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by
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Grasses, and especially the native grasses, play a major role in the agriculture of the Great Plains area. Propagation of these grasses necessitates knowledgeable handling and use of seed. The seed units of most native and introduced range grasses have hair, awns, and other inert appendages surrounding the caryopses. These surface characters make the planting, purity test and establishment of the chaffy seed difficult. Neither the producer nor seller gives much attention to the conditions of range seeds as long as there appears to be an appreciable amount of the desired seed along with the inert material. It has been suggested that much can be done to improve the quality and the likelihood of establishment of range grass seeds (7) (8) by different intensities and methods of processing. However, all kinds of chaffy grass seeds can not be processed alike. The shape of the caryopsis enclosed in the subtending appendages must be considered carefully (1) before deciding on the extent or degree to which processing should be carried out.

Processing the chaffy range grass seed involves the removal of some, most, or all inert attachments. Various degrees can be obtained ranging from slightly trimmed to clean caryopses. The results are 1) a seed lot easily analyzed for pure seed content and germination, 2) an improved seed planting quality, and 3) a higher number of pure seed units per pound. However, commercial outlets are not likely to sell seed containing, for example, 140,000 pure seed units per pound when they receive the same price for seed containing 90,000 units without the added cost of processing.

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This bulletin reports the results of several years of study on the effects of various degrees of processing seeds of three native grasses and one introduced range grass.

METHODS AND MATERIALS

The initial quality of the grass seeds used in these studies was representative of the material available for consumer use. Seeds of Indiangrass, *Sorghastrum nutans* (L.) Nash; sandbluestem, *Andropogon hallii* Hack.; buffalograss, *Buchloe dactyloides* (Nutt.) Engelm.; and marash bluestem (A-1359), *Bothriochloa ischaemum* (L.) Keng var. *ischaemum,* were obtained from increase blocks grown at the Livestock Research Station, El Reno, Oklahoma.

Bulk seed of each grass species was divided into four equal parts, drawn at random and assigned one of the following treatments (Figure 1):

1) Check—Combined seed cleaned only to the extent of removing the obvious inert material.

2) Slightly processed—Seeds were lightly trimmed of hair and awns with the aid of a small modified hammermill, Kneebone and Brown (5), calibrated for speeds of 1000 to 1400 R.P.M. and equipped with a 3/8 inch screen. Only the seed burs of buffalograss were hammermilled at 1400 R.P.M.

3) Heavily processed—This treatment involved hammermilling the seeds at 1400 R.P.M. varying the screen sizes, 1/4, 1/8 x 1/16, 1/8 x 1/16, and 1/8 inches for buffalograss, sandbluestem, Indiangrass, and marash bluestem, respectively.

4) Free caryopses—Cleaned to grain by hammermilling several times using the same screen as in treatment 3. After each hammermilling treatment the extracted grain was separated from the remaining rough seed with a Clipper seed cleaner. This prevented extensive damage to the freed caryopses by further milling. The hammermilling and cleaning cycles were repeated until all caryopses were extracted.

Comparisons were made between the varying degrees or grades of processing as to 1) pure seed content (number of seeds required to equal a pound), 2) germination, and 3) planting quality of grass species.

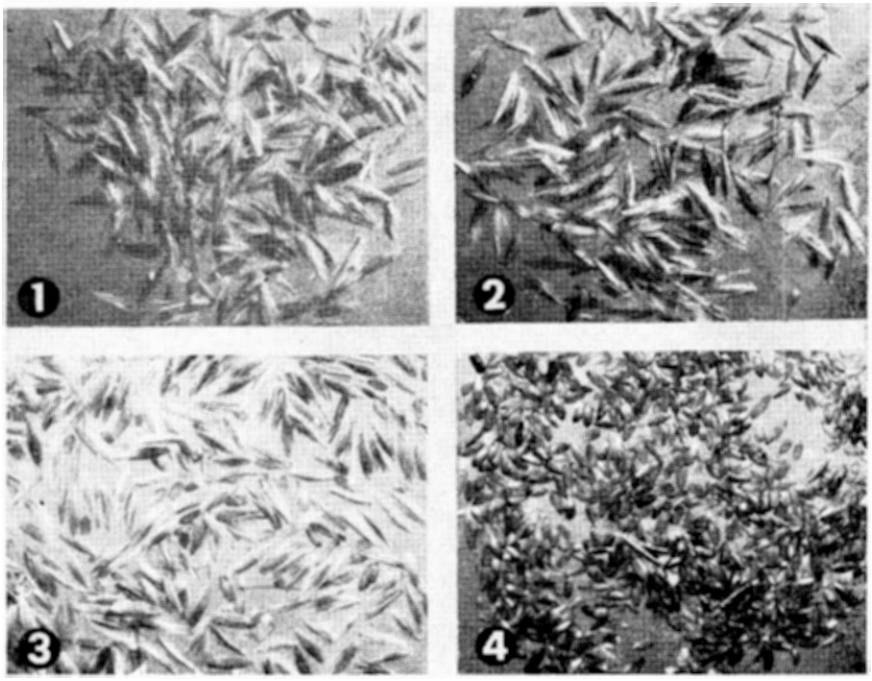

Figure 1. Processed grades of Indiangrass seed: 1) check, unprocessed, 2) slightly hammermilled, 3) heavily hammermilled, and 4) extracted and clean caryopses.

The number of seed units required to equal a pound of pure seed and the percent pure seed per treatment, with the exception of buffalograss, were determined from available data on the method suggested by Harlan and Ahring (4) for determining the pure seed content of certain chaffy seeded grasses. The number of buffalograss seed burs per pound was determined previously by Ahring (2) as ranging from 35,000 to 47,000. Pure seed content of each buffalograss treatment was determined as prescribed in the *Rules for Testing Seeds* (3).

Germination tests were made in a Stults germinator set for 8 hours of artificial light at 30° C. and 16 hours of darkness at 20° C. Separate germination tests were conducted on both the caryopses and rough seed units constituting the processed grades of treatments 2 and 3.

The pure live seed content was obtained by multiplying the percent germination times the pure seed content. The number of seed units

required to equal a pound pure seed for each processed grade was determined on the basis of the percent of each fraction, caryopses and rough seed, representative of the processed treatment. Example of calculation on number pure seed required to equal 1 pound live seed:

1 lb. of material has .544 lb. pure rough seed and .069 lb. of pure caryopses with a germination capacity of 65.5 and 75.0 percent respectively.

If 113,000 pure rough sandbluestem seed units are required to equal a pound of pure seed and likewise 159,500 pure caryopses are required to equal a pound of pure seed, then:

1 lb. of material has (.544) (113,000) pure rough seed and (.069) (159,500) pure caryopses.

Number live seed planted would then be:

(.544) (113,000) (.655) = Number pure live rough seed
(.069) (159,500) (.75) = Number pure live caryopses

% pure rough seed x number pure rough seed per pound x % germination = Number P.L.S. per pound of material

If 2.5 lbs. of seed material were planted per acre, the number of germinable seed expected per acre would be:

$$(2.5)\ [\ (113{,}000)\ (.544)\ (.655) + (159{,}500)\ (0.69)\ (.75)\ ] = X \text{ and}$$

$$\frac{X}{43{,}560} = \text{Number of plants expected per sq. foot.}$$

Two rates of 1 and 2 pounds pure seed per acre were used in each year of study. The field layout consisted of a randomized block design with three replications. Each replicate consisted of five rows, 12 inches apart and 20 feet long. A firm seed bed was well prepared and adequate moisture applied prior to planting during both years of study. A half inch planting depth was used for each species regardless of processed treatment.

Counts of the number of seedlings to emerge within each replication were made 15 days after planting while seedlings were still in the one- and two-blade stage of growth. The counts were the total number of emerged seedlings within a randomly selected 20-foot length of row of each field replicate. Field comparisons were made on the basis of the expected number versus the observed number of emerged seedlings per acre.

RESULTS AND DISCUSSION

To substantiate the indicated number of pure seeds required to equal a pound, a comparison was made between the number calculable from the mechanical method of determining purity (4), Table 1, to those listed in the *Rules for Testing Seeds* (3). These data indicate that the numbers of both caryopses and rough seeds used per pound were valid.

The appendages surrounding the caryopses of the chaffy range grass seeds not only cause difficulty in obtaining reliable analysis of seed quality, but also create problems in planting and obtaining uniform stands. The results of this study show (Table 2) that the pure seed content and ease of handling these seeds were improved by the various clipping and cleaning treatments. Each degree of processing increased the number of naked seeds and lowered the proportion of rough seed, thereby progressively increasing the number of pure seeds per pound with each treatment.

The immediate effect of the method used for processing the chaffy seeds of sandbluestem and Indiangrass was an increase in amount of pure seed per pound of material and in the germination capacity of the pure seed fraction, as compared to the unprocessed check. Retests of the seed material several weeks after and prior to planting under field conditions showed that the viable seed content, depending on the extent of processing, had decreased as much as 60 percent. Treatments 3 and 4, having

Table 1. Number of pure seed units per pound calculated from data used in determining conversion factors compared to the average listed by the Association of Official Seed Analysts' Rules for Testing Seeds.

Grass	Seed Form	No./Pound Mechanical Test	No./Pound A.O.S.A.
Indiangrass	Rough	174,992 to 197,168	165,408
	Caryopses	228,000 to 368,096	----
Sandbluestem	Rough	90,720 to 112,992	105,872
	Caryopses	159,515 to 166,973	----
Marash (A-1359)[1]	Rough	478,779	----
	Caryopses	735,723	----
Buffalograss	Rough (seed burs)	35,000 to 47,000[2]	49,984
	Caryopses	223,400 to 250,000	335,344

[1]A-1359 is an experimental introduced variety.
[2]Number seed burs per pound listed by Ahring (2).

Table 2. Comparison of purity test results, by treatment, to number of pure seeds required to equal a pound live seed for three native grasses and one introduced grass.

Grass and Year	Treatment	% Pure seed	% Components		Eq. Number pure seed units represented/lb. PLS		Number live seed based on % germination	
			Rough	Caryopses	Rough	Caryopses	Rough	Caryopses
Sandbluestem								
1958	1	47.0	47.0	0.0	159,330	----	112,646	----
	2	61.3	54.4	6.9	153,680	27,512	100,660	20,634
	3	98.2	86.2	12.0	131,498	25,839	101,253	19,379
	4	91.0	00.0	91.0	----	209,008	----	156,756
1963	1	28.0	28.0	0.0	154,719	----	112,944	----
	2	30.0	22.0	8.0	108,141	55,506	84,349	39,964
	3	36.0	22.0	14.0	95,959	86,194	69,090	62,059
	4	63.9	00.0	63.9	221,166	----	----	159,239
Indiangrass								
1958	1	62.0	62.0	0.0	550,095	----	174,380	----
	2	80.2	71.9	8.3	578,795	87,050	156,853	9,140
	3	97.8	74.3	23.5	739,820	304,334	133,167	31,955
	4	79.6	00.0	79.6	----	2,168,781	----	227,722
1963	1	61.0	61.0	0.0	277,550	----	174,856	----
	2	89.0	83.0	6.0	232,400	21,888	160,356	8,864
	3	90.0	76.0	14.0	232,750	55,860	147,563	22,623
	4	87.8	00.0	87.8	----	562,517	----	227,819

Table 2. (Continued)

Grass and Year	Treatment	% Pure seed	% Components		Eq. Number pure seed units represented/lb. PLS		Number live seed based on % germination	
			Rough	Caryopses	Rough	Caryopses	Rough	Caryopses
Marash (A-1359)								
1958	1	---[1]	---	---	----	----	----	----
	2	---	---	---	----	----	----	----
	3	---	---	---	----	----	----	----
	4	---	---	---	----	----	----	----
1963	1	22.0	22.0	---	1,092,272	---	480,599	---
	2	58.2	46.5	11.7	643,400	299,554	382,179	245,634
	3	55.9	21.6	34.3	219,239	534,984	185,037	438,686
	4	66.6	00.0	66.6	----	896,679	----	735,276
Buffalograss								
1958	1	76.7	76.7	0.0	429,941	---	37,404	---
	2	78.0	80.0	2.0	399,836	60,524	37,990	34,196
	3	85.5	70.5	15.0	183,638	236,544	30,667	133,647
	4	96.2	00.0	96.2	----	396,497	----	224,020
1963	1	92.0	92.0	0.0	298,530	---	37,017	---
	2	93.0	91.0	2.0	137,373	18,278	36,266	9,504
	3	96.0	83.0	13.0	121,304	115,024	32,024	59,812
	4	94.9	00.0	94.9	----	429,403	----	223,289

[1]No data gathered for Marash in 1958.

the highest percentage of extracted caryopses, were affected most. The deterioration in seed quality was attributed to slight mechanical injuries not apparent to the eye. Processing the seeds of these two grasses beyond a slightly trimmed and cleaned treatment appeared to be unrealistic and costly.[1]

These results are in contrast with the findings of Weber (8) and Schwendiman and Mullen (6). These people obtained no immediate change in germination after processing. Only Schwendiman and Mullen recognized the possibility of an adverse effect on the germination capacity and suggested that processing seeds of tall oatgrass to completely free caryopses should not be conducted until shortly before planting. The excellent stands obtained by Weber were more than likely due to the increased number of seed units per pound of material, since the numbers involved in a pound unprocessed and processed differ greatly.

The shape of the caryopses of marash bluestem and buffalograss are such that injury due to treatments was not as evident as with the long, slender and pointed caryopses of sandbluestem and Indiangrass. Seeds of both bluestem and buffalograss exhibited and maintained a high germination capacity with each increasing grade of processed seed.

A buffalograss seed bur contains an average of two to five spikelets and likewise may contain an average of two caryopses per bur. A pound of pure seed burs requires approximately 35,000 to 47,000 seeds. The number of caryopses extracted from the pound of burs would yield approximately 74,000 to 94,000 caryopses. When rates are figured on the basis of live seeds planted per square foot, it is obvious that the caryopses extracted from a pound of seed burs would plant two or three times more land—not to mention the fact that a caryopsis in most cases germinates more readily than a seed bur.

The number of pure seeds per pound of material was increased with each grass in proportion to the degree of processing. Based on pure live seed, however, the number of seeds per pound did not differ greatly for treatment 3 in both sandbluestem and Indiangrass. The extracted caryopses of this treatment, as in treatment 4, were extensively damaged. The major part of the live seed content was obtained from the rough seed fraction of treatment 3 and therefore reduced the number live seed per pound. The number of pure seeds of marash and buffalograss was increased progressively with the degree of processing. Only slight injury

[1]Broken and extensively damaged caryopses composed the remaining inert fraction not included in the percent pure seed shown. The fact that three to four, and possibly more, pounds of pure rough seeds may be required to equal an extracted pound of caryopses illustrates the cost of processing in terms of potentially good seeds.

to the caryopses was observed in the completely extracted clean grain of buffalograss. The same treatment with seed of marash bluestem was more damaging but not as extensive as with the seeds of the two native grasses.

The planting rates of 1 and 2 pounds live seed per acre varied as to number of live seed per pound. One pound of live seed was calculated as ranging from 112,646 to 159,239; 174,380 to 227,722; 480,599 to 735,276; and 37,017 to 223,289 seeds (unprocessed and dehulled) for sandbluestem, Indiangrass, marash bluestem, and buffalograss, respectively. Considering the differences in number of seeds required to equal a pound, rates of 1 and 2 pounds live seed per acre were too high.

The pattern of planting quality was fairly consistent between processed grades. The mixed seed forms of treatments 2 and 3 present problems in uniform planting, and stands of such seed appear as thick and thin in parts of each plot. In general, the unprocessed check grades and the slightly processed treatments, Table 3, with the exception of buffalograss, produced the most seedlings in proportion to the number of seed units involved. The number of seedlings to emerge under field conditions was observed to be close to or more than was expected at the rate of 1 pound live seed per acre. This was evident in 2 of 4, 3 of 4, 3 of 4 and 4 of 4 treatments for sandbluestem, Indiangrass, marash bluestem and buffalograss, respectively.

Sandbluestem

Under field conditions, the live seeds that germinated were generally greater in 1958 for all treatments at the rate of 1 pound live seed per acre. The number of seedlings observed was approximately 20 percent higher than expected for unprocessed and slightly trimmed treatments. Emergence in 1963, however, fell short of the performance expected for each grade of seed and emphasized the fact that a great deal of uncertainty is involved in stand establishment even when high seeding rates of live seeds are used. A reason can not be set forth due to the fact that the problem of emergence was not evident with the other grasses.

Indiangrass

Where the rough pure seed units constituted the bulk of the processed treatments (treatments 1, 2, and 3), the rate of emergence under field conditions was in general greater than expected at both 1- and 2-pound rates during both years of study. The rough seed units evidently germinate better under field conditions than in controlled artificial en-

Table 3. Number seedlings expected compared to the average approximated number seedlings observed at two different rates of pure live seed per acre.

Grass and Year	Treatment	Rate (Pure Live Seed/Acre) 1 Pound/Acre No. seedlings expected 1958	1963	No. seedlings observed 1958	1963	2 Pounds/Acre No. seedlings observed 1958	1963
Sandbluestem	1	112,646	112,944	135,616	47,460	183,968	65,395
	2	121,292	124,313	135,616	97,554	217,800	172,356
	3	120,632	131,149	72,600	113,279	169,448	93,320
	4	156,756	159,239	130,680	38,280	193,696	169,070
Indiangrass	1	174,380	174,856	188,700	138,250	237,256	441,000
	2	165,993	169,220	145,200	185,141	232,320	356,040
	3	165,122	170,186	140,408	222,162	179,176	273,150
	4	227,722	227,819	87,120	53,808	77,536	109,440
Marash	1	----	480,599	----	694,224	----	1,168,211
	2	----	627,813	----	673,664	----	1,218,454
	3	----	632,723	----	951,469	----	785,996
	4	----	735,276	----	367,124	----	766,620
Buffalograss	1	37,404	37,017	130,680	105,450	208,216	210,900
	2	72,186	45,770	101,640	497,900	169,448	496,862
	3	164,314	91,836	82,329	88,928	164,656	88,704
	4	224,020	223,289	227,528	295,196	309,856	514,569

vironments. The results suggest that processing beyond the slightly trimmed unit by hammermilling is detrimental to the seeds.

Marash bluestem

Seed of marash bluestem can be processed by hammermilling without much damage. Seeds of this type are typical of a large number of grasses. The caryopses enclosed in the subtending appendages are more oval in shape and not long, slender and brittle like those of sandbluestem and Indiangrass.

With the exception of treatment 4, all processed seed grades had a higher-than-expected rate of plant emergence in the field. Approximately 44 percent more seedlings for the unprocessed grade of seed were observed than were expected, based on the germination values obtained in laboratory tests. Similar results were obtained from treatments 2 and 3. Only in treatment 4, where clean caryopses were planted, was the rate of emergence lower than expected. The results suggest that processing seeds of this type to caryopses is wasteful. Reliable stands are likely to be obtained if the laboratory test results are used only as a suggestive guide to seeding rates used. The ease of planting such seeds can be easily improved by trimming, removing the major portion of the hair and awns from the subtending appendages before planting. However, the number of seeds per pound of live seed is such that a certain amount of pulverized inert matter is desirable in large plantings in order to obtain the desired rate. A pound of pure live seed contains enough seed units to establish an area of 10 acres at a rate of one plant per square foot.

Buffalograss

A quick and uniform established stand of buffalograss can be obtained easily by processing the seed bur to clean caryopses. Rates based on laboratory tests of the seed burs are generally high. A caryopsis usually germinates readily while the bur which contains several caryopses, by comparison, germinates poorly.

CONCLUSIONS

In summary, processing the chaffy range grass seeds to the extent of extracting the grain damages seed quality. Considering the differences in numbers of seed units required to equal a pound, processing seeds to cleaned caryopses can be very costly. Extracted caryopses almost always germinate faster and more completely in laboratory tests than caryopses

which are left in their enclosing appendages. However, slight mechanical injuries not detected in laboratory tests may affect seed longevity and stand establishment under field conditions.

Seed processing improved the seed quality only from the standpoint of seed analyses and ease of planting. In general, and with the exception of buffalograss, only the unprocessed check and slightly trimmed treatments performed the best under field conditions.

The results of this study suggest that:

1) With the exception of buffalograss, processing the seeds to naked caryopses injures planting quality and increases the rate of planting two to five times over the check, when number of damaged seeds involved are considered.

2) Processing to the extent that 10 to 20 percent of the pure seed present is extracted grain results in irregular stands. The two seed forms do not feed through present planting equipment at the same rate.

3) Only two seed forms, the seed bur and clean caryopses, of buffalograss plant uniformly. The caryopses greatly improve chances of stand establishment.

The amount of caryopses present in a pound of seed burs is sufficient to plant a much larger area than the same pound of burs unprocessed.

LITERATURE CITED

(1) Ahring, R. M. 1963. Methods of handling introductions of grass seeds belonging to the tribe Andropogoneae. Crop Science 3:102.

(2) _____. 1964. The management of buffalograss *Buchloe dactyloides* (Nutt.) Engelm. for seed production in Oklahoma. Okla. Agr. Exp. Sta. Tec. Bull. T-109.

(3) Association of Official Seed Analysts. 1960. Rules for testing seeds. Proc. Assoc. Official Seed Analysts 49(2):4-10.

(4) Harlan, J. R. and R. M. Ahring. 1960. A suggested method for determining purity of certain chaffy seeded grasses. Agron. Jour. 52:223-226.

(5) Kneebone, W. R. and H. W. Brown. 1953. A modified hammermill for processing grass seed. Agron. Jour. 45:389-391.

(6) Schwendiman, J. L. and L. A. Mullen. 1944. Effects of processing on the germination capacity of seed of tall oatgrass. Jour. Amer. Soc. Agron. 36:783-785.

(7) Stoesz, A. D. 1932. Harvesting, processing and seeding of native grasses in central and northern great plains. Agron. Jour. 44:378-383.

(8) Weber, G. L. 1939. A method of preparing some native grass seeds for handling and seeding. Jour. Amer. Soc. Agron. 31:729-733.

Oklahoma's Wealth in Agriculture

Agriculture is Oklahoma's number one industry. It has more capital invested and employs more people than any other industry in the state. Farms and ranches alone represent a capital investment of four billion dollars—three billion in land and buildings, one-half billion in machinery and one-half billion in livestock.

Farm income currently amounts to more than $700,000,000 annually. The value added by manufacture of farm products adds another $130,000,000 annually.

Some 175,000 Oklahomans manage and operate its nearly 100,000 farms and ranches. Another 14,000 workers are required to keep farmers supplied with production items. Approximately 300,000 full-time employees are engaged by the firms that market and process Oklahoma farm products.

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