ORIGINAL ARTICLE

Effect of cutting height and time on seed yield and seed quality of *Stylosanthes guianensis* CIAT 184

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Abstract

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Effect of cutting height and time on seed yield and seed quality of *Stylosanthes guianensis* CIAT 184

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The objectives of this experiment were to study the effect of cutting height and time on seed yield and seed quality of *Stylosanthes guianensis* CIAT 184 in Korat soil series at Khon Kaen Animal Nutrition Research Center, during April 2000 - May 2001. The experimental design was 2 × 4 factorial in randomized complete block design with 4 replications. The treatment consisted of 2 factors: - 1) Two levels of cutting height viz. 20 and 30 cm above ground; 2) Four periods of cutting time viz. at 60, 75, 90 days before 50% flowering date and uncut.

The results revealed that seed yield and seed quality were unaffected by cutting height (P>0.05). Seed yield and PGSY obtained from cutting at 90 days and uncut were significantly higher (P<0.05) than cutting at 75 and 60 days (1,575 and 1,438; 1,563 and 1,425; 1,119 and 988; 644 and 563 kg/ha, respectively). There were no significant differences between cutting at 60 and 75 days in 1000-seed weight, but both treatments were significant higher (P<0.05) than cutting at 90 days and uncut. Seed purity and germination

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percentages were unaffected by cutting height and time, ranging from 93 to 95 and 93 to 96 %, respectively. Significant interactions between cutting height and time on seed yield and seed quality were not found.

Key words : *Stylosanthes guianensis* CIAT 184, cutting height and time, seed yield, seed quality

บทคัดย่อ

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ผลของความสูงและอายุการตัดต่อผลผลิตและคุณภาพของเมล็ดพันธุ์ถั่ว *Stylosanthes guianensis* CIAT 184

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การศึกษาผลของความสูงและอายุการตัดต่อผลผลิตและคุณภาพของเมล็ดพันธุ์ถั่ว *Stylosanthes guianensis* CIAT 184 ที่ศูนย์วิจัยอาหารสัตว์ขอนแก่น อำเภอเมือง จังหวัดขอนแก่น ระหว่างเดือนเมษายน 2543 ถึงเดือนพฤษภาคม 2544 โดยวางแผนการทดลองแบบ 2 × 4 Factorial in randomized complete block จำนวน 4 ซ้ำ มี 2 ปัจจัยทดลอง ประกอบด้วย 1) ความสูงของการตัด 2 ระดับ คือ 20 และ 30 ซม. จากพื้นดิน 2) อายุการตัดต้นถั่ว 4 ระยะ คือ ตัดก่อนออกดอก 50% ของทั้งแปลง 60, 75, 90 วัน และไม่ตัดต้นถั่ว

ผลการทดลองพบว่า ความสูงของการตัดไม่มีผลต่อผลผลิตและคุณภาพของเมล็ดพันธุ์ถั่ว *Stylosanthes guianensis* CIAT 184 (P>0.05) สามารถตัดได้ทั้งความสูง 20 และ 30 ซม. จากพื้นดิน ถั่วที่ไม่ตัดและที่ตัดที่ระยะเวลาก่อนออกดอก 90 วัน ให้ผลผลิตเมล็ดและผลผลิตเมล็ดพันธุ์บริสุทธิ์ที่งอกได้ไม่แตกต่างกัน (250 กับ 252 และ 228 กับ 230 กก./ไร่) แต่สูงกว่าถั่วที่ตัดที่ระยะเวลาอื่น ๆ อย่างมีนัยสำคัญทางสถิติ (P<0.05) การที่ไม่ตัดและตัดถั่วที่ระยะเวลาต่าง ๆ กัน ไม่มีผลกระทบต่อความบริสุทธิ์และความงอกของเมล็ดแต่มีผลกระทบต่อน้ำหนัก 1,000 เมล็ด ซึ่งมีน้ำหนักมากที่สุดเมื่อตัดถั่วที่ระยะเวลาก่อนออกดอก 60 วัน เท่ากับ 2.783 กรัม รองลงมาได้แก่ การตัดที่ระยะเวลาก่อนออกดอก 75, 90 วัน และถั่วที่ไม่ตัด (2.758, 2.721 และ 2.705 กรัม) (P<0.05)

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Stylo (*Stylosanthes guianensis*) is a perennial fodder legume of Latin America and Central America origin. It is a sub-shrub, semi-erect or erect, with a strong taproot and small round root nodules. Its stem has many branches, is herbaceous or lignified at the base, and grows to a height of 1 m. Leaves are trifoliate, leaflets elliptical to lanceolate. Inflorescence is a loosely capitate spike, terminal or axillary, with more than 4 flowers. There are several varieties. At the present time, it is widely grown in many tropical countries (Mannetje and Jones 1992). The variety CIAT 184 (*Stylosanthes guianensis* CIAT 184) was introduced to Thailand in 1993 to evaluate growth and biomass yield production including flowering and seed production. It was found is grow well; flowering started in late October and finished in early November and showed good seed setting and was free of insect and disease problems (Satjipanon *et al*., 1995).

In Thailand, *Stylosanthes guianensis* CIAT 184, is nowadays commonly known as "Thapra Stylo" (Department of Livestock Development 2002). Department of Livestock Development has encouraged farmers to grow this fodder legume for feeding their animals and producing

seed for propagating and selling. Cutting the tip of legume at the appropriate time before flowering causes a multiplying of the branches that leads to increases in inflorescence number and seed yield could be increase and farmers could also obtain forage for animals. However, inappropriate cutting height and time may decrease seed yield and seed quality of the legume. Hare and Waranyuwat (1960) suggested that cutting or grazing legume should not be done after August as it would affect the productivity of flowering. In addition, cutting height must not be less than 20 cm height. Therefore, the objectives of this experiment were to study the effect of cutting height and time on seed yield and seed quality of *Stylosanthes guianensis* CIAT 184.

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 °N, 103 °E; 95 m above sea level), during April 2000 - May 2001. The soil is classified as the Korat soil series and is characterized by a sandy clay loam with pH 5.27. The chemical of the top 0-15 cm of soil was 29.85 ppm available P, 40.20 ppm K, 179.29 ppm Ca, 31.93 ppm Mg and 0.55 % organic matter.

Plant cultivation

Three-week-old seedlings of *Stylosanthes guianensis* CIAT 184 were planted on May 26, 2000 at a spacing of 1 m × 1 m. A basal complete fertilizer (156 kg/ha N, 156 kg/ha P, 156 kg/ha K); triple superphosphate (125 kg/ha P); and gypsum (31 kg/ha S) were applied at planting. The plot area was kept weed-free with hand hoeing at 20 and 75 days after planting and whenever necessary.

Design

The trial was 2 × 4 factorial in randomized complete block design with 4 replications. Plots were 3 m × 4 m. The treatments consisted of 2 factors.

1) Two levels of cutting height viz. 20 and 30 cm height above ground level.

2) Four periods of cutting time viz.

- cut at 60 days before 50% flowering date (September 2, 2000);
- cut at 75 days before 50% flowering date (August 17, 2000);
- cut at 90 days before 50% flowering date (August 2, 2000);
- uncut.

Data collection and seed harvesting

All recordings were taken from the inner 2 × 3 m of each plot. Initial flowering date was 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 there for duration of the harvest. Bags facilitate the collection of all seed produced. Plots were cut according to their respective treatments. A fresh forage sample from each plot was weighed, a 200-g sub-sample taken, and oven-dried at 65 °C for 48 hours to estimate DM. Sub-samples were analyzed for crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF). Ca and P were determined using the methods of Goering and Van Soest (1970). At peak flowering stage, two 1 m^2 quadrants were sampled for inflorescence number. Plots were harvested individually. Harvest took place after mature seeds were observed; seedheads with nylon gauze bags were cut. Seed was allowed to collect in the gauze bags until such time weather permitted the collection of dry seed. Ripe seed was threshed off the inflorescences by heavily threshing the gauze bag using a mallet.

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 concentration dropped 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 using the seed test methods of the International Seed Testing Association for *Stylosanthes guianensis* CIAT 184. TSW was determined from pure-seed spikelet weight. Germination tests were done at 42, 33 and 36 days after seed harvesting in 2001. Seed was treated with concentrated H_2SO_4 before germinating in a growth chamber with 16 h of darkness at 20 °C, and 8 h of light at 35 °C for a 14-day germination period. Seed yield and TSW were corrected to 9 % SMC. The inflorescence number/m^2 were obtained by calculation. Further parameters were calculated as follows: Pure seed yield (PSY) = SY*SP/100; and Pure germinated seed yield (PGSY) = PSY*SG/100.

Statistical analysis

The experimental data were statistically analysed using analysis of variance procedures for a randomized complete block design. The mean differences between treatment means were tested for significance by least significance difference procedures. All data were analysed using the SAS programme (1985).

Results

Rainfall

The amount and distribution of rainfall are shown in Figure 1. Rainfall was evenly distributed in the wet season (May-September). Total precipitation during the planting period (April-December) was 1,683.3 mm in 2000 and 1146.4 on the average over the previous 10 years (1990-1999). In the year 2000 and in the previous 10 years, the heaviest rainfall occurred in September, which is the time of the growing and flowering stage of *Stylosanthes guianensis* CIAT 184.

Seed yield components

It appeared that there was no significant difference between cutting at 90 days and uncut in inflorescence number, but both treatments were highly significantly greater (P<0.001) than cutting at 75 and 60 day. Cutting height had no effect on inflorescence number. Significant interactions between cutting height and time on inflorescence were not found (Table 1).

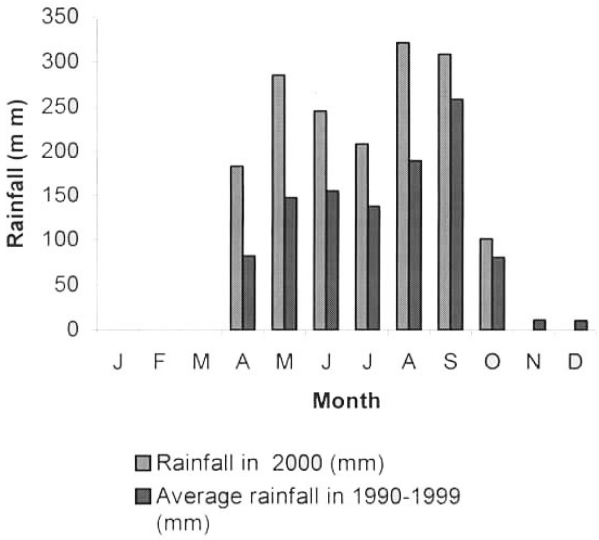

Figure 1. Monthly fainfall in 2000 and an average of the previous 10 years (1990-1999).

Table 1. Effect of cutting height and time on inflo rescence number of *Stylosanthes guianensis* CIAT 184.

Treatment	Inflorescence number (per m^2)
Cutting height (cm)	
20	1,452
30	1,511
Cutting time (days)	
60	771 [c]
75	1,352 [b]
90	1,929 [a]
uncut	1,925 [a]
height X time	NS
CV (%)	19.8

[1] **Within columns, means followed by different superscript letters differ significantly (P<0.05).**
[2] **NS : Values are non significantly different at P<0.05.**

Table 2. Effect of cutting height and time on seed yield and seed quality of *Stylosanthes guianensis* CIAT 184.

Treatment	Pure seed yield (kg/ha)	PGSY (kg/ha)	1000-seed weight (g)	Seed purity (%)	Seed germination (%)
Cutting height (cm)					
20	1,194	1,075	2.740	95	94
30	1,256	1,125	2.744	94	95
Cutting time (days)					
60	644[c]	563[c]	2.783 [a]	94	93
75	1,119[b]	988[b]	2.758 [ab]	93	94
90	1,575[a]	1,438[a]	2.721 [bc]	95	96
uncut	1,563[a]	1,425[a]	2.705[c]	94	95
Cutting height × Cutting time	NS	NS	NS	NS	NS
CV (%)	20.9	21.0	1.7	2.1	2.8

[1]**Within columns, means followed by different superscript letters differ significantly (P<0.05).**
[2]**NS : Values are non significantly different at P<0.05.**

Table 3. Effect of cutting height and time on DM yield of *Stylosanthes guianensis* CIAT 184.

Treatment	DM yield (t/ha)
Cutting height (cm)	
20	4.7
30	4.3
Cutting time (days)	
60	8.2
75	4.4
90	0.9

Note: The data were not analysed statistically.

Seed yield and seed quality components

Cutting time had a significant effect on seed yield and seed quality of *Stylosanthes guianensis* CIAT 184 (Table 2). There were no significant differences between cutting at 90 days and uncut in pure seed yield and PGSY but both were significant greater (P<0.05) in treatments than in others. There were no significant differences between cutting at 60 and 75 days in 1000-seed weight but 1000-seed weight at 75 days is insignificant difference from that at 90 days. There were no significant differences between cutting height treatments in seed yield and seed quality. Seed purity and germination percentages were unaffected by both cutting height and time.

Dry matter yield

The effect of cutting height and time on DM yield are shown in Table 3. Increasing cutting height from 20 to 30 cm affected DM yield, which was reduced from 4.7 to 4.3 t/ha. Cutting at 60, 75 and 90 days reduced DM yield from 8.2 to 4.4 and 0.9 t/ha.

Chemical composition

The effects of cutting height and time on chemical composition are shown in Table 4. Increasing the cutting height from 20 to 30 cm affected CP, which tend to be increase, from 17.97 to 18.81%, whereas NDF and ADF values tended to decrease from 55.72 to 53.84 and from 41.01 to 36.48 %, respectively. Cutting at 60, 75 and 90 days affected CP, which tended to increase from 15.39 to 17.91 and 21.87%, while NDF and ADF values tended to decrease from 63.34 to 55.77 and 45.23; from 47.08 to 38.03 and 31.12%, respectively. Ca and P showed no differences, and were in the range of 0.12 - 0.18 and 0.39 - 0.50%.

Table 4. Effect of cutting height and time on chemical composition of *Stylosanthes guianensis* CIAT 184 (dry basis).

Items	Chemical composition (%)				
	Cutting height (cm)		Cutting time (days)		
	20	30	60	75	90
CP	17.97	18.81	15.39	17.91	21.87
NDF	55.72	53.84	63.34	55.77	45.23
ADF	41.01	36.48	47.08	38.03	31.12
Ca	0.12	0.18	0.17	0.13	0.13
P	0.50	0.45	0.39	0.41	0.40

Note: The data were not analysed statistically.

Discussion

Inflorescence numbers of plants cut at 90 days and uncut were greater than that of plants cut at 75 and 60 days. It is because the longer period of time for growing and storing food in stem led to more branching and flowering. Inflorescence number of 20 and 30 cm cutting height were 1,452 and 1,511, respectively. *Stylosanthes guianensis* CIAT 184 is a short-day plant as observation in plots, revealed that flowering appearance started on October 21, 2000 continued until late December. The maximum inflorescence number occurred in mid November 2000, which was similar to the findings of Chen *et al*. (1994), who reported that flowering appearance of *Stylosanthes guianensis* CIAT 184, planted in Northern and Northeast Malaysia, started in October and the maximum inflorescence number occurred in December 1973.

Seed yield and PGSY obtained from cutting at 90 days and uncut were higher than those from cutting at 75 and 60 days (1,575 and 1,438; 1,563 and 1,425; 1,119 and 988; 644 and 563 kg/ha, respectively). This is because the inflorescence number of cut at 90 days and uncut were higher, led to a higher number mature of seeds. Seed yields obtained from cutting at 90 days and uncut were higher than in the experiment of Chen *et al*. (1994) (1,575; 1,563 and 838 kg/ha, respectively). In addition they were higher than in Graham stylo (*S. guianensis* cv. Graham), 1,250 kg/ha (Udchachon *et al*., 1992). Seed yield and seed quality were unaffected by cutting height (pure seed yield, PGSY, TSW, SP and SG were 1,194 kg/ha, 1,075 kg/ha, 2.740 g, 95 %, and 94 %; when cut at 20 cm height and 1,256 kg/ha, 1,125 kg/ha, 2.744 g, 94 % and 95 % when cut at 30 cm height, respectively). Seed purity and germination percentages were unaffected by cutting height and time, ranging from 93 to 95 and 93 to 96 %, respectively. Because the inflorescences were covered with nylon gauze bags since early seed setting stage, it was unlikely those seeds directly fell down to the soil and there was a lower chance of seeds being contaminated; consequently seed quality was not different. The method of covering inflorescences with nylon gauze bag currently used by Thai farmers to harvest seed from *Stylosanthes guianensis* CIAT 184 gave high quality seed. The highest DM yield obtained under this experiment was 8.2 t/ha when cut at 60 day and decreased when cut at 75 and 90 days, respectively, since the period of time for growing and a branching was reduced. In this experiment, P was found in the range of standard requirement of beef cattle, but Ca was lower than the standard. Standard requirement of Ca and P according to McDowell (1983) are in the range of 0.18 - 1.04 and 0.18 - 0.70 %, respectively. CP was found in the range of 15.39 - 21.87 %. At the 75-d harvest, CP was 17.91 %,

which was similar to the report of Panichapol and Jiumjetjaroon (1999) that the average crude protein (CP) was 17.57 % at 75-d harvest.

Conclusion and recommendation

Stylosanthes guianensis CIAT 184 cultivation for seed production, could be cut at 20 to 30 cm height above ground levels and should be cut at 90 days before approximately 50% flowering (August 2), which would achieve high seed yield and seed quality as well as forage yield for animals. As *Stylosanthes guianensis* CIAT 184 is a perennial fodder legume, the experiment in second- and third-year crops needs to be further investigated to confirm that cutting at 90 day before approximately 50% flowering will still give the highest seed yield and seed quality, in order to provide practical recommendations to farmers especially those in the Northeast of Thailand.

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