Some Effects of Gibberellic Acid on Turfgrasses

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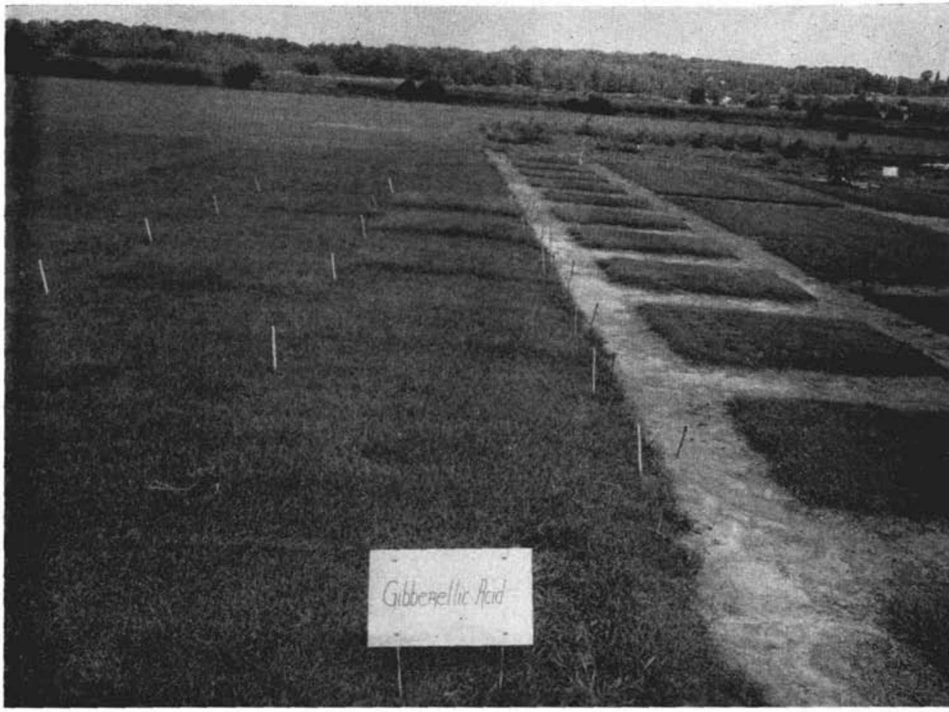
Gibberellic acid, a plant growth substance, is known to promote the growth of a wide variety of plants including grasses. The gibberellins, of which gibberellic acid is the most common, are isolated culture filtrates of the fungus Gibberella fujikuroi. This fungus causes a disease of rice seedlings in many countries of the Far East and in Italy. A characteristic early symptom of the disease in rice is an elongation of the shoot so that the diseased plants are spindly and much taller than the healthy ones. In advanced stages of the disease, some of the lower tissues of the seedlings become weak and may die. The crystalline material causing many symptoms characteristic of the disease was first isolated by Japanese workers in 1939 from a liquid portion of the culture medium on which the fungus was grown. Gibberellic acid is produced commercially by growing the fungus in a culture medium. The process is somewhat similar to that used in the production of antibiotics such as penicillin. Gibberellic acid in pure form is not readily soluble in water; therefore, water soluble formulations generally contain a water miscible solvent or the acid is converted to a water soluble salt form.

Outside of Japan, experimental work with gibberellic acid was delayed by language barriers and war, and it was not until 1951 that the U. S. Department of Agriculture resumed work with gibberellic acid. It shows promise as a growth regulator since it stimulates overall plant growth at extremely low concentrations while high amounts generally show slight to severe adverse effects of over-stimulation and weak plants. The action of gibberellic acid, therefore, is different than that of 2,4-D which is highly toxic at greater concentrations. Gibberellic acid in its dry form as an acid or as a potassium salt of the acid (Potassium gibberellate) is apparently fairly stable. Once dissolved, the material should be used within a week or two because it will gradually lose its growth stimulating properties.

Probably the greatest plant response to gibberellic acid is stem elongation or distance between the nodes of the plant stem. Research conducted at the various Agricultural Experiment Stations indicates that it may help plant growers in several ways, depending upon the crop being grown. With some crops gibberellic acid treated seed may emerge earlier. It may promote more rapid seedling growth; however, rate of root growth may be reduced where stem growth has been greatly stimulated (3). On many ornamental plants, gibberellic acid may be applied in a lanolin paste. A small amount of the acid is dissolved in the lanolin and stirred thoroughly to form a paste which can



The effect of gibberellic acid in promoting the growth of Kentucky bluegrass. Starting in the foreground (directly behind the sign), rectangular plots were sprayed July 17, 1957, with solutions containing 10, 0, 50, 0, 100, 0, 250, 0, and 500 ppm of gibberellic acid, respectively. Photograph taken August 6, 1957.

be applied just below the growing point of the plants. Perhaps a more common method is to apply gibberellic acid as a foliar spray. For experimental purposes various ranges in parts per million (ppm) of gibberellic acid can be readily applied. For grasses, 1 to 2 ounces per acre of gibberellic acid (equivalent to 100-200 ppm when 100 gallons of water are applied) are generally effective. Since gibberellic acid is a growth regulator or growth inducer and not a plant food, it will not replace fertilizer. In fact, it is thought that more fertilizer will be needed to produce balanced growth when gibberellic acid is used.

Treatment of Merion and Kentucky Bluegrass Seed

Bluegrasses are relatively slow to germinate, therefore, a chemical hastening seed germination by several days would be valuable in the establishment of turfgrasses. Rapid germination would provide faster coverage, decrease erosion and enable grass seedlings to compete more favorably with weeds.

Seed of both Merion and Kentucky bluegrass received the following treatments: (a) untreated—dry seed; (b) control—soaked in water; (c) 0.1% dust of gibberellic acid; (d) 1.0% dust of gibberellic acid; (e) 5 ppm, 10 ppm, 50 ppm, 100 ppm and 500 ppm of gibberellic acid.

Water and gibberellic acid treated seed were soaked for 24 hours prior to planting on March 28, 1957. Observations taken after germination began indicated that the water soaked seed germinated as soon as the seed treated with various concentrations of gibberellic acid. Dry seed (untreated) and seed treated with gibberellic acid dust did not show any difference in time of germination. Seed soaked in both water and gibberellic acid germinated 2-3 days earlier than dry seed. Other workers (1) found water and KNO_3 treatments on Kentucky bluegrass equal to or superior to gibberellic acid. Growth after emergence was not affected by gibberellic acid treatments; apparently, gibberellic acid dissipates rather rapidly in moist soil.

Effect of Gibberellic Acid on the Growth of Bermudagrass, Bentgrass, and Zoysiagrass Stolons

Golf course superintendents and others using vegetative material for the establishment of turf are tremendously interested in obtaining rapid cover for new turf areas such as greens, tees and fairways. With this thought in mind stolons of bermudagrass, bentgrass and zoysiagrass were soaked 24 hours in water only or in solutions containing 5 ppm, 10 ppm, 50 ppm, 100 ppm and 500 ppm of gibberellic acid. Measurements of stolon growth were taken six times during a period of twenty-two days following treatment. (Table 1)

TABLE I

Response of Bentgrass, Bermudagrass and Zoysiagrass Stolons to Gibberellic Acid Treatments Under Greenhouse Conditions.

Average increase in length of stolons (centimeters)

Treatments	Cohansey Bentgrass	U-3 Bermuda	Meyer Zoysia
Water	10.4	14.5	.3
5 ppm	13.7	6.8	.5
10 ppm	15.4	12.7	.5
50 ppm	19.0	15.4	.9
100 ppm	16.2	24.0	1.1
500 ppm	9.5	31.4	-1.2

Stolons were soaked for 24 hours before planting. Growth period: March 29-April 20, 1957.

Growth of Cohansey bentgrass increased with each concentration of gibberellic acid to 50 ppm, after which, the increase in the growth of stolons began to decrease. Treatments of 500 ppm reduced the growth of stolons below that of the control. The 50 ppm treatments increased the length of stolon growth approximately ⅓ over the control. U-3 bermudagrass, with the exception of the 5 ppm treatments, showed a continuous increase in stolon growth through the entire range of treatments and the rate of growth for bermuda was more rapid than bentgrass at higher concentrations. Meyer zoysia stolons used for this experiment showed very little response to gibberellic acid. The 500 ppm treatments increased growth of stolons only .9 cm over the controls. This may be due to the fact that the zoysia species are much slower to become established from stolons than either bermudagrass or bentgrass.

To test further the response of bermuda, bent and zoysia grasses to gibberellic acid, 4 inch plugs of each species were planted in replicated plots in the field. The plugs were planted in June and allowed to become well established before treatments were applied in July. Treatments included a control, 10 ppm, 50 ppm, 100 ppm, 250 ppm and 500 ppm of gibberellic acid. The first application was made on July 17, 1957.

An application of 10 ppm gave a decided increase in growth of bentgrass over the control; whereas, considerable etiolation and yellowing began to appear at 50 ppm. Concentrations over 50 ppm affected bentgrass adversely causing thin, anemic growth. Growth of Meyer zoysia was not stimulated except at high concentrations in which case the zoysia plant grew taller and the leaves became more yellow. Zoysia plants which received 500 ppm of gibberellic acid were 2½ times taller than the controls; however, there was no apparent increase in stolon extension. At the higher concentrations, zoysia stolons no longer grew prostrate but began to turn upward exhibiting a geotropic reaction. Reversal of the upward growth of stolons occurred later in the season. California workers (5) have reported that gibberellic acid applied to zoysia vegetative material did not improve the rate of turf establishment.

COMING EVENTS

July 14
Oklahoma Turfgrass Association Field Day
Stillwater, Okla.
Dr. Wayne W. Huffine

July 16
Texas Turfgrass Association Field Day
College Station, Texas
Dr. Ethan C. Holt

August 4-8
Annual Meetings American Society of Agronomy
Purdue University, Lafayette, Ind.
L. G. Monthey
Executive Sec., Madison, Wis.

August 26
Rutgers University Turfgrass Field Day
New Brunswick, N. J.
Dr. Ralph E. Engel

September 3, noon to September 4, noon
Penn State Turfgrass Field Days
University Park, Pa.
Prof. H. B. Musser

September 11-12
University of Rhode Island Field Days
Kingston, R. I.
Dr. Jesse A. DeFrance

September 30
St. Louis Field Day
Clayton, Mo.
Leo S. Bauman

October 15-16-17
Central Plains Turfgrass Conference
Manhattan, Kans.
Dr. Ray A. Keen

U-3 bermudagrass responded to gibberellic acid somewhat similarly to Meyer zoysia with respect to top growth, although geotropism of stolons was not observed. The high response of bermudagrass stolons to gibberellic acid obtained in the greenhouse was not evident in the field; moreover, a concentration of 500 ppm inhibited growth of bermuda selections.

A pronounced growth response was obtained in Kentucky bluegrass by treating with gibberellic acid. Increased growth, yellowing and etiolation were roughly proportional to the concentrations applied. The effect of gibberellic acid on Kentucky bluegrass was observed in three to four days and was still evident three months after treatment.

Leben (2) obtained an increase in both fresh and dry weight of Kentucky bluegrass clippings treated with gibberellic acid especially when it was used in conjunction with fertilizer. For pasture purposes, an increase in forage production is important; but for turf purposes, it may be of questionable value. Once a dense turf is established, it would be preferable for lawn purposes to have grass grow slowly in order to decrease maintenance costs.

Field tests indicate that gibberellic acid may be useful for inducing the growth of some grasses in the fall and again in the spring. Gibberellic acid has been used successfully in Michigan (4) in the spring to induce growth in bluegrasses and bermudagrasses when growth would not have otherwise accurred. Bermudagrass was dark green within 10 days when treated on April 16, 1957, with 2 ounces of gibberellin per acre.

Gibberellic acid may prove to have a place on golf courses where it could be used to enable play to start earlier in the spring and to extend play later in the fall. However, the effect of gibberellic acid for breaking spring and fall dormancy has not been well established.

Summary

Merion Kentucky bluegrass and Common Kentucky bluegrass seed were treated with various concentrations of gibberellic acid. Seed treated with gibberellic acid did not germinate earlier than the control, nor was subsequent seedling growth more rapid.

Stolons of bentgrass, bermudagrass zoysiagrass were soaked for 24 hours in different concentrations of gibberellic acid. In the greenhouse, bentgrass was most responsive followed by bermudagrass. Zoysiagrass responded very little to gibberellic acid treatments.

In the field, the best growth of bentgrass was observed at 10-50 ppm; above these rates spindling growth was evident. At the 500 ppm concentration bermudagrass stolon growth was slightly inhibited. In Meyer zoysia additional upright growth was observed following application of gibberellic acid but no improvement was obtained in rate of turf establishment.

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