pressure-compensating emitters But pressure-compensating emitters provide the same flow rate even with changes in elevation, and even with their additional initial cost they should be used on undulating terrain.

The whole trickle system is put together with elbows, tees, risers, C-clamps, and end plugs All of these components are held together by friction fits supported by the C-clamps.

In summary, the installation of a trickle system is not a complicated process and can be handled by most anyone with a basic understanding of trickle.

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PRELIMINARY NOTES ON DESICCATION AND VIABILITY OF LIVE OAK ACORNS

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Abstract. Acorns of the live oak (*Quercus virginiana* Mill) failed to germinate when frozen or stored in dry peat moss Stored in moist peat moss at 5°C (41°F), and at 21-30°C (70-86°F), they germinated but were heavily infected with soil-borne fungal pathogens at 3 months, rendering them unsuitable for planting Acorns dried at 34°C (93°F) lost viability as they desiccated A 15% weight loss reduced viability to 66%, and 20% weight loss reduced germination to 4% Acorns collected fresh from tree limbs germinated at higher rates than those collected from the ground, where they presumably had dried over time There was an inverse linear relationship between CO_2 evolution (an indicator of respiration) and percent weight lost through drying Implications of seed storage in controlled atmospheres and at near-freezing temperatures are discussed

REVIEW OF LITERATURE

Due to convenience and tradition, Southern nurserymen propagate the live oak (*Quercus virginiana* Mill.) from seed

(acorns). The live oak seed is not easily stored, and in years when few seeds are produced, nurserymen have to travel throughout the southern United States in search of sufficient quantities of acorns to provide trees Growers commonly sow live oak acorns immediately after collecting them to avoid loss of seed viability. Live oak acorns commonly remain on the tree for sometime after they are mature; in fact, they often germinate while still attached to tree limbs (4), particularly during a rainy or humid autumn season. Moisture content, insects, disease, temperature and storage atmosphere affect viability of all seed types during storage (2), although seed of different species vary in their responses to these conditions. The majority of seeds benefit from drying, and lowering moisture content is one way of increasing the life span of many seeds (1). Dry storage in sealed containers at 0 to 2°C (32-36°F) has been used for some white oak species, but attendant to such storage there has been great loss of viability due to loss of moisture (3).

Hartmann and Kester (2) agree with Schopmeyer (3) that the large, fleshy seeds of many oaks are difficult to store for periods over a year Schopmeyer reported that although seeds of one species (*Q. robur* L) have been stored dry up to 3 years, most white oaks will not germinate after loss of 30 to 50% of seed moisture content.

Crocker and Barton (1) suggested that the best storage conditions for seeds of any species are those which best preserve the complex nuclei and the mitotic mechanism of the cells of the embryo, critical determinations that may relate to moisture loss and temperature. The following experiments were designed to determine the effects of water loss on live oak seed germination, and to determine the effects of selected storage techniques on seed viability.

MATERIALS AND METHODS

All seeds were collected from trees in Dallas, Texas, with the exception of one lot which came from trees growing on the Texas A&M campus at College Station. The College Station seeds were a year old and had been stored at room temperature of 21° to 30°C (70°-86°F) in a laboratory. Immediately after collection, seeds from all sources were immersed in water. The "floaters" were discarded, as were those with obvious physical defects, weevil holes, and those that had already germinated. The seeds from each tree were separated into lots of equal weight and number.

Seed Germination and Moisture: Eight hundred seeds from Tree "A" and 600 from Tree "B" in Dallas were sorted

into groups of 100 seeds each of uniform weight in October, 1975. One hundred seeds of each tree were selected for control and placed immediately in a germinator. The remainder were dusted with Spectracide (40% diazinon) insecticide in an attempt to kill weevils and Captan-Thiram 43-43 seed-protectant fungicide and dried to 5 or 10% intervals of weight loss in a commercial seed drier (Precision Scientific Co.). After drying the groups of seeds to preselected weights, each lot was placed in a seed germinator at 26 ± 2°C (79 ± 4°F) for 30 days.

Seed Storage: Seeds were collected in November, 1975 from 6 trees for an experiment involving 2 levels of moisture, 3 levels of temperature, and 4 time periods in storage. After storage, seeds were placed in a germinator at 26 ± 2°C (79 ± 4°F), for 30 days. The seeds from each tree were randomly assigned to each combination of treatments, and then were sealed in 3 mil polyethylene bags. Conditions of storage were: (a) 21° to 30°C (70 to 86°F) room temperature; (b) 5°C (41°F) in a seed storage coldroom; and (c) frozen at −10°C (−18°F). Storage periods were: (a) control, immediately after adjusting for equal weight; (b) 1 month; (c) 3 months; and (d) 5 months in storage. The seeds were dusted with Spectracide (40% diazinon) insecticide and Captan-Thiram 43-43 seed protectant fungicide. Seed sources included.

No 1 - collected from ground
16 seeds per treatment
32 6g average weight of lot of 16
No 2 - collected from tree limbs
7 seeds per treatment
7 7g average weight per lot of 7
No 3 - collected from ground under the tree
6 seeds per treatment
11 6g average weight per lot of 6
No 4 - collected from ground
13 seeds per treatment
27 7g average weight per lot of 13
No 5 - collected from ground (College Station), kept in paper bag for a year in room conditions
9 seeds per treatment
15 8g average weight of lot of 9
No 6 - collected from tree limbs
9 seeds per treatment
12 7g average weight of lot of 9

CO_2 Evolution: To assess the effects of moisture loss on respiration, lots of seeds were dried to 0, 5, 10, 15, and 20% weight loss, and CO_2 evolution was measured by gas chromatography. Acorns were picked from the branches of a single tree in Samuell-Grand Park in Dallas in December, 1980, returned immediately to the laboratory, sorted into 24-seed lots of equal weight, and dried at 20°C (68°F) to desired weights.

They were then allowed to remain in a sealed flask for 90 minutes, after which CO_2 was determined using a gas chromatograph (Gow Mac Series 500) with thermal conductivity detector to take air samples

RESULTS

Seed Germination and Moisture: In both seed sources "A" and "B", germination decreased sharply after 20% weight loss. In seed source "A" (in which observations were recorded after 5% increments), moisture loss of 15% reduced germination to 66% (Figure 1).

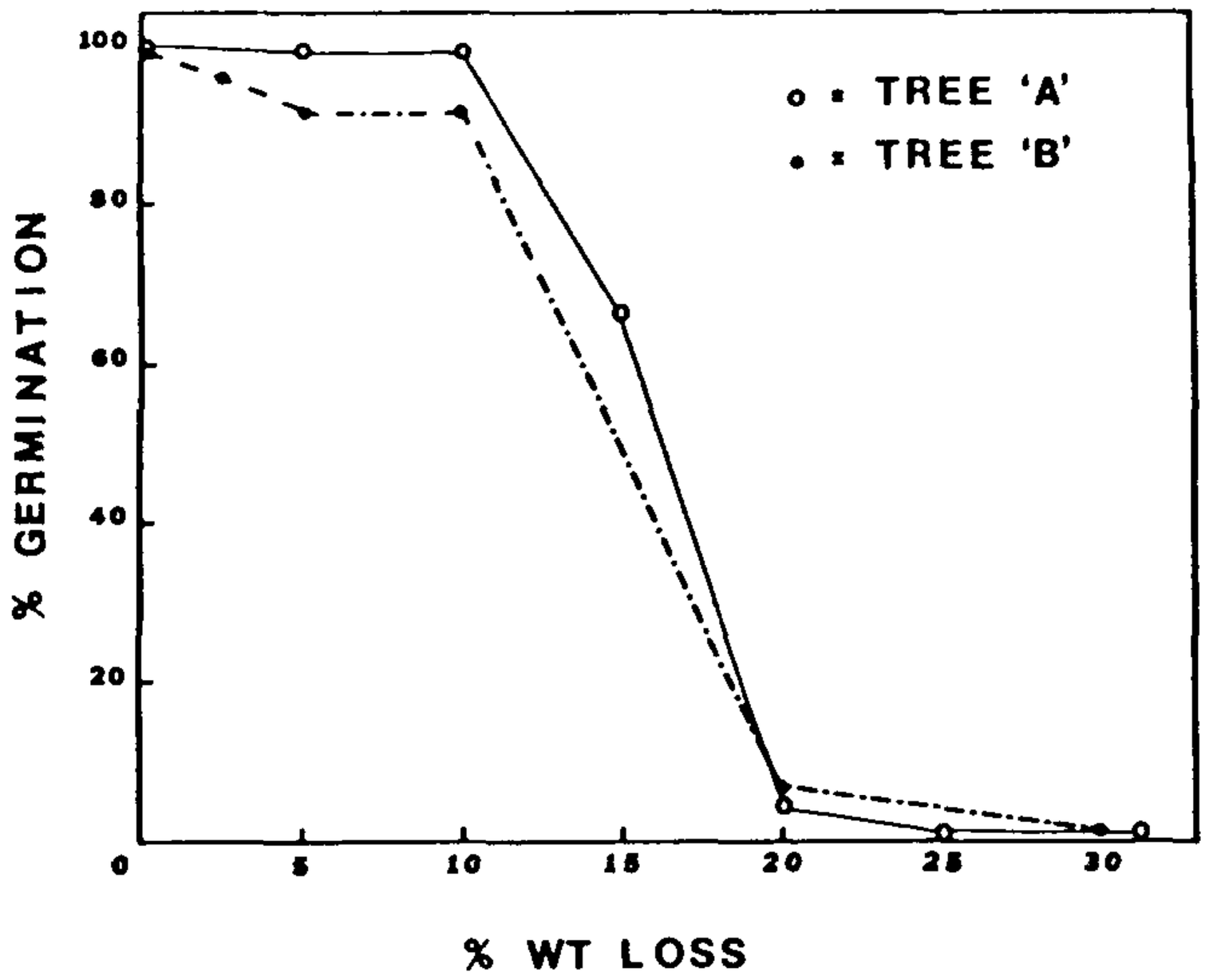

Figure 1. Percent germination of acorns as a function of weight loss by drying 100 acorns per treatment group

Seed Storage: Germination percentage was highest in acorns maintained in moist peat moss at room temperature, 21-30°C (Table 1) and at 5°C (Table 2). Under these conditions, moisture uptake was greater than other methods tested, and these seeds uniformly germinated in the storage media even before they were placed in the germinator. The College Station seeds, No 5, stored for a year failed to germinate, as did source No. 3, also collected from the ground.

Frozen live oak seeds and those allowed to dry in peat moss failed to germinate, regardless of seed source. Freezing also totally inhibited subsequent moisture uptake as did placing them in dry peat.

Table 1 The influence of storage on germination of live oak seeds held at room temperature (21-30°C) in moist peat moss

	Control	1 Month		3 Months		5 Months	
Tree No [1]	Percent Germination	Percent Germination	Percent Moisture Loss (−) Gain (+)	Percent Germination	Percent Moisture Loss (−) Gain (+)	Percent Germination	Percent Moisture Loss (−) Gain (+)
1 (ground)	6 2	25 0	+19 4	0	+16 5	12 5	—
2 (limb)	100	85 0	+29 2	85 0	+68 9	85 0	—
4 (ground)	23 1	23 1	+11 4	0	+17 8	46 2	—
6 (limb)	100	88 9	+20 9	100	+49 6	100	—

[1] Seeds from trees 3 and 5, collected from the ground, failed to germinate

Table 2. The influence of storage on germination of live oak seeds held at 5°C in moist peat moss

	Control	1 Month		3 Months		5 Months	
Tree No [1]	Percent Germination	Percent Germination	Percent Moisture Loss (−) Gain (+)	Percent Germination	Percent Moisture Loss (−) Gain (+)	Percent Germination	Percent Moisture Loss (−) Gain (+)
1 (ground)	6 2	31 3	+14 6	0	+20 6	12 5	—
2 (limb)	100	85 7	+17 8	100	+46 2	85 7	—
4 (ground)	23 1	61 5	+8 6	61 5	+11 8	0	—
6 (limb)	100	100	+21 6	100	+28 3	77 8	—

[1] Seeds from trees 3 and 5 collected from the ground failed to germinate

Differences due to the location of the seeds at the time of collection were apparent. Seeds collected directly from tree limbs (no 2 and no. 6) germinated at a higher rate both in storage and in control than those collected from the ground (no. 3, 4, and 6). All seeds absorbed water during moist storage (Tables 1 and 2) except those that had been frozen.

While all seeds in moist media gained weight, nearly all in the dry storage conditions lost weight as a result of loss of water. Rehydration failed to promote germination.

CO_2 Evolution: The inverse linear relationship between CO_2 evolution and weight loss in drying ($r = -0.96$, $\hat{y} = -9\,60x + 30.86$) indicates the negative effect of drying on CO_2 evolution (Figure 2).

DISCUSSION

In these preliminary studies, seeds of two live oak trees lost viability dramatically as they were dried at temperatures coinciding with expected seasonal high temperatures. At the 34°C drying temperature, tree "A" lost 15% weight, likely vital liquids and leakage of electrolytes, at 46.5 hours, resulting in the 34% loss of viability A 20% weight loss — 4% germination — occurred after 70 hours of drying. The corresponding decrease in respiration, as measured by CO_2 evolution, further

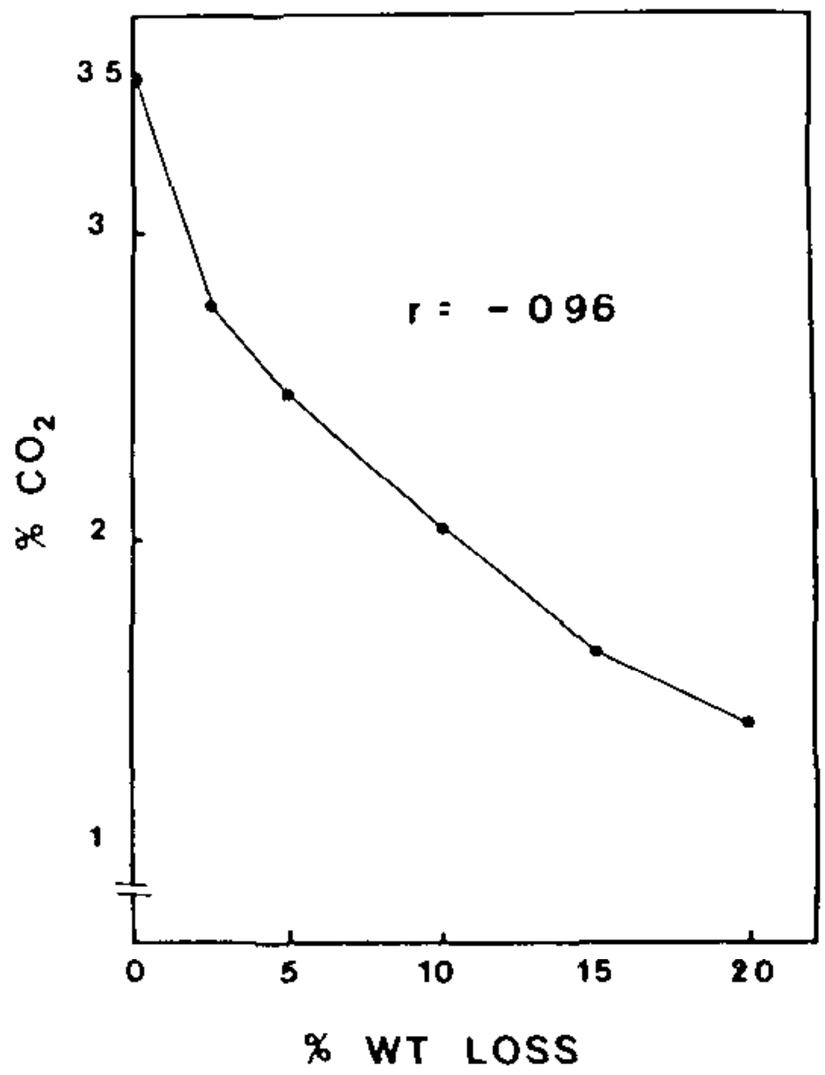

Figure 2. CO_2 evolution from acorns, as determined through gas chromatography, as a function of weight loss by drying

corroborates the loss of viability. Clearly, these data suggest that nurserymen could collect seed with assurance of quality by gathering only those acorns that remain on the trees, instead of scooping those that have fallen to the ground and begun to dry

Dry storage of seeds had the same effect as did desiccation; germination was reduced. Seeds stored in moist peat at 5°C and at a 21 to 30°C range germinated immediately in storage but the seedlings decayed by fungus after 3 months in moist storage, those that germinated after 3 months did not survive after transplanting. Neither the seed-protectant fungicide nor the insecticide was of apparent benefit. In addition to the fungal involvement, weevil (*Curculio* spp.) larvae emerged from the acorns in greater numbers from those collected from the ground than from those taken from the tree limbs (Nurserymen commonly attempt to kill these insect pests by immersing acorns in 120°F water for 30 minutes (4). The effects of this treatment on the seed are unreported.)

Seeds stored frozen, moist or dry, died due possibly to destruction of the enzymatic system or the complex nuclei and mitotic mechanism of the cells of the embryo, as suggested by Crocker and Barton (1), or simply due to massive tissue destruction by ice crystals.

The present findings present opportunity for further investigation. Germination may be inhibited at temperatures lower

than 5°C without freezing or drying the seed, minus 2°C likely would not freeze the seeds but would suppress germination as well as fungal activity. Manipulation of relative humidity above the percent moisture of the seed should be a related effort Mixtures of O_2, CO_2 and N_2 could be manipulated in a controlled atmosphere chamber such as those used for fruit storage, to find a suitable atmosphere. CA is reported to be used in China to store the fleshy fruit of the litchi (*Litchi chinensis* Sonn) (from correspondence with L D. Tukey)

Means by which the acorn can be freed of insect damage by chemical or other means should be investigated, as should the effects of the presence of the larvae on germination and post-germinated seedling growth.

Whether seed size (i.e., fresh weight) and year of collection influence the effect of moisture loss on germination should be considered, and identification of possible electrolytes subsequently lost after drying would be of interest.

Acknowledgment. The authors wish to thank P F Colbaugh for the use of the Gow Mac Series 500 gas chromatograph

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QUESTION BOX

The Southern Region Question Box was moderated by Charles Parkerson and Frank Willingham.

CHARLIE PARKERSON. We have had trouble controlling *Thielaviopsis* in our nursery and feel containers may be one source of infection We are wondering about a container made to collapse like the separators in old-fashioned egg cases. It could be made of light-weight plastic and thrown away after one use. That would eliminate the necessity of attempting to sanitize used containers with methyl bromide or by other methods that may or may not be effective. In addition, the collapsible feature would make storage easy and the fact that many cells could replace many separate pots would cut down tremendously on handling and filling time. Is anything like