ORIGINAL ARTICLE

Effect of cutting time on seed yield and seed quality of *Andropogon gayanus* cv. Kent

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Abstract

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The objectives of this experiment were to study the effect of cutting time on seed yield and seed quality of *Andropogon gayanus* cv. Kent in Korat soil series at Khon Kaen Animal Nutrition Research Center, during April 1997 - January 1998. The experiment was arranged in a randomized complete block design with 6 treatments and 4 replications. The treatments were: T 1 -no cut; T 2 -cut at 60 days after transplanting; T 3 -cut at 70 days after transplanting; T 4 - cut at 80 days after transplanting; T 5 -cut at 90 days after transplanting; T 6 -cut two times: the first cut at 60 days after transplanting and the second cut at 30 days after first cut.

The result revealed that pure seed yield of T3 was highly significantly greater than others (P<0.01). Pure germinated seed yield of T3 was significantly greater than T5, T6 and T1 (P<0.05), but was not significantly different from T2 and T4. Thousand-seed weight of T4 was significantly greater than others (P<0.05), but TSW of T3 was not significantly different from the other treatments. Seed purity and germination percentages were not affected by cutting time, ranging from 93 to 97 and 54 to 63 %, respectively.

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Height of T1 and T2 were significantly greater than T4, T5 and T6 (P<0.05), whereas T3 was not significantly different from the other treatments. Inflorescence length was not significantly different among treatments, ranging from 54 to 66 centimeter. Tiller number of T3 was significantly greater than other treatments (P<0.05), but T2 was not significantly different with the others. Inflorescence number of T3 was highly significantly greater than others (P<0.01). Percentage of fertile tiller of T1, T2, T3, T4 and T5 were significantly greater than T6 (P<0.05); percentage of fertile tiller was markedly and consistently higher in the 5 treatments (T1, T2, T3, T4 and T5) and lowest in T6.

Key words : *Andropogon gayanus*, cutting time, seed yield, seed quality

บทคัดย่อ

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ผลของอายุการตัดหญ้าที่มีต่อผลผลิตและคุณภาพของเมล็ดหญ้ากัมบ้าสายพันธุ์ Kent

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การศึกษาผลของอายุการตัดหญ้าที่มีต่อผลผลิตและคุณภาพของเมล็ดหญ้ากัมบ้าสายพันธุ์ Kent ที่ปลูกในดินร่วนปนทรายชุดดินโคราช ที่ศูนย์วิจัยอาหารสัตว์ขอนแก่น อำเภอเมือง จังหวัดขอนแก่น ระหว่างเดือนเมษายน 2540 ถึงเดือนมกราคม 2541 โดยวางแผนการทดลองแบบ Randomized Complete Block มี 4 ซ้ำ มี 6 สิ่งทดลอง ได้แก่ ไม่มีการตัดหญ้า, ตัดหลังจากย้ายปลูก 60 วัน (9 สิงหาคม 2540), 70 วัน (19 สิงหาคม 2540), 80 วัน (29 สิงหาคม 2540), 90 วัน (8 กันยายน 2540), และตัดสองครั้ง คือ ตัดครั้งแรกหลังจากย้ายปลูก 60 วัน (9 สิงหาคม 2540) และตัดครั้งที่สอง หลังจากตัดครั้งแรก 30 วัน (8 กันยายน 2540)

ผลการทดลองพบว่า การตัดหญ้าที่อายุ 70 วันได้ผลผลิตเมล็ดสูงกว่าการตัดหญ้าที่อายุอื่น ๆ และไม่มีการตัดหญ้า (P<0.01) เท่ากับ 125.1 กก./ไร่ สำหรับผลผลิตเมล็ดพันธุ์บริสุทธิ์ที่งอกได้ ที่ตัดที่อายุ 70 วัน สูงกว่าการตัดหญ้าที่อายุ 90 วัน, ตัดสองครั้ง และไม่มีการตัดหญ้า (P<0.05) มีค่าเท่ากับ 69.4, 49.6, 40.1 และ 48.7 กก./ไร่ ตามลำดับ การที่ไม่ตัดและตัดหญ้าที่อายุต่าง ๆ กัน ไม่มีผลกระทบต่อความบริสุทธิ์และความงอกของเมล็ดหญ้า (P>0.05) แต่มีผลกระทบต่อน้ำหนัก 1000 เมล็ด ซึ่งมีน้ำหนักมากที่สุดเมื่อตัดหญ้าที่อายุ 80 วัน เท่ากับ 3.454 กรัม (P<0.05) หญ้ากัมบ้าที่ไม่ได้ตัด และตัดที่อายุ 60 วัน มีความสูงสูงกว่าการตัดที่อายุอื่น ๆ อย่างมีนัยสำคัญทางสถิติ (P<0.05) ซึ่งเท่ากับ 267 และ 259 ซม. ตามลำดับ การตัดหญ้าที่อายุ 70 วัน มีจำนวนหน่อและจำนวนช่อดอกสูงกว่าการตัดหญ้าที่อายุอื่น ๆและหญ้าที่ไม่ได้ตัด (P<0.05) ซึ่งเท่ากับ 136 หน่อ/ตร.เมตร และ 115 ช่อดอก/ตร.เมตร ตามลำดับ การที่ไม่ตัดหญ้าและตัดหญ้าที่อายุต่าง ๆ กัน ไม่มีผลกระทบต่อความยาวช่อดอก

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Northeast Thailand covers approximately one-third of the total area of the country. It is situated between latitudes 14 °N to 19 °N. The general topography is rolling uplands with the elevation of 100-300 meters above sea level and average annual rainfall 1,186 millimeters. The vegetation is mainly semi-arid tropical forest. The soil is infertile and characterized by being sandy with about 10% of the area being saline. A large portion of land is regarded less suitable for cash crop production and is thus being left fallow or used as communal grazing areas for cattle and buffalo. There is generally a long dry season of 6-7 months (Boonpukdee and Leera-

tanachai, 2000).

Gamba (*Andropogon gayanus*) is a tropical pasture grass thriving in areas with a long dry season up to 7 months. It is adapted to a wide range of soil types, with different ecotypes ranging from sandy to heavy black cracking clays. It is very drought resistant and not susceptible to frost (Duke, 1978). Satjipanon *et al*. (1995) conducted an experiment at Chiagyeun Animal Nutrition Station, Maha Sarakham Province on forage crop evaluation in Korat soil series, where soil properties were 4.5 pH, 0.49 % organic matter, 12.93 ppm available P, 13.75 ppm exchangeable K and 1.70 ppm S. They found that Gamba grass (*Andropogon gayanus* cv. Kent) gave highest DM yield of 18.50 t/ha/year. *Andropogon gayanus* is a short-day plant with a critical day-length for flowering of between 12 and 14 hours (Tompsett, 1976). Flowering stems are erect and up to 3 m high (Cameron, 2000). Seed harvesting is quite inconvenient and seeds often fall before harvest, leading to low seed yield and seed quality. Andrade *et al*. (1983) reported that uncut Gamba grass variety Planatina encounters seed falling during seed setting stage, and that seed yield could be decreased 65 %. Cutting of Gamba grass could be enhance seed yield and decrease the problem of stem fall down. The objectives of this experiment were to study the effect of cutting time on seed yield and quality of *Andropogon gayanus* cv. Kent in order to identify appropriate cutting time for seed production.

Materials and methods

Location, climate and soil characteristics of the experimental site

The experiment was conducted at Khon - Kaen Animal Nutrition Research Center, Northeast Thailand (16.5 ^{o}N, 103 ^{o}E; 105 m above sea level), during April 1997 - January 1998. The soil is classified as the Korat soil series and is characterized by a sandy loam over a clay loam with pH 5.20. The chemical analysis of the top 0-15 cm of soil revealed 28.85 ppm available P, 39.10 ppm exchangeable K, 169.29 ppm Ca, 32.00 ppm Mg and 0.53 % organic matter.

Plant cultivation

One-month-old seedlings of *Andropogon gayanus* cv. Kent were transplanted on June 9, 1997 at the rate of three seedlings/hill and spacing of 80 cm × 50 cm. A basal complete fertilizer (312 kg/ha N, 312 kg/ha P, 312 kg/ha K) was applied at planting, with an additional application of 100 kg/ha N as urea in early August 1997, before flowering. The plot area was kept weed-free with hand hoeing at 20 and 75 days after transplanting and whenever necessary.

Design

The trial was arranged in a randomized complete block design (RCBD) with 6 treatments and 4 replications. Plots were 3 m × 4 m. The treatments were as follows:

T 1 - no cut;
T 2 - cut at 60 days after transplanting (August 9, 1997) (Cut 60);
T 3 - cut at 70 days after transplanting (August 19, 1997) (Cut 70);
T 4 - cut at 80 days after transplanting (August 29, 1997) (Cut 80);
T 5 - cut at 90 days after transplanting (September 8, 1997) (Cut 90);
T 6 - cut two times: at 60 days after transplanting (August 9, 1997) and 30 days after first cut (September 8, 1997) (Cut 60 and 30).

Data collection and seed harvesting

All records were taken from the inner 2 × 3 m of each plot. Initial flowering dates were recorded for each plot. Ripening seedheads were tied together into manageable bunches and when the seed was almost ripe, nylon gauze bags were tied over the bunches and remained for duration of the harvest. Bags were used to facilitate the seed collection. Plant height, inflorescence length (IL), tiller number (TN), and inflorescence number (IN) per plant were counted on 10 randomly selected plants in each plot at harvest. Seed in each plot were harvested separately. Harvest took

place after seed started to shed, and when seed was easily displaced from racemes by light brushing. Seed was allowed to collect in the gauze bags until such time weather permitted the collection of dry seed. Ripe seed was threshed by lightly rubbing or tapping the gauze bag. At the final retrieval, seed heads were cut, heaped in the shade, and allowed to sweat for 5 days.

Seed processing, seed quality measurement and calculation of secondary attributes

Seed from all treatments was air-dried at ambient temperature for 3-4 days in a seed shed until seed moisture content was below 10%, before cleaning through hand screens and a Dakota seed blower. Seed yield was weighed for each plot. Seed moisture content (SMC), 1000-seed weight (TSW), seed purity (SP), and seed germination (SG) were determined and tested following the rules of the International Seed Testing Association for *Andropogon gayanus*. TSW was determined from pure-seed spikelet weight. Germination tests were done at 42, 33 and 36 days after seed harvesting in 1999. Seed was treated with 0.2% KNO_3 before germinating in a growth chamber with 16 h of darkness at 20 ^{o}C and 8 h of light at 35 ^{o}C for a 14-day germination period. Seed yield and TSW were corrected to 9% SMC. The percentage of fertile tillers (PFT), tiller number/m^2, and inflorescence number/m^2 were obtained by calculation. Pure seed yield (PSY) was calculated by SY*SP/100; and pure germinated seed yield (PGSY) was calculated by PSY*SG/100.

Statistical analysis

The experimental data were statistically analysed by analysis of variance for a randomized complete block design using the SAS programme (1985). The treatments means were tested for significance by least significant difference.

Results

Rainfall

The amount and distribution of rainfall are shown in Figure 1. Total precipitation during the planting period (April-December) was 926.9 mm in 1997.

Seed yield components

The cutting time had a significant effect on seed yield components of *Andropogon gayanus* cv. Kent (Table 1). Height of T1 and T2 were significantly greater than T4, T5 and T6 ($P<0.05$), whereas T3 was not significantly different from other cuts. Inflorescence length was not significantly different among treatments, ranging from 54 to 66 cm. Tiller number of T3 was significantly greater than other treatments ($P<0.05$), but T2 was not significantly different from the others. Inflorescence number of T3 was highly significantly greater than others ($P<0.01$). Percentage of fertile tiller of T1, T2, T3, T4 and T5 were significantly greater than that of T6 ($P<0.05$); Percentage of fertile tiller was markedly and consistently higher in the 5 treatments (T1, T2, T3, T4 and T5) and lowest in T6.

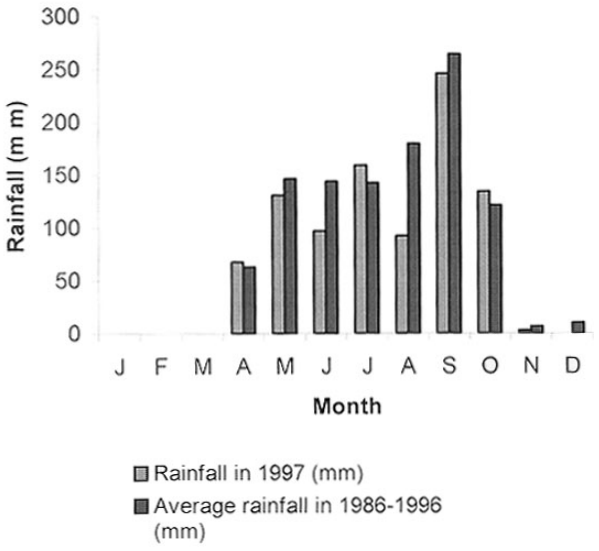

Figure 1. Monthly rainfall in 1997 an average of last 10 years (1986-1996).

Table 1. Effects of cutting time on seed yield components of *Andropogon gayanus* cv. Kent.

Treatment	Height (cm)	Inflorescence length (cm)	Tillers (no./m^2)	Inflorescences (no./m^2)	Fertile tillers (%)
T 1 - no cut	267^a	64	95^b	76^b	80^a
T 2 - (Cut 60)	259^a	66	115^{ab}	95^b	82^a
T 3 - (Cut 70)	244^{ab}	54	136^a	115^a	86^a
T 4 - (Cut 80)	244^b	54	109^b	88^b	81^a
T 5 - (Cut 90)	231^b	56	102^b	82^b	80^a
T 6 - (Cut 60 and 30)	230^b	59	112^b	79^b	70^b
Significant	*	NS	*	*	*
CV (%)	6.80	15.02	12.70	13.61	7.50

(Cut 60) = cut at 60 days after transplanting (August 9, 1997); (Cut 70) = cut at 70 days after transplanting (August 19, 1997); (Cut 80) = cut at 80 days after transplanting (August 29, 1997); (Cut 90) = cut at 90 days after transplanting (September 8, 1997); (Cut 60 and 30) = cut two times: at 60 days after transplanting (August 9, 1997) and 30 days after first cut (September 8, 1997).

[1] **Within columns, means followed by different superscript letters differ significantly (P<0.05).**
[2] *** = P<0.05.** [3] **NS: Values are not significantly different (P>0.05).**

Seed yield and seed quality components

Pure seed yield of T3 was highly significantly greater than that of others (P<0.01). Pure germinated seed yield of T3 was significantly greater than that of T5, T6 and T1 (P<0.05), but was not significantly different from that of T2 and T4.

Thousand-seed weight of T4 was significantly greater than others (P<0.05), but TSW of T3 was not significantly different from the other treatments. Seed purity and germination percentages were not affected by cutting time, ranging from 93 to 97 and 54 to 63 %, respectively.

Discussion

Heights of T1 and T2 were greater than that of T4, T5 and T6; whereas T3 was not different from the other treatments (Table 1). In our study, falling of plants did not occur, since it was the first year of growing Gamba grass. Gobius *et al*. (1998) reported that Gamba grass which was shorter than 274 cm height had no problem when uncut or cutting at different times. Inflorescence length of all treatments were not different. Hare *et al*. (1999) reported that inflorescence length of Paspalum atratum cut in June and July 1996 were alike. The T3 treatment gave the highest tiller number and inflorescence number, 136 tiller/m^2 and 115 inflorescence/ m^2, respectively. Percentage of fertile tillers was markedly and consistently higher in the 5 treatments (T1, T2, T3, T4 and T5) and lowest in T6. This might be due to the low rainfall as well as poor distribution in late August to September (Figure 1), and the drought affect on tillering. As Gamba grass is a short-day plant, when cutting was done in late rainy season, flowering stage would be affected by drought, causing a lower inflorescence and fertile tiller numbers.

Thousand-seed weight of T4 was higher than other treatments (P<0.05), but TSW of T3 was not different from the other treatments. This might be due to uncut Gamba having a lot of dry leaves causing a decrease in photosynthesis area. When cutting after 80 days, the growth period until flower would be decreased, causing a decrease in size of seed (Humphreys and Riveros, 1986). Purity and germination of seed were not affected by cutting time, ranging from 93 to 97

Table 2. Effect of cutting time on seed yield and quality of *Andropogon gayanus* cv. Kent.

Treatment	Pure seed yield (kg/ha)	PGSY (kg/ha)	1000-seed weight (g)	Seed purity (%)	Seed germination (%)
T 1 - no cut	571[b]	304[b]	2.968[b]	94	56
T 2 - (Cut 60)	604[b]	372[ab]	3.128[b]	97	63
T 3 - (Cut 70)	782[a]	434[a]	3.202[ab]	93	60
T 4 - (Cut 80)	579[b]	345[ab]	3.454[a]	96	61
T 5 - (Cut 90)	559[b]	310[b]	3.146[b]	93	61
T 6 - (Cut 60 and 30)	496[b]	251[b]	3.152[b]	94	54
Significant	*	*	*	NS	NS
CV (%)	17.88	22.03	5.84	2.46	15.28

(Cut 60) = cut at 60 days after transplanting (August 9, 1997); (Cut 70) = cut at 70 days after transplanting (August 19, 1997); (Cut 80) = cut at 80 days after transplanting (August 29, 1997); (Cut 90) = cut at 90 days after transplanting (September 8, 1997); (Cut 60 and 30) = cut two times: at 60 days after transplanting (August 9, 1997) and 30 days after first cut (September 8, 1997).

[1] Within columns, means followed by different superscript letters differ significantly (P<0.05).
[2] * = P<0.05. [3] NS: Values are not significantly different (P>0.05).

and 54 to 63 %, respectively, since the inflorescences were covered with nylon gauze bags since early seed setting stage. Unlike seeds which directly fall down to soil, there was a smaller chance of contamination and consequently no difference in seed quality.

Average seed yields of *Andropogon gayanus* cv. Kent from this experiment were very high, compared with the research data of Gobius *et al*. (1998), which showed 599 and 235 kg/ha, respectively. In this study, the T3 treatment gave the highest seed yield of 782 kg/ha. This might be because inflorescence number, fertile tiller and 1000 seed weight were greater than the others. This result was similar to Cameron and Humphreys (1976), who reported that increases in seed yield were associated with an increase in both tiller density and fertile tiller. Increasing inflorescence number led to increasing seed yield. PGSY of T3 also was higher than others. Ramirez and Hacker (1994); Andrade and Thomas (1984) reported that PGSY of Gamba grass cut in the late rainy season or uncut would be decreased. In addition, cutting before flowering caused a decrease in fertile tillers which led to an increase in seed yield (Mishra and Chatterjee, 1968).

Conclusion and Recommendation

Andropogon gayanus cv. Kent cultivation for seed production, could be cut until August 19, which will give the highest seed yields and seed quality. Moreover, harvesting seed will be shorter that more convenient. As *Andropogon gayanus* cv. Kent is a perennial grass, the experiment in second- and third-year crops needs to be further investigated to confirm that cutting at 70 days after transplanting (August 19) will still give the highest seed yields and seed quality, in order to provide practical recommendations to farmers especially those in the Northeast of Thailand.

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