nurseries — we don't have state nurseries in Nebraska. And the incidence of the Federal Nurseries is bad enough in seed rows that a million and three quarters *J. virginianum* seedlings were destroyed. Now we don't find it too bad, just in isolated plots. Here again, Dr. Peterson's theory is that if plants are spaced wide enough apart, and you don't have this high concentration of plants as in the seed bed or the seed row the problem is reduced. It is very, very, minor in landscape work.

CASE HOOGENDOORN: Now you talk about *Phomopsis* blight in *Juniperus virginiana.* Do you also get that in Hetzi, Pfitzer or any other varieties?

RALPH SHUGERT: Mr. Hoogendoorn, I noticed in a Rhode Island paper they listed a bunch of host plants susceptible to this blight. I have never witnessed it in Nebraska or anything except *J. virginiana.* We also grow quite a few *J. scopulorum* from seed — almost as much *J. scopulorum* as we grow *J. virginiana* and I've been told that I don't have to spray the *J. scopulorum.* Very rarily do you ever see it get it. If the disease which shows up is *Phomopsis,* I have a type of insurance program and spray the 2-0 beds, but only two-zero. And even though the disease is light in 3-0 *J. virginiana* beds, again it is an insurance policy, we also spray the 3-0 beds. No, I have never seen it, sir, on any other than *J. virginiana.*

HANS HESS: Our final paper this morning is by R. E. Odom and W. J. Carpenter, Jr. on endogenous auxins and the rooting of cuttings. The paper will be presented by Dr. Odom.

ENDOGENOUS ACIDIC AND NEUTRAL AUXINS AND THE ROOTING OF CUTTINGS[1]

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Environmental and internal factors influence initiation of roots on stem cuttings. Indole auxins have been shown to be a major internal factor in root initiation. Other essesntial chemical substances have been found, but all require the presence of auxins.

The presence of and changes in endogenous indole auxins in bases of several species of herbaceous and woody cuttings during rooting were determined. The five herbaceous species were *Alternanthera bettzickiana* 'Aurea Nana,' *Coleus blumei, Chrysanthemum morifolium* 'Dawn Star,' *Pelargonium hortorum* 'Pink Cloud,' *Dianthus caryophyllus* 'Alaska.' Those species root readily but their root emergence varies from approximately 2 to 15 days. The two woody species studied were *Pyracantha coccinea lalandi,* which is somewhat erratic in rooting, and *Carya illinoensis,* which is considered a nonrooter.

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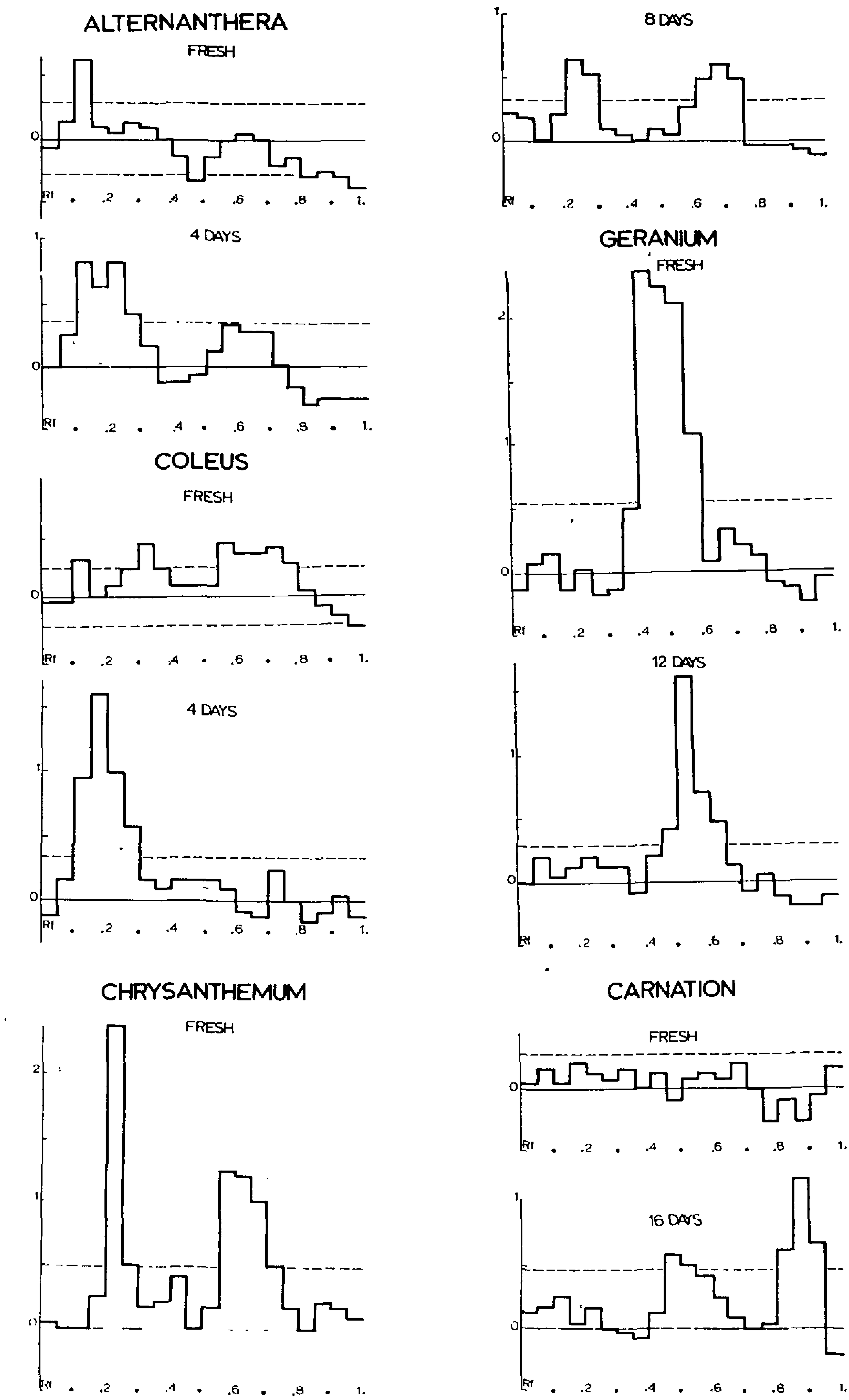

Plate 1. Histograms from bioassays of fresh cuttings and time of root emergence of alternanthera, coleus, chrysanthemum, geranium and carnation. Growth of coleoptile sections shown in mm, and significance at 5% levels indicated by dashed line

Uniform terminal cuttings were sampled at propagation and predetermined intervals of 1 to 4 days during rooting. The sampling of pecan differed since changes in auxins were determined during 5 weeks of dormant storage of hardwood cuttings at 7-day intervals.

The basal one-inch portion of the cuttings were lyophilized and extracted with methyl alcohol for 2 hours at temperatures below freezing. The extracts were purified (Nitsch, 1955) prior to separation by paper chromatography in a solvent system of isobutanol-methanol-water (80-5-15 v/v) (Nitsch, 1956). The chromatograms were cut to 20 equal 1 cm. sections and bioassayed by the Avena coleoptile test (Nitsch and Nitsch, 1956). Those procedures permitted determination of both acidic and neutral 'free' auxins in the bases of the cuttings at sampling time.

Selected data from the bioassays are shown in Plates I and II. The histograms illustrate auxin levels in fresh samples and when roots emerged in all species except pecan. Pecan bioassays were made from samples collected in November, February, and April. Comparisons are presented between auxin levels in fresh cuttings and after 5 weeks of dormant storage.

The histograms indicate qualitative and quantitative differences in auxins among the various species studied. Six auxins were tentatively identified by Rf location of growth peaks in the bioassay as A(0.05-0.20), B(0.20-0.35), C(0.40-0.60), D(0.55-0.75), E(0.70-0.85), and F(0.85-1.0). They closely parallel Rf values of indolepyruvic acid (1Pya), indoleacetic acid (IAA), indolebutyric acid (IBA), an unknown, indoleacetonitrile (IAN), and ethylindoleacetate (IAE) when chromatographed in the same solvent. Further identification attempts indicated that the substance tentatively identified as IBA in geranium probably was an unknown neutral precursor.

Quantitative bioassays showed either high levels of one or more auxins in fresh samples or a tendency to increase rapidly during rooting of alternanthera, coleus, chrysanthemum and geranium. Carnation and pyracantha cuttings initially had low auxin levels, but some accumulation occurred prior to or during root emergence. The levels of auxins in pecan were higher in November and April than in February with very little change during storage periods.

Qualitatively, the presence or accumulation of acidic auxins occurred in alternanthera, coleus and chrysanthemum, while the presence or accumulation of neutral auxins were more predominant in geranium, carnation and pyracantha.

Several indole auxins have been found in plant tissues. and several synthetic auxins have been shown to be capable of stimulating root initiation on stem cuttings. The precise effects of those substances are not known, but it is generally believed that their auxin activity may be due to conversion in plant tissue to IAA (Leopold, 1964) (Fawcett, 1961). The accumulation of a substance at the Rf of IAA was found in fairly high quantities

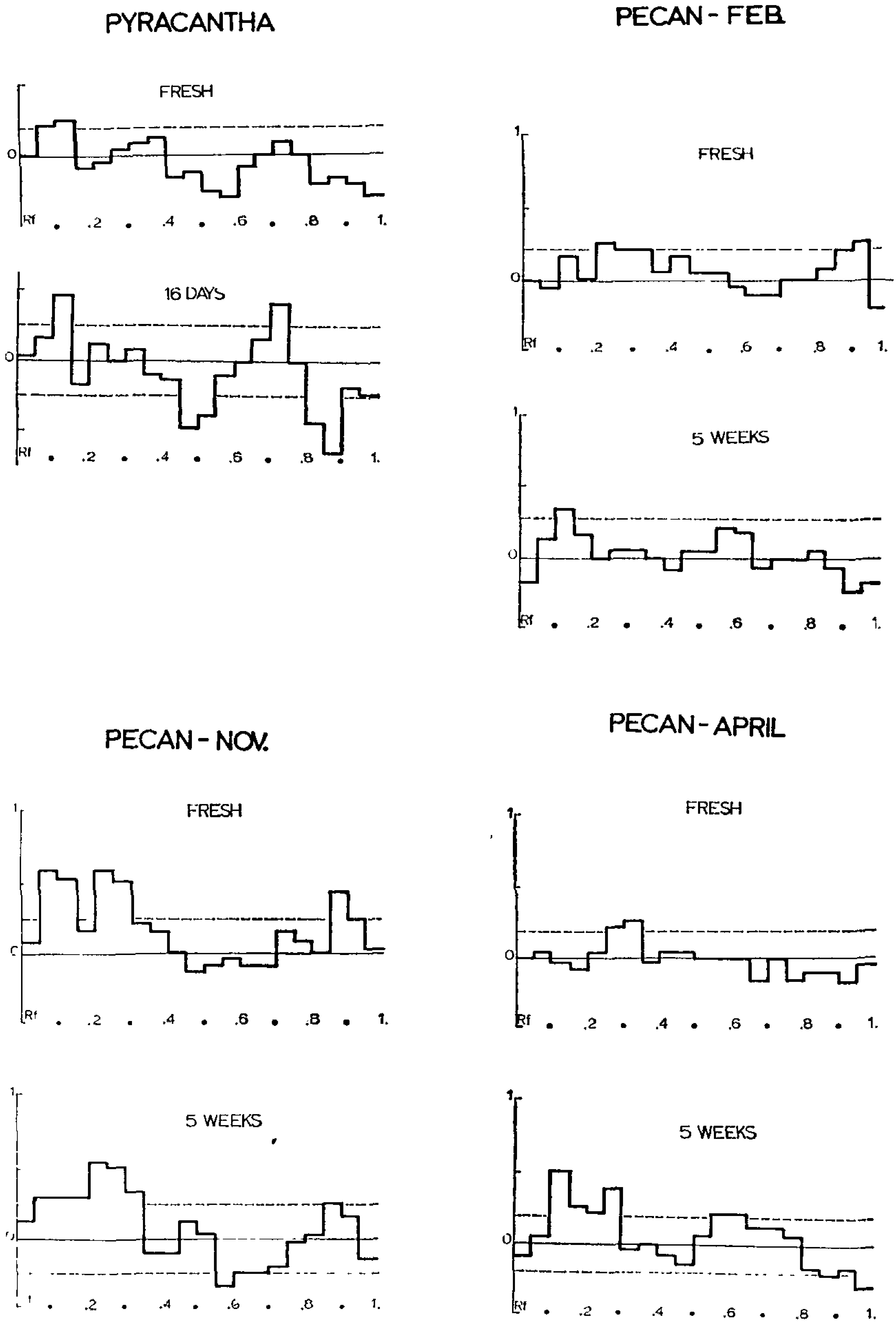

Plate 2: Histograms from bioassays of fresh cuttings and after five weeks of dormant storage of pecan taken in November, February and April. Growth of coleoptile sections shown in mm., and significance at 5% level indicated by dashed line.

in alternanthera, coleus and chrysanthemum, but it was inconsistent in geranium, carnation, and pyracantha. The inconsistent appearance in those species may be caused by slow conversion of neutral auxins to acidic types. Under such conditions, IAA could have been utilized in rooting as it was produced.

Although added root promoting substances have not been studied in these tests, geranium and carnation have been shown to respond to added auxins by producing more roots per cutting and rooting more rapidly (Hartmann and Kester, 1959). Similar beneficial responses were obtained in pyracantha when cuttings were selected in early spring and fall (Thimann and Behnke-Rogers, 1950). Alternanthera, coleus and chrysanthemum normally root so rapidly and profusely that added root promoting substances are of little consequence. Beneficial responses to added rooting stimulants with the species studied closely parallel the lack of or inconsistent accumulation of endogenous acidic auxins.

The nonrooting of pecan and the erratic rooting of pyracantha do not appear to be entirely related to lack of or low levels of auxins. Pyracantha and pecan have total auxin levels comparable with carnations, which indicates that substances other than auxins could be involved. Skoog and Tsui (1948) found a relationship between auxins and kinins in cell division and cell differentiation. Hess (1960, 1963) showed a correlation between the capacity of certain plants to root and the number of rooting cofactors present in the tissue. These findings also do not preclude the possibility of structural limitations.

In summary, the vigor and rapidly of rooting in the species studied paralleled the presence or accumulation of acidic auxins. The species that showed a delayed or inconsistent accumulation of acidic auxins are generally known to respond favorably to added rooting stimulant. Endogenous auxins did not appear to be the limiting factor in the erratic or nonrooting responses of the woody species studied.

LITERATURE CITED

1. Fawcett, C H. 1961. Indole auxins. Ann. Rev. Plant Physiol, 12:345-368
2. Hartmann, Hudson T. and Dale E. Kester. 1959 Plant propagation principles and practices Prentice-Hall, Inc, Englewood Cliffs, N.J.
3. Hess, Charles E 1960 Research in root initiation — a progress report Proc Plant Prop. Soc, 10.118-123
4. Hess, Charles E 1963 Why certain cuttings are hard to root Proc. Plant Prop Soc. 13.63-71.
5. Leopold, A C 1964. Plant growth and development. McGraw-Hill Book Co, N Y.
6. Nitsch, J P. 1955 Free auxins and free tryptophane in the strawberry Plant Physiol, 30 33-39
7. Nitsch, J P 1955 Methods for the investigation of natural auxins and growth inhibitors In chemistry and mode of action of plant growth substances, ed. by Wain, R. L. and Wightman, F, 3-31
8. Nitsch, J P. and C Nitsch 1956 Studies on the growth of coleoptile and first internode sections A new, sensitive straight-growth test for auxins. Plant Physiol, 31.94-111
9. Skoog, F. and C Tsui 1948 Chemical Control of growth and bud formation in tobacco stem and callus Amer Jour Bot, 35:782-787.
10. Thimann. K V and J Behnke-Rogers 1950. The use of auxins in the rooting of woody cuttings M M Cabot Foundation, Publ No 1, Harvard Forest Petersham, Mass.