Research note: Evaluation of introduced forage accessions for fodder production at a subhumid site in southern Ghana

P. BARNES AND A. ADDO-KWAFO
Animal Research Institute, C.S.I.R, Achimota, Ghana

Abstract

A number of herbaceous legumes, shrub legumes and grasses developed by CIAT, Colombia were evaluated for dry matter yields at 3-week and 6-week cutting intervals in the wet and dry seasons, respectively, at a subhumid site in southern Ghana.

In the herbaceous legumes, there were high dry matter yields in both seasons in *Centrosema acutifolium, Centrosema macrocarpum, Centrosema pubescens, Stylosanthes capitata* and *Stylosanthes guianensis* with the highest wet season yields greater than 2 t/ha DM.

Cajanus cajan (pigeon pea) showed very high dry matter yields in both wet and dry seasons with yields exceeding 6 t/ha in the dry season.

Brachiaria brizantha cvv. La Libertad and Marandu and *Panicum maximum* accessions CIAT 673 and T58 were the best entries in herbage productivity in two seasons yielding in excess of 3 t/ha.

The highest yielding accessions in the three forage categories will be evaluated further in large plots.

Introduction

Screening of forage accessions developed by CSIRO Tropical Crops and Pastures (Australia) over the years in Ghana has resulted in the selection of a number of species adapted to lowland tropical conditions (Adjei and Fianu 1985; Barnes 1985). Consequently, these selected species and many productive indigenous forage species like *Panicum maximum, Cynodon nlemfuiensis* and *Andropogon gayanus* are cultivated for pastures and fodders on large livestock farms in southern Ghana.

There is still scope to identify pasture species suitable for conditions in subhumid transitional and coastal savanna zones in southern Ghana. For that reason, a suite of pasture species developed at CIAT (Centro Internacional de Agricultura Tropical), Cali, Colombia, was evaluated at a typical subhumid site in southern Ghana to identify adapted and productive accessions for recommendation for forage and fodder production for livestock.

Correspondence: Mr P. Barnes, Animal Research Institute, Council for Scientific and Industrial Research, P O Box 20, Achimota, Ghana

Materials and methods

The study was conducted at Pokoase, a substation of the Animal Research Institute of Ghana (5° 58′N, 0° 18′W; altitude 153 m). Tests conducted on samples from the top 15 cm of soil at the trial site showed the following — pH 5.8–6.4; 2 ppm P (Bray II extraction); 0.025%N; and 1.4% organic matter. Mean annual rainfall is 980 mm but figures for 1991, 1992 and 1993 were 765, 649 and 762 mm, respectively.

The trial was sown on August 22, 1991 on cultivated plots in a split-plot design with 3 replications. Herbaceous legumes, grasses and shrub legumes (Tables 2, 3 and 4, respectively) were established separately and formed the main plots and different regrowth periods formed the subplots. Main plots measured 5.0 m × 2.5 m each and contained four 5-m rows of plants with inter-row spacing of 0.5 m. Grasses and herbaceous legumes were sown in free-flowing drills, whereas shrubs were sown in spots 50 cm apart. Sample areas on plots comprised 4.0 m^2 and involved the 2 internal rows. The initial studies on plant establishment and primary growth were concluded on February 24, 1992 and are not reported in the present paper.

The maximum precipitation period (wet season) and minimum precipitation period (dry season) measurements were carried out between June 9–September 2, 1992 and between December 1, 1992–February 23, 1993, respectively. The sample area on each plot was subdivided into four 1 m^2 subplots which were sampled once at the end of 3,6,9 and 12 weeks regrowth in the wet season and at the end of 6 and 12 weeks regrowth in the dry season. Standardisation cuts (6–10 cm high for prostrate grasses and herbaceous legumes; 10–20 cm high for erect grasses and herbaceous legumes; and 30 cm high for shrub legumes) were carried out on June 9 for wet season measurements, and December 1, 1992 for dry season measurements. For the regrowth measurements, the same cutting heights were used. Dry matter concentrations were determined by drying subsamples of fresh material at 60°C for 48 hours.

Results

The rainfall data for the period of the evaluation are shown in Table 1. The total rainfall for 1991 was 765 mm and that for 1992 was 649 mm. The rainfall data in early 1993 show that the dry season witnessed some effective rainfall amounts.

Table 1. Rainfall totals (mm) and raindays for 1991, 1992 and 1993 at Pokoase, site of the trial. (Raindays in parenthesis.)

Month	Year		
	1991	1992	1993
January	3 (2)	0	8 (1)
February	4 (1)	0	40 (3)
March	21 (3)	33 (3)	37 (5)
April	110 (7)	3 (4)	59 (5)
May	51 (14)	123 (4)	47 (4)
June	155 (10)	31 (5)	173 (5)
July	252 (9)	29 (8)	34 (2)
August	38 (7)	7 (3)	47 (6)
September	23 (5)	183 (7)	78 (10)
October	50 (5)	67 (10)	95 (5)
November	28 (5)	129 (7)	95 (5)
December	5 (2)	17 (1)	190 (5)
Total	765 (71)	649 (52)	762 (56)

The dry matter herbage yield for the herbaceous legume entries at the different regrowth periods in the wet and dry seasons are shown in Table 2. *Desmodium ovalifolium* had the highest yields at 3 and 6 weeks. Other herbaceous legumes which produced high herbage yields were the *Centrosema macrocarpum, C. acutifolium* and *Stylosanthes guianensis* varieties. *Arachis pintoi, Cassia rotundifolia* and *Zornia glabra* produced low dry matter yields in the wet season but generally improved in yields in the dry season.

Overall, most entries yielded well in the dry season with yields being higher than for comparative regrowth periods in the wet season. Of all herbaceous legumes, the best performers in the dry season were the two *Centrosema macrocarpum* varieties, *Stylosanthes guianensis* var. *pauciflora* and *Centrosema pubescens.*

Table 3 presents dry matter herbage yields of grass entries at the different regrowth periods in the wet and dry seasons. As for the herbaceous legumes, dry matter yields of the grasses increased as the regrowth period increased. There were few significant differences in dry matter yields between entries, the only ones being during the first 9 weeks of the wet season regrowth.

Table 4 shows the dry matter yields of the shrub legumes. All entries performed well with the highest yields from *Cajanus cajan.*

Discussion

In almost all entries in the study, dry matter yields increased as regrowth period lengthened and dry matter yields in the dry season were higher than in the wet season. This may be a function of the many rainfall occasions in the dry season in 1992–1993 (December–February) when many entries were well established, a year after the trial was planted.

High herbage yields in the *Centrosema macrocarpum* varieties, the *Centrosema acutifolium* varieties, *Centrosema pubescens,* the *Stylosanthes guianensis* varieties and *Stylosanthes hamata* (147) make them eligible for evaluation in terms of persistence, quality and animal production. Evaluation of *Centrosema* species at CIAT, Colombia revealed that *C. macrocarpum* cultivars produced high dry matter yields and

Table 2. Dry matter herbage yield (kg/ha) of herbaceous legume entries at different regrowth periods in the wet and dry seasons.

Entries	Wet season				Dry season	
	3 wk	6 wk	9 wk	12 wk	6 wk	12 wk
Aeschynomene histrix (9690)	117	402	771	1354	485	810
Arachis pintoi (17434)	113	297	573	577	553	1163
Cassia rotundifolia (Wynn)	103	274	761	790	1105	1145
Centrosema acutifolium (Vichada)	207	510	869	1309	1230	1613
Centrosema acutifolium 5568	207	493	851	1221	1180	1600
Centrosema brasilianum (5234)	260	581	908	1141	1227	1540
Centrosema macrocarpum (5452)	183	683	1159	1420	1563	2830
Centrosema macrocarpum (5713)	267	607	1405	1878	2100	2353
Centrosema pascuorum (Cavalcade)	220	377	931	1195	625	540
Centrosema pubescens (5172)	310	341	815	1675	2010	1540
Desmodium ovalifolium (13089)	428	789	1110	1398	1353	1050
Stylosanthes capitata (Capica)	277	369	1122	1661	755	1950
Stylosanthes guianensis (Pucallpa)	243	529	1315	2009	610	1653
Stylosanthes guianensis (pauciflora)	273	592	1185	1985	2023	3317
Stylosanthes hamata (Verano)	240	276	681	700	1117	1540
Stylosanthes hamata (147)	137	368	1282	1839	1303	1360
Stylosanthes macrocephala (1281)	205	412	680	920	—	—
Stylosanthes sympodialis (1044)	127	291	670	1193	997	917
Zornia glabra (8279)	147	183	655	903	1187	1387
Zornia latifolia (728)	370	378	771	1041	970	930
Mean	223	438	926	1310	1179	1539
LSD (P < 0.05)	182.9	258.7	311.9	600.4	673.7	656.4

Table 3. Dry matter herbage yield (kg/ha) of grass entries at different regrowth periods in the wet and dry seasons.

Entries	Wet season				Dry season	
	3 wk	6 wk	9 wk	12 wk	6 wk	12 wk
Andropogon gayanus (Carimagua)	277	676ab[1]	762d	953	2523	1880
Brachiaria brizantha (La Libertad)	573	903a	1972a	3526	2177	3727
Brachiaria brizantha (Marandu)	440	669ab	1255bcd	3036	2120	4130
Brachiaria decumbens (Basilisk)	373	632ab	1261bcd	1725	1230	3187
Brachiaria dictyoneura (Llanero)	370	500ab	1622ab	2468	1985	2375
Brachiaria humidicola (6379)	373	236b	875cd	1672	1810	2320
Panicum maximum (673)	573	864a	865cd	2301	1693	2650
Panicum maximum (T58)	287	600ab	1431abc	2125	1040	2353
Mean	408	635	1256	2226	1822	2828
LSD (P < 0.05)	296.2	565.4	594.7	n.s.	n.s.	n.s.

[1]Within regrowth periods, means followed by the same letter do not differ significantly (P > 0.05).

Table 4. Dry matter herbage yields (kg/ha) of shrub legume entries at different regrowth periods in the wet and dry seasons.

Entries	Wet season				Dry season	
	3 wk	6 wk	9 wk	12 wk	6 wk	12 wk
Cajanus cajan (18700)	287	855	2031a[1]	3938a	3350	6907a
Cratylia argentea (18516)	167	852	1261abc	1880bc	2047	4897ab
Codariocalyx gyroides (3001)	230	661	996e	1550c	2400	3017b
Flemingia macrophylla (17403)	303	490	1237bc	1830bc	1837	2927b
Leucaena leucocephala (17502)	393	765	1866ab	2502b	1713	2000b
Mean	276	725	1478	2340	2269	3949
LSD (P = 0.05)	204.7	n.s.	783.8	806.4	n.s.	2982.3

[1]Within regrowth periods, means followed by the same letter do not differ significantly (P > 0.05).

were also highly palatable and resistant to drought and major leaf diseases affecting most other species of the genus (Grof 1986). Our findings support this observation. In an evaluation of 6 herbaceous legumes for fodder bank development in northern Nigeria, *Stylosanthes guianensis* cultivars produced the highest dry matter yields (Peters *et al.* 1994), in line with the findings in the present study.

Among the grasses evaluated, *Brachiaria brizantha* varieties, *Brachiaria decumbens* and *Panicum maximum* varieties showed the highest dry matter yields. Heering (1989) found that, among a number of *Brachiaria* species evaluated in Zwai, Ethiopia, it was accessions of *B. decumbens, B. ruziziensis* and *B. brizantha* which performed the best. This finding agrees with the result in the present study.

Cajanus cajan and *Leucaena leucocephala* were the most outstanding forage shrubs in herbage production in the study. In a study involving the effect of cutting intervals on herbage yields of some legumes in the coastal savanna of Ghana, *Aeschynomene americana* and *Cajanus cajan* produced the highest dry matter yield among the legumes evaluated, which included *Stylosanthes humilis, Macroptilium lathyroides, M. atropurpureum, Centrosema pubescens* and *Desmodium intortum* (Adjei and Fianu 1985). This finding confirms our results.

The species and cultivars with highest herbage yields have now been subjected to intensive seed multiplication and multi-site testing for eventual selection of a broad range of pasture species and cultivars for cultivation in different areas of the country.

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