GREY SPECK OF OATS IN ALBERTA[1]

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Abstract

It has been found that grey speck of oats is widely but sporadically distributed throughout central and northern Alberta and that here, as elsewhere, manganese deficiency which is responsible for the disorder, is generally associated with high organic matter content of the soil, high soil pH, or both. It is also shown that this disorder can be prevented by spraying the foliage with manganous sulphate, but not by applying manganese to the soil, where it apparently is quickly converted to an unavailable form.

Introduction

During recent years a leaf-spot of oats has become prominent in the cereal test plots of the University of Alberta at Edmonton and at the Experimental Farm at Lacombe. This disorder, first noted at Edmonton in 1956 on varieties imported from Great Britain, is, in its early stages, similar in appearance to halo blight induced by Pseudomonas coronafaciens (Elliott) Stapp. The lesions are brown to grey, with yellowish borders, and whereas the halo blight lesions are scattered over the surface of the leaf, the spots under discussion tend to be localized in the central portion of the blade and the base and tip remain green. The patchy distribution of the disease throughout the fields suggested unfavorable soil conditions and 'it was thought that manganese deficiency might be the cause. A preliminary field test in which manganese sulphate was sprayed on the plots at Edmonton and a greenhouse test in which manganese was rendered unavailable by the addition of lime to pots of soil, demonstrated that the disease was indeed due to manganese deficiency, A survey of oat fields in central and northern Alberta indicated an association of the disease with certain types of soil, although localized areas showing severe leaf spotting of oats were found scattered throughout the whole region.

This paper reports the results of tests which confirmed that manganese deficiency was the cause of this disease. Furthermore, evidence of the effects of some factors which might influence the availability of manganese in Alberta soils, and a possible means of control, are presented.

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Materials and Methods

pH and Manganese Availability

Samples of peaty soil at Leslieville and black soil at Lacombe, on which oats showed severe leaf spotting, were collected. Also, a peat soil and a grey-wooded soil east of Edmonton, on neither of which the disease occurred, were sampled. The Leslieville peat, which was mixed with high lime subsoil, was slightly basic, while that from Edmonton, a deeper peat, was strongly acid. Each soil sample was divided into three lots. One per cent lime was added to the first, 0.1 per cent sulphur to the second, and the third one was left untreated. Half of the soil in each lot was further amended by the addition of 1 gm. $MnSO_4$ to each kilogram of soil. Soil reaction was determined for each sample initially and every two weeks thereafter. Garry oats and Harosoy soybeans were planted in pots of the soil and grown in the greenhouse. The plants in half of each treatment were then sprayed every second week with a 1 per cent solution of $MnSO_4$.

Influence of pH and Organic Matter Content of Soil on the Incidence of Grey Speck

During the summer of 1959, oat crops throughout central and northern Alberta were assessed for the incidence of grey speck.

The pH of each soil sample was determined with the use of a Model H Beckman meter and the organic matter content was determined as follows. The samples were ground in a mortar and oven dried before accurately weighed aliquots were removed to tared porcelain crucibles. These samples were then ignited to constant weight by the method of Wilde and Voigt (21) and the weight loss was considered to be the organic matter content. It is recognized that this method may destroy or drive off part of the inorganic carbonates and hence give a slightly high value, but a comparison of this method with others available has indicated (22) that none was appreciably more accurate as to offer any great advantage.

Results

pH and Manganese Availability

Table 1 shows the pH of each soil sample initially and its pH two weeks after treatment. Bi-weekly pH tests indicated that there was very little further change during the 4 months the soil was in use.

Table 1. pH of test soils before and after the addition of lime and sulphur

	Source and type of soil			
Treatment	Leslieville Peat	Lacombe Black Loam	Edmonton Grey Wooded	Edmonton Peat
pH before treatment	7.2	7.1	6.7	4.3
pH two weeks after treatment				
Lime added	8.8	8.7	8.7	7.5
Untreated	7.2	7.1	6.9	4.3
Sulphur added'	4.5	4.8	3.2	1.6

The plants in soil with a reaction below pH 4 either did not emerge or died soon after emergence. All unsprayed plants growing in soil at pH 6.9 or higher developed symptoms similar to those noted in the field, while those in the more acid soils remained healthy. All plants sprayed with manganese sulphate developed normally. The pot tests with soybeans yielded parallel results and field experiments corroborated the greenhouse results.

Grey Speck and Its Relation to pH and Organic Matter Content in Field Soils

Organic matter content and pH were determined on samples of soil from 121 oat fields. Average results are shown in Table 2. Oats in 65 of the fields were free from grey speck; those in 36 fields showed slight symptoms; and in 20 fields symptoms were rated moderate to severe. Data in Table 2 show that generally the severity of symptoms increased with increasing pH and organic matter content. In individual cases though, this does not always hold true, but it was true that in any case where deficiency symptoms did appear either the pH was above 6.2 or the organic matter content was above 10 per cent. In most cases where symptoms were moderate,. to severe both values were high.

Table 2. Average pH and organic matter content of soils of oat fields where the crops showed varying degrees of grey speck

Severity of symptoms	pH	Organic matter, per cent
Nil	6.4	9.9
Slight	6.6	13.4
Moderate - severe	6.9	21.2

Discussion

The results of the test on the pH levels of the soils are in accord with those of Arrhenius (1), who found that grey speck of oats in Europe did not occur on soils with a pH level below pH 6, and Lundegårdh (12), who found that the hydrogen-ion concentration of the 'soilsolution determines the availability of manganese. In addition, Leeper (11) in Australia was able to overcome grey speck by acidifying the soil with sulphur to a point below pH *6.5.* Heavy liming of the soil induces manganese deficiency in many crops (3, 7, 14). Several workers (4, 10, 18) have reported that soils with a high organic matter content are deficient in availaole manganese, especially if the pH is above 6, Poor drainage has also been shown to intensify manganese deficiency (15, 17), a fact that is in agreement with the observed conditions in many of the most severely affected areas in Alberta. This may be due to lower temperatures in the poorly drained soils which might render the elements less soluble, or favor the growth of microorganisms that adversely affect the availability of manganese (13).

Some workers (7, 20) have overcome manganbse deficiency by the application of manganese salts to the soil but the soils in these cases were slightly acid, The results of the work reported here indicate that this practice has little effect, especially on more basic soils, since soluble ions are rendered unavailable soon after incorporation into the soil. This conclusion is supported by Wallace and Jones (19), Stale and Bovey (16), MacLachlan (13), Heintze (9), and Barbier et al. (2), 'as well as by workers in New Zealand (5) and in Sweden (8), all of whom state that soil applications of manganese are of little or no use, The results reported here are in agreement with those of earlier workers (2, 6, 16, 17) who have shown that grey speck can be controlled by the application of a small amount of manganous sulphate as a spray at about the time the first symptoms appear.

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GERMINATION OF RAPE SEED AFTER BURIAL IN SOIL OF SUBGERMINATION MOISTURE CONTENT[1]

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Introduction

Wallace (1) has shown, in carefully conducted experiments, that the subsequent germination of cereal seeds is usually greatly reduced after burial in soils of subgermination moisture content, This loss in germinability was found to be correlated with injuries to the seed coat during, or subsequent to, threshing. Other factors such as growth cracks, sprouting and frost injuries may also adversely affect germination. It was shown that the reduced germination after incubation in "dry" soil of subgermination moisture content was caused by seed-rotting organisms such as Penicillium, Aspergillus, Rhizopus and Mucor. Seed treatment with fungicides improved the germination of cereal seeds in moist soil after the "dry" soil treatment, but germination never equalled that of untreated seed sown in moist soil.

Saskatchewan-grown rape seed, of both the Argentine (Brassica napus L, var. annua Koch) and the Polish (B. campestris L.) types has a relatively high germination rate, comparable with that of cereals and flax. This suggested that the subsequent germination of rape seed sown in soils of subgermination content should be tested by Wallace's methods,

Materials and Methods

Air-dry soil was moistened with 8 per cent water by weight. This was used as the "dry" soil of subgermination moisture content, Wallace's Petri-dish method was used as follows: a layer of "dry" so91 was placed in a Petri dish and 50 rape seeds were sown on its surfade. The seeds were covered with more of the same soil and the Petri dish cover was pressed down to pack the soil. After 9 days the seeds were removed and tasted for germination by plating on moist filter paper or in moist soil. At the same time one lot of seed treated with Ceresan M and one treated with Orthocide 75 were subjected to the "dry soil germination test." Untreated seed samples were also germinated on moist filter paper or in moist soil.

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