

RECOMMENDATIONS FOR SUCCESSFUL STORAGE OF TREE SEED

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In storing tree seed the following must be considered: type of container, seed moisture content, storage temperature and facilities, and seed condition. This article includes recommendations and information intended as a guide for people storing tree seed. Table 1 is based on a thorough review of the literature, observations and experience, and the results of research at the Eastern Tree Seed Laboratory.

Many varieties of containers are used in storing seed, but the main points to consider are the type of container and the effectiveness of the seal. A container now used by many people for dry storage is a fiberboard drum with an aluminum foil innerlining. These drums are light in weight, economical, and are available in different sizes.

As an additional safety factor in maintaining moisture content, it may be desirable to place the seed inside a polyethylene bag before it is put into the drum. Drums should be filled so that there will be a minimum of air space; within limits, the greater the air space, the greater the chance of the moisture content rising. In addition, if the drums or containers are not full, storage space is wasted.

Several studies have shown that seed moisture content rises during closed storage (31, 35, 52, 54, 72). Seed should be dried down to the lowest recommended level, especially if it is anticipated that the seed will be stored for more than 1 or 2 years. Moisture content should be checked periodically. Sealed containers should not be used when seed are stored in a moist condition. Optimum seed moisture content is given (table 1) if enough information is available to make a recommendation; otherwise, "dry" or "moist" is given. "Moist" seed usually approximates the moisture content when it is in stratification.

Storage temperature should be held constant. The highest acceptable temperature is listed (table 1) under recommendations. For most species, a lower storage temperature will be more desirable, since seed moisture content may rise more rapidly during storage at higher temperatures.

Some species, such as the oaks, will benefit if they are treated for insects prior to storage. The insects may not be active during storage, but immediately upon removal they become so again.

¹ Georgia Forestry Commission and Georgia Forest Research Council cooperating.

TABLE 1.--Recommended moisture content and temperature for storage of tree seed species

Species	Recommendations		Remarks and references
	Moisture content ¹	Temperature	
<u>ABIES</u>	<i>Percent</i>	<i>Degrees F.</i>	
<u>A. balsamea</u> (L.) Mill. (Balsam fir)	5-8	33-38	Stored successfully for 5 years. (27, 68, 70)
<u>A. concolor</u> (Gord. & Glend.) Lindl. (White fir)	5-8	20	0° F. probably better if long periods of storage are antici- pated. (2, 56, 68)
<u>A. grandis</u> (Dougl.) Lindl. (Grand fir)	5-8	20	May retain viability for 1 or 2 years at 33° to 38° F. if moisture content is low. (8, 13, 56, 70)
<u>A. procera</u> Rehd. (Noble fir)	5-8	20	(8)
<u>ACER</u>			
<u>A. ginnala</u> Maxim. (Amur maple)	dry	33-40	Moisture content not determined, probably around 10 percent. (70)
<u>A. negundo</u> L. (Boxelder)	dry	33-38	Moisture content not determined, probably around 10 percent. (70).
<u>A. rubrum</u> L. (Red maple)	dry	33-40	Moisture content not determined, probably around 10 percent. Have retained viability in storage for 23 years. (70)
<u>A. saccharinum</u> L. (Silver maple)	30-35 (moist)	33-35	Should not plan to store over 1 or 2 years. (37)
<u>A. saccharum</u> Marsh. (Sugar maple)	dry	33-38	Should not plan to store over 1 or 2 years. (70)
<u>ALNUS</u>			
<u>A. glutinosa</u> (L.) Gaertn. (European alder)	7-10	33-38	Below 32° F. may be better. (69, 70, 72)
<u>BETULA</u>			
<u>B. alleghaniensis</u> Britton (Yellow birch)	dry	33-38	Needs further study. (70)
<u>B. nigra</u> L. (River birch)	dry	33-38	Needs further study. (70)

TABLE 1.--(continued)

Species	Recommendations		Remarks and references
	Moisture content ¹	Temperature	
<u>CARAGANA</u>	<i>Percent</i>	<i>Degrees F.</i>	
<u>C. arborescens</u> Lam. (Siberian peashrub)	dry	33-38	Russia reports that viability was maintained under dry storage conditions. (70)
<u>CUPRESSUS</u>			
<u>C. arizonica</u> Greene (Arizona cypress)	dry	33-38	(56, 70)
<u>C. macrocarpa</u> Hartw. (Monterey cypress)	dry	33-38	(66, 70)
<u>ELAEAGNUS</u>			
<u>E. angustifolia</u> L. (Russian-olive)	dry	33-50	Viability maintained 5 1/2 years. (70)
<u>FRAXINUS</u>			
<u>F. americana</u> L. (White ash)	dry	33-38	Little loss in viability noted in 3 years. Below 32° F. may be better. (70)
<u>F. pennsylvanica</u> Marsh. (Green ash)	7-10	33-38	Maintained viability for 7 years. (7, 62, 70)
<u>GLEDITSIA</u>			
<u>G. triacanthos</u> L. (Honeylocust)	dry	33-38	
<u>JUGLANS</u>			
<u>J. nigra</u> L. (Black walnut)	moist	33-38	Store over winter in a moist medium. Do not freeze. (6, 16)
<u>JUNIPERUS</u>			
<u>J. scopulorum</u> Sarg. (Rocky Mountain juniper)	dry	33-38	Pulp should be removed. (34, 70)
<u>J. virginiana</u> L. (Eastern redcedar)	6-10	33-38	Pulp should be removed.
<u>LARIX</u>			
<u>L. decidua</u> Mill. (European larch)	5-7	33-35	Below 32° F. probably better. (32, 29, 38, 70, 71, 72)
<u>L. leptolepis</u> Sieb. & Zucc. (Japanese larch)	5-7	33-35	Below 32° F. probably better. (32, 29, 58)

TABLE 1.--(Continued)

Species	Recommendations		Remarks and references
	Moisture content ¹	Temperature	
<u>LIBOCEDRUS</u>	<i>Percent</i>	<i>Degrees F.</i>	
<u>L. decurrens</u> Torr. (Incense-cedar)	dry	33-38	(<u>56</u> , <u>70</u>)
<u>LIQUIDAMBAR</u>			
<u>L. styraciflua</u> L. (Sweetgum)	dry	33-38	Have been stored successfully for 1 year. (<u>70</u>)
<u>LIRIODENDRON</u>			
<u>L. tulipifera</u> L. (Yellow-poplar)	moist	33-38	May store up to 2 or 3 years. (<u>63</u> , <u>15</u> , <u>70</u>)
<u>MACLURA</u>			
<u>M. pomifera</u> (Raf.) Schneid. (Osage-orange)	dry	33-38	Seed should be cleaned.
<u>PICEA</u>			
<u>P. abies</u> (L.) Karst. (Norway spruce)	4-6	33-38	(<u>1</u> , <u>11</u> , <u>5</u> , <u>12</u> , <u>28</u> , <u>32</u> , <u>30</u> , <u>29</u> , <u>44</u> , <u>49</u> , <u>53</u> , <u>72</u>)
<u>P. engelmannii</u> Parry (Engelmann spruce)	4-6	33-38	Storage below 32° F. preferable. (<u>2</u> , <u>3</u> , <u>56</u> , <u>64</u> , <u>70</u>)
<u>P. glauca</u> (Moench) Voss (White spruce)	4-6	33-38	Storage below 32° F. preferable (<u>2</u> , <u>5</u> , <u>20</u> , <u>70</u>)
<u>P. mariana</u> (Mill.) B.S.P. (Black spruce)	4-6	33-38	Will keep for 17+ years if moisture content is maintained. (<u>45</u> , <u>70</u>)
<u>P. pungens</u> Engelm. (Blue spruce)	4-6	33-38	
<u>P. sitchensis</u> (Bong.) Carr. (Sitka spruce)	4-6	33-38	Storage below 32° F. preferable. (<u>9</u> , <u>32</u>)
<u>PINUS</u>			
<u>P. attenuata</u> Lemm. (Knobcone pine)	6-10	33-38	(<u>66</u> , <u>70</u>)
<u>P. banksiana</u> Lamb. (Jack pine)	6-10	33-38	(<u>28</u> , <u>55</u> , <u>70</u>)
<u>P. canariensis</u> C. Smith (Canary pine)	dry	below 32	(<u>43</u>)

TABLE 1.--(Continued)

Species	Recommendations		Remarks and references
	Moisture content ¹	Temperature	
<u>PINUS</u> --Continued	<i>Percent</i>	<i>Degrees F.</i>	
<u>P. contorta</u> Dougl. (Lodgepole pine)	6-10	33-38	Below 32° F. preferable for long periods of storage. (<u>2</u> , <u>3</u> , <u>20</u> , <u>43</u> , <u>56</u> , <u>64</u> , <u>70</u>)
<u>P. coulteri</u> D. Don (Coulter pine)	dry	33-38	(<u>43</u> , <u>70</u>)
<u>P. echinata</u> Mill. (Shortleaf pine)	6-10	33-38	Below 32° F. preferable. (<u>8</u> , <u>5</u> , <u>46</u> , <u>74</u>)
<u>P. elliotii</u> Engelm. (Slash pine)	6-10	below 32	0° to 20° F. preferable for long periods of storage. (<u>5</u> , <u>46</u> , <u>73</u> , <u>74</u>)
<u>P. halepensis</u> Mill. (Aleppo pine)	dry	33-38	Has maintained viability for 2 years, unsealed at room temperature. (<u>70</u>)
<u>P. jeffreyi</u> Grev. & Balf. (Jeffrey pine)	6-10	below 32	(<u>43</u> , <u>57</u> , <u>56</u> , <u>70</u>)
<u>P. lambertiana</u> Dougl. (Sugar pine)	6-10	below 32	0° to 20° F. preferable for long periods of storage. (<u>43</u> , <u>57</u> , <u>61</u> , <u>60</u> , <u>64</u>)
<u>P. monticola</u> Dougl. (Western white pine)	6-10	below 32	0° to 20° F. preferable for long periods of storage. (<u>64</u>)
<u>P. mugo</u> Turra (Swiss Mountain pine)	6-10	33-38	(<u>69</u> , <u>70</u>)
<u>P. nigra</u> Arnold (Austrian pine)	6-8	below 32	(<u>18</u> , <u>29</u> , <u>42</u> , <u>56</u> , <u>70</u>)
<u>P. palustris</u> Mill. (Longleaf pine)	7-10	0-25	(<u>5</u> , <u>41</u> , <u>46</u> , <u>73</u>)
<u>P. pinaster</u> Ait. (Cluster pine)	dry	33-38	Stored successfully for 14 years. (<u>43</u> , <u>70</u>)
<u>P. ponderosa</u> Laws. (Ponderosa pine)	6-10	33-38	Has been stored successfully for 10 years. (<u>9</u> , <u>11</u> , <u>5</u> , <u>21</u> , <u>43</u> , <u>57</u> , <u>56</u> , <u>64</u>)
<u>P. radiata</u> D. Don (Monterey pine)	dry	33-38	Has maintained viability for 21 years. (<u>43</u> , <u>48</u> , <u>56</u>)
<u>P. resinosa</u> Ait. (Red pine)	5-8	33-38	(<u>5</u> , <u>19</u> , <u>28</u> , <u>40</u> , <u>50</u> , <u>70</u>)

TABLE 1.--(Continued)

Species	Recommendations		Remarks and references
	Moisture content ¹	Temperature	
<u>PINUS</u> --(continued)	<i>Percent</i>	<i>Degrees F.</i>	
<u>P. rigida</u> Mill. (Pitch pine)	6-10	33-38	(<u>66</u> , <u>68</u> , <u>70</u>)
<u>P. roxburghi</u> Sarg. (Chir pine)	dry	33-38	(<u>70</u>)
<u>P. strobus</u> L. (Eastern white pine)	6-10	0-25	20° F. or below preferable for long periods of storage. (<u>23</u> , <u>50</u> , <u>52</u> , <u>56</u> , <u>64</u> , <u>70</u>)
<u>P. sylvestris</u> L. (Scotch pine)	5-8	33-38	(<u>1</u> , <u>18</u> , <u>26</u> , <u>29</u> , <u>32</u> , <u>33</u> , <u>65</u> , <u>69</u> , <u>70</u> , <u>72</u>)
<u>P. taeda</u> L. (Loblolly pine)	6-10	33-38	Below 32° F. preferable. (<u>5</u> , <u>8</u> , <u>46</u> , <u>73</u>)
<u>P. thunbergi</u> Parl. (Japanese black pine)	6-10	33-38	(<u>56</u> , <u>58</u>)
<u>P. Virginiana</u> Mill. (Virginia pine)	6-10	33-38	Below 32° F. preferable for long periods of storage. (<u>70</u>)
<u>PLATANUS</u>			
<u>P. occidentalis</u> L. (American sycamore)	dry	33-38	(<u>70</u>)
<u>POPULUS</u>			
<u>P. grandidentata</u> Michx. (Bigtooth aspen)	5-6	below 32	(<u>14</u>)
<u>P. nigra</u> var. <u>italica</u> Muenchh. (Lombardy poplar)	dry	33-38	(<u>70</u>)
<u>PRUNUS</u>			
<u>P. americana</u> Marsh. (American plum)	dry	33-38	Should be cleaned. (<u>70</u>)
<u>P. serotina</u> Ehrh. (Black cherry)	8-12	33-38	Should be cleaned. (<u>70</u>)
<u>PSEUDOTSUGA</u>			
<u>P. menziesii</u> (Mirb.) Franco (Douglas-fir)	6-8	below 32	0° to 20° F. preferable for long periods of storage. (<u>2</u> , <u>4</u> , <u>9</u> , <u>10</u> , <u>64</u> , <u>70</u>)

TABLE 1.--(Continued)

Species	Recommendations		Remarks and references
	Moisture content ¹	Temperature	
<u>QUERCUS</u>	<i>Percent</i>	<i>Degrees F.</i>	
Most red oaks	30-40 (moist)	33-34	Should be held in a moist medium not sealed over winter; otherwise, sealed with extra space in container. Do not freeze. Northern red oak has been stored successfully for 3 years. (<u>22</u> , <u>29</u> , <u>39</u> , <u>51</u>)
Most white oaks	30-40 (moist)	33-34	Should be held in a moist medium not sealed. Do not freeze. May be stored over winter. (<u>22</u> , <u>39</u>)
<u>ROBINIA</u>			
<u>R. Pseudoacacia</u> L. (Black locust)	dry	cool	(<u>25</u> , <u>47</u> , <u>70</u>)
<u>SALIX</u>			
<u>S. alba</u> L. (White willow)	5-6	below 32	(<u>14</u>)
<u>SEQUOIA</u>			
<u>S. gigantea</u> (Lindl.) Decne. (Giant sequoia)	dry	33-38	Below 32° F. probably better. (<u>56</u> , <u>67</u> , <u>70</u>)
<u>S. sempervirens</u> (D. Don) Endl. (Redwood)	dry	33-38	Below 32° F. probably better. (<u>66</u> , <u>70</u>)
<u>TAXODIUM</u>			
<u>T. distichum</u> (L.) Rich (Baldcypress)	6-10	33-38	
<u>THUJA</u>			
<u>T. occidentalis</u> L. (Northern white-cedar)	dry	33-38	(<u>70</u>)
<u>T. plicata</u> Donn (Western redcedar)	6-10	below 32	(<u>2</u> , <u>9</u> , <u>70</u>)
<u>TILIA</u>			
<u>T. americana</u> L. (American basswood)	dry	33-38	Below 32° F. probably better. (<u>17</u> , <u>70</u>)

TABLE 1.--(Continued)

Species	Recommendations		Remarks and references
	Moisture content ¹	Temperature	
<u>TSUGA</u>			
<u>T. canadensis</u> (L.) Carr. (Eastern hemlock)	6-8 (dry)	33-38	Below 32° F. probably better. (<u>70</u>)
<u>T. heterophylla</u> (Raf.) Sarg. (Western hemlock)	6-8	33-38	Below 32° F. probably better. (<u>2</u> , <u>8</u> , <u>9</u> , <u>10</u> , <u>56</u> , <u>70</u>)
<u>ULMUS</u>			
<u>U. americana</u> L. (American elm)	2-4	33-38	Below 32° F. preferable. (<u>8</u> , <u>24</u> , <u>36</u> , <u>59</u> , <u>70</u>)
<u>U. parvifolia</u> Jacq. (Chinese elm)	dry	33-38	Below 32° F. preferable.

¹ Owendry weight basis.

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