THE EFFECT OF B-NINE AND CYCOCEL ON THE ROOTING OF CUTTINGS[1]

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INTRODUCTION

The use of chemicals to modify plant growth and development is rapidly becoming one of the most stimulating and exciting fields in horticulture. Chemicals have been found which will hasten or delay flowering, cause blooms to set fruit or to absciss, promote rooting of cuttings, kill undesirable plants and plant pests, and a host of other uses beneficial to the plantsman. B-Nine (N-dimethyl amino succinamic acid), a chemical which is commercially used as a growth retardant for florist crops, has been demonstrated to increase flowering and fruiting of tomatoes when applied at early stages of growth, while the same chemical can be used to eliminate bloom on the same plants when applied to the flower buds (2).

B-Nine was demonstrated to increase tuberous root formation (Fig. 1) when applied as a foliar spray to rooted dahlia cuttings. Cuttings taken from such treated plants rooted more readily than those from untreated plants or plants treated with Cycocel (2-chloroethyl trimethylammonium chloride) Table 1). These results led to attempts to utilize B-Nine in a manner similar to commercial rooting compounds such as those containing 3-indolebutyric acid (IBA).

Table 1 Rooting of dahlia cuttings taken from plants treated with growth retardants. (cv 'Nita')

Treatment	Mean Wt of Roots (gms)	Mean Length of 4 Longest Roots (mm)
Untreated	2.396	131.0
Cycocel 2360 ppm 23 days after potting.	0.643	68.4
B-Nine 2500 ppm 23 days after potting.	4.275	152.3
B-Nine 2500 ppm 23 days and 37 days after potting	7.073	236.5
B-Nine 5000 ppm 23 days after potting.	6.730	158.3

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Fig. 1. Effects of B-Nine treatments on tuberous root formation in *Dahlia pinnata* 'Celebrity'. Note the greater size and number of tuberous roots in the B-Nine treatments.

MATERIALS AND METHODS

Uniform 4-inch cuttings of geranium (*Pelargonium hortorum*), dahlia (*Dahlia pinnata*) and chrysanthemum (*Chrysanthemum morifolium*) were taken from greenhouse stock plants and treated with B-Nine or Cycocel individually or in combination with IBA. The cuttings were rooted in sterile sand under intermittent mist at a diurnal temperature regime of 60° - 70°F. The basal inch or the upper ⅔ of the cuttings were dipped for 15 seconds in distilled water solu-

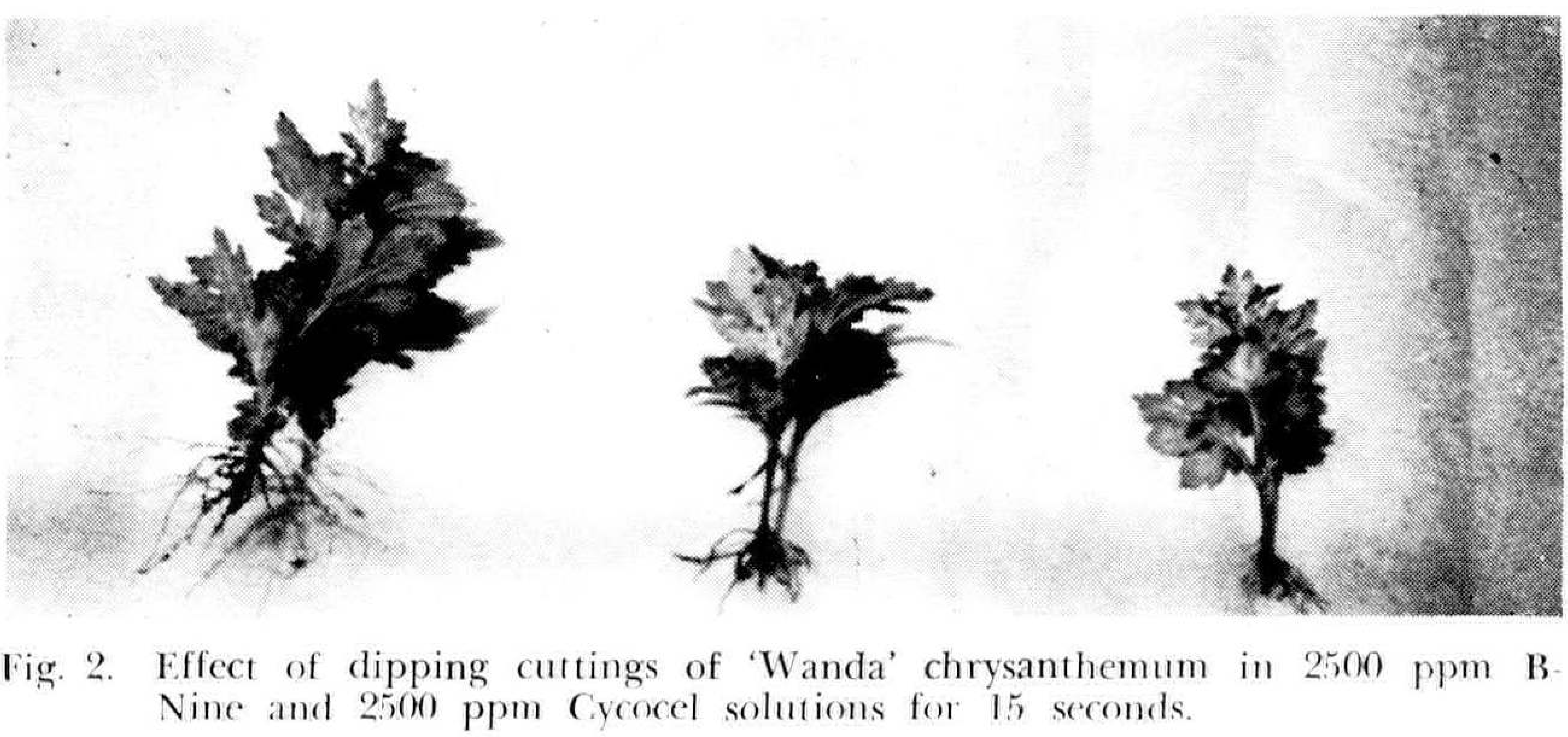

Fig. 2. Effect of dipping cuttings of 'Wanda' chrysanthemum in 2500 ppm B-Nine and 2500 ppm Cycocel solutions for 15 seconds.

tions of B-Nine or Cycocel. In studies involving IBA interactions, some cuttings were allowed to dry and then were dipped in talc dilutions of IBA. Length of treatment was investigated in another series of experiments, utilizing 2500 ppm B-Nine. Experiments were concluded as soon as the control (untreated) cuttings were considered at the optimum degree of rooting for potting. Data taken included number of roots over 1 mm in length, root length, and dry weight of roots.

RESULTS AND DISCUSSION

Figures 2 and 3 illustrate the increased adventitious root formation stimulated by B-Nine and the retardation repeatedly experienced from Cycocel treatment. Rooting of chrysanthemum and geranium cuttings was most effectively advanced by B-Nine concentrations of 1000, 2500, and 5000 ppm.

Table 2. Effect of stem dips of B-Nine and CCC on rooting of 'Minn White' chrysanthemum cuttings.

Treatment	Root Wt. (gm) Mean Fresh	Root Wt. (gm) Mean Dry	Mean No. of Roots	Mean length of Longest Root (cm)
Control	1.32	.0336	8.0	5.46
B-9 1000 ppm	2.64	.0725	12.6	6.86
B-9 2500 ppm	3.56	.0920	15.2	7.24
B-9 5000 ppm	2.76	.0816	13.2	6.73
CCC 1000 ppm	0.74	.0207	5.0	3.30
CCC 2500 ppm	0.62	.0168	5.4	2.92
LSD .05	0.47	.0085	2.5	0.74
LSD .01	0.64	.0116	3.4	1.02

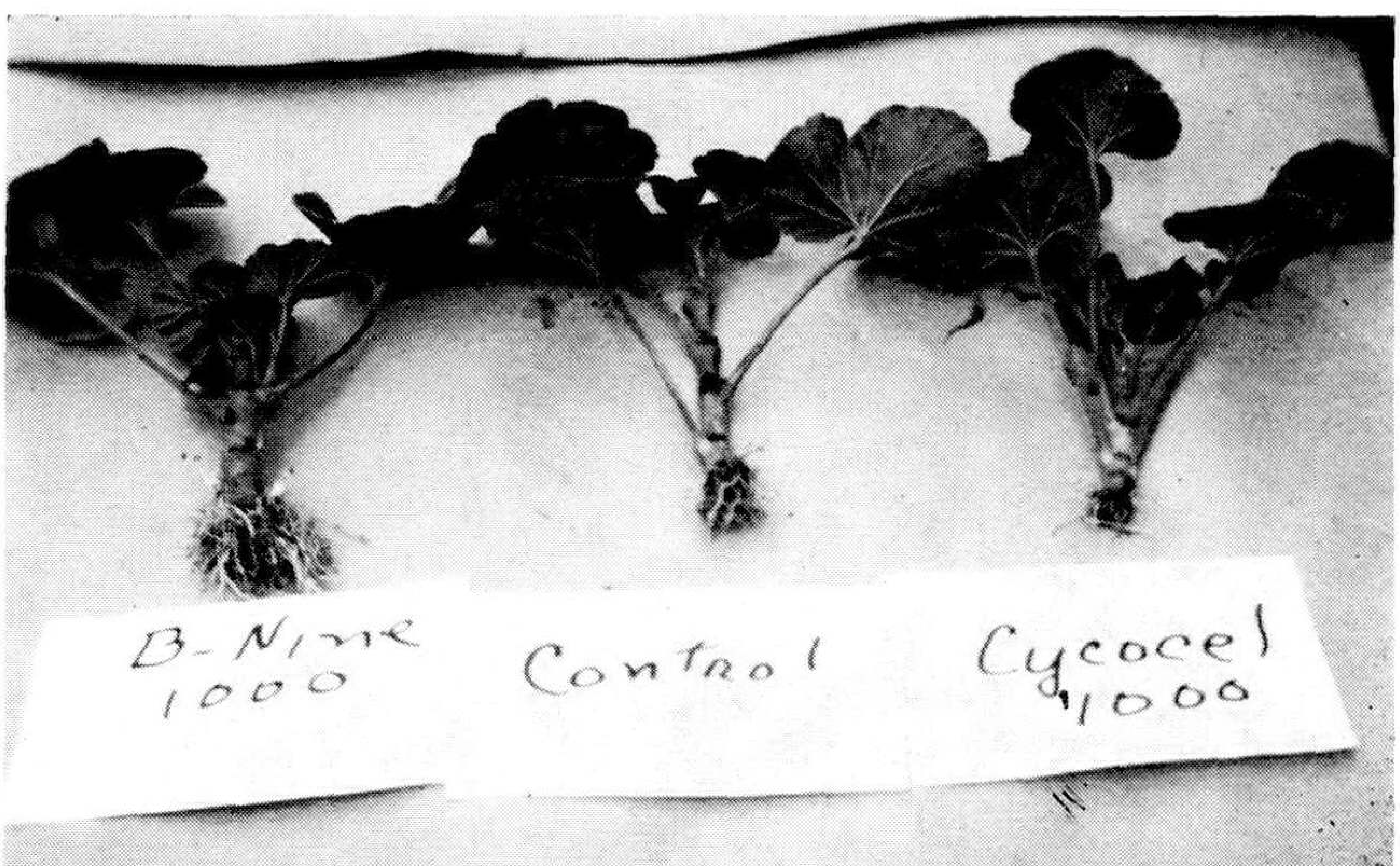

Fig. 3. Effect of dipping 'Salmon Irene' geranium cuttings in 1000 ppm B-Nine and 1000 ppm Cycocel solutions for 15 seconds.

Condition of the stock plant was observed to affect rates of B-Nine necessary, with 5000 ppm most desirable for rooting of cuttings from slow-growing stock plants. Data presented in Tables 2 and 3 illustrate that 'Minnwhite' and 'Wanda' chrysanthemum cuttings produced more roots when treated with B-Nine, but Cycocel retarded rooting. Increases in root development were achieved with all of the B-Nine treatments indicated, but 2500 ppm produced the greatest number and weight of roots. Similar responses were obtained with cuttings of 'Nita' dahlia (Table 4) and seven other geranium cultivars.

Table 3. Effect of B-Nine and CCC stem dips on rooting of 'Wanda' chrysanthemum cuttings

Treatment	Mean Fresh Root Wt (gm)	Mean Dry Root Wt (gm)	Mean No of Roots	Mean length of Longest Root (cm)
Control	2.46	.0401	9.80	2.67
B-9 1000 ppm	3.64	.0596	10.60	2.79
B-9 2500 ppm	4.48	.0868	11.60	3.43
B-9 5000 ppm	4.20	.0790	11.60	4.19
CCC 1000 ppm	1.08	.0220	7.00	1.65
CCC 2500 ppm	0.68	.0103	5.20	1.27
LSD .05	0.66	.0152	2.93	0.86
LSD .01	0.90	.0207	3.99	1.17

Table 4 Effect of B-Nine and CCC stem dips on rooting of 'Nita' dahlia cuttings.

Treatment	Mean Dry Root Wt (gm)	Mean No of Roots	Mean length of Longest Root (cm)
Control	.0155	5.0	5.59
B-9 1000 ppm	.2047	6.8	8.64
B-9 2500 ppm	.1710	6.6	7.37
B-9 5000 ppm	.2008	6.6	8.26
CCC 1000 ppm	.0051	3.2	2.79
CCC 2500 ppm	.0025	3.6	1.52
LSD .05	.0437	2.5	2.11
LSD .01	.0596	3.3	2.90

Dipping the foliage of geranium and chrysanthemum cuttings stimulated rooting, but not as uniformly as the stem dips.

In tests designed to determine optimum length of time for treatment of geranium and chrysanthemum cuttings (Table 5), a one minute dip caused the most rapid root development, but a 15-second dip was nearly as effective and more conserving of time. Dips of 5 and 10 minutes duration reduced rooting rate especially on chrysanthemums. Results similar to those in Table 5 were achieved with 'Carefree Light Salmon' and 'Carefree Picotee' geranium cuttings.

Table 5 Effect of duration of 2500 ppm B-Nine stem dips on rooting of 'Wanda' chrysanthemum cuttings

Treatment	Mean Dry Root Wt (gm)	Mean No of Roots	Mean length of Longest Root (cm)
Control	.0372	11.75	2.86
2 sec.	.0405	8.40	2.70
15 sec.	.0891	13.75	3.33
1 min.	.0923	12.25	3.49
5 min.	.0275	6.25	2.86
10 min.	.0194	5.25	1.75
LSD .05	.0121	2.34	0.86
LSD .01	.0167	3.24	1.18

When geranium and dahlia cuttings were treated with 500, 1000 and 2000 ppm IBA and combinations with several rates of B-Nine and Cycocel, B-Nine was demonstrated to improve rooting more rapidly than the best IBA treatment, when such treatments were compared with the control (Table 6 and Fig. 4). The combination of B-Nine and IBA did not promote as large an increase as B-Nine alone. However, IBA tended to reduce the root-retarding effect of Cycocel. Rooting was more strongly favored by 1000 ppm B-Nine on dahlias than on geraniums and chrysanthemums. B-Nine at all levels was more effective than IBA at the rates tested while B-Nine and IBA combinations were no better than B-Nine alone. The mediation of Cycocel's retardation effects by IBA suggests corroboration of the theories of Kuraishi and Muir (1) that the effects of Cycocel are antagonistic to those of auxin-like chemicals. However, B-Nine's root-stimulation could be considered to be enhancing or replacing auxin behavior.

This research has demonstrated the potential of B-Nine for stimulation of rooting of geranium, chrysanthemum and dahlia cuttings. The increased rooting was related to an increase in root numbers together with increased root length and branching. B-Nine at 2500 and 5000 ppm were the most effective rates on chrysanthemums and geraniums, while 1000 ppm was also effective on dahlias. Cycocel treatments consistently inhibited root initiation and it is recommended that Cycocel not be used on stock plants intended for propagation purposes.

Although data presented are for single harvest dates, cuttings dipped in 2500 ppm B-Nine for 15 seconds could be harvested from 5 to 10 days earlier than untreated cuttings. This could conceivably allow a propagator to produce several more crops of rooted cuttings per year, the number of extra crops depending on crop, cultivar, and growing conditions.

Research is presently underway to determine the usefulness of B-Nine as a root promoting chemical for other plants propagated by cuttings, particularly carnation, poinsettia and

Table 6. Effect of growth regulator stem dips on rooting of 'Carefree Light Salmon' geranium cuttings.

Treatment	Mean Fresh Root Wt. (gm)	Mean Dry Root Wt. (gm)	Mean No. of Roots	Mean length of Longest Root (cm)
Control	2.10	.0672	11.00	6.60
B-9 2500 ppm	3.92	.1529	16.00	8.99
B-9 5000 ppm	4.32	.1749	17.80	9.02
CCC 1000 ppm	0.76	.0194	6.60	2.59
IBA 1000 ppm	2.84	.0881	13.60	7.49
B-9 2500 ppm & IBA 500 ppm	4.24	.1684	18.00	8.13
CCC 1000 ppm & IBA 1000 ppm	1.34	.0401	8.80	4.83
LSD .05	0.75	.0247	3.38	1.19
LSD .01	1.00	.0329	4.49	1.57

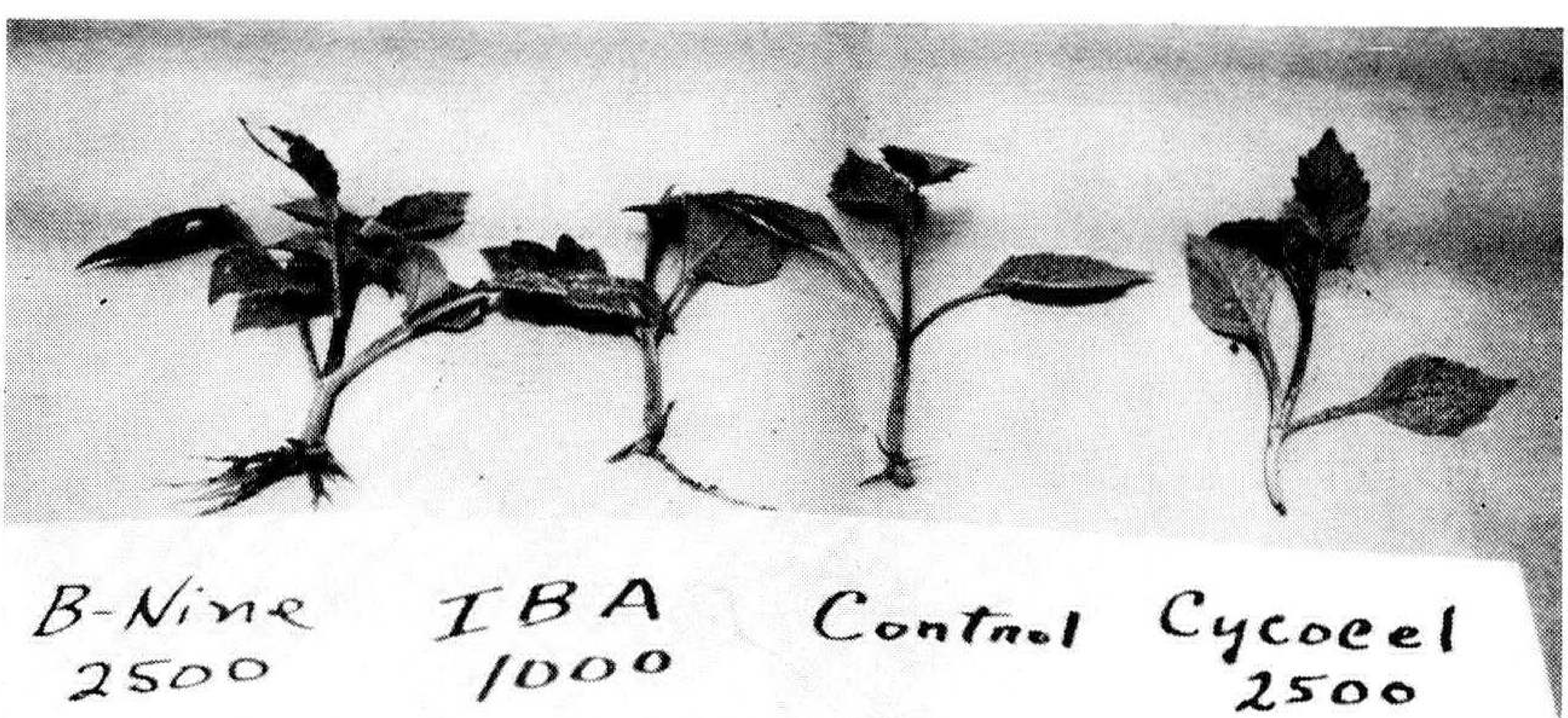

Fig. 4. Effect of growth regulator treatments applied as dips of the basal inch of 'Nita' dahlia cuttings. Figures are ppm.

several woody plant species. Experiments designed to ascertain the nature of the root-promoting ability of B-Nine, together with inter-actions with other growth regulating chemicals are being developed.

LITERATURE CITED

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3. Van Overbeek, J. 1966 Plant hormones and regulators *Science* 152:721-731.

MODERATOR NIELSON: Our next speaker requires no introduction to most of us, Mr. Al Fordham of Arnold Arboretum.

AL FORDHAM: We have now reached the point in the program where members describe plants which they feel have particular merit. We have a number of slides and the first person up is Roy Nordine of the Morton Arboretum.

ROY NORDINE: As long as I can remember the discussions have continued regarding the differences between White and Green Ash. And the literature is not clear about the growing habits or rate of growth between these two specimens. The slide shows a tree of each species on a highway east of Rockford, Illinois. Both trees were of the same size when planted during WPA days in the mid-1930's. The tree on the left with its irregular branching is Green Ash; the tree on the right with regular branching is White Ash. Thirty years later they are both of the same diameter and height. Another distinct difference occurs in the fall. The Green Ash always turns a light brown. If it escapes an early frost, White Ash changes into shades of purple, ranging from a bright reddish to a dark wine-like purple. A slide from a plant in The Morton Arboretum exhibits this color. Several selections of White Ash have appeared. This slide is from the old parent tree of "Autumn Purple" on the campus of The University of Wisconsin. The tree is now declining with age. The next slide is of nursery grown trees of "Autumn Purple" taken from the older parent tree. There is also another selection of White Ash called "Rose Hill".

In recent years interest has developed for Blue Ash, *Fraxinus quadrangulata*. This plant occurs on rich bottom lands and usually as a lone or scattered tree in the woods. A number of incorrect plants have appeared and are advertised as Blue Ash. The first slide is a tree in The Morton Arboretum showing a typical form and shape with a good central leader and well spaced branches. The second slide shows the distinct identifying marks of the four wings on the annual growth; these wings disappear in the second year leaving faint lines.

AL FORDHAM: Dr. Pike from the University of New Hampshire would like to describe a tree which he feels has been overlooked.

DR. PIKE: One of my chief interests have been the use of native plants for landscape work and one which is particularly pretty in the architecture of its branches is *Cornus alternifolia.* It is difficult to find in nurseries but is very hardy and has a tremendous range over the continent. Its blossoms are not as spectacular as the Florida and Korean Dogwood but it is quite handsome in fruit. The fruits are up to ⅓" in diameter in large clusters on red peduncles. I feel it should be grown more widely. Thank you.

AL FORDHAM: Next we will have Lanny Pride of Butler Pa. who has done a good deal of work with Holly and Rhododendrons who would like to show a few slides.

LANNY PRIDE: *Ilex Opaca* 'Carnival' and 'Arlene Leach' are selections of Grace Hybrids, the result of testing and breeding for 40 years at Butler, Pennsylvania by Orlando S. Pride. The Grace Hybrids have proven to be hardier and have more vigor than other clones tested in the Butler area. They also grow more compact and transplant more readily than most other clons tested.

CEDRUS DEODARA 'KASHMIR' AND IT'S PROPAGATION BY CUTTINGS

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Cedrus deodara, commonly known as the Deodar, Indian or Himalayan Cedar, is a tree native to the Himalayan Mountains from Nepal to Afghanistan at altitudes of 1200 meters or higher. Although perhaps the most striking, it has been considered the least hardy of the true cedars. Rehder lists it as a Zone 7 plant while Den Ouden and Boom, in their recent *Manual of Cultivated Conifers,* speak of it as being not quite hardy in Western Europe. L. H. Bailey considered it to be by far the best conifer for planting on the Pacific slope and one of the most popular conifers planted in Southern California. It is also widely used throughout the Gulf States. Through the years deodar cedars have been tested repeatedly for hardiness at the Arnold Arboretum but have always failed to survive for they lacked the ability to withstand the winters.

In 1961 two one-year-old grafted plants of a cultivar named *Cedrus deodara* 'Kashmir' were given to the Arnold Arboretum and since that time they have proven hardy. This clone provides an excellent example of the unseen differences that can be present in individual plants. In a nursery row this plant would appear similar to others, yet there was an invisible genetic difference — the ability to withstand low