 1 show that seed treatment with Dexon alone was not beneficial to sugar beets planted in non-inoculated soil and the amount of disease in non-inoculated soil was even greater than in the check soil. In the inoculated soil this treatment also was of little benefit and the amount of disease was high; however, it was slightly below the check soil. It is possible that some other fungi in addition to *Aphanomyces* may have contributed to the higher degree of disease in non-inoculated soil.

Sugar beet seedlings grown from seeds treated with Dexon-PCNB combination had a rather low amount of disease in both types of soil. Since this soil was known to be infested with *Rhizoctonia,* and since PCNB is quite effective against this fungus, it is possible that the low incidence of the disease was due to the combined effect of Dexon and PCNB on *Aphanomyces* and *Rhizoctonia,* respectively.

The amount of disease of beets in the non-inoculated soil treated with 1 lb of both kinds of Dexon was relatively high and similar in both cases. Considerably less disease occurred in the same treatments in the inoculated soil. Treatments of soil with 2 lbs of Dexon produced considerable reduction in beet diseases in both types of soil. Beets grown in the inoculated check soil had a high amount of disease.

In the above-mentioned test, non-sterilized soil was used. This soil undoubtedly was infested with several plant pathogens like *Aphanomyces, Pythium, Rhizoctonia,* and possibly others, all of which could produce seedling diseases of sugar beets. It is practically impossible to identify the causal organism responsible for disease of those seedlings on the basis of symptom expression alone. For this reason it is difficult to make any conclusions regarding the specific action of Dexon or Dexon-PCNB combination for controlling any specific disease of beet seedlings caused by a certain organism.

To obtain more information on this subject, another test was conducted in which the soil was sterilized and inoculated with *Aphanomyces cochlioides.* This test made it possible to investigate the effect of Dexon in controlling this particular disease of sugar beets. In this test nine flats of soil were used. Three petri dish cultures of *Aphanomyces* were added to each flat of soil. Three rows were planted in each flat of soil with 30 segmented seeds per row.

Results presented in Table 2 show that both seed treatments producd only a slight reduction in disease and Dexon alone was

Table 2.—Soil and seed treatment experiments for controlling *Aphanomyces* seedling disease of sugar beets—1960.

Soil and seed treatments	Sugar beet seedlings Healthy percent
1. Seed—70% Dexon, 2 oz/100 lbs seed	27.5
2. Seed—Dexon-PCNB, (35-35), 4 oz/100 lbs seed	16.2
3. Soil—Dexon 5%, regular, 1 lb/acre	91.8
4. Soil—Dexon 5%, coated, 1 lb/acre	100.0
5. Soil—Dexon 5%, regular, 2 lbs/acre	93.1
6. Soil—Dexon 5%, coated, 2 lbs/acre	96.4
7. Soil—Dexon 5%, regular, 4 lbs/acre	83.5
8. Soil—Dexon 5%, coated, 4 lbs/acre	79.1
9. Check Soil—Inoculated	0.0

more effective than Dexon-PCNB combinations. All soil treatments were effective in controlling this disease. A slightly lower percentage of beet seedlings remained healthy in the soil which received the highest application of Dexon as compared to the other dosages. It is possible that some of the seedlings were lost in these flats due to Dexon toxicity.

It was mentioned above that in addition to *Aphanomyces cochlioides,* there are present in Montana soils other fungi which can infect young sugar beets and cause disease. It is believed that under field conditions *Rhizoctonia* is probably the next in importance to *Aphanomyces* in causing seedling diseases of sugar beets in Montana.

In the following experiment an attempt was made to investigate the fungicidal effect of Dexon alone and in combination with PCNB, on the control of seedling diseases of beets caused by *Aphanomyces* and *Rhizoctonia* alone and also in combination.

Three parallel series of flats with sterilized soil were used. Each series consisted of nine flats. One set was inoculated with *Aphanomyces,* the other with *Rhizoctonia* and the third was inoculated with a combination of these two organisms. Three petri dish cultures of *Aphanomyces* or *Rhizoctonia* were added to each flat inoculated with these organisms singly. The same amounts of inoculum were added to flats inoculated with both of these fungi. Three rows of beets were planted in each flat of soil with 30 segmented seeds per row. Results of this test are presented in Table 3.

A very high percentage of sugar beet seedlings remained healthy in a set inoculated only with *Aphanomyces* in both soil and seed treatments. Plants grown from seed treated with a combination of Dexon and PCNB showed slightly more disease than beets with the other seed treatment. Check beets in this set had a very high percentage of disease. It is quite evident that

Table 3.—Soil and seed treatment experiments for controlling *Aphanomyces* and *Rhizoctonia* seedling diseases of sugar beets—1960.

Soil and seed treatments	Sugar beet seedlings grown in soil inoculated with: Aphanomyces — Healthy %	Rhizoctonia — Healthy %	Aphanomyces and Rhizoctonia — Healthy %
1. Seed—70% Dexon, 2 oz/100 lbs seed	99.3	62.3	56.4
2. Seed—Dexon-PCNB, (35-35), 4 oz/100 lbs seed	82.9	90.8	92.6
3. Soil—Dexon 5%, regular, 1 lb/acre	96.1	60.0	64.7
4. Soil—Dexon 5%, coated, 1 lb/acre	97.2	43.2	71.1
5. Soil—Dexon 5%, regular, 2 lbs/acre	96.9	37.8	58.9
6. Soil—Dexon 5%, coated, 2 lbs/acre	92.8	51.2	50.0
7. Soil—Dexon 5%, regular, 4 lbs/acre	93.0	43.8	38.1
8. Soil—Dexon 5%, coated, 4 lbs/acre	100.0	56.1	61.5
9. Check Soil—Inoculated	19.7	52.3	8.8

Dexon treatments produced a beneficial effect on the control of disease of beets caused by *Aphanomyces.*

Sugar beet seedlings grown in soil inoculated only with *Rhizoctonia* had a considerable amount of disease in all treatments except one where seed was treated with a combination of Dexon and PCNB, in which 90.8 percent of plants remained healthy. The percentage of healthy plants in all treatments, including the check, varied, and was either slightly above or below 50 percent. These results indicate that Dexon was not very effective against *Rhizoctonia.* However, where PCNB was used in combination with Dexon as a seed treatment it definitely produced a beneficial effect in the control of this disease.

Percentages of healthy beet plants, grown in flats inoculated with a combination of *Aphanomyces* and *Rhizoctonia,* were quite comparable to those in the set inoculated with *Rhizoctonia* alone, except that only a few healthy plants remained in the check soil. This undoubtedly was caused by an addition of *Aphanomyces* to the inoculum.

General Conclusions

It appears that Dexon used as a soil treatment is quite effective in controlling the disease of sugar beets caused by *Aphanomyces,* but it is not reliable against *Rhizoctonia.* On the other hand PCNB is quite effective against the disease caused by *Rhizoctonia.* In controlling seedling disease of beets caused by *Aphanomyces,* seed treatments either with Dexon alone or Dexon-PCNB combination are not as reliable as soil treatmnt with Dexon.

Since there may be present in the soil various pathogenic fungi which can cause seedling diseases of sugar beets, it would

be advisable to use combinations of Dexon and PCNB for their control.

As far as soil treatment is concerned it appears that Dexon applied at the rate of 1 lb per acre (active material) to flats of soil in the greenhouse is not toxic to beets. However, a 2-lb rate of this substance may produce a slight degree of toxicity and 4 lbs of Dexon is definitely toxic. Even at a 4-lb rate of Dexon most of the beets survived until harvest. Under field conditions this toxicity would probably not be as evident as it was in the very limited amount of soil in flats.

Literature Cited

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