Germination and Emergence of Different Age Seeds of Six Grasses[1]

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Highlight

Different aged seeds of six grass varieties were tested for percentage laboratory germination and percentage field emergence. Best age of seed for planting differed greatly among the varieties and the results from laboratory and field tests were not always consistent. One-year-old seeds of sand bluestem, blue grama and A-6606 switchgrass; two-year-old side-oats grama and yellow indiangrass; and seven-year-old Grenville switchgrass seeds had emerged best at the end of the field test. Except for sandhill bluestem, seeds two years and older emerged faster, a factor that may be important in successful field establishment of seeded grasses.

The germination of seeds does not begin until special conditions (moisture, time, temperature, etc.) have been provided. Freshly harvested seeds of many plants have a dormant period during which germination is greatly retarded or completely inhibited, although moisture and temperature conditions may be optimal.

Coukos (1944) showed conclusively that seeds of big bluestem (*Andropogon furcatus* Muhl.), little bluestem (*Andropogon scoparius* Michx.), and yellow indiangrass (*Sorghastrum nutans* (L.) Nash) possessed prolonged dormancy and some collections of side-oats grama and a Kansas selection of little bluestem possessed brief dormancy. Seeds of these grasses stored in either a barn loft or at room temperature in bags or jars did not begin normal germination until from 14 to 18 months after harvesting. After dormancy broke, germination remained high for several months.

Laude (1956) studied germination of some western range species and found some degree of dormancy in freshly harvested seed of smilograss (*Oryzopsis miliacea* (L.) Benth. and Hook.), broadleaf filaree (*Erodium botrys*), and 12 annual grasses. The duration of delayed germination varied by species. For a given species, germination rate varied from year to year and among seed production locations. In the annual grasses studied, dormancy persisted from one to five months, decreasing with time after seed maturity. Certain lots of smilo seed possessed dormancy for six months.

Thornton and Thornton (1962) concluded that firm seed dormancy in freshly harvested blue grama (*Bouteloua gracilis* (H.B.K.) Lag.) seed is of comparatively short duration, disappearing by the spring following harvest. They stated that blue grama seed retained its original viability for at least seven years under usual storage conditions at the Colorado Seed Laboratory. On the other hand, Sautter (1962) obtained 84% germination of switchgrass seed (*Panicum virgatum* L.) when it was scarified but germination was low for untreated seeds.

Sprague (1940) found that the best treatment for germinating freshly harvested seed of Kentucky bluegrass (*Poa pratensis* L.) and orchardgrass (*Dactylis glomerata* L.) was to alternate daily temperature from 15 to 30 C with the lower temperature effective for 16 to 18 hr and the higher temperature for 6 to 8 hr. In addition, he subjected moistened seed of these species to temperatures between 5 and 15 C for a period of 10 to 14 days and obtained over 90% germination.

Because the right combination of environmental conditions for field germination may occur only fleetingly, rapid germination of planted seeds is desired. We believe that many seeding failures result because the seeds planted are of improper age for rapid emergence when optimum field conditions for germination occur. For example, ability of planted seeds to emerge in the field within four days vs. eight days may spell the difference between success or failure. Therefore, the present research

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Table 1. Accession and age of seed for grasses tested, Fort Collins, Colorado, 1967. All seeds provided by Plant Materials Center, SCS, Los Lunas, New Mexico.

Species[1]	Origin of Seeds	Year of Harvest
Sand bluestem (Elida)	Collected in 1956 from native stand near Elida, New Mexico	1966 1965 1960
Side-oats grama (Vaughn)	Collected in 1935 from native stand at Vaughn, New Mexico	1966 1965 1964 1962
Blue grama (Lovington)	Field harvested in 1944 near Lovington, New Mexico	1966 1965 1962 1960
Switchgrass (A-6606)	Collected near Colorado springs, Colorado, about 1937	1966 1965 1960
Switchgrass (Grenville)	Collected near Grenville, New Mexico	1966 1965 1960
Yellow indiangrass (Llano)	Collected in 1957 from sandy plains sites in eastern New Mexico	1966 1965 1962

[1] All varieties are available commercially except A-6606 switchgrass.

measured the aging characteristics for seeds of: sand bluestem (*Andropogon hallii* Hack. var. Elida), side-oats grama (*Bouteloua curtipendula* (Michx.) Torr. var. Vaughn), blue grama (var. Lovington), switchgrass (varieties A-6606 and Grenville), and yellow indiangrass (var. Llano).

Methods and Materials

We tested all varieties studied in the laboratory and in the field to determine the influence of seed age on germination and emergence. The ages of seeds tested varied from one to seven years (Table 1).

The seeds were separated according to the provisions and regulations of pure seed sampling. For each variety, 200 seeds were selected as a sample and of these, 100 were used to test germination in the laboratory and the other 100 to evaluate seedling emergence in the field.

Laboratory Experiment.—The 100 seeds of each variety were divided into five replicates of 20 seeds each and placed on blotters according to standard procedure for "covered petri-dish tests" (Agricultural Handbook No. 30, 1952). The 20 seed lots were placed on wet blotter paper in five different petri dishes and placed in the germinator. Water was carefully applied each time under the edges of the blotter paper. To maintain constant humidity, distilled water was pumped to the top of the germinator and constantly dripped back into the storage area to be recycled. Temperatures were set for 30 C for 16 hr and 20 C for 8 hr to simulate natural conditions. Fluorescent lights were used for 16 hr daily to simulate daylight.

Fluctuations in precipitation can cause differences among seed lots that would otherwise be attributed to age of seed or duration of storage. However, the U.S. Soil Conservation Service Plant Materials Center at Los Lunas, New Mexico, produced the seeds for this study in an area that has an arid climate. All plants grown there for seed production are regularly irrigated. Therefore, it was assumed that normal climatic differences were not sufficient to confound the differences among seed lots attributed to duration of storage.

Field Experiment.—Seedling emergence trials were made at the Fort Collins Experimental Range Station, 11 miles north of Fort Collins, Colorado.

Soil in the study area is classified as a larimer gravelly loam. The land was moldboard plowed to a depth of 15 cm; then immediately harrowed and disked. On 1 June, five plots 150 × 50 cm were prepared.

A board with 20 markers set 2.5 cm apart and extending 6 mm downward was used for making depressions to assure a uniform depth in hand-planting the seeds. Following planting, the seeds were hand covered. Rows were 7.5 cm apart. The 100 seeds of each variety tested were divided into five replicates of 20 seeds each. Each of the six varieties had either three or four harvest years involved, so the combined total of varieties and years provided 20 test items that were planted in five blocks, or a total of 100 rows. The plots were sprinkler-irrigated daily, enough to keep a surface crust from forming and to keep the soil moist for a depth of at least three inches.

The seeds of the different varieties and harvest years were randomly located within the blocks. They were not pretreated in any way. The seeds tested differed only in length of time in storage. Observation began the day after planting and continued for a period of 30 days. Emerged seedlings were removed after each daily count.

Results

Age of seed affected laboratory germination and field emergence percentages of all varieties tested. Because rapid germination when favorable climatic conditions occur could be more important in stand establishment than total germinability, the initial percentages are compared to final results for both the laboratory and field study.

For sand bluestem, the youngest seeds germinated first and gave highest total percentages for both the laboratory and field studies. Viability appeared to decline proportionally with age. On the other hand, the two-year-old side-oats grama seeds gave highest values for both studies. This age seed also emerged fastest and after the first day, laboratory germination also was more rapid for this age of seed. Viability of seeds from this species declined after two years of age. (Figures 1 and 2).

Two-year-old blue grama seeds germinated and emerged first, but final field emergence values favored the youngest seeds by 8%.

Although the youngest A-6606 switchgrass seeds had highest total field-emergence values, they were three days slower in emerging and they required 19 days to overtake the seven-year-old seeds. For Grenville switchgrass, the seven-year-old seeds germinated first, emerged first and gave highest final percentages. This data suggests that rapid

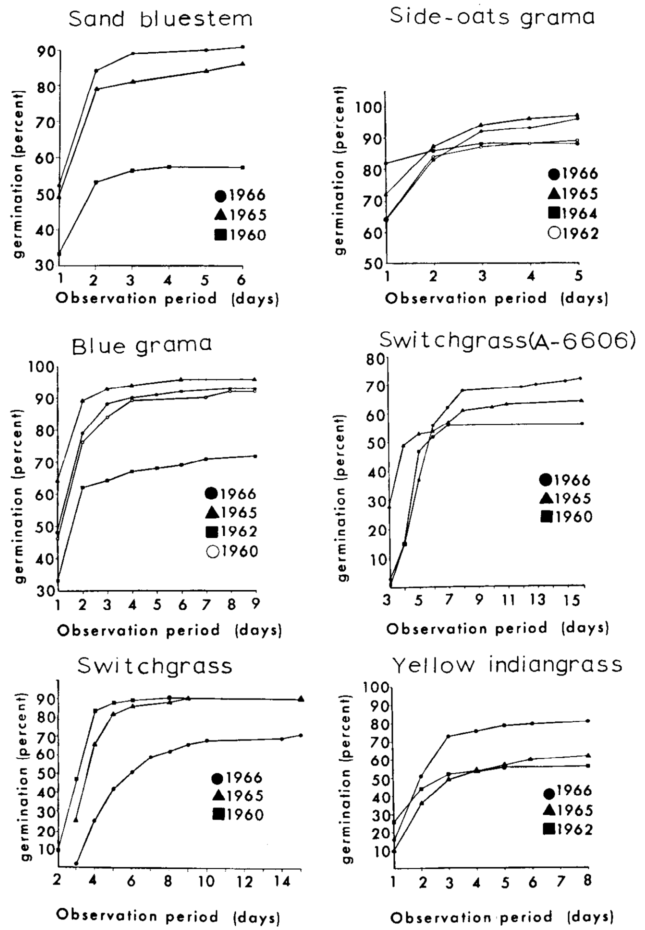

FIG. 1. Daily accumulated germination from laboratory tests conducted at alternating temperatures of 20 and 30 C for six warm-season grasses.

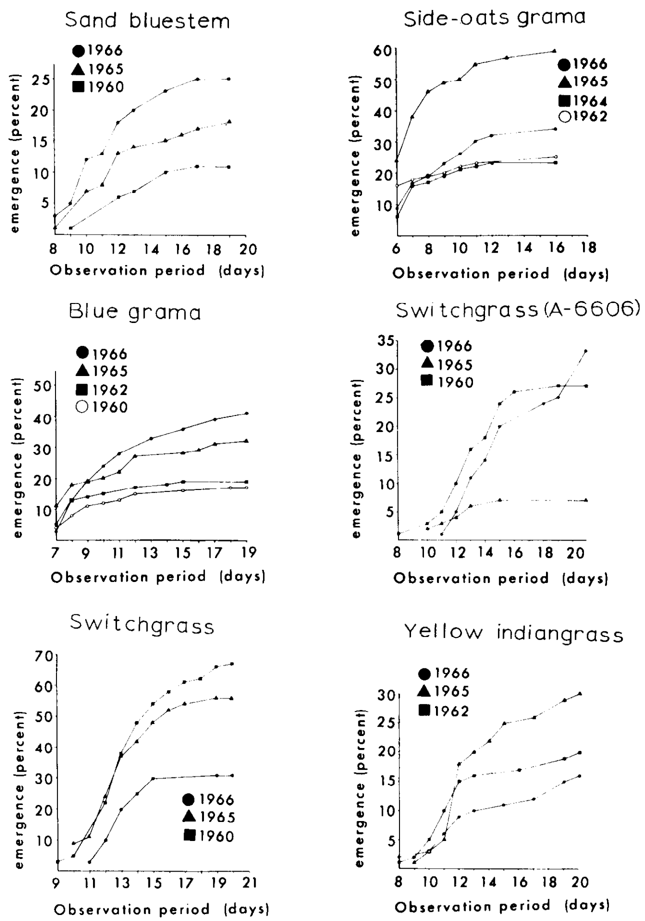

FIG. 2. Daily accumulated emergence from the field experiment for six warm-season grasses at Fort Collins Range Station, Colorado.

early germination of young switchgrass seeds may depend on scarification as indicated by Sautter's 1962 work.

Year-old yellow indiangrass seed had highest laboratory germination percentages, but the lowest field emergence percentages. This may be due to dormancy having been overcome in storage, but unfavorable climatic conditions in the field, e.g., low temperature, may have re-established the dormant conditions in the younger seeds. Dormancy was completely broken in the two-year-old seeds, which emerged 50% better than seeds from 1962, the next best year.

Discussion and Conclusions

Because the field experiment was carried out under natural conditions, its results should be the most valuable for use in range management. Rapid germination and early establishment of seedlings is very important because it contributes to the success of field plantings when other conditions such as moisture and temperature are optimum. From the standpoint of range revegetation, those species which have the fastest germination should be most useful for seeding. If soil moisture were adequate for germination at the time of seeding, those varieties having no delayed dormancy would be able to emerge while the conditions were favorable and the young root could possibly reach deeper moisture.

Taylor and Hudspeth (1961) reported that under field conditions on the southern Great Plains, sufficient moisture for seedling emergence of grasses planted at the customary shallow depths cannot be maintained with practical moisture-conserving treatments except under extremely favorable weather conditions. Therefore, rapid germination would be an important factor influencing stand establishment.

Commonly, seedling vigor, percent of a full stand established, and yield are compared to evaluate grass species and varieties in a nursery. At planting, uniformity among varieties is usually based on percent of pure live seeds but age of the seed is ignored. Variation among varieties is then attributed to adaptability to the local conditions. From this study, we conclude that germinability as determined in a laboratory is not the only factor that should be considered before species can most effectively be compared in a common planting. For example, 97% of our side-oats grama seeds germinated within 8 days from both one- and two-year-old seeds, but only 33% of the year-old seeds emerged in the field compared to 59% for the two-year-old seeds. Similarly, one- and two-year-old yellow indiangrass seeds germinated 82 and 61%, respectively, but almost twice as many two-year-old seeds emerged in the field.

Apparently, dormancy in some seeds is overcome in storage, but certain environmental conditions cause a recurrence of dormancy under field conditions in young seeds that does not occur in older seeds of the same variety. (See the yellow indiangrass results in Figs. 1 and 2). However, this seems to vary by specie and variety. The point is that for a given locale relatively few species and varieties are recommended for planting. Field establishment is usually erratic and undoubtedly there is one "best" age of seed for planting for each variety. This would seem to be an important enough item economically that all recommended varieties be researched for best age of seed to plant.

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