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Germination and Growth of Sourgrass and its Competition with Forage Grasses

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牧野雜草 Sourgrass의 發芽 및 生育과 飼料作物과의 競合에 關한 研究

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ABSTRACT

Germination and growth of sourgrass, and its competition with improved pasture species, buffelgrass and guineagrass were studied.

Optimum germination was obtained under light with alternating temperatures. Germination was stimulated by GA but greatly decreased as moisture stress was increased. Sourgrass in pastures can be controlled throug hcompetition with buffelgrass or guineagrass.

INTRODUCTION

Sourgrass (*Trichachne insularis* Nees) is one of the most serious pasture weeds in southern U.S. and South America. Sourgrass has ruined many dryland pastures and it was estimated that over 80,000 acres were infested with this pest in Hawaii (2). However, no comprehensive work has been done on the life cycle, characteristics, and control of sourgrass and little is known about it.

These studies were made to better define the factors influencing seed germination, growth pattern and competitiveness in association with buffelgrass and guineagrass.

MATERIALS AND METHODS

Germination tests were carried out in the growth chamber using petri dishes and filter paper blotters. One hundred seeds per treatment were used with four replications. Germination was evaluated at 20, 25, and 30 C in constant dark and under 8-hr. light and 16-hr. dark conditions. The effects of alternating temperatures, 15-25, 20-30, and 25-35 C were also evaluated.

To evaluate the ability of gibberellic acid to overcome light and temperature limitations sourgrass seeds were presoaked for 24 hours in aqueous solutions of GA 62.5, 125, 250, 500, 1,000, and 2,000 ppm. Presoaking was done in darkness at room temperature (26 C). The seeds were then incubated in darkness at 22 C.

The effect of moisture stress on seed germination of sourgrass were evaluated under mannitol-induced moisture tensions. Solutions were prepared for specific moisture tensions according to the formula described by Helmerick and Pffeifer (5).

The effect of plant density on growth of sourgrass were evaluated at six levels of densities; 5, 10, 20, 40, 80, and 160 plants per pot (9.5 liters) having a surface area of 452cm^2.

Competition among sourgrass, buffelgrass, and guineagrass under different levels of shade (0, 30, and 60%) and nitrogen (0, 60kg/ha) was studied in monospecific, bispecific, and trispecific combinations using pots 30cm diameter and 23cm deep. Stands were thinned to 69 plants per pot. Shade was provided by polypropylene shade cloth stretched over the top and sides of wooden frames.

RESULTS AND DISCUSSION

1. Effect of temperature and light on seed germination.

Sourgrass seeds germinated well in the light at all temperatures tested, but was best at constant 30 C and alternating 20-30 C and 25-35 C (Table 1). Reduced germination at the lower temperatures was probably due to decreased enzyme and metabolic activity with consequent suppression of germination. Germination in complete darkness was poor except at the alternating temperature of 25-35 C which gave good germination. The mechanism of the effect of temperature fluctuations on dark germination of light-sensitive seeds is unknown but may be related to modification of the macromolecular compound hypothesized by Cohen (3). Optimum germination of sourgrass was obtained under light conditions with alternating temperatures and relatively high constant temperatures. This agrees with a report by Peters *et al.*(10).

2. Gibberellic acid effect on seed germination.

Germination was clearly stimulated by GA treatment at all treatment concentrations (Table 2). None of the concentrations reduced germination of sourgrass. Under dark conditions a concentration of 1000 ppm GA was required to obtain maximum germination. GA not only had an effect upon total germination but also increased the rate of germination. Dark inhibition of germination was overcome to a greater extent by treatment with GA. Sourgrass is thus similar to a number of other light-requiring plants which will germinate in the dark when treated with GA (1,4).

Table 1. The effect of temperature and light on seed germination 9 days after treatment.

Temperature	Light condition	
	Light	Dark
C	%	%
20	88.0 b[1)]	13.3 e
25	89.8 b	14.1 e
30	96.3 a	38.0 d
15-25	87.8 b	3.5 f
20-30	95.5 a	32.3 d
25-35	92.5 ab	72.8 c

1) Means followed by different letters are significantly different at the 5% level by Duncan's Multiple Range Test.

3. The effect of moisture stress on seed germination.

Average germination percentage decreased as moisture stress was increased(Table 3). These results are in agreement with the findings of other workers (6, 7). Germination of sourgrass was not significantly reduced until a moisture tension of 4.0 bars was reached. Sourgrass was more tolerant to increased moisture tension than was buffelgrass and guineagrass(11). An important characteristic of sourgrass

Table 2. Effect of gibberellic acid on germination of sourgrass seeds in the dark at 22°C.

Concn. GA	Cumulative germination days after treatment				
	3	5	7	9	11
ppm	%	%	%	%	%
0	0 e[1)]	1.0 e	2.5 f	4.9 e	5.7 f
62.5	7.1 d	15.9 d	17.8 e	20.4 d	20.9 e
125	17.2 c	38.5 c	43.0 c	44.7 c	46.6 d
250	17.5 c	39.7 c	50.0 c	52.8 c	53.5 c
500	21.9 b	55.9 b	63.8 b	66.6 b	68.6 b
1000	36.8 a	76.6 a	82.3 a	84.3 a	85.0 a
2000	16.6 c	43.7 c	64.3 b	70.3 c	72.8 b

1) Means within a column followed by different letters are significantly different at the 5% level by Duncan's Multiple Range Test.

Table 3. Effect of mannitol-induced moisture stress on germination of sourgrass seeds.

Moisture stress	Cumulative germination days after treatment				
	3	5	7	9	11
bar	%	%	%	%	%
0	33.7 a[1)]	61.8 a	78.7 a	84.6 a	86.5 a
0.1	31.2 ab	58.2 a	76.9 a	78.8 b	79.0 b
0.5	28.7 b	53.0 b	66.8 b	71.3 c	72.8 bc
1.0	28.2 b	53.0 b	65.8 bc	69.5 cd	72.0 cd
2.0	16.9 c	45.5 c	59.7 c	64.3 de	67.5 d
4.0	5.7 c	34.7 d	52.2 d	62.0 e	64.5 d
8.0	0 d	4.0 e	10.2 e	13.9 f	15.4 e
12.0	0 d	0 f	0 f	0 g	0 f

1) Means within a column followed by different letter are significantly different at the 5% level by Duncan's Multiple Range Test.

is its ability to germinate rapidly under relatively low soil moisture. This characteristic is a contributing factor in the dominance of sourgrass in extensive areas under limited moisture availability.

4. The effect of plant density on growth and development.

Highly negative curvilinear regressions were found between plant density and dry weight of shoots and roots (Fig. 1). Seedling dry weight of shoot and root decreased drastically as planting density increased. As density increased, the dry weight of sourgrass shoots was reduced proportionately more than was root weight. With increasing density, competition became more intense until growth was completely arrested. Visual observations of seedling mortality indicated that mortality increased markedly at densities greater than 80 plants per plot. Intraspecific competition is thus a major factor controlling seedling development and survival of sourgrass.

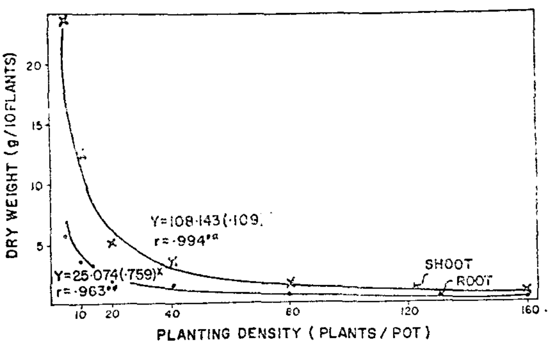

Fig. 1. Effect of plant density on dry weight of sourgrass 60 days after planting.

5. Effects of competition on growth and development of sourgrass, buffelgrass, and guineagrass.

Yields of sourgrass were negligible regardless of shade and nitrogen level when sourgrass was planted with buffelgrass, guineagrass, or both species (Fig. 2). This may have been the result of the more rapid germination, early growth and root development of buffelgrass and guineagrass. Buffelgrass and guineagrass shaded out the slower growing sourgrass by their development of greater leaf surface. Therefore, the early growth of sourgrass appeared to be suppressed by the associated grass species. On the other hand, the growth of buffelgrass and guineagrass were not greatly affected when grown in any combination of mixture. Buffelgrass and guineagrass were also more tolerant to shade and more responsive to nitrogen fertilization than sourgrass.

In conclusion, buffelgrass and guineagrass were excellent competitors and thus sourgrass may be crowded out by them under natural condition. Furthermore, this process is enhanced by nitrogen application. Oakes (8) and Peters and Lowance (9) similarly concluded that weeds might be reduced or choked out by planting more competitive plants and by applying fertilizers.

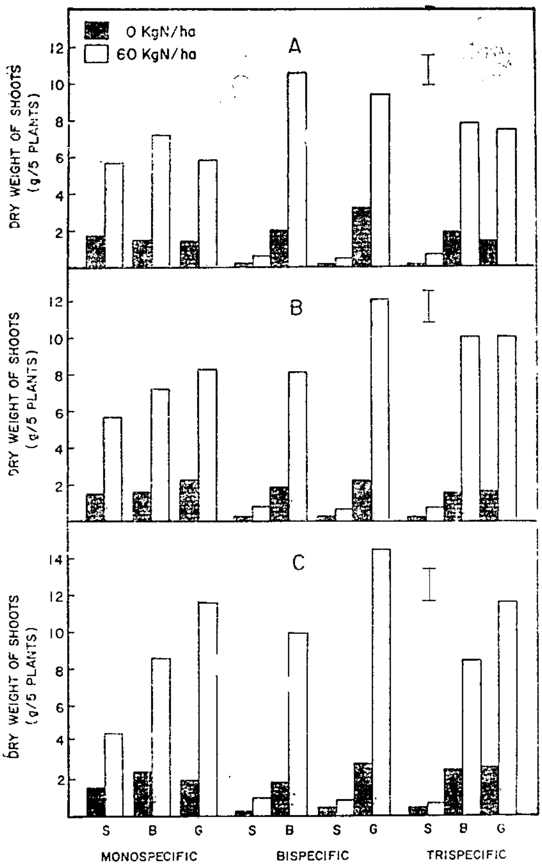

Fig. 2. Effect of shade and nitrogen on dry weight of sourgrass (S), buffelgrass (B), and guineagrass (G) grown in monospecific, bispecific, and trispecific combinations. A=0% shade, B=30% shade, C=60% shade. The vertical distance spanned by the bar for each shade level indicates the 0.05 LSD for difference in dry weight among treatments.

SUMMARY

This study was conducted to better define the factors influencing seed germination and growth of sourgrass, and its competitiveness in association with buffelgrass and guineagrass. The results obtained are summarized as follows;

1. Optimun germination of sourgrass seed was obtained under light with alternating temperatures of 20-30 C or 25-35 C or with constant 30 C. Germination in complete darkness was poor except at 25-35 C alternating temperature.
2. Dark inhibition of germination was overcome to a greater extent by GA treatment at all concentrations tested.
3. Germination of sourgrass decreased with increasing moisture stress but was not significantly reduced until a moisture tension of 4.0 bars was reached.
4. Highly negative curvilinear regressions were found between plant density and dry weight of shoots and roots.
5. The growth of sourgrass was seriously suppressed by the associated grass species, buffelgrass and guineagrass. Sourgrass can be crowded out through competition with buffelgrass or guineagrass under natural condition.

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摘　　要

Sourgrass는 하와이를 비롯한 美國南部와 남아메리카 全地域의 牧野地에서 가장 問題되는 多年生 雜草의 하나이다. 그러나 이 雜草에 대한 硏究는 거의 되어 있지 않으므로 發芽 및 生育 그리고 防除方法으로 飼料作物과의 競合에 依한 牧野管理를 통해 除去할 수 있는 可能性을 檢討하였다. 그 結果를 要約하면 다음과 같다.

1. Sourgrass의 發芽適溫은 照明下에서 20～30 C 또는 25～35 C의 變溫이나 30 C의 恒溫이었다. 暗條件下에서는 25～35 C의 變溫을 除外하고는 不良하였다.

2. 暗條件下에서는 發芽가 抑制되었으나 GA를 處理하므로 매우 向上되었다.

3. 發芽率은 水分吸水 억제가 增加됨에 따라 減少되는 傾向이었으나 4.0바아 이상이 되어야 비로소 급격히 떨어졌다.

4. 栽植密度와 乾物重과는 高度의 負의 曲線回歸關係가 있었다.

5. Sourgrass는 Buffelgrass 혹은 Guineagrass와 競合하므로 生育이 심히 억제되었으며 自然條件下에서 牧野管理를 通해 除去될 수 있음이 立證되었다.