Seed production potential of *Brachiaria* species in northeast Thailand

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Introduction

The northeast region of Thailand, which accounts for approximately one-third of the national land area, has a tropical climate with pronounced dry and rainy seasons. The mean annual rainfall is 1300 mm with 85% falling from mid-April to mid-October (Shelton 1982). The majority of cattle and buffalo in Thailand are concentrated in this region. Feed shortages are a major concern, especially during the 6-months long dry season when livestock are mainly fed rice straw. To ease this problem, Thai research organisations have been developing improved forages and appropriate management guidelines for their use. As a result, Ruzi grass (*Brachiaria ruziziensis*) has become widespread, primarily because of its high seed yields and ease of establishment. However, although seed production is relatively easy, Ruzi is poorly adapted to areas with long dry seasons.

Within the same genus, one species (*B. decumbens*) has been identified in several agronomic trials as having better dry season growth (Thinnakorn and Kreethapon 1993, Phaikaew et al. 1996). However, its use in Thailand is constrained by low seed yield and poor seed quality (Boonpukdee et al. 1996, Gobius et al. 1996).

The approach taken in the present study was to screen a larger range of *Brachiaria* accessions for their seed production potential. Accessions with promising seed yields will be further tested for their environmental adaptation, with particular emphasis on dry season performance.

Materials and methods

The experiment was conducted at Pakchong Animal Nutrition Research Centre, Nakornratchasima, northeast Thailand (latitude 14°42'N, longitude 101°25'E, altitude 330 m, mean annual rainfall 1100 mm – see Fig. 1). The soil is a red clay with a pH 5.8.

Thirty two accessions of *Brachiaria* spp., comprising five species (*B. brizantha, B. decumbens, B. humidicola, B. jubata* and *B. ruziziensis,)* introduced from CIAT Colombia, were established along with a control (*B. ruziziensis*). As the quantity of seed available was very limited, seed was pre-germinated in polyethylene bags in May 1996 and transplanted to the field in August 1996. Plots were arranged in a randomised complete block design with three replications. Each plot consisted of nine plants arranged in a 0.4x-0.4m grid pattern. 300 kg/ha compound fertiliser (15-15-15) and 60 kg/ha urea were applied at transplanting. Plants were cut back after seed

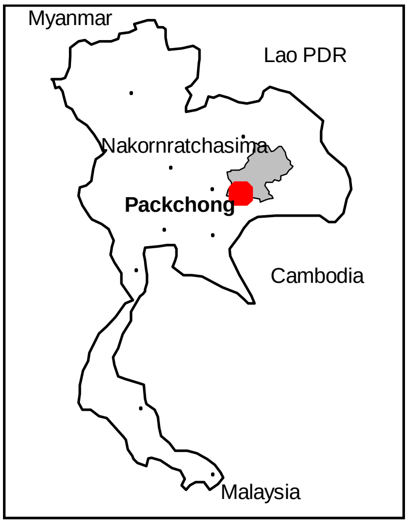

Fig. 1. Experimental site.

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harvest in the first year (Jan 1997) and were sampled for dry matter yield during the dry season (May 1997).

Data collection and seed harvesting

Dry matter yields during the dry season and at initial flowering were recorded for each plot. Regrowth after cutting and drought tolerance were visually estimated. To measure seed yield, seed heads were tied together into manageable bunches. When seed was almost ripe, the bunches were covered by nylon net bags which remained there for the duration of the harvest. Inflorescence density and number of tillers per plant were recorded in December 1997. Tiller fertility was expressed as the number of inflorescences divided by the total number of tillers.

Random samples of 15g seed were used to measure seed purity (in accordance with ISTA rules for seed testing) and one-thousand seed weight. The pure seed component was estimated as the number of caryopses in a sample of 100 spikelets. A germination test will be conducted in March/April 1998, and a tetrazolium test will determine the viability of seed that fails to germinate. Data on dry matter yield and seed yield were recorded only in the second year because of late transplanting in the first year.

Results and discussion

The experiment was conducted in a year of adverse rainfall conditions. The 1997 total rainfall was 663 mm, which was only 60% of the long-term mean annual rainfall for Pakchong (Fig. 2). This makes the drought tolerance measurements particularly relevant. However, seed production is likely to have been adversely affected by moisture stress.

All the accessions established well, but *B. humidicola* CIAT 16886 and 26149 died during the first year. In 1996, only 20 accessions flowered due to late planting (Table 1). It is likely that some accessions need a long juvenile phase before they reach their critical daylength for flowering.

In 1997, all accessions flowered except *B. brizantha* CIAT 16306 (Table1). Flower initiation varied from June to October (31-161 after closing cut on 22 May 1997). Ten accessions initiated flowers by June, three accessions by July, four by August, five by September and seven by October.

There was a large variation in inflorescence density, noted on 12 December 1997 (Table 2). Flowering in most species was adequate, except in *B. brizantha* CIAT 16288, CIAT 26566, and *B. decumbens* CIAT 26297.

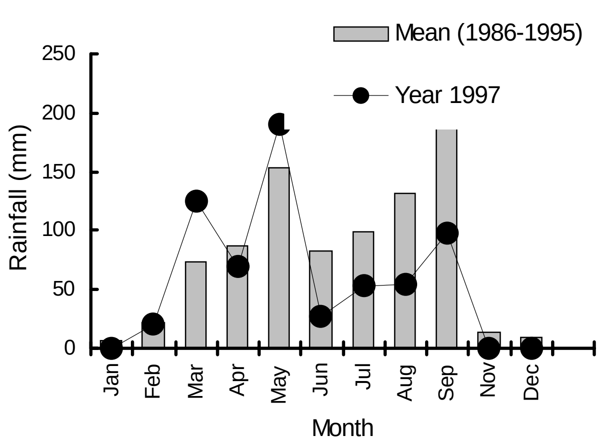

Fig. 2. Mean monthly rainfall (1986-95) and monthly rainfall in 1997 at Pakchong.

Table 1. Survival and flowering of 33 *Brachiaria* accessions.

Species	CIAT Accession Number	Survival	Flowering 1996	Flowering 1997
Brachiaria brizantha	667	✔	✔	✔
"	6387	✔	✔	✔
"	6780	✔	✘	✔
"	16288	✔	✔	✔
"	16306	✔	✘	✘
"	16307	✔	✘	✔
"	16309	✔	✘	✔
"	16311	✔	✔	✔
"	16319	✔	✘	✔
"	16444	✔	✔	✔
"	16463	✔	✔	✔
"	16464	✔	✔	✔
"	16472	✔	✔	✔
"	16488	✔	✘	✔
"	16549	✔	✔	✔
"	16779	✔	✔	✔
"	16827	✔	✔	✔
"	16829	✔	✔	✔
"	16830	✔	✘	✔
"	16835	✔	✔	✔
"	26110	✔	✘	✔
"	26566	✔	✘	✔
Brachiaria decumbens	cv. Basilisk	✔	✔	✔
"	16497	✔	✘	✔
"	26112	✔	✘	✔
"	26297	✔	✔	✔
"	Brazil	✔	✔	✔
Brachiaria humidicola	cv. Tully	✔	✔	✔
"	6133	✔	✔	✔
"	16886	✘	–	–
"	26149	✘	–	–
Brachiaria jubata	26188	✔	✔	✔
Brachiaria ruziziensis	'Ruzi'	✔	✔	✔

The seed yield components are presented in Table 2. There was wide variation in tiller fertility, from 9% in *B. brizantha* CIAT 16488 to 68% in *B. ruziziensis.* The highest inflorescence density occurred in *B. decumbens* CIAT 16497. Inflorescence density was not always associated with high seed yield because soil moisture was limiting during the flowering period. The number of racemes per inflorescence varied: 2.2 - 9.8 in *B. brizantha*, 2.4 – 7.0 in *B. decumbens,* 2.6 - 3.7 in *B. humidicola*, 3.9 for *B. jubata,* and 4.9 for *B. ruziziensis.*

Table 2. The components of seed yield in *Brachiaria* species.

Accessions	Onset of flowering	Tiller fertility (%)	Inflorescence density (no./plant)	Racemes/ inflorescence (no.)	Raceme length (cm)	Spikelet density (no./cm)
Brachiaria brizantha						
CIAT 667	5 Aug	34	50	4.0	4.0	7.2
CIAT 6387	20 Jun	60	75	7.3	2.2	5.5
CIAT 6780	1 Oct	-[1]	-	3.4	7	5.3
CIAT 16288	5 Jun	27	11	3.0	11.6	4.3
CIAT 16306	x[2]	x	x	x	x	x
CIAT 16307	1 Oct	-	-	-	-	-
CIAT 16309	20 Sep	-	-	-	-	-
CIAT 16311	25 Jun	32	41	5.0	7.0	5.1
CIAT 16319	25 Oct	-	-	-	-	-
CIAT 16444	20 Jun	17	33	3.1	7.6	5.2
CIAT 16463	20 Jun	29	55	2.6	7.7	5.1
CIAT 16464	20 Jun	23	54	3.4	7.7	6.1
CIAT 16472	25 Jun	38	93	2.7	5.2	6.0
CIAT 16488	14 Jul	9	19	5.4	6.4	6.0
CIAT 16549	20 Jun	45	100	4.1	5.5	5.6
CIAT 16779	23 Sep	-	-	3.2	7.2	3.8
CIAT 16827	14 Oct	22	22	3.9	9.4	4.7
CIAT 16829	23 Sep	-	-	4.0	7.2	4.8
CIAT 16830	23 Sep	40	39	2.9	7.0	5.6
CIAT 16835	30 Aug	55	80	3.0	9.8	4.5
CIAT 26110	28 Oct	13	19	4.5	6.8	4.6
CIAT 26566	14 Oct	28	14	4.6	9.6	4.8
Brachiaria decumbens						
cv. Basilisk	23 Sep	-	-	4.0	3.3	8.3
CIAT 16497	27 Jun	57	141	2.4	5.0	7.3
CIAT 26112	16 Jul	-	-	3.0	5.8	6.7
CIAT 26297	14 Oct	-	-	3.5	6.2	4.8
BRAZIL	23 Sep	-	-	4.6	7.0	5.2
Brachiaria humidicola						
cv. Tully	18 Jul	26	61	2.6	4.8	4.0
CIAT 6133	23 Jun	40	35	3.7	4.2	4.5
Brachiaria jubata						
CIAT 26188	22 Aug	56	35	2.8	3.9	7.5
Brachiaria ruziziensis	5 Aug	68	75	2.6	4.9	9.3

[1] - = data unavailable

[2] x = did not flower

Seed yields are presented in Table 3. Significant differences were observed among the 31 accessions. Pure seed yield ranged between 0 and 601 kg/ha. *Brachiaria ruziziensis* and *B. brizantha* CIAT 16835 were the most productive accessions, yielding 601 kg/ha. All other accessions produced significantly lower yields, mostly less than half of these two accessions. The very high seed production potential of *B. ruziziensis* has been reported earlier (Phaikaew and Pholsen 1993). However, the result for *Brachiaria brizantha* CIAT 16835 was new.

Table 3. Pure seed yield (kg/ha), 1000-seed weight (g), and caryopsis content (%) of 31 *Brachiaria* accessions.

Accession	Pure seed yield			1000 seed weight	Caryopsis content
	(kg/ha)	Relative yield[1]	Rank	(g)	(%)
Brachiaria brizantha					
CIAT 667	43	7	20	5.6	14
CIAT 6780	249	41	7	7.7	30
CIAT 16288	75	12	18	7.9	35
CIAT 16306	0	0	27	0	0
CIAT 16307	0	0	27	0	0
CIAT 16309	0	0	27	0	0
CIAT 16311	150	30	12	7.4	16
CIAT 16319	9	2	26	7.5	8
CIAT 16444	0	0	27	0	0
CIAT 16463	158	26	11	6.9	28
CIAT 16464	98	16	15	6	12
CIAT 16472	128	21	13	6.8	14
CIAT 16488	18	3	23	5.8	7
CIAT 16549	64	11	19	5.8	12
CIAT 16779	281	47	6	7	38
CIAT 16829	286	48	5	7.2	30
CIAT 16830	220	37	8	7.3	14
CIAT 26110	15	2	24	8.4	6
CIAT 26566	28	5	21	7.8	15
CIAT 6387	333	55	3	7.2	30
CIAT 16835	601	100	1	7.1	43
CIAT 16827	311	52	4	7.5	43
Brachiaria decumbens					
cv. Basilisk	19	3	22	43	93
CIAT 16497	168	28	10	6.4	23
CIAT 26112	178	30	9	5.6	25
CIAT 26297	86	14	16	9.8	18
Brazil	11	2	25	5.6	2
Brachiaria humidicola					
cv. Tully	0	0	27	-	0
CIAT 6133	84	14	17	4.9	34
Brachiaria jubata					
CIAT 26188	102	17	14	5.6	36
Brachiaria ruziziensis	*601*	*100*	*1*	*6.2*	*41*
LSD ($p < 0.05$)	171				

[1] Pure seed yield (%) relative to the *B. ruziziensis* control.

Seven accessions produced little or no seed (*B. brizantha* CIAT 16306, CIAT 16307, CIAT 16309, CIAT 16319, CIAT 16444, *B. humidicola* cv. Tully and *B. decumbens* Brazil). Of these, *B. brizantha* CIAT 16307, CIAT 16309, CIAT 16444, and *B. humidicola* cv. Tully showed good flowering but failed to set seed.

From these results, it appears that seed yield was related to flowering time. Accessions that flowered during severe moisture stress (June and July) produced low seed yields. The exception was *B. brizantha* CIAT 6387, which had a series of flowerings throughout the year. The highest seed yields were obtained from accessions which flowered in August, probably because of the better soil moisture conditions. Continuous soil moisture availability is one of the factors needed for high seed production in grasses (Loch, 1980).

Dry matter yields over a period of 114 days (27 Jan-22 May) were measured to assess forage production potential in the dry period. *B. decumbens* Brazil was the most productive accession, yielding 22.5 t dry matter/ha or 215% of the yield of the control (*B. ruziziensis*). *Brachiaria decumbens* CIAT 16497, CIAT 26112, and *B. brizantha* CIAT 16472 produced yields of about 20 t/ha, or about 200% of the yield of the control. The lowest yield was obtained from *B. brizantha* CIAT 26566 (3.2 t/ha).

Visual scoring for drought tolerance, conducted during the dry period, revealed that *B. decumbens* cv. Basilisk, CIAT 26112, and CIAT 26297 were the most tolerant, remaining green throughout much of the dry season (Table 4). Visual scoring for regrowth potential was conducted 7 days after cutting in January 1997 (Table 4). *B. decumbens* CIAT26297, CIAT 26112 and Brazil and *B. brizantha* CIAT16472 had the highest regrowth scores, with fast, dense regrowth after cutting. The regrowth scores of 22 accessions were superior to that of the control.

Conclusions

Based on seed production potential, seven *B. brizantha* (CIAT 16835, CIAT 6387, CIAT 16827, CIAT 16829, CIAT 16779, CIAT 6780 and CIAT 16830) and two *B. decumbens* accessions (CIAT 26112 and CIAT 16497) appear promising for northeast Thailand. In particular, *B. brizantha* CIAT 16835 equalled the seed yield of *B. ruziziensis*. The other accessions produced half or less of the pure seed yield of these two high-yielding accessions. However, not all of these accessions performed well in the dry season.

The highest yielding accession in the dry season was *B. decumbens* Brazil, but this accession produced almost no seed. The most promising accessions on the basis of both seed yields and dry season performance were:

B. brizantha CIAT 6387 (which produced 64% of dry matter of the highest yielding accession and 55% of the pure seed yield of *B. brizantha* CIAT 16835)
B. decumbens CIAT 26112 and CIAT 16497 (which both produced 88% of the dry matter yield of the highest yielding accession but produced only about 30% of the pure seed yield of *B. brizantha* CIAT 16835).

Further monitoring is needed on both seed production and forage production potential in the dry season. This trial will be continued in the 1998 season, with the addition of 19 more accessions. On-farm trials will start in 1998 using promising accessions from this trial, to gain early feedback from farmers about their potential.

Table 4. Drought tolerance, regrowth score, and dry matter yield over 114 days in the dry season of *Brachiaria* species.

Accession	Regrowth score[1]	Drought tolerance[1]	DM Yield t/ha	DM Yield Relative yield[2]	Rank
Brachiaria brizantha					
CIAT 667	2	4	11.4	51	11
CIAT 6780	2	4	10.3	46	14
CIAT 16288	4	4	9.1	40	18
CIAT 16306	4	2	14.0	62	9
CIAT 16307	1	2	8.6	38	19
CIAT 16309	2	1	8.4	37	20
CIAT 16311	3	3	8.3	37	21
CIAT 16319	2	1	7.4	33	22
CIAT 16444	1	3	3.4	15	26
CIAT 16463	2	3	12.1	54	10
CIAT 16464	1	4	14.8	66	6
CIAT 16472	5	4	20.5	91	2
CIAT 16488	3	3	11.5	51	13
CIAT 16549	1	3	6.7	30	23
CIAT 16779	1	2	9.4	42	16
CIAT 16829	3	4	9.2	41	17
CIAT 16830	1	4	5.8	26	24
CIAT 26110	2	2	11.1	49	12
CIAT 26566	1	4	3.2	14	27
CIAT 6387	3	4	14.5	64	7
CIAT 16835	3	3	9.2	41	17
CIAT 16827	4	3	4.7	21	25
Brachiaria decumbens					
cv. Basilisk	3	5	17.1	76	5
CIAT 16497	4	4	19.8	88	4
CIAT 26112	5	5	19.8	88	3
CIAT 26297	5	5	13.1	58	9
'Brazil'	5	4	22.5	100	1
Brachiaria humidicola					
cv. Tully	1	3	10.2	45	14
CIAT 6133	2	3	8.8	39	19
Brachiaria jubata					
CIAT 26188	2	4	14.2	63	8
Brachiaria ruziziensis	1	3	10.5	47	15
LSD (5%)			9.1		

1 Visual scores: 1 = very poor, 2 = poor, 3 = fair, 4 = good, 5 = excellent.
2 DM yield (%) relative to the highest yielding accession (*B. decumbens* Brazil).

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