# Establishment of Eastern Gamagrass from Seed and Vegetative Propagation[1]

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## Highlight

**The actual pure seed content of eastern gamagrass (*Tripsacum dactyloides* L.) was determined efficiently and rapidly by air separation at an air valve setting of 70° with a South Dakota blower. The pure seed fraction separated in this manner contained 5 to 27% empty seed units. Germination potential of the air-blown seed was between 72 and 95%. Seeds separated by visual means contained 32 to 48% empty seed units. Chilling seeds for 6 weeks at 5 to 10 C on moist substrate before germination significantly increased germination over the check. Natural prechilling in moist soil may greatly reduce the risks of stand failure. Salt solutions of $KNO_3$, sodium hypochlorite, and ethylene chlorohydrin did not promote germination. Fall seedings in either October or November were found to be more desirable than spring seedings. Difficulties in establishing stands of eastern gamagrass may have been in part due to the inability to separate true seeds from nonviable inert material. When seed of known quality is planted in the fall, good to excellent stands can be obtained.**

Stockmen and range specialists have long recognized eastern gamagrass as a palatable, nutritious, and productive range plant. The value of gamagrass was recognized by Magoffin as early as 1843. He felt that although the grass appeared to be most productive, nutritious, and palatable as a hay crop, it would not be extensively grown because of the difficulty and labor involved in establishing stands from root stocks.

The problems of establishing eastern gamagrass may be categorized as follows: 1) poor seed quality; 2) improper seed preparation and seeding techniques; and 3) unfavorable climatic and soil environments. When seeds of known quality are

[1] Contribution of Crops Research Division, Agriculture Research Service, U.S. Department of Agriculture, and Oklahoma Agricultural Experiment Station.

used, failures in establishment are generally due to moisture stress.

On clay soils which crust and crack following heavy rains, seedlings possessing primary blades often are observed within the cracks and below the soil surface. Such seedlings may be enveloped when additional rains occur. The germinating seeds trapped under the crusted soil cannot emerge and therefore die.

Because of its erect habit of growth and the extremely high preference of livestock for it, eastern gamagrass has almost been eliminated from range sites where it once flourished. The inability to determine seed quality, resulting in an uncertainty of establishing a stand, has been a major deterrent in reseeding attempts. It is not unusual for seeds of eastern gamagrass to be either entirely devoid of caryopses or to contain shriveled, poorly developed ones. The thick, tough appendages surrounding the caryopsis make it difficult to determine visually the existence of a complete, well-filled seed unit. Service laboratory reports of 3 to 5% germinable seeds from locally harvested crops are not uncommon.

The objectives of this study were: 1) to develop methods to determine seed quality more accurately; 2) to evaluate methods of establishment by both seed and vegetative propagation; and 3) to measure the longevity and performance of root stocks stored at room temperature and under refrigerated conditions. There are no official rules for germinating seed of eastern gamagrass, and no literature is available concerning previous studies.

## Methods and Materials

Two methods of separating empty from filled seed units were studied: 1) a water flotation procedure and 2) an air-blowing or fanning procedure, using a South Dakota Seed Blower. Treatments consisted of 100 seeds per replicate soaked in water for a specified time. Blowing procedure treatments were with air-valve settings of 60 and 70 degrees. Seeds of both light and heavy fractions were dissected and the number of units containing healthy caryopses recorded. Ten replicates of each treatment were used for each method of evaluating seed quality.

The most reliable treatment for obtaining a high percent of pure seed was selected and used as the method for obtaining seeds for germination studies.

The germination studies consisted of: 1) a study of 1 to 10 weeks of prechill treatment on germination; 2) the effect of varying concentrations of $KNO_3$ salt solutions as a moistening agent alone and in combination with prechill; 3) the effect of soaking seeds for various intervals in solutions of sodium hypochlorite; and 4) the effect of subjecting the seeds to vapors of and soaking directly in varying concentrations of ethylene chlorohydrin. The preparation and procedures used are essentially the same as reported in previous studies (Ahring et al., 1959; Ahring and Harlan, 1961; Ahring et al., 1963). Three to four replicates of each treatment were used throughout, with one replicate of each treatment on a like number of trays in a randomized block design. Two Stults Da-Lite germinators were used: one set for a constant temperature of 30 C for 16 hr darkness and 8 hr of light; the other for an alternating temperature of 20 to 30 C with 16 hr of darkness at 20 C and 8 hr light at 30 C.

Preparation of the seed for field plantings consisted of removing the light seeds by blowing with the seed blower at an air valve setting of 70 degrees. Beginning March 17, 1964, five planting dates were made at weekly intervals. Fall plantings were made at monthly intervals during October, November, and December of the same year, and repeated during the spring months of April, May, and June of 1965. Plantings on different dates were in triplicate. Similarly, freshly dug rhizomes were hand planted on the same dates for a comparison of the two methods of establishment.

Several bushels of rhizomes were gathered from a local source on March 15, two days before the initial planting. One half of the remaining root material, following the initial planting date, was stored at room temperature and the other half under refrigerated (5–10 C) conditions. Three replicates of each treatment were planted in 1964, at five weekly intervals or until the supply was exhausted. Fall and spring plantings in 1965 were made with seed. Sprigging of rhizomes for stand establishment as compared with seed was not included in the fall and spring plantings of 1965.

One hundred seeds per 20-ft row were planted at an approximate depth of 0.5 to 1 inch, with a drop planter. Five rows 20 ft long and 40 inches apart were considered a replication. Twenty rhizomes were planted per 20-ft row. Unless indicated otherwise three replications on each date of planting of both seed and rhizomes were used throughout the study.

Comparisons were made on the basis of emergence (growing seedlings) four to five weeks after the last spring planting date. The number of rhizomes surviving and growing at each date of planting was also recorded.

The field studies on stand establishment from seed were conducted on Zaneis sandy loam and Brewer clay loam soil of McClain and Canadian counties, Oklahoma, respectively. The comparative study using rhizomes for establishing stands was conducted only in McClain County. The seed was obtained in both 1963 and 1964 from Robert D. Lippert, Area Plant Material Technician, Soil Conservation Service, U.S.D.A., Manhattan, Kansas.

## Results and Discussion

A part of the overall problem of establishing eastern gamagrass lies in the inability to determine what constitutes a pure seed unit. Hand dissection of several random samples, of 100 seeds from an apparently pure seed fraction, revealed that seed set varied from 52 to 68%. Empty seed units, although inert, cannot be distinguished visually in analytical work because of the heavy, thick glumes surrounding the caryopsis. Present procedures, Rules for Testing Seed 1960, recommended for other grasses are not adequate to determine seed quality in eastern gama.

Results of separating filled seed from empty units by soaking seeds in water for varying lengths of time and by the use of varying amounts of forced

**Table 1. Average number of heavy and light seeds found with soaking and forced air methods of determining pure seed and compared on the basis of percent of each fraction containing a caryopsis.**

| Treatment | | Ave. no. seeds | | Containing caryopses (%) | |
|---|---|---|---|---|---|
| | | Afloat (Light) | Sank (Heavy) | Afloat (Light) | Sank (Heavy) |
| Soaking interval (hr) | 12 | 22 | 78 | 54.5 | 80.7 |
| | 20 | 17 | 83 | 35.3 | 89.3 |
| | 28 | 10 | 90 | 50.0 | 85.5 |
| | 44 | 10 | 90 | 33.3 | 78.5 |
| Forced air[1] degrees (setting) | 60 | 22 | 78 | 0 | 70.5 |
| | 70 | 32 | 68 | 2 | 95.2 |
| Check (hand dissected) | | — | — | 34 (empty) | 66.0 (filled) |

[1]South Dakota seed blower—air flow as to degrees (setting) will vary somewhat between laboratories.

**Table 2. Average percent germination obtained by prechilling two different lots of eastern gamagrass seed at 5 to 10 C from 1 to 9 weeks.**

| Duration (weeks) of prechill (5–10 C) | Lot-1 | Lot-2 |
|---|---|---|
| 0 | 14.6 | 28.0 |
| 1 | 24.0 | — |
| 2 | 20.6 | 64.0 |
| 3 | 42.0 | 62.0 |
| 4 | 42.6 | 62.0 |
| 5 | 48.6 | 62.0 |
| 6 | 58.0* | 66.0 |
| 7 | 51.2 | 52.0 |
| 8 | 47.2 | 46.2 |
| 9 | 22.0 | 46.0 |

* Significant at the 5% level.

air are shown in Table 1. The percent of seeds that contained a caryopsis and remained afloat decreased with each additional interval of soaking up to 28 hr. The number of seeds that sank during this interval of soaking were from 73 to 95% well-filled. A flotation technique, utilizing solvents of low and high specific gravity as described by Stermer (6) for determining the pure seed fraction of difficult seed groups, may be an efficient analytical tool. However, the effect of certain solvents other than water may drastically affect seed germination.

Separating light seed by blowing at air valve settings of 60 to 70° compared favorably with the results from flotation and the actual pure seed content of the lot determined earlier by hand. Both methods yielded seed with only 5 to 27% empty units and more accurately determined the pure seed content than separations on the basis of visual inspection which contained 32 to 48% empty seed units.

Using five different sources of seed, it was established that a pound of pure seed (joints of eastern gamagrass) contains from 5928 to 6387 units with an average of 6268 units. A quick method of estimating the pure seed content of a particular lot may be obtained by determining the number of units in a pound and dividing this value into 6268, the average number of units per pound. If a pure seed content of more than 95% is obtained a quick check of accuracy can be made by dissecting a hundred or so units to determine the presence of a caryopsis. In the event all contain a caryopsis then 5928, the smallest number of units per pound, can be used as the numerator.

Since seed viability is an essential part of evaluating planting quality, a number of tests were conducted to find treatments that would stimulate the seed to germinate at its maximum potential. The seed used were blown at an air valve setting of 70° and were considered to have a germination potential of 73 to 95%.

Prechilling eastern gamagrass seeds on moistened substrate at 5 to 10 C was the only study in which germination was stimulated (Table 2). Heavy infestation of the substrate by mold in both the 20 to 30 C alternate and 30 C constant environments did not appear to restrict germination. The results indicate that seed lots respond differently to prechill treatment. In general, a 6- to 8-week treatment on moist substrate was sufficient to promote germination to within 60 to 80% of all live seeds. A similar germination response was obtained within both environments studied.

Soaking seeds in sodium hypochlorite and subjecting the seeds to vapors, as well as soaking in varying concentrations of ethylene chlorohydrin did not stimulate germination. Seeds soaked 1, 2, 3, and 4 hr in 1% solution of ethylene chlorohydrin had an insignificant, although higher, germination rate than the check, but did not compare favorably with the highest obtained by prechilling. Infestation by molds and fungi on the surrounding substrate was completely absent or significantly reduced by both chemicals. Salt solutions of .1 to .8% $KNO_3$ used as moistening agents did not increase germination.

The laboratory tests indicated that natural prechilling in moist soil by timing the planting operation may greatly reduce the risks of establishing a stand from seed. Weekly plantings were made in 1964, beginning in early March. The results (Table 3) showed a large difference in number of plants which emerged at each date of planting. March planting, as compared to later dates, improved germination under field conditions; however, only a very small portion of the expected viable seeds emerged. Seedlings emerging the second season,

**Table 3. Average number of eastern gamagrass seedlings obtained from seed at various dates of planting, 1964.**

| Item | Date of planting (1964) | | | | |
|---|---|---|---|---|---|
| | 3/17 | 3/22 | 3/29 | 4/5 | 5/9 |
| Ave. no. seedlings per 20′ row—1964 | 5.2 | 2.0 | 1.4 | .8 | .8 |
| Ave. no. seedlings 1965 | 10.8 | 7.4 | 5.0 | 3.4 | 24.8 |
| Number expected based on 70% pure live seed | 74.0 | 74.0 | 74.0 | 74.0 | 74.0 |
| Percent of expected observed | 14.5 | 10.0 | 6.7 | 4.6 | 33.5 |

1965, were more prevalent in the areas planted in May the previous year. Full stands, one plant every six to eight inches, were obtained from fall plantings, which substantiated earlier observations. No difference in stands was observed between October, November, and December dates of planting in McClain and Canadian Counties.

FIG. 1. Stand of eastern gamagrass obtained by spring planting (large sparse plants) as compared to fall seeding in Canadian County.

A comparison of stands established from spring seeding as compared to fall is shown in Fig. 1. Blank areas void of plants from spring plantings were reseeded in the fall. Near perfect stands were obtained.

In 1964, at each date of planting seed, simultaneous plantings were made with root stalks or rhizomes. The results indicated that 1) establishment by sprigging with live roots is as difficult as with seed; 2) roots planted within a day or two of digging improved the rate of survival under field conditions; 3) longevity of the root stalks is 1 to 2 weeks at room temperatures and 4 to 5 weeks under refrigerated conditions; and 4) the time and labor involved makes establishment by sprigging unpractical on a large scale. Progressively fewer roots were viable at successive weekly plantings after digging, whether the roots were stored at room temperatures or at 5 to 10 C.

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