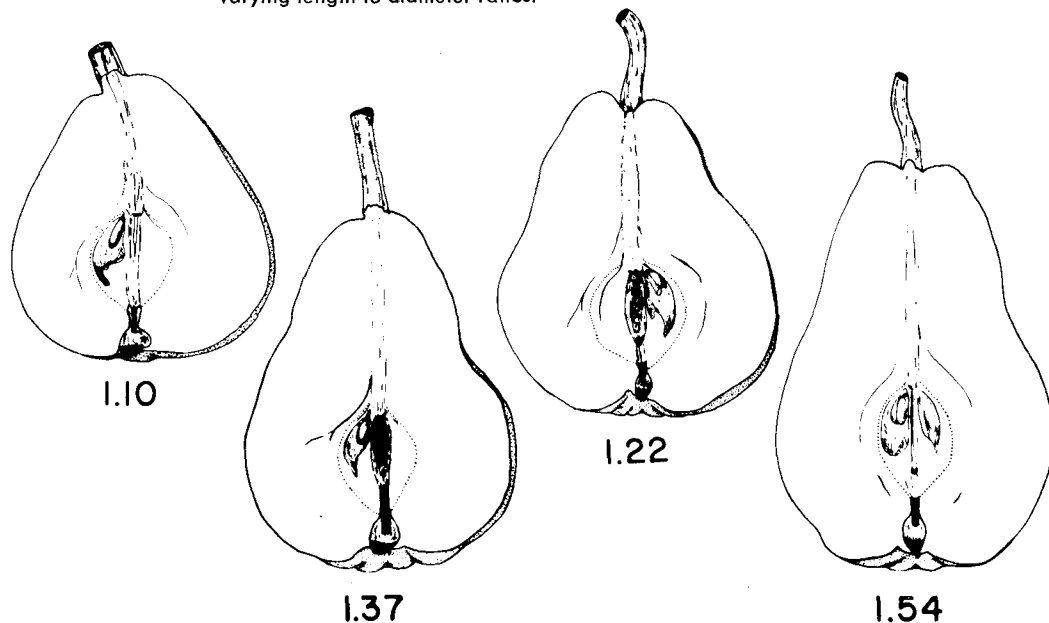


Longitudinal sections of Bartlett pears showing different shapes under varying length-to-diameter ratios.



the year the sample was taken. Current standards and pricing consider that all pears to the right of the  $2\frac{3}{8}$ -inch diameter line, and free from defects, were acceptable. A tolerance was allowed for those between  $2\frac{1}{4}$  and  $2\frac{3}{8}$  inches in diameter and all to the left of the  $2\frac{1}{4}$ -inch diameter line were rejected.

Counting the pears in a weighed sample was considered first. This was a quick and accurate measure of average size and very useful where the range of sizes was limited, as in the outputs of mechanical sizers. However, although 20% of the pears in this lot were under  $2\frac{1}{4}$  inches in diameter and also were lighter than the  $2\frac{1}{4}$ -inch pears, enough large pears were in the lot to raise the average weight to that of  $2\frac{1}{2}$ -inch pears. An average weight determined by weight-count was evidently not suitable for such a situation.

Sorting samples of pears by weight, much as they are now sorted by diameter, might serve as a basis for size standards and for pricing. The weight of individual pears could be estimated by eye and checked on small tippie scales about as quickly and perhaps more accurately than diameters can be checked by ringing. Small mechanical sizers, similar in principle to the full-scale weight sizers now available for various fruits, might be used at inspection stations where larger volumes are handled.

Referring again to the graph, horizontal dashed lines drawn at 4.9 ounces and 4.2 ounces can segregate virtually the same numbers and weights of pears as acceptable, and as subject to tolerances,

as do the vertical lines at  $2\frac{3}{8}$  and  $2\frac{1}{4}$  inches, with this particular sample. This sample was about average in the relation of the weights of the pears to their diameters. The weight segregation would rate more pears as acceptable if they averaged heavier in relation to their diameters, or fewer pears as acceptable if they averaged lighter in relation to their diameters. Trials indicate that segregation by weights instead of by diameters would change the fraction of a sample rated as acceptable by roughly one percent for each one percent difference in average weight of the pears in relation to their diameters.

Weight segregation of samples as a basis for size standards and for pricing appears to be entirely practicable and could even expedite inspection at stations where volume justified the use of mechanical sizers. Segregation of average fruit could be very similar to that resulting from current diameter standards. Most important, weight segregation would avoid any controversy between growers or producing areas regarding failure of diameter standards to reflect the true weight of the pears.

*Rene Guillou is Associate Specialist, Retired, Department of Agricultural Engineering; and William H. Griggs is Professor and Pomologist, Department of Pomology, University of California, Davis. Galen Geller is Manager, California Tree Fruit Agreement and Pear Zone, Sacramento, California.*

# VIGOR IN LETTUCE SEEDS UNDER ADVERSE STORAGE CONDITIONS

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ORRIN E. SMITH

**L**ETTUCE SEEDS that have a high germination percentage are not always high in vigor. Low vigor seeds may germinate and emerge from the soil acceptably under favorable conditions, but under unfavorable situations they perform poorly. In recent years, most lettuce growers in the central coast area of California have been using reduced seeding or precision planting techniques. With a reduction in the number of seeds planted per acre, the quality of seeds both in terms of germination and vigor becomes more critical. Rapid emergence of seedlings during the critical stages of emergence, and establishment of the tender plant, is important to help reduce stand losses due to soil crusting, insect and fungi attack.

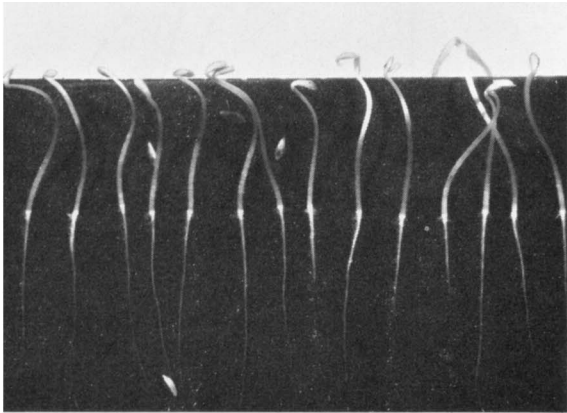
In past years, considerable information has been collected on the effects of storage conditions upon germination, but little work has been done to determine the effects upon vigor. Adverse storage conditions such as high heat, relatively high humidity, and a combination of both can occur before seed is thrashed. Humid weather such as heavy dew or rain followed by hot weather can seriously reduce vigor in lettuce seeds. Seeds high in moisture, stored in non-insulated sheds, or partially emptied

# VS. GERMINATION

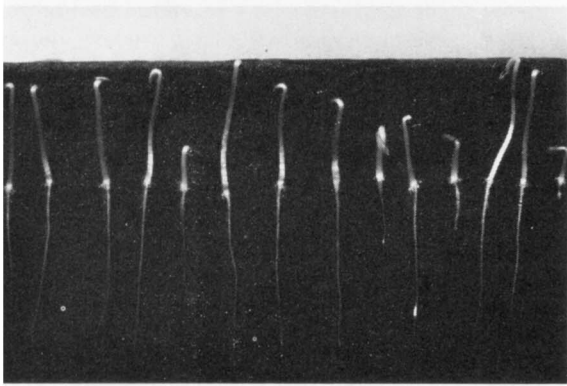
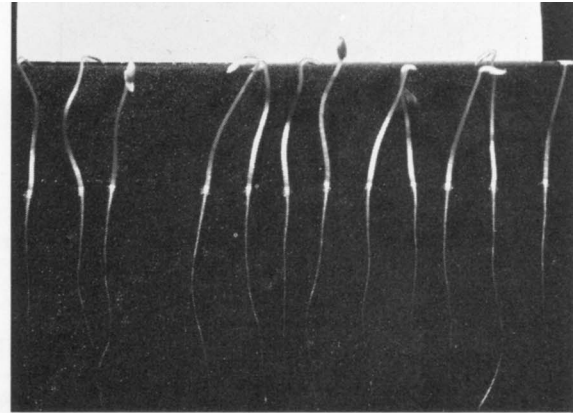
EFFECT OF 35° C AND 85% RELATIVE HUMIDITY ON LETTUCE SEEDLINGS STORED FOR 0, 5, 10, AND 20 DAYS

CALMAR

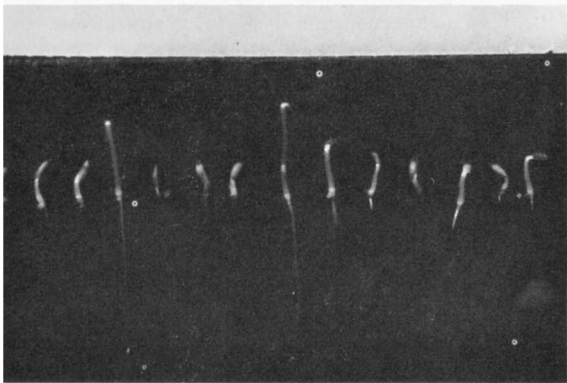
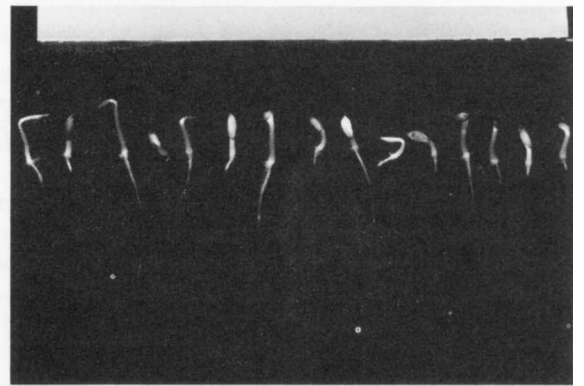
MESA



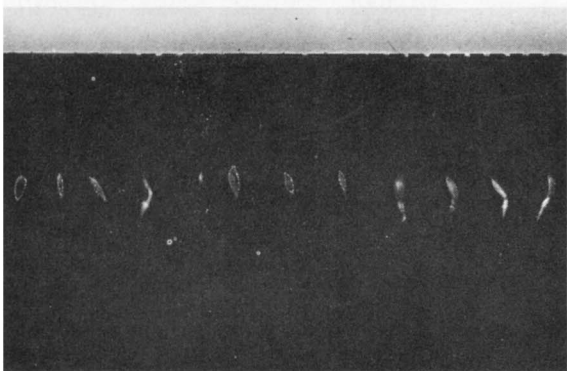
0 DAYS



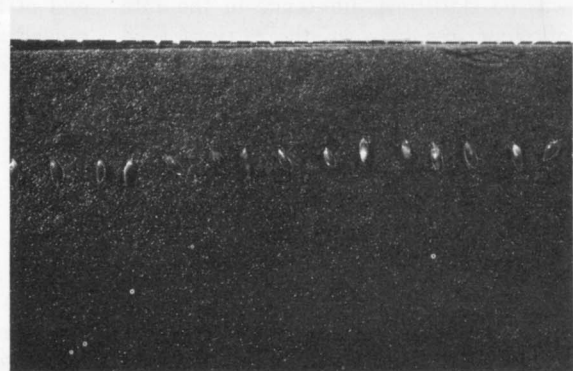
5 DAYS



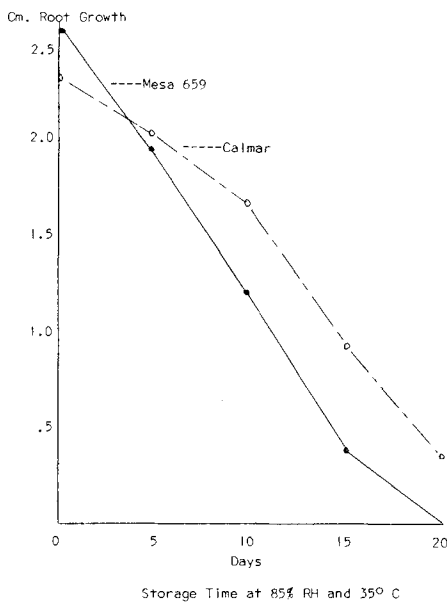
10 DAYS



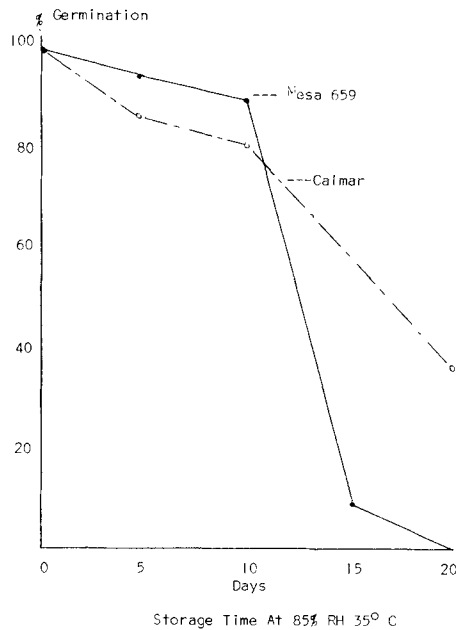
20 DAYS



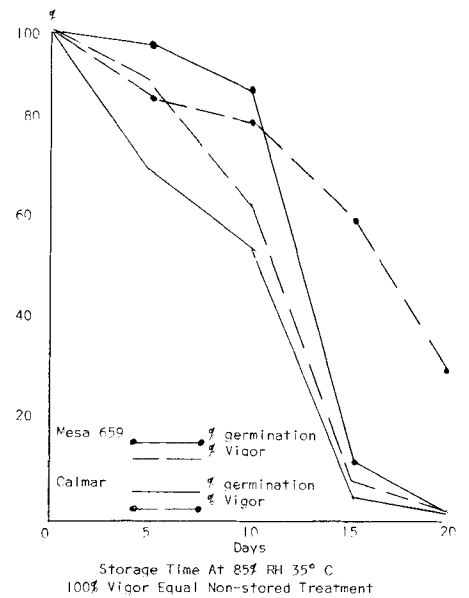
GRAPH 1. VIGOR LOSS IN LETTUCE SEEDLINGS AS MEASURED BY ROOT GROWTH



GRAPH 2. LOSS IN PERCENT GERMINATION IN LETTUCE SEEDS UNDER ADVERSE STORAGE CONDITIONS



GRAPH 3. LOSSES IN GERMINATION AND VIGOR IN LETTUCE SEEDS AND SEEDLINGS EXPRESSED AS PERCENT



containers, are susceptible to deterioration.

Study reports on germination and loss of vigor in lettuce seeds in two varieties under adverse storage conditions. Mesa 659 and Calmar seeds were used in this investigation. Both varieties germinated above 92% at the start of these experiments. With the aid of round hole screens and an air column separator, three seed fractions were sorted from each variety. Each fraction contained seeds with approximately the same shape, size and weight. These fractions represented (1) the smallest, lightest seeds, (2) medium-size and weight seeds (3) the largest size and heaviest seeds from each variety of lettuce. The reason for testing various seed weights within a seed lot was to determine whether the more vigorous fractions would retain vigor for a longer period of time. However, this did not occur in these experiments. There was no statistical difference in the rate of vigor loss between the various seed sizes within each variety, so the data presented in this paper represent an average of all three seed fractions.

Eighty seeds per treatment were used from each seed fraction and variety. When the seeds were prepared for storage, they were first wrapped in tissue paper, and then placed in glass beakers. Seed moisture at the start of these experiments was 5 to 6% for both varieties. The 85% relative humidity atmosphere

used in these experiments was maintained by placing approximately a 22% sulfuric acid solution in the bottom of a glass desiccator. The lid was sealed with a silicone lubricant to prevent moisture loss. The desiccator was placed inside an electric oven maintained at a constant 35° C.

### Storage

After storage periods of 0, 5, 10, 15 and 20 days, the seeds were held in a beaker of distilled water for five hours then transferred to prewashed and soaked germination blotters. These blotters were supported inside plastic shoe boxes on plastic plates, which were set at a 70° angle. Enough buffer solution (pH 7.0) was placed in the bottom of the shoe boxes to keep the blotters saturated. Each box was covered with a lid. The boxes were then placed in a dark incubator at 25° C for three days. At the end of the 3 days, the blotters were removed and the seedling roots measured. The average root length in 3 days was used as a vigor measurement. Abnormal or dead seeds were noted and the percentage of germination recorded at this time.

Two complete experiments were conducted in this study. The results were similar and the data presented here is an average of the two.

Loss of vigor in germinating lettuce seeds increased dramatically as storage time increased. Graph 1 shows the dif-

ference in loss of vigor between varieties. Mesa 659 seemed to lose vigor more rapidly than Calmar. This was especially true in longer storage treatments. Germination (graph 2) of Mesa 659 was affected slightly during 5- and 10-day storage periods, but dropped rapidly after that point. In contrast, the reduction in Calmar germination percentage increased almost linearly over the entire period. Graph 3 represents a comparison of percentage loss in germination and vigor as storage time increased.

### Vigor loss

It appears that considerable loss in vigor can occur in lettuce seeds before there is much loss in germination. Further investigation is needed to fully explore the relationship between vigor and germination. However, this study suggests loss of vigor and germination may be independent of each other. If this is true, a germination test may not be a completely adequate means of testing seeds for modern space planting requirements.

*Norman C. Welch is Farm Advisor, Santa Cruz County; and Orrin E. Smith is Associate Plant Physiologist, University of California, Riverside. Mesa 659 lettuce seeds used in this investigation were provided by the Ferry-Morse Seed Company. The Calmar seeds were obtained from experimental plots at the West Side Field Station, Five Points.*