

# Effect of Hormodin A, a Growth Substance, on the Rooting of Cuttings

BY MARCUS A. MAXON, B. S. PICKETT AND H. W. RICHEY

AGRICULTURAL EXPERIMENT STATION  
IOWA STATE COLLEGE OF AGRICULTURE  
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POMOLOGY SUBSECTION  
HORTICULTURE SECTION



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# Effect of Hormodin A, a Growth Substance, on the Rooting of Cuttings<sup>1</sup>

BY MARCUS A. MAXON, B. S. PICKETT AND H. W. RICHEY

Florists, nurserymen and gardeners are deeply interested in recent discoveries that certain chemical compounds, when absorbed into the appropriate living plant tissues, induce or stimulate the initiation of roots. Depending on species, point of application of the chemical and various environmental conditions, roots appear on stems or leaves at points where roots do not ordinarily arise. The chemicals used have been variously designated by different investigators as growth substances (6), hormones (3), phytohormones (28) and auxins (28). When applied to the rootage of cuttings, these substances may have a wide practical use.

Some of the most effective growth substances are offered to the trade under proprietary names. This bulletin deals with a series of experiments designed to test, under Iowa conditions, the efficacy of Hormodin A, a widely distributed trade product known to contain an effective growth-promoting chemical, indolebutyric acid, for the rooting of cuttings of many species and varieties of horticultural plants. The project was sponsored by the Boyce Thompson Institute for Plant Research, located at Yonkers, N. Y., under a cooperative agreement with the Iowa Agricultural Experiment Station. The study covered a period of 2 years and included tests with approximately 50 species and varieties. The immediate objectives of the research were: 1. To discover the most effective concentration of Hormodin A for the rooting of each species or variety; 2. to determine the effect of the treatment on cuttings taken at different stages of maturity; 3. to determine the reaction of cuttings taken at different seasons of the year to the treatments.

Research workers are generally agreed that, 1. indolebutyric acid is more effective than indoleacetic, indolepropionic or naphthaleneacetic acids in rooting cuttings; 2. growth substances are effective in extremely minute quantities, but within sharp limits; high concentrations kill the base of the cutting, cause excessive proliferation of cells, cause callusing and check further growth of roots and shoots; concentrations below optimum are ineffective; 3. the duration of the time of treatment is

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<sup>1</sup>Project 586 of the Iowa Agricultural Experiment Station.

closely correlated with the concentration of the solution used; within limits a high concentration may be used for a short period of time or a lower concentration for a longer period with comparable results (6, 11); 4. treatment accelerates the rooting of cuttings, produces a larger root system, increases the percentage of rooting and makes it possible to root cuttings of some species that normally root poorly, or not at all; 5. if neither speedy rooting nor rapid growth of roots in the cutting stage is important in the propagation of a particular species, there may be no economic advantage to the propagator in using growth-promoting chemicals; Skinner (17), for example, calls attention to the fact that most reported data are incomplete because of failure to allow for the effect of time on the rooting of untreated cuttings; these cuttings, if left in the rooting medium long enough, may ultimately root and give as high a percentage of rooting as treated cuttings; 6. comparatively few species which root with extreme difficulty under ordinary propagating conditions are benefited by treatment; inherent factors other than those affected by growth substances are involved (19).

Although the hormone theory of root production in cuttings was advanced by Sachs in 1880 (16) and substantiated by Van der Lek (22) in 1925, there was little save inferential evidence to support their hypotheses until Went (27) reported in 1929 that a substance of unknown composition and character, and present only in very small amounts, extracted from certain plant tissues, exerted a marked stimulus on the root production of cuttings. Further work in Holland and Germany revealed that substances obtained from a variety of plant tissues, as well as from human urine, were effective in stimulating root formation. Three substances were isolated, physiologically indistinguishable from the natural growth substances, which were named auxin a, auxin b and heteroauxin (indoleacetic acid). Studies were immediately undertaken in Europe to determine the effectiveness of indoleacetic acid for the rooting of cuttings of horticultural plants. Among the experimenters making these tests were Fischnich (4), Laibach (13), Tincker (20) and Van der Lek and Krijthe (23). In America, in 1936, Hitchcock and Zimmerman (6) found that several synthetic organic acids, especially indolebutyric and naphthaleneacetic, were more effective than indoleacetic acid in stimulating rootings of cuttings.

Three methods of introducing the growth substance into the living cells of the cuttings, where it must arrive to be effective, have been used. The first was to mix the substance with lanolin and smear the mixture over the base of the cutting or the part from which it was hoped that roots would grow. The second, introduced by Hitchcock and Zimmerman (6, 7) was to immerse

the base of the cutting in a solution of the growth substance and rely on absorption and the movement of the transpiration stream to make it effective. The third method, first reported in 1937 by Grace (5), consisted of dipping the ends of the cuttings into a fine talc powder with which a growth substance had been mixed. Further work with powders has been done by Stoutemyer (18). The success of the lanolin and dust methods depends on direct absorption of the growth substance by the cells immediately in contact with the material or on enough being dissolved in the soil moisture so that it will ultimately reach the points of root initiation in the transpiration stream.

Neither the lanolin nor the dust methods permit precise control of concentrations nor quantities of growth substance entering the cuttings, and the former is not adapted to horticultural practice because of its inconvenience. The solution method, although less convenient than the dust method, is, nevertheless, simple enough for practical use and is comparatively exact in its control of concentration and absorption into the cutting. The technique of using the solution method needs to be standardized for local conditions, the work of several investigators, Brase (1), Chadwick (2), Hitchcock and Zimmerman (7), Oliver (14), Pearse (15), Thimann and Delisle (19), Tincker (20, 21), Van der Lek and Krijthe (23) and Yerkes (29), disagreeing on certain details.

## THE EXPERIMENTS

Herbaceous, greenwood, evergreen and hardwood cuttings from many species of plants growing in the college greenhouses or on the campus and horticultural farm were employed in the tests. The cuttings were made monthly from October to May in the case of evergreens, as frequently as material permitted in plants propagated by herbaceous and greenwood cuttings and during the winter with hardwoods. Herbaceous and greenwood cuttings were generally selected from the tips of vigorously growing shoots and were prepared in the regular commercial manner, except that as much foliage as possible was left above the ground line. In a few very foliaceous plants the leaves themselves were trimmed back. Side branches near the base of evergreen cuttings were cut away smoothly to prevent rotting, but needles alone caused no difficulty and were not similarly removed. Within limits large cuttings were preferred to small ones. Hardwood cuttings were taken while dormant, cut 12 to 18 inches long and stored in moist sphagnum moss at a tem-

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<sup>2</sup>The nomenclature used in this publication follows Standardized Plant Names, except in case of direct quotation from a reference. This authority is used because of its general accuracy and its widespread acceptance in American horticulture.

perature which ranged between 40° and 50°F., until callus had formed.

Incident to the tests, modifications of technique were introduced in special cases. At the beginning of the experiments, two media were used; the first, a fine-screened plasterer's sand with a water-holding capacity of 27 percent, and the second, a mixture of three parts of this sand and one part of German peat, with a water-holding capacity of 34 percent. These media "waterlogged" and were later replaced with corresponding media made up with a coarse river sand having a water-holding capacity of 24 percent. A mixture of this sand with peat proved no better than the previous peat and fine sand mixture; and the coarse sand alone, having given the best results during the first year's experiments, was used generally as a medium thereafter. Drainage of the media was improved by spacing the bench boards 2 inches apart and laying  $\frac{1}{4}$ -inch wire screen over the cracks, this in turn overlaid with enough coarse gravel to prevent the sand from running through. Cypress flats set in the bench were also used freely for *Thuja*, *Taxus* and *Chamaecyparis*, which were found to root better than most of the other species in a medium holding more moisture. The flats, 5 inches deep, provided with several half-inch holes in the bottom for drainage, filled 2 inches deep with coarse gravel and then filled to the top with coarse sand, were found to retain a higher percentage of moisture for longer periods than the open benches.

#### GROWTH SUBSTANCE (HORMODIN A)

Hormodin A, a solution of indolebutyric acid dissolved in ethyl alcohol, used throughout the investigation, is the trade name of a compound manufactured by Merck and Company, Rahway, N. J. The manufacturers give specific directions for preparing various dilutions by the addition of water to the stock solution. To simplify its use by non-technical workers, the strength of the stock solution and of the dilutions is expressed by an arbitrary standard—the B. T. I. unit, 1 milligram of indolebutyric acid per liter of water, or 1 part per million.

Herbaceous cuttings were usually tested within the ranges of 20, 10, 5 and 2.5 B. T. I. units; greenwood cuttings fell within the same range but were treated with 40 units as well. The range for evergreens included 80, 40, 20 and 10 B. T. I. units. Hardwood cuttings were unresponsive except at still higher concentrations, usually 160 and 80, but 40 and 20 units were also included in the tests. The 160-unit material was specially prepared by Merck and Co. in order to avoid the toxic effect of the high concentration of alcohol incident to the use of the regular Hormodin A solution.

## TREATMENT OF CUTTINGS

The treatment of the cuttings described by Watkins (25, 26) and Kirkpatrick (9, 10, 11, 12), of the Boyce Thompson Institute, was followed. The cuttings were sorted into uniform lots of 10 each, bound with rubber bands and placed in 150-milliliter beakers containing about 50 to 80 milliliters of solution, immersed to the depth of an inch or two, depending on the bulk of the cuttings. The beakers were placed on a laboratory bench protected from direct sunlight. Any glass or enameled vessel of suitable size and depth makes a satisfactory container. As the temperature of the laboratory was variable, and the humidity low, it was necessary to syringe the cuttings frequently to prevent wilting. Usually a piece of cheesecloth was thrown over them as an additional protection.

The customary practice of leaving the cuttings in the solution for 24 hours was followed throughout the investigation. At the end of this time the cuttings were removed from the solution, labeled with the concentration and date, washed at the tap to remove any solution that might cling to the base of the cuttings, and immediately set in the propagation bench. They were thoroughly watered as soon as planted, after which water was applied as needed. Some difficulty was encountered in maintaining the proper moisture relationships for the many different species all close together in the same bench. This was not serious in the case of easily and quickly rooted species; but for those that rooted with difficulty, or stayed long in the bench, it doubtless contributed to occasional failures.

## DATA

The effectiveness of the treatments was determined from observations which included: 1. The length of time required for the development of a satisfactory root system for transplanting purposes, 2. the excellence of the root system as determined by number, size, vigor and location of roots, 3. the absence of abnormal reactions such as excessive splitting and swelling of the stem, killing of the base of the cutting, checking of shoot growth and loss of foliage.

As the cuttings were dug they were graded on an arbitrary numerical basis, 100 for very good roots, 75 for good, 50 for fair, 25 for poor and 0 for dead and unrooted cuttings. The highest ranking was given to cuttings having several well-developed roots arising close to the base. Grading was done by sorting all the cuttings of a given species from any single series of tests into their respective classes, treatment by treatment, and then recording the number of cuttings falling into each category and computing the average grade of the lot.



The observations were summarized and are presented in four tables: 1, dealing with reactions of herbaceous cuttings; 3, dealing with reactions of greenwood cuttings; 5, dealing with reactions of evergreen cuttings; 7, dealing with reactions of hardwood cuttings. The treatment which produced the best root systems in each series is indicated by underlining the average grade of that series. For more convenient reference the various species in each group, except the hardwoods, are listed under the concentration to which each gave the best response, tables 2, 4 and 6.

Many photographs were made, the subjects being selected carefully to illustrate the typical responses of various species to the treatments. The material was particularly well adapted to picture records. The plates included in this bulletin should be studied as carefully as the text, because they were chosen for the accuracy with which they represent the results of the experiments. Professional propagators will find them valuable for comparison with their own work, especially if they are experimenting with growth substances.

#### HERBACEOUS CUTTINGS

It will be seen from table 1 that herbaceous cuttings, almost without exception, responded favorably to treatment at one or more of the concentrations unless old, woody tissue was used or decay had attacked them. The optimum concentration for herbaceous cuttings ranged between 2.5 and 10 B. T. I. units. Table 2 lists the species responding most favorably to each concentration.

Responses to variation in concentration of Hormodin A varied unfavorably from the optimum in either direction. Higher than optimum concentrations were toxic, and lower concentrations were ineffective. Herbaceous cuttings treated with high concentrations of Hormodin A showed injury in the twisting and bending of stem and leaf-petioles, in the swelling and splitting of the stem caused by the formation of dense masses of short, underdeveloped roots and in the death of the base of the cutting. Concentrations higher than 20 units were usually injurious to herbaceous and succulent greenwood cuttings. A typical case of injury at high concentrations is seen in *Iresene herbstii*, (fig. 5). *Chrysanthemum hortorum* (fig. 6) and *Fuchsia speciosa* (fig. 7) also show the injury attending overtreatment. Injury was seldom permanent, however, for even the iresene cuttings treated with 80 units slowly recovered and grew into normal plants.

#### GREENWOOD CUTTINGS

The rooting response of greenwood cuttings of many species of deciduous trees and shrubs was variable. Failures due to faulty growing technique sometimes occurred. Two Iowa sum-

mers of wide and sudden fluctuations in temperature and generally low humidity were unfavorable for rooting greenwood cuttings even in the lath house. When the humidity was raised by watering or enclosing the frames, the combination of high humidity and high temperature led to loss of foliage and rotting of the cuttings. Some species, notably apple, failed with monotonous regularity regardless of the treatment. Compared with untreated cuttings, however, greenwood cuttings generally responded favorably to Hormodin A.

Table 3 shows that the spread of effective concentrations for greenwood cuttings was wide, ranging from 1.25 to 80 units. Only a few species, however, withstood treatments stronger than 40 units without injury. Greenwood cuttings when treated with too high concentrations were more severely injured than herbaceous cuttings. The leaves turned yellow and fell; only a little callus formed, and the base of the cutting blackened, then died; roots appeared far up on the stem in such numbers that the cutting could not support them; and further growth of bud, stem and root was checked.

The more leafy, succulent type of greenwood cutting suffered less permanent injury from overtreatment than the firmer wooded cuttings. *Buddleia asiatica* (fig. 8) and *Acalypha wilkesiana* (fig. 9), for example, although injured by overtreatment recovered soon after potting. Less succulent types, like *Rosa indica odorata* (fig. 10), *Lonicera japonica* (fig. 11), *Lonicera standishi*, *Lantana camara*, and *Syringa vulgaris* (fig. 12), lost their leaves shortly after potting, became dormant and seldom recovered. The ability of such cuttings to recover from the injury was correlated with vigorous growth.

Table 4 lists the species according to their optimum response to the several concentrations.

#### EVERGREEN CUTTINGS

Evergreen cuttings presented numerous problems in techniques not presented by herbaceous and greenwood cuttings. Generally slow to root, they sometimes rotted or died in the propagation bench before roots were initiated. Many cuttings made in the summer died either because the high temperatures were unfavorable or because the material was not at the right stage when the cuttings were made. Cuttings used during the winter of 1937-38, which had to be taken from short, stunted shoots, reacted less favorably, both with reference to injury and rooting, than cuttings made the following year. Treated cuttings were more damaged by high temperatures and fluctuations in moisture in the rooting medium than were untreated cuttings. Apparently they were also less resistant to decay. Frequently untreated cuttings, though failing to root, lived several weeks

or even months after treated cuttings had died. Nevertheless, as will be seen by a study of table 5, when material, temperatures and moisture were properly controlled, evergreen cuttings responded favorably to Hormodin A. Slow-rooting species commonly propagated by cuttings, including *Buxus sempervirens* (fig. 31), *Juniperus squamata* (figs. 29, 30), *Taxus media hicksi* (fig. 27) and *Thuja occidentalis* were greatly benefited by the treatment.

Evergreens ordinarily difficult to root, which responded to treatment, included *Picea excelsa*, *Abies concolor*, *Juniperus chinensis* and varieties, and *Pinus mughus*. *Picea excelsa* (figs. 38, 39, 40) showed good rooting at 20 B. T. I. units, but as it required a comparatively long time for rooting, it was difficult to maintain satisfactory conditions in the propagating medium, and many cuttings rotted before roots had time to form. *Juniperus chinensis* and its varieties behaved somewhat erratically. Eighty units, which induced formation of large root systems, were often injurious to the base of the cuttings; consequently 40 units, though less stimulating to rootage, are recommended because of the higher percentage of survivals. Possibly the erratic responses of *Juniperus communis* were allied with dormancy and the age of the cutting wood. *Pinus mughus* rooted well at 80 units but was subject to rotting in the cutting bed.

The concentration required for evergreen cuttings was higher than for herbaceous and greenwood cuttings, most of the species falling between 20 and 80 B. T. I. units. Cuttings of evergreens varied in their response, depending upon the species, time of year, age of tissue and concentration employed. *Thuja*, *Chamaecyparis*, *Juniperus communis* varieties and *Juniperus horizontalis* were injured by treatments higher than 40 units. *Picea excelsa* and *P. pungens* cuttings were damaged by 40 units, while *Pinus mughus* was not injured by the highest concentration (80 units). Table 6 lists the species responding most favorably to each concentration; species responding about equally well to more than one concentration are listed under each.

Coniferous evergreen cuttings taken at intervals from October to April, except *Juniperus communis depressa* and *Juniperus communis pfitzeriana*, rooted with approximately equal celerity and excellence under the same optimum concentration of Hormodin A, regardless of the exact date of taking. Cuttings of *Juniperus communis depressa* when taken in October and February rooted best at a concentration of 40 units, but when taken in April they rooted best at 20 units. Cuttings of Pfitzer's juniper, on the other hand, responded better to a high concentration in April (80 units) than earlier in the winter (November and January) when 40 units gave the best rooting.

The data do not justify any attempt to state a certain time of

year is best for the taking and treating of cuttings of the more difficult species. *Taxus cuspidata brevifolia* cuttings taken in summer rooted best at 40 units, while those taken in winter rooted best at 80 units. This is the only case which agrees with Kiplinger's findings on Pfitzer's juniper (8).

Coniferous evergreen cuttings varied in their behavior in different media. *Arborvitae*, *Chamaecyparis* and *Taxus* rooted better in a medium holding more moisture than the coarse sand. Root growth was more vigorous in sand and peat mixtures for all the conifers than in coarse sand, but the percentage of cuttings rooting was generally lower.

#### HARDWOOD CUTTINGS

Hardwood cuttings from many plants were treated and planted in the greenhouse bench in 1938. Apple, pear, black raspberry, red oak, black walnut, barberry, black haw, *Forsythia* species, *Rosa* species, and others were treated unsuccessfully both before and after callusing. In fact, treated cuttings were more often damaged by the treatment than helped. Frequently the base of the cutting would swell and form peculiar enlargements about the buds; cushions of spongy callus would appear underneath the bark which would finally split as a baked apple splits its skin; buds would be checked in growth and large lenticels would form. The symptoms of injury corresponded to those described by Wallace for hardwood apple cuttings treated with ethylene (24).

In general the results with hardwood cuttings were unfavorable. A limited number of cuttings of peach, *Philadelphus coronarius* and the grape variety "Lucile" rooted, indicating that further experiments, possibly involving improvements in technique, might lead to a higher percentage of success in rooting this type of cutting. Table 7 presents the data for treatments of hardwood cuttings.

An interesting experiment on the importance of a callus in rooting hardwood cuttings was performed on peach. Eighty peach cuttings callused at the base were taken from storage April 20, 1938. The calluses were removed from half the cuttings and retained on the other half. Each group was then divided equally and treated with growth substance, one-half with the tops of the cuttings immersed in the solution, the other half with the bases immersed. No roots formed on cuttings from which the calluses were removed, regardless of the end immersed; 23 percent of the callused cuttings which were basally treated rooted. It is concluded, therefore, that the formation of callus tissue is necessary for rootage of peach cuttings, the observations adding weight to the correctness of the common practice of callusing hardwood cuttings of many species before "sticking" them in the propagating beds.

## RECOMMENDATIONS

The experiments described in this bulletin show that the rooting of herbaceous, greenwood and evergreen cuttings of many species of horticultural plants was hastened, a larger percentage of cuttings was successfully rooted and raised and the size of the roots was increased by the use of Hormodin A. Cuttings treated with optimum concentrations made vigorous, normal plants when potted or transplanted to nursery rows.

The cost of treatment varied with the concentration required for individual species. At retail prices Hormodin A will treat from 500 to 1,000 herbaceous, greenwood or evergreen cuttings at a cost varying from \$1, when purchased in very small quantities, to 35 cents in larger amounts.

Propagators are advised to use growth substance under the following circumstances:

1. Only with plants which have responded favorably to experimental treatments as reported in tables 8 and 9.
2. Where propagation space is limited and rapid succession of plantings is economically desirable.
3. When, for any special reason, extra speedy rooting is desired.
4. With species which, though rootable, are rooted only with considerable difficulty when untreated.

Propagators are emphatically cautioned to follow directions closely, especially with reference to concentration and length of time of treatment. The quantity of growth substance necessary to stimulate rooting is so much less than the average user's imagination can picture that there is the greatest temptation to use too much. Table 8 shows the concentrations found most effective in the experiments above reported. Especially important for successful treatment with growth substances are optimum environmental conditions. Treated cuttings are more sensitive to unfavorable temperature and moisture than untreated cuttings. The great majority of treated herbaceous, greenwood and evergreen cuttings would root best if soil temperatures could be maintained constantly within a range of 65° to 70° F., with air temperatures approximately 10° lower. Recognizing the practical difficulties involved in maintaining these conditions, the propagator nevertheless is advised to come as near to furnishing these temperatures as possible. The humidity requirements naturally vary somewhat with species, but percentages generally should be high and should be kept under control by maintaining as even an air temperature as possible, thus preventing condensation with falling temperatures and drying out with rising temperatures, and by such devices as syringing the foliage, dampening the soil under the benches and the walks, and covering cuttings with cheesecloth.

TABLE 1. ROOTING RESPONSE OF HERBACEOUS CUTTINGS TREATED WITH DIFFERENT CONCENTRATIONS OF HORMODIN A FOR A PERIOD OF 24 HOURS

Name of plant	No. of cuttings per lot	Date made	Days in medium	Rooting medium (*)	Average grade of each lot treated with each concentration							Remarks †	
					80	40	20	10	5	2.5	1.25		Ok
<i>Ageratum houstonianum</i> -----	15	2-4-38	17	F.S.				90	88	75	51	26	See fig. 55
<i>Antirrhinum majus</i> -----	10	11-24-37	81	F.S.P.				95	57	67		47	
<i>Antirrhinum majus</i> -----	10	1-9-38	16	F.S.			15	52	37			5	20 Injured
<i>Antirrhinum majus</i> -----	10	2-24-38	36	O.S.			87	72	80			22	20 and 10 injured
<i>Antirrhinum majus</i> -----	10	3-30-38	23	C.S.			100	95	65			62	
<i>Antirrhinum majus</i> (27 hr. period).	10	4-16-38	19	C.S.			85	65	57			10	20 injured
<i>Begonia semperflorens</i> -----	28	1-25-38	49	F.S.					40	18		15	
<i>Begonia semperflorens</i> -----	50	2-16-38	27	F.S.					27	23		27	
<i>Centaurea gymnocarpa</i> -----	10	10-9-38	24	C.S.				22	27	50		7	Old tissue
<i>Cerastium tomentosum</i> -----	10	11-7-37	22	F.S.P.		62	70	67	52			12	40 and 20 injured
<i>Chrysanthemum hortorum</i> -----	10	11-26-37	12	F.S.P.				92	97	77		22	10 injured
<i>Chrysanthemum hortorum</i> -----	20	12-6-37	18	F.S.P.				91	83	83		51	
<i>Chrysanthemum hortorum</i> Gold Lode -----	13	1-23-38	16	F.S.P.					84	86		51	
<i>Chrysanthemum hortorum</i> Dr. Enguehardt -----	10	1-23-38	16	F.S.P.					87	77		27	
<i>Chrysanthemum hortorum</i> Anna-belle -----	10	1-23-38	16	F.S.P.					55	35		55	Diseased
<i>Chrysanthemum hortorum</i> -----	11	3-4-38	21	O.S.			68	90	90	90		40	20 and 10 injured.
<i>Chrysanthemum hortorum</i> Cora Peck Buehl -----	15	5-5-38	16	O.S.				73	85	83		73	See fig. 6
<i>Chrysanthemum hortorum</i> Gold Lode -----	8	5-5-38	16	O.S.				75	70	75		62	10 injured
<i>Chrysanthemum hortorum</i> Legal Tender -----	8	5-5-38	16	C.S.				28	15	72		6	10 Injured
<i>Chrysanthemum frutescens</i> -----	10	12-9-37	15	F.S.P.				97	92	90		27	

TABLE 1. ROOTING RESPONSE OF HERBACEOUS CUTTINGS TREATED WITH DIFFERENT CONCENTRATIONS OF HORMODIN A FOR A PERIOD OF 24 HOURS—Continued

Name of plant	No. of cuttings per lot	Date made	Days in medium	Rooting medium (*)	Average grade of each lot treated with each concentration							Remarks †	
					80	40	20	10	5	2.5	1.25		0k
<i>Chrysanthemum frutescens</i> -----	15	2-6-38	15	F.S.P.				90	71	66	63	48	
<i>Dianthus caryophyllus</i> -----	10	12-3-37	21	F.S.P.		82	92	90	92			82	
<i>Dianthus caryophyllus</i> -----	10	2-19-38	23	O.S.		85	82	47	63			22	
<i>Dianthus caryophyllus</i> -----	10	3-19-38	30	O.S.			97	82	70			57	
<i>Dianthus caryophyllus</i> -----	10	10-11-38	42	O.S.			90	45	42			37	
<i>Dianthus caryophyllus</i> -----	10	10-18-38	19	O.S.			60	37	15			30	Mature tissue
<i>Dianthus caryophyllus</i> -----	10	11-11-38	11	O.S.			82	60	32			10	Soft tissue
<i>Dianthus caryophyllus</i> -----	15	1-9-39	16	F.S.				48				0	
<i>Dianthus caryophyllus</i> -----	10	4-2-39	22	F.S.			72	57	52			7	20 injured
<i>Eupatorium riparium</i> -----	10	5-2-39	16	O.S.			82	47	37			85	20 and 10 injured
<i>Fuchsia speciosa</i> (25 hrs)-----	10	2-27-38	16	O.S.			80	80	82	72		2	See fig. 7.
<i>Fuchsia speciosa</i> -----	10	3-27-38	23	O.S.				75	55	32		5	
<i>Fuchsia speciosa</i> -----	10	1-21-39	33	F.S.				27	95	37		5	20 and 10 injured
<i>Iresene herbstii</i> -----	10	12-9-37	25	F.S.P.				97	100	97		72	
<i>Iresene herbstii</i> -----	10	2-6-38	30	F.S.				70	72			65	Leafless cuttings
<i>Iresene herbstii</i> -----	10	2-6-38	30	F.S.				52	62			20	Internodal cuttings
<i>Iresene herbstii</i> (20 hr.)-----	20	2-16-38	18	F.S.P.	67	92	95	90	92	97	67	90	80, 40 and 20 injured. See fig. 5.
<i>Lathyrus latifolius</i> -----	10	11-7-37	59	F.S.				12	0	15		20	Damped off
<i>Linum flavum</i> -----	10	10-29-38	24	O.S.				5	6	0		7	Old tissue
<i>Medicago sativa</i> -----	10	11-13-37	31	F.S.		40	60	72	64	82		12	
<i>Medicago sativa</i> -----	10	11-13-37	31	F.S.		45	41	72	31	62		37	
<i>Mesembryanthemum roseum</i> -----	10	2-18-38	25	F.S.			80	80	82			67	Soft tissue
<i>Mesembryanthemum roseum</i> -----	10	2-18-38	25	F.S.			90	95	95			80	Mature tissue
<i>Monarda didyma</i> -----	10	10-11-38	22	O.S.			32	10	0	17		2	20 injured: old tissue

TABLE 1. ROOTING RESPONSE OF HERBACEOUS CUTTINGS TREATED WITH DIFFERENT CONCENTRATIONS OF HORMODIN A FOR A PERIOD OF 24 HOURS—Continued

Name of plant	No. of cuttings per lot	Date made	Days in medium	Rooting medium (*)	Average grade of each lot treated with each concentration							Remarks †	
					80	40	20	10	5	2.5	1.25		0k
<i>Monarda didyma</i> -----	10	10-29-38	24	C.S.			80	50	35			22	Terminal soft tissue
<i>Pelargonium hortorum</i> -----	5	2-25-38	18	O.S.			85	80	45			15	See fig. 1
<i>Pelargonium hortorum</i> -----	10	12- 8-38	24	F.S.				40	70	77		65	Rot at base
<i>Pelargonium hortorum</i> Missouri.....	8	6-15-38	22	O.S.				98	71			0	Basal rot
<i>Pelargonium hortorum</i> S. A. Nutt.	10	6-15-38	22	O.S.				57	75			2	
<i>Pelargonium hortorum</i> Riccard.....	8	6-15-38	22	O.S.				62	63			12	
<i>Pelargonium hortorum</i> Mrs. Waters	13	6-15-38	22	O.S.			42	94	94			5	20 injured
<i>Pelargonium hortorum</i> Mt. Mort.....	10	6-15-38	22	O.S.				72				15	
<i>Pelargonium hortorum</i> Mrs. Beach.	10	6-15-38	22	O.S.			77	60	80			2	
<i>Pelargonium hortorum</i> -----	10	10- 9-38	24	O.S.			30	7	55			15	Basal rot
<i>Pelargonium domesticum</i> -----	10	2-27-38	33	O.S.				63	27	25		10	20 injured
<i>Pelargonium domesticum</i> -----	15	6-24-38	26	O.S.			45	53	36	40		25	
<i>Pelargonium peltatum</i> -----	10	2-27-38	16	O.S.				100	80	80		15	See fig. 15.
<i>Pelargonium peltatum</i> -----	10	6-16-38	22	O.S.			62	80	62			30	
<i>Pelargonium tricolor</i> -----	10	1-26-38	41	F.S.				62	80	87		22	
<i>Pelargonium tricolor</i> (26 hr.).....	10	2-27-38	33	C.S.				57	57	25		2	
<i>Penstemon barbatus</i> -----	10	10-11-38	26	O.S.			20	40	20			0	Diseased
<i>Penstemon barbatus</i> -----	10	10-11-38	25	C.S.			45	65	50			2	
<i>Petunia hybrida</i> -----	10	4- 3-38	19	O.S.				72	45	40		45	
<i>Phlox paniculata</i> -----	10	10- 9-38	24	O.S.				75	45	52	25	49	
<i>Piqueria trinervia</i> -----	15	3-31-38	22	O.S.		60		86	93				40 and 20 injured
<i>Piqueria trinervia</i> -----	10	5- 3-38	16	O.S.			62	60	90			57	20 and 10 injured
<i>Pilea microphylla</i> -----	10	1-21-39	33	F.S.				70	67	47		42	10 injured
<i>Senecio mikanoides</i> -----	10	1-26-38	27	F.S.				77	85	57		67	
<i>Senecio mikanoides</i> -----	10	1- 9-39	16	F.S.				82	80	95		45	
<i>Senecio cineraria</i> -----	10	1-26-38	26	F.S.				80	30	42		35	
<i>Senecio cineraria</i> -----	10	10-16-38	17	O.S.			69	37	45			12	20 injured



TABLE 1. ROOTING RESPONSE OF HERBACEOUS CUTTINGS TREATED WITH DIFFERENT CONCENTRATIONS OF HORMODIN A FOR A PERIOD OF 24 HOURS—Continued

Name of plant	No. of cuttings per lot	Date made	Days in medium	Rooting medium (*)	Average grade of each lot treated with each concentration								Remarks †	
					80	40	20	10	5	2.5	1.25	Ok		
<i>Telanthera versicolor</i> -----	10	10-9-38	18	O.S.				72	95	<u>97</u>			80	
<i>Verbena erinoides</i> -----	10	10-29-38	15	C.S.			70	<u>80</u>	77				37	
<i>Verbena hybrida</i> -----	10	10-9-38	7	C.S.			22	<u>22</u>	<u>32</u>				0	
<i>Verbena hybrida</i> -----	10	10-28-38	8	C.S.			52	78	<u>65</u>				5	
<i>Verbena venosa</i> -----	7	10-29-38	15	C.S.			89	85	<u>85</u>				32	
<i>Veronica longifolia subsessilis</i> -----	19	10-30-38	23	C.S.			<u>60</u>	82	<u>15</u>	2			2	Old tissue.
<i>Euphorbia pulcherrima</i> -----	15	1-29-38	35	F.S.		53	<u>33</u>	35					20	40 and 20 injured.
<i>Euphorbia pulcherrima</i> -----	20	6-15-38	22	C.S.		73	<u>70</u>	51	42				28	See figs. 44, 45.
<i>Euphorbia pulcherrima</i> -----	20	6-21-38	21	C.S.	40	30	20	15	10	5			Ok	See figs. 16, 17.
					12	47	30	<u>51</u>	28	35			33	Mature wood

\*F.S.—Fine sand.

F.S.P.—Fine sand and peat mixture.

C.S.—Coarse sand.

†Number given refers to B. T. I. concentration causing injury.

NOTE: Underline indicates treatment considered best by the authors.

TABLE 2. OPTIMUM CONCENTRATIONS OF HORMODIN A FOR CUTTINGS OF HERBACEOUS SPECIES

B. T. I. Units			
2.5	5	10	20
<i>Centaurea gymnocarpa</i> <i>Chrysanthemum hortorum</i> <i>Chrysanthemum frutescens</i> <i>Iresene herbstii</i> <i>Medicago sativa</i> <i>Senecio mikanoides</i> <i>Telanthera versicolor</i>	<i>Antirrhinum majus</i> <i>Begonia semperflorens</i> <i>Chrysanthemum hortorum</i> <i>Chrysanthemum frutescens</i> <i>Eupatorium riparium</i> <i>Fuchsia speciosa</i> <i>Iresene herbstii</i> <i>Mesembryanthemum rossum</i> <i>Phlox paniculata</i> <i>Pelargonium species</i> <i>Piqueria trinerva</i> <i>Pilea microphylla</i> <i>Senecio mikanoides</i> <i>Verbena hybrida</i> <i>Verbena venosa</i>	<i>Ageratum houstonianum</i> <i>Antirrhinum majus</i> <i>Cerastium tomentosum</i> <i>Dianthus caryophyllus</i> <i>Pelargonium species</i> <i>Penstemon barbatus</i> <i>Petunia hybrida</i> <i>Fuchsia speciosa</i> <i>Medicago sativa</i> <i>Piqueria trinerva</i> <i>Senecio cineraria</i> <i>Verbena erinoides</i> <i>Euphorbia pulcherrima</i>	<i>Monarda didyma</i> <i>Dianthus caryophyllus</i> <i>Veronica longifolia subsessilis</i>

TABLE 3. ROOTING RESPONSE OF GREENWOOD CUTTINGS TREATED WITH DIFFERENT CONCENTRATIONS OF HORMODIN A FOR A PERIOD OF 24 HOURS

Name of plant	No. of cuttings per lot	Date made	Days in medium	Rooting medium (*)	Average grade of each lot treated with each concentration								Remarks †	
					80	40	20	10	5	2.5	1.25	Ck		
<i>Acalypha hispida</i> .....	10	4-1-38	20	C.S.		70	35	42					7	40 and 20 injured
<i>Acalypha hispida wilkesiana</i> marginata .....	10	4-1-38	21	C.S.		55	77	95					47	40 and 20 injured. See fig. 9.
<i>Allamanda cathartica</i> .....	10	2-4-38	55	C.S.		87	72	70	37				47	
<i>Allamanda cathartica</i> .....	10	11-6-38	48	C.S.		50	65	25					2	
<i>Ampelopsis tricuspidata</i> .....	10	7-30-38	42	C.S.P.	27	30	42						5	Large calluses
<i>Berberis thunbergi</i> .....	10	10-14-38	29	C.S.		5	27	12					0	Old tissue
<i>Berberis thunbergi</i> .....	10	10-29-38	24	C.S.		30	10	30					5	Old tissue
<i>Buddleia asiatica</i> .....	20	3-31-38	21	C.S.			45	38	73	62			36	20 and 10 injured. See fig. 8.

TABLE 3. ROOTING RESPONSE OF GREENWOOD CUTTINGS TREATED WITH DIFFERENT CONCENTRATIONS OF HORMODIN A FOR A PERIOD OF 24 HOURS—Continued

Name of plant	No. of cuttings per lot	Date made	Days in medium	Rooting medium (*)	Average grade of each lot treated with each concentration								Remarks †
					80	40	20	10	5	2.5	1.25	0k	
<i>Buddleia asiatica</i> .....	15	5-8-38	18	O.S.				58	70	<u>80</u>		46	10 injured
<i>Buddleia davidi</i> .....	10	10-30-38	14	C.S.				67	<u>67</u>	<u>27</u>	30	2	Mature material
<i>Buddleia davidi</i> .....	5	10-30-38	14	C.S.						<u>60</u>	60	15	Soft material
<i>Bougainvillea glabra</i> .....	10	11-6-38	48	O.S.		55	<u>62</u>	35	43			7	40 injured
<i>Callicarpa japonica</i> .....	10	10-9-38	24	O.S.		60	<u>65</u>	30				10	40 injured. See figs. 47, 48.
<i>Caragana frutex</i> .....	10	11-10-38	56	F.S.	0	10	<u>62</u>	55				45	
<i>Caryopteris incana</i> .....	10	4-20-38	33	S.P.			<u>97</u>	72	72	77		70	
<i>Caryopteris incana</i> .....	10	10-9-38	18	O.S.				<u>60</u>	52	0		7	
<i>Ceanothus ovatus</i> .....	10	10-9-38	44	O.S.		80	20	<u>37</u>				5	
<i>Cissus rhombifolia</i> .....	10	2-27-38	32	O.S.			70	<u>90</u>	35			10	40 and 20 injured
<i>Clematis paniculata</i> .....	10	7-23-38	28	O.S.		27	<u>80</u>	<u>75</u>				3	40 and 20 injured
<i>Clematis paniculata</i> .....	10	10-18-38	45	C.S.		88	<u>60</u>	<u>20</u>				5	40 injured
<i>Clerodendron thompsonae</i> .....	15	2-16-38	43	O.S.		72	<u>72</u>	63				53	
<i>Clerodendron thompsonae</i> .....	10	11-6-38	48	O.S.		50	<u>60</u>	40				42	
<i>Oodiaeum variegatum</i> (26 hr.) .....	10	2-27-38	32	O.S.		35	<u>60</u>	37				3	See fig. 2.
<i>Otoneaster soongarica</i> .....	10	10-17-38	36	O.S.	0	3	<u>0</u>					0	
<i>Cytisus canariensis</i> .....	10	12-15-37	45	O.S.		50	<u>52</u>	32	17			0	40 injured
<i>Cytisus canariensis</i> .....	15	3-27-38	66	O.S.		65	<u>48</u>	<u>57</u>				47	
<i>Deutzia scabra watereri</i> .....	10	10-9-38	24	O.S.			53	<u>38</u>	30			5	20 injured
<i>Deutzia Pride of Rochester</i> .....	10	10-14-38	39	C.S.				<u>90</u>	<u>78</u>	78		85	
<i>Deutzia laxifolia</i> .....	10	10-14-38	71	C.S.				73	<u>53</u>	<u>90</u>		80	
<i>Deutzia scabra pleniflora</i> .....	10	11-4-38	39	C.S.			55	45	<u>50</u>			55	
<i>Diervilla trifida</i> .....	10	10-30-38	23	C.S.			50	28	<u>25</u>			10	
<i>Elaeagnus angustifolia</i> .....	10	10-18-38	35	C.S.		20	<u>0</u>	0				0	
<i>Euonymus japonicus</i> .....	10	3-30-38	22	C.S.		<u>78</u>	70	<u>43</u>				0	40 and 20 injured. See fig. 56.

TABLE 3. ROOTING RESPONSE OF GREENWOOD CUTTINGS TREATED WITH DIFFERENT CONCENTRATIONS OF HORMODIN A FOR A PERIOD OF 24 HOURS—Continued

Name of plant	No. of cuttings per lot	Date made	Days in medium	Rooting medium (*)	Average grade of each lot treated with each concentration								Remarks †	
					80	40	20	10	5	2.5	1.25	Ck		
<i>Euphorbia splendens</i> -----	10	3-30-38	35	O.S.		48	<u>50</u>	48					23	See figs. 53, 54.
<i>Forsythia intermedia spectabilis</i> ---	10	10- 9-38	24	O.S.			<u>63</u>	<u>70</u>	35				45	
<i>Forsythia intermedia primulina</i> ---	8	10-14-38	23	O.S.			<u>60</u>	<u>45</u>	15				20	
<i>Forsythia intermedia primulina</i> ---	10	10-30-38	66	O.S.			<u>65</u>	<u>77</u>	45				30	
<i>Fontanesia fortunei</i> -----	10	10-30-38	64	F.S.	40	45	<u>53</u>	5					0	See figs. 21, 22, 23, 24.
<i>Gardenia veitchi</i> -----	15	3-26-38	39	O.S.			<u>18</u>	18	<u>23</u>				0	
<i>Hibiscus rosa-sinensis</i> -----	10	1-23-39	40	O.S.			<u>48</u>	<u>35</u>	20				23	
<i>Hibiscus rosa-sinensis</i> -----	8	3-14-38	32	O.S.			<u>41</u>	9	6				0	
<i>Hydrangea opuloides</i> -----	10	6-24-38	26	O.S.			<u>68</u>	60	<u>73</u>				25	
<i>Kolkwitzia amabilis</i> -----	10	10-30-38	66	F.S.			8	3	0				0	
<i>Lantana camara</i> -----	10	12- 8-37	24	F.S.P.		75	60	62	<u>67</u>	36			0	
<i>Lantana camara</i> -----	13	1- 6-38	29	F.S.				64	<u>52</u>				0	
<i>Lantana camara</i> -----	10	2- 7-38	25	O.S.				85	<u>82</u>				62	
<i>Lantana camara</i> -----	10	10-16-38	19	O.S.				68	<u>50</u>				5	
<i>Lantana camara</i> -----	10	1-21-39	33	F.S.				12	<u>25</u>				22	
<i>Lantana sellowiana</i> -----	10	12- 8-37	24	F.S.P.		85	82	<u>92</u>	<u>42</u>				26	
<i>Lantana sellowiana</i> -----	10	2- 7-38	25	O.S.				95	<u>90</u>				75	
<i>Lantana sellowiana</i> -----	10	2- 7-38	25	O.S.				92	<u>72</u>				72	
<i>Lantana sellowiana</i> -----	10	2- 7-38	25	O.S.				50	12	<u>30</u>			5	
<i>Lantana sellowiana</i> -----	10	10-16-38	17	O.S.				82	45	<u>47</u>			2	
<i>Ligustrum amurense</i> -----	15	7-28-38	23	O.S.	67	27	23						30	
<i>Ligustrum amurense</i> -----	10	10-15-38	45	O.S.	<u>83</u>	<u>83</u>	78						65	
<i>Ligustrum regelianum</i> -----	10	11-10-37	42	F.S.P.	75	42	27	0					0	
<i>Ligustrum regelianum</i> -----	10	10- 9-38	44	O.S.	<u>17</u>	12	2						0	



TABLE 3. ROOTING RESPONSE OF GREENWOOD CUTTINGS TREATED WITH DIFFERENT CONCENTRATIONS OF HORMODIN A FOR A PERIOD OF 24 HOURS—Continued

Name of plant	No. of cuttings per lot	Date made	Days in medium	Rooting medium (*)	Average grade of each lot treated with each concentration							Remarks †		
					80	40	20	10	5	2.5	1.25		Ck	
Rosa multiflora -----	10	3-29-38	21	C.S.				53	<u>53</u>	53		35	See fig. 34.	
Rosa multiflora x R. blanda-----	10	10-16-38	21	O.S.				38	<u>38</u>	20		0		
Rosa multiflora Excelsa-----	10	4-23-38	40	C.S.	30	45	<u>43</u>					30		
Rosa multiflora Climbing America Beauty -----	10	10-19-38	66	C.S.				5	13	<u>25</u>		13		
Rosa multiflora Ohenaults -----	10	10-14-38	71	O.S.				3	8	<u>20</u>		20		
Rosa multiflora Dorothy Perkins...-	10	10-14-38	23	C.S.				<u>80</u>	60	<u>63</u>		43		
Rosa multiflora Tausend schoen...-	10	10-18-38	26	C.S.				<u>28</u>	5	18		0		
Rosa polyantha Kluis' Scarlet-----	8	4- 2-38	32	O.S.					<u>97</u>	53		19		See fig. 46. 80 injured. See fig. 12.
Syringa vulgaris Chas. Joly-----	10	5- 1-38	66	C.S.	<u>58</u>	10	10					0		
Spiraea billardi -----	8	10-14-38	30	C.S.		28	72	<u>66</u>				16		20 injured
Spiraea arguta -----	10	10-17-38	36	C.S.			68	<u>63</u>	30			8	20 injured	
Spiraea bumaldi -----	10	10-30-38	66	C.S.			83	<u>65</u>	<u>65</u>			13	20 injured	

\*F.S.—Fine sand.

F.S.P.—Fine sand and peat mixture.

O.S.—Coarse sand.

O.S.P.—Coarse sand and peat mixture.

†Number given refers to B. T. I. concentration causing injury.

NOTE: Underline indicates treatment considered best by the authors.

TABLE 4. OPTIMUM CONCENTRATIONS OF HORMODIN A FOR GREENWOOD CUTTINGS OF VARIOUS SPECIES

B. T. I. Units					
2.5	5	10	20	40	80
<i>Buddleia asiatica</i>	<i>Buddleia asiatica</i>	<i>Acalypha hispida</i>	<i>Allamanda cathartica</i>	<i>Eleagnus</i>	<i>Ligustrum amurense</i>
<i>B. davidi</i>	<i>B. davidi</i>	<i>A. wilkesiana</i>	<i>Ampelopsis triocspidata</i>	<i>angustifolia</i>	<i>L. regelianum</i>
<i>Lonicera bella albida</i>	<i>Deutzia</i> species	<i>marginata</i>	<i>Berberis thunbergi</i>	<i>Hibiscus rosa-</i>	<i>L. vulgare foliosa</i>
<i>L. japonica articulata</i>	<i>Gardenia veitchii</i>	<i>Berberis thunbergi</i>	<i>Bougainvillea glabra</i>	<i>sinensis</i>	<i>L. vulgare lowdense</i>
<i>L. standishi</i>	<i>L. japonica articulata</i>	<i>Caryopteris incana</i>	<i>Callicarpa japonica</i>	<i>Ligustrum amurense</i>	<i>Syringa vulgaris</i>
<i>Rosa indica odorata</i>	<i>Rosa indica odorata</i>	<i>Oenanthus ovatus</i>	<i>Caragana frutex</i>	<i>L. vulgare lowdense</i>	
	<i>Rosa multiflora</i>	<i>Oleus rhombifolia</i>	<i>Caryopteris incana</i>	<i>Pyracantha coccinea</i>	
	and hybrida	<i>Olemais paniculata</i>	<i>Olemais paniculata</i>	<i>gibbsi</i>	
	<i>Rosa polyantha</i>	<i>Oytisus canariensis</i>	<i>Olerodendron</i>		
	<i>Spiraea bumaltii</i>	<i>Deutzia</i> species	<i>Thompsonae</i>		
		<i>Euonymus japonicus</i>	<i>Oediacum variegatum</i>		
		<i>Forsythia</i> species	<i>Oytisus canariensis</i>		
		<i>Hydrangea opuloides</i>	<i>Diervilla trifida</i>		
		<i>Lantana camara</i>	<i>Euphorbia splendens</i>		
		<i>L. selowiana</i>	<i>Forsythia</i> species		
		<i>Nerium oleander</i>	<i>Fontanesia fortunei</i>		
		<i>Potentilla fruticosa</i>	<i>Hibiscus rosa-</i>		
		<i>Rosa manetti</i>	<i>sinensis</i>		
		<i>R. multiflora Excelsa</i>	<i>Malus sylvestris</i>		
		<i>Spiraea billardi</i>	(root sprouts)		
		<i>S. arguta</i>	<i>Nerium oleander</i>		
			<i>Philadelphus</i>		
			<i>coronarius</i>		

TABLE 5. ROOTING RESPONSE OF EVERGREEN CUTTINGS TREATED WITH DIFFERENT CONCENTRATIONS OF HORMODIN A FOR A PERIOD OF 24 HOURS

Name of plant	No. of cuttings per lot	Date made	Days in medium	Rooting medium (%)	Average grade of each lot treated with each concentration							Remarks †			
					80	40	20	10	5	2.5	1.25		Ok		
<i>Abies concolor</i> .....	20	1-23-38	60	C.S.	17	7	0								
<i>Buxus sempervirens</i> .....	10	3-27-38	68	C.S.	70	40	8								
<i>Buxus sempervirens</i> .....	20	1-23-38	57	C.S.	70	50	16								
<i>Chamaecyparis pisifera plumosa</i> .....	10	1-22-39	39	C.S.	23	48	8							See fig. 31.	
<i>Chamaecyparis pisifera plumosa</i> .....	5	11- 8-38	74	F.S.P.	30	45	30								
<i>Chamaecyparis pisifera plumosa</i> .....	10	4-16-38	82	C.S.	23	60	48							See fig. 18.	
<i>Chamaecyparis pisifera plumosa</i> .....	10	10-30-38	70	C.S.	5	10	10								
<i>Juniperus chinensis</i> .....	10	10-10-38	143	C.S.	35	25	28								
<i>Juniperus chinensis pfitzeriana</i> .....	10	2- 4-38	152	C.S.		30	5	18							
<i>Juniperus chinensis pfitzeriana</i> .....	10	4-16-38	147	C.S.	55	20	20								
<i>Juniperus chinensis pfitzeriana</i> .....	10	4-16-38	147	C.S.P.	70	00	35								
<i>Juniperus chinensis pfitzeriana</i> .....	10	11- 4-38	120	C.S.	3	38	28								
<i>Juniperus chinensis pfitzeriana</i> .....	10	1- 7-39	97	C.S.	10	23	8								
<i>Juniperus chinensis pfitzeriana</i> .....	10	1- 8-39	96	C.S.	15	35	8								
<i>Juniperus chinensis pfitzeriana</i> .....	10	1- 8-39	72	C.S.	45	5	0								
<i>Juniperus chinensis pyramidalis</i> .....	10	10-10-38	182	C.S.	13	33	10							80 injured	
<i>Juniperus chinensis pyramidalis</i> .....	10	10-10-38	182	C.S.	0	10	30							80 and 40 injured	
<i>Juniperus communis depressa</i> .....	10	10-10-38	92	C.S.	0	20	5								
<i>Juniperus communis depressa</i> .....	10	2- 4-38	182	C.S.		75	68	40						See fig. 25.	
<i>Juniperus communis depressa</i> .....	10	4-14-38	83	C.S.	18	15	43								
<i>Juniperus communis depressa</i> .....	10	4-14-38	83	C.S.P.	25	20	33								
<i>Juniperus communis depressa plumosa</i> .....	10	4-14-38	149	C.S.	15	15	35								
<i>Juniperus communis depressa plumosa</i> .....	10	10- 9-38	98	C.S.	3	35	0								
<i>Juniperus communis depressa plumosa</i> .....	10	1- 9-39	94	C.S.	10	5	0								



TABLE 5. ROOTING RESPONSE OF EVERGREEN CUTTINGS TREATED WITH DIFFERENT CONCENTRATIONS OF  
HORMODIN A FOR A PERIOD OF 24 HOURS—Continued

Name of plant	No. of cuttings per lot	Date made	Days in medium	Rooting medium (*)	Average grade of each lot treated with each concentration								Remarks †	
					80	40	20	10	5	2.5	1.25	0k		
<i>Juniperus communis depressa</i>	10	10-9-38	144	C.S.	15	45	3						13	
<i>plumosa</i> -----	10	4-15-38	154	C.S.	18	8	0						0	
<i>Juniperus procumbens</i> -----	10	1-8-39	53	C.S.	0	10	0						0	
<i>Juniperus sabina</i> -----	10	10-10-38	143	C.S.	0	0	0						8	
<i>sabina horizontalis</i> "gray form" -----	10	11-4-38	118	C.S.	35	60	27						8	
<i>sabina horizontalis</i> "green form" -----	10	1-21-39	82	C.S.	20	20	8						0	See figs. 36, 37.
<i>Juniperus squamata wilsoni</i> -----	10	1-21-39	82	C.S.	43	35	8						0	See figs. 29, 30.
<i>Juniperus squamata</i> var. -----	10	11-11-38	111	C.S.	5	10	33						15	
<i>Picea excelsa</i> -----	10	11-11-38	111	C.S.	0	0	40						20	See figs. 33, 39, 40.
<i>Picea excelsa</i> -----	10	1-9-39	84	C.S.	8	5	0						8	
<i>Picea pungens</i> -----	10	4-16-38	81	C.S.	10	8	28						0	
<i>Pinus mughus</i> -----	10	11-16-38	99	C.S.	13								0	
<i>Pinus mughus</i> -----	10	1-21-39	40	C.S.	33	0	0						0	See fig. 35.
<i>Pinus mughus</i> -----	10	1-21-39	42	C.S.	28	0	0						0	
<i>Taxus cuspidata brevifolia</i> -----	10	4-16-38	81	C.S.	30	25	48						45	
<i>Taxus cuspidata brevifolia</i> -----	10	11-16-38	106	C.S.	50	65	40						0	
<i>Taxus media hicksi</i> -----	10	3-5-38	77	C.S.	83	63	83	43					48	
<i>Taxus media hicksi</i> -----	10	3-5-38	77	C.S.	83	50	3	10					8	
<i>Taxus media hicksi</i> -----	10	4-14-38	109	C.S.	83	58	43						20	See fig. 27.
<i>Taxus media hicksi</i> -----	10	4-14-38	109	C.S.P.	78	48	83						10	
<i>Teucrium chamaedrys</i> -----	20	1-21-38	46	F.S.	80	68	80						30	See fig. 26.
<i>Teucrium chamaedrys</i> -----	10	3-27-38	25	C.S.	30	50	33						0	
<i>Teucrium chamaedrys</i> -----	10	10-9-38	44	C.S.	68	35	13						0	

TABLE 5. ROOTING RESPONSE OF EVERGREEN CUTTINGS TREATED WITH DIFFERENT CONCENTRATIONS OF HORMODIN A FOR A PERIOD OF 24 HOURS—Continued

Name of plant	No. of cuttings per lot	Date made	Days in medium	Rooting medium (*)	Average grade of each lot treated with each concentration							Remarks †		
					80	40	20	10	5	2.5	1.25		Ck	
Teucrium chamaedrys -----	10	1-31-39	33	F.S.	100	50	55						0	
Thuja occidentalis -----	50	1-21-39	42	C.S.	20	26	3						1	In flats
Thuja occidentalis -----	50	1-21-39			0	3	10							In bench
Thuja occidentalis -----	10	1-29-38	183	C.S.	55	80	30						18	80 injured
Thuja occidentalis -----	10	1-29-38	73	F.S.P.	35	40	5						3	80 injured
Thuja occidentalis -----	10	1-29-38	73	F.S.	38	63	10						6	80 injured
Thuja occidentalis -----	10	1-29-38	182	F.S.P.	60	55	0						8	
Thuja occidentalis -----	10	10-10-38	31	C.S.		68	3						25	
Thuja occidentalis -----	10	10-10-38	92	C.S.		18	10						23	
Thuja occidentalis -----	10	10-30-38	123	C.S.	5	35	0						5	80 injured
Thuja occidentalis wareana -----	20	12-17-37	116	F.S.P.	29	53	28						8	80 injured. See fig. 52.
Thuja occidentalis wareana -----	10	3- 8-38	134	C.S.		18	20	0	8				0	80 injured
Thuja occidentalis wareana -----	10	10-30-38	123	C.S.	33	58	25						18	80 injured
Thuja occidentalis var. -----	10	1- 8-39	95	C.S.	75	35	25						38	80 injured
Thuja occidentalis var. -----	10	12-14-38	52	F.S.P.	15	8	8						0	80 injured

\*F.S.—Fine sand.

F.S.P.—Fine sand and peat mixture.

C.S.—Coarse sand.

C.S.P.—Coarse sand and peat mixture.

†Number given refers to B. T. I. concentration causing injury.

NOTE: Underline indicates treatment considered best by the authors.

TABLE 6. OPTIMUM CONCENTRATIONS OF HORMODIN A FOR CUTTINGS OF EVERGREEN SPECIES

B. T. I. Units		
20	40	80
<i>Juniperus chinensis pyramidalis</i> <i>J. communis depressa</i> <i>J. communis depressa plumosa</i> <i>Picea excelsa</i> <i>Taxus cuspidata brevifolia</i> <i>Thuja occidentalis wareana</i>	<i>Ohamaecyparis pisifera plumosa</i> <i>Juniperus chinensis pfitzeriana</i> <i>J. chinensis pyramidalis</i> <i>J. communis depressa</i> <i>J. communis depressa plumosa</i> <i>J. sabina</i> <i>J. sabina horizontalis "green form"</i> <i>J. squamata wilsoni</i> <i>Taxus cuspidata brevifolia</i> <i>Teucrium chamaedrys</i> <i>Thuja occidentalis</i> <i>T. occidentalis wareana</i>	<i>Abies concolor</i> <i>Buxus sempervirens</i> <i>Ohamaecyparis pisifera plumosa</i> <i>Juniperus chinensis</i> <i>J. chinensis pfitzeriana</i> <i>J. procumbens</i> <i>J. squamata</i> <i>Pinus mughus</i> <i>Taxus media hioksi</i> <i>Teucrium chamaedrys</i>

TABLE 7. THE ROOTING RESPONSE OF HARDWOOD CUTTINGS TREATED WITH DIFFERENT CONCENTRATIONS OF HORMODIN A FOR A PERIOD OF 24 HOURS

Name of plant	No. of cuttings	Date treated	Days in medium	Concentration	No. of cuttings rated as:		
					Good	Poor	Not rooted
<i>Amygdalus persica</i> ..... Callused cuttings Base treated	10	4-20-38	42	80	1	2	7
				40	1	1	8
				20	1	1	8
				Ok	0	0	10
<i>Amygdalus persica</i> ..... Callused cuttings Top treated	10	4-20-38	41	80	0	2	8
				40	0	0	10
				20	0	1	9
				Ok	0	0	10
<i>Phladelphus coronarius</i> ..... Callused cuttings	10	6- 8-38	29	80	6	4	0
				40	0	0	10
				20	0	8	2
				Ok	0	0	10
<i>Vitis labrusca</i> —Lucile..... Base treated Callused cuttings	10	5-30-38	33	160	8	2	0*
				80	7	2	1
				40	8	1	1
				20	5	5	0
				10	3	4	3
				Ok	3	4	3
<i>Vitis labrusca</i> —Lucile..... Tops treated Buds damaged Callused cuttings	10	5-30-38	33	160	7	3	0
				80	2	5	3
				40	4	3	3
				20	4	2	4
				Ok	4	5	1

\*See figs. 42, 43.

NOTE: All cuttings were rooted in the fine sand.

The data on the uncallused *Amygdalus* cuttings are omitted. All failed to root, though treated as were the callused cuttings.

TABLE 8. RECOMMENDATIONS FOR TREATMENT OF CUTTINGS WITH DIFFERENT CONCENTRATIONS OF HORMODIN A FOR A PERIOD OF 24 HOURS

Name of plant	Type of cutting	Hormodin A B. T. I. Units
<i>Antirrhinum majus</i> .....	Herbaceous	10
<i>Begonia semperflorens</i> .....	Herbaceous	5
<i>Chrysanthemum hortorum</i> .....	Herbaceous	2.5
<i>Chrysanthemum frutescens</i> .....	Herbaceous	5-2.5
<i>Dianthus caryophyllus</i> .....	Herbaceous	10
<i>Fuchsia speciosa</i> .....	Herbaceous	5
<i>Iresene herbatii</i> .....	Herbaceous	5
<i>Meembryanthemum roseum</i> .....	Herbaceous	5
<i>Monarda didyma</i> .....	Herbaceous	20
<i>Pelargonium hortorum</i> .....	Herbaceous	5
<i>P. domesticum</i> .....	Herbaceous	10
<i>P. peltatum</i> .....	Herbaceous	10
<i>P. tricolor</i> .....	Herbaceous	5-2.5
<i>Penatemon barbatus</i> .....	Herbaceous	10
<i>Piqueria trinervia</i> .....	Herbaceous	5
<i>Senecia mikanioides</i> .....	Herbaceous	5-2.5
<i>S. cineraria</i> .....	Herbaceous	10-5
<i>Verbena hybrida</i> .....	Herbaceous	5
<i>Euphorbia pulcherrima</i> .....	Herbaceous	20-15
<i>Allamanda cathartica</i> .....	Greenwood	20
<i>Berberis thunbergi</i> .....	Greenwood	20-10
<i>Buddleia asiatica</i> .....	Greenwood	5-2.5
<i>B. davidi</i> .....	Greenwood	5-2.5
<i>Oxyopteris incana</i> .....	Greenwood	20-10
<i>Olematis paniculata</i> .....	Greenwood	20-10
<i>Olerodendron thompsonae</i> .....	Greenwood	20
<i>Deutzia species</i> .....	Greenwood	5
<i>Forrythia species</i> .....	Greenwood	10
<i>Hibiscus rosa-sinensis</i> .....	Greenwood	20
<i>Lantana camara</i> .....	Greenwood	10
<i>Lantana sellowiana</i> .....	Greenwood	10-5
<i>Ligustrum species</i> .....	Greenwood	80
<i>Lonicera species</i> .....	Greenwood	2.5
<i>Nerium oleander</i> .....	Greenwood	20-10
<i>Philadelphus coronarius</i> .....	Greenwood	20
<i>Rosa indica odorata</i> .....	Greenwood	5-2.5
<i>Rosa multiflora</i> .....	Greenwood	10-5
<i>Buzus sempervirens</i> .....	Evergreen	80-40
<i>Ohamaescyparis pisifera plumosa</i> .....	Evergreen	40
<i>Juniperus chinensis</i> .....	Evergreen	80
<i>Juniperus chinensis pfitzeriana</i> .....	Evergreen	40
<i>Juniperus chinensis pyramidalis</i> .....	Evergreen	80-40
<i>Juniperus communis depressa</i> .....	Evergreen	40-20
<i>J. communis depressa plumosa</i> .....	Evergreen	40-20
<i>Picea excelsa</i> .....	Evergreen	20
<i>Pinus mughus</i> .....	Evergreen	80
<i>Taxus cuspidata brevisfolia</i> .....	Evergreen	40
<i>Taxus media hicksi</i> .....	Evergreen	80-40
<i>Teucrium chamaedrys</i> .....	Evergreen	80-40
<i>Thuja occidentalis</i> .....	Evergreen	40
<i>Thuja occidentalis varieties</i> .....	Evergreen	40

TABLE 9. LIST OF DIFFICULT PLANTS REPORTED BENEFITED BY TREATMENT WITH HORMODIN A, OR INDOLEBUTYRIC ACID

Name of Plant	Reference
<i>Acer rufrinerve limbatum</i> .....	Tincker (21)
<i>Azalea calendulacea</i> .....	Yerkes (29)
<i>Azalea indica</i> .....	Watkins (26)
<i>Azalea japonica</i> .....	Yerkes (29)
<i>Azalea mollis</i> .....	Yerkes (29)
<i>Camellia japonica alba plena</i> .....	Watkins (26)
<i>Camellia sasanqua</i> .....	Watkins (26)
<i>Carya pecan</i> .....	Stoutemyer (18)
<i>Ohimnanthus fragrans (Meratia praecox)</i> .....	Tincker (21)
<i>Cornus florida</i> .....	Kiplinger (8)
	Yerkes (29)
<i>Cornus florida rubrum</i> .....	Kiplinger (8)
<i>Ginkgo biloba</i> .....	Kiplinger (8)
<i>Ilex crenata</i> .....	Hitchcock & Zimmerman (6)
<i>Ilex glabra</i> .....	Kiplinger (8)
<i>Ilex opaca</i> .....	Hitchcock & Zimmerman (6)
<i>Kalmia latifolia myrtifolia</i> .....	Tincker (21)
<i>Kolkwitzia amabilis</i> .....	Kiplinger (8)
	Yerkes (29)
<i>Lagerstroemia indica</i> .....	Watkins (26)
<i>Magnolia grandiflora</i> .....	Watkins (26)
<i>Magnolia kobus borealis</i> .....	Yerkes (29)
<i>Magnolia liliflora</i> .....	Yerkes (29)
<i>Malus var. Eleyi</i> .....	Yerkes (29)
<i>Pitosporum dalli</i> .....	Tincker (21)
<i>Podocarpus nagi</i> .....	Watkins (25)
<i>Polygonum paniculatum</i> .....	Tincker (21)
<i>Prunus triloba plena flore</i> .....	Yerkes (29)
<i>Robinia pseudoacacia rectissima</i> .....	Stoutemyer (18)
<i>Syringa emodi</i> .....	Kirkpatrick (10)
<i>Syringa henryi</i> .....	Kirkpatrick (10)
<i>Syringa josikaea</i> .....	Kirkpatrick (10)
<i>Syringa persica</i> .....	Kirkpatrick (10)
<i>Syringa tomentosa</i> .....	Kirkpatrick (10)
<i>Syringa villosa</i> .....	Kirkpatrick (10)
<i>Syringa vulgaris</i> varieties.....	Kirkpatrick (10)
	Oliver (14)
<i>Thuja canadensis</i> .....	Hitchcock & Zimmerman (6)
	Yerkes (29)
<i>Vitis rotundifolia</i> .....	Yerkes (29)

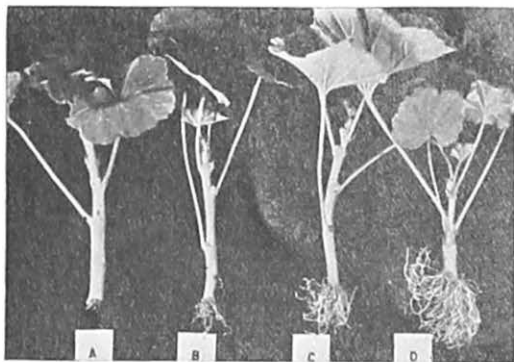


FIG. 1.  
*Pelargonium hortorum.*

Treated 2-25-38.  
Dug 3-15-38.  
A—Check.  
B—5 B. T. I. Units.  
C—10 B. T. I. Units.  
D—20 B. T. I. Units.



FIG. 2.  
*Codiaeum variegatum.*

Treated 26 hrs., 2-27-38.  
Dug 4-1-38.  
A—Check.  
B—10 B. T. I. Units.  
C—20 B. T. I. Units.  
D—40 B. T. I. Units.

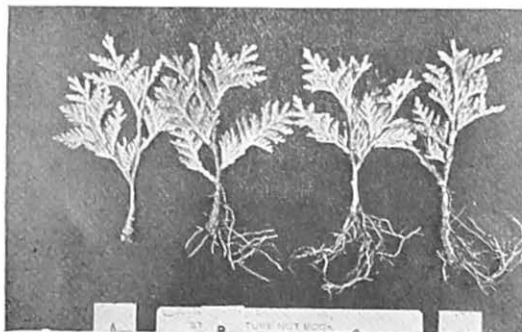


FIG. 3.  
*Thuja occidentalis wareana.*

Treated 12-17-38.  
Dug 4-12-38.  
A—Check.  
B—20 B. T. I. Units.  
C—40 B. T. I. Units.  
D—80 B. T. I. Units.

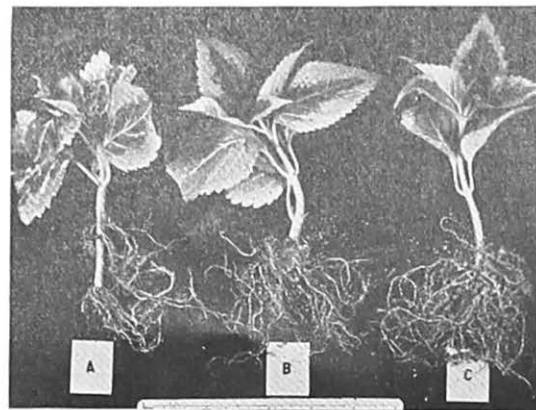


FIG. 4.  
*Coleus blumei.*

Data not recorded.  
A—Check.  
B—5 B. T. I. Units.  
C—10 B. T. I. Units.

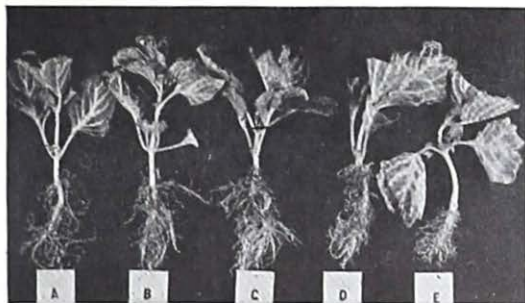


FIG. 5.  
*Iresene herbstii*.  
 Treated 2-16-38.  
 Dug 3-6-38.  
 A—Check.  
 B—2.5 B. T. I. Units.  
 C—10 B. T. I. Units.  
 D—20 B. T. I. Units.  
 E—80 B. T. I. Units.

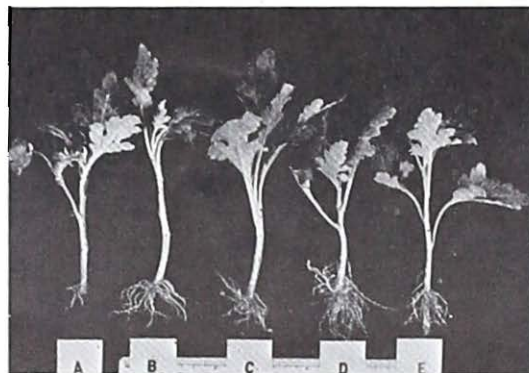


FIG. 6.  
*Chrysanthemum hortorum*.  
 Treated 3-4-38.  
 Dug 3-25-38.  
 A—Check.  
 B—2.5 B. T. I. Units.  
 C—5 B. T. I. Units.  
 D—10 B. T. I. Units.  
 E—20 B. T. I. Units.

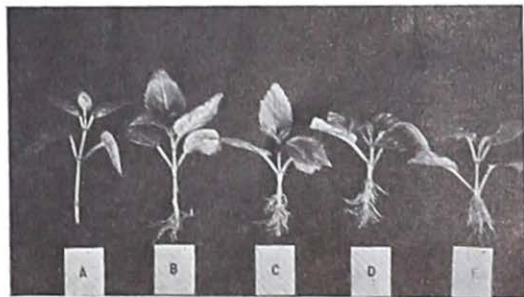


FIG. 7.  
*Fuchsia speciosa*.  
 Treated 26 hrs., 2-27-38.  
 Dug 3-15-38.  
 A—Check.  
 B—2.5 B. T. I. Units.  
 C—5 B. T. I. Units.  
 D—10 B. T. I. Units.  
 E—20 B. T. I. Units.



FIG. 8.  
*Buddleia asiatica*.  
 Treated 3-31-38.  
 Dug 4-21-38.  
 A—Check.  
 B—2.5 B. T. I. Units.  
 C—5 B. T. I. Units.  
 D—10 B. T. I. Units.  
 E—20 B. T. I. Units.



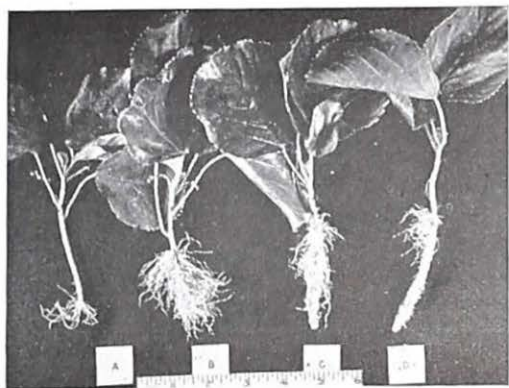


FIG. 9.  
*Acalypha wilkesiana*  
*marginata.*  
Treated 4-1-38.  
Dug 4-22-38.  
A—Check.  
B—2.5 B. T. I. Units.  
C—5 B. T. I. Units.  
D—10 B. T. I. Units.

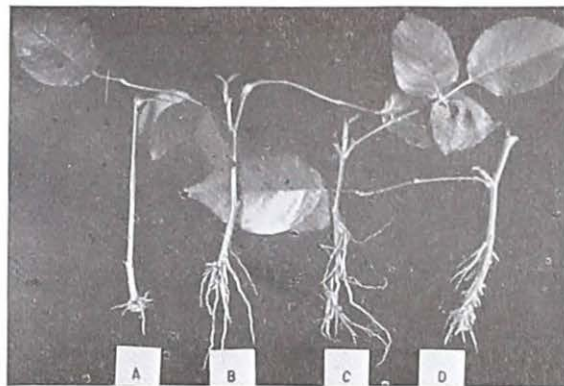


FIG. 10.  
*Rosa indica odorata.*  
Treated 2-1-38.  
Dug 3-6-38.  
A—Check.  
B—2.5 B. T. I. Units.  
C—5 B. T. I. Units.  
D—10 B. T. I. Units.

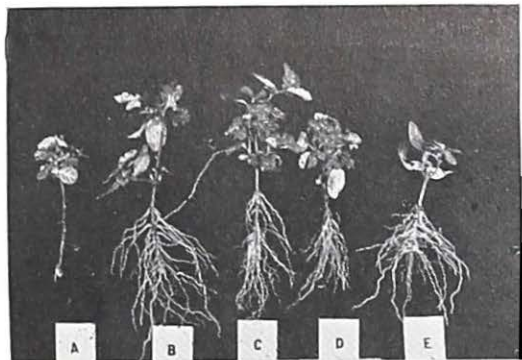


FIG. 11.  
*Lonicera japonica articulata.*  
Treated 1-26-38.  
Dug 3-11-38.  
A—Check.  
B—2.5 B. T. I. Units.  
C—5 B. T. I. Units.  
D—10 B. T. I. Units.  
E—20 B. T. I. Units.

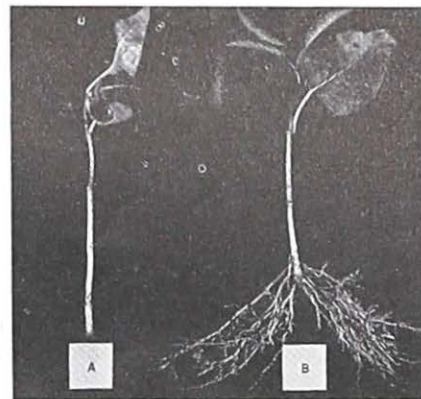


FIG. 12.  
*Syringa vulgaris,*  
Charles Joly  
Treated 5-1-38.  
Dug 7-6-38.  
A—Check.  
B—80 B. T. I. Units.

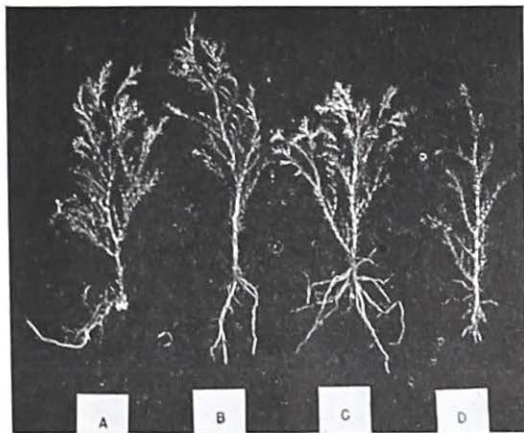


FIG. 13.  
*Chamaecyparis pisifera*  
*plumosa.*

Treated 4-16-38.  
Dug 7-3-38.  
A—Check.  
B—20 B. T. I. Units.  
C—40 B. T. I. Units.  
D—80 B. T. I. Units.

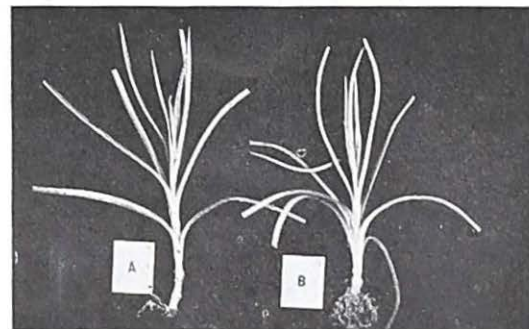


FIG. 14.  
*Dianthus caryophyllus.*

Treated 1-20-38.  
Dug 2-22-38.  
A—Check.  
B—10 B. T. I. Units.

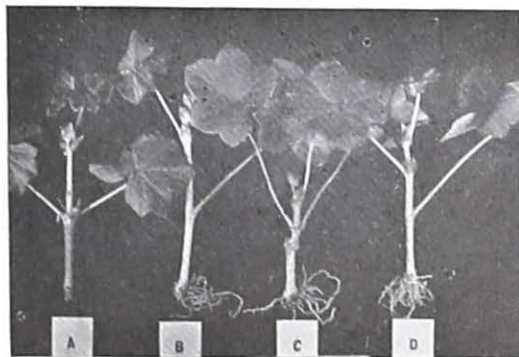


FIG. 15.  
*Pelargonium peltatum.*

Treated 2-27-38.  
Dug 3-15-38.  
A—Check.  
B— 2.5 B. T. I. Units.  
C— 5 B. T. I. Units.  
D—10 B. T. I. Units.

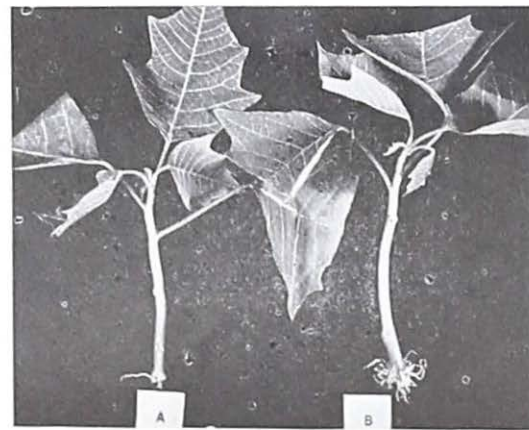


FIG. 16.  
*Euphorbia pulcherrima.*

Treated 6-15-38.  
Dug 7-7-38.  
A—Check.  
B—10 B. T. I. Units.

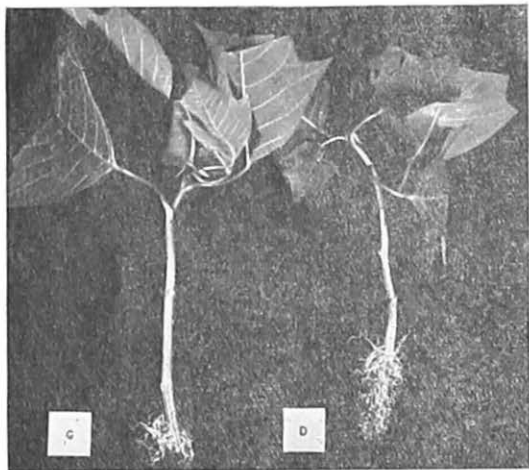


FIG. 17.  
*Euphorbia pulcherrima*.  
Treated 6-5-38.  
Dug 7-7-38.  
C—20 B. T. I. Units.  
D—40 B. T. I. Units.

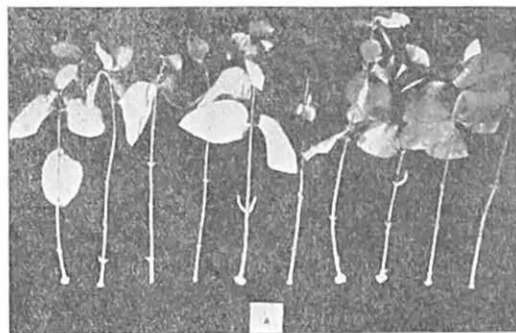


FIG. 18.  
*Lonicera bella albida*.  
Treated 10-13-38.  
Dug 11-18-38.  
A—Check.

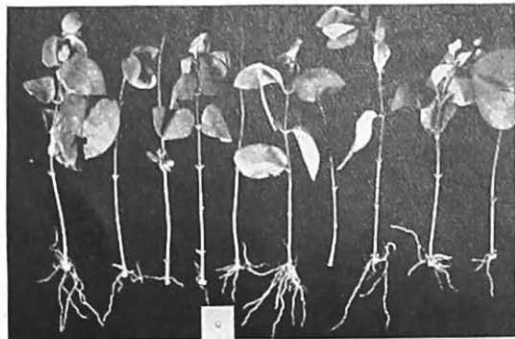


FIG. 19.  
*Lonicera bella albida*.  
Treated 10-13-38.  
Dug 11-18-38.  
C—2.5 B.T.I. Units.

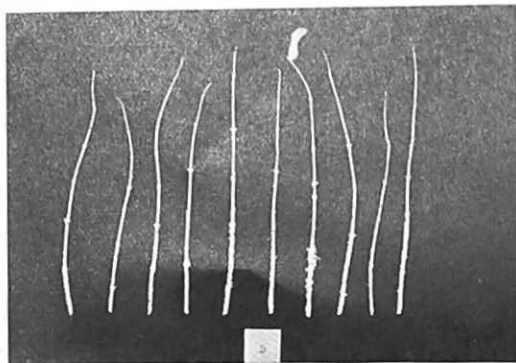


FIG. 20.  
*Lonicera bella albida*.  
Treated 10-13-38.  
Dug 11-18-38.  
B—10 B. T. I. Units.

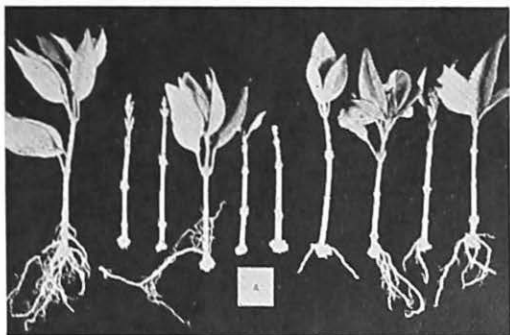


FIG. 21.  
*Forsythia intermedia  
primulina.*  
Treated 10-30-38.  
Dug 1-4-39.  
A—Check.



FIG. 22.  
*Forsythia intermedia  
primulina.*  
Treated 10-30-38.  
Dug 1-4-39.  
B—5 B. T. I. Units.



FIG. 23.  
*Forsythia intermedia  
primulina.*  
Treated 10-30-38.  
Dug 1-4-39.  
C—10 B. T. I. Units.

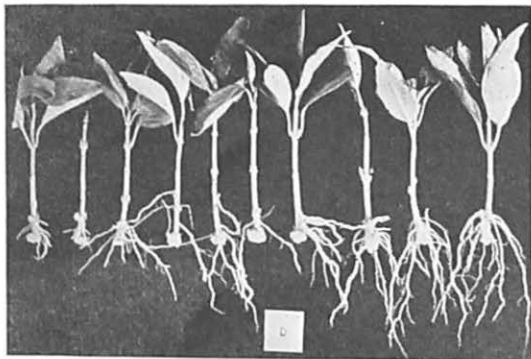
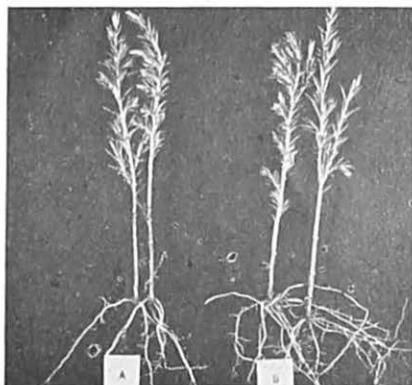
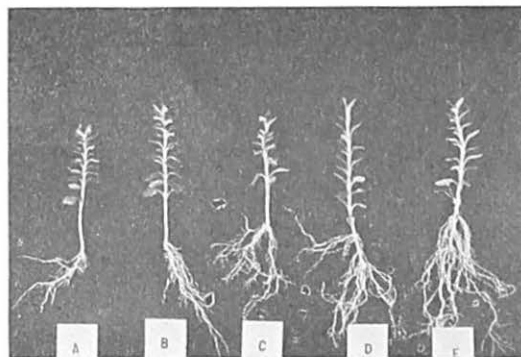


FIG. 24.  
*Forsythia intermedia  
primulina.*  
Treated 10-30-38.  
Dug 1-4-39.  
D—20 B. T. I. Units.



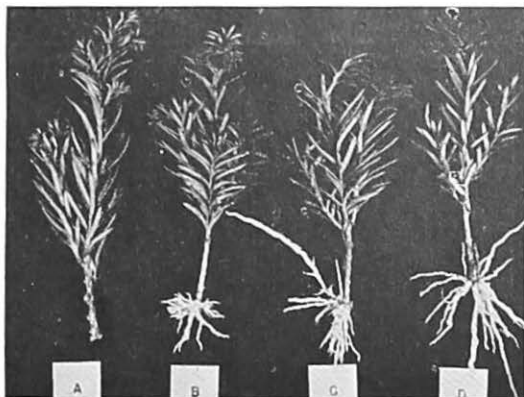
**FIG. 25.**  
*Juniperus communis*  
*depressa.*

Treated 2-4-38.  
Dug 7-5-38.  
A—Check.  
B—40 B. T. I. Units.



**FIG. 26.**  
*Teucrium chamaedrys.*

Treated 1-21-38.  
Dug 3-8-38.  
A—Check.  
B—5 B. T. I. Units.  
C—10 B. T. I. Units.  
D—20 B. T. I. Units.  
E—40 B. T. I. Units.



**FIG. 27.**  
*Taxus media hicksi.*

Treated 4-14-38.  
Dug 7-1-38.  
A—Check.  
B—20 B. T. I. Units.  
C—40 B. T. I. Units.  
D—50 B. T. I. Units.



**FIG. 28.**  
*Rosa manetti.*

Treated 3-27-38.  
Dug 4-19-38.  
A—Check.  
B—2.5 B. T. I. Units.  
C—5 B. T. I. Units.  
D—10 B. T. I. Units.

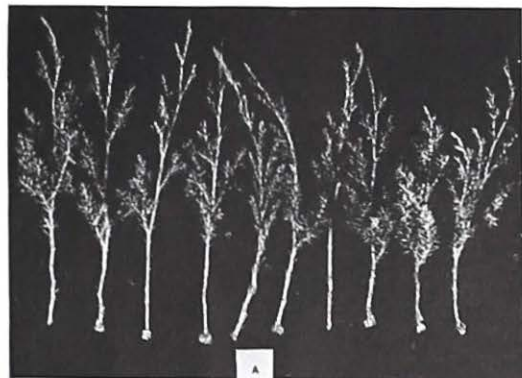


FIG. 29.  
*Juniperus squamata* variety.

Treated 1-21-39.  
Dug 4-13-39.  
A—Check.

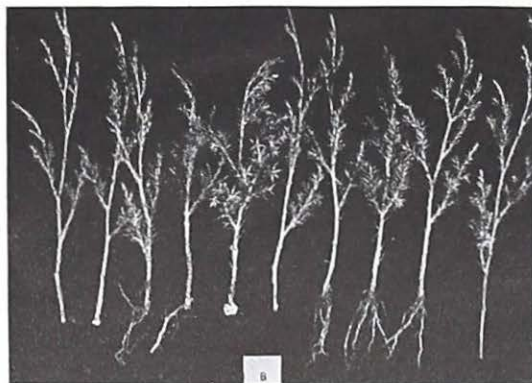


FIG. 30.  
*Juniperus squamata* variety.

Treated 1-21-39.  
Dug 4-13-39.  
B—80 B. T. I. Units.

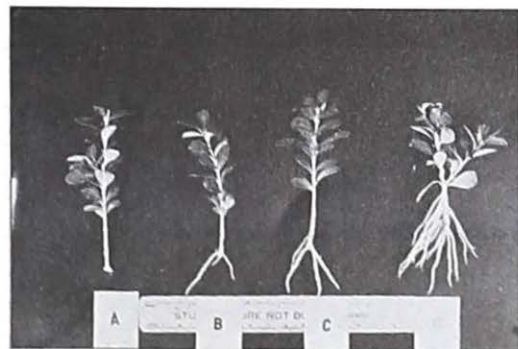


FIG. 31.  
*Buxus sempervirens*.

Treated 1-23-38.  
Dug 3-21-38.  
A—Check.  
B—20 B. T. I. Units.  
C—40 B. T. I. Units.  
D—80 B. T. I. Units.

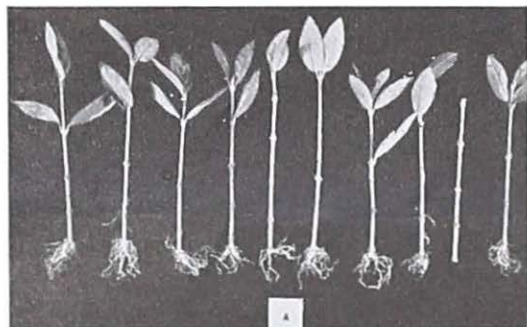


FIG. 32.  
*Ligustrum amurense*.

Treated 10-15-38.  
Dug 11-29-38.  
A—Check.

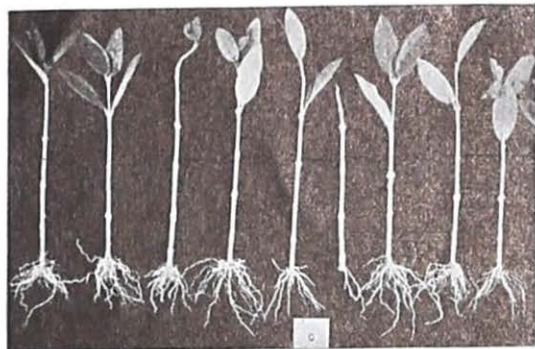


FIG. 83.  
*Ligustrum amurense*.  
Treated 10-15-38.  
Dug 11-29-38.  
C—40 B. T. I. Units.

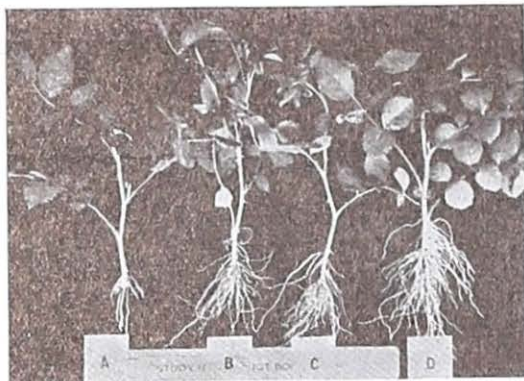


FIG. 84.  
*Rosa multiflora*.  
Treated 3-29-38.  
Dug 4-19-38.  
A—Check.  
B—2.5 B. T. I. Units.  
C—5 B. T. I. Units.  
D—10 B. T. I. Units.

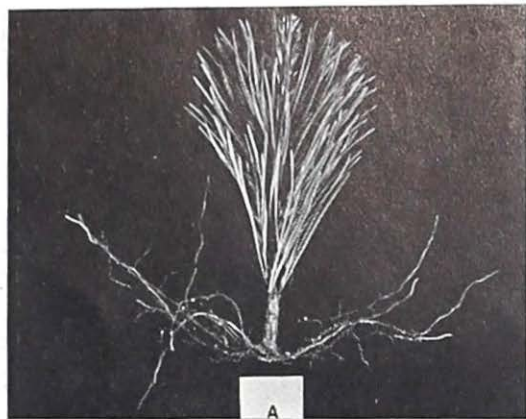


FIG. 85.  
*Pinus mughus*.  
Treated with Unit 80  
1-21-39.  
Photographed 4-13-39.  
Controls all dead.

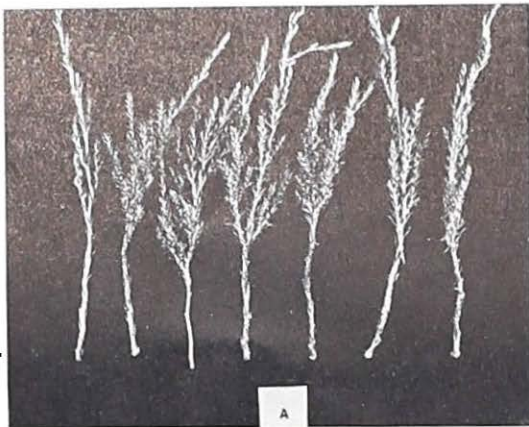


FIG. 86.  
*Juniperus squamata wilsoni*.  
Treated 1-21-39.  
Dug 4-13-39.  
A—Check.



FIG. 37.  
*Juniperus squamata wūsoni.*

Treated 1-21-39.  
Dug 4-13-39.  
B—Unit 40.

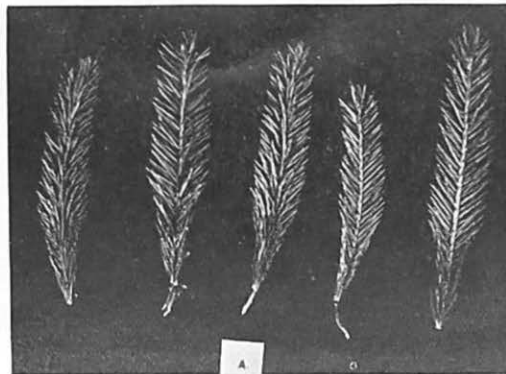


FIG. 38.  
*Picea excelsa.*

Treated 11-11-38.  
Dug 3-2-39.  
A—Check.

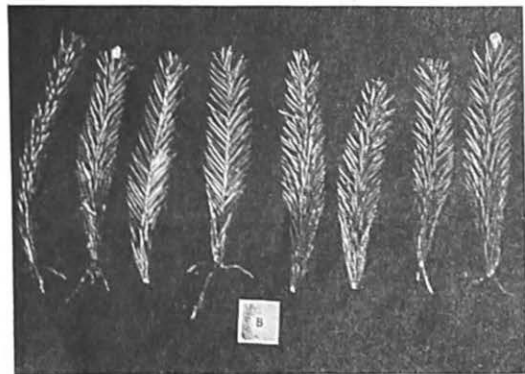


FIG. 39.  
*Picea excelsa.*

Treated 11-11-38.  
Dug 3-2-39.  
B—20 B. T. I. Units.

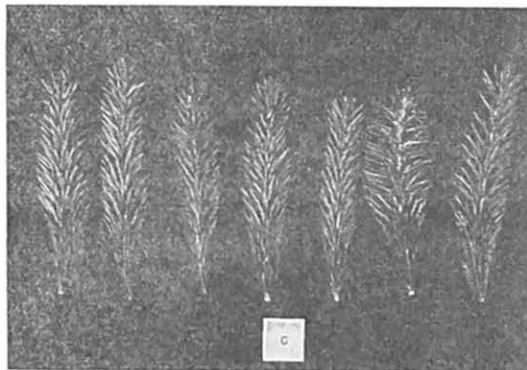


FIG. 40.  
*Picea excelsa.*

Treated 11-11-38.  
Dug 3-2-39.  
C—80 B. T. I. Units.



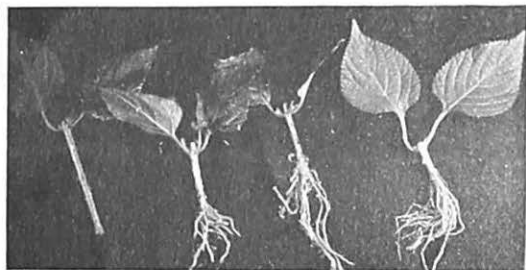


FIG. 41.  
*Lantana camara.*

Treated 1-6-38.  
Dug 2-4-38.  
Left to right: Check, 5,  
10, 20 B. T. I. Units.



FIG. 42.  
*Vitis labrusca* Lucile.

Control lot. Treated with  
tap water 5-30-38 and dug  
after 33 days.



FIG. 43.  
*Vitis labrusca* Lucile.

Treated at the base with  
Unit 160 on 5-30-38. Dug  
after 33 days.

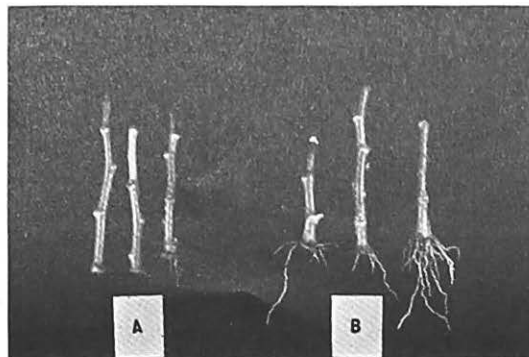


FIG. 44.  
*Euphorbia pulcherrima.*

Treated 1-29-38.  
Dug 8-5-38.  
A—Check.  
B—10 B. T. I. Units.

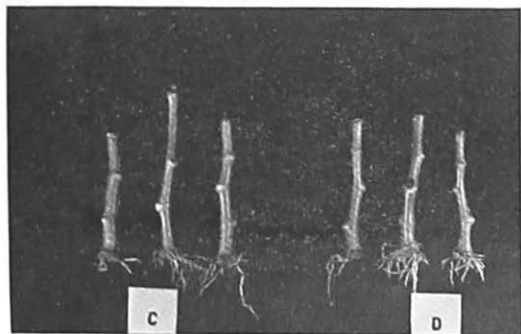


FIG. 45.  
*Euphorbia pulcherrima*.

Treated 1-29-38.  
Dug 3-5-38.  
C—20 B. T. I. Units.  
D—40 B. T. I. Units.

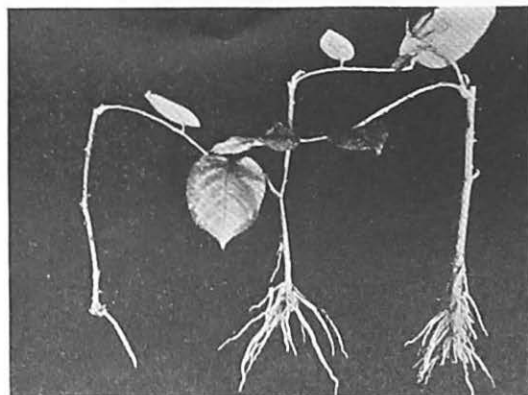


FIG. 46.  
*Rosa polyantha* Kluis  
Scarlet.

Treated 4-2-38.  
Dug 5-4-38.  
Left to right: Check, 2.5,  
5 B. T. I. Units.

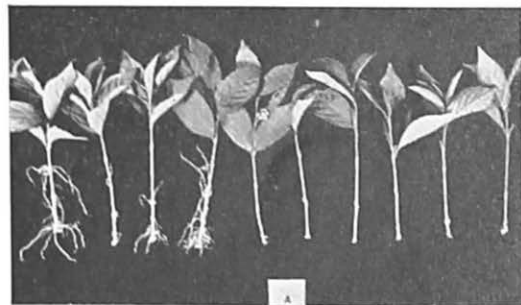


FIG. 47.  
*Callicarpa japonica*.

Treated 10-9-38.  
Dug 11-2-38.  
A—Check.

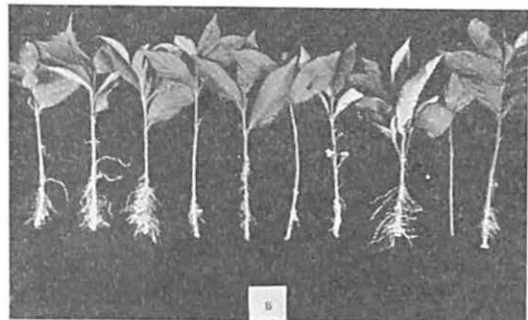


FIG. 48.  
*Callicarpa japonica*.

Treated 10-9-38.  
Dug 11-9-38.  
B—20 B. T. I. Units.

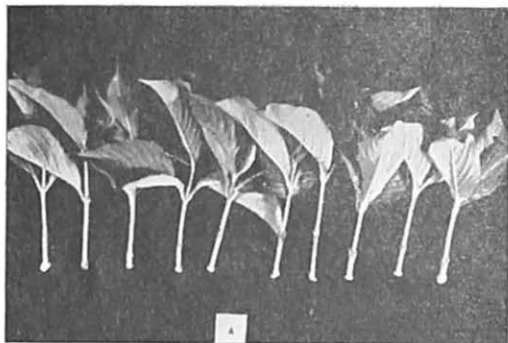


FIG. 49.  
*Weigela Isolene.*

Treated 10-14-38.  
Dug 11-9-38.  
A—Check.



FIG. 50.  
*Weigela Isolene.*  
Treated 10-14-38.  
Dug 11-9-38.  
C—5 B. T. I. Units.

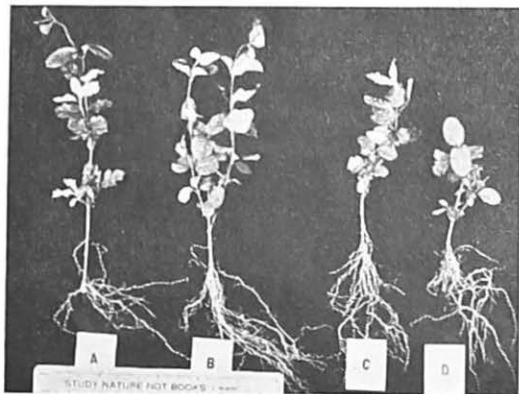


FIG. 51.  
*Lonicera japonica articulata.*

Treated 1-26-38.  
Dug 4-3-38. Note checking effect of high concentrations on shoot growth.  
A—Check.  
B—2.5 B. T. I. Units.  
C—10 B. T. I. Units.  
D—20 B. T. I. Units.

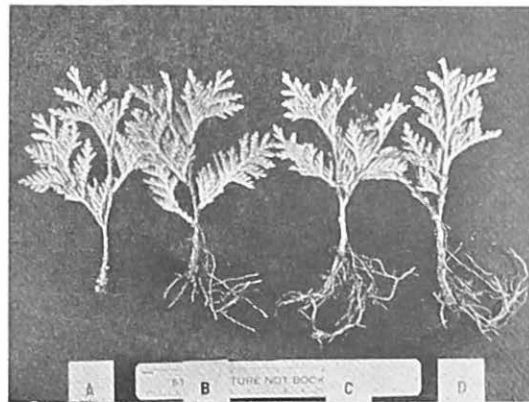


FIG. 52.  
*Thuja occidentalis wareana.*

Treated 12-17-38.  
Dug 4-12-38.  
A—Check.  
B—20 B. T. I. Units.  
C—40 B. T. I. Units.  
D—80 B. T. I. Units.

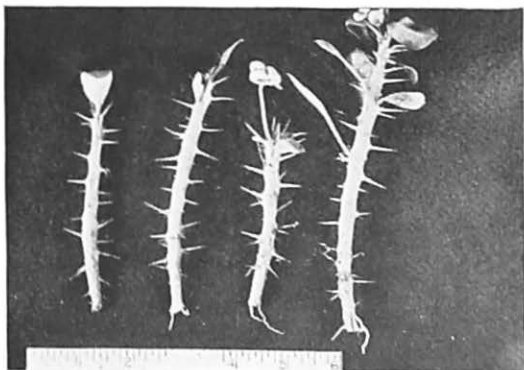


FIG. 53.  
*Euphorbia splendens*.  
Treated 3-30-38.  
Dug 5-4-38.  
Check.



FIG. 54.  
*Euphorbia splendens*.  
Treated 3-30-38.  
Dug 5-4-38.  
20 B. T. I. Units.

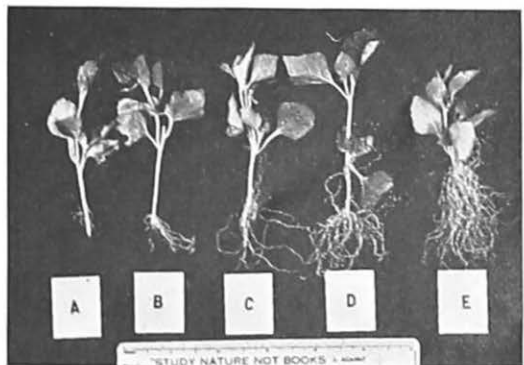


FIG. 55.  
*Ageratum houstonianum*.  
Treated 2-4-38.  
Dug 2-21-38.  
A—Check.  
B—1.25 B. T. I. Units.  
C—2.5 B. T. I. Units.  
D—5 B. T. I. Units.  
E—10 B. T. I. Units.

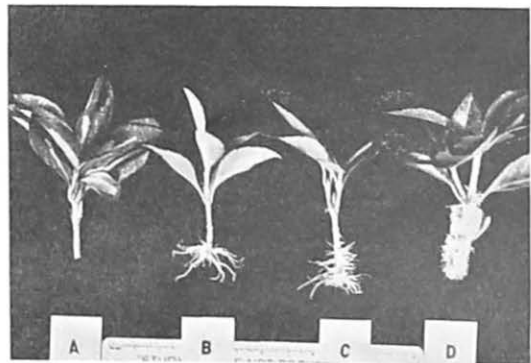


FIG. 56.  
*Euonymus japonicus*.  
Treated 3-30-38.  
Dug 4-21-38.  
A—Check.  
B—10 B. T. I. Units.  
C—20 B. T. I. Units.  
D—40 B. T. I. Units.

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