THE EFFICACY OF SOIL APPLICATIONS OF FUNGICIDES FOR THE CONTROL OF BLACKROOT OF SUGAR BEET SEEDLINGS[1]

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Field and greenhouse observations in Ontario during the past 6 years have indicated that the post-emergence phase of damping-off of sugar beet seedlings is more destructive than the pre-emergence phase. Almost every year just when emergence of seedlings is approaching its maximum, damping-off or blackroot makes its appearance. After a period of several days during which the seedlings are apparently especially susceptible to attack, stands in many instances are reduced to the extent that it becomes questionable whether they should be saved even though, following the period of high mortality, the surviving seedlings show evidence of "coming out of blackroot".

Although the terms damping-off and blackroot are used almost synonmously, nevertheless, the latter is somewhat of a misnomer; for, in the case of many infected seedlings, the roots are not attacked at all. Rather, the hypocotyl is the vulnerable part of the young plant. Thus, strictly speaking, the term "black hypocotyl" would be more accurately descriptive of the condition of the seedling in many cases. The hypocotyl becomes infected usually at or not far from the soil level. Infection spreads rapidly and the hypocotyl is soon killed or reduced to a thin, black thread that is incapable of supporting the seedling in an erect position.

Because seedlings are especially susceptible to attack by parasitic organisms during a certain period in their early development and because further the point of attack is fairly localized, then, would it not seem reasonable to suppose that if seedlings were afforded additional protection against the pathogens at the right time and place, they might have a greater chance of survival? During the past year in a series of preliminary tests an answer to this question has been sought at the Harrow laboratory. The materials used and the techniques evolved are described below.

Seed - To ensure as uniform germination as possible, the segmented seed to be used in the trials was first examined under a dissecting microscope and non-viable particles were eliminated. Petri-plate tests showed that such selected seed had a germinating capacity of about 98%. The seed was planted at a depth of $\frac{1}{4}$ to $\frac{1}{2}$ inch in greenhouse flats. In each flat were planted 132 seeds arranged in 3 rows, 44 seeds per row, the seeds being spaced $\frac{1}{2}$ inch apart in the rows.

Soil - The soil, a Brookston clay loam, was obtained from fields on two farms, where after repeated failures due to blackroot the owners had given up attempts to grow sugar beets.

Fertilizer - To all but certain check flats was added a 2-16-10 commercial fertilizer at the rate of 300 lb. per acre, half of which amount was placed in a band 1½ inches below the seed, the other half in a band in contact with the seed.

Protectant materials - So far as the tests reported in this paper are concerned only two materials were employed:

Arasan - tetramethyl thiurumdisulphide, 50% active material, non-wettable.
Fermate - ferric dimethyldithiocarbamate, 7-% active material, wettable.

Arasan at the rates of 200, 150, 100, 75, 50, 25, 15, 10, 5, 3 and 1 lb. per acre (calculations were made on the basis of rows 22 inches apart, i.e., 23,760 linear feet per acre) was applied to strips of soil in which the seeds were planted, each strip being 2 inches wide and 1 inch deep. The technique employed is illustrated in Figure 1. Similarly, Fermate was applied in other flats, the rate of application starting, however, at 75 lb. per acre and grading downward as in the case of Arasan to 1 lb. per acre. In check flats, seed but not the soil was treated with each of the two protectants (each at the rate of ½ lb. per 100 lb. of seed). Three flats comprised each individual test.

The tests were carried out in the greenhouse during the months of January, February and March, 1946. Counts of emergence of seedlings and incidence of blackroot were made daily until the thirty-fifth day following the planting of the seed. Tooth picks were used to mark the position of dead seedlings. Flats were watered uniformly as required with measured quantities of water. A summary of the results obtained is presented in Table I. This summary, it will be noted, includes only the results obtained with applications of Arasan at and below 75 lbs. per acre. Under the conditions of the trials Fermate was so ineffective as compared with Arasan, that results with the former are omitted.

Table I - Emergence of seedlings, incidence of blackroot, and toxic effects in relation to treatment of seed and soil with Arasan

Seed	Treatment: Soil: Arasan	Treatment: Soil: Fertilizer	Emergence of seedlings (per cent)	Toxicity to seedlings	Incidence of blackroot (per cent)
Treated[1]	15 lb.[2]	300 lb.[3]	80.3	Severe	0
"	10 "	" "	89.3	"	0
"	5 "	" "	84.0	"	0
"	3 "	" "	97.7	Slight	6.2
"	1 "	" "	94.7	None	15.2
"	0 "	" "	95.4	"	20.8
Untreated	0 "	" "	96.2	"	26.7
"	0 "	Untreated	93.9	"	42.7

[1]Arasan at rate of ½ lb. per 100 lb. seed
[2]Per acre application of Arasan
[3]Per acre application of a 2-16-10 commercial fertilizer

As Table I indicates, no blackroot occurred where Arasan was applied at the rates of 15, 10 and 5 lb. per acre. These concentrations did, however, not only reduce emergence but also produced severe toxicity symptoms on the seedlings. Arasan at 3 lb. per acre had no deleterious effect on germination, produced only slight toxicity effects and inhibited blackroot to the extent of all but 6.2%. At this concentration the disease did not appear until the twenty-second day after planting. At the 1 lb.-per-acre application of the protectant, blackroot developed to the extent of 15.2%, the disease having first appeared on the seventh day after planting. Where the seed alone was treated incidence of the disease reached 20.8%, thus indicating the ineffectiveness of seed treatment alone. Highest incidence of the disease, i.e., 42.7%, occurred where neither seed nor soil was treated with Arasan and where, too, fertilizer was omitted from the soil.

A fact not indicated in the above table is that treatment of seed and soil with Arasan (3 lb. per acre or less) tends to retard emergence slightly during the first few days but by the tenth day after planting the retarding effect was no longer noticeable.

Conclusions

While the eventual control of blackroot of sugar beet will no doubt fundamentally centre around breeding for resistance to the disease and long-range soil emendation programmes, nevertheless, the approach to the problem described above is not without value. One of its merits lies in the fact that it offers meanwhile the possibility of a fairly effective and economical remedial measure. As research proceeds with more and more of the new synthetic protectants, other compounds will no doubt be found which when added to the soil will prove as effective as Arasan has in the present preliminary investigations.

Acknowledgement

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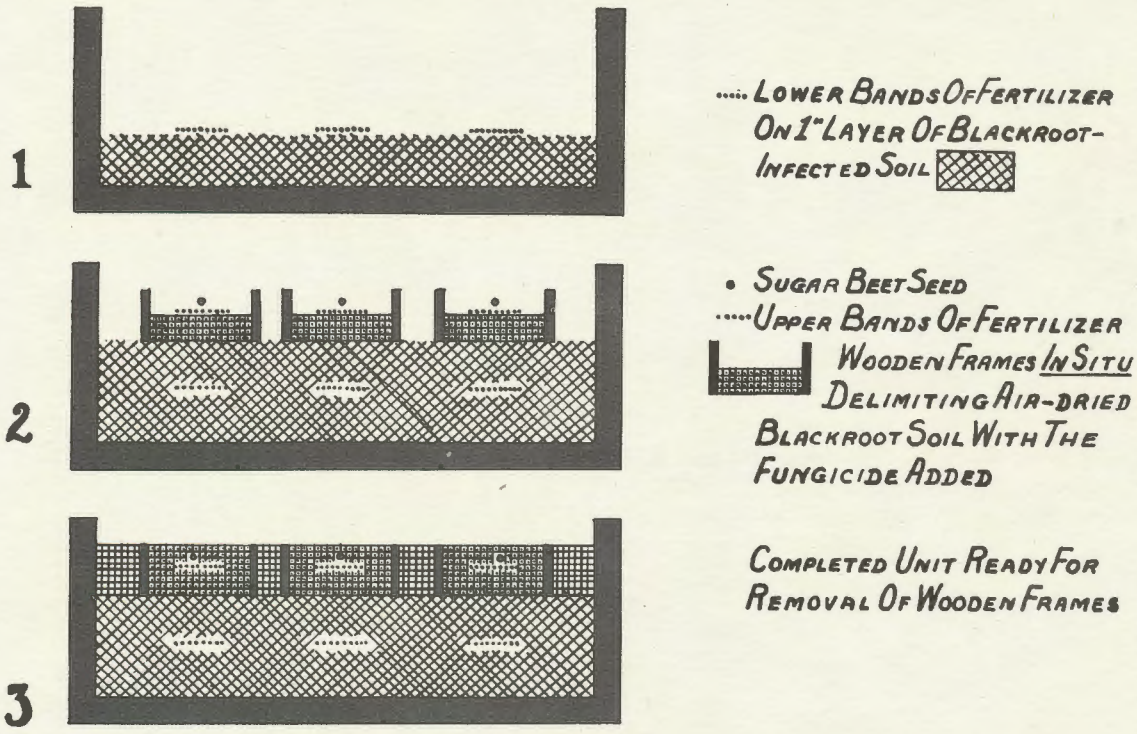

Fig. 1 - Showing technique employed in planting of seed in Arasan-treated, naturally infected, black-root soil.