INHIBITION OF POTATO SPROUTING BY 2, 3, 5, 6-TETRACHLORONITROBENZENE AND METHYL ESTER OF A-NAPHTHALENEACETIC ACID[1]

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In a report from England, Brown (1) stated that tetrachloronitrobenzene (TCNB) was quite inhibitory to sprout growth of potatoes. Numerous workers in America have reported sprout inhibition of potatoes by methyl ester of a-naphthaleneacetic acid (MENA) (2,3,4,5,6,7,8). A sample of 2,3,5,6-tetrachloronitrobenzene was obtained in 1949 in order to compare it with MENA.

METHODS

Paper Bag Test. An exploratory test was set up on February 1, 1949, to compare TCNB with MENA as a sprout inhibitor on four varieties of potatoes. Tubers of Harford, Virgil, Sebago and Snowdrift, which had begun to sprout in storage, were desprouted and separated into lots of twelve. Each lot was treated and stored separately in a brown paper bag. TCNB was used at the rate of 3.64 grams of active ingredient per bushel and MENA was used at the rate of 1 gram per bushel. Both chemicals were applied in dust carriers, and untreated tubers of each variety were left as controls. The varieties and sprout inhibitors were combined in factorial arrangement in three replications. The bags were stored in an office cellar, in which the temperature averaged approximately 60 degrees F and the relative humidity averaged about 40 per cent. On April 30, 1949, the tubers were desprouted and the sprouts weighed to the nearest gram.

Large Bin Experiment. This experiment was set up in a common storage on October 26, 1949, using the variety Green Mountain. The treatments consisted of TCNB at 2.7 grams per bushel, MENA at 1 gram per bushel, methyl ester of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) at 1 gram per bushel and an untreated control. Treatments were applied to potatoes in bins of 25 bushel capacity, and four replications were used. The entire experiment consisted of 400 bushels of potatoes stored in 16 bins, which simulated actual commercial storage conditions. The temperature varied from 45 to 50 degrees F in the fall to 35 to 40 degrees F in midwinter. The relative humidity was 90 per cent or above for the entire experimental period. Sprout inhibitors were applied in dust form to potatoes as they were placed in the bins. The experiment was broken down on January 12 and 13, 1950, at which time two 50-tuber samples were taken near the center of each bin for sprout growth measurements.

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Bag versus Bin Test. Dormant Green Mountain tubers, which had been in common storage for four to six weeks, were used in a test to study the sprouting behavior of small lots in paper bags compared to larger lots in bins. On December 6, 1950, ten lots of ten tubers each were placed in paper bags and treated with TCNB at the rate of 2.7 grams per bushel. Ten similar lots were used as untreated controls. Two bins of ten-bushel capacity each were set up in the same manner as the bags in that one contained tubers treated with TCNB at 2.7 grams per bushel and the other bin was untreated. The bags and bins were stored side by side in an office cellar with the temperature around 60 degrees and the relative humidity approximately 40 per cent. On January 29, 1951, five samples of ten tubers each were removed from the central portions of the bins and desprouted, the sprouts being weighed to the nearest gram. The tubers stored in bags were desprouted and the sprouts similarly weighed.

Results and Discussion

Paper Bag Test. When used on small lots of tubers in paper bags, MENA retarded sprouting much better than did TCNB (Table 1). TCNB reduced sprouting compared with the control, but the reduction was not of practical significance. The varieties Harford, Virgil, Sebago and Snowdrift responded in essentially the same way to MENA and TCNB.

Table 1.—*Mean weight of sprouts from lots of 12 tubers stored in paper bags. (Stored February 1 to April 30, 1949)*

	Grams
MENA (1 gm./bu.)	10
TCNB (3.6 gm./bu.)	77
Control	91
L.S.D. .05	13

Large Bin Experiment. TCNB inhibited sprouting significantly better than MENA when used on potatoes in bins of 25-bushel capacity, although there was no practical difference in the amount of sprouting (Table 2). Both materials kept the tubers in good condition. Although 2,4,5-T reduced sprouting significantly compared to the control, this was not a practical treatment, because the tubers still sprouted enough to cause serious economic loss. Figure 1 is a photograph of one replication of the bin experiment, showing the differences in sprouting. Figure 2 shows the sprouts removed from 400 tubers from each of the treatments in the bin experiment.

Bag versus Bin Test. To check on the discrepancy in the performance of TCNB in bags and in bins, a test was conducted in which TCNB was used on tubers in small bags and in a bin of 10-bushel capacity. All lots were stored under the same conditions. In bags the TCNB reduced sprout growth slightly, but in the bins, sprouting was nearly eliminated by the TCNB (Table 3).

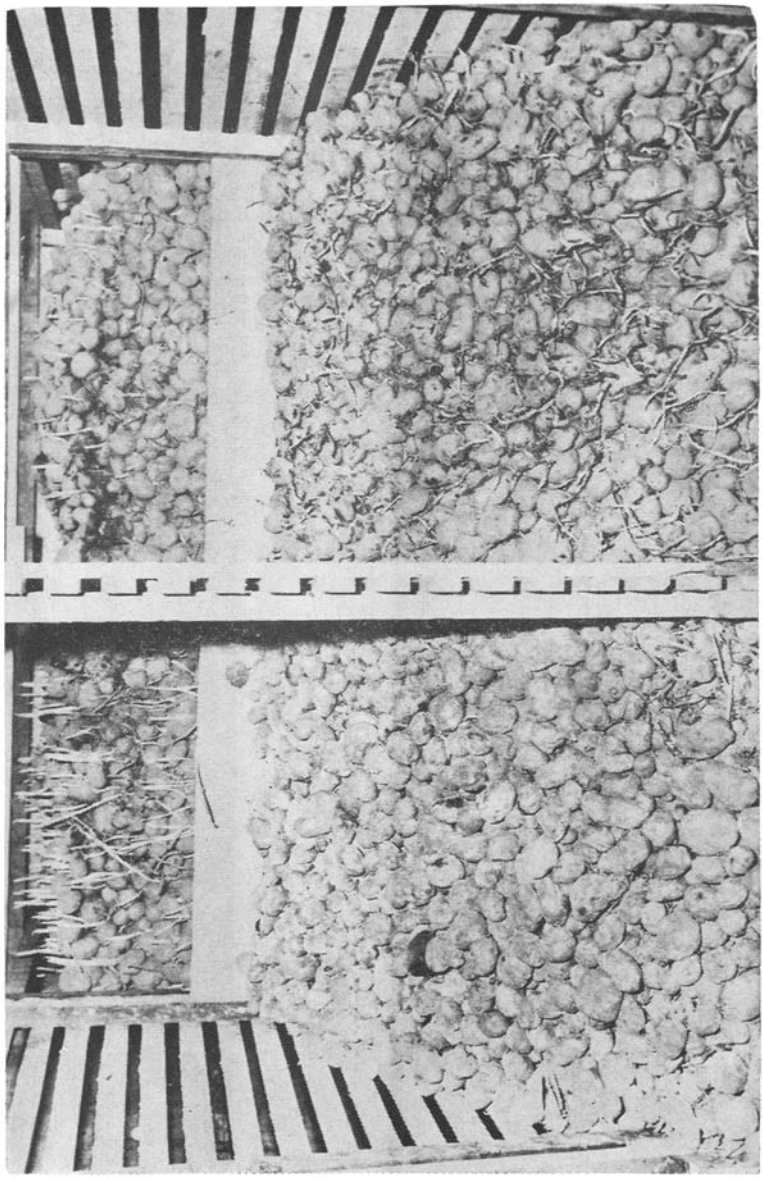

Fig. 1.—Upper left: untreated control, upper right: MENA, lower left: TCNB, lower right: 2, 4, 5-T. Treated October 26, 1949 and photographed January 13, 1950.

TABLE 2.—*Mean weight of sprouts per 100 tubers from bins of 25 bushel capacity. Stored October 26, 1949 to January 12-13, 1950.*

	Grams
TCNB (2.7 gm./bu.)	16
MENA (1 gm./bu.)	48
2,4,5-T (1 gm./bu.)	168
Control	248
L.S.D. .05	32

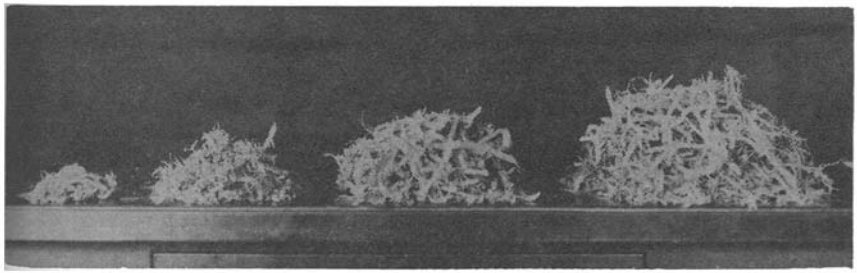

Fig. 2.—Each pile of sprouts is from 400 tubers. Treatments (left to right) TCNB, MENA, 2, 4, 5-T and untreated control.

TABLE 3.—*Weight of sprouts per ten tubers from small and large lots of potatoes. Stored December 6, 1950 to January 29, 1951.*

	Ten Tubers per Lot	Ten Bushels per Bin
	Grams	Grams
TCNB	33	0.25
Control	44	38.40

Figure 3 shows the difference in sprout growth between treated and untreated tubers in the bins. A six-inch layer of potatoes was removed from each bin, with a few top layer tubers left in one corner of each bin. Note how tubers in the top layer of the treated bin sprouted. Likewise, tubers around the outside edge of the treated bin sprouted considerably, although the potatoes three inches inside the bin sprouted scarcely at all. This shows that TCNB does not inhibit sprouting when the treated tubers are exposed to the outside air. Small lots of potatoes treated with TCNB sprout for the same reason, namely, because the mass is so small that essentially all the tubers are exposed to the air. In large bins, a very small proportion of the tubers are exposed to the air, so that relatively few potatoes would sprout in a TCNB-treated bin.

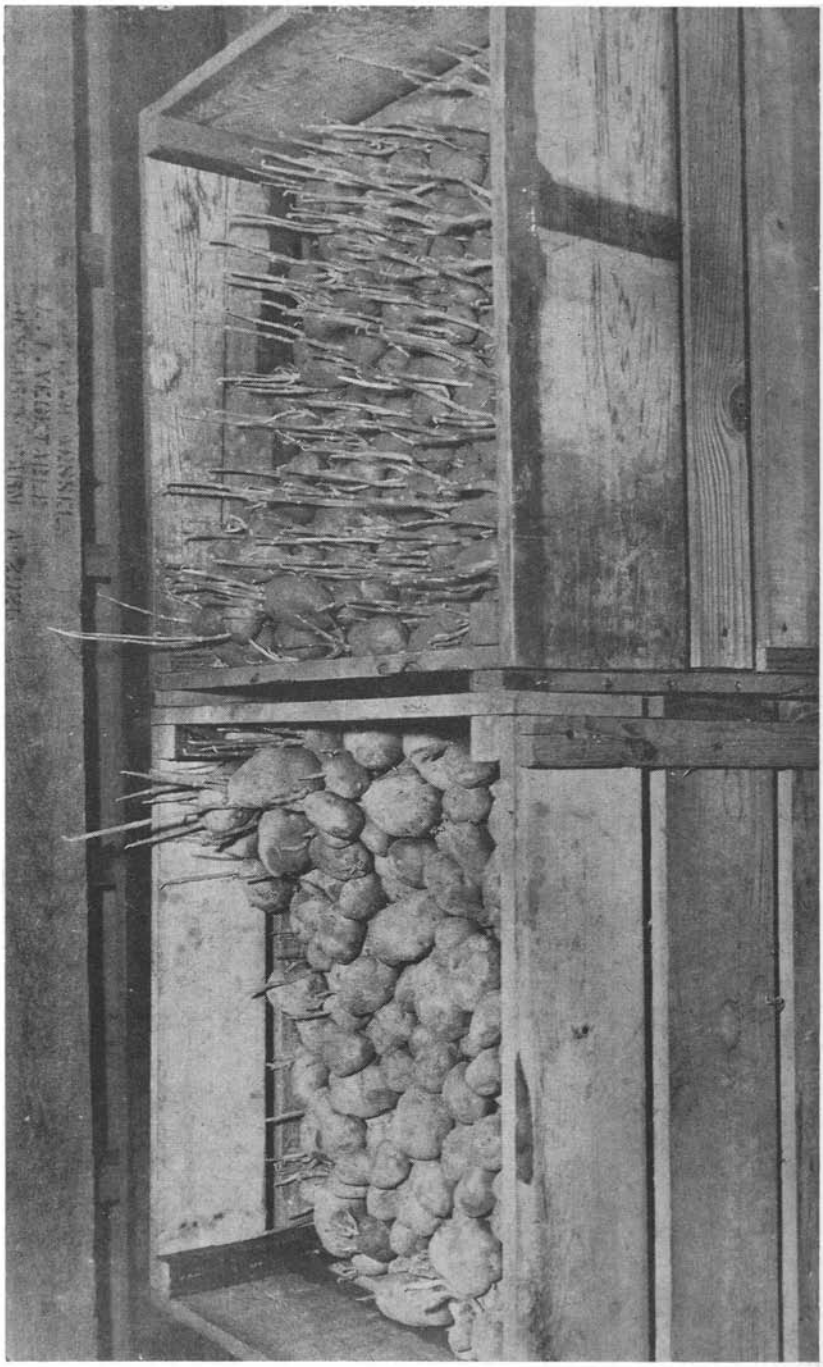

Fig. 3.—Left: Potatoes treated with TCNB, Right: untreated control. Treated December 6, 1950 and photographed January 29, 1951.

Summary

Three separate though related tests are reported in this paper. It was found that 2,3,5,6-tetrachloronitrobenzene (TCNB) was an excellent inhibitor to sprouting when used in bins of 10 or 25-bushel capacity, although it was a poor sprout inhibitor when used on lots of 10 or 12 potato tubers. TCNB was ineffective when treated tubers were exposed to free air circulation, as demonstrated by the excessive sprouting of tubers at the surface of treated bins. Methyl ester of a-napthaleneacetic acid (MENA) proved to be a good sprout inhibitor when used in either small or large lots of potatoes. Poor sprout inhibition resulted from the use of methyl ester of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T).

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