Kika de la Garza Plant Materials Center

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GERMINATION AND EMERGENCE IN FIVE ACCESSIONS OF WILDRYE

INTRODUCTION

Virginia wildrye *(Elymus virginicus*) and Canada wildrye (*Elymus canadensis*) are both native, cool season, perennial bunchgrasses which grow two to three feet in height. Both species reproduce by tillering and seed. Virginia wildrye can be found throughout the United States except for Nevada, California, and Oregon; whereas Canada wildrye is distributed throughout the United States except for Alabama, Georgia, Louisiana, South Carolina, and Tennessee (Hitchcock, 1971). Both species can be found scattered on shaded banks, along fencerows and in open woodlands (Gould, 1975). Virginia wildrye prefers moister soils, higher soil fertility, heavier soil textures, and is more shade tolerant than Canada wildrye (Phillips Petroleum Company, 1963). Virginia wildrye is very palatable and nutritious, and is readily eaten by all classes of livestock in the spring and fall when it is green (Phillips Petroleum Company, 1963). In the spring when it is green, Canada wildrye also has good forage value for cattle and horses; however, the forage value for sheep and wildlife is reported to be only fair. (Stubbendiek, Hatch, and Kjar, 1980). Stubbendiek, et al. also note that the forage value of Canada wildrye decreases sharply when the plant matures. Both species self-fertilize (Dewey, 1979), but have been known to hybridize and introgress (Brown & Pratt, 1960).

Two studies were conducted in the fall of 1997 at the Kika de la Garza Plant Materials Center in Kingsville, Texas. The first study was done to evaluate germination. The second study evaluated emergence. Both studies used the same five accessions of wildrye. In addition, the emergence study included a commercial variety, ‘Beefbuilder’ ryegrass, for comparison.

MATERIALS AND METHODS

The accessions of wildrye that were used in these studies are currently being evaluated at the Kika de la Garza Plant Materials Center in Kingsville, Texas. One Virginia wildrye accession (#845) was obtained from San Marcos, Texas. A second Virginia wildrye accession (#763) was obtained from Madisonville, Texas. Two other wildrye accessions (#971 & #957) were obtained from the East Texas Plant Materials Center in Nacogdoches, Texas. Finally, one Canada wildrye accession (#285) was originally obtained from Halletsville, Texas. This particular accession of Canada wildrye was chosen because it showed itself to have superior survival, foliage height, plant width, foliage density and other desirable agronomic characteristics after eight years of Initial Evaluation at the Kika de la Garza Plant Materials Center beginning in 1986. The Virginia wildryes #763 and #845 were similarly selected after eight years of Initial Evaluation, also conducted at Kika de la Garza Plant Materials Center. The 'Beefbuilder' ryegrass that was used in the planting study is a commercially available variety. It was used only for comparison purposes.

The Germination Study

Each germination test consisted of 50 untreated seeds of one accession evenly distributed on two sheets of blotter paper stacked one on top of the other, and placed in plastic boxes, with tight fitting lids. The blotter paper was moistened with de-ionized water, and remoistened with de-ionized water when necessary. Each test was replicated four times. Twenty plastic boxes, each containing one of the five wildrye accessions were placed in a randomized design on one of four shelves in a controlled environment chamber. The chamber was set to provide 16 hours of darkness and 8 hours of light in each twenty-four hour period. The temperature was set at 15ºC during the hours of darkness, and 30ºC during the hours of light. Samples were checked on a daily basis for 28 days starting on September 25, 1997. Shelf position was rotated daily. Seeds were considered to be germinated when the coleoptile and radicle extended one half the length of the seed or more. Percent of germination was the number of seeds germinated per box multiplied by two. Once seeds were considered germinated, they were removed from the plastic boxes and planted approximately ½" deep in 1"x 3" containers filled with potting soil mix. Emergence was watched and recorded.

The Emergence Study

For this study, 25 seeds of each wildrye accession and the ryegrass were planted in one of two soil treatments in 6- inch pots. Soil treatment #1 consisted of a 50/50 mix of potting soil and sterilized sand. Soil treatment #2 consisted of sterilized Victoria Clay from Block K of the Kika De La Garza Plant Materials Center. There were separate pots for each accession, each soil treatment, and each planting depth. Plantings were done at ½", 1", 1 ½", and 2" depths. Pots were labeled by accession, planting depth, soil treatment, and replication number. The pots were then filled with the specified soil treatment to a 2" depth. Seeds were then arranged on the soil and

covered by ½", 1", 1 ½", or 2" of the same soil treatment, according to a preset mark on the inner wall of the pot. All pots were set in the greenhouse on a table with premoistened capillary matting so that all pots had equal access to water. Pots were placed on the table according to soil treatment, planting depth, and accession in a split-strip block design. The order of soil treatments, planting depths, and accessions were chosen randomly. The capillary matting was remoistened as needed. Pots were checked daily for new seedlings starting on November 26, 1997, the day after planting. A total count was made at the end of 45 days. There were two replications of each accession/planting depth/soil treatment combination. Replications one and three were given the clay soil treatment, while replications two and four used the sand/soil mix.

RESULTS

The Germination Study

Radicles were beginning to emerge from many of the seeds by day five. However, no seeds were classified as "germinated" until day six. On day six, all accessions but one (Wildrye #957) showed some seeds with both the coleoptile and the radicle extending at least ½ the length of the seed. This was determined visually; no measurements were made. Virginia wildrye #845 showed the highest percentage of early germination, followed by Virginia wildrye #763, and Canada wildrye #285. The two East Texas accessions were slower to germinate, possibly due to a difference in the harvest year (the two East Texas accessions, #957 and #971 were harvested in 1997; the other two Virginia wildrye accessions, #763 and #845, and the one Canada wildrye accession, #285, were all 1996 harvest). This year difference may have affected the total germination percentage. The 1997 harvested seed may need to "over-winter" to achieve its full germination potential. Treatment differences in the seed cleaning process may also have impacted the data. The two East Texas accessions were cleaned by hand, and were not debearded. The other three accessions were machine cleaned, and run through the debearder.

The results of this germination study were much better than anticipated. Three accessions (Virginia wildryes #763, #845, and Canada wildrye #285) achieved 80% germination or better in all replications. One accession (Canada wildrye #285) exceeded 90% germination in all replications, with 2 replications being 100% germinated. When averaged across replications, the Canada wildrye #285 achieved 96% germination. The Virginia wildryes #763 and #845 had 88% and 89% germination, respectively, when averaged across all replications. The two East Texas accessions did not perform quite as well. The wildrye #957 achieved an average germination rate of 74%, with all replications achieving better than 60% germination. Wildrye #971 was the poorest performer. Its lowest germination rate for a replication was 30% and no replication exceeded 60% germination. The average germination rate for this accession was only 47%. Again, differences in harvest year and seed cleaning treatment may have impacted germination. Further study using similarly cleaned seeds from the same harvest year should be pursued to see if differences in germination were due to seed year and /or seed treatment differences.

Statistical Analysis was conducted using SPSS for Windows. A one-way ANOVA was run to determine if replication differences in germination existed. No significant differences between replications were found. A one-way ANOVA was also run to determine if there were germination differences present between accessions. Results of the ANOVA showed that there were in fact significant differences in germination between accessions. Tukey's Test for Honestly Significant Difference was used to pinpoint specific differences. Wildrye #971 was found to have significantly poorer germination than any of the other accessions tested. In addition, wildrye #957 was found to have significantly poorer germination than Canada wildrye #285 (table 1).

The Emergence Study

Statistical Analysis was conducted using SAS. All statistical tests were run using both the actual emergence figures from the study and an emergence figure that was adjusted for germination. The adjusted emergence figure was calculated by dividing the actual emergence figure by the estimated germination rate for each accession. The purpose of the adjusted rate was to be able to look at emergence rates without germination functioning as a confounding variable. The germination rates used were based on the results of a 1997 germination study conducted at the Kika de la Garza PMC (see above). They are as follows: Virginia wildrye #763 - 88%, Virginia wildrye #845 – 89%, wildrye #957 – 74%, wildrye #971 – 47%, Canada wildrye #285 – 96%; and 'Beefbuilder' ryegrass – 98%.

A Factorial ANOVA was run for the factors, accession (ACC), planting depth (DEPTH), and soil treatment (TRT) using the actual emergence figures (GERM) as the dependent variable. The ANOVA was then repeated using the same factors, but with the adjusted emergence figure (ADJGERM) as the dependent variable. The error factors used for each main effect and interaction were adjusted as needed in accordance with the split-strip block design used. The results of both ANOVAs indicated significant main effects for accession and depth, and a significant 2-way interaction for treatment by accession. Tukey's Test for Honestly Significant Difference (Tukey's HSD) was run for the factor, depth, and also run using the 2-way interaction between accession and soil treatment as a combined factor. The adjusted error terms were also used for these tests. Tukey's HSD was done to help pinpoint specific areas of significant difference (table 2).

Treatment by Accession

Tukey's HSD was run for the combined variable soil treatment by accession (TBYA), using the GERM as the dependent variable. Results showed that Virginia wildryes #845 had significantly better emergence than all other accessions except the Virginia wildrye #763, when planted in clay soil. In addition, Virginia wildrye #763 showed significantly better emergence than wildrye #971, Canada wildrye #285, and 'Beefbuilder' ryegrass when planted in clay soil. Also, wildrye #957 showed significantly better emergence than 'Beefbuilder' ryegrass and wildrye #971. When

planted in sandy soil, all accessions outperformed wildrye #971, which was found to have significantly poorer emergence. 'Beefbuilder' ryegrass had significantly better emergence in sandy soil than all accessions, except Virginia wildrye #845. Finally, Virginia wildrye #845 outperformed wildryes #957 and #971.

When Tukey's HSD was run using ADJGERM as the dependent variable, the 'Beefbuilder' ryegrass in clay soil was found to perform significantly poorer than all other accessions regardless of soil treatment, with the exceptions of Canada wildrye #285 and wildrye #971, both in clay soil. In addition, Canada wildrye #285 in clay soil performed significantly poorer than Virginia wildrye #845 in clay soil. When planted in sandy soil, no significant accession differences were found.

Planting Depth

When Tukey's HSD was run for the factor DEPTH, it was found that there was significantly less emergence at the 1 ½" and 2" planting depths than there was at the ½" planting depth. Also, there was shown to be significantly poorer emergence at the 2" planting depth than there was at the 1" depth. This was true regardless of whether actual emergence or adjusted emergence figures were used for the dependent variable.

DISCUSSION AND CONCLUSION

Based on the results of the emergence study, significant differences in emergence were found for a soil treatment/accession interaction, and for planting depth. Wildrye #971 was found to perform significantly poorer than all other accessions in sandy soil. It was believed that this was due in part to that accession's germination rate being significantly lower than the other accessions. This proved to be at least partly true. When the emergence figures were adjusted for germination, a difference still existed – but it was no longer statistically significant. Based on these results, if planting wildrye #971, more seed should be used to achieve the same seeding rate as the other accessions in order to account for the lower germination (and therefore a lower emergence) rate. In addition, the Virginia wildrye #845 performed significantly better than the Canada wildrye #285 in clay soil. This was true whether or not an adjustment was made for germination. Virginia wildrye #763 also showed significantly better emergence than the Canada wildrye #285 in clay soil, but this was only true if the adjustment for germination was not made.

Emergence differences for different planting depths were also found. It was believed that as planting depth increased, emergence would decrease. Tukey's HSD supported this finding. However, significant differences in emergence were only found between emergence at the 2" depth and both the ½" and 1" depths, and between the 1 ½" and ½" depth. No significant differences were found between ½" and 1" depths. Based on this information, a ½" to 1" planting depth is recommended when planting wildryes and/or ryegrass.

Soil texture was also shown to have an effect on emergence. This emergence difference tends to manifest itself more often with some accessions than with others. For instance, when both accession and soil texture were considered 'Beefbuilder' ryegrass showed strong emergence in the sandy soil (mean emergence of 23.3750 seeds out of 25), yet it had a very poor emergence in clay soil (mean emergence of only 7 out of 25 seeds). Canada wildrye #285 also showed poorer emergence in clay soil than in sandier soil. This was found to be predominately true at deeper planting depths. It is recommended that you choose either the #845, #763 Virginia wildryes or the #957 wildrye with a preferred planting depth close to ½", but no more than 1", or the Canada wildrye #285 planted at a ½" depth, if the soil to be planted in is more clayey. In sandy soils, accession is not as much of an issue. Preferred planting depth is ½" to 1"; however, seedlings will emerge from as deep as 2" so there is a little more flexibility when planting.

TABLE 1.

GERMINATION PERCENTAGES FOR WILDRYES

Acc	Rep 1	Rep 2	Rep 3	Rep 4	Mean*
285	100	94	92	100	96.5[a]
763	80	88	90	96	88.5[ab]
845	90	88	86	92	89.0[ab]
957	62	64	82	86	73.5[bc]
971	30	48	58	54	47.5[c]

* Means followed by the same letter are not significantly different at the 5% level of probability.

TABLE 2.

MEAN EMERGENCE[1] FOR WILDRYES

Accession	Actual Emergence		Adjusted Emergence[2]	
	SAND	CLAY	SAND	CLAY
285	17.8730[bc]	10.3750[cd]	18.6175[a]	10.8075[bc]
763	17.6250[bc]	15.8750[ab]	20.0288[a]	18.0388[ab]
845	19.3750[ab]	19.3750[a]	21.9113[a]	21.7770[a]
957	14.3750[c]	13.0000[bc]	19.4250[a]	17.5663[ab]
971	7.8750[d]	7.3750[d]	16.7550[a]	15.6913[abc]
BB	23.3750[a]	7.0000[d]	23.8525[a]	7.1413[c]

Planting Depth	Actual Germination	Adjusted[2] Germination
½"	17.8750[a]	22.050[a]
1"	16.0420[ab]	19.274[ab]
1 ½"	13.0420[bc]	16.044[bc]
2"	10.875[c]	13.167[c]

[1]Means in columns followed by the same letter are not significantly different at the 5% probability level.
[2]Emergence adjusted for germination

REFERENCES

Brown, W.V., and Pratt, G.A. (1957). " Hybridization and introgression in the grass genus Elymus". *American Journal of Botany, v.47* p. 669-676.

Dewey, D.R. (1979). "Genomic and phylogenetic relationships among North American perennial Triticaceae", p 51-88. In *Grasses and Grasslands, P*roceedings of the American Society of Taxonomy Symposium, August 1979.

Gould, F. W. (1975). *The Grasses of Texas*. College Station, Texas: Texas A&M University Press.

Hitchcock, A. S. (1971). *Manual of the Grasses of the United States, Volumes 1&2, 2nd Edition*. Revised by Agnes Chase. New York: Dover Publications.

Phillips Petroleum (1963). *Pasture and Range Plants*. Bartlesville, OK: Phillips Petroleum Company.

Stubbendiek, Hatch, and Kjar (1980). *North American Range Plants.* Lincoln, NE: Natural Resources Enterprise, Inc.