for 8 years, the site at YNS under *P. plicatulum* pastures for 5 years, the site at SAC under paddy rice and the sites at UAC and YAC under a mixture of *P. plicatulum* and *Mimosa pudica*.

Soil tests were conducted on samples taken in May 1998, just prior to sowing the pastures. Annual rainfall was recorded as in Trial 1 for UBU, 100 m from the YNS site, 200 m from the SAC site and 15 km from the UAC site. No rainfall was recorded near the YAC site but, as it was only 15 km from the YNS site, data from this site were used.

Seven grasses (*P. plicatulum*, *P. atratum* cv. Ubon, *B. ruziziensis*, *B. decumbens* cv. Basilisk, *S. sphacelata* var. *splendida* cv. Splenda, *D. milanjiana* cv. Jarra and *P. maximum* cv. Purple) were sown at 12 kg/ha together with *S. guianensis* cv. Tha Phra (CIAT 184) at 6 kg/ha in a randomised block design with 4 replications. Each plot measured 5 × 5 m.

The species were hand broadcast into well cultivated seed beds at UBU on May 7, at YNS and YAC on May 13, at SAC on May 14 and at UAC on May 15, 1998 and the seed lightly surface raked into the soil. The plots were fertilised at sowing with N (20 kg/ha), K (25 kg/ha), P (10 kg/ha) and S (10 kg/ha).

Plant counts were made in four 0.25m^2 quadrats per plot, 6 weeks after sowing. Dry matter cuts were taken from four 0.25m^2 quadrats at 5 cm from ground level in each plot 3–4 times each wet season and 2–3 times each dry season.

Cattle grazed plots at UAC before sampling in October 1998, so, on October 27, 1998, all plots were trimmed to 5 cm above ground level and fertiliser applied. At YAC, the trial was terminated after sampling in September 1999 due to uncontrolled grazing and, at SAC and UAC, observations ceased in October 1999 following repeated cutting by village farmers. At other sites, the trial was terminated at the end of April 2000.

At each sampling, the samples were sorted into grass and Tha Phra styio and a 200 g subsample of each species was dried as in Trial 1. After each sampling, all plots were topped as described for Trial 1 and fertilised with the same amounts spread at sowing.

Trial 3 — Evaluation of legumes

This study was conducted at 3 sites (UBU, YNS and YAC) adjacent to Trial 2. Soil tests and rainfall were the same as in Trial 2.

Seven legumes (*Stylosanthes hamata* cv. Verano, *S. guianensis* cv. Tha Phra, *Centrosema pascuorum* cv. Cavalcade, *Calopogonium mucunoides*, *Macroptilium gracile* cv. Maldonado, *Pueraria phaseoloides* and *Aeschynomene americana* cv. Lee) were sown at 12 kg/ha in a randomised block design with 4 replications. Each plot measured 5 × 5 m.

The species were hand broadcast into well cultivated seed beds at UBU on May 7, and at YNS and YAC on May 13, 1998 and the seed lightly surface raked into the soil. The plots were fertilised at sowing with N (20 kg/ha), K (25 kg/ha), P (10 kg/ha) and S (10 kg/ha).

Plant counts were made in four 0.25m^2 quadrats per plot, 6 weeks after sowing. Dry matter cuts were taken from four 0.25m^2 quadrats at 5 cm from ground level in each plot on 3 occasions in the first wet season, twice in the first dry season, once at YNS and twice at UBU and YAC in the second wet season and once in the second dry season at UBU. No cuts were taken at YAC and YNS in the second dry season.

At each sampling, total fresh weight was recorded and a 200 g subsample was dried as in Trial 1. After each sampling, all plots were topped as described for Trial 1 and fertilised with K (25 kg/ha), P (10 kg/ha) and S (10 kg/ha).

Data from all trials were analysed using the IRRISTAT programme for conventional analyses of randomised block experiments.

Results

Soil

Soils at all sites were acid, with pH ranging from 4.6 at UAC to 5.6 at YAC (Table 1). The soils were low in N (0.02–0.07%), P (2–11 ppm; Bray II extraction method) and organic matter (0.2–1.4%). All soils contained more than 60% sand except for the soil at UAC which was 67% silt.

Rainfall

Average rainfall for all trial sites from 1997–1999 was similar, ranging between 1300–1600 mm, and most sites experienced good wet season rainfall (Table 2). The site at YNS was the only site to have an early season moisture deficit in 1997 and 1998.

Table 1. Soil analysis of trial sites.

Site[1]	pH (1:5 water)	Total N	P	OM	Sand	Silt
		(%)	(ppm)	(%)	(%)	(%)
UBU Trial 1	5.3	0.02	7.9	1.0	66	34
UBU Trials 2 & 3	5.3	0.02	9.5	1.1	64	35
MUK	5.2	0.02	5.0	1.2	69	30
DET	4.9	0.02	2.3	1.4	61	39
YNS	5.4	0.02	4.9	1.3	85	14
YAC	5.6	0.04	7.4	0.6	62	37
SAC	5.2	0.03	11.7	1.1	64	35
UAC	4.6	0.07	4.2	0.2	31	67

[1]UBU = Ubon Ratchathani University Farm; MUK = Mukdahan Animal Nutrition Station; DET = Village in Det Udom district of Ubon Ratchathani Province; YNS = Yasothon Animal Nutrition Station; YAC = Yasothon Agricultural Technology College Farm; SAC = Sisaket Agricultural Technology College Farm; UAC = Ubon Ratchathani Agricultural Technology College Farm.

Trial 1 — Evaluation of grasses sown with legumes

Grasses. Plant density of most grass species was good at 6 weeks after sowing (Table 3), except for signal at all sites and Purple guinea at MUK. Plant densities at DET were 2–3 times higher overall than those at UBU and MUK.

Plicatulum produced the most dry matter (13 t/ha) at all sites in the first wet season (Table 4) followed by Ubon paspalum at UBU and DET and Purple guinea and ruzi at MUK. Purple guinea produced significantly less dry matter than plicatulum and Ubon paspalum at UBU and DET. At all sites, yields of signal and Jarra digit were less than half that of plicatulum in the first wet season.

In the first dry season, signal produced high dry matter yields at UBU and MUK but not at DET, and first dry season production of Ubon paspalum was also high at all sites (Table 4).

In the second wet season, Purple guinea produced in excess of 33 t/ha DM at MUK followed by Ubon paspalum, Jarra digit and plicatulum which produced more than 20 t/ha DM (Table 4). At UBU, Purple guinea, Splenda setaria, ruzi, Ubon paspalum and signal also produced more than 20 t/ha DM in the second wet season. Ruzi and Jarra digit died out at the DET site in the second wet season and signal and Purple guinea produced very low yields.

In the second dry season at UBU, there were no significant differences in dry matter production between species but, at MUK and DET, Purple guinea and plicatulum, respectively, were the most productive grasses (Table 4).

Ubon paspalum, plicatulum, Purple guinea and Jarra digit produced the highest dry matter yields at both UBU and MUK in the third wet season (Table 4). Ubon paspalum, Splenda setaria and plicatulum produced the highest yields at DET in both the third wet and dry seasons. In the third dry season at MUK, Purple guinea produced over 12 t/ha DM, which was nearly 40% more than the second most productive grasses, Ubon paspalum and signal (Table 4).

Legumes. Plant density of all legumes 6 weeks after sowing was considerably less than that of the grasses except at MUK, where total legume numbers were generally greater than grass numbers (Table 3). Verano stylo and Cavalcade plant numbers were sparse at all sites.

In the first wet season, legumes at MUK produced 4–5 times more dry matter than legumes at UBU and DET (Table 4). Calopo was the main legume at MUK, growing from buried seed from the previous pasture (data for individual legumes not presented). Llanos macro also grew well in the first wet season at MUK and UBU. Lee jointvetch was the best producing legume at DET in the first wet season. However, by the third cut in October 1997, legumes at all sites were very sparse.

Legumes in all plots died out during the first dry season but grew again from fallen seed as a minor component in the swards in the early part of the second wet season (Table 4). The main legumes were Llanos macro, Calopo and Lee jointvetch at UBU, MUK and DET, respectively. Following the first cut in the second wet season, legumes died out at all sites and failed to reappear for the duration of the trial.

Table 2. Rainfall for the trial sites.

Month	Rainfall																	
	UBU[1]			UAC			YNS			MUK			DET			SAC		
	1997	1998	1999	1997	1998	1999	1997	1998	1999	1997	1998	1999	1997	1998	1999	1997	1998	1999
	(mm)																	
Jan	3	0	1	0	0	0	0	0	0	0	0	6	2	1	0	0	0	0
Feb	2	44	3	7	58	23	47	25	0	32	35	0	22	115	0	26	68	0
Mar	71	0	92	41	0	96	41	0	32	46	15	18	27	7	107	36	0	103
Apr	52	60	92	82	75	125	99	37	97	64	24	103	151	116	159	101	33	115
May	150	294	235	194	244	305	47	197	251	115	217	345	153	279	222	284	224	138
Jun	352	183	221	312	154	251	314	75	190	283	335	121	173	52	245	167	101	126
Jul	399	168	291	453	155	279	432	160	228	120	81	368	449	173	265	340	229	245
Aug	324	193	96	224	241	129	337	292	157	407	215	157	265	274	98	156	286	129
Sep	239	208	256	157	201	166	118	163	293	172	223	263	239	190	245	267	289	201
Oct	107	85	95	86	69	201	57	67	111	180	28	30	122	116	98	170	118	99
Nov	0	106	0	0	117	6	0	67	9	0	9	11	0	78	21	0	98	16
Dec	0	0	0	0	3	1	0	0	0	0	4	0	0	1	0	0	2	0
Total	1554	1341	1382	1556	1317	1582	1492	1083	1368	1423	1186	1422	1601	1402	1460	1547	1448	1172

[1]UBU = Ubon Ratchathani University Farm; UAC = Ubon Ratchathani Agricultural Technology College Farm; YNS = Yasothon Animal Nutrition Station; MUK = Mukdahan Animal Nutrition Station; DET = Village in Det Udom district of Ubon Ratchathani Province; SAC = Sisaket Agricultural Technology College Farm.

Table 3. Plant populations (6 weeks after sowing) in grass-legume swards at UBU, MUK and DET (Trial 1).

Treatment	Grass	Lee jointvetch	Verano stylo	Cavalcade	Llanos macro	Total legume
			(plant/m²)			
			UBU[1]			
Ruzi	52cde[2]	11abc	3a	7a	22ab	43ab
Signal	22e	7bc	2a	7a	4c	20b
Jarra digit	69bcd	13abc	3a	8a	9abc	33ab
Ubon paspalum	109a	14ab	3a	11a	22ab	50a
Plicatulum	98ab	9bc	2a	11a	24a	46a
Purple guinea	42de	21a	4a	8a	18abc	51a
Splenda setaria	89abc	3c	3a	7a	6bc	19b
			MUK[1]			
Ruzi	59cd	60a	10ab	8a	32b	110a
Signal	17d	68a	11ab	9a	39ab	127a
Jarra digit	41cd	52a	8ab	8a	30b	98a
Ubon paspalum	140b	41a	10ab	5a	32b	88a
Plicatulum	245a	50a	11a	4a	54a	119a
Purple guinea	6d	48a	5ab	7a	33b	93a
Splenda setaria	111bc	66a	4b	9a	41ab	120a
			DET[1]			
Ruzi	112de	53a	9a	11a	18a	91a
Signal	28e	64a	7a	9a	21a	101a
Jarra digit	219cd	67a	9a	11a	19a	106a
Ubon paspalum	346bc	72a	10a	9a	17a	108a
Plicatulum	587a	66a	6a	11a	19a	102a
Purple guinea	169de	50a	7a	9a	17a	93a
Splenda setaria	455ab	63a	7a	9a	19a	98a

[1]UBU = Ubon Ratchathani University Farm; MUK = Mukdahan Animal Nutrition Station; DET = Village in Det Udom district of Ubon Ratchathani Province.
[2]Within columns and sites means followed by a common letter are not significantly different at P=0.05 by Duncan's Multiple Range Test.

Trial 2 — Evaluation of grasses sown with Tha Phra stylo

Plant populations of Ubon paspalum, plicatulum and Splenda setaria at 6 weeks after sowing exceeded 200 plants/m² at UBU, YNS and UAC and 100 plants/m² at YAC and SAC (Table 5). Density of signal, Jarra digit and Purple guinea was lower at 19–85 plants/m². The average densities of Tha Phra stylo at UBU and UAC (135 and 173 plants/m²) were higher than those at the other sites (71 plants/m²).

In the first wet season, Ubon paspalum and plicatulum tended to produce the most dry matter at all sites (Table 6). However, there were few significant differences in dry matter production between most species. Signal and Jarra digit were the least productive species at all sites. Dry matter production at SAC was affected by severe waterlogging from August–October. Tha Phra stylo was generally sparse in the productive grass swards in the first wet season at UBU, YNS and YAC, contributing less than 5% of total dry matter (Table 6). At SAC and UAC, where grass production was lower than at the other sites, Tha Phra stylo represented a higher percentage of total dry matter.

In the first dry season, Ubon paspalum and plicatulum produced high dry matter yields at all sites (Table 7) followed by signal, Purple guinea and Splenda setaria. Jarra digit was the least productive species at all sites. In most plots, Tha Phra stylo contributed about 5% of total sward dry matter yields in the first dry season but in some plots it died out (Table 7).

In the second wet season, all grass species produced well at UBU, with mean yield exceeding 16 t/ha DM (Table 8). Ubon paspalum, plicatulum and Purple guinea produced equally high yields at YNS and YAC. At UAC, Purple guinea produced nearly 7 t/ha DM more than Ubon paspalum and