GROWTH SUBSTANCES ON TURF GRASSES

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In the preceding article the fact has been emphasized that, although growth substances are unquestionably significant in the life of plants, they are almost universally distributed in plants and in organic matter in the soil and are therefore normally accessible to plants growing under favorable conditions. It is, therefore, only in cases where they are the factors which limit growth that stimulation can be expected from their application. Even then, the right substance must be applied at the proper concentration if germination or growth is to be stimulated.

In spite of these well recognized facts, however, voluminous publicity has been given to the claims of commercial firms as well as of enthusiastic investigators concerning the amazing results achieved by their application. Little cans or bottles of these amazing chemicals to be used as dust or in solution, and even seed which has previously been dusted with one hormone or another, are now available on the market under various trade names, and results little short of miraculous are promised to those who use them.

Exploratory investigations have been necessary to determine whether or not hormones are as effective on turf grasses as scientists have found them to be on some other plants, or even a fraction as beneficial as some enthusiasts claim they are. So far, the most uniform and best results appear to have been obtained with cuttings. It was only logical to suppose, there-

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fore, that hormones might have some effect in accelerating the rooting of grass stolons, particularly those of the slow growing species such as Zoysia and velvet bent.

In addition, it appeared that some of these growth substances might prove to be valuable in midsummer when the failure of roots in turf is most pronounced. If, by adding them to turf at this time, root growth could be stimulated, injury from drought and other causes might be avoided. Also, it appeared that some of them might be useful in speeding up the germination of the seed of such slowly germinating grasses as Kentucky bluegrass when a quick establishment of turf is desired.

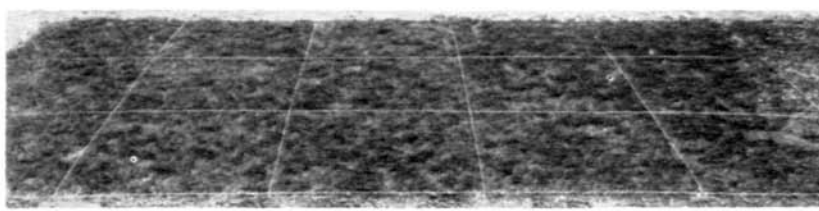
Therefore, during the past 2 years, the Green Section has been testing in a preliminary way the effects of a few of the growth substances on the rooting of stolons, root development of grass in turf, and the germination of grass seed. So far, no encouraging results have been obtained. The results have either been entirely negative or so inconsistent that no conclusions could be justified either in favor of or opposed to their use in the establishment or maintenance of turf.

Hormones on Stolons

In three series of greenhouse experiments in the fall of 1938 and the spring of 1939, stolons of *Zoysia matrella,* velvet bent, and the Washington and Metropolitan strains of creeping bent were used. The bent grass stolons, about 2 inches long, were taken from mature growth in the center of nursery rows and the Zoysia stolons from the old growth of plants growing in a warm greenhouse. Although an attempt was made to select uniform stolons, there was some difference in the number of nodes per stolon planted. The nodes on the Washington stolons

were much closer together than were those on the other stolons.

Solutions of the commercial product, Auxilin (a beta indole-butyric acid preparation) as well as of beta indole-acetic, alpha naphthalene-acetic and ascorbic acids were used. In the first two series the stolons were immersed in the solutions to a depth of ¾ to 1½ inches and in the third they were completely immersed. Treatments were made at greenhouse temperatures



Turf resulting from the use of Kentucky bluegrass seed which had been treated with various synthetic hormones, compared with that produced by untreated seed. Front row, left to right—talc dust containing 1,000 p.p.m. of indole-butyric acid, the same at 100 p.p.m., Rootone, Hormone powder, Auxan; center row—untreated seed, Transplantone, Hormodin, untreated seed, Hormonized dust; back row—talc dust containing 1,000 p.p.m. of naphthalene-acetic acid, the same at 100 p.p.m., thiourea, talc and untreated seed. The seeds were dusted thoroughly with the chemicals at the rate of 1 ounce of dust to 10 pounds of seed and were immediately planted in 4 by 4-foot plots on August 10, 1940. This picture, taken on September 3, shows no significant difference between the turf resulting from the planting of untreated seed and that resulting from the use of seed given any of these various treatments.

of 80° to 85° F. The time of treatment varied from 24 to 96 hours in the first experiment, 12 to 48 hours in the second and 4 to 24 hours in the third. For comparison purposes, similar stolons were soaked for equal lengths of time in tap water. Immediately following treatment, the stolons were planted in flats of sand. The bent stolons were kept in a relatively cool house and the Zoysia in a warm greenhouse at 80° to 85° F.

In the first two series of experiments the Auxilin was used according to directions at the rate of one-half measure to a

pint of water and the other substances at the rate of 10 parts per million (p.p.m.) of water. In the final series the rates were doubled.

In the first experiment, 3 days after the last of the stolons were planted, counts were made of the number of nodes which had no roots and the average number of roots to a node. On the Washington bent, roots were found on three to five of the nodes of each stolon, Metropolitan bent developed roots on one to two of the nodes of each stolon and velvet bent usually formed roots at only one node on each stolon. In the second and third experiments, only velvet bent and Zoysia stolons were used and counts were made 12 and 4 days respectively after the last stolons were planted.

Stolons of Washington and Metropolitan creeping bent, velvet bent, and *Zoysia matrella* were used in the first experiment. Those stolons which were planted with no treatment produced fewer roots per node and had a greater percentage of nodes with no roots than either the stolons which were soaked in water or in Auxilin solution, except in a few cases where the stolons had been soaked in the Auxilin for 96 hours. In general the stolons treated with Auxilin solution gave results similar to those soaked in water, but in some cases the number of roots per node was greater and the percentage of nodes with no roots was smaller than in the water-treated stolons. However, in an equal number of cases, the reverse of this was true, particularly following the Auxilin treatments for the longer periods of time.

After the results of the first series had been obtained, the creeping bent stolons were dropped from all subsequent series of experiments, since such stolons normally start growth rapidly within a few days after planting. The Zoysia and velvet bent

stolons are much slower to establish themselves under field conditions and therefore they alone were used in the second and third series of experiments. In these experiments beta indolebutyric, alpha naphthalene-acetic and ascorbic acids were used in addition to the Auxilin and water treatments of the first experiment. Much the same results were secured in the second series as in the first except that the stolons planted without treatment produced a lower percentage of nodes without roots. In fact in this series the untreated stolons were as good in this respect as were the treated ones. Also, the untreated stolons produced as many roots per node as the treated ones, and in some cases more. As in the first series, there was a great deal of variation in the number of roots per node, so that the differences in average numbers could not be considered significant.

In the third series of experiments, however, all of the treated Zoysia and velvet bent stolons gave results far superior to those with untreated stolons in that they had many more nodes producing roots. All the treatments, including the water, doubled the number of roots per node in the Zoysia stolons. Most of the hormone-treated stolons of Zoysia produced more roots per node than did the water-treated stolons, but the number per node in all cases was so variable that differences in averages could not be considered significant. All of the velvet bent stolons which were treated in this series produced an equal or greater number of roots per node than did the freshly planted stolons. In most cases the chemical treatments produced a slight increase in the average number of roots per node, over water-soaked stolons, but again the individual numbers were so variable that this increase was not considered significant.

In May, 1938, stolons of *Zoysia matrella* and *Zoysia japonica* and the roots of three selected strains of Kentucky bluegrass

were soaked in Auxilin solution for a 24-hour period before planting in field plots. The solution used contained beta indole-butyric acid at the rate of 10 p.p.m. Comparable lots of stolons and roots were soaked in water for the same period of time. As a check against these soaking treatments fresh stolons of Zoysia and fresh bluegrass roots were planted at the same time.

Before being soaked, the *Zoysia matrella* and *Zoysia japonica* stolons were stopped to two degrees of fineness, some being coarsely chopped and others merely shredded. In addition, some of the *Zoysia japonica* stolons were also finely chopped. Fresh stolons were chopped in the same way and planted without soaking.

The stolons and roots were then planted in soil which was low in fertility and contained but little organic matter, and all plots received the same treatment following planting. The following fall estimates were made of the percentage of cover on each of the plots. The stolons which had been soaked in water had produced the densest turf in all plots except those planted with coarsely chopped *Zoysia matrella* stolons. In no case did the Auxilin-treated stolons or roots produce a denser turf than did corresponding material soaked in water, although in most cases the turf was denser than on those plots planted with fresh stolons. In some cases, however, the turf produced by fresh stolons was significantly superior to that produced by Auxilin-treated stolons or roots. In these cases the Auxilin apparently inhibited the growth of the grasses.

There were no significant changes in the density of the turf on any of the plots the following spring. During the summer there was no significant difference in vigor or drought resistance on any of the plots.

Hormone-Treated Seed

In several series of experiments, Italian ryegrass seed and Kentucky bluegrass seed from two different sources were treated with talc dust containing various concentrations of several different hormones as given in the table on this page. The seeds were treated with the dust at the rate of 1 ounce of dust to 10 pounds of seed. Treatment simply consisted of

Table of Treatments Used on Seed of Italian Ryegrass and Kentucky Bluegrass

Key letter of treatment	Compound used	Proportions in talc	Parts per million (p.p.m.)
A	None		
B	Talc alone	Pure talc	
C	Alpha naphthalene-acetic acid	1:2,000	500 p.p.m.
D	Ditto	1:1,000	1,000 p.p.m.
E	Ditto	1:250	4,000 p.p.m.
F	Beta indole-butyric acid	1:2,000	500 p.p.m.
G	Ditto	1:1,000	1,000 p.p.m.
H	Ditto	1:250	500 p.p.m.
I	Rootone	As directed	
M	Thiourea	1:1,000	1,000 p.p.m.
N	Vitamin B_1 (thiamin)	1:1,000	1,000 p.p.m.
O	Thiourea, 1 part Napthalene-acetic acid, 3 parts	1:1,000	1,000 p.p.m.
T	Hormodin A	As directed	

coating the seeds with the dust by shaking them in a jar with the calculated amount of dust.

The seeds were then placed in sand, in flats or in petri dishes on filter paper for germination. In most of the experiments the petri dishes were kept in the dark in the laboratory, whereas in some of the Kentucky bluegrass experiments they were placed in thermostatically controlled germinators and sub-

jected to the optimum conditions of alternation of temperature and light. In still other experiments, Kentucky bluegrass seed was treated with hormones and sown in well-prepared seed beds in order to follow the effects of the hormones on the establishment of turf.

Italian Ryegrass Seed

Duplicate lots of 50 Italian ryegrass seeds were dusted with hormone treatments A to O, inclusive, and the seed germinated in petri dishes in the dark in the laboratory. Germination counts were made after 48, 66, 72, and 96 hours. After 96 hours, the length of tops and roots of the best 25 seedlings in each lot were recorded and the average compared with that for the best 25 seedlings coming from untreated seed. The experiment was originally set up on January 31 and repeated on February 5 and February 17. In general, results which might have appeared significant in one experiment were not duplicated in other experiments.

Although at the end of 48 hours there were indications of increased germination in some of the lots of treated seed, notably those treated with 1,000 p.p.m. of beta indole-acetic acid, such increases were scarcely evident after 66 hours. At the end of 96 hours the untreated seed had germinated as well as any of the lots of treated seed. It was concluded that under these conditions and at the rates used, the final percentage of germination of Italian ryegrass seed was not significantly altered by any of the growth substances used. The stimulation in speed of germination which, in a few instances, appeared at the end of 48 hours was of such short duration that it could not be considered as worthwhile in practical large scale plantings of the seed.

Measurements of the 25 best seedlings showed considerable variation in length of roots and tops in both the treated and untreated seed. A comparison of the averages of root length shows that in both experiments in which measurements were taken there was a significant increase in length following 7 of the 14 treatments tried. However, the increase with talc dust alone was as great as or greater than that with any of the other treatments except for beta indole-butyric acid at 1,000 p.p.m. and Vitamin B_1 at 1,000 p.p.m. The only treatment which was accompanied by a significant increase in length of tops in both experiments was 1,000 p.p.m. of indole-butyric acid. It should be remembered that these seedlings were growing in petri dishes and were discarded after the ninety-sixth hour.

Kentucky Bluegrass Seed

In February, Kentucky bluegrass seed was dusted with hormones, using treatments A to T, inclusive, as given on page 116. Immediately after treatment the seeds were planted in flats of sand and germinated in the warm greenhouse at 80° F. Germination counts were made from the eighth to the twentieth day. Probably because of slight inequalities in watering, the results in duplicate flats varied over such a wide range that the significance of any differences which appeared was questionable. There was an apparent retardation in germination in evidence from the eighth to the twelfth or thirteenth day following treatments with talc alone, 1,000 p.p.m. and 4,000 p.p.m. of alpha naphthalene-acetic acid, 1,000 and 4,000 p.p.m. of beta indole-butyric acid, Rootone and Vitamin B_1. However, by the twentieth day germination was approximately equal in treated and untreated seed.

In April, Kentucky bluegrass seed was again dusted with hormone treatments A, B, D, G, H, I and T. Duplicate lots of 200 seed were placed on blotters in petri dishes and germinated under conditions of alternating temperature and light which are generally accepted as the most favorable for the germination of Kentucky bluegrass seed. Germination counts were made on the ninth, thirteenth, eighteenth, and twenty-seventh days but no significant differences appeared between the percentage of germination of the untreated and any of the treated seed.

At the same time, bluegrass seed from the same sources was treated with the same hormones and planted in field plots. There was no apparent difference in the rates at which the bluegrass seedlings appeared following any of the treatments as compared with the plots planted with untreated seed. As the season progressed, crabgrass invasion was equally severe in all of the plots.

In mid-August of this year the experiment was repeated and at the time of writing (3 months after planting) all of the plots are practically equally covered with bluegrass seedlings. To date, therefore, the field experiments as well as the germination tests indicate that under our conditions and at the rates applied, alpha naphthalene-acetic acid, beta indole-butyric acid, Vitamin B_1, Rootone and Hormodin A have had no significant effects in increasing the speed of germination or the total germination when applied to Kentucky bluegrass seed.

Vitamin B_1 on Turf

Turf of redtop (*Agrostis alba*) was grown on soil from which the topsoil had been removed to a depth of 1½ inches. Duplicate 4- by 4-foot plots of this turf were watered three

times a week with 2½ gallons of a solution containing 0.1 p.p.m. of Vitamin B_1. Comparable plots received the same amounts of water; this was enough to soak the ground thoroughly. The treatments, begun in June, were continued until early in September. No effect of the treatment could be observed, either during the period in which the solutions were applied or until the plots were abandoned the following May.

In another experiment, duplicate 4- by 8-foot plots of two different stolon-propagated strains of creeping bent have been watered with a solution of Vitamin B_1. On these plots 1¼ gallons of a solution containing 0.2 p.p.m of Vitamin B_1 were used three times a week during the critical month of August when root growth on bent normally is at the lowest point of the season. No effect of the treatment on the grass was discernible.

From the results of the preceding tests in which stolons, seed, and turf of various grasses were treated with numerous preparations of different types of growth substances, there appears to be little or no likelihood of helping grass in a practical way with any of the growth substances now available.

Mowrah meal used on turf as an earthworm expellant is made from the beans of the *Bassia latifolia* tree, which grows to a height of 40 to 50 feet in tropical India. The tree is strictly tropical and probably cannot be grown anywhere in the United States. The wood is tough and the beans yield an edible oil. Mowrah meal is made from the cake left after the oil is expressed. The meal is not suitable for feed but is used as a fertilizer, and when finely ground as an earthworm expellant. It is used also to stupefy fish.