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# INFLUENCE OF VITAVAX SEED TREATMENT AND LOOSE SMUT INFECTION ON YIELDS OF BARLEY AND WHEAT[1]

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## Abstract

Vitavax seed treatments at 4 and 8 oz per 100 lb of seed gave complete control of the loose smuts of barley and wheat. The 4 oz rate gave the highest yields in most cases, and the 8 oz rate reduced the yield of some seed lots. Levels of embryo smut infection ranging from 4 to 13% caused yield reductions, the highest level reducing yield by approximately 10%. In addition, although loose smut was controlled by treatment with Vitavax, the yield potential of the infected barley seed was not as high as that of smut-free seed.

## Introduction

The control of loose smuts of cereals where infection takes place during flowering has been difficult and uncertain until the recent appearance of oxathiin fungicides, of which Vitavax appears to be the most effective (1,4). There is little doubt about the efficacy of these chemicals in controlling cereal smuts. However, further information is necessary on the influence of internal smut infection of seed and Vitavax treatment on specific crops and varieties. The work reported here concerns greenhouse and field experiments with samples of barley and wheat seed infected with various levels of the loose smut fungi Ustilago nuda (Jens.) Rostr. and U. tritici (Pers.) Rostr., respectively.

## Materials and methods

Three seed lots of 'York' barley, Hordeum vulgare L., infected with 3.5, 13.5 and 5.4% loose smut, as determined by the embryo test, were used in this study. The seed was grown at Ottawa and represented successive crops from one original smaple. An additional sample of 'York' barley from another source was included for comparative purposes. Two samples of 'Opal' spring wheat seed with a light infection of loose smut (less than 1% head infection in the field) were obtained from Charlottetown, P.E.I., and Kentville, N.S., and were compared with an Ottawa sample from a plot free from smutted heads. One-lb portions of seed from each lot were treated with Vitavax (75% carboxin [2,3-dihydro-5-carboxanilido-6-methyl-1,4 oxathiin];. Uniroyal Ltd., Elmira, Ontario) at the rates of 4 and 8 oz per 100 lb (113 and 227 g per 45.4 kg) of seed. Treated and untreated samples of barley and wheat were sown in the greenhouse and in the field in 1970. The barley greenhouse test was sown twice and all others once. In the greenhouse seeding was done in beds, one row per treatment replicated four times. In one barley test and in the wheat test 20 seeds were planted per row 1 inch (2.5 cm) apart, while in the second barley test 25 seeds were planked approximately 1 inch apart. Rows were spaced approximately 12 inches (30.5 cm) apart. All plants were harvested at maturity. In the field seeding was done in 4-row plots with the rows 7 inches (17.8 cm) apart and 11.5 ft (3.5 m) long: each plot was replicated four times. Ten-foot (3-m) sections of the two center rows of each plot were harvested for yield and 1000 kernel weight determinations. A randomized block design was used in both the greenhouse and field.

Plant and head counts were made in all rows in the greenhouse and head counts on all four rows of each plot having loose smut in the field. Emergence counts were made on the two center rows of each field plot. Smut counts were taken when the plants were fully headed and percentages were determined on the basis of head counts.

## Results and discussion

Vitavax completely controlled the loose smuts of barley and wheat at the two concentrations used (Tables 1,2, and 3). Because the amount of loose smut present in the barley seed lots had been determined by the embryo test prior to seeding, these figures could be compared with the amount that actually appeared in the resulting plants. The average smut infection in the untreated seed in the greenhouse and in the field amounted to only 40% of that indicated by the embryo test, and the highest infection was only 54%. Thus the smutted head counts were considerably lower than the embryo

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Table 1. Effect of Vitavax seed treatment on control of loose smut and on number of plants, heads, and seed yield of York barley grown in the greenhouse from seed lots containing different levels of loose smut infection*

| Seed Lot No. | Embryo infection (%) | Vitavax (8 oz/100 lb) Plants (no.) | Heads (no.) | Yield (g) | Smut (%) | Vitavax (4 oz/100 lb) Plants (no.) | Heads (no.) | Yield (g) | Smut (%) | Untreated Plants (no.) | Heads (no.) | Yield (g) | Smut (%) | Mean Plants (no.) | Heads (no.) | Yield (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.5 | 20.3 | 57.1 | 55.2 | 0 | 20.9 | 69.1 | 57.9 | 0 | 20.7 | 71.7 | 54.2 | 1.9 | 20.6 | 65.9 | 55.8 |
| 2 | 13.5 | 18.6 | 52.2 | 49.0 | 0 | 18.7 | 60.8 | 56.3 | 0 | 21.1 | 62.5 | 48.8 | 5.8 | 19.4 | 58.5 | 51.3 |
| 3 | 5.4 | 20.1 | 56.3 | 51.2 | 0 | 20.6 | 65.3 | 57.1 | 0 | 17.4 | 60.0 | 53.9 | 1.2 | 19.4 | 60.4 | 54.1 |
| | Mean | 19.7 | 55.2 | 51.8 | 0 | 20.1 | 65.1 | 57.1 | 0 | 19.7 | 64.6 | 52.3 | 3.0 | 19.8 | 61.6 | 53.6 |

* Average of two tests.

counts and this was consistent in the two greenhouse tests and in the one field test. Russell and Popp (2) found that in general there was a good correlation between the embryo test percentage and the subsequent Smut percentage in the field, but occasionally the field infection was considerably lower. However, Stokes and Dewey (3) recently found that smut counts in barley were generally slightly higher in the field than was indicated by the embryo count. In the tests reported here the seed lots of York barley were identical except for their age and level of smut infection. The low levels of smut present in the qreenhouse and field tests with the three lots of barley indicate that the embryo test provides an overestimate of the amount of smut likely to occur in a subsequent crop of this variety.

Also the amount of smut present in a parent crop as measured by head counts apparently has little bearing on the percentage of smut in the next crop. When barley Seed Lot 2 was produced approximately 20% of the heads were affected with loose smut in the field, and according to the embryo test 13.5% of the seed from that crop (Tables 1 and 2) were infected. The crop grown from Seed Lot 2 had 12% of the heads affected by smut in the field but the embryo test indicated that only 5.4% of the seeds were infected. As suggested by Russell and Popp (2), the amount of loose smut in the succeeding crop is largely controlled by weather conditions at the time the parent crop is in flower. If it is unfavorable and inoculum is sparce then the new crop will have a lower percentage than the parent crop.

The yields of the untreated barley samples (Tables 1 and 2) indicate that the highest level of embryo infection reduced yields by 5-10%, and that lower levels of smut reduced yields by lesser amounts. Considering the relatively low levels of smut - the highest infection that occurred in the field amounted to *1%* (Table 2) - the yield reductions appeared to be substantial. However, none of the barley yields were significantly different and co-efficients of variation ranged from 10 to 20%. Stokes and Dewey (3) found that low levels of smut caused significant yield reductions of about the same magnitude as those in the present experiments. In this work treatment of the seed with Vitavax at 4 oz/100 lb gave the highest yield in the greenhouse, while in the field the highest yield occurred at the 8 oz rate. Control samples of York barley were included in the two qreenhouse tests (Table 1), but emergence of the untreated seed was extremely poor both times so it was not a legitimate comparison and the data were not included. The results of our greenhouse tests with barley agree with those of Reinbergs et al. (1) who also found that there was some yield reduction with the 8 oz concentration of Vitavax.

The barley seed with the highest embryo smut infection (Seed Lot 2) produced the fewest plants and heads in the greenhouse and had the lowest yield in both tests even though the smut was completely controlled at both treatment levels (Table 1). This was also true for yields at the 4 *oz* rate in the field, and only one seed lot (No. 3) yielded less at the 8 *oz* rate (Table 2). Therefore the seed with the highest smut infection produced plants with less vigor and consequently less yield. In the field test there appeared to be no change in kernel weight due to the Vitavax treatment or to smut infection.

Levels of smut infection in samples of Opal wheat seed were very low. No smut developed in untreated seed in the greenhouse. However, Vitavax treatment did give some improvement in yield. In the field a small amount of loose smut was present in the untreated plots of the Charlottetown and Kentville samples but it had no influence on yield (Table 3). No smut appeared in plants grown from seed treated with either level of Vitavax. The Ottawa sample showed a considerable yield benefit from treatment with Vitavax, but this was obviously due to factors other than smut control.

Table 2. Effect of Vitavax seed treatment on control of loose smut and on seed yield and 1000-kernel weight of York barley grown in the field from seed lots containing different levels of loose smut infection

| | | Vitavax (8 oz/100 lb) | | | Vitavax (4 oz/100 lb) | | | Untreated | | | Mean | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Seed Lot NO. | Embryo infection (%) | Seed yield (g) | 1000-k weight (g) | Smut (%) | Seed yield (g) | 1000-k weight (g) | Smut (%) | Seed yield (g) | 1000-k weight (g) | Smut (%) | Seed yield (g) | 1000-k weight (g) |
| 1 | 3.5 | 335.5 | 30.9 | 0 | 326.1 | 32.6 | 0 | 288.6 | 31.7 | 1.1 | 316.7 | 31.7 |
| 2 | 13.5 | 302.8 | 31.6 | 0 | 220.6 | 32.6 | 0 | 283.6 | 31.5 | 7.1 | 269.0 | 31.9 |
| 3 | 5.4 | 265.0 | 32.0 | 0 | 314.4 | 31.7 | 0 | 296.9 | 32.2 | 1.3 | 292.1 | 31.9 |
| 4 | Control | 352.0 | 32.4 | 0 | 315.2 | 32.0 | 0 | 307.6 | 32.4 | 0 | 324.9 | 32.2 |
| | Mean | 313.8 | 31.7 | 0 | 294.1 | 32.2 | 0 | 294.2 | 31.9 | 3.2 | | |

Table 3. Effect of Vitavax seed treatment on control of loose smut and on seed yield and 1000-kernel weight of Opal wheat grown in the field from seed from three locations

| | Vitavax (8 oz/100 lb) | | | Vitvax (4 oz/100 lb) | | | Untreated | | | Mean | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Seed source | Seed yield (g) | 1000-k weight (g) | Smut (%) | Seed yield (g) | 1000-k weight (g) | Smut (%) | Seed yield (g) | 1000-k weight (g) | Smut (%) | Seed yield (g) | 1000-k weight (g) |
| Charlottetown | 313.7 | 36.1 | 0 | 325.2 | 36.1 | 0 | 357.8 | 36.2 | 0.33 | 332.2 | 36.1 |
| Kentville | 315.5 | 32.1 | 0 | 316.7 | 31.9 | 0 | 339.3 | 32.3 | 0.68 | 323.8 | 32.1 |
| Ottawa | 316.5 | 32.2 | 0 | 357.8 | 32.5 | 0 | 271.5 | 32.1 | 0 | 315.2 | 32.2 |
| Mean | 315.2 | 33.4 | 0 | 333.2 | 33.5 | 0 | 322.8 | 33.5 | 0.33 | | |

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