

## Rewriting of *Seeds of Woody Plants in the United States*

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### INTRODUCTION

A team of scientists from the U.S.D.A. Forest Service is currently rewriting the classic publication, *Seeds of Woody Plants in the United States*. Originally published in 1974, Agriculture Handbook 450 (AH-450) replaced the older "Woody Plant Seed Manual" which had been out of print for many years (Table 1). The AH-450 handbook has long been the primary reference for foresters and horticulturists on the collecting, cleaning, testing, and storing of woody plant seeds. Nursery managers also use the popular reference for information on seed propagation. Unfortunately, although it has been reprinted five times, AH-450 is currently unavailable.

To fill this void, Timber Press published *Seeds of Woody Plants in North America* in 1992 (Table 1). Because there are no copyrights on government publications, the authors borrowed heavily from AH-450, but added 200 new genera and 1000 new literature citations. The vast majority of the new additions are native to Asia or are ornamentals, however, and most rate only a short paragraph or two. Another limitation is that the technical references for the majority of genera important to forestry, such as *Pinus*, *Picea*, and *Eucalyptus*, were not updated from that given in AH-450 (Bonner, 1993). Nevertheless, *Seeds of Woody Plants in North America* remains the best source of technical information for seed dealers and nursery managers growing forest and conservation species from seed.

### FORMAT FOR THE NEW EDITION

The editorial team began planning the rewriting project back in 1993 and decided that the new edition of *Seeds of Woody Plants in the United States* would cover at least 290 genera of woody plants (Table 1). A good proportion of the new genera are subtropical and so the new edition may need to be published in two volumes. Like its predecessor, this book will be published as an Agriculture Handbook by the U.S. Department of Agriculture.

The rewriting project has proven to be a formidable challenge. Many of the original authors have retired and so other government scientists have graciously agreed to help write the sections on those genera. The entire 883 pages of AH-450 was scanned by computer into a word processing format and each author was provided with a disk of the original article. In addition, the Forest Service INFO-South library database was computer searched and a list of relevant articles was made available. Of course, much of the newest technical information has never been published and so seed processors and nurseries from across the United States were surveyed to see if they could provide any new operational techniques.

Besides the new genera of plants that will be added, we plan to increase the usability of the new edition in a couple of other important ways: the addition of more technical illustrations, and expansion of the general information chapters.

**Table 1.** Comparison of the chronology and features of the various publications.

Title	Publication Date	Publisher	Price	Photo Format	General Information Sections	Genera Covered
Woody Plant Seed Manual	1948	U.S.D.A., Misc. Pub. 654	\$2.75 Out of print	Black and white	Yes - 5 chapters	126
Seeds of Woody Plants in the United States	1974 5 Reprints	U.S.D.A., Agr. Handbk. 450	\$41.00 Out of print	Black and white w/ color plates	Yes - 8 chapters	188
Seeds of Woody Plants in North America	1992	Timber Press, Portland, OR	\$49.95 available	Black and white	None	386 (many exotics)
Seeds of Woody Plants in the United States	1997-layout 1998-printing	U.S.D.A., Agr. Handbk. XXX	???	Color photos	Yes - 7 chapters	290 +

**New Technical Illustrations.** One of the outstanding features of AH-450 was the large number of detailed illustrations of seed anatomy and seedling development along with black-and-white photographs of fruits and seeds. In addition, a section of color photographs provided the reader with a good index of seed maturity for some of the species in which color is a criterion for ripeness. The use of color will be greatly expanded in the new addition as the cost of color printing has decreased substantially in the past few years. The editorial team has identified numerous high-quality color photos from personal collections and other government publications. These high-quality technical illustrations will greatly add to the usefulness of the new addition.

**Expansion of General Information Chapters.** One of the real benefits of the new edition of *Seeds of Woody Plants in the United States* to plant propagators is the inclusion of seven introductory chapters that will present comprehensive coverage of general seed and nursery topics: seed biology, harvesting and conditioning seeds, seed testing, storage, certification and seed exchange, nursery practices, genetic principles, and conservation. These chapters are an excellent way to present new technical information in one handy location.

As an example, there are new techniques to improve seed stratification. The traditional way to stratify woody plant seeds was to imbibe them in water at room temperature until they were at maximum moisture content, drain off the excess water, and put them in bags for the cold treatment (Bonner, 1974). Some people mixed the seeds with moist media, such as peat moss, and some just put the imbibed seeds into plastic bags ("naked stratification").

In recent years, however, new ideas have been emerging about stratification, primarily in terms of the moisture content of the seeds. The key point of this new technology was that seeds were stratified as usual, then redried to a lower moisture content (e.g., 35% for Douglas fir) and returned to cold storage. The benefits are that premature germination during stratification is largely prevented and germination rates are improved to the point that total germination can even be higher than with traditional treatments. Most of the early work on this "stratification-redry" technique was done on western conifers (Edwards, 1986).

The next improvement in the technique came from work on hardwood seed in Europe (Muller and Bonnet-Masimbert, 1989) where they found that if proper seed moisture content was determined and controlled during stratification, full imbibition and subsequent drying was unnecessary. Seeds could be stratified at a moisture content that overcame dormancy yet prevented germination, and then cold stored for up to 5 years without loss of viability. These critical moisture contents were determined to be 30% for European beech, 27% to 30% for cherry, and 55% to 60% for European ash (Muller, 1993). Of primary interest to propagators, the seeds could be removed from storage and planted at any time without further treatment.

I.P.P.S. members will be particularly interested in new or improved seed propagation methods such as transplanting emergents—commonly known as "pricking out". Many seeds of forest and conservation species are too small or fragile to be direct seeded or planted as germinants. For example, the seeds of quaking aspen (*Populus tremuloides* Michx.) are very small with an average of over 3.5 million seeds per pound. The seeds also germinate within days, but the germinants are very susceptible to drying and damping-off. To propagate these sensitive seeds, growers fill shallow trays with a sterile peat moss/vermiculite growing medium and sow the

seeds by hand. The seeds are irrigated and placed into a greenhouse and are misted lightly until the young seedlings ("emergents") are well-established (Landis and Simonich, 1984). When the emergents reach the cotyledonary stage and begin to grow the first set of primary leaves, they are ready for transplanting to the growth containers or even bareroot seedbeds.

The traditional transplanting technique consists of working the emergents loose from the seed tray, making a dibble hole, placing the plant in the hole, and firming the soil or growing medium around the stem. Unfortunately, this procedure sometimes produces a "J-root" or kink in the seedling root that can reduce growth in the nursery and cause mechanical weakness or mortality after outplanting (Gordon and Hayes, 1995). To overcome this problem, growers have developed an innovative tool to make transplanting emergents much more successful. The tool has a sharpened probe with a v-notch in the tip. The top of the emergent is held by one hand and the bottom of the root is hooked with the notched tip of the transplanting tool. The root is pushed down into the soil or growing medium until the seedling is at the proper depth. Then, while still stabilizing the seedling, the hooked bottom of the root is cut off and the tool removed. This simple technique leaves the emergent transplanted without the possibility of a "J-root" or other deformation.

These and other new techniques will add greatly to the usefulness of the new edition of *Seeds of Woody Plants in the United States*.

### ESTIMATED PUBLICATION DATE

The publication team hopes to have the final draft of the new edition ready for computer layout by 1997 and the final printing done by the following year. With the recent advances in computer technology, it may be possible to jointly publish *Seeds of Woody Plants in the United States* in an electronic version that would be available on compact disk or perhaps on the Forest Service Homepage over the World-Wide Web via the Internet.

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## Worker Protection Standard: How It Affects Cutting Propagation

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The Worker Protection Standard (WPS) for agricultural pesticides, issued by the U.S. EPA in August, 1992, (40 CFR part 156 subpart K, and 40 CFR part 170) required labeling changes for many pesticide end-use products registered under section 3 or 24(c) of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). Among those end-use products are biological pesticides and, more specifically, plant growth regulators including rooting hormones.

Pesticide Regulation (PR) Notice 93-7 was issued to manufacturers on 20 April 1993, and outlined the requirements for meeting the labeling revisions required by WPS. Included in PR Notice 93-7 were the deadlines specified in WPS: After 21 April 1994, all products must bear the new WPS labeling when sold by the manufacturer. After 23 October 1995, all products must bear the new WPS labeling when distributed or sold by any person.

Pre-WPS approved labeling was simple for a rooting hormone; however, the *accepted labeling under WPS included major new sections involving:*

- Personal Protective equipment (PPE).
- Statement of practical treatment.
- Agricultural use requirements, including the restricted entry interval (REI).

Through various supplements, PR Notice 93-7 determined the following:

- The "toxicity category signal word" CAUTION was based upon the toxicity category number that applies to acute toxicity tests performed on the end-use product.
- The "chemical resistance category" was based upon the solvents used in the end-use product. In the case of Dip'N Grow®, the solvent is alcohol.
- "PPE" requirements were based upon both the toxicity category and the chemical resistance category.
- "REI" was based upon the WPS active ingredient list (5 April 1993) indicating indole-3-butyric acid (IBA), with a 12-hour REI and naphthaleneacetic acid (NAA), with a 24-h REI.

Personal protective equipment was specifically outlined in the WPS worksheet. Applicators and other handlers must wear: long-sleeved shirt and long pants;