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STORAGEABILITY
Under Laboratory Conditions
of Seed of
BLUE GRAMA, SIDE-OATS GRAMA
and SMOOTH BROMEGRASS

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Under Laboratory Conditions of Seed of BLUE GRAMA, SIDE-OATS GRAMA and SMOOTH BROMEGRASS

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Perennial native grass seeds are generally harvested from wild stands in good years and stored until the supply is needed for reseeding range and pasture lands. One of the most difficult problems facing seedsmen dealing in grass seeds is the question of safe storage limits. These seeds are generally stored in warehouses, where the length of storage may last one to five years. It is not uncommon to have relative humidities as high as 65 to 80 percent with 25° to 35°C. temperatures in Oklahoma. During this time, without control of temperature and humidity, seeds deteriorate rapidly.

A similar situation generally exists with breeding material of grasses which are chaffy-seeded. The chaffy or rough seeds of selected plants are harvested and often processed to naked grain. This is done to avoid the need of a large storage area and for ease in handling. These seeds are often kept at room temperature several years for further study in relation to the breeding program. When needed, seeds stored in this manner may have deteriorated to the point of no further value.

This study was initiated to measure the normal pattern of seed longevity of one introduced and two native grasses. The objective was to measure both the length of seed longevity in the laboratory and the effect of container and insecticide treatment on the pattern of deterioration.

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REVIEW OF LITERATURE

The requirements for maintenance of viability of different kinds of seeds vary with temperature, humidity, and length of storage. According to both Toole (9) and Akamine (1), under ideal storage conditions both relative humidity and temperature are kept low, but in practice it is often necessary to control only one of these factors. Toole (8) stated most crops seeds lose their viability very rapidly at humidities approaching 80 percent and at temperatures of 25° to 30°C., whereas seeds can be kept for 10 years or longer without loss of viability at humidities of 45 to 50 percent and temperatures of 50°C. or lower.

Haferkamp *et al.* (5) found that seeds stored with hulls intact retained viability longer than seeds threshed to naked grain. He also observed that for maximum viability and longevity, seeds must be well-matured, thoroughly dried and stored unthreshed under cool dry conditions.

The initial viability has been found by a number of research people, Barton (2), McKee and Musil (7), and Brewer and Butt (4) to be important in the storageability of seeds.

The moisture content of seeds at the time of storage has been found to have profound effect on the length of viability. Moisture in keeping quality of seeds is closely related to temperature during storage. Kearns and Toole (6), studying the effect of different levels of seed moisture in fescue stored at 10°, 20°, and 30°C., recommended that the moisture content of seed stored at 30° not exceed 8 percent, at 20° not over 10 percent and at 10°C. not over 12 percent for long-time storage. Barton (3) showed that reducing the moisture content of some vegetable seeds to approximately 40 to 50 percent of their initial contents before placing in sealed storage at room temperature was effective in prolonging viability.

METHODS AND MATERIALS

Materials selected for study were 'Southland' smooth bromegrass (*Bromus inermis* Leyss.), 'Coronado' side-oats grama, (*Bouteloua curtipendula* (Michx.) Torr.) 'Capitan' blue grama (*Bouteloua gracilis* (H.B.K.) Lag. ex Steud.). Seed of blue grama was studied in both the rough and clean caryopses forms, whereas only the caryopsis form was used for side-oats grama.

Small quantities of high-quality seed of each kind of grass were stored in the laboratory in various types of containers. During storage no attempt was made to control temperature or humidity. The only control of seed moisture as affected by humidity was the storage containers. These studies were started in February 1956 with seed harvested in 1955.

The seed moisture content of each species, although not actually determined until one year after the study began, was 10.3, 9.8, and 9.7 percent for rough seeds of smooth bromegrass and blue grama and caryopses of side-oats grama, respectively.

Seeds of bromegrass having an initial germination capacity of 93.0 percent were stored in three types of containers: laminated paper bags, ice cream cartons, and muslin bags. As shown in Table 1, seeds stored in the laminated and carton containers received three insecticide treatments: 25% lindane, 20% aldrin, and 75% dieldrin. These insecticides were wettable powders mixed thoroughly with the seed, at a rate of 0.5 gram active ingredient per pound alone, and in combination with a desiccant. Activated alumina was used as the desiccant. The exceptionally high porosity of this material gives it a high absorptive capacity per unit of weight. Approximately 80 grams were oven-dried, placed in a small muslin bag, and stored with the seed as one of the treatments. The desiccant was not used with the seed stored in cloth bags.

Ice cream cartons were used as storage containers for caryopses of side-oats grama and both seed forms of blue grama. Where a desiccant was used alone and in combination with one rate of the insecticide in the storage of smooth bromegrass seed, two rates of each insecticide were used in the storage of both seed forms of blue grama and the caryopses of side-oats grama.

Table 1. Storage container and insecticide treatments used on seeds of bromegrass, blue grama and side-oats grama.

		Insecticide (gm./lb. of seed)					
		Lindane		Aldrin		Dieldrin	
	Check	0.5	1.0	0.5	1.0	0.5	1.0
Muslin bag							
Smooth bromegrass	+	+		+		+	
Ice-cream carton							
Smooth bromegrass[1]	+	+	+	+	+	+	+
Blue grama[2]	+	+	+	+	+	+	+
Side-oats grama	+	+	+	+	+	+	+
Laminated bag							
Smooth bromegrass[1]	+	+		+		+	

[1]Seeds stored both with and without a desiccant (activated alumina).

[2]Both forms of blue grama—caryopses and rough seed units, were used in these treatments.

From the start of the study and at each 6-month interval thereafter, four samples of 100 seeds each were drawn at random from each container and germinated. After samples were drawn, containers were resealed and placed in storage. The activated alumina used in the storage of smooth bromegrass seed was placed in a standard air-oven and redried before the containers were resealed.

RESULTS AND DISCUSSION

The storageability of blue grama, side-oats grama, and smooth bromegrass seeds at room temperature were found to differ considerably.

Blue grama stored as caryopses and rough seed units, Figure 1, had a greater rate of deterioration than side-oats grama and highly processed seeds of smooth bromegrass. After the first year of storage, rough seeds of blue grama germinated higher than at the start of the study, whereas caryopses showed a marked decrease in germinable seeds. Using the initial germination as a basis of comparison, no loss in viable seeds stored in the rough form was found until 2½ years from the date of harvest. At this time the viability of both seed forms decreased at a rapid rate. Assuming the original estimate of 41 percent viable rough seed as not a true picture of its initial capacity, both seed forms of blue grama deteriorated similarly. Although the deterioration pattern appeared to be slowed when stored as rough seeds, the length of time required for both seed forms to deteriorate completely was about the same. By the end of 52 months of storage, no seeds of either form of blue grama germinated.

Bromegrass responded to storage similar to that of blue grama (Figure 1). Except for the rate of deterioration as measured at different age intervals, both kinds of seeds had about the same longevity. Where averages of 90 and 54 percent decrease in viable seed were found after 36 months of storage in blue grama caryopses and rough seed units, respectively, a decrease of 65 percent was found in bromegrass. The highest rate of seed deterioration occurred between the third and fourth year of storage for bromegrass seed, and between the second and third year for both forms of blue grama. The lack of storageability of the blue grama caryopses may be attributed partly to minute damage to the outer seed layers during the process of grain extraction. Evidently, the slight mechanical seed injuries accelerated the rate of seed deterioration as compared to uninjured seeds. This was most evident in the caryopses form at the 24-month germination interval, since an average of 16.2 percent abnormal seedlings was found as compared to only 3.2 percent from the unprocessed seed form.

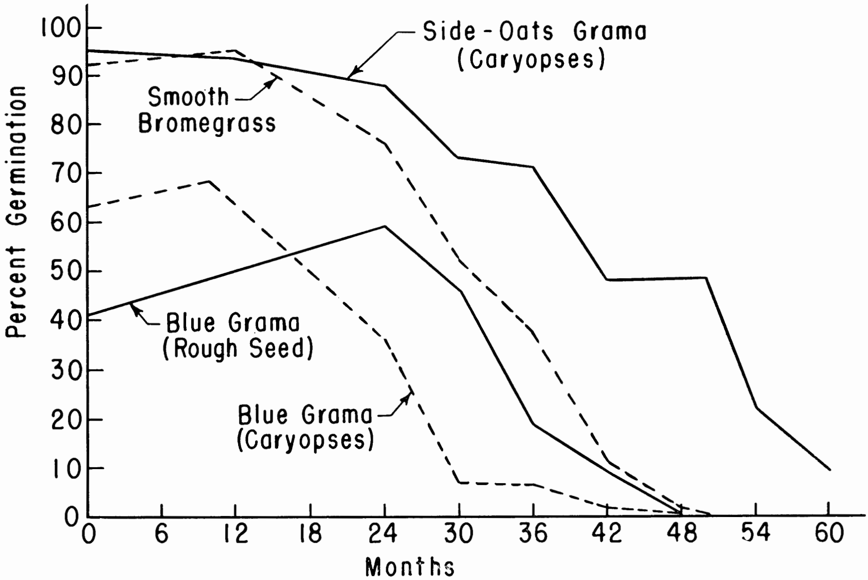

Figure 1. Average germination of the Check treatments (no insecticide) plotted against the duration of storage at 6-month intervals on seed of blue grama, side-oats grama, and smooth bromegrass.

Caryopses of side-oats grama had the longest longevity of the three grasses studied (Figure 1). The longevity of caryopses of side-oats grama exceeded five years stored under laboratory conditions. After four years of storage, side-oats grama caryopses had maintained as much as 50 percent of their original germination capacity. The average viable seed content for the same period of storage for bromegrass and both seed forms of blue grama was only 1.0 percent.

The differences in seed viability between containers of bromegrass seed were not obvious until after two years of storage (Table 2). The data indicate that bromegrass seed will apparently tolerate varying humidity levels for one to two years. Seeds stored in muslin bags lost their viability at a rate of 28 to 54 percent greater than seeds stored in cartons and laminated bags. The humidity of the surrounding atmosphere appeared to be a contributing factor for more rapid decrease in viable bromegrass seeds stored in porous muslin bags. Although the rate of seed deterioration was slowed when stored in tight containers, the length of seed longevity or the presence of some germinable seeds was found to be the same regardless of storage container. The addition of the desiccant within the laminated and carton containers as compared

Table 2. Average percent germination of bromegrass seed stored in various containers for a period of 50 months.

Container—Insecticide[1] Treatment	Average germination by storage intervals (months) 6	12	24	30	36	42	50
	(percent)						
Laminated bag (desiccant)							
Check	93.5	95.1	76.5	52.0	37.8	11.0	.5
Lindane		95.47	82.3	56.2	45.8	14.2	2.87
Aldrin		95.25	75.7	56.2	42.6	14.3	1.25
Dieldrin		96.00	79.7	57.2	43.5	18.0	2.12
Laminated bag (no desiccant)							
Check	93.5	95.1	76.5	52.0	37.8	11.0	.5
Lindane		95.6	79.1	55.2	36.9	9.2	1.25
Aldrin		95.1	75.4	56.5	38.6	11.2	1.25
Dieldrin		96.0	77.4	50.7	36.4	10.5	2.12
Ice-cream carton (desiccant)							
Check		94.0	83.8	53.2	35.7	12.2	1.87
Lindane		92.7	78.2	60.5	38.0	10.7	1.75
Aldrin		95.2	77.2	53.7	37.5	11.5	1.37
Dieldrin		91.8	79.2	56.5	35.3	11.2	1.12
Ice-cream carton (no desiccant)							
Check		94.8	75.4	50.5	32.0	7.2	.5
Lindane		95.6	79.4	44.7	27.0	6.2	.5
Aldrin		95.0	76.8	46.5	29.5	6.0	.87
Dieldrin		97.5	79.5	47.0	28.4	7.7	.5
Cloth bag (no desiccant)							
Check		94.0	80.7	45.5	25.2	4.5	.37
Lindane		94.5	74.3	44.5	22.8	3.5	.87
Aldrin		95.7	77.6	40.2	22.8	3.0	.25
Dieldrin		94.5	74.4	48.7	21.0	4.7	.5

[1]Check treatments received no insecticide. Insecticide treatments were used at a rate of 0.5 gm./lb. of seed.

to seed within the same containers without a desiccant did not alter the pattern of deterioration to any marked degree.

An average 6.52 grams of moisture was evaporated from the parcels containing the desiccant within each container. The amount of moisture absorbed by the dried desiccant during the time it was exposed to room temperature and before containers were sealed, is not known.

The insecticides aldrin, dieldrin, and lindane mixed thoroughly with both seed forms of blue grama at the rate of 0.5 gram per pound of seed, did not appear to have any phyto-toxic effect on the young seedlings. The heavier rate, one gram per pound of either lindane or dieldrin, after 12 months of storage, appeared to reduce the number of normal seedlings and increase the number of abnormal seedlings found in the caryopses form. The abnormal seedlings found in the caryopses were highest in all treatments at the 24-month germination interval.

Apparently this was due to the accumulative effect of storage condition, age, chemical, and perhaps slight damage to the caryopses during extraction. In every case, the number of abnormal seedlings found at the 24-month germination interval were highest when stored with the insecticide. However, the numbers found differed so much between replicates that statistical differences could not be found. Almost without exception, blue grama stored as rough seed germinated higher when an insecticide treatment was present. In addition, fewer abnormal seedlings were observed in the rough seed units than in the caryopses.

Caryopses of side-oats grama receiving the same levels of the various insecticides showed no early damage due to treatment. As the length of storage increased to 24 months, the caryopses in the presence of the insecticides deteriorated faster than the check. In the untreated seed, a reduction in average percent normal seedlings to germinate was not evident until after the 36-month storage interval. This occurred without an increase in the production of abnormal seedlings.

The insecticide treatments used did not have any detrimental effect on seed germination of bromegrass at any storage interval.

As shown in Figure 2, blue grama caryopses, with an initial viable seed content of 63 percent, deteriorated rapidly when stored under laboratory conditions. Eighty percent of the initial germination capacity was lost by the end of 24 months. Under the same conditions but in separate tests, the rough seed units of blue grama required approximately 36 months to lose 80 percent of their initial capacity. Bromegrass seed

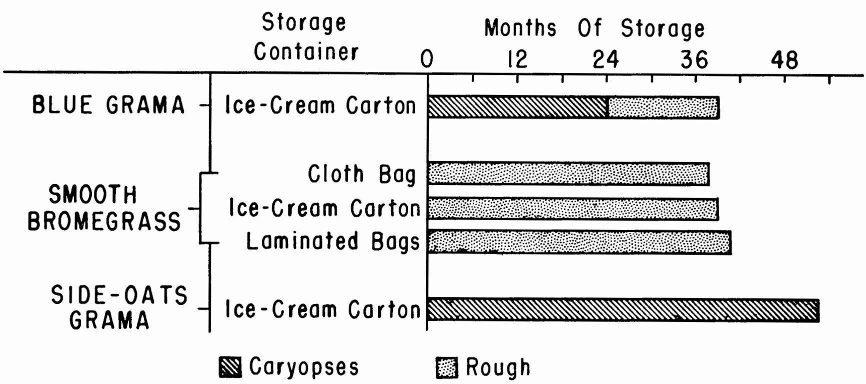

Figure 2. Number of months of storage at room temperature required for seeds of blue grama, side-oats grama, and bromegrass to lose 80 percent of their initial viability.

stored in cloth, carton, and laminated bags required approximately 36, 38, and 42 months, respectively, to lose 80 percent of their germination capacity.

SUMMARY

These studies indicate that seeds of smooth bromegrass and blue grama cannot be safely stored at laboratory room temperature much beyond 24 months if they are to be utilized for planting purposes. On the other hand, seeds of side-oats grama can be held in storage for as long as three to four years without a drastic loss in viability.

Blue grama seed stored separately as caryopses and rough seed units appeared to have a greater rate of deterioration than caryopses of side-oats grama or highly processed seed of smooth bromegrass. The pattern of deterioration appeared to be slowed when seeds were stored as rough units. The length of time required for both seed forms to completely deteriorate was 52 months.

Bromegrass seed stored in muslin cloth bags lost its viability at a rate 28 to 54 percent faster than seed stored in tightly sealed ice-cream cartons and laminated paper bags. Although the pattern of seed deterioration was slowed when stored in tight containers, the length of longevity or the presence of a few germinable seeds was found to be the same regardless of storage container. The addition of activated alumina as a desiccant within the laminated bags and carton containers did not alter the pattern of deterioration markedly.

Under the conditions of these studies the life-span of side-oats grama exceeded five years. After four years of storage at room temperature the caryopses had maintained as much as 50 percent of their original germination capacity.

The insecticides aldrin, dieldrin, and lindane mixed thoroughly at 0.5 gram active ingredient per pound of seed with the caryopsis form of blue grama did not appear to have any phyto-toxic effect on germination. After 12 months of storage, the heavier rate, 1.0 gram per pound of seed of either lindane or dieldrin reduced the number of normal seedlings and increased the number of abnormal seedlings. However, the rough seed units of this grass germinated higher in the presence of the insecticides than the untreated seed. Abnormal seedlings observed in the caryopses form were highest at the 24-month storage interval. This was attributed to the accumulative effect of storage conditions,

age, insecticide, and the fact that the caryopses may have been slightly damaged during the process of grain extraction.

Caryopses of side-oats grama receiving the same insecticide treatments as both forms of blue grama seed showed no early damage due to treatment. As the length of storage increased, the caryopses stored in the presence of the insecticides deteriorated faster than did the check. However, there was no evidence of decrease until after 36 months of storage.

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