IDENTIFICATION OF BLUE PANICGRASS SOURCES, *PANICUM ANTIDOTALE* RETZ., BY VARIOUS NUTRIENT SOLUTIONS AND GERMINATION TESTS

by

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ABSTRACT

Distinguishing between blue panicgrass, Panicum antidotale Retz., sources (commercial A-130, irrigated forage experimental, and seedling drought tolerant experimental) on individual seed basis is unlikely. There is a need to develop a method of distinguishing among these 3 sources.

Seed from 3 sources were tested for rapidity of germination, ability to germinate in mannitol simulated water stress, and for sensitivity to various concentrations of herbicide Diuron. The same seed sources were planted with different nutrient solutions in a controlled environment.

Commercial (A-130) cultivar showed different germination behavior from irrigated forage experimental and seedling drought tolerant experimental. It achieved 50% germination point faster, and showed better germination capability in lower concentrations of herbicide and in the simulated water stress; however the other 2 sources were indistinguishable.

Nutrient solution without nitrogen revealed significant differences between commercial (A-130) and the other 2 sources in number of seedlings with solid red first leaf sheaths. Seedling drought tolerant experimental had the

highest percent of healthy leaves (77%), compared to 64% for irrigated forage experimental and 45% for commercial (A-130).

CHAPTER 1

INTRODUCTION

Blue panicgrass (Panicum antidotale Retz.) is a rhizomus perennial grass suited to conditions of the southwestern United States and northern Mexico (Wright 1966). A great deal of information about the responses of blue panicgrass to fertilization, irrigation, and forage production was reported by Wright (1966).

The increase in seed trade regulations make it a necessity for plant breeders and seed analysts to develop meaningful criteria for cultivar seed identification in order to make certain that any seed lot sold as an improved cultivar is correctly labelled.

Under many circumstances a field cultural trial, for cultivar identification purposes, is impractical and time consuming. Individual seed identification is tedious and in many cases unreliable. Use of a controlled environment such as a greenhouse and a growth chamber for cultivar identification seems to be promising. Using these procedures, cultivar seedlings can be evaluated and results can be reported in a matter of weeks.

The objective of this study was to develop methods to identify blue panicgrass. Three plant materials, irrigated forage experimental, seedling drought tolerant experimental, and commercial A-130, are referred to as sources throughout this thesis. These blue panicgrass sources can be related to the Plant Variety Protection Act of 1970 if they can be properly identified.

CHAPTER 2

LITERATURE REVIEW

Larsen (1966) reported use of fluorescence as a possible means of distinguishing between cultivars of plant species. However, the value of the fluorescence technique has been reduced since hybrids, certain new cultivars, and experimental materials deviate from the classic fluorescence percentages. Nittler (1973) stated that the morphological differences exhibited by seedlings can be of value in distinguishing among cultivars. Nittler proposed the seven following categories as helpful means for cultivar identification:

1. careful observation of seedling characteristics to detect cultivars that differ,
2. manipulation of environment to induce seedlings to express genetic differences in a detectable manner,
3. induction of morphological differences with chemicals,
4. induction of morphological differences by manipulation of mineral nutrition,
5. defoliation of seedlings to induce cultivar to differ morphologically,

6. induction of blooming or heading in a short time to make flowers or heads available for observation,

7. testing cultivar seedlings for resistance to pests or pathogens.

Nittler (1973) disclosed significant differences between alfalfa (Medicago sativa L.) cultivars in percentage of leaves with serriated tips. Ten percent of 'Buffalo' plants had serriated leaves as compared to 49% of 'Vernal'. Sheridan and McKee (1968) reported significant differences in internode number and length among ten cultivars of M. sativa L. of similar type and origin. For instance, 'Alfa', 'Cardinal', and 'DuPuits' did not differ significantly in internode number but did differ from 'Buffalo' and 'Cody'.

Nittler, Kenny and Osborne (1963), while working with orchardgrass (Dactylis glomerata L.) using a controlled environment, found cultivar differences when light was supplied in large quantities, either by the use of longer photoperiods or relatively high light intensity. Cultivar differences were magnifical when plants were given small quantities of light, produced either by the use of low intensity or short photoperiods. Differences were greater in tiller production than in production of green weight of the tops. Nittler (1967) stated that seedlings of cultivars of red fescue (Festuca rubra L.) and of chewing fescue (Festuca rubra var. commulata Gaud.) grown in a controlled

environment showed differences in growth habit, color of lower leaf sheaths, and green weight. A high correlation was found between decumbent growth habit and green color of lower leaf sheath. Daily cold periods induced up to 50% of the plants to become decumbent in growth habit. Nittler and Kenny (1965) grew seedlings of birdsfoot trefoil (Lotus corniculatus L.) cultivars in a growth chamber under several combinations of photoperiod, light quality, light intensity, and temperature. The authors reported that great differences were found in growth habits of cultivars. To obtain maximum cultivar differentiations it was necessary to provide the plants with short photoperiods and relatively high light intensity with a limited proportion in the warm end of the spectrum.

Ueno and Smith (1970) found significant differences among three cultivars of M. sativa L. under three temperature regimes; most of the differences occurred in the cold regimes. Eifrigh (1968), working with Lolium species listed in the German register, tested cultivar seed after vernalization at temperatures between 0 C and 5 C. The majority of annual ryegrass (Lolium multiflorum Lam.) seed sprouted without heat treatment. Annual ryegrass cultivars were divided into four groups: plants ready to sprout 4 weeks after a vernalization period of 6 weeks, those which sprout 4 weeks after a 12-week vernalization period, those which

show an acceleration of readiness to sprout only after 18 weeks vernalization, and those which require an extended temperature treatment to sprout.

Kranski and Bula (1970) grew seven cultivars of Lolium species under a controlled environment in an attempt to use characteristics of leaf blade, such as width, length, dry-matter accumulation, and leaf blade proteins for cultivar or ploidy identification. The authors stated that the leaf width measurements after two weeks of growth at 20 C and 20-hour photoperiod provided the most definitive statistical separation between cultivars. Dry weight measurements of plants grown at 20 C and a series of photoperiods for 4 weeks provided reasonable separation of cultivars, but not to the degree noted for leaf blade width measurements.

After reviewing the literature on cultivar identification in the laboratory and the greenhouse, Isely (1956) suggested the use of seed characteristics for cultivar identification as the first consideration; however, he noted that seedlings potentially present a much broader field for attack than seed since dealing with plants in active stages of growth allows various physiological determinations.

Nittler (1971) stated that when seedlings of oat (Avena sativa L.) cultivars were grown with continuous light and with a complete nutrient solution, cultivars differed significantly in percentages of plants with roots at lower

leaf nodes. Cultivars 'Clintland', 'Kelsey', 'Orbit', or 'Russel' plants grown at 27 ± 2 C did develop roots at third leaf nodes. In contrast, 90% of cultivar 'Niagara' and 100% of cultivar 'Dorval' plants developed roots at the third node. Nittler also reported little difference among seed lots within cultivars. While working with 23 cultivars of Kentucky bluegrass (Poa pratensis L.) grown in a controlled environment and nutrient lacking calcium, Nittler and Kenny (1972a) reported that, of 23 cultivars tested, most seedlings of five cultivars were green and healthy after 4 weeks without calcium. Most plants of nine cultivars were very chlorotic, and plants of the other nine were intermediate or were a mixture of healthy and chlorotic. Nittler (1968) grew seedlings of seven A. Sativa L. cultivars in inerted sand irrigated with phosphorus-deficient nutrient solution. Seedlings of 'Russel' oats developed red anthocynin pigment in the coleoptiles and lower leaf sheaths. Cultivar seedlings of 'Garry', 'Niagara', 'Orbit', and 'Tioga' were entirely green. Two-thirds of the 'Rodney' seedlings were classed as having slight red color. 'Clintland' seedlings had a moderate amount of red color but much less than 'Russel'.

Jensen and Nittler (1971) were able to distinguish between seedlings of 24 spring barley (Hordeum vulgare L.) cultivars grown with continuous light and supplied with

complete nutrient solution or with solution lacking nitrogen or phosphorus. Significant differences were found among cultivars in necrosis of first leaf blades induced by a lack of phosphorus. Average necrotic area of first leaf blades of cultivars 'Svaloef Pallas', 'Svaloef Bonus' and 'Svaloef Hellas' was 70% or more. On the other hand, no more than 1% of the leaf blade area of 'Dickson', 'Erie', and 'Vaughn' was necrotic. With all three nutrient solutions, very obvious differences in color were developed in the lower leaf sheaths, ranging from green to intense red. A few cultivars were variable among colors of red and green plants, but most were uniform for this characteristic.

Nittler and Kenny (1972b) grew L. multiforum Lam. and perennial ryegrass (Lolium perenne L.) in a controlled environment with a constant and alternating temperature and nutrient solutions made by adding 3.8, 7.5, or 15.0 ml of molar ammonium nitrate per liter of a solution lacking nitrogen. Nittler and Kenny reported that alternating temperature resulted in significantly more plants with stems or heads than constant temperature. Italian ryegrass plants that had not developed stems could be identified by the fact they had rolled leaf buds whereas perennial ryegrass seedlings had folded buds. Nittler and Kenny (1969) found significant differences between seedlings of four Agrostis species when grown with continuous light and supplied with

complete nutrient solution. Within 5 weeks significant differences developed among species in several characteristics such as growth habit and size of leaf and stem. Nittler and Jensen (1974) stated that cultivar purity determinations of H. vulgare L. based on characteristics of grain or seedling is not possible due to the fact that many cultivars are so similar. For this reason he planted seed of barley cultivar in sand irrigated with a complete nutrient solution or with solution lacking nitrogen (-N) or phosphorus (-P). Five weeks after planting, cultivars differed significantly in length of internodes above first, second, third, and fifth leaf nodes. Length of first and second leaf internodes was affected greatly by nutrient treatments. Cultivars also differed in tiller number per plant, but not in stem diameter.

Nittler and Kenny (1970) disclosed highly significant differences in length of lower internodes of A. sativa L. cultivars grown in a controlled environment and supplied with complete nutrient solution. Wiseman (1970) stated that the use of cellulose acetate prints of the upper leaf surface of 25 cultivars of P. pratensis L. for studying stomata dimensions, hairs, and fundamental cells was useful in identification of individual cultivars.

Nittler and Kenny (1972c) found that maleic hydrazide when applied as a soil drench to 13-day-old L. perenne

L. caused leaves of many plants to become chlorotic. Cultivars differed in percentages of chlorotic plants, and conversely in percentage of green plants. For instance, 'Manhattan' had significantly fewer chlorotic plants than the other cultivars tested. Nittler (1973) reported that a growth regulator called B-995 proved to be useful in distinguishing 'Empire', (Lotus corniculatus L.), late cultivar from cultivars of the early type. When they were sprayed with 2,500 ppm solution of B-995 in the cotyledon stage, plants of the cultivar 'Empire' became decumbent within 3 weeks, but plants of cultivar 'Viking' remained upright. The author also stated that timothy (Phleum pratense L.) cultivars differed in response to soil application of the fungicide Captan. Hordeum vulgare L. cultivars reacted differently when sprayed with DDT at the seedling stage. Certain cultivars had no external symptoms while others were severely checked in growth and sprayed leaves turned yellow and died (Dhesi, Pauksens, and Desormeaux 1970). Stickler and Pauli (1962) reported that sorghum grain (Sorghum bicolor L.) cultivars reacted differently to gibberellic acid treatment. Nittler (1958) was able to distinguish between five cultivars of A. sativa L. based on their responses to different races of stem rust.

Nittler and Kenny (1964), while raising seedlings of L. multiforum Lam. and L. perenne L. in a controlled

environment, found none of the perennial seedlings developed heads, but with continuous light and favorable temperature conditions as many as 74% of annual Italian ryegrass had developed heads 5 weeks after planting. Nittler, McKee, and Newcomer (1964), while working with four cultivars of M. sativa L. grown in controlled conditions, observed cultivar differences in number of days from seedling to flowering among alfalfa cultivars studied. Using the same alfalfa cultivars, the authors reported that transmission curves for alcohol extracts did not differ greatly among these cultivars. However, curves for the aqueous extracts provided fairly good cultivar resolution between 350-550 mμ.

Maguire and Steen (1975) suggested the use of phenol test as a possible means of characterizing current cultivars and to detect mixtures of winter and spring types of wheat (Triticum species) of the northwestern United States. Almgard and Norman (1970) stated that the enzyme pattern obtained by the use of isoenzyme technique on 10-day-old leaf and root homogenates of four closely resembling H. vulgare L. cultivars showed that cultivar 'Cilla' can be distinguished from the other three cultivars, 'Ingrid', 'Fitis' and 'WW6040', most clearly in the esterase pattern of the leaves. Using the same isoenzyme technique, Almgard and Norman (1970) found clear differences between 'Selma' on the one hand and 'Tiger' and 'Astor' on the other.

Larsen (1966) examined proteins from 30 samples of L. multiforum Lam., 28 samples of L. perenne L., and 2 samples of hybrid ryegrass (Lolium species) seed using electrophoretic technique. A distinct protein was found in the perennial that was not found in either the annual or the hybrid ryegrass seed. Larsen (1967) analyzed seed proteins of 61 soybean [Glycine max (L.) Merr.] cultivars using electrophoresis. Two components were found which separated the cultivars into two groups; component "A" was present in 13 cultivars, and component "B" was present in 48 cultivars. In no instance were A and B observed in a single cultivar. Miller, Schonhorst, and McDaniel (1972) distinguished hybrid from selfed alfalfa (M. species) by extraction and separation of proteins from single alfalfa seeds using disc-gel electrophoresis. One pattern band was consistently dark in three S_1 (first generation selfed) lines, consistently dark in another S_1 line, and varied in two other S_1 lines. Hybrids of parents with light and dark protein bands contained the protein at an intermediate concentration. McDaniel (1970) resolved at least 16 proteins of embryonic axis and scutellum (2n) tissues of ungerminated Hordeum species cultivar seed of local and world collection. McDaniel reported that quantity and quality of proteins were characteristic for a specific cultivar. Cultivars related by descent, breeding, or geography were more similar in

protein genotype than relatively unrelated cultivars. McKee (1973) suggested the use of thin-layer chromotography for testing cultivar purity and authenticity.

Sharma, Puntamkar, and Seth (1971) reported that cultivars of indigenous and Mexican Triticum species showed differences in response to salt solution made of NaCl, Na_2SO_4, Na_2HCO_3, and $CaCl_2$ and their combinations. Cultivar and strainal differences in ability to germinate under various degrees of osmotic pressure was reported for P. pratense L., Triticum species, and M. sativa L. (Nittler et al. 1964). Dotzenko and Dean (1959) germinated six M. sativa L. cultivars in different solutions of mannitol of different osmotic pressures. They reported a decrease in number of seed germinated of each cultivar as osmotic pressure increased. Dotzenko and Dean found significant interactions of cultivar by osmotic treatments, indicating that the ability to germinate under high osmotic stress might be heritable. Donovan and Day (1969), while working with a number of H. vulgare L. strains of geographical origin similar to 'California Mariout' and other commercial cultivars, observed differences in emergence when cultivars were germinated in salinized water and soil cultures.

CHAPTER 3

MATERIALS AND METHODS

Studies were conducted at the Agricultural Research Service facilities, Tucson Plant Material Center, Tucson, Arizona to test the possibility of establishing criteria for identification of three sources of blue panicgrass (Panicum antidotale Retz.)--irrigated forage experimental, seedling drought tolerant experimental, and commercial (A-130). Breeder seed of the experimentals and certified seed of commercial (A-130) cultivar, all of 1974 harvest, were utilized during the course of the experiment.

Estimating Rapidity of Germination

Seed (100) of each blue panicgrass source were placed on two filter papers (E and D 617) in petri dishes, saturated with 8 ml distilled water. The petri dishes were placed in germinator at 30 C for 16 hours of light and 20 C for 8 hours of darkness. The experiment was replicated 6 times in a complete randomized design. Daily germination count was recorded for a 3-week period. Seed was considered germinated when shoot and root were a minimum of 5 mm and 3 mm in length, respectively. Germination test was

conducted twice. Data were combined for Regression Index analysis (Tucker and Wright 1965).

Germination in Simulated Water Stress

Seed (50) of each source were placed on two filter papers (E and D 617) in petri dishes, saturated with 8 ml distilled water for the zero osmotic pressure and with 8 ml of mannitol solutions for the 7 and 10 atmospheres of osmotic pressures. The petri dishes were placed in germinator at 25 C and photoperiod of 16 hours. The experiment was replicated 6 times in a complete randomized design. Germinated seed were counted at the end of 2 weeks. Criteria for germinating were same as in the previous experiment. Tolerance of each cultivar to mannitol stress was determined on the basis of differences calculated after transforming germination percentages into arcsine on square root.

Germination Response to Diuron

A preliminary experiment was conducted using eight selective and nonselective herbicides to test the impact of these herbicides on the germination of seed of the entries used in the previous experiments. Among the eight herbicides used, Diuron [3-(3,4-dichlorophenyl)-1,1-dimethylurea] 80% active ingredient showed marked differences in germination among the three blue panicgrass sources under study. Based on this background information, a designed experiment

was conducted. Seed (50) of each source were germinated in petri dishes on two filter papers (E and D 617), saturated with 8 ml of six Diuron concentrations (4, 2, 1, .5, .25, and 0.125%). The experiment was conducted in a germinator, with 16 hours of light and 8 hours of darkness. Temperature was kept at 25 C during darkness and 30 C during light. Three replications in a complete randomized design were used. Germination counts were recorded at the end of 7 days. Seed was germinated when shoot length was 3 mm. No consideration was given to the root length since only a few seed developed abnormal roots and particularly at higher concentrations. Analysis of variance was conducted after converting the germination percentage data into arcsine on square root.

Nutrient Solutions Studies

Seed of each source were planted in white crystal silica sand 4.5 cm deep in greenhouse flats 45 by 32 by 5 cm. Seed were planted 0.5 cm deep with 12 rows per flat, 4 rows per cultivar and 7 hills per row. Rows were 4 cm apart, and hills within the rows were 4 cm apart. Three seed were planted per hill. Holes in the bottom of the flats were covered with one sheet of paper towel for drainage of solutions. Sand surfaces were saturated with distilled water 3 times before planting to leach soluble nutrients. Number 2-solution of Hoagland and Arnon (1950) and solutions lacking nitrogen (-N) or phosphorus (-P) were applied every

other day to the surface of the sand with a sprinkling can. Distilled water was applied to the sand surface at days when nutrient solutions were not applied. A split-plot design with 5 replications was used. Nutrient solutions were the main plots, and the seed sources were sub-plots.

This experiment was conducted in a growth chamber (Wright 1961). Plants were exposed to 16 hours light of intensity ranging from 5,500 to 1,700 ft-c from the glass to the floor. Temperature was kept at 30 C during light periods and 25 C during darkness.

Seedlings were thinned to one per hill when they were 14-days of age. Normal healthy seedlings were kept. Three weeks after planting, 20 seedlings per seed source per replication were picked at random. Hills in which none of the seed germinated were replaced with adjacent normal seedlings. On the same data the 20 seedlings were selected, they were evaluated for development of anthocynin in the first leaf sheaths and for necrosis of the first leaf blades.

CHAPTER 4

RESULTS AND DISCUSSION

In a series of studies designed to develop a method of purity testing for use in 3 blue panicgrass sources, data were obtained on germination rapidity, percentage germination in simulated water stress, and percentage germination in herbicide Diuron. Seedlings from the same sources were classified into three categories--solid red, solid green, and intermediate--as indicated by anthocyanin intensity developed at lower leaf sheaths as a result of treatment with various nutrient solutions.

Rapidity of Germination Evaluation

Coefficients of regression and correlation along with regression indices for germination of blue panicgrass sources are presented (Table 1). These data suggest that blue panicgrass sources do not have the same capacity to achieve a 50% germination level. Commercial (A-130) showed 50% germination by 1.5 and 2 days before irrigated forage experimental and seedling drought tolerant experimental, respectively, had reached that germination point (Fig. 1).

Commercial (A-130) had the highest regression coefficient, 922.3 and the lowest correlation coefficient,

Table 1. Comparisons of Coefficients of Regression, Coefficients of Correlation, and Regression Indices (RI) for Germination of Blue Panicgrass Sources*

Sources	Regression coefficients	Regression indices	Correlation coefficients
Commercial (A-130)	922.3	7.0	0.91
Irrigated forage experimental	855.2	8.5	0.96
Seedling drought tolerant experimental	857.3	9.0	0.98
Mean	878.3	-	0.91

*Analysis was conducted on accumulative germination of two experiments combined.

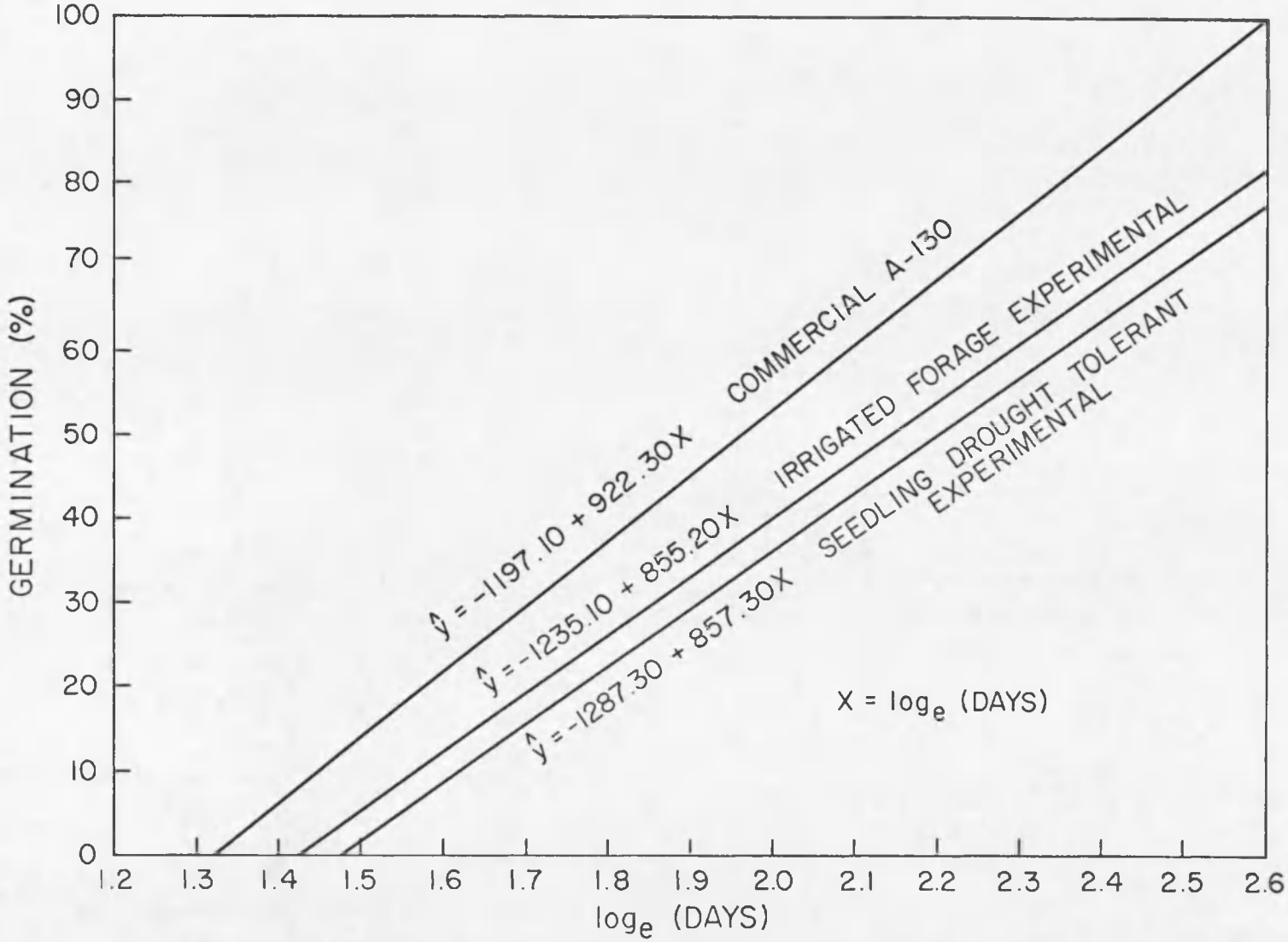

Fig. 1. Number of Days for 50% Germination Points for 3 Sources of Blue Panicgrass

0.91. From these data one can conclude that rapidity of germination of commercial (A-130) is not totally dependent on time but may be related to rapidity of water inhibition, among other unknown factors. Data of these determinations, regression coefficients, regression indices, and correlation coefficients, were not adequate to distinguish between the blue panicgrass sources.

Germination in Simulated Water Stress Evaluation

Data on germination percentages along with source by treatment combinations show that the number of seed germinated of each source decreased as the osmotic pressure increased (Tables 2 and 3); however, the reduction in germination was not of the same magnitude among the three sources. Commercial (A-130) cultivar had the least decrease in germination at each level of osmotic pressure while irrigated forage and seedling drought tolerant experimentals showed a greater decrease in germination. Analysis of variance indicated significant differences between treatments as well as between sources, but cultivar by treatment was not significant at 5% level of significance (Table 4). Seed germinated in mannitol solutions required 2 to 4 days longer for germination than seed germinated in distilled water.

Table 2. Germination Percentages of Three Sources of Blue Panicgrass at Different Levels of Osmotic Pressure

Source	Osmotic pressure 0 (atm)	7 (atm)	10 (atm)	Mean
Commercial (A-130)	91	53	22	55.3
Irrigated forage experimental	81	44	12	45.7
Seedling drought tolerant experimental	72	42	12	42.0

Table 3. Effect of Different Osmotic Pressure Levels on Germination of Blue Panicgrass Sources†

Source	Osmotic pressure 0 (atm)	7 (atm)	10 (atm)
Commercial (A-130)	.952a	.728c	.470e
Irrigated forage experimental	.898ab	.658d	.341f
Seedling drought tolerant experimental	.846b	.647d	.349f

†Germination percentage data were transformed into arcsine on square root.

*Values followed by the same letter within an experiment differ at 5% level of significance according to SNK test. CV (%) = 7.2.

Table 4. Analysis of Variance of Blue Panicgrass Sources Germinated at Different Levels of Osmotic Pressure†

Source	d.f.	Ms	F
C	2	2.407	601.86**
V	2	0.1363	33.39**
CV	4	0.0099	2.42
Error	45	0.0041	
Total	53		

†Data transformed into arcsine on square root.

**F-values significant at 1% level.

Germination of commercial cultivar responded under low osmotic pressure. According to SNK test, Table 3, commercial cultivar was significantly different than the irrigated forage and seedling drought tolerant experimentals. Influence of germination during low levels of osmotic stress was of great enough magnitude to distinguish commercial (A-130) from the experimentals.

Germination Response to Diuron Evaluation

The data on germination percentages and the critical differences for blue panicgrass sources are presented (Tables 5 and 6). The mean germination percentages of the three sources over all Diuron treatments were 38.0, 36.0, and 31.0 for commercial (A-130), irrigated forage experimental, and seedling drought tolerant experimental, respectively. The analysis of variance (Table 7) indicated highly significant treatment interaction. The F value for sources was not significant at 5% level of significance. There was no significant difference in germination of irrigated forage experimental and seedling drought tolerant experimental at Diuron treatments lower than 0.5%; however, there were significant differences between the germination percentages of these two sources and commercial (A-130).

There were no significant interactions higher than 0.5% between sources and treatments. Irrigated forage

Table 5. Germination Percentages of Blue Panicgrass Sources Following Seven Days of Treatment in Specified Levels of Diuron

Sources	Diuron concentration (gm/100 ml water) 0.125	0.25	0.50	1.0	2.0	4.0	Mean
Commercial (A-130)	83	82	45	17	2	0	38.0
Irrigated forage experimental	54	63	50	47	1.3	0	35.9
Seedling drought tolerant experimental	56	62	44	21	3	1	31.0

Table 6. Seed Germination Response of Three Blue Panicgrass Sources at Various Levels of Diuron†

Sources	Diuron concentrations 0.125	0.25	0.5	1.0	2.0	4.0
Commercial (A-130)	1.153a	1.148a	.736a	.416b	.114a	.0a
Irrigated forage experimental	.825b	.922b	.785a	.751a	.095a	.0a
Seedling drought tolerant experimental	.846b	.913b	.724a	.459b	.182a	.047a

†Results based on conversion of the germination percentage data into arcsine on square root.

*Values followed by the same letter within each column do not differ at 5% level of significance according to LSD test.

Table 7. Analysis of Variance of Blue Panicgrass Sources Germinated at Six Concentrations of Diuron†

Source	d.f.	Ms	F
C	5	1.532	133.142**
V	2	0.019	1.583
CV	10	0.049	4.083**
Error A	36	0.012	
Total	53		

†Data transformed to arcsine on square root.

**F-values significant at 1% level.

source was significantly different from the other two sources at treatment 1.0% level.

The results show that blue panicgrass sources differ in response to Diuron treatments. Seed of these three sources failed to germinate at the highest concentration. Except for satisfactory germination of commercial (A-130) at Diuron concentrations of 0.125 and 0.25%, seed of these sources showed poor germination in all levels of Diuron. Mean germination percentages (Table 6) indicate that commercial (A-130) cultivar can be separated from the other two sources based on germination at lower concentrations of Diuron.

Color of Lower Leaf Sheaths Evaluation

Commercial (A-130) showed uniform germination 4 days after planting while irrigated forage experimental and seedling drought tolerant experimental required 5 to 6 days after planting for uniform germination. Except for this difference, blue panicgrass sources grown in inert sand and a controlled environment showed no observable differences in germination or growth rate of seedlings. Seedlings of all sources were vigorous and bright green when grown in a complete nutrient solution. Seedlings grown in phosphorus-deficient solution were stunted, with leaves of a dark green color. Cultivar seedlings grown in solution

lacking nitrogen showed less stunting growth than under the phosphorus treatment, leaves were very chlorotic.

Red color, presumably caused by anthocynin pigments (Nittler 1968), which developed at lower leaf sheaths as a result of nutrient solution treatments, was evaluated by classifying seedlings into three categories: those with solid red first leaf sheaths, those with solid green first leaf sheaths, and seedlings whose first leaf sheaths had color which was between these two extremes. The third category has more than one class of red and green plants, but these classes cannot be separated by visual evaluation. Thus, all seedling plants without either solid red or solid green first leaf sheaths were designated as intermediate.

None of the blue panicgrass seedlings developed strong red color at the lower leaf sheaths (Table 8) when grown in solution lacking phosphorus. These data do not agree with the findings of Jensen and Nittler (1971) and Nittler (1968). These variations may be attributed to the differences in frequency of nutrient solution applications, differences in temperature, the different plant species used, or possibly due to all of these factors together.

The percentages of seedlings that developed solid red at the lower leaf sheaths varied among sources when grown with a nutrient solution lacking nitrogen or with a complete nutrient solution (Tables 9 and 10). Commercial (A-130)

Table 8. Color of Lower Leaf Sheaths of Blue Panicgrass Plants Grown without Phosphorus

Source	Classification		
	Solid red (%)	Intermediate (%)	Solid green (%)
Commercial (A-130)	0a	14a	86a
Irrigated forage experimental	0a	17a	83a
Seedling drought tolerant experimental	0a	23a	77a

*Values followed by the same letter within each column do not differ at the 5% level of significance according to LSD test.

Table 9. Color of Lower Leaf Sheaths of Blue Panicgrass Plants Grown without Nitrogen

Source	Classification		
	Solid red (%)	Intermediate (%)	Solid green (%)
Commercial (A-130)	41b	45a	14a
Irrigated forage experimental	63a	35a	2a
Seedling drought tolerant experimental	78a	21a	1a

*Values followed by the same letter within each column do not differ at the 5% level of significance according to LSD test.

Table 10. Color of Lower Leaf Sheaths of Blue Panicgrass Plants Grown with Complete Nutrient Solution

Source	Classification		
	Solid red (%)	Intermediate (%)	Solid green (%)
Commercial (A-130)	53a	42a	5a
Irrigated forage experimental	61a	39a	0a
Seedling drought tolerant experimental	69a	21a	3a

*Values followed by the same letter within each column do not differ at the 5% level of significance according to LSD test.

cultivar significantly differed from irrigated forage experimental and seedling drought tolerant experimental after 21 days of growth in solution without nitrogen.

Chi-square test (Table 11) indicated highly significant treatments and source effect on color induction. Source by treatment interaction had no influence on red color expression by seedlings.

Leaf Blade Necrosis Evaluation

Blue panicgrass sources grown in a complete nutrient solution, in nitrogen-deficient solution, or in solution lacking phosphorus brought about the necrosis of first leaf blades (Tables 12, 13, and 14). Treatments with complete nutrient solution and solution lacking nitrogen produced no significant differences among sources. Treatment with phosphorus-deficient solution revealed significant differences between cultivar commercial (A-130) and the other two experimentals with respect to percentages of seedlings whose leaf blades showed no signs of necrosis. Of the commercial (A-130) seedlings, 45% had healthy leaf blades, while irrigated forage experimental and seedling drought tolerant experimental had 64% and 77%, respectively.

No significant differences were found among sources at 30% and 50% necrosis of first leaf blades.

Chi-square test (Table 15) indicated no significant source by treatment interaction in bringing about leaf blade

Table 11. Chi-square Test for Data Presented in Tables 8, 9 and 10 Calculated at Simultaneous Confidence Interval P = .05

Source by treatment by color	ns
Treatment by color	**
Source by color	**
Conservative LSD	22%

Table 12. Percentage of First Leaf Blade Area Necrosis as a Result of Growing with a Complete Nutrient Solution

Sources	Necrosis of first leaf blades 0.0%	30%	50%
Commercial (A-130)	71a	19a	10a
Irrigated forage experimental	83a	14a	3a
Seedling drought tolerant experimental	84a	12a	4a

*Values followed by the same letter within each column do not differ at the 5% level of significance according to LSD test.

Table 13. Percentage of First Leaf Blade Area Necrosis as a Result of Growing in Nitrogen-deficient Solution

Sources	Necrosis of first leaf blades 0.0%	30%	50%
Commercial (A-130)	15a	44a	41a
Irrigated forage experimental	13a	45a	42a
Seedling drought tolerant experimental	28a	40a	32a

*Values followed by the same letter within each column do not differ at the 5% level of significance according to LSD test.

Table 14. Percentage of First Leaf Blade Area Necrosis as a Result of Growing Blue Panicgrass Plants without Phosphorus

Sources	Necrosis of first leaf blades 0.0%	30%	50%
Commercial (A-130)	45b	42a	13a
Irrigated forage experimental	64ab	22ab	14a
Seedling drought tolerant experimental	77a	13b	10a

*Values followed by the same letter within each column do not differ at the 5% level of significance according to LSD test.

Table 15. Chi-square Test for Data Presented in Tables 12, 13 and 14 Calculated at Simultaneous Confidence Interval P = .05

Source by treatment by necrosis	ns
Treatment by necrosis	**
Source by necrosis	**
Conservative LSD	22%

necrosis; however, treatment by necrosis and source by necrosis interactions were highly significant.

CHAPTER 5

SUMMARY AND CONCLUSIONS

Seed from 3 sources of blue panicgrass (commercial A-130, irrigated forage experimental, and seedling drought tolerant experimental) were utilized in a series of experiments aimed to develop a meaningful method for their identification.

Commercial A-130 cultivar showed higher germination in simulated water stress, higher germination in Diuron treatments lower than 0.5%, and achieved 50% germination point faster compared to irrigated forage experimental and seedling drought tolerant experimental.

Seedlings from 3 sources grown in a complete nutrient solution or solution lacking nitrogen exhibited varying degrees of red color at their lower leaf sheaths and necrosis of leaf blades. Sources expression of red color and leaf blade necrosis were not large enough for precise source purity determinations.

Data presented in this work suggest that seed lots from commercial (A-130) cultivar can be separated from seed lots belonging to irrigated forage experimental or seedling drought tolerant experimental by germination in lower levels

of water stress and lower concentrations of Diuron, if the contaminations were not of great magnitude. The other 2 sources cannot be distinguished with the treatments used.

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