Gibberellic Acid, Scarification, and Stratification Treatments for Quicker Germination of Fringetree Seed

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White fringetree, *Chionanthus virginicus* is a native plant of exceptional ornamental value for its fleecy white bloom in midspring. Unfortunately, it is not well known by the average homeowner nor is it readily available in landscape nurseries or garden centers. Nurseries propagate fringetree by seed. Seeds require two years to germinate and remain in the seed bed an additional two years before transplanting to the field. Seedlings are grown in the field for three to four years to produce a salable size plant 3 to 4 ft. Six- to 7-ft fringetrees are in demand, but they require a total of 10 or more years to produce from seed (Hiscock, 1990).

Up to 1987, propagation of white fringetree by cuttings had not been successful (Dirr, 1990; Dirr and Heuser, 1987). At the Southern Region Plant Propagators' Society meeting in October 1990, a grower reported successful development of a population of rootable juvenile plants. The grower successfully rooted cuttings from 4% of a large seedling population. The daughter plants in turn could be rooted. Whether or not this rootability will be a fixed trait is unknown Chinese fringtree, *C. retusus,* can be propagated in commercial numbers by rooting just-hardened stem cuttings about six weeks after full bloom (Russell, 1983; Witte, 1984)

White fringetree typically begins blooming and fruiting after plants are five-to-eight years old. It is dioecious, or polygamo-dioecious; however, individual plants are generally all male or all female. Peak bloom occurs around May 15 to May 20 in Knoxville,Tenn In the deep southern part of the U.S., flowering time may be in late March or April (Gill and Pogge, 1974). The USDA Woody Plant Seed Manual states that seed should be harvested in September or October (Gill and Pogge, 1974), when the fruits have turned deep purple In Knoxville, fruit begins to turn color as early as mid-July. Full coloration and ripening occurs by the first week of August. Collections must be made before birds take the fruits or fruit drop occurs.

White fringetree seed possesses a double dormancy, sometimes called a two-phase dormancy (Dirr, 1990, Dirr and Heuser, 1987, Gill and Pogge, 1974; Hartmann and Kester, 1983; Kester, 1960). This type of dormancy is generally characterized by a hard or impermeable seed coat and a rudimentary or dormant epicotyl (Hartmann and Kester, 1983). In white fringetree dormancy is fairly complex and also seems to involve inhibitors in the endosperm (Hartmann and Kester, 1983) All these dormancy conditions must be overcome in proper sequence.

The seedcoat must first be degraded so water may be imbibed. During a following cold moist period of stratification inhibitors are degraded and embryo dormancy overcome (Fordham, 1960; Gill and Pogge, 1974; Hartmann and Kester, 1983). Three to five months of warm stratification may be required to allow for microbial decomposition of the endocarp, followed by imbibition of water and radicle (root) emergence Then at least three-months cold stratification is required to overcome

the epicotyl dormancy, at which time shoots emerge (Dirr, 1990; Fordham, 1960; Gill and Pogge, 1974; Hartmann and Kester, 1983).

Germination may be erratic and has been reported as early as one week after stratification was completed and as late as one year later (Fordham, 1960). First-year seedlings do not put on much shoot extension.

Chionanthus propagation by grafting has been reported but no mention has been made in the literature of its commercial feasibility. Bean reports that *Chionanthus* may be grafted onto *Fraxinus*, but the plants resulting from this union are not as healthy or long-lived as those on their own roots (Bean, 1970). This is probably due to the relatively distant relationship of fringetree to ash

Frett extracted embryos from August-collected seed and incubated them on a gibberellic acid:nutrient solution. The embryos greened up and produced both shoots and roots (Dirr, 1990). Gibberellic acid (GA_3) is known to have a role in seed germination and stimulates alpha-amylase activity in the aleurone layer of some seeds (Hartmann and Kester, 1983). GA_3 can also partially substitute for the chilling requirement in some types of dormancy (Wittwer, 1968).

Based on this knowledge, we designed an experiment to test gibberellic acid soaks on whole or scarified fringetree seed, followed by different periods of warm and cold stratification. The objective was to induce seed germination in one year.

METHODS AND MATERIALS

Ripe fruits were collected from three white fringetrees on the University of Tennessee Ag campus. Seeds were cleaned 1 August 1989, and stored dry in a refrigerator On 20 August 1989, seeds were divided into two groups of 560 seeds each The control group of seeds was left whole. Seeds in the other group were scarified by nicking the hilum end, using a sharp knife to remove a chip of the bony seedcoat. The radicle of the embryo is located on the opposite end of the seed from the hilum. The shape of the seed is not always a good clue as to which end is which, and a 10× hand lens aided identification. We were careful not to penetrate the thin brown seedcoat.

GA_3 was dissolved in aqueous potassium hydroxide, the pH adjusted to 9 0 and diluted to yield 300 ppm solution. On 24 August 1989, each group of seeds was divided in half and each half placed in a separate beaker containing 250 ml GA_3 solution. The remaining seeds were placed in separate beakers containing distilled water. The four beakers were then placed under vacuum at 20 in. Hg (-68Kpa) for 24 hours. Shortly after vacuum was pulled, air (or gas) bubbles were seen escaping from some seeds. Some whole seeds floated initially, but sank.

Seeds were planted 25 August 1989, in a pine bark.peat moss mix (3:1, v/v). Individual tubes measuring 2 5/8 × 2 5/8 × 5 in. deep were used, with 40 tubes per tray. Thus, one tray contained 10 single seed replications of each of the four combinations of scarification x GA treatment. Trays were placed on raised benches in a propagation greenhouse equipped with a Biotherm hot water system. Medium temperature at 2-in. (5 cm) depth was about 70°F (21°C). Seeds in the outside bed were planted one-half inch deep and covered. Soil and medium temperatures were recorded weekly.

Groups of trays were moved to a 36 to 41°F (3-5°C) cold storage after two, three and four months on the heated benches and rotated out of cold storage to a warm greenhouse after three or four months.

This experiment was set up as a randomized complete block design with a factorial arrangement of treatments. Seven stratification treatments x two scarification treatments (nicked or whole) x two GA_3 treatments (GA_3 or water) x four replications x 10 seed per treatment totals 1120 seeds in the experiment.

RESULTS AND DISCUSSION

We were successful in obtaining early germination of some seed. Seventy-five of the total number of seeds (960) in the six stratification treatments produced shoots by 13 July 1990. Those seeds in the outside bed have not yet (March 1991) produced any shoots and are being monitored for germination this spring.

The difference between treatments using Chi square analysis was not significant due to low germination. However, we noticed the following.

The normal sequence of emergence occurred with the radicle rooting down first, followed by shoot emergence, which was both hypogeal and epigeal in the nicked seeds. In this report, germination refers to emergence of both radicle and shoot, and radicle emergence refers to emergence of the root but not the shoot.

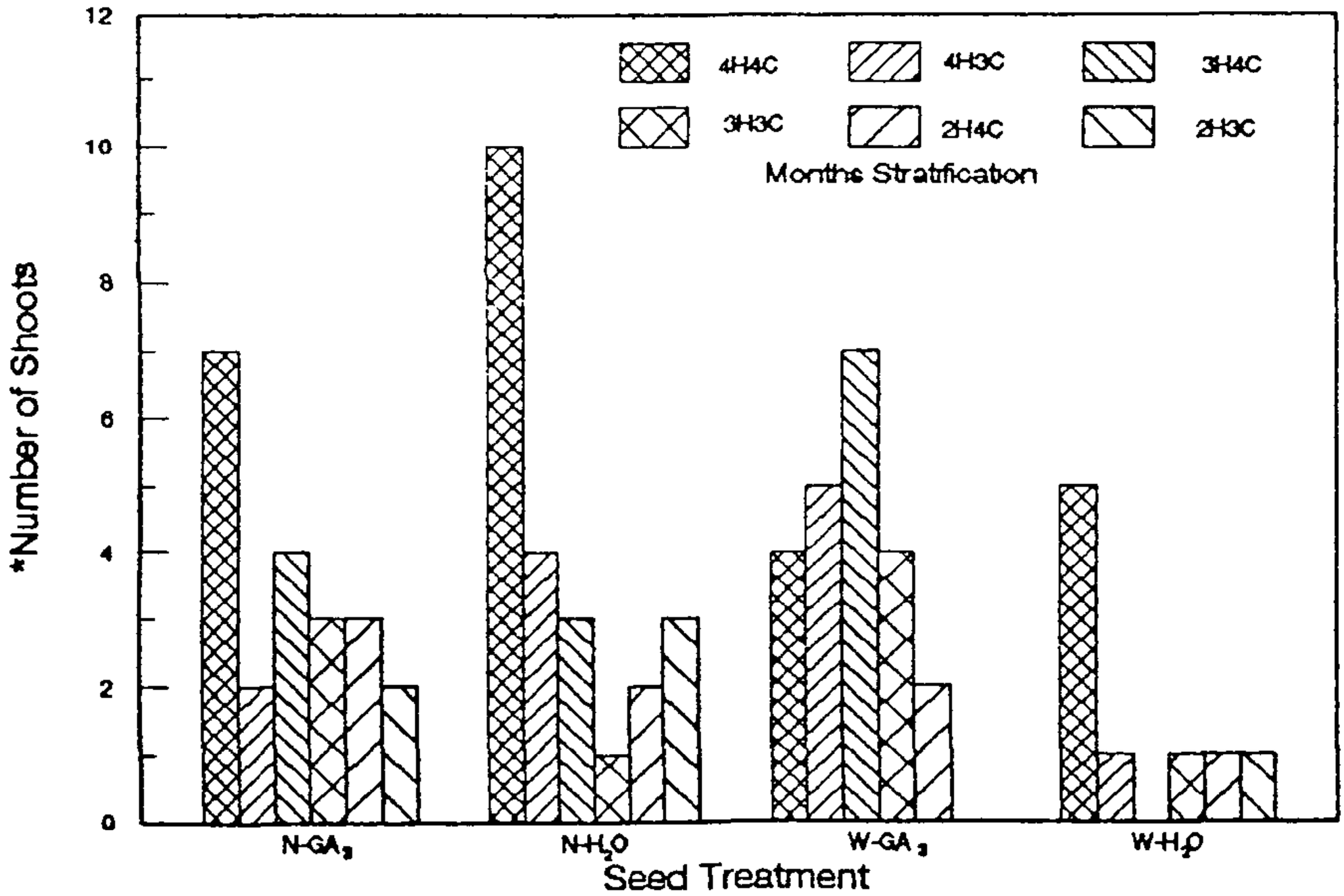

Figure 1. Germination of *Chionanthus virginicus* seed after scarification (N=nicked, W=whole), gibberellic acid infusion (GA_3=gibberellic acid, H_2O=water), and six stratification treatments (H=warm, C=cold), *40 seeds per bar

Figure 1 shows germination in each of 24 treatment combinations. We think germination may be better after longer warm stratification periods.

Figure 2 shows the total number of seed with either radicle emergence alone or with complete germination for each of the stratification treatments, disregarding scarification and gibberellic acid treatment. Many more seed produced roots alone than produced shoots or roots and shoots. Shoot emergence occurred erratically all summer and into late fall.

Figure 3 shows the total number of seed with either radicle emergence alone or

with complete germination for each of the stratification/GA_3 combinations, disregarding stratification treatment.

Scavenger mites, earthworms and scavenger nematodes infested the decaying seed, but their presence was considered as a secondary factor in the seed mortality.

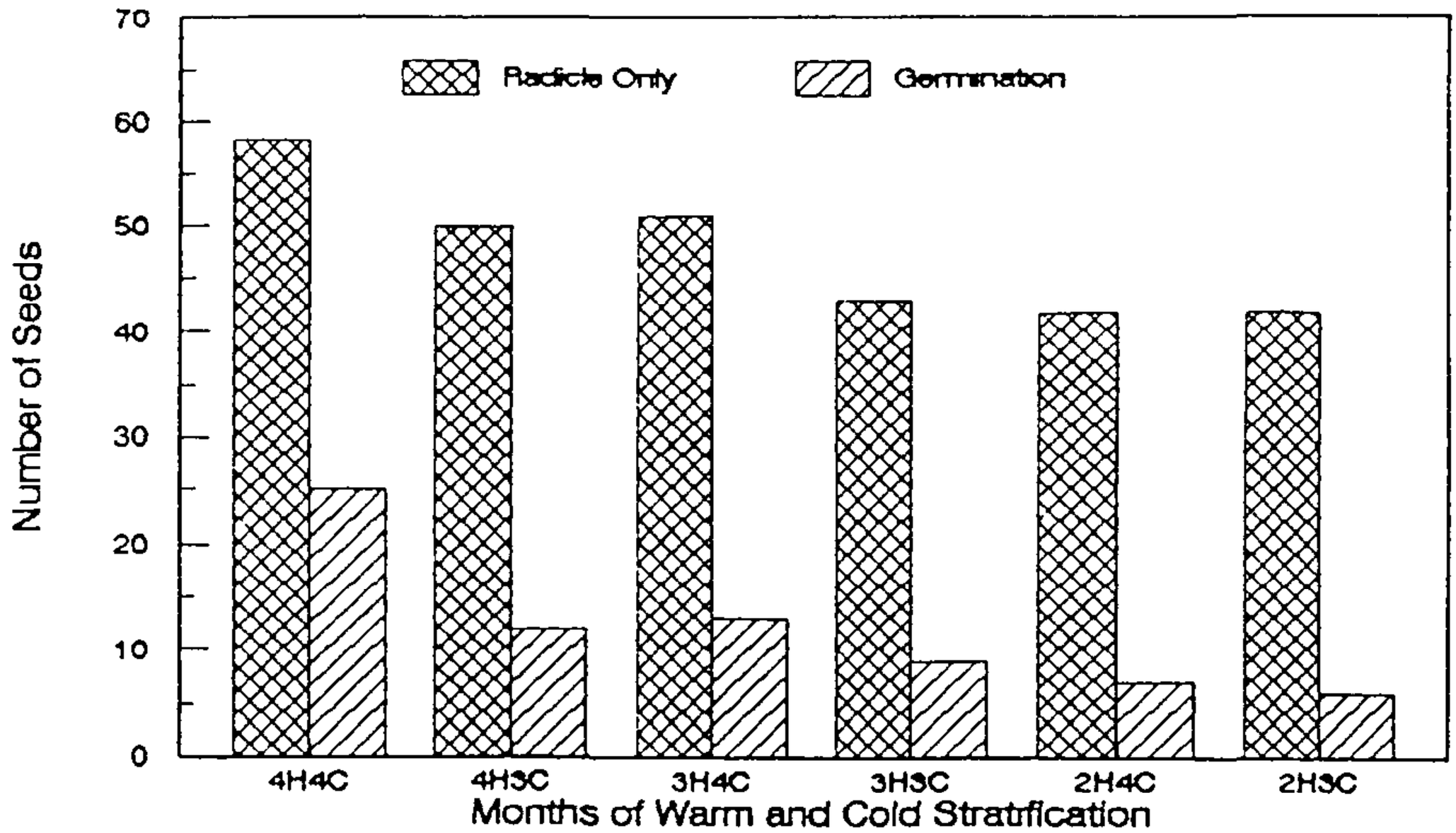

Figure 2. Total number of seed with either radicle emergence or complete germination for each stratification treatment (H=warm, C=cold), disregarding scarification and gibberellic acid treatments Each pair of bars represents total number out of 160 seeds

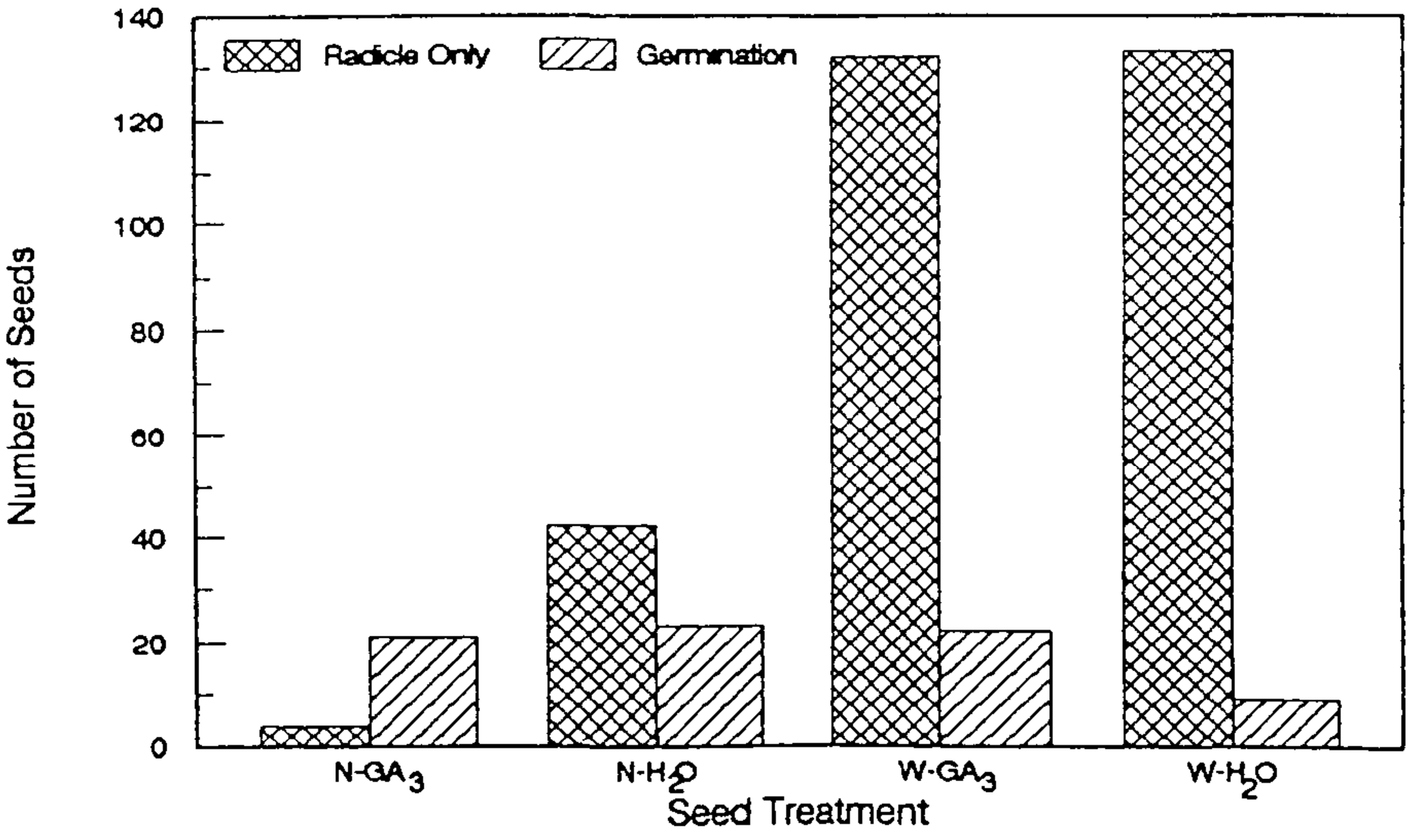

Figure 3. Total number seed with either radicle emergence or complete germination for each scarification (N=nicked, W=whole), gibberellic acid combination (GA_3=gibberellic acid,

H_2O=water), disregarding stratification treatment Each pair of bars represents total number out of 240 seeds

CONTINUING STUDIES

The above observations encouraged us to repeat the experiment with some modifications. A second experiment is underway with the following changes:

1) Pro-Mix B medium to avoid potential problems with scavenger mites, nematodes, earthworms or other microfauna.

2) Electric heating pads instead of the Bio-Therm system to provide more uniform heat with better control of the 80°F (26 5°C) target temperature.

3) Seeds drilled instead of nicked A mechanical drill press equipped with a stop helped prevent penetration of the inner seed coat and endosperm

4) Two additional seed treatments; non-vacuum treatments using nicked and whole seed to show whether or not the vacuum is damaging the seed, and whether or not gibberellic acid must go into the seed.

5) Two- and three-month heat stratification periods eliminated and a five-month heat and a five-month cold stratification added.

6) Turface applied over the medium surface in each tube to prevent splattering when watering and to moderate algae growth.

7) Plexiglass growth chambers used for accessory seed lots to enable visual observation of radicle elongation

8) Trays covered with black plastic during warm stratification to help maintain uniform temperature and moisture and to prevent algae growth.

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