STORAGE OF TREATED MOIST GRAIN[1]

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The storage of chemically treated moist seed grain is of considerable concern when seed is cleaned and treated at commercial plants because the need for spreading the work load over several months necessitates long storage periods for some of the treated grain, Also treated grain cannot be marketed or fed to livestock so must be held over until the next planting season, one year hence. In years when the harvest season is wet, the seed is often tough, if not damp, when it is placed in storage.

The literature is somewhat contradictory. Some reports state that certain mercurial seed dressings protect moist grain in storage from damage by storage molds, and there are other reports of phytotoxicity under similar conditions, Most of the independent studies have been done in Sweden, where workers seem to be reconsidering their original theories on phytotoxicity, Gadd (2) suggested that the damage resulting from mercurial seed dressings may be due to a failure on the part of the chemicals to kill all of the Penicillium spores, thus permitting the fungus to recolonize as the effect of the treatment diminishes during storage. He also found evidence of phytotoxicity characterized by the seedling symptoms typical of mercury poisoning with overdoses of the dressing at high moisture levels, Roth (4, 5) and Ebner (1) found that large overdoses of mercury were phytotoxic to barley and sugar beets and that, at high moisture levels, the mercurials were ineffective against certain organisms, chiefly Penicillium and Aspergillus spp. Gadd(2) found that tetramethylthiuramdisulfide was much more effective than mercury against these molds, and that when added to the mercury compounds it gave good protection under moist conditions. However, there are many papers that disclaim that mercurial seed dressings are phytotoxic or fail to protect seed at high moisture levels.

Because of the contradictions in the literature, and because we were asked to make recommendations, it was decided to investigate the problem under our local conditions.

Materials and Methods

In April, 1960 two mercurial seed dressings, methoxyethyl mercury acetate (MEMA) and methyl mercury dicyandiamide (Panogen 15), were chosen for tests involving Thatcher wheat, Rodney oats and Husky barley, The seed used was Registered No. 1 from the 1959 crop. The grain was treated in one bushel lots and then divided into 1,000 gram samples. The barley originally contained 11.0% moisture and the wheat and oats 13,1% each, Samples of barley were adjusted to 13.1, 14.5, 16.0

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and 18.07'0 moisture by the addition of distilled water and samples of oats and wheat were similarly adjusted to 14.5, 16.0 and 18.0% moisture. After storage for several days in sealed flasks to allow the water to become evenly distributed through the seed the moisture levels were determined with a moisture meter used by the Board of Grain Commissioners Inspection Office, Edmonton (Canadian'aviation electronics (Halross)). Two hundred grams were then withdrawn from each flask and placed in sealed glass containers at 2°C. The main lots were stored at 15°C. No further moisture determinations were made.

After the moisture levels of the grain were adjusted, samples were planted in soil in the greenhouse and the percentage emergence was recorded two weeks after planting. Samples of the material stored at 15°C were withdrawn and planted every two weeks for two years. The samples stored at 2°C were planted every three months.

Results

After storage at 2°C for two years, none of the seed had deteriorated appreciably regardless of treatment or moisture level; nor was there any evidence of an increase in the fungal flora during this period.

Barley stored at 15°C (Plate 1) and treated with Panogen did not exhibit any signs of damage until 35 weeks after treatment and then only in the sample containing 18% moisture. The seed in this sample was completely dead by the 80th week. The lot containing 16% moisture did not store as well as the dry grain (13.1% and 14.5% moisture) but was still about 80% germinable after two years. The dry samples germinated as well two years after treatment as they did when the fungicide was first applied. The treatment with Mema gave essentially the same results, The untreated sample with 18%moisture did not deteriorate quite as rapidly as the treated ones but the difference was not significant from the practical standpoint.

At the 18% moisture level germinability of oats (Plate 2) in both treatments and in the untreated control, began to decrease 10 to 12 weeks after application of the chemicals and within 80 weeks the seed in all three samples were dead, The treated samples with 16% moisture began to show signs of damage after 45 weeks whereas the control sample began to deteriorate after 25 weeks, At the end of two years all three lots showed 20 to 30% germination, The dry samples, whether treated or not, did not exhibit any loss of viability within two years.

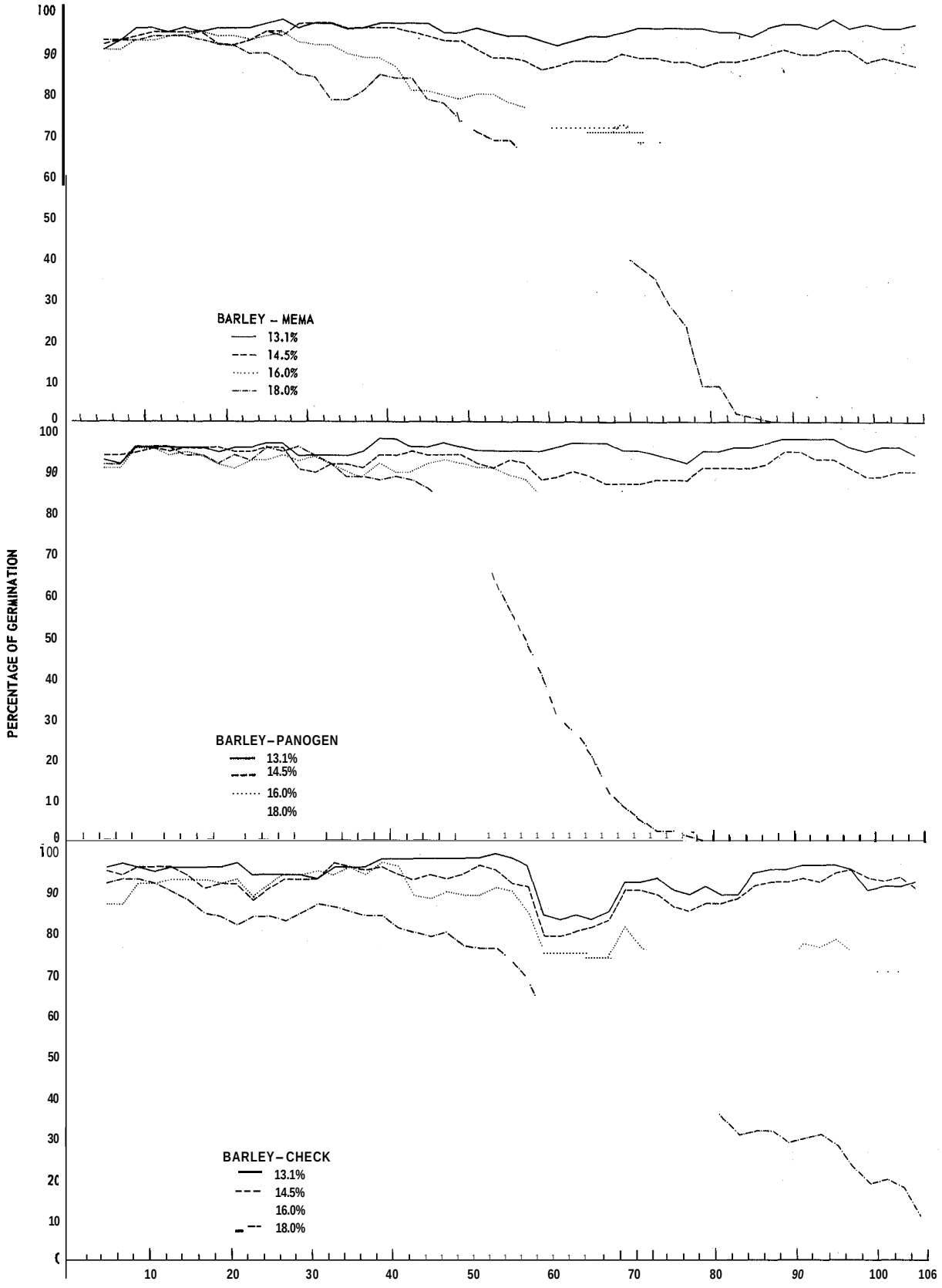
Legend

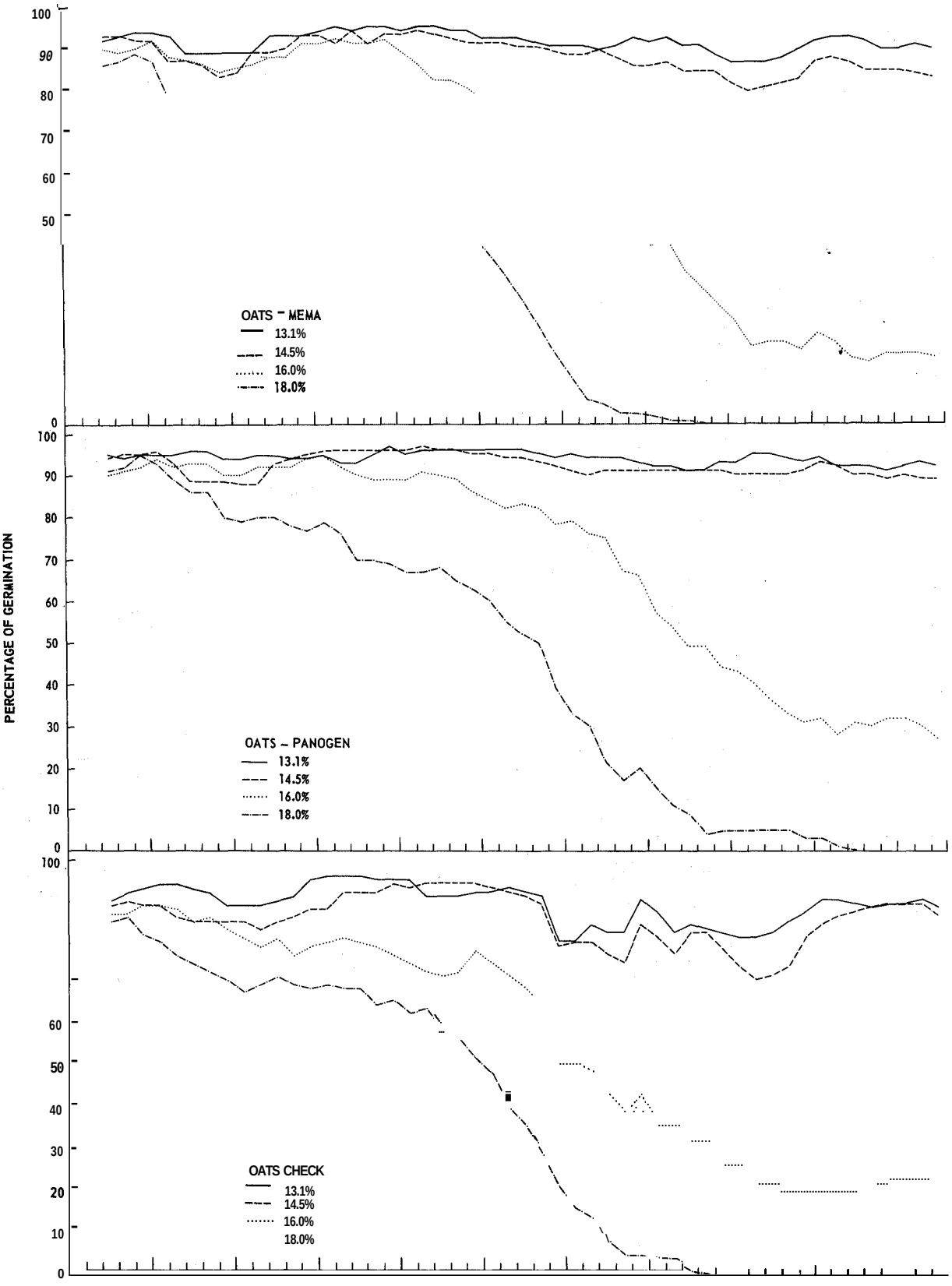
Plate 1 - Percentage germination of barley at 2-week intervale following treatment. *

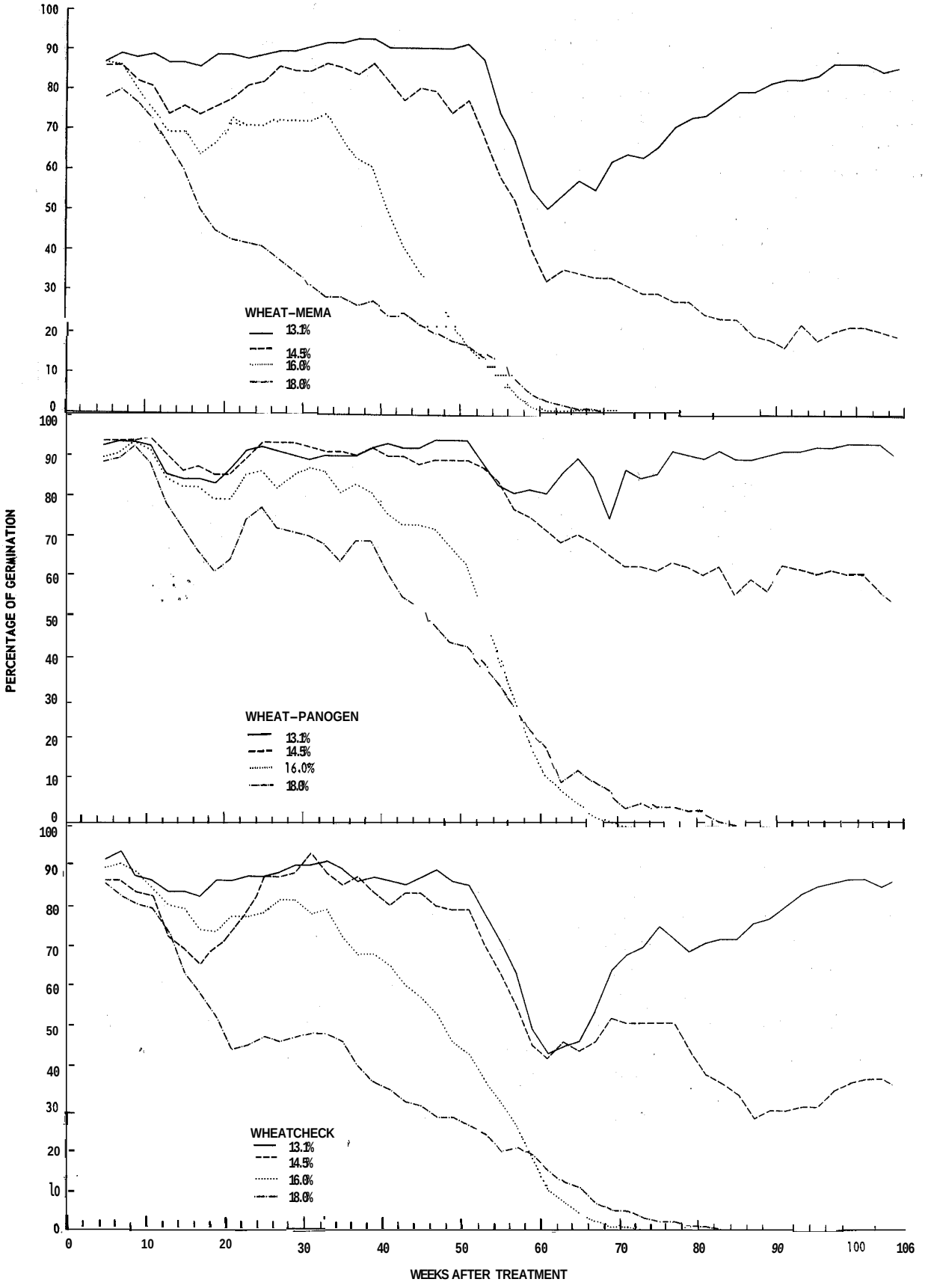
Plate 2 - Percentage germination of oats at 2-week intervals following treatment, *

Plate 3 - Percentage germination of wheat at 2-week intervals following treatment. *

* Top graph is for samples treated with "Mema" center graph is for samples treated with "Panogen" and the bottom graph is for untreated seed.


PERCENTAGE OF GERMINATION
BARLEY – MEMA
13.1%
14.5%
16.0%
18.0%
BARLEY–PANOGEN
13.1%
14.5%
16.0%
18.0%
BARLEY–CHECK
13.1%
14.5%
16.0%
18.0%
WEEKS AFTER TREATMENT


OATS - MEMA
13.1%
14.5%
16.0%
18.0%
OATS - PANOGEN
13.1%
14.5%
16.0%
18.0%
OATS CHECK
13.1%
14.5%
16.0%
18.0%
PERCENTAGE OF GERMINATION
WEEKS AFTER TREATMENT


WHEAT–MEMA
13.1%
14.5%
16.0%
18.0%
WHEAT–PANOGEN
13.1%
14.5%
16.0%
18.0%
WHEATCHECK
13.1%
14.5%
16.0%
18.0%
PERCENTAGE OF GERMINATION
WEEKS AFTER TREATMENT
0
10
20
30
40
50
60
70
80
90
100
106

Wheat (Plate 3) suffered more severely than oats or barley under the conditions of the experiment. At the 18% moisture level all three samples began to deteriorate after only 12 weeks of storage. The samples containing 16% moisture showed signs of damage within 35 to 40 weeks. The seed in all of the samples at the 16% and 18% moisture levels were dead within 70 weelcs. Within two years the wheat with 14.5% moisture was reduced to about 50% viability regardless of treatment. The wheat stored with 13.1% moisture germinated as well after two years as it had at the beginning of the test, Wheat, whether treated or not, was found to be very sensitive to high greenhouse temperatures during the summer months, as demonstrated by depressions in all of the curves centred around the 15th and 60th weeks.

The onset of deterioration in germinability of all three species whether treated with a fungicide or not, was accompanied by a strong development of fungi (largely Aspergillus and Penicillium spp.) on the seeds.

Discussion

Sealing small samples of grain in glass jars following treatment with fungicide is admittedly not strictly comparable to farm storage of treated seed, but the exposure to toxic vapors is considered to be just as severe, if not more so (Koehler and Bever) (3). Thus any damage occurring in these experiments that might be attributable to the chemical seed dressing should be at least as severe as that found under farm conditions. It is however, possible that large piles of damp seed may be more readily damaged by heating. From the results then, it can be concluded that since the treated lots of seed did not deteriorate any faster than the controls, even at 18% moisture, the loss in germinability was probably not due to phytotoxicity of the seed dressings used. Also, since the samples possessing poor viability were also the ones severely infested with storage fungi, whether treated or not, it is probably that loss of germinability was caused by attack by these microorganisms, from which the mercurial dressings failed to protect the seed. This agrees with the suggestion of Gadd (2).

It seems safe, therefore, to store grain treated with mercurial seed dressings for at least two years provided the sample is dry enough to store that long if not treated. Or conversely, grain that is too wet to store, if treated with mercurial seed dressings, will likely not store safely even if not treated.

It should also be mentioned here that further work to be published later indicates that seed dressings containing insecticides may be phytotoxic, even at recornmended rates of application, if the grain is stored for more than a few weeks. In this case increasing the moisture level has been found to increase phytotoxicity. The same is true of fungicides if used at rates in excess of those recommended.

Acknowledgement

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Literature Cited

1. EBNER, L. 1960. Einfluss der Quecksilberbeizung auf Keimung und Jungendwachstum der Zuckerrübe unter besonderer Berücksichtigung ihrer selektiven Wirkung auf die samenbegleitende Mikroflora, Phytopathologische Zeitschrift 39: 297-320.
2. GADD, I. 1957. Kvicksilverbetningens inverkan på lagringsdugligheten hos vårvete. Särtryck ur Flökentrollanstaltens meddelandenr. 33: 1-29.
3. KOEHLER, B, and W.M. BEVER. 1954. Oat and wheat seed treatments: methods, injuries, and gains. Plant Disease Reporter 38: 762-768.
4. ROTH, G, 1958. Einfluss der Quecksilber-Beizung auf Keimung und Jungendwachstum der Gerste unter besonderer Berücksichtigung ihrer selektiren Wirkung auf die samenbegleitende Mikroflora. Phytopathologische Zeitschrift 34: 137-168.
5. ROTH, GEORG, 1959. Beitrag zur Wirkung Hg-haltiger Beizmittel auf Gesundheitszunstand von Samen und Keimling verschiedenerl Kulturpflanzen sowie auf die Physiologie der Jungpflanzen. Hofchen-Briefe 12: 53-97.

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