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ORIGINAL ARTICLE

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## **Effect of planting dates on seed yield and seed quality of *Stylosanthes guianensis* CIAT 184**

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### **Abstract**

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**Effect of planting dates on seed yield and seed quality of  
*Stylosanthes guianensis* CIAT 184**

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The objective of this experiment was to investigate the effect of planting dates on seed yield and quality of *Stylosanthes guianensis* CIAT 184 at Khon Kaen Animal Nutrition Research and Development Center, during May 2003 to February 2004. A randomized complete block design with four replications was used. Experimental treatments consisted of four planting dates spaced at about 30-day intervals from 23 May to 23 August 2003.

The results revealed that planting date had a significant effect on seed yields and pure germinable seed yields (PGSY) of *S. guianensis* CIAT 184. Plots planted on 23 July produced the highest seed yield and PGSY of 630 and 601 kg/ha, respectively followed by plots planted on 23 June and 23 May (514 and 501; 443 and 421 kg/ha, respectively). Plots planted on 23 August produced the lowest seed yield and PGSY of 269 and 262 kg/ha, respectively. There were no significant differences in seed purity percentage, germination

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percentage and 1000-seed weight among planting dates. Based on this research, it was concluded that late-July was the optimum planting date for *S. guianensis* CIAT 184 cultivation for seed production in Northeast Thailand.

**Key words :** *S. guianensis* CIAT 184, planting dates, seed yield, seed quality

### บทคัดย่อ

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ผลของวันที่ปลูกที่มีต่อผลผลิตและคุณภาพของเมล็ดพันธุ์ถั่วท่าพระสไตโล

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การศึกษาผลของวันที่ปลูกที่มีต่อผลผลิตและคุณภาพของเมล็ดพันธุ์ถั่วท่าพระสไตโล (*Stylosanthes guianensis* CIAT 184) ที่ศูนย์วิจัยและพัฒนาอาหารสัตว์ขอนแก่น อำเภอเมือง จังหวัดขอนแก่น ระหว่างเดือนพฤษภาคม 2546 ถึงเดือนกุมภาพันธ์ 2547 โดยวิธีการทดลองแบบ Randomized complete block design จำนวน 4 ชั้้า โดยทำการปลูกถั่วเว็บห่างกันทุก ๆ 30 วัน จำนวน 4 วันปลูก คือ วันที่ 23 พฤษภาคม, 23 มิถุนายน, 23 กรกฎาคม และ 23 สิงหาคม 2546

ผลการทดลองพบว่า การปลูกถั่วท่าพระสไตโลวันที่ 23 กรกฎาคม 2546 ได้ผลผลิตเมล็ดพันธุ์และผลผลิตเมล็ดพันธุ์บริสุทธิ์ที่งอกได้สูงสุด 101 และ 96 กก./ไร่ ตามลำดับ ซึ่งสูงกว่าถั่วที่ปลูกวันที่ 23 พฤษภาคม, 23 มิถุนายน และ 23 สิงหาคม 2546 อย่างมีนัยสำคัญทางสถิติ ( $P < 0.05$ ) (71 และ 67; 82 และ 80; 43 และ 42 กก./ไร่ ตามลำดับ) ถั่วท่าพระสไตโลทุกวันปลูกมีน้ำหนัก 1000 เมล็ด (3.769-3.829 กรัม) ความบริสุทธิ์ของเมล็ดพันธุ์ (97-98%) และความงอก (98.0-99.2%) ไม่แตกต่างกัน ดังนั้นการปลูกถั่วท่าพระสไตโลเพื่อผลิตเมล็ดพันธุ์ในภาคตะวันออกเฉียงเหนือ ควรปลูกปลายเดือนกรกฎาคม

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*Stylosanthes guianensis* CIAT 184 is a tropical perennial forage crop that originated in Central and South America. It is high forage yield potential which can thrive in a wide range of soil types, well adapted to sandy-loam soil with low organic matter and rather high acidity, and drought tolerance. *S. guianensis* CIAT 184 was evaluated for its forage production potential, persistence including flowering and seed setting in Thailand since 2000. It adapted in the region and exhibited high forage yield potential, high seed production particularly in Northeast Thailand (Satjipanon *et al.*, 1995). Its wide use is due to its easily being established from seed, which is an important key for Thai farmers to plant forage for their livestock, since it is easier and cheaper than vegetative propagation.

*S. guianensis* CIAT 184 is a short-day plant, it requires a day length of less than 12 hours for flowering, with best results at ten hours (Mannetje and Jones, 1992). Its planting time would therefore affect its growth, days to first flowering, seed maturity and plant height. Abhams and Julia (1973) found that planting time of pigeon pea (*Cajanus cajan*) in Puerto Rico effect on days to first flowering and fresh pod yield. A summary of planting duration recommendations compiled by the Thai DLD (2002) reported optimum planting duration for *S. guianensis* CIAT 184 seed production was between early-May to late-July, planting after late-July resulted in seed yield decline. Time of sowing (March-July) had significant effects on seed production of *Paspalum atratum* in the establishment year. Early sowing in March produced the

highest seed yield, followed by April, May and June, with no seed from July sowings. *P. atratum* should be sown within May at the higher latitude at Lampang, and within March in the lower latitudes at Sukhothai and Sakaew (Phaikaew, 2004). Few management studies have been conducted on planting dates for *S. guianensis* CIAT 184 seed production. Studies investigating the effect of planting dates on seed yield and seed quality of *S. guianensis* CIAT 184 have not been established. Scientific information of *S. guianensis* CIAT 184 regarding planting date in producing areas of the Northeast Thailand is needed to assist farmers in making crop management decisions. The objective of this research was to identify the optimum planting date for *S. guianensis* CIAT 184 seed production in Northeast Thailand.

## Materials and Methods

### Location and climate of the experimental site

Field experiment was conducted under rainfed conditions during May 2003 to February 2004 at Khon Kaen Animal Nutrition Research and Development Center, Khon Kaen Province, in Northeast Thailand (16°00' N, 102°30' E; elevation 166 m). The field was cropped with *S. guianensis*

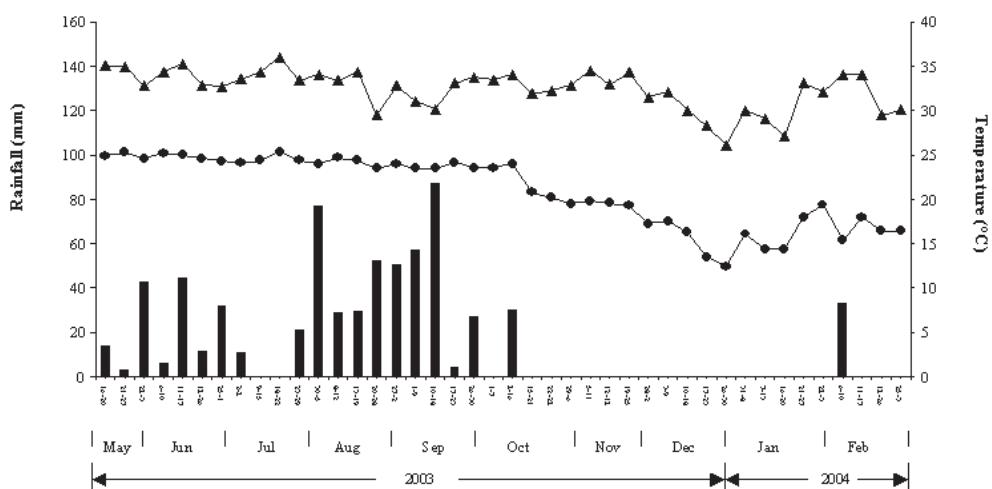
CIAT 184 in the season before application of the treatments. The soil is a sandy loam (fine-loamy, siliceous, isohyperthermic oxygenic Kandiustults). Temperature and precipitation data were obtained from the Thapra Meteorological Station, located about 1 km north of the experiment site. The climatic data of weekly mean rainfall, maximum and minimum air temperatures throughout the growing season of this study are shown in Figure 1.

### Experimental design and treatments

A randomized complete block design with four replications was used. Experimental treatments consisted of four planting dates spaced at about 30-day intervals from 23 May to 23 August 2003 (23 May, 23 June, 23 July and 23 August 2003). The experimental treatment had been imposed using general practices of farmers for seed production of *S. guianensis* CIAT 184 involved in planting period, which generally has been around late-May till late-August.

### Seedling preparation

Scarification of seeds was done by soaking in hot water at 80°C for 5 min to reduce hard-seededness, then sown in a plastic drainable



**Figure 1. Weekly weather data during the experimental period: rainfall is shown by the columns; minimum temperature ●-●; maximum temperature ▲-▲.**  
Source: Thapra Meteorological Station, Khon Kaen (2004).

seedling tray in the nursery according to their respective treatments. Plants were watered every day as necessary to avoid drought. Seedlings stayed 28 d in the nursery and were then transplanted to the plots.

### Crop cultivation

The experimental site was moldboard-plowed to a depth of about 20 cm and then roller-harrowed in late April 2003. Soil samples were taken from depths of 0 to 15 cm as composites of four samples from four random locations within each plot. The samples were shade dried, crushed and sieved through a 2 mm mesh before being analyzed for major nutrients. Plot size was 4x5 m with four rows per plots. Plots were hand-transplanted in 100-cm-wide rows with 50-cm spacing within rows at a rate of 1 seedling/hill, which resulted in 2 plants/m<sup>2</sup>. Two days prior to planting, each plot was top dressed 25 kg N/ha as urea, 150 kg P/ha as triple superphosphate, 25 kg K/ha as potassium choride and 62.5 kg S/ha as gypsum. The entire plot area was kept weed-free with hand hoeing at 20 and 75 d after planting and whenever necessary.

### Data collection and seed harvesting

In order to minimize the effect of border row, all samples were taken from the 3x4 m strip perpendicular to the row direction of each plot. Ten plants were selected randomly from the central two rows and the following growth variables were recorded for each plot; date of start flowering, days to first flowering, days to seed maturity and plant height at seed maturity. 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 harvested individually in the last week of January 2004. 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.

### Chemical analyses, seed processing, seed quality measurement and calculation of secondary attributes

Seed from all treatments was air-dried at ambient temperature for 3 d in a seed shed until seed moisture content dropped below 10%, before cleaning through hand screens and a Dakota seed blower. Cleaned seed was weighed for each plot. Seed moisture content (MC), 1000-seed weight (TSW), seed purity (SP), and seed germination (SG) were determined using the methods of the International Seed Testing Association for *S. guianensis*. TSW was determined from pure-seed spikelet weight. Germination test was done in February 2004. Four replications of a 100-seed sample were treated with concentrated H<sub>2</sub>SO<sub>4</sub> then tested for germination on blotters in clear plastic petri dishes at alternating temperatures of 20°C for 16 h and 30°C for 8 h in a daylight/fluorescent-lighted germinator (AOSA, 1988). Seedlings were counted and removed from petri dishes every second day during a 10-d test period. Germination percentage was determined. Seed yield and TSW were corrected to 9 % MC. Further parameters were calculated as follows: pure seed yield (PSY) = SYxSP/100; and PGSY = PSYxSG/100.

### Statistical analyses

The various data were subjected to the analyses of variance (ANOVA) procedure for randomized complete block design experiments using the general linear models (GLM) of the SAS System for Windows (SAS 6.12, TS level 020, SAS Institute, 1989). Probabilities less than 0.05 were considered significant. Treatment means were compared using Duncan's New Multiple Range test (Steel and Torries, 1980).

## Results

### Climatic conditions and soil characteristics

Climatic conditions in the Northeast Thailand were generally considered to be good for

*S. guianensis* CIAT 184 growth and seed yielding. During experimental period, rainfall was rather low as well as poorly distributed. Rainfall was evenly distributed in the wet season (May to September 2003), which was the timing of the growing stage of *S. guianensis* CIAT 184. The precipitation was highest in early-September 2003. Early-season precipitation was abundantly for establishment of plants. Less rain was received with an abnormal suspended period in mid-July 2003. Extremely low amount of rainfall was received after mid-October 2003, with no measurable precipitation occurring in November 2003 to January 2004, which was the timing of the flowering and seed setting stage of *S. guianensis* CIAT 184. Total precipitation during the experimental period (May 2003 to February 2004) was 663.7 mm. Weekly

mean maximum and minimum air temperatures ranged from 29.2 to 36.3 and 15.7 to 25.2°C, respectively. Analysis of a composite sample collected from the experimental site revealed that soil pH (water) was 5.12, with 0.04%, 55.72, 37.69, 149.32, 12.60, 0.00 and 1.14 % for total-N, available P, available K, Ca, Mg, S and organic matter, respectively.

### Plant growth

The effects of planting date on some agronomic characters of *S. guianensis* CIAT 184 are presented in Table 1. Days to first flowering, days to seed maturity and plant height at seed maturity were significantly greatest ( $P<0.05$ ) for 23 May treatment and significantly lowest ( $P<0.05$ ) for 23 August treatment.

Table 1. Effect of planting date on some agronomic characters of *S. guianensis* CIAT 184.

Planting date	Start flowering	Days to first flowering (d)	Days to maturity (d)	Plant height (cm)
23 May	28 Oct 2003	157.5 <sup>a</sup>	193.0 <sup>a</sup>	140.0 <sup>a</sup>
23 June	12 Nov 2003	141.0 <sup>b</sup>	164.0 <sup>b</sup>	100.0 <sup>b</sup>
23 July	18 Nov 2003	116.0 <sup>c</sup>	137.0 <sup>c</sup>	85.0 <sup>c</sup>
23 August	21 Nov 2003	88.8 <sup>d</sup>	116.3 <sup>d</sup>	60.0 <sup>d</sup>
Significance	-	*	*	*
CV (%)	-	0.65	0.35	0.88

<sup>a,b,c,d</sup> Means with different superscripts in the same row are significantly different ( $p<0.05$ ).

\* =  $P<0.05$ , CV = coefficient of variation.

Table 2. Effect of planting date on seed yield and quality of *S. guianensis* CIAT 184.

Planting date	Seed yield (kg/ha)	Seed quality			Pure germinable seed yield (kg/ha)
		Purity (%)	1000-seed weight (g)	Germination (%)	
23 May	443 <sup>b</sup>	98	3.813	98.7	421 <sup>b</sup>
23 June	514 <sup>b</sup>	97	3.787	99.0	501 <sup>b</sup>
23 July	630 <sup>a</sup>	97	3.769	98.0	601 <sup>a</sup>
23 August	269 <sup>c</sup>	98	3.829	99.2	262 <sup>c</sup>
Significance	*	NS	NS	NS	*
CV (%)	11.8	7.7	3.7	0.9	12.3

<sup>a,b</sup> Means with different superscripts in the same row are significantly different ( $p<0.05$ ).

\* =  $P<0.05$ , NS = Values are not significantly different ( $P>0.05$ ), CV = coefficient of variation.

### Seed yield and seed quality

The results of the effects of planting date on seed yield and seed quality of *S. guianensis* CIAT 184 are presented in Table 2. Seed yield and PGSY were significantly greatest ( $P<0.05$ ) on 23 July planting and significantly lowest ( $P<0.05$ ) for 23 August planting, whereas seed yield and PGSY were not significantly different between 23 May and 23 June plantings. There were no significant differences in seed purity percentage, germination percentage and 1000-seed weight among treatments.

### Discussion

Delayed planting resulted in a decrease in days to first flowering, days to seed maturity, and plant height at seed maturity. This result was in agreement with Abhams and Julia (1973), who found that planting time of pigeon pea (*Cajanus cajan*) in Puerto Rico had an effect on days to first flowering. The flowering of *S. guianensis* CIAT 184 planted on 23 May, 23 June, 23 July and 23 August 2003 commenced on 28 October, 12 November, 18 November and 21 November 2003, respectively. A similar finding was reported by Kiyothong *et al.* (2002) reported that flowering of *S. guianensis* CIAT 184 grown at Khon Kaen Animal Nutrition Research and Development Center in 2001 commenced in mid-October continued until late-December.

Planting date had a significant effect on seed yields and PGSY of *S. guianensis* CIAT 184. Plots planted on 23 July produced the highest seed yield and PGSY of 630 and 601 kg/ha, followed by plots planted on 23 June and 23 May (514 and 501; 443 and 421 kg/ha). Plots planted on 23 August produced the lowest seed yield and PGSY of 269 and 262 kg/ha. This was mainly due to plots planted on 23 July being transplanted in a time of good rainfall (Figure 1). Plots planted on 23 July had a plant height of 85 cm (Table 2). This result was similar to that of Kiyothong *et al.* (2004), who reported *S. guianensis* CIAT 184 gave highest seed yields (plots closed on 10 September) from a plant height of 82 cm. This was likely due to plant height

of these plots being optimum. From the observation in field plots, it could also be noted that plant could be grown in optimum condition. These contributed to more branching and flowering subsequent to seed setting and eventually resulted in high seed yield. From the observation in field plots, it could also be noted that stem and leaves of plots planted on 23 May and 23 June grew abundantly as compared to plots planted on 23 July and 23 August. In addition, lodging and pile up itself has been obviously observed. This led to competition for light and nutrient, which ultimately resulting in a lower seed yield. The plots planted on 23 August were transplanted on the timing of the low rainfall, abnormal suspension as well as poor distribution during late September to October 2003 (Figure 1). These contributed to less branching and flowering subsequent to less seed setting and eventually resulted in the lowest seed yield. This result was in agreement with Phaikaew (2004), who reported that time of sowing (March-July) had significant effects on seed production of *P. atratum* in the establishment year.

TSW and germination percentage were unaffected by planting date, ranging from 3.769 to 3.829 g and 98.7 to 99.2%, respectively. Seed purity percentage was also unaffected by planting date, ranging from 97 to 98. The reason could possibly be 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 purity was not different. A similar finding was reported by Kiyothong *et al.* (2002), who reported that seed purity percentage of *S. guianensis* CIAT 184, which its inflorescences covered with nylon gauze bags since early seed setting stage was not different. The method of covering inflorescences with nylon gauze bag is currently used by Department of Livestock Development to harvest seed of *Panicum maximum* TD58, which obtain high purity seed.

### Conclusion and Recommendations

Based on this research, it was concluded that

late-July would be the optimum planting date for *S. guianensis* CIAT 184 cultivation for seed production in Northeast Thailand, which would achieve high seed yield and good quality seed. However, the experiments in second- and third-year crops still need to be clearly defined in order to provide practical recommendations to farmers especially those in the Northeast of Thailand.

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