yaupon is a good example of a species that could be difficult. However, heavy cuttings stuck shallow (¼ to ½ inch deep) can give results near the 100% mark.

The ventilation and isolation provided by 2- to 3-inch spacing of the cutting stuck in the pots goes a long ways toward controlling leaf disease problems. If decay at the bottom of the stem becomes a problem, shallow sticking or more porosity in the soil mix will usually correct the situation.

Everyone will have his own pet mix. One such mix that works well is:

3 parts finely ground pine bark
2 parts peat
2 parts gritty sand (very coarse)
6 lbs/cu yd Osmocote (18-6-12)
1 lb/cu yd Micromax
10 lbs/cu yd dolomite limestone

Direct rooting is destined to become standard procedure in the nursery business of the future It lends itself well to year-round planting that can support year-round sales, to say nothing of the considerable savings in the time and labor that are critical factors in anyone's future.

PROPAGATION OF UPRIGHT JUNIPERS

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Abstract. Cuttings of *Juniperus chinensis* L 'Hetzii' were rooted at monthly intervals over a 2-year period with IBA treatments of 0, 2000, 4000, or 8000 ppm Rooting varied greatly over this period, but was consistently poor in early spring (March) IBA did not significantly improve rooting percentages when rooting capacity was low, but did increase numbers of roots per cutting during favorable rooting periods Trimming the upper half of the leaf from the cuttings also had no effect on rooting In another experiment, rooting medium temperatures of 20° and 25°C improved rooting of cuttings of *J virginiana* L 'Skyrocket' and 'Hillspire', and *J chinensis* L 'Kaizuka' *Cupressocyparis leylandii* rooted equally well at 15°C

REVIEW OF LITERATURE

Rooting juniper cuttings has concerned plant propagators for many years. Although some junipers root readily, others are difficult to root, or root well sometimes and poorly at others. Generally, the upright forms are more difficult and erratic in their rooting than the prostrate forms. For many junipers the time of year for taking the cuttings greatly influences rooting. In 1953 Snyder (4) reviewed several references related to juniper rooting prior to that time and found that most investigators indicated November through February was the best time to take juniper cuttings He also found that difficult-to-root cultivars usually were not benefited by root promoting hormones. In the late 1950's Nelson (3) investigated summer rooting of several juniper cultivars in Canada. Most were quite slow to root, with marked differences in rooting success from one year to the next. Cuttings taken in winter rooted consistently for most cultivars (2). Lanphear and Meahl followed seasonal fluctuations of Andorra juniper (*Juniperus horizontalis* 'Plumosa') over a one-year period in 1963 (1). They found high rooting percentages and root numbers from November through April. IBA increased the number of roots initiated during the favorable rooting period, but did not improve rooting during the months rooting was poor

Although these studies indicate juniper cuttings are best taken from late fall to spring, we still hear of poor or erratic rooting of juniper cuttings from nurserymen in Virginia, particularly if cuttings are taken in the spring. It was considered that since the previously discussed studies took place in more northern localities, seasonal response to rooting in southern regions may be somewhat different. Therefore, a two year study was made to follow the seasonal rooting characteristics of cuttings of *Juniperus chinensis* L. 'Hetzii' in Virginia and determine the effects of IBA on rooting.

Some propagators trim a portion of the leaves from their cuttings to reduce crowding or moisture loss. Effects of trimming on juniper rooting has not been reported, therefore, leaf trimming was investigated during part of the study. A preliminary experiment was also conducted to determine optimum bottom heat temperature during juniper rooting.

MATERIALS AND METHODS

Seasonal and IBA effects: At monthly intervals starting in November 1979, and for almost two years thereafter, 20 to 25 cm terminal cuttings of *Juniperus chinensis* L. 'Hetzii' were selected for rooting. The leaves were stripped from the basal 4 to 5 cm prior to dipping for 5 seconds in a 50% ethanol solution of 2000, 4000 or 8000 ppm IBA. Control cuttings were left untreated. During the summer an outdoor mist bench was used covered with 40% shade cloth. In late fall, winter, and early spring the cuttings were placed on a greenhouse mist bench. The minimum greenhouse temperature was 12°C with a rooting medium temperature maintained at 25°C with heat cables. Mist frequency and duration were adjusted according to environmental conditions. After 10 weeks in the rooting medium the cuttings were evaluated for number of roots initiated per cutting and percent cuttings rooted.

Effects of leaf trimming. From January to June, 1980, the above experiment was duplicated except that the upper half of each cutting was trimmed off with scissors. These trimmed cuttings were compared with the corresponding untrimmed cuttings for number of roots and percent rooting.

Effects of rooting medium temperatures and of IBA: In a separate experiment, cuttings of *Juniperus virginiana* L. 'Skyrocket' and 'Hillspire', and *J. chinensis* L. 'Kaizuka' (Hollywood juniper) and *Cupressocyparis leylandii* (Leyland cypress) were started in flats of 1·1 peat moss:perlite with bottom heat temperatures of 15, 20, or 25°C. Half the cuttings at each temperature had the basal end dipped in a 2000 ppm IBA solution in 50% ethanol for 5 seconds. The other half of the cuttings were untreated. This experiment was started October 29, 1980, and the cuttings were evaluated March 20, 1981.

RESULTS

Seasonal and IBA effects: During the first year (1979-80) (Figure 1) rooting was poor in November, improved slightly in December and January and was very poor again in March (cuttings were not taken February 1980). Rooting improved in April and May, declined again in June, then gradually improved from August through October 1980. During the second year, 1980-81, (Figure 2) rooting was generally better than the first year, with exceptionally good rooting both in December and July Very poor rooting in February and March corresponded with the low point in March of the previous year. Cuttings taken in September and October of 1981 have not yet been evaluated. There was no consistent effect from IBA except during the exceptionally good rooting period of December-January 1980-81, where increasing concentrations of IBA produced greater numbers of roots per cutting but had no significant effect on rooting percentage.

Effects of leaf trimming: There were no significant differences either in rooting percentages or number of roots per cutting between trimmed and untrimmed cuttings during the months this factor was evaluated (Figures 3 and 4).

Effects of rooting medium temperatures and IBA: Table 1 shows the results of bottom heat and IBA treatments on three juniper cultivars and on Leyland cypress. Cuttings were evaluated on a scale of 1 to 4 (1=no roots, 4=heavily rooted). For junipers 20 and 25°C usually produced better root systems than 15°C. The IBA treatment appeared to be of limited bene-

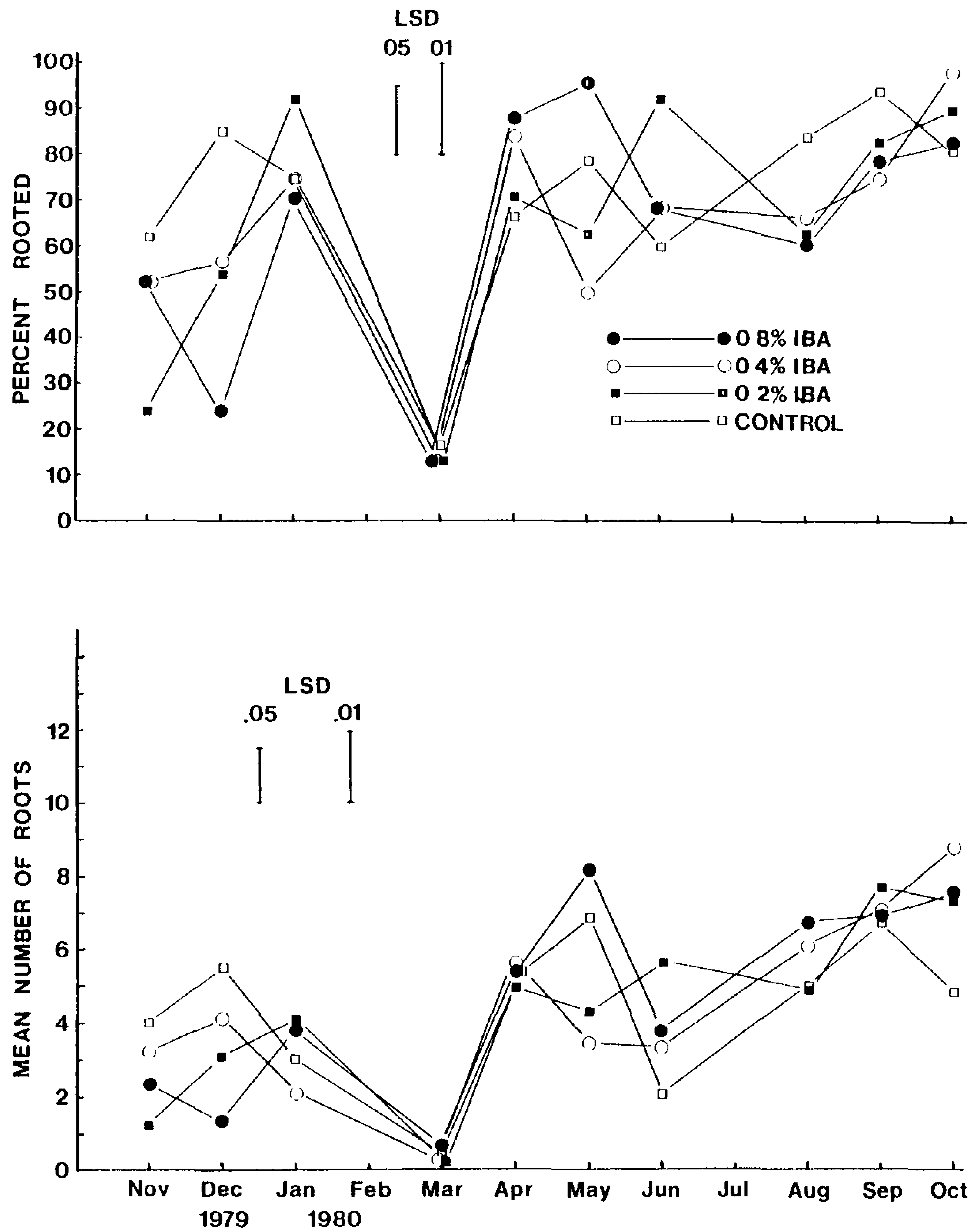
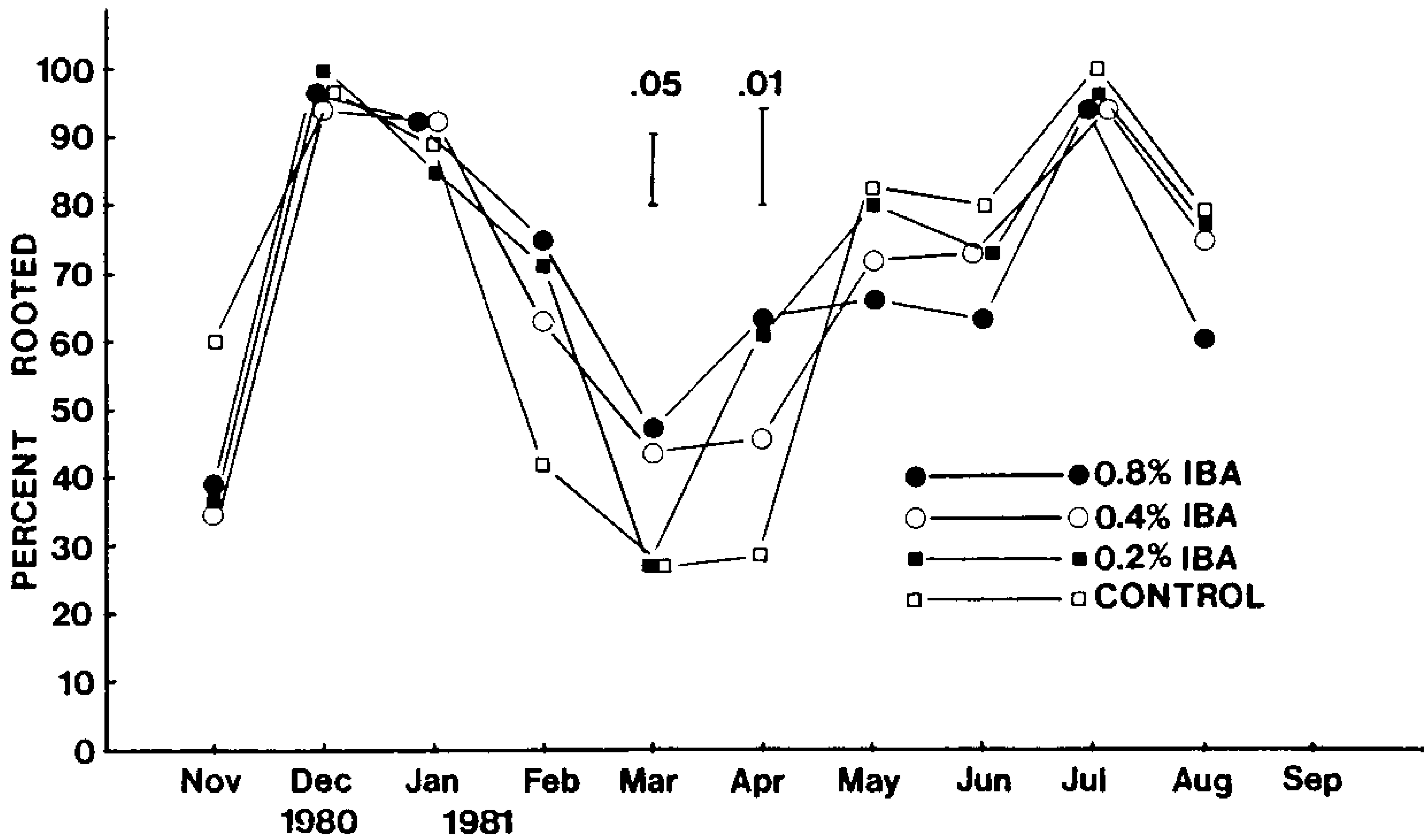


Figure 1. Percentage of cuttings that rooted (upper graph) and mean number of roots per cutting (lower graph) for cuttings of 'Hetzii' juniper taken from November 1979 to October 1980



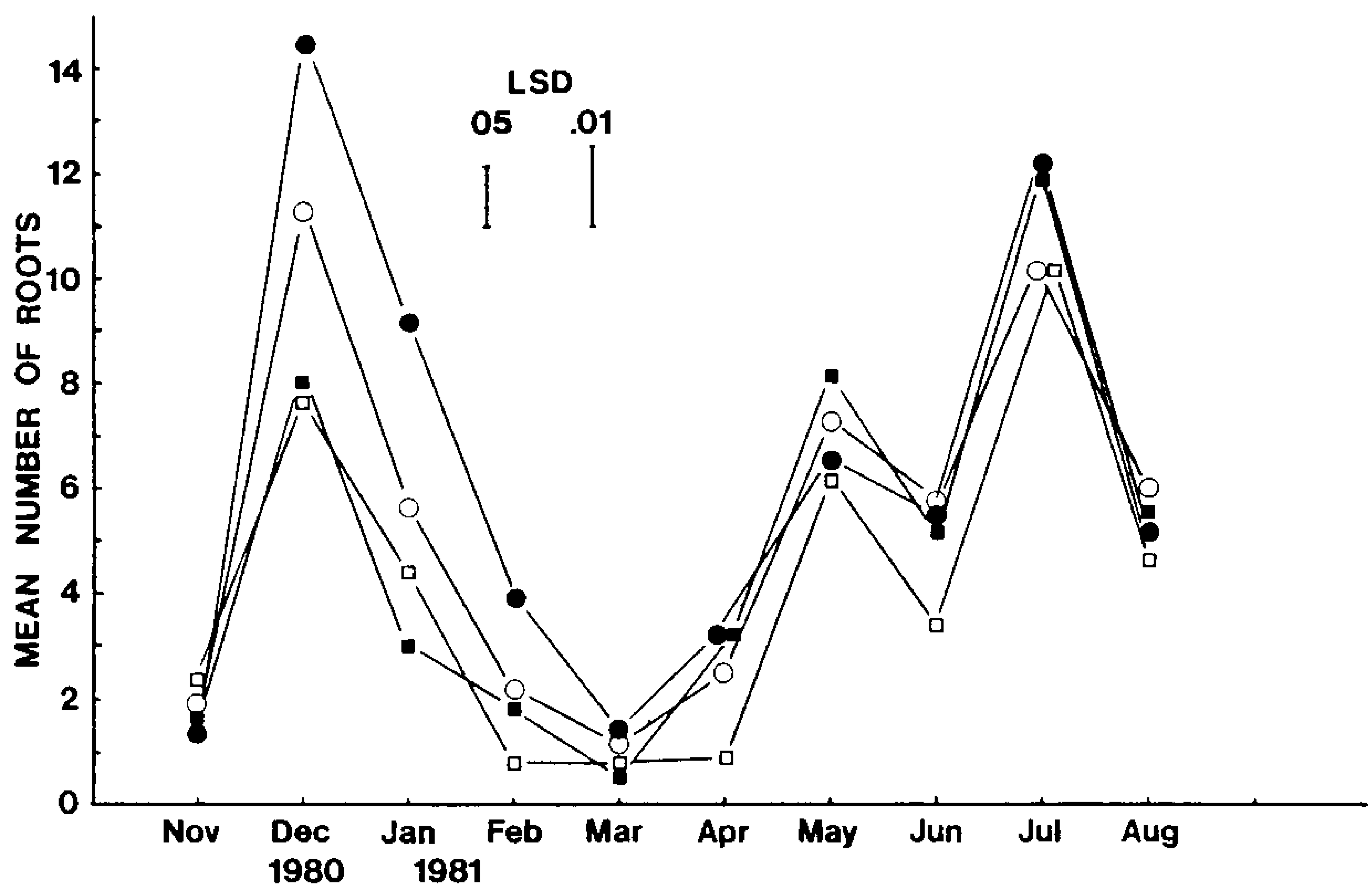


Figure 2. Percentage of cuttings that rooted (upper graph) and mean number of roots per cutting (lower graph) for cuttings of 'Hetzii' juniper taken from November 1980 to August 1981

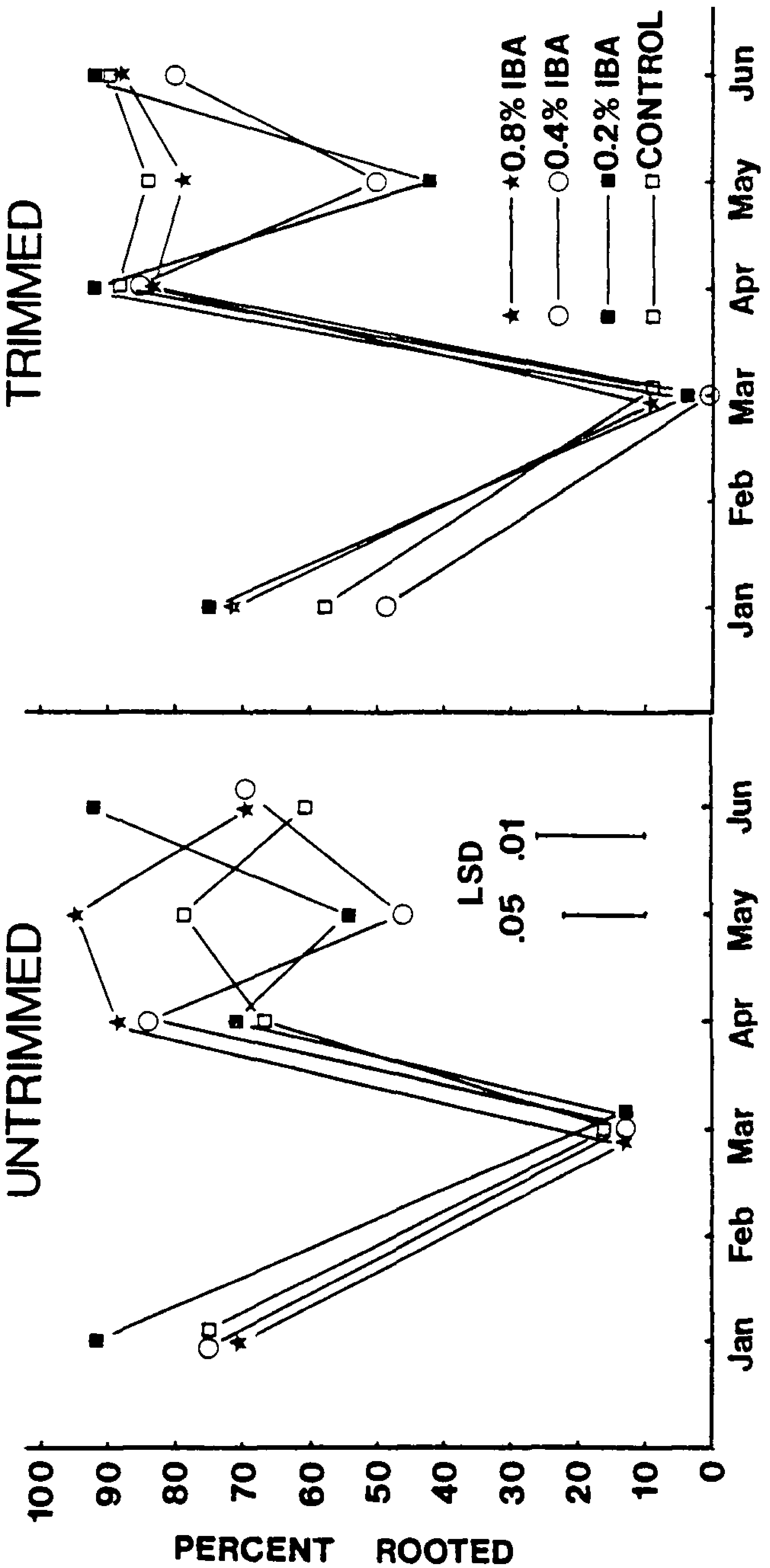


Figure 3. Effects of trimming off the top half of each cutting on rooting percentage of 'Hetzii' juniper

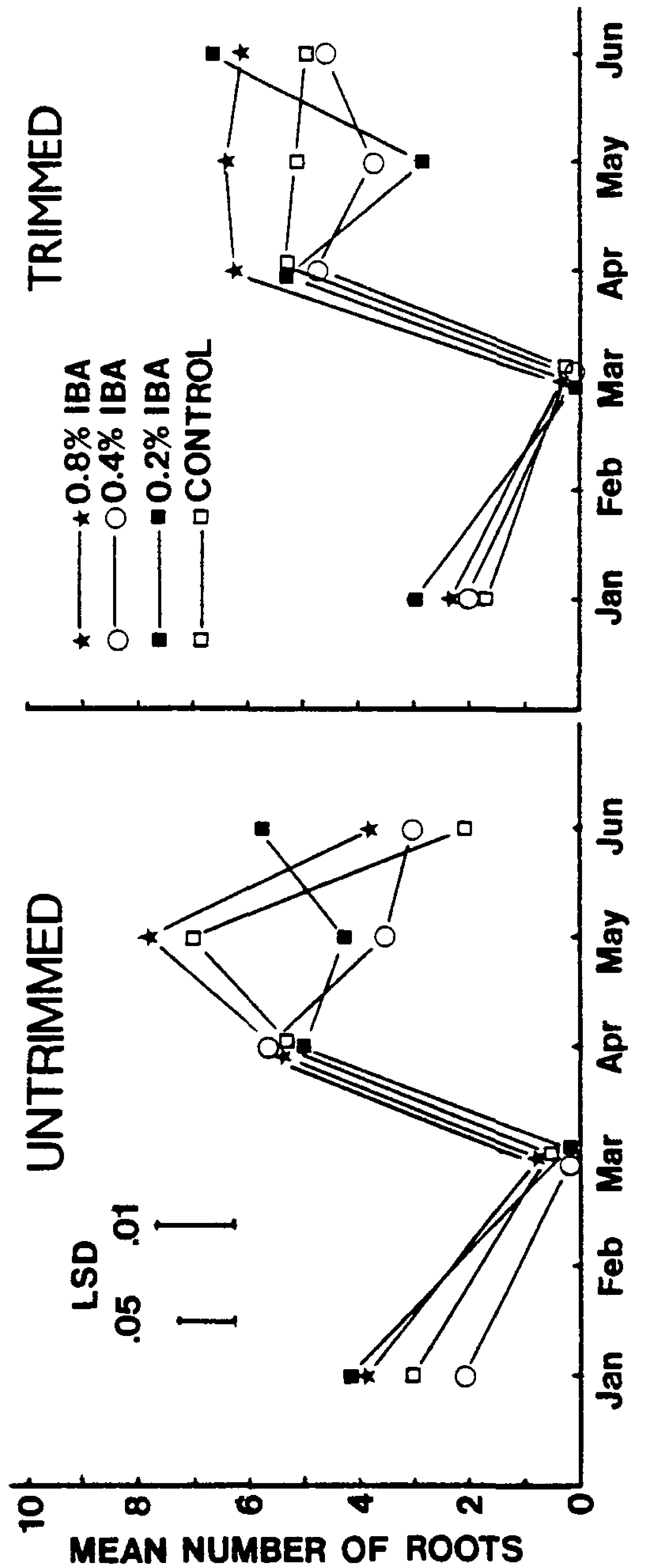


Figure 4. Effects of trimming off the top half of each cutting on mean number of roots per cutting of 'Hetzii' juniper

fit. Only with 'Skyrocket' juniper at 15°C did IBA appear to improve rooting This effect was not evident at higher temperatures. Leyland cypress rooted equally well at all temperatures evaluated, with or without IBA.

Table 1. Effects of medium temperature and IBA on rooting of juniper and Leyland cypress cuttings

		Mean rooting index[1]		
		15°C	20°C	25°C
'Skyrocket' juniper	IBA[2]	3 0	3 0	3 0
	No IBA	1 8	3 2	2 8
Leyland cypress	IBA	1 8	3 1	3 3
	No IBA	1 4	2 9	2 9
Hollywood juniper	IBA	2 8	3 7	3 3
	No IBA	2 8	3 2	2 5
Leyland cypress	IBA	2 8	3 3	3 1
	No IBA	3 2	3 0	3 0

[1] Rooting index 1=no roots, 2=poor root system, 3=moderately well rooted, 4=heavily rooted 50 cuttings per treatment were used

[2] 2000 ppm IBA in 50% ethyl alcohol applied as a 5-sec dip

DISCUSSION

The time of year when cuttings were taken had a marked effect on rooting of 'Hetzii' juniper cuttings. The most notable feature of the seasonal study was the consistently poor rooting in March. Although results for October 1981 have not yet been evaluated, the 1979-80 experiment and other preliminary experiments have shown October to be a good time to take juniper cuttings in Virginia. Poor rooting has occurred in November, and both poor and good rooting in December and January of different years. These results contrast with what was reported by Lanphear and Meahl on Andorra juniper, which was characterized by high rooting percentages and root numbers from November through April and poor rooting from May to October. These differences may be due to species differences or environmental effects.

IBA generally was not effective in improving rooting during the months that rooting was poor; however, IBA may cause some increase in root numbers under conditions when rooting is favorable. This agrees with what was found for Andorra juniper (1).

The three junipers tested responded favorably to moderate bottom heat. In most cases 20°C was optimum. Increasing to 25°C had little additional effect. With 'Skyrocket' juniper IBA seemed to compensate for low root temperatures, but this did not occur with the other cultivars. Temperature differences over the range tested had little effect on root quality of Leyland cypress.

In summary, the rooting capacity of juniper cuttings varies greatly throughout the year, and may be different for various localities and species. IBA has little effect when rooting capacity is low, therefore, optimum rooting periods need to be determined for each region and preferably, cultivar involved.

LITERATURE CITED

1 Lanphear, F O and R P Meahl 1963 Influence of endogenous rooting cofactors and environment on the seasonal fluctuations in root initiation of selected evergreen cuttings *Proc Amer Soc Hort Sci* 83 811-818

2 Nelson, S H 1959 Mist propagation of evergreens in the greenhouse during winter *Proc Plant Prop Soc* 9 67-76

3 Nelson, S H 1959 The summer propagation of conifer cuttings under intermittent mist *Proc Plant Prop Soc* 9 61-66

4 Snyder, William E 1953 The fundamentals of juniper propagation *Proc Plant Prop Soc* 3 67-77

TRICKLE IRRIGATION FOR FIELD PRODUCTION

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Much has been written about trickle irrigation and drip irrigation. So much has been written in fact, that there has arisen some confusion of how trickle irrigation relates to drip irrigation. The answer is that they are one and the same. Different authors generally choose one of the terms. In this country trickle irrigation seems to be the more popular term and, in fact, more accurately describes this irrigation system. This paper will henceforth use the term "trickle irrigation."

It is now time that we ask ourselves the question — What is trickle irrigation? One definition is that trickle irrigation is the daily maintenance of an adequate portion of the root zone of a plant at, or close to, field capacity during the growing and production cycle (1) For a moment let's take a close look at what is really being said in this definition. First, trickle irrigation works on the principle of the prevention of drought stress, as opposed to correcting an existing water stress. Never allowing a plant to be under moisture stress maximizes growth. Second, it implies that only a portion of the root zone needs to be kept under optimum moisture conditions. Research has shown that ¼ of the root zone kept under good water conditions can sustain the whole plant. From this it can be concluded that the trickle system does not have to wet the whole root