入火가 Zoysia -82의 生育, 種子收量 및 Thatch 減少에 미치는 效果

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Effects of Burning Treatment on Development, Seed Yield, and Reduction of Thatch in Zoysia -82

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摘 要

入火(Burning)가 zoysia -82의 生育, 種子生産 및 thatch 減少에 미치는 効果를 調査한 結果는 다음과 같다.

1. 幼草出現日数는 對比區(自然狀態)와 幼草出現 約 2個月前에 入火処理한 區가 짧았다.
2. 種子收量은 對比區가 가장 많았고 休眠直前과 幼草出現直後의 入火區가 가장 적었다.
3. Thatch 蓄積은 對比區가 가장 깊었으며 休眠直前과 休眠 約 2個月後 入火処理區가 가장 얇았다.
4. 根乾重, runner 乾重, 總 乾物重은 休眠 約 2個月後 入火區가 가장 무거웠으며, 葉 및 葉莖乾重은 休眠直後의 入火區가 가장 무거웠으나 根乾重 以外의 形質들은 入火処理間 有意差가 없었다.
5. Zoysia -82의 幼草出現日数의 短縮과 種子收量의 增加및 thatch 減少를 爲해서는 幼草出現 約 2個月前과 休眠 約 2個月後가 入火適期라 思料된다.

I. INTRODUCTION

Turf is one of the blessings of nature. It is both a thing of service and of beauty.

Zoysiagrass is a warm season, slow growing, and sod forming grass that belongs to the family gramineae, and tribe Zoysieae[1]. This grass spreads by above and below surface runners and is characterized by vigorous growth of all plant parts when ambient temperatures reach 28 to 32℃. On thd other hand, when temperatures drop much below 15℃, growth slows rapidly and leaves begin to lose color. Turf becomes dormant and remains dormant for about 6 to 7 month until late spring when temperature increases and growth resumes[7,9,11,12].

Copeland and Youngberg[3] reported burning early in the season when green tissue is minimal, before regrowth is initiated, and the straw is dry, appears to be very beneficial from the standpoint of smoke emission as well as subsequent seed yield.

Musser[8] reported a significant seed yield increase from burning red fescue in the fall but no

significant effect from spring burning in Pennsylvania.

Several authors have observed the benifits of burning in terms of high seed yield and quality [2,4,8,10].

Little is known about the effect of burning treatment on Zoysiagrasses. Therefore, this study was conducted to know the effects of burning treatment on the development, seed yield and thatch reduction of zoysia −82 having more vigorous growth than other zoysiagrasses [6].

Ⅱ. MATERIALS AND METHODS

For this study, a turf (zoysia −82) plot nursery was established on the experimental field of Kyungpook Natl. Univ. in 1983, 3 years prior to the initiation of burning treatments, by planting sprigs. The area was maintained by irrigation, fertilization, mowing, and hand pulling of weeds from 1983 to the initiation of this experiment.

Prior to this experiment the turf plot had been squared with 1×1 m in size and mowed to about 4 cm.

Burning treatments were conducted from Oct. 27, 1986 using alcohol to Mar. 26, 1987 with 30− day intervals. A total of 50−50−25 g/m^2, nitrogen, phosphate, and potassium fertilizer was applied three times during the year from May 10 to July 30, 1987. Weeds were controlled only by hand pulling because some herbicides change the growth habits of the turfgrass.

Leaf length and width were measured from Apr. 25, 30 days after last burning treatment, to Oct. 6 with 15 days interval. To minimize the environmental variation, the measurement was made on the 3rd youngest leaf as reported by Youngner [12].

Days to the emergences of shoot and flowering culms were counted for the days after Mar. 26, last burning treatment. Shoot emergence was considered to have more than 10 shoots in 5×5 cm and flowering culms emergence was considered to have more than 5 culms in 10×10 cm.

The 3rd internode length from the growing point and stolon growth were measured for 6 days during the early June and July, respectively. Measurements were made on seven stolons in each replication

Thatch depth was measured from the natural soil line to the green vegetation by dugging with a putting green cup cutter of 10.4 cm in diameter. After measuring of the depth of thatch, each plant part was seperated, oven − dried overnight at 110℃ and weighed.

Plots were arranged in a randomized complete block design with three replications.

All data were subjected to the analysis of variance and Duncan's Multiple Range Test at the 0.05 level to determine the differences among treatment means.

Ⅲ. RESULTS AND DISCUSSION

Due to the seven different dates of burning treatment on zoysia −82, the length and width of leaves were significantly different at all measuring dates except at the measurement on Apr. 25 (Table 1).

In leaf length, natural state (unburned, control) and the plot burned at prior to dormancy were showed the longest at the measurement on Sep. 7, the plots burned at about one month after dormancy and about 2 months after

Table 1. Mean performance of leaf length and width in zoysia—82 by the different dates of burning

Burning date	Dates measured															
	Leaf length(cm)												Leaf width(mm)			
	Apr. 25	May 10	May 25	June 9	June 24	July 9	July 24	Aug. 8	Aug. 23	Sep. 7	Sep. 22	Oct. 6	Apr. 25	May 10	May 25	Oct. 6
Control	3.8^{a*}	5.2^{ab}	7.6^{ab}	9.6^{a}	12.2^{a}	13.4^{a}	17.0^{a}	23.8^{a}	24.4^{ab}	24.5^{b}	24.0^{ab}	22.5^{b}	4.0^{bc}	4.1^{b}	4.6^{c}	3.3^{b}
'86.Oct.27	4.2^{a}	4.5^{b}	7.0^{b}	8.7^{ab}	9.9^{b}	10.7^{b}	15.3^{b}	22.6^{b}	23.7^{ab}	24.5^{b}	23.9^{ab}	21.2^{b}	3.9^{c}	4.1^{b}	4.5^{a}	3.7^{ab}
Nov.26	4.1^{a}	5.1^{ab}	7.4^{ab}	8.6^{b}	10.1^{b}	10.5^{b}	14.4^{c}	21.6^{cd}	22.8^{b}	23.9^{bc}	24.3^{a}	22.2^{b}	4.3^{a}	4.4^{a}	4.6^{a}	3.5^{ab}
Dec.26	3.8^{a}	5.2^{ab}	7.6^{ab}	7.9^{b}	9.9^{b}	10.1^{b}	14.1^{c}	21.4^{cd}	22.7^{b}	23.7^{bc}	24.7^{a}	22.8^{b}	4.1^{a-c}	4.5^{a}	4.5^{a}	3.5^{ab}
'87.Jan.25	4.0^{a}	5.1^{ab}	7.2^{ab}	8.4^{b}	9.7^{b}	10.3^{b}	14.2^{c}	19.5^{c}	24.2^{ab}	22.6^{c}	21.7^{b}	21.9^{b}	4.2^{ab}	4.4^{a}	4.5^{a}	3.7^{a}
Feb.24	4.1^{a}	5.5^{a}	7.7^{a}	8.5^{b}	9.7^{b}	10.1^{b}	14.2^{c}	21.0^{d}	25.9^{ab}	24.9^{ab}	25.4^{a}	23.4^{ab}	4.2^{ab}	4.5^{a}	4.6^{a}	3.6^{ab}
Mar.26	3.7^{a}	5.5^{a}	7.7^{a}	8.8^{ab}	10.5^{b}	10.6^{b}	14.7^{bc}	22.1^{bc}	26.7^{a}	26.1^{a}	25.2^{a}	26.2^{a}	4.0^{bc}	4.5^{a}	4.6^{a}	3.7^{ab}
Mean	4.0	5.0	7.5	8.6	10.3	10.8	14.8	21.7	24.3	24.3	24.2	22.9	4.1	4.4	4.6	3.6

*Those mean values within a column not followed by the same letter are significantly different at 0.05 level by Duncan's Multiple Range Test.

Table 2. The morphological characteristics of the zoysia—82 by the seven different dates of burning

Burning date	Days1/ to shoot emergence	Days to1/ flowering culms emergence	Length2/ of leaf blade (cm)	Leaf2/ width (mm)	Length of flowering culms (cm)	Number of flowering culms per replication	Rachis length (cm)	Number of florets per ear	100 seed weight (mg/rep.)	Seed yield per replication (mg)
Control	-2.6^{d}	30.0^{b}	24.4^{ab}	4.6^{a}	14.0^{a}	216.3^{a}	3.4^{a}	23.5^{a}	91.3^{a}	36.9^{a}
'86.Oct.27	11.0^{ab}	33.6^{b}	23.7^{ab}	4.5^{a}	11.3^{b}	83.6^{c}	3.1^{a}	22.1^{a}	83.4^{a}	7.0^{c}
Nov.26	11.6^{ab}	31.6^{b}	22.8^{b}	4.6^{a}	12.0^{ab}	132.6^{b}	3.2^{a}	22.4^{a}	86.3^{a}	22.5^{b}
Dec.26	10.6^{ab}	31.6^{b}	22.7^{b}	4.5^{a}	11.5^{b}	114.3^{b}	3.1^{a}	21.8^{a}	90.5^{a}	18.6^{b}
'87.Jan.25	3.0^{cd}	30.3^{b}	24.1^{ab}	4.5^{a}	12.9^{ab}	124.0^{b}	3.4^{a}	23.5^{a}	85.0^{a}	24.8^{b}
Feb.24	6.6^{bc}	33.3^{b}	25.9^{ab}	4.6^{a}	13.4^{ab}	121.0^{b}	3.5^{a}	22.8^{a}	81.6^{a}	18.1^{b}
Mar.26	14.0^{a}	39.6^{a}	26.7^{a}	4.6^{a}	12.3^{ab}	49.3^{d}	3.2^{a}	21.3^{a}	86.3^{a}	7.6^{c}
Mean	7.7	32.8	24.3	4.6	12.4	120.1	3.2	22.4	86.3	19.4

*Those mean values within a column not followed by the same letter are significantly different at 0.05 level by Duncan's Multiple Range Test

1 Measured from the last burning treatment

2 Recorded the maximum reading during this experiment periods.

dormancy showed the longest at the measurement on Sep. 22, and the plots burned at about 2 months prior to shoot emergence, about one month prior to shoot emergence, and shortly after shoot emergence showed the longest at the measurement on Aug. 23.

Leaf width was gradually increased up to May 25 but reduced after Oct. 6.

All morphological characteristics are listed in Table 2. There were significant differences in days to the emergences of shoot and flowering culms, length and number of flowering culms, and seed yield but no significant differences in rachis length, number of florets per ear, and 100− seed weight.

Days to shoot emergence was shorter in the following order of burning dates : 1) control, 2) about 2 months prior to shoot emergence, 3) about one month prior to shoot emergence, 4) about 2 months after dormancy, 5) shortly before dormancy, 6) about one month after dormancy, and 7) shortly after shoot emergence. This result suggested that the optimal burning date for the early shoot emergence be the treatment on about two months prior to shoot emergence and control.

Days to flowering culms emergence was the shortest in control and the longest when the residue was burned shortly after shoot emergence.

Length of flowering culms was the longest when the residue was unburned (control) and the shortest when the residue was burned prior to dormancy. It ranged from 14.1 to 11.4 cm.

Number of flowering culms was the highest in control and the lowest when the residue was burned shortly after shoot emergence. It ranged from 216.3 to 49.3.

Seed yield was the highest in control and the lowest when the residue was burned prior to dormancy and shortly after shoot emergence. It ranged from 36.9 to 7.0 mg and 7.6 mg. It was suggested that the burning treatments on prior to dormancy and shortly after shoot emergence were inadequate for abundant seed yield.

Correlations among morphological chatacteristics of zoysia −82 are shown in Table 3. High negative correlation was existed between seed yield and days to shoot emergence. But significant positive correlation was existed between seed yield and number of flowering culms. It was suggested that the shorter the days to shoot emergence, the more abundant the seed yield.

The 3 rd internode length and stolon growth during two periods are shown in table 4. The two periods were from June 1 to June 7 and from July 1 to July 7. There were no significant differences at first periods but significant differences at second periods. Average 3 rd internode length was the longest in control but the shortest when the residue was burned shortly after dormancy. It ranged from 5.8 to 4.2 cm.

Average internode length for two periods was the longest in control, but the shortest when the residue was burned shortly after shoot emergence. It ranged from 5.8 to 4.6 cm.

There were no significant differences for the depth of thatch between control and burning at shortly after emergence (Table 5).

Depth of thatch was the deepest in control but the shallowest when the residue was burned prior to dormancy. It ranged from 14.4 to 10.1 mm. This result was suggested that the adequate burning date would be all dates except control and plot burned shortly after shoot emergence for the reduction of thatch.

Dry weight of plant parts measured at '87.

Table 3. Correlation coefficients among ten morphological characteristics of zoysia—82 related with seed yield by the different burning treatments

Characteristic	Days to shoot emergence (DSE)	Days to flowering culms emergence (DFE)	Length of leaf blade (LL)	Leaf width (LW)	Flowering culms length (FCL)	Number of flowering culms (NFL)	Rachis length (RL)	Number of florets (NF)	100 seed weight (SW)	Seed yield (SY)
DFE	0.604**									
LL	0.085	0.476*								
LW	-0.109	0.005	0.208							
FCL	-0.354	-0.052	0.472*	-0.210						
NFL	-0.822**	-0.714**	-0.198	0.208	0.370					
RL	-0.243	-0.165	0.369	-0.294	0.893**	0.236				
NF	-0.225	-0.389	-0.078	-0.308	0.541*	0.320	0.697**			
SW	0.043	-0.009	0.249	0.159	0.451*	0.208	0.242	0.033		
SY	-0.751**	-0.312	-0.198	0.224	0.450*	0.902**	0.310	0.343	0.358	

*, **: Significant at the 5 and 1% level, respectively.

Table 4. Average third internode length and growth of stolon from the growing point of zoysia—82 during two periods by the different buring date

Burning date	Ave. internode length			Stolon length				Mean growth of stolon per day 1/
	June 1—7	July 1—7	Ave.for two periods	June 1	June 7	July 1	July 7	
Control	5.9[2/a] *	5.8[a]	5.8[a]	12.0[2/a]	16.8[a]	13.1[a]	17.5[a]	0.8[a]
'86.Oct.27	5.2[a]	4.9[b]	5.1[ab]	12.2[a]	16.7[a]	11.4[bc]	15.7[ab]	0.7[a]
Nov.26	5.9[a]	4.8[b]	5.4[ab]	13.4[a]	18.7[a]	11.1[cd]	16.4[ab]	0.9[a]
Dec.26	5.4[a]	5.1[b]	5.3[ab]	11.6[a]	15.7[a]	10.9[cd]	15.9[ab]	0.8[a]
'87.Jan.25	5.4[a]	5.0[b]	5.2[ab]	13.1[a]	17.3[a]	12.6[a]	18.0[a]	0.8[a]
Feb.24	5.8[a]	5.2[b]	5.5[ab]	12.5[a]	18.3[a]	12.4[ab]	17.7[a]	0.9[a]
Mar.26	5.0[a]	4.2[c]	4.6[b]	11.8[a]	15.9[a]	10.1[a]	14.5[b]	0.7[a]
Mean	5.5	5.0	5.3	12.4	17.1	11.7	16.5	0.8

* Those mean values within a column not followed by the same letter are significantly different at 0.05 level by Duncan's Multiple Range Test

1/ Mean stolon growth $= \frac{(\text{June } 7 - \text{June } 1) + (\text{July } 7 - \text{July } 1)}{12}$

2/ Measurements(cm) are an average of 7 readings in each replication.

Oct. 22 are shown in Fig. 1. Dry weights of root, runner, and whole plant were the heaviest when the residue was burned two months after dormancy and dry weight of leaf and branch stem was the heaviest when the residue was burned shortly after dormancy. But there were no significant differences in dry weight of each plant parts with the exception of the root dry weight.

Correlations among eleven characteristics related with dry matter weight are listed in Table 6. High negative correlation between root dry weight and T/R − ratio and high positive correlations between root dry weight and total dry weight and between leaf and branch stem and total dry weight were recognized. At the same time, significant positive correlation was observed between runner dry weight and total dry weight. Except above characters, no significant correlation was existed among the characters examined.

Table 5. Effect of different dates of burning on the depth of thatch

	Burning date						
	Control	'86 Oct.27	Nov.26	Dec.26	'87 Jan.25	Feb.24	Mar.26
Depth[1]/of thatch[2]/ (mm)	14.4[a]*	10.1[b]	11.0[b]	10.6[b]	10.9[b]	11.1[b]	12.5[ab]

* Those values within a row not followed by the same letter are significantly different at 0.05 level by Duncan's Multiple Range Test.

1 Measurements are an average of three plugs in 10.4cm diameter in each replication.

2 Measured from the natural soil line to the green vegetation.

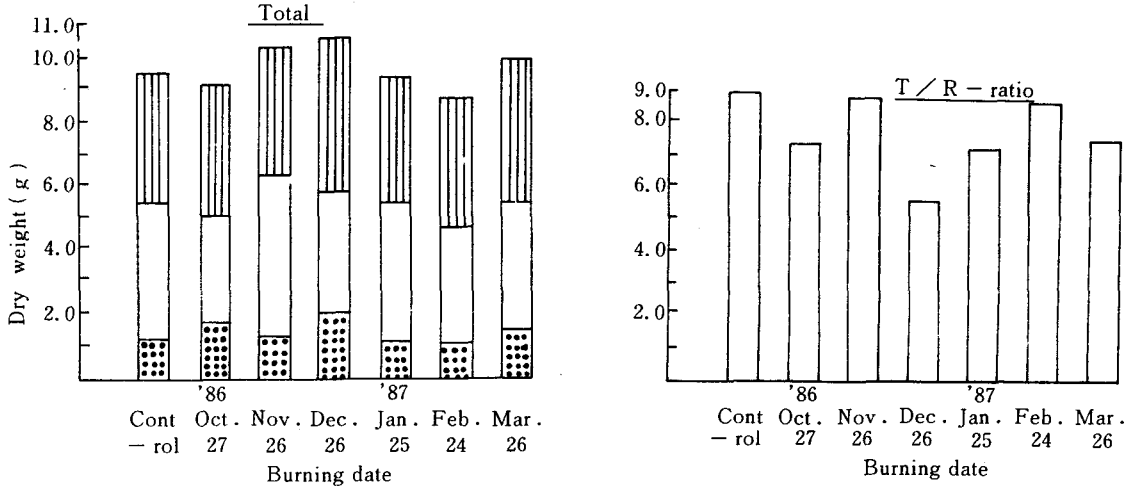

Fig. 1. Dry weight per plug in 10.4 cm diameter of plant parts (▦ : root, □ : leaf and branch stem, ▥ : runner) and the ratio of root dry weight over total dry weight (T/R − ratio) of zoysia −82 measured at '87. Oct. 22.

Table 6. Correlation coefficients among eleven characteristics of zoysia—82 related with dry matter weight by the different dates of burning

	Days to shoot emergence (DSE)	Leaf blade length (LL)	Leaf width (LW)	Average internode length (AIL)	Mean runner growth per day (MRG)	Root dry weight (TDW)	Leaf and branch stem dry wt. (LDW)	Runner dry weight (RDW)	Thatch depth (TDH)	Total dry wt. per root dry wt. (T/R)	Total dry wt. (TDWT)
LL	0.254										
LW	0.227										
AIL	-0.310	-0.345									
MRG	-0.057	0.241	0.289								
TDW	0.253	-0.046	-0.171	-0.278	-0.336						
LDW	-0.014	0.024	-0.203	0.213	-0.145	0.192					
RDW	0.034	0.099	-0.174	-0.140	0.049	0.198	-0.017				
TDH	-0.383	0.014	-0.212	0.222	-0.420	-0.211	0.147	-0.304			
T/R	-0.141	-0.057	0.094	0.348	0.190	-0.863**	0.147	-0.028	0.192		
TDWT	0.098	0.042	-0.285	-0.007	-0.211	0.597**	0.794**	0.477*	-0.098	-0.251	

*, ** : Significant at the 5 and 1% level, respectively.

Ⅳ. SUMMARY

Several authors have observed the benifits of burning in terms of high seed yield and quality. But little is known about the effects of burning treatment on zoysiagrasses. Therefore, this study was undertaken to know the effects of burning teratment on development, seed yield and thatch reduction of zoysia—82 by the seven different dates of burning. The results obtained are summarezed as follows :

1. The earliest shoot emergence in the spring was observed from the control plot (unburned) and the plot burned about two months before the shoot emergemce.

2. The highest seed yield was obtained from the control while the lowest seed yields were obtained from either the plot burned prior to dormancy or the plot burned shortly after shoot emergence.

3. The deepest thatch accumulation was resulted when the residue was unburned but the shallowest when the residue was burned right before dormancy or burned about two months after dormancy.

4. Dry weights of root, runner and whole plant were the heaviest when the residue was burned about two months after dormancy and dry weight of leaf and branch stem was the heaviest when the residue was bruned shortly after dormancy. But there were no significant differences in dry weight of each plant parts with the exception of the root dry weight.

5. It was considered that the optimal burning date for shortening the days to shoot emergence, increasing the seed yield, and reducing thatch accumulation be either about two months after dormancy or two months prior to shoot emergence.

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