The Effect of Pretreatment and Substrata on the Germination of Sugar Beet (Beta vulgaris L.) Seedballs

ALICE M. ANDERSEN[1]

IT HAS BEEN reported by some growers of sugar beet seed that lower germination results were obtained by seed laboratories on some lots of seed than had been obtained by the growers. These differences may result from the fact that the seedballs of certain lots, when tested between blotters at 20 degrees and 30 degrees centigrade alternating temperatures, produce some seedlings which are browned and are, therefore, considered abnormal and are not included with those considered to have germinated. Stout and Tolman (6)[2] in their investigation of the germination of sugar beet seedballs reported that the browning of some of the seedlings is due to ammonia released during germination from organic nitrogen compounds in the seedballs and that the browning can be overcome in general by washing the seedballs in running water for 2 hours or more, prior to placing them to germinate between blotters. The method stated in the Rules and Regulations under the Federal Seed Act (1) for the germination of garden beet seed is to soak the seed for 2 hours followed by a brief washing in running water prior to placing them to germinate between blotters at 20 degrees and 30 degrees centigrade alternating temperatures for a period of 14 days. The same provision is made for garden and sugar beet seed in the rules of the Association of Official Seed Analysts (2).

It was the purpose of this investigation to devote further study to such methods of germinating sugar beet seedballs under laboratory conditions as might give results more comparable with those obtained by the growers.

Materials and Methods

Nine samples of sugar beet seedballs, from the 1947 crop, were used in these tests. These samples were selected because they produced a high proportion of browned seedlings. Five samples were grown near Phoenix, Arizona, 2 near Las Cruces, New Mexico, and 1 in Ogden Valley, Utah. Each sample was divided into 4 portions and treated as follows (a) untreated seedballs, (b) 12 replicates of 100 seedballs each soaked in 250 c.c. of water for 2 hours, then rinsed in running water, (c) 12 replicates of 100 seedballs each soaked in 250 c.c. of water for 4 hours, the water being changed after 2 hours and soaking continued for 2 more hours followed by rinsing in running water, (d) 12 replicates of 100 seedballs each washed in running water for 4 hours in the seed washer described by Gaddie (3).

[1]Seed Technologist, United States Department of Agriculture, Production and Marketing Administration, Grain Branch, Washington, D. C.

[2]Numbers in parentheses refer to literature cited.

Each portion of the treated seed was wrapped in several thicknesses of paper towels to remove the excess moisture.

Each sample was tested in three kinds of substrata as follows: (a) 8 replicates of 50 seeds each of the treated and untreated seedballs were placed between moistened blotters, (b) 4 replicates of 100 seedballs of the treated and untreated seed were placed in a mixture of sand and soil, at a planting depth ½ to ¾ inch, and (c) 4 replicates of 100 seedballs of the treated and untreated seed were placed on Kimpak (20-ply crepe paper). All tests were conducted at 20 degrees and 30 degrees centigrade alternating temperatures for a period of 14 days. The sand and soil tests were made in 1⅞x8½x8½-inch paraffined cardboard boxes containing partitions separating each seedball. The moisture of the sand and soil was not measured but enough water was added to make a loose ball when soil particles were pressed together. The Kimpak tests were made as follows: A moist blotter, 9x9½ inches, was placed on the tray; a 9x9½-inch piece of Kimpak was placed on the moistened blotter and 100 c.c. of water sprayed into the Kimpak; 100 seedballs were lightly pressed into the Kimpak with the counter, and the seedballs were covered with a slightly moistened blotter.

Results

The average percentage of balls germinating free of browned seedlings was approximately equal on Kimpak and in soil and 28 percent higher than on blotters (table 1). The 3 pretreatments gave approximately equal results and were about 11 percent higher than the untreated seedballs when tested between blotters. There was no appreciable difference in the average germination results of treated and untreated seedballs when grown on Kimpak or a mixture of sand and soil (average of 2 percent or less in favor of the treated seedballs).

When the first count of the germinating seedballs in blotter tests was made the seedlings had no stem, practically no hypocotyl, but a well-developed root. However, in the soil and Kimpak tests the seedlings had a relatively long hypocotyl, as well as a well-developed root on the first count. Browning of the seedlings in the blotter tests varied from a stunting of the root hairs in the upper root-hair zone of the root, thus giving a ringed effect on the seedling, to a browning of the entire root, almost to the tip, and in some cases including the tip of the root. Browning of the seedlings in Kimpak and soil tests was mainly due to 1 or 2 very vigorous seedlings pushing the ball into the air and a smaller seedling with a browned root remained attached to the ball. However, in some cases the root of the seedling was browned under ground or in the Kimpak. The lesions on the hypocotyl of the seedling in the Kimpak or soil tests were in the form of cracks, brown streaks, or small round holes with a brown fringe. Seedlings with lesions on the hypocotyl were classified together with the browned roots in Kimpak tests as they were infrequent but separated from those with browned roots in the soil tests.

Table 1.—Average germination results obtained with 9 samples, from the current year's crop, of sugar beet seedballs sown from November 9 to December 5, 1947, at 20 degrees and 30 degrees centigrade alternating temperatures (8x50 or 4x100 seedballs used on each test).

Pretreatments	Percentage of germination of sugar beet seedballs on designated substrata and indicated number of seedlings of balls and type of seedlings produced from balls, 14 days after sowing—								
	Between Blotters		Kimpak			Soil and Sand			
	Balls having 1 or more seedlings	Balls having 1 or more seedlings	Balls having 1 or more seedlings	Balls having 2 or more seedlings		Balls having 1 or more seedlings	Balls having 2 or more seedlings		
	None of the seedlings were browned	Usually 1 or more seedlings were browned	None of the seedlings were browned	Usually only 1 seedling with lesions on the hypocotyl or browned root, and 1 or more normal seedlings	Total	None of the seedlings were browned	Usually only 1 seedling with lesions on the hypocotyl and 1 or more normal seedlings	Usually only 1 seedling with browned root and 1 or more normal seedlings	Total
Untreated seedballs	48.28	41.67	85.53	3.50	89.03	81.36	3.11	3.50	87.97
Seedballs soaked 2 hours	58.14	34.44	86.44	2.25	88.69	82.86	4.33	3.03	90.22
Seedballs soaked 4 hours	60.31	32.67	85.81	2.31	88.11	83.36	3.92	3.06	90.33
Seedballs washed in running water 4 hours	59.22	34.17	86.78	3.14	89.92	83.81	4.25	2.67	90.72
Average	56.48	35.74	86.14	2.80	88.94	82.85	3.90	3.06	89.81

The tests made with treated and untreated seedballs in Kimpak gave an average germination of 86.14 percent seedballs of which none of the seedlings were browned or displayed lesions, and 2.80 percent of the balls contained 2 or more seedlings of which usually only 1 seedling had lesions on the hypocotyl or the root was browned and 1 or more were normal seedlings. This resulted in a total average of 88.9 percent germination on Kimpak. During the test period the substratum of the untreated seedballs was not as clean in appearance as the substratum of the treated balls. The untreated balls of some samples stained the Kimpak brown. The tests made with treated and untreated seedballs in a mixture of sand and soil gave an average of 82.85 percent germination of seedballs of which none of the seedlings showed lesions or browning, 3.9 percent of the balls contained 2 or more seedlings of which usually only 1 seedling had lesions on the hypocotyl and 1 or more were normal seedlings, and 3.06 percent of the balls contained 2 or more seedlings of which usually only 1 seedling was browned and 1 or more seedlings were normal. This resulted in a total germination of 89.81 percent balls on sand and soil. Seedballs pretreated by soaking for 2 or 4 hours and washed in running water for 4 hours and placed between blotters gave an average germination of 59.2 percent balls of which none of the seedlings were browned and 33.7 percent of the balls contained 1 or more seedlings of which 1 or more seedlings were browned. The untreated seedballs placed between blotters gave an average germination of 48.3 percent balls of which none of the seedlings were browned and 41.67 percent of the balls contained 1 or more seedlings of which 1 or more seedlings were browned.

The speed of germination was greater in blotter and Kimpak tests than in soil tests. The first count on blotters and Kimpak was made 3 or 4 days after sowing and in soil tests 6 or 7 days after sowing. The results of the blotter tests were not quite comparable with those obtained from Kimpak and soil. In the blotter tests the balls having 1 normal seedling and 1 browned seedling were not separated out and added to the total germination as they were in Kimpak and soil tests.

In general, the results reported herein with blotters and soil are in agreement with those of Stout and Tolman (6) except that they obtained a greater difference between treated and untreated seedballs tested between blotters (about 18.7 percent) than the writer obtained (about 11 percent). This difference may be due to the fact that Tolman and Stout washed the seedballs in running water for 24 hours while the writer washed the balls in running water for 4 hours, prior to testing between blotters. The difference between the treated seedballs and the untreated seedballs tested between blotters was noted in the severity of browning as well as on the percentage basis. The seedlings from the treated seedballs were considerably less browned than the seedlings from the untreated balls.

Rumbold (5) reported that sugar beet seedballs carried many fungus spores. The writer observed an abundance of *Alternaria* spores on many of the browned seedlings which were examined microscopically. *Rhizopus*

fruiting bodies were observed on a less number of browned seedlings and *Aspergillus* and *Fusarium* on an occasional browned seedling. From 45 plantings on agar made by Dr. Kotila (4) from the browned seedlings tested between blotters, 36 were identified as species of *Alternaria*, 4 as *Aspergillus*, 3 as bacteria, 1 as *Fusarium*, and 1 as *Rhizopus*. No conclusions on the cause of browning can be made from the tests completed at this time.

Summary

The above preliminary results from 9 samples of sugar beet seedballs indicated that approximately equal germination results were obtained on Kimpak and soil. There was no appreciable difference in the germination results whether the seed was treated or untreated prior to testing on these 2 substrata. Seedballs pretreated by soaking for 2 or 4 hours and washed in running water for 4 hours, and tested between blotters gave higher results (percentage of balls producing seedlings free from browning) than untreated seedballs; none of the blotter tests gave as high germination results as Kimpak or soil tests.

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