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EVALUATION OF FORAGE LEGUMES IN THE SEMI-ARID REGION OF EASTERN KENYA. I. ESTABLISHMENT, VISUAL BULK RATING, INSECTS PESTS AND DISEASES INCIDENCES OF A RANGE OF FORAGE LEGUMES

[EVALUACIÓN DE LEGUMINOSAS FORRAJERAS EN LA REGIÓN SEMI-ARIDA ORIENTAL DE KENYA. I. ESTABLECIMIENTO, CLASIFICACIÓN E INCIDENCIA DE PLAGAS Y ENFERMEDADES]

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SUMMARY

A total of 155 accessions of forage legumes from 23 genera were evaluated for adaptability at 3 sites; Katumani (1°58'S, 37°28'E), Kiboko (2°28'S, 37°83'E) and Ithookwe (1°37'S, 28°02'E) in the semi-arid mid-altitude region of eastern Kenya. A series of 3 experiments were carried out at Katumani while at Kiboko and Ithookwe one experiment was conducted at each site. The evaluation was conducted in double rows of 2 m long for each accession consisting of fertilized and unfertilized rows. The plant population, accumulated herbage growth i.e. visual bulk rating (VBR) and insects pests and diseases incidences were monitored at monthly interval for a period of 2 wet and 2 dry seasons. Generally majority of the legumes established well, but the *Stylosanthes* genus was superior to the other genera and had highest number of accessions with high plant population (at least 10 plants per 2 m row) across all sites. In Experiment 1, at Katumani, there were 19 accessions of *Stylosanthes* out of the 31 accessions that achieved 10 plants per 2 metres planting row while at Kiboko, 20 out of 37 accessions that achieved 10 plants per 2 m row met this criteria. The other genus that showed high plant survival was *Cassia* followed by a few species in the *Macrotyloma* and *Rhynchosia* genera while the genus *Macroptilium* was restricted to Ithookwe. Only a limited number of species failed to establish in each site. Three different maturity groups were identified, short lived annuals (SLA) (33 accessions), long lived annuals (LLA) (34 accessions) and perennials (88 accessions). There were differences between the maturity groups in the VBR. The SLA had a high VBR at early stages of growth and declined as they matured at the end of wet season; the LLA had their highest VBR at mid of the 2 rainy seasons while the perennials achieved their highest VBR during the second wet season. Majority of the legumes with high VBR (≥2.5) were in the genus *Stylosanthes* at Katumani and Kiboko while at Ithookwe the *Macroptilium* had the highest VBR. Of the highly rated legumes, only *Macrotyloma sp*. (Acnno 129) and *Vigna unguiculata* (Accno 80) were SLA. Generally plant population and VBR were better at the relatively wetter sites of Katumani and Ithookwe than at less wetter site of Kiboko. Insect pests and diseases were not particularly important except for a few species in the *Lablab* and *Vigna* genera which had high damage indices. The insect damage indices for the genus *Lablab* ranged from 24 - 52 and for the *Vigna* it was 25-36 across all sites. *Lablab purpureus* cv. Rongai and *V. unguiculata* (CPI 60452) were the most widely affected by diseases and had indices of between 20 - 29 and 20 - 75 respectively. It is recommended that further evaluation is required for the adapted legumes to assess their herbage production and identify the specific benefits these legumes can contribute in the local farming system. For *Lablab* and *Vigna* which are widely grown by the small scale farmers in this region for grain, the extent of damage by pest and disease need to be investigated.

Key words: Forage legumes, accessions, plant survival, visual bulk rating, maturity, short lived annuals, long lived annuals, perennials, insect damage index, and disease damage index.

RESUMEN

Se evaluó la adaptabilidad de 155 accesiones de leguminosas forrajeras pertenecientes a 23 generos en 3 sitios; Katumani (1°58'S, 37°28'E), Kiboko (2°28'S, 37°83'E) e Ithookwe (1°37'S, 28°02'E) la región semiárida de altitud media de la zona oriental de Kenya. Se realizaron 3 experiementos en Katumani, mientras que en Kiboko e Ithookwe se realizó un sólo experimento. La evaluación se realizó en hileras dobles de 2m de longitud para cada accesión (con y sin fertilización). Se evaluó cada mes el número de plantas, el crecimiento acumulado (VBR) y la incidencia de plagas y enfermedades durante dos períodos de secas y lluvias. En general, la mayoría de las leguminosas se establecieron bien, pero el género *Stylosanthes* fue superior en todas las localidades, teniendo el mayor número de accesiones con una alta densidad (al menos 10 plantas por cada 2m). En el Experimento 1, en Katumani, 19 de 31 accesiones de *Stylosanthes* obtuvieron 10 plantas / 2m hilera, mientras que en Kiboko fueron 20 de 37 accesiones. El género *Cassia* mostró también una alta subrevivencia seguido por algunas especis de *Macrotyloma* y *Rhynchosia*, mientras que el género *Macroptilium* fue restringido a Ithookwe. Sólo un limitado número de especies no pudo establecerse exitosamente en cada sitio. Se identificaron tres grupos de madurez, anuales de vida corta (SLA) (33 accesiones), anuales de vida larga (LLA) (34 accesiones) y perenes (88 accesiones). Hubo diferencias entre los grupos de madurez para el VBR. El grupo SLA tuvo un VBR alto en las etapas tempranas de crecimiento, declinando conforme maduraban al final de la estación lluviosa; el grupo LLA tuvo su máximo VBR a la mitad de las 2 épocas lluviosas, mientras que las perenes lograron su mayor VBR durante la segunda estación lluviosa. La mayoría de las leguminosas con una alta calificación de VBR (≥2.5) fueron del género *Stylosanthes* en Katumani y Kiboko, mientras que en Ithookwe el género *Macroptilium* tuvo el mayor VBR. Las leguminosas con mejores calificaciones, sólo *Macrotyloma sp*. (accnno 129) y *Vigna unguiculata* (accno 80) fueron del grupo SLA. En general, densidad y VBR fueron mejor en sitos relativamente más húmedos de Katumani e Ithookwe. Plagas y enfermedades no fueron de particular importancia excepto para algunas especies el género *Lablab* y *Vigna* con altos índices de daño. Los índices de daño fueron dee 24 a 52 para el género *Lablab* y de 25 a 36 para *Vigna*. *Lablab purpureus* cv. Rongai y *V. unguiculata* (CPI 60452) fueron lase species má afectadas por enfermedades con indices entre 20 - 29 y 20 - 75 respectivamente. Se recomienda continuar con las evaluaciones de las especies adaptadas para estimar su producción de biomasa e identificar las beneficios específicos que estas especies de leguminosas pueden proporcionar en los sistemas agrícolas locales. En el caso de *Lablab* y *Vigna* especies ampliamente cultivadas por los pequeños agricultures del region, es necesario investigar la magnitud del efecto de las plagas y enfermedades.

Palabras clave: Leguminosas forrajeras, accesiones, sobrevivencia, calificación visual, madurez, anuales de vida corta, anuales de vida larga, perenes, índice de daño por insecto, índice de daño por enfermedades.

INTRODUCTION

The semi-arid region covers about 14 % (8,115,679 ha) of the total land mass of Kenya (KARI 2001). Annual rainfall in the eastern region of Kenya is usually low (500-800 mm) and erratic with two distinct wet and two dry seasons (Kusewa 1985). This makes mixed farming (crop and animal production) in the semi-arid environments a risky enterprise (Rukandema 1984).

Rapid increase in population densities, continuous cultivation, cereal cropping and overgrazing in the semi-arid eastern Kenya, have resulted to depletion of soil fertility and severe soil erosion (Muhammad 1993). These together with low inputs for production have resulted to low crop yields and poor pastures. There is need therefore to explore other alternatives for improving pasture productivity and enhance soil fertility. Although nitrogenous fertilizers can replenish soil nutrients and meet crop requirements they are too expensive for the low income small-scale farmers (Njarui 1990).

Forage legumes have shown numerous potential in other parts of the world and can be used to improve soil fertility as well as improve the quality and quantity of animal feed in this region if legumes well adapted to this environment are identified. Benefits of forage legumes in ley farming have been mentioned by Jones *et al*. (1991) in semi-arid tropics of Australia. They have the potential to contribute large amount of nitrogen to the farming systems (Mohamed-Saleem *et al*. 1986) and legumes are of high quality to cattle (Abdulrazak *et al*. 2000). Lablab (*Lablab purpureus*) cv. Rongai (forage type) produced upto 3.9 t/ha of biomass when grown in a moderately eroded grazed land in Kitui, eastern Kenya (Gichangi *et al*. 1990). Nnadi and Hague (1986) reported higher fodder potential yield from intercropping forage legumes than cereal alone in the sub-Sahara Africa.

During 1957 to 1962, Sands *et al*. (1970) tested a number of grasses and forage legumes at Katumani and Baringo for adaptability to the semi-arid regions of Kenya. However, they found no legume that could be relied upon to persist either in pure stand or when in association with a grass. This was because the majority of the legumes they evaluated are from temperate regions. Since 1974 a lot of work has been conducted on forage legumes collection and evaluation at several locations in Kenya including Kitale, Katumani, Kiboko and Mtwapa involving both the native lines and new accessions from overseas (Wilton 1976; Ibrahim 1981). However much of the data obtained during this period is unpublished or is semi-quantitative. It was therefore necessary to evaluate a wide range of new materials that were available through collections and introductions from other countries.

A Kenya Agricultural Research Institute (KARI) and Australian Centre for International Agricultural Research (ACIAR) collaborative project was commenced in 1985 to concentrate on search for species of forage legumes that are adapted to the semi-arid region of eastern Kenya. Introduced legume accessions of world-wide collections from CSIRO, (Commonwealth Scientific and Industrial Research Organisation, Australia) Division of Tropical Crops and Pastures, Brisbane, Australia were evaluated. Several cultivars were introduced in the evaluation to be used as standard for comparison with other accessions. Also legume lines native to Kenya were included in the evaluation.

Selection for adaptability was based on ability of plant to survive environmental stress and attain a large proportion of herbage. The incidence of insect pests and diseases damage were also recorded. The objective of the experiments was to investigate the adaptation and performance of 155 accessions of forage legumes to 3 tropical environments in semi-arid Kenya

MATERIALS AND METHODS

Sites

The study was conducted at 3 sites (Katumani, Kiboko and Ithookwe) of different climatic conditions located in the semi-arid mid-altitude eastern Kenya. The sites descriptions are given in Table 1. The elevation ranges from 975-1600 m above sea level with mean annual rainfall of between 595-1080 mm. The rainfall is bimodal, the long rains occurs from March to May and the short rains are from October to December with peak in April and November respectively. There are two distinct dry seasons, the long dry season is from June to September and a short dry spell in January to February. The soils are generally low in nitrogen and phosphorus (Okalebo *et al.* 1992).

Table 1. Description of location, elevation, temperature, rainfall and soils for the 3 experimental sites, Katuamni, Kiboko and Ithookwe.

Site	Katumani	Kiboko	Ithookwe
Latitude	1° 58'S	2° 28'S	1° 37'S
Longitude	37° 28'E	37° 83'E	38° 02'E
Altitude (masl)	1600	975	1160
Mean temperature (°C)	19.6	25.7	22.5
Mean annual rainfall (mm)	717	595	1080
Soil type	chromic luvisol	rhodic ferasol	red sandy earth
Soil pH	6.5	5.8	5.8

Design and treatments

A total of 155 accessions of forage legumes from 23 genera were evaluated. Details of species, Commonwealth and Kenya introductions numbers and the sites where each species was evaluated are given in Table 2. A series of 3 experiments were carried out in Katumani while in Kiboko and Ithookwe one experiment was conducted at each site. In Experiment 1 at Katumani, 104 accessions were screened while in Experiment 2 and 3, 60 and 58 accessions were evaluated respectively. At Kiboko and Ithookwe 104 and 53 accessions were evaluated. At Katumani sowing was carried out in October, 1985, April 1986 and November, 1986. At Kiboko, sowing was carried out in November, 1985 while at Ithookwe sowing was carried out in November 1986. Accessions were planted in double rows, each 2 m long, at 1.5 m apart with 3 replicates in a randomised complete block design. One of each pair of rows received a single dressing of basal fertilizer while the other row was unfertilized. Approximately 50% of the seed sown for the hard-seeded accessions were gently mechanically scarified with sand paper or scalpel to break the seed coat where necessary, thus facilitating water uptake. After scarification, the seeds were sampled for germination testing prior to sowing and found to satisfy minimum standard for germination and purity. The seeds were then inoculated with appropriate *Rhizobium* strains listed in Table 2, in a Gum Arabica/distilled water solution before planting.

Land preparation was minimal except for Ithookwe where the grass and shrub vegetation was cut back and the land ploughed and harrowed prior to planting. In the other sites the grass and shrub vegetation was cut back and burned off. A small chisel plough attached to a 2-wheel Honda mini-tractor marked a 4 cm deep furrow along each planting row.

The furrows were dusted with Aldrin 2.5% at a rate of 20 kg/ha to prevent harvester ants from taking the seed away. The seed were hand drilled in each furrow and then covered with a small layer of soil depending on seed size. Different seed rates were used for each accession, and was usually adjusted basing on the germination test to produce at least20 seedlings per row.

Approximately after one week of seedling emergence, a basal fertilizer was broadcasted evenly in a 60 cm wide strip along one of the row for each entry. The rates used were equivalent to 200, 41.7, 250, 15, 10, 10, 10 and 0.36 kg/ha of triple superphosphate, muriate of potash, dolomite, manganese sulphate, borax, zinc sulphate, copper sulphate, and sodium molybdate respectively. Before emergence of legumes from the ground or 2 days after planting, Roundup herbicide was sprayed at a rate of 2 litres/ha in a band, 30 cm on either side of the row to control weeds. The subsequent weeding was done by hand. Weeds which grew in the remaining 90 cm between the rows were mown once or twice each season to reduce competition with the legumes.

Table 2. Forage legume species sown at Katumani, Kiboko and Ithookwe, their origin, *Rhizobium* strains used for inoculation and maturity types.

Legume species	CPI[1]	K[2]	Accn. No.[3]	Origin	Site[4]	*Rhizobium* strain[5]	MG[6]
Aeschynomene americana	91145	19712	131	Mexico	1	CB 756	1
Aeschynomene americana	cv. Glenn	19897	134	Mexico	1,3	CB 756	1
Aeschynomene elegans	37552	19714	132	Argentina	1	CB 756	1
Aeschynomene falcata	cv. Bargoo	19715	133	Paraguay	1,3	CB 756	2
Aeschynomene villosa	37235	19716	135	Mexico	1	CB 756	1
Aeschynomene villosa	91113	19720	136	Mexico	1	CB 756	1
Alysicarpus glumaceus	52366	14449	54	Madagascar	1,2	CB 278	2
Alysicarpus hamosus	94491	14374	13	Oman	1,2	CB 278	2
Alysicarpus longifolius	94490	14376	93	Oman	1,2	CB 278	2
Alysicarpus monilifer	52343	14377	5	Madagascar	1,2	CB 278	2
Alysicarpus rugosus	52351	14384	82	Malawi	1,2,3	CB 278	2
Alysicarpus rugosus	94489	14395	22	Ethiopia	1,2	CB 278	2
Alysicarpus rugosus	-	(50)	50	Kenya	1,2	CB 278	2
Alysicarpus vaginalis	34149	14386	63	Nicaragua	1,2,3	CB 278	2
Arachis monticola	CQ990	14388	108	-	1	CB 756	1
Arachis pintoi	58113	14416	109	Brazil	1	CB 3036	1
Cassia pilosa	57503	14451	87	Venezuela	1,2,3	CB 1483	2
Cassia rotundifolia	86172	19724	137	Mexico	1	CB 1483	2
Cassia rotundifolia	86178	19725	138	Mexico	1	CB 1483	2
Cassia rotundifolia	Q10057	14450	7	Brazil	1	CB 1483	2
Cassia rotundifolia	cv. Wynn	18177	17	-	1,2,3,3	CB 1483	2
Centrosema acutifolium	92874	14391	20	Brazil	1,2	CB 1923	1
Centrosema acutifolium	94303	14390	105	Colombia	1	CB 1923	1
Centrosema brasilianum	55698	14417	91	Brazil	1,2,3	CB 1923	1
Centrosema macrocarpum aff	78358	20170	160	Brazil	3	CB 1923	1

Legume species	CPI[1]	K[2]	Accn. No.[3]	Origin	Site[4]	*Rhizobium* strain[5]	MG[6]
Centrosema pascuorum	65950	14392	37	Equador	1,2,3	CB 1923	1
Centrosema pascuorum	cv. Cavalcade	14418	42	-	1,2,3	CB 1923	1
Centrosema plumieri	60477	14393	24	Brazil	1,2	CB 1923	1
Centrosema plumieri	82269	14394	46	Cuba	1,2	CB 1923	1
Centrosema pubescens	46543	19395	103	Guatemala	1,2	CB 1923	3
Centrosema pubescens	58575	20172	158	Colombia	3	CB 1923	3
Centrosema pubescens	63895	14396	89	Brazil	1,2,3	CB 1923	3
Centrosema pubescens	92721	14397	118	Colombia	3	CB 1923	3
Centrosema pubescens	cv. Belalto	14332	1	-	1,2	CB 1923	3
Centrosema pubescens	43147x58575	-	161	-	3	CB 1923	3
Centrosema pubescens	cv. Centro	14419	47	-	1,2	CB 1923	3
Centrosema schottii	82271	14445	43	Cuba	1,2	CB 1923	2
Centrosema virginianum	CQ2748	14399	66	-	1,2,3	CB 1923	2
Centrosema virginianum	91142	14400	38	Mexico	1,2,3	CB 1923	2
Clitoria ternatea	48337	14403	16	Tanzania	1,2,3	CB 930	3
Desmanthus virgatus	40071	14456	10	Brazil	1,2,3	CB 3058	3
Desmanthus virgatus	55719	14407	96	Venezuela	1,2	CB 3058	3
Desmanthus virgatus	65947	14405	84	Equador	1,2	CB 3058	3
Desmanthus virgatus	78373	14408	75	Argentina	1,2	CB 3058	3
Desmanthus virgatus	83570	14409	58	Brazil	1,2,3	CB 3058	3
Desmanthus virgatus	84508	14410	86	Mexico	1,2	CB 3058	3
Desmanthus virgatus	58178	14411	12	Mexico	1,2	CB 3058	3
Desmanthus virgatus	90750	14412	27	Mexico	1,2	CB 3058	3
Desmanthus virgatus	91146	14413	31	Mexico	1,2	CB 3058	3
Desmanthus virgatus	91326	14414	51	Mexico	1,2,3	CB 3058	3
Desmanthus virgatus	92818	14415	90	Belize	1,2,3	CB 3058	3
Desmanthus dichototum	47186	-	100	-	1,2	CB 3058	3
Desmodium intortum	cv. Greenleaf	14455	4	-	1,2,3	CB 627	3
Desmodium intortum	91135	14338	18	Mexico	1,2	CB 627	3
Desmodium pringlei	37232	14334	77	Mexico	1,2	CB 627	3
Desmodium prostratum aff	91232	14336	56	Mexico	1,2	CB 627	3
Desmodium setigeruam	52431	14340	61	Malawi	1,2	CB 627	3
Desmodium subsericeum	78402	14335	70	Argentina	1,2	CB 627	3
Desmodium wigginsii	990418	14337	64	U.S.A	1,2	CB 627	3
Desmodium sp. D	91186	14453	106	Mexico	1	CB 627	3
Desmodium sp. D	91212	14333	48	Mexico	1,2	CB 627	3
Dolichos sp.	24973	14452	101	Zimbabwe	1,2	CB 1024	2
Dolichos sericeus aff	-	(128)	128	Kenya	1,3	CB 1024	2
Lablab purpureus	30702	14466	110	Burma	1	CB 1024	2
Lablab purpureus	41222	14341	3	Burma	1,2	CB 1024	2
Lablab purpureus	cv. Highworth	14463	29	-	1,2	CB 1024	2
Lablab purpureus	cv. Rongai	14420	98	Kenya	1,2,3	CB 1024	2
Lespedeza striata	cv. Kaloe	19899	140	U.S.A.	1,3	CB 756	2
Lotononis angolensis	62202	14435	9	-	1,2,3	CB 1323	3
Lotononis bainesii	cv. Miles	14421	71	-	1,2,3	CB 376	3
Macroptilium atropurpureum	84989	14343	111	Mexico	1,3	CB 756	3
Macroptilium atropurpureum	84999	14344	68	Mexico	1,2	CB 756	3
Macroptilium atropurpureum	90748	14468	112	Mexico	1,3	CB 756	3

Legume species	CPI[1]	K[2]	Accn. No.[3]	Origin	Site[4]	*Rhizobium* strain[5]	MG[6]
Macroptilium atropurpureum	90776	14469	146	Mexico	1,3	CB 756	3
Macroptilium atropurpureum	90821	14465	147	Mexico	1	CB 756	3
Macroptilium atropurpureum	cv. Siratro	14461	25	Mexico	1,2,3	CB 756	3
Macroptilium heterophyllum	90448	14345	148	Mexico	1,3	CB 627	3
Macroptilium heterophyllum	91144	14367	149	Mexico	1	CB 627	3
Macroptilium heterophyllum	91222	14346	113	Mexico	1	CB 627	3
Macroptilium lathyroides	cv. Murray	14464	36	India	1,2	CB 756	1
Macroptilium longipendunculatum	557751	14422	59	Brazil	1,2	CB 756	1
Macroptilium martii	49780	14447	23	Brazil	1,2,3	CB 756	3
Macroptilium prostrata	48450	14342	114	Argentina	1	CB 756	3
Macrotyloma africanum	24972	14348	95	Zambia	1,2,3	CB 756	1
Macrotyloma africanum	60207	14349	115	Zambia	1,2,3	CB 756	1
Macrotyloma axillare	cv. Archer	14462	117	-	1,3	CB 1024	3
Macrotyloma daltonii	60303	14350	81	Namibia	1,2,3	CB 1024	1
Macrotyloma daltonii	94496	14351	116	-	1	CB 1024	1
Macrotyloma uniflorum	cv. Leichardt	14460	15	-	1,2	CB 1024	1
Macrotyloma sp.	-	(129)	129	Kenya	1,3	CB 1024	1
Medicago rugosa	cv. Paraponto	19905	151	-	1,3	CB 756	3
Medicago rugosa	cv. Sapo Gama	19906	152	-	1,3	CB 756	3
Medicago sativa	cv. H. River	19900	139	-	1,3	CB 756	3
Medicago scutella	cv. Sava	19907	153	-	1,3	CB 756	3
Medicago trunculata	cv. Jemalong	19908	154	Australia	1,3	CB 756	3
Mucuna pruriens aff	-	(119)	119	Kenya	1,3	CB 756	2
Neonotonia wightii	-	75.2366	67	Kenya	1,2,3	CB 1913	3
Neonotonia wightii	cv. Cooper	(35)	35	Kenya	1,2,3	CB 1913	3
Neonotonia wightii	-	(150)	150	Kenya	1,3	CB 1913	3
Rhynchosia densiflora	52690	14353	49	Tanzania	1,2	CB 756	3
Rhynchosia edulis	52127	14352	30	Paraguay	1,2	CB 756	3
Rhynchosia malacophylla	-	18176	121	Tanzania	1,2,3	CB 756	3
Rhynchosia minima	52713	14355	34	Tanzania	1,2	CB 756	3
Rhynchosia minima	84953	14357	73	Mexico	1,2	CB 756	3
Rhynchosia minima aff	-	(120)	120	Kenya	1,2	CB 756	3
Rhynchosia minima aff	-	(41)	41	Kenya	1,2	CB 756	3
Rhynchosia minima aff	-	(45)	45	Kenya	1,2	CB 756	3
Rhynchosia sp.	-	(125)	125	Kenya	1,2	CB 756	3
Rhynchosia totta	52742	14358	107	Zambia	1,3	CB 756	3
Stylosanthes capitata	55843	14426	69	Brazil	1,2,3	CB 2898	3
Stylosanthes fruticosa	41219A	14426	32	Sudan	1,2,3	CB 756	3
Stylosanthes fruticosa	-	(33)	33	Kenya	1,2	CB 756	3
Stylosanthes gracilis	-	(104)	104	Kenya	1,2	CB 756	3
Stylosanthes guianensis	79637	14364	55	Brazil	1,2,3	CB 756	3
Stylosanthes guianensis	-	Alupe C	85	Kenya	1,2,3	CB 756	3
Stylosanthes guianensis	-	Alupe I	92	Kenya-	1,2	CB 756	3
Stylosanthes guianensis	cv. Cook	18189	127	Colombia	1,2,3	CB 756	3
Stylosanthes guianensis	cv. Graham	14427	40	Bolivia	1,2,3	CB 756	3
Stylosanthes guianensis	cv. Oxley	19901	141	Argentiana	1,3	CB 756	3
Stylosanthes hamata	49080	14365	6	Colombia	1,2	CB 82	2
Stylosanthes hamata	70522	14366	94	U.S.A.	1,2	CB 82	2

Legume species	CPI[1]	K[2]	Accn. No.[3]	Origin	Site[4]	*Rhizobium* strain[5]	MG[6]
Stylosanthes hamata	73507	14367	83	Antigua	1,2	CB 82	2
Stylosanthes hamata	cv. Verano	14428	53	Venezuela	1,2,3	CB 82	2
Stylosanthes humilis	61674	14368	11	Venezuela	1,2	CB 756	2
Stylosanthes humilis	cv. Greenvale	14429	44	Australia-	1,2	CB 756	2
Stylosanthes scabra	55856	18190	74	Brazil	1,2	CB 756	3
Stylosanthes scabra	cv. Fitzroy	14431	19	-	1,2,3	CB 786	3
Stylosanthes scabra	cv. Seca	14430	65	-	1,2,3	CB 756	3
Stylosanthes scabra	-	K81.15	78	-	1,2	CB 756	3
Stylosanthes scabra	-	K81.11	21	-	1,2	CB 756	3
Stylosanthes scabra	-	K81.105	39	-	1,2	CB 756	3
Stylosanthes subsericea	38605	14457	62	Guatemala	1,2	CB 756	3
Styslsanthes sympodialis	67704 (B)	14369	28	Equador	1,2	CB 756	3
Stylosanthes viscosa	34904	14371	14	Brazil	1,2	CB 756	3
Stylosanthes sp.	85895	14359	52	Mexico	1,2	CB 756	3
Stylosanthes sp.	85899	14360	102	Mexico	1,2	CB 756	3
Stylosanthes sp.	86137	14361	79	Mexico	1,2	CB 756	3
Stylosanthes sp.	87469	14458	97	Mexico	1,2	CB 756	3
Stylosanthes sp.	87479	14362	88	Mexico	1,2	CB 756	3
Stylosanthes sp.	87485	14424	2	Mexico	1,2	CB 756	3
Stylosanthes sp.	87487	14425	156	Mexico	1,2	CB 756	3
Stylosanthes sp.	91138	14363	8	Mexico	1,2	CB 756	3
Trifolium repens	cv. Haifa	19902	142	Israel	1,3	CB 756	1
Trifolium sp.	-	(26)	26	Kenya	1	CB 756	1
Vigna ambacensis	47188	14433	99	Sudan	1,2	CB 756	1
Vigna frutescens	-	(126)	126	Kenya	1	CB 756	1
Vigna luteola	ILCA 133	18172	155	Belize	1,3	CB 756	1
Vigna oblongifolia	60430	14372	57	-	1,2	CB 756	1
Vigna trilobata	13671	14434	76	-	1,2,	CB 756	1
Vigna unguiculata	60442	14313	72	-	1,2	CB 756	1
Vigna unguiculata	60452	-	80	Kenya	1,2,3	CB 756	1
Vigna unguiculata	cv. Red Caloona	14436	60	-	1,2,3	CB 756	1
Vigna unguiculata	-	M66	168	Kenya	1,2,3	CB 576	1
Vigna vexillate	-	(122)	122	Kenya	1,3	CB 576	2
Voandzeia subterranea	-	18174	162	Mali	3	CB 576	2
Zornia sp.	-	(123)	123	Kenya	1	CB 576	2

[1]Commonwealth plant introduction numbers unless otherwise stated; CQ, Central Queensland; ILCA, International Livestock Centre for Africa number.
[2]Kenya plant number (numbers in parenthesis are accessions collected within the district of evaluation).
[3]Project accession numbers.
[4]Site 1, Katumani; Site 2, Kiboko; Site 3, Ithookwe.
[5]CB - Cunningham Brisbane.
[6]Maturity group; 1, short lived annual; 2, long lived annual; 3 perennial

Observations

The performance of each accession in each row was observed and rated for herbage growth, insect pests and diseases attack on a monthly basis. To assess survival, plant population was monitored over two growing seasons in all experiments. Counting was stopped when the number of plants per row reached 20. In subsequent calculations, these numbers were taken as 20, so the mean plant populations may underestimate the total number if more plants were present in some cases. At each observation time, each row was rated for the amount or bulk of legume herbage material present and the apparent vigour, i.e. visual bulk rating (VBR) of its growth at that stage on a 1-5 scale (1, lowest; 5, highest vegetative growth material). Also at each time, a count was made (out of possible 3 replications x 2 fertilizer levels = 6 for each accession) of the number of rows which had been noted as being damaged in some way by insects and diseases.

Data analysis

Plant populations were examined first and accessions which failed to produce an average of two or more plants per 2 m length of row (i.e. 12 plants per experiment) in any of the first three dates of observations after seedling emergence were excluded from the analysis. It was considered that these accessions which did not meet this arbitrary criterion had not been fairly and effectively evaluated because of poor establishment (for reasons unknown) under the conditions of the experiment. Mean population for all the observations for each accession was calculated and the data was transformed using a square root transformation in order to make the variance homogeneous before analysis. Analysis of variance was conducted using Statistical Analysis Systems (SAS) general linear model (SAS, 1987) and means were separated by Least Significant Difference (LSD) (Steel and Torrie, 1981). The fertilizer treatments had no effect on plant numbers hence it was ignored during the analysis and all the mean populations were pooled together. Mean VBR was also calculated for all observations for each accession and fertilizer level and the data transformed in the same way before analysis. The counts for insect pests and diseases incidences were summed over all times of observations and an Insect Damage Index and Disease Damage Index calculated respectively.

RESULTS

Rainfall

Rainfall data (Table 3) for three sites, Katumani, Kiboko and Ithookwe during the experimental period have been presented for 4 seasons: long rains (LR) (March-May), short rains (SR) (October-December), short dry season (January-February) and long dry season (June-September) from the time the trials commenced. At Katumani the LR and SR were below the long term average except the LR 1986 which was well above the long-term average. The long term average rainfall at Kiboko and Ithookwe were not available. However, the SR 1985 at Kiboko were similar to those in Katumani but the LR1986 were less. Ithookwe received more rainfall than Katumani in both SR 1986 and LR 1987.

Maturity types

Based on the time taken to reach maturity and subsequent regeneration from seeds or original plants we sub-divided the 155 accessions into three broad maturity types. The maturity groups are shown along with other details of the accessions tested in Table 2.

1) short lived annuals (SLA); these accessions made substantial growth, flowered, seeded and died within one wet season of 90-100 days (33 accessions);
2) long lived annuals (LLA) or short lived perennials; i.e. accessions which made some growth in the first wet season but required a second wet season to complete their life cycle (34 accessions), and
3) perennials; is those which grew slowly in the first and perhaps even the second wet season, but were still alive by the end of the second wet season (88 accessions).

Plant establishment

The mean numbers of plants per 2 m of rows are shown in Table 4. There were significant differences ($P<0.05$) between accessions on the number of plants. Majority of the accessions established and grew well in all the experiments. In Experiment 1, at both Katumani and Kiboko, there was a large number of *Stylosanthes* accessions planted and many of them achieved the mean populations of 10 or more per 2 m row. In Katumani, 19 of the 31 accessions which exceeded this figure were from the *Stylosanthes* genus. In Experiment 1, at Kiboko, 20 of the 37 accessions with 10 or more plants were from the *Stylosanthes* genus. Similarly in Experiment 2, Katumani; 11 of the 26 accessions meeting this criterion were from the genus *Stylosanthes*. In both Experiments 3, at Katumani and Ithookwe, there were only 9 *Stylosanthes* accessions planted but 7 and 6 of these met the criterion, respectively. There were seedling establishment problems with some accessions, in spite of adjustment of sowing rates. Most of the plant that failed to establish occurred in Experiment 2 at Katumani (9 accessions) followed by Experiment 3, at Ithookwe (4 accessions). In Experiment 2, at Katumani, only 3 accessions failed while at Kiboko and Experiment 3 at Katumani only one accession failed to establish at each site.

Table 3. Rainfall at the experimental sites during the short dry season, long rains, long dry season and short rains

	Short dry season (Jan-Feb)	Long rains (Mar-May)	Long dry season (Jun-Sep)	Long rains (Oct-Dec)
Katumani				
1985	-	-	-	252
1986	59	324	6.4	311
1987	38	119.4	77.1	105.8
Long term average	**119**	**249**	**18**	**343**
Kiboko				
1985	-	-	-	261
1986	20.3	158	7.7	176.7
Ithookwe				
1986	-	-	-	652
1987	11	200	31.2	272.2

Visual bulk rating

Means VBR for all accessions in the 3 categories of maturity group of SLA, LLA and perennials is shown in Figure 1. Each curve represents the averaged VBR for the days recorded for all the accessions in a particular maturity group. The SLA had consistently the lowest VBR; they were rated (VBR) as producing high herbage in the early stages of growth, then declined as they matured at end of first wet season, but the VBR rose in the second wet season. Difference in mean VBR between the LLA and the perennials were small in Experiment 2 at both Katumani and Kiboko and Experiment 4, at Ithookwe although the VBR for LLA was higher than for the perennials in most instances. In Experiments 3 and 4, at Katumani, the LLA maintained a higher VBR than the perennials. The perennials achieved their highest VBR in the second growing season.

Statistical analyses did not show any interaction between the fertilizer treatments for the VBR on the legume accessions. However there were significant differences between accessions on the VBR in all experiments and is shown in Table 5. Majority of the legumes that recorded high VBR (≥2.5) were the perennials followed by the LLA. Of the highly rated legumes, only *Macrotyloma sp.* (Accno 129) and *Vigna unguiculata* (Accno 80) were SLA. The genus *Stylosanthes* had the largest number of legumes that scored high VBR at Katumani (20, 5, and 4 and accessions in Experiments 1, 2 and 3 respectively) and Kiboko (10 accessions) while at Ithookwe the genus *Macroptilium* had the largest accessions (5) that were rated highly. At Kiboko, *Lablab purpureus* cv. Rongai had the highest VBR (4.1) while at Katumani *Mucuna pruriens* (Accno119) had the highest VBR (4.0). All the 5 species in the genus *Medicago* which were included in the evaluation in Experiment 3 at both Katumani and Ithookwe were generally rated lowly.

Insect and disease incidence

Only accessions with insect and disease indices of 20 and above are shown in Tables 6 and 7 respectively. Insect pest damage was a problem to some accessions under some circumstances. Although it was of little consequence at Kiboko and Ithookwe, it was quite serious at Katumani, particularly in Experiment 1, where most of the damage was mainly restricted to the dry period. There were 16, 7 and 10 accessions with insect damage index (IDI) of 20 and above in Experiments 1, 2 and 3 respectively at Katumani compared with only 1 accession at Kiboko and Ithookwe. Accessions with more serious problems were often in the *Lablab* (IDI 24-52) and *Vigna* genera (IDI 25-36); these tended to have problems in both rainy seasons. The most common insect pests were beetles on flowers, bollworms and sucking bugs on seed pods. There were also 4 accessions from *Stylosanthes* with insect problems (IDI 20-32) - all in Experiment 1 at Katumani but the attack were not evident until the second season and did not seriously affect the growth of the legumes.

Disease was not a very serious factor in any of the experiments (Table 7), but it is interesting to note that accessions with some problems were mainly *L. purpureus* cv Rongai and the *Vigna* genera with *V. unguiculata* (CPI 60452) being the most attacked. It had a disease damage index (DDI) of 75 in Experiment 2, at Katumani and 72 in Experiment 3 at Ithookwe. *Lablab purpureus* cv. Rongai had DDI of 20 and 29 in Experiment 1 and 3 respectively at Katumani. No legume scored greater than DDI of 20 at Kiboko. Rust was the major disease noted on the genus *Vigna*.

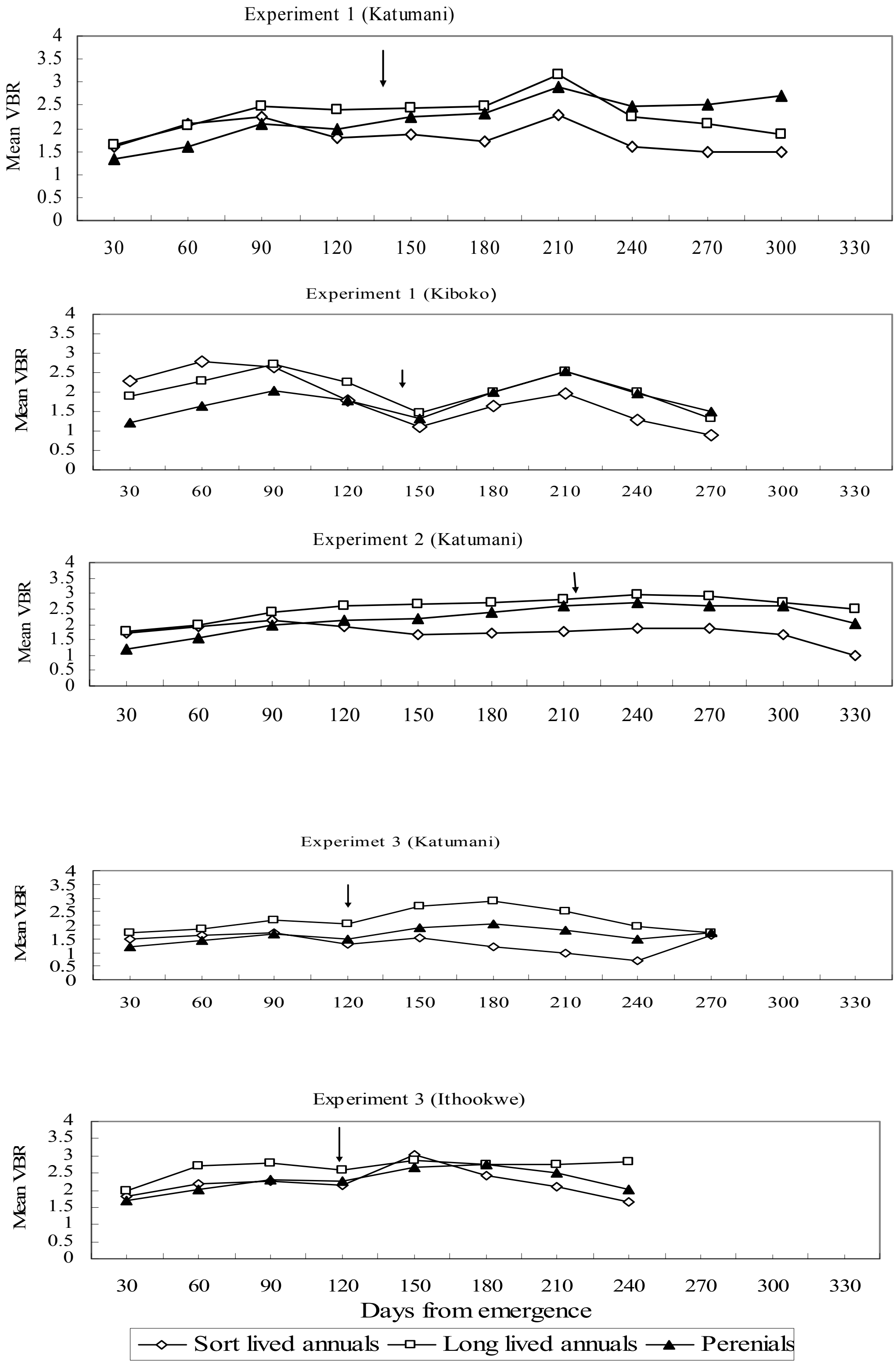

Figure 1. Changes in mean visual bulk rating (VBR) for 3 maturity group (short lived annuals, long lived annuals and perennials) of forage legumes at Katumani, Kiboko and Ithookwe, eastern Kenya. Arrow pointing downward indicates the start of second wet season.

Table 4. Mean plant population of forage legumes after 2 rainy seasons (arranged in genus and species) grown in experiments at Katumani, Kiboko and Ithookwe (Plant numbers up to 20, brackets: square root transformation [√Y+½]).

Legume species	CPI[1]	Accn. No.[2]	Exp. 1 Katumani	Exp. 1 Kiboko	Exp. 2 Katumani	Exp. 3 Katumani	Exp. 3 Ithookwe
Aeschynomene americana	91145	131	-[3]	-	-	8.6(2.90)	-
Aeschynomene americana	cv. Glenn	134	-	-	-	15.6(4.00)	16.2(4.23)
Aeschynomene elegans	37552	132	-	-	-	4.3(2.01)	-
Aeschynomene falcate	cv. Bargoo	133	-	-	-	12.0(3.50)	10.5(3.23)
Aeschynomene villosa	37235	135	-	-	-	F	-
Aeschynomene villosa	91113	136	-	-	-	5.7(2.48)	-
Alysicarpus glumaceus	52366	54	6.1(2.47)	12.8(3.62)	-	-	-
Alysicarpus hamosus	94491	13	9.1(2.92)	7.9(2.86)	-	-	-
Alysicarpus longifolius	94490	93	1.9(1.48)	7.4(2.81)	-	-	-
Alysicarpus monilifer	52343	5	7.9(2.88)	8.2(2.94)	-	-	-
Alysicarpus rugosus	52351	82	11.9(3.41)	13.1(3.66)	11.6(3.45)	18.1(4.31)	15.7(3.97)
Alysicarpus rugosus	94489	22	12.5(3.59)	6.2(2.57)	-	-	-
Alysicarpus rugosus	-	50	2.1(1.49)	3.1(1.88)	-	-	-
Alysicarpus vaginalis	34149	63	5.0(2.16)	14.2(3.82)	-	13.7(3.76)	16.5(4.10)
Arachis monticola	CQ990	108	-	-	F	-	-
Arachis pintoi	58113	109	-	-	F	-	-
Cassia pilosa	57503	87	18.8(4.39)	15.8(4.02)	18.1(4.30)	17.6(4.25)	16.5(4.12)
Cassia rotundifolia	86172	137	-	-	-	11.1(3.40)	-
Cassia rotundifolia	86178	138	-	-	-	10.9(3.30)	-
Cassia rotundifolia	Q10057	7	3.8(2.04)	5.9(2.52)	-	-	-
Cassia rotundifolia	cv. Wynn	17	18.6(4.37)	17.9(4.29)	18.8(4.39)	17.1(4.19)	12.8(3.62)
Centrosema acutifolium	92874	20	F	6.1(2.53)	-	-	-
Centrosema acutifolium	94303	105	-	-	4.1(2.09)	-	-
Centrosema brasilianum	55698	91	1.8(1.44)	4.0(2.10)	5.5(2.39)	2.8(1.63)	3.9(2.04)
Centrosema macrocarpum aff	78358	160	-	-	-	-	-
Centrosema pascuorum	65950	37	1.1(1.15)	7.2(2.77)	2.2(1.62)	-	-
Centrosema pascuorum	cv. Cavalcade	42	1.6(1.40)	9.6(3.13)	-	-	-
Centrosema plumieri	60477	24	2.5(1.71)	5.2(2.33)	6.1(2.55)	-	-
Centrosema plumieri	82269	46	2.9(1.77)	3.2(1.93)	-	-	-
Centrosema pubescens	46543	103	3.6(1.98)	6.3(2.58)	-	-	-
Centrosema pubescens	58575	158	-	-	-	-	5.4(2.42)
Centrosema pubescens	63895	89	3.7(1.89)	7.6(2.82)	7.1(2.59)	7.6(2.73)	16.1(4.06)
Centrosema pubescens	79630	157	-	-	-	-	-
Centrosema pubescens	92721	118	-	-	6.6(2.58)	-	-
Centrosema pubescens	cv. Belalto	1	1.4(1.33)	3.0(1.79)	-	-	-
Centrosema pubescens	43147x58575	161	-	-	-	-	4.3(2.19)
Centrosema pubescens	cv. Centro	47	2.4(1.63)	4.8(2.28)	-	-	-
Centrosema schottii	82271	43	2.0(1.55)	5.5(2.43)	9.2(3.10)	-	-
Centrosema virginianum	CQ2748	66	9.0(3.01)	13.3(3.70)	-	-	-

Legume species	CPI[1]	Accn. No.[2]	Exp. 1 Katumani	Exp. 1 Kiboko	Exp. 2 Katumani	Exp. 3 Katumani	Exp. 3 Ithookwe
Centrosema virginianum	91142	38	10.0(3.22)	12.8(3.49)	12.1(3.49)	10.0(3.20)	12.7(3.62)
Clitoria ternatea	48337	16	F	4.2(2.16)	-	3.6(1.96)	5.5(2.41)
Desmanthus virgatus	40071	10	11.2(3.40)	13.8(2.76)	13.2(3.65)	19.2(4.44)	19.9(4.52)
Desmanthus virgatus	55719	96	3.5(1.89)	4.5(2.22)	-	-	-
Desmanthus virgatus	65947	84	1.1(1.21)	2.0(1.58)	-	-	-
Desmanthus virgatus	78373	75	4.9(2.28)	4.2(2.13)	10.7(3.19)	-	-
Desmanthus virgatus	83570	58	10.8(3.33)	9.2(3.19)	-	7.2(2.75)	5.3(2.37)
Desmanthus virgatus	84508	86	6.3(2.55)	7.7(3.85)	-	-	-
Desmanthus virgatus	58178	12	8.2(2.84)	15.1(3.94)	-	-	-
Desmanthus virgatus	90750	27	6.2(2.51)	6.8(2.65)	-	-	-
Desmanthus virgatus	91146	31	6.3(2.57)	9.1(3.02)	14.4(3.76)	-	-
Desmanthus virgatus	91326	51	6.2(2.55)	7.3(2.79)	18.6(4.36)	14.7(3.88)	18.0(4.29)
Desmanthus virgatus	92818	90	3.4(1.95)	3.4(1.93)	-	8.2(2.86)	17.4(4.21)
Desmanthus dichototum	47186	100	3.1(1.87)	5.2(2.37)	-	-	-
Desmodium intortum	cv. Greenleaf	4	9.7(3.07)	4.4(2.21)	10.5(3.26)	10.2(3.24)	8.0(2.83)
Desmodium intortum	91135	18	12.1(3.41)	3.2(1.92)	-	-	-
Desmodium pringlei	37232	77	2.1(1.54)	5.3(2.15)	-	-	-
Desmodium prostratum aff	91232	56	4.4(2.20)	3.4(1.15)	-	-	-
Desmodium setigeruam	52431	61	3.2(1.82)	1.3(1.29)	-	-	-
Desmodium subsericeum	78402	70	11.1(3.35)	4.9(2.30)	-	-	-
Desmodium wigginsii	990418	64	14.9(3.89)	14.1(3.75)	-	-	-
Desmodium sp. D	91186	106	-	-	2.8(1.63)	-	-
Desmodium sp. D	91212	48	1.8(1.45)	2.2(1.64)	-	-	-
Dolichos sp.	24973	101	3.3(1.87)	3.3(1.91)	5.8(2.47)	-	-
Dolichos sericeus aff	-	128	-	-	-	3.0(1.84)	1.9(1.52)
Lablab purpureus	30702	110	-	-	8.8(3.00)	-	-
Lablab purpureus	41222	3	2.6(1.75)	1.5(1.40)	9.9(3.19)	-	-
Lablab purpureus	cv. Highworth	29	2.8(1.74)	4.0(2.08)	-	-	-
Lablab purpureus	cv. Rongai	98	3.4(1.91)	3.6(2.00)	-	5.8(2.49)	5.0(2.34)
Lespedeza striata	cv. Kaloe	140	-	-	-	4.8(2.20)	6.1(2.55)
Lotononis angolensis	62202	9	6.8(2.67)	1.7(1.23)	-	16.1(4.06)	16.9(4.17)
Lotononis bainesii	cv. Miles	71	4.1(2.09)	1.2(1.26)	9.3(3.10)	-	-
Macroptilium atropurpureum	84989	111	-	-	3.0(1.79)	2.4(1.66)	7.3(2.78)
Macroptilium atropurpureum	84999	68	3.2(1.87)	5.4(2.25)	-	-	-
Macroptilium atropurpureum	90748	112	-	-	3.3(1.19)	4.8(2.23)	12.9(3.41)
Macroptilium atropurpureum	90776	146	-	-	-	2.6(1.63)	15.4(3.98)
Macroptilium atropurpureum	90821	147	-	-	-	3.0(1.84)	-
Macroptilium atropurpureum	cv. Siratro	25	5.0(2.30)	11.5(3.47)	11.7(3.18)	8.7(3.00)	12.2(3.56)
Macroptilium heterophyllum	90448	148	-	-	-	2.1(1.62)	1.7(1.45)
Macroptilium heterophyllum	91144	149	-	-	-	4.7(2.21)	-
Macroptilium heterophyllum	91222	113	-	-	2.9(1.77)	-	-
Macroptilium lathyroides	cv. Murray	36	2.3(1.67)	12.7(3.56)	6.7(2.59)	-	-
Macroptilium longipendunculatum	557751	59	2.8(1.80)	8.4(2.79)	4.7(2.20)	-	-
Macroptilium martii	49780	23	1.6(1.43)	4.0(2.11)	6.9(2.56)	10.9(3.33)	13.5(3.71)
Macroptilium prostrata	48450	114	-	-	4.9(2.26)	-	-
Macrotyloma africanum	24972	95	14.9(3.90)	13.0(3.66)	12.2(3.43)	-	-

Legume species	CPI[1]	Accn. No.[2]	Exp. 1 Katumani	Exp. 1 Kiboko	Exp. 2 Katumani	Exp. 3 Katumani	Exp. 3 Ithookwe
Macrotyloma africanum	60207	115	-	-	9.7(3.18)	-	-
Macrotyloma axillare	cv. Archer	117	-	-	18.8(4.38)	12.1(3.46)	17.5(4.23)
Macrotyloma daltonii	60303	81	4.8(2.06)	3.7(2.02)	6.3(2.60)	-	-
Macrotyloma daltonii	94496	116	-	-	9.0(3.06)	-	-
Macrotyloma uniflorum	cv. Leichardt	15	1.3(1.30)	3.6(2.01)	-	-	-
Macrotyloma sp.	-	129	-	-	-	10.3(3.29)	3.69(13.7)
Medicago rugosa	cv. Paraponto	151	-	-	-	4.5(2.01)	F
Medicago rugosa	cv. Sapo Gama	152	-	-	-	2.9(1.80)	F
Medicago sativa	cv. H. River	139	-	-	-	6.7(2.59)	7.0(2.62)
Medicago scutella	cv. Sava	153	-	-	-	3.1(1.89)	2.5(1.63)
Medicago trunculata	cv. Jemalong	154	-	-	-	7.9(2.82)	2.0(1.55)
Mucuna pruriens aff	-	119	-	-	6.8(2.69)	3.2(1.90)	2.9(1.82)
Neonotonia wightii	-	67	7.7(2.80)	11.0(3.35)	-	-	-
Neonotonia wightii	cv. Cooper	35	5.8(2.47)	2.9(1.83)	5.7(2.48)	16.5(4.11)	14.2(3.79)
Neonotonia wightii	-	150	-	-	-	7.2(2.76)	F
Rhynchosia densiflora	52690	49	7.3(2.62)	10.5(3.34)	9.4(2.98)	-	-
Rhynchosia edulis	52127	30	1.3(1.25)	1.8(1.50)	-	-	-
Rhynchosia malacophylla	-	121	-	-	16.0(4.05)	14.8(2.88)	19.8(4.50)
Rhynchosia minima	52713	34	4.7(2.22)	13.0(3.67)	9.0(2.97)	-	-
Rhynchosia minima	84953	73	10.7(3.32)	14.9(3.92)	-	-	-
Rhynchosia minima aff	-	120	-	-	7.3(2.78)	-	-
Rhynchosia minima aff	-	41	F	2.4(1.68)	-	-	-
Rhynchosia minima aff	-	45	F	F	-	-	-
Rhynchosia sp.	-	125	-	-	6.3(2.45)	-	-
Rhynchosia totta	52742	107	-	-	12.8(3.55)	7.9(2.88)	12.2(3.40)
Stylosanthes capitata	55843	69	16.2(4.09)	17.5(4.39)	15.1(3.91)	15.8(4.04)	5.0(2.24)
Stylosanthes fruticosa	41219A	32	8.1(2.89)	10.6(3.31)	10.3(3.08)	9.5(3.18)	7.9(2.80)
Stylosanthes fruticosa	-	33	3.5(1.97)	4.5(2.22)	-	-	-
Stylosanthes gracilis	-	104	F	1.1(1.21)	-	-	-
Stylosanthes guianensis	79637	55	18.1(4.31)	16.8(4.15)	17.9(4.29)	17.1(4.20)	16.4(3.92)
Stylosanthes guianensis	-	85	18.3(4.33)	17.1(4.19)	16.3(4.06)	17.2(4.21)	15.3(3.96)
Stylosanthes guianensis	-	92	F	1.5(1.38)	-	-	-
Stylosanthes guianensis	cv. Cook	127	-	-	13.6(3.70)	9.5(3.16)	11.8(3.50)
Stylosanthes guianensis	cv. Graham	40	7.1(2.71)	10.9(3.35)	-	-	-
Stylosanthes guianensis	cv. Oxley	141	-	-	-	14.5(3.85)	7.4(2.80)
Stylosanthes hamata	49080	6	14.1(3.79)	17.2(4.19)	15.2(3.96)	-	-
Stylosanthes hamata	70522	94	16.8(4.15)	16.8(4.15)	-	-	-
Stylosanthes hamata	73507	83	11.1(3.35)	8.0(2.87)	-	-	-
Stylosanthes hamata	cv. Verano	53	18.4(4.34)	19.1(4.42)	17.9(4.29)	15.9(4.03)	10.3(3.27)
Stylosanthes humilis	61674	11	14.6(3.87)	17.0(4.18)	-	-	-
Stylosanthes humilis	cv. Greenvale	44	7.6(2.82)	8.5(2.99)	13.0(3.61)	-	-
Stylosanthes scabra	55856	74	17.6(4.25)	16.2(4.07)	-	-	-
Stylosanthes scabra	cv. Fitzroy	19	18.9(4.40)	18.0(4.30)	-	18.1(4.31)	17.1(4.16)
Stylosanthes scabra	cv. Seca	65	19.5(4.47)	16.8(4.15)	15.6(3.99)	17.6(4.25)	18.6(4.37)
Stylosanthes scabra	-	78	16.2(3.67)	12.4(3.83)	-	-	-
Stylosanthes scabra	-	21	11.0(3.14)	19.0(4.41)	-	-	-
Stylosanthes scabra	-	39	12.8(3.54)	15.0(3.93)	-	-	-

Legume species	CPI[1]	Accn. No.[2]	Exp. 1 Katumani	Exp. 1 Kiboko	Exp. 2 Katumani	Exp. 3 Katumani	Exp. 3 Ithookwe
Stylosanthes subsericea	38605	62	14.4(3.84)	10.8(3.35)	10.1(3.22)	-	-
Styslsanthes sympodialis	67704 (B)	28	8.3(2.89)	13.0(3.66)	12.6(3.22)	-	-
Stylosanthes viscosa	34904	14	18.7(4.38)	17.1(4.19)	-	-	-
Stylosanthes sp.	85895	52	4.8(2.26)	3.0(1.86)	-	-	-
Stylosanthes sp.	85899	102	6.8(2.64)	8.9(3.04)	-	-	-
Stylosanthes sp.	86137	79	4.1(2.11)	2.6(1.75)	-	-	-
Stylosanthes sp.	87469	97	18.5(4.36)	15.2(3.75)	-	-	-
Stylosanthes sp.	87479	88	10.1(3.22)	6.9(2.28)	-	-	-
Stylosanthes sp.	87485	2	15.3(3.96)	10.0(2.23)	-	-	-
Stylosanthes sp.	87487	156	-	-	-	-	2.7(1.78)
Stylosanthes sp.	91138	8	5.3(2.24)	1.3(1.34)	-	-	-
Trifolium repens	cv. Haifa	142	-	-	-	4.4(2.21)	7.0(2.72)
Trifolium sp.	-	26	1.1(1.26)	1.1(1.26)	-	-	-
Vigna ambacensis	47188	99	0.6(1.02)	2.9(1.89)	-	-	-
Vigna frutescens	-	126	-	-	4.0(2.00)	-	-
Vigna luteola	ILCA 133	155	-	-	-	3.0(1.83)	5.2(2.35)
Vigna oblongifolia	60430	57	2.4(1.65)	4.5(2.24)	-	-	-
Vigna trilobata	13671	76	4.0(2.05)	7.6(2.85)	-	-	-
Vigna unguiculata	60442	72	F	3.8(2.05)	-	-	-
Vigna unguiculata	60452	80	4.7(2.21)	7.2(2.75)	9.2(2.83)	9.8(3.17)	9.5(3.16)
Vigna unguiculata	cv. Red Caloona	60	F	1.8(1.47)	F	-	-
Vigna unguiculata	-	168	-	-	-	-	-
Vigna vexillate	-	122	-	-	11.2(3.39)	10.1(3.23)	6.0(2.51)
Voandzeia subterranea	-	162	-	-	-	-	5.0(2.27)
Zornia sp.	-	123	-	-	1.1(1.25)	-	-
LSD (P <0.05)			- (0.66)	- (0.42)	- (0.69)	- (0.55)	- (0.55)

[1]Commonwealth plant introduction numbers unless otherwise stated; CQ, Central Queensland; ILCA, International Livestock Centre for Africa number.
[2]Project accession number.
[3]No sowing was conducted
F; accessions that failed to establish

Table 5. Mean visual bulk rating of forage legumes after 2 rainy seasons (arranged in genus and species) grown in experiments at Katumani, Kiboko and Ithookwe (brackets: square root transformation [√Y+½]).

Legume species	CPI[1]	Accno. No.[2]	Exp. 1 Katumani	Exp. 1 Kiboko	Exp. 2 Katumani	Exp. 3 Katumani	Exp. 3 Ithookwe
Aeschynomene americana	91145	131	-[3]	-	-	1.2(1.30)	-
Aeschynomene americana	cv. Glenn	134	-	-	-	1.8(1.52)	3.0(1.84)
Aeschynomene elegans	37552	132	-	-	-	1.2(1.28)	-
Aeschynomene falcata	cv. Bargoo	133	-	-	-	1.5(1.41)	1.8(1.50)
Aeschynomene villosa	37235	135	-	-	-	F	-
Aeschynomene villosa	91113	136	-	-	-	1.2(1.30)	-
Alysicarpus glumaceus	52366	54	2.7(1.77)	2.3(1.68)	-	-	-
Alysicarpus hamosus	94491	13	1.6(1.43)	1.1(1.26)	-	-	-

Legume species	CPI[1]	Accno. No.[2]	Exp. 1 Katumani	Exp. 1 Kiboko	Exp. 2 Katumani	Exp. 3 Katumani	Exp. 3 Ithookwe
Alysicarpus longifolius	94490	93	0.6(1.05)	0.8(1.15)	-	-	-
Alysicarpus monilifer	52343	5	1.5(1.42)	1.5(1.41)	-	-	-
Alysicarpus rugosus	52351	82	2.8(1.78)	2.4(1.68)	1.9(1.52)	2.8(1.81)	3.1(1.91)
Alysicarpus rugosus	94489	22	2.1(1.61)	1.3(1.32)	-	-	-
Alysicarpus rugosus	-	50	1.6(1.38)	1.4(1.33)	-	-	-
Alysicarpus vaginalis	34149	63	1.2(1.26)	2.0(1.56)	-	1.6(1.46)	2.4(1.71)
Arachis monticola	CQ990	108	-	-	F	-	-
Arachis pintoi	58113	109	-	-	F	-	-
Cassia pilosa	57503	87	3.5(2.01)	2.6(1.75)	3.5(2.00)	2.6(1.76)	2.5(1.73)
Cassia rotundifolia	86172	137	-	-	-	2.3(1.68)	-
Cassia rotundifolia	86178	138	-	-	-	2.0(1.56)	-
Cassia rotundifolia	Q10057	7	2.5(1.72)	2.2(1.65)	-	-	-
Cassia rotundifolia	cv. Wynn	17	3.5(2.01)	2.8(1.83)	3.2(1.93)	2.7(1.79)	2.4(1.70)
Centrosema acutifolium	92874	20	F	1.4(1.35)	-	-	-
Centrosema acutifolium	94303	105	-	-	0.8(1.16)	-	-
Centrosema brasilianum	55698	91	2.2(1.59)	2.5(1.70)	2.4(1.69)	1.0(1.18)	2.6(1.75)
Centrosema macrocarpum aff	78358	160	-	-	-	-	-
Centrosema pascuorum	65950	37	0.6(1.01)	1.4(1.35)	0.4(0.94)	-	-
Centrosema pascuorum	cv. Cavalcade	42	1.5(1.40)	2.4(1.69)	-	-	-
Centrosema plumieri	60477	24	2.6(1.76)	2.2(1.62)	1.8(1.51)	-	-
Centrosema plumieri	82269	46	2.2(1.62)	1.4(1.35)	-	-	-
Centrosema pubescens	46543	103	2.0(1.55)	1.9(1.55)	-	-	-
Centrosema pubescens	58575	158	-	-	-	-	1.7(1.47)
Centrosema pubescens	63895	89	2.0(1.53)	2.8(1.80)	2.2(1.64)	1.4(1.35)	3.0(1.87)
Centrosema pubescens	92721	118	-	-	2.0(1.58)	-	-
Centrosema pubescens	cv. Belalto	1	1.9(1.51)	1.4(1.35)	-	-	-
Centrosema pubescens	43147x58575	161	-	-	-	-	2.1(1.61)
Centrosema pubescens	cv. Centro	47	1.9(1.52)	2.3(1.67)	-	-	-
Centrosema schottii	82271	43	2.2(1.63)	2.8(1.80)	2.4(1.69)	-	-
Centrosema virginianum	CQ2748	66	2.6(1.75)	2.7(1.79)	-	-	-
Centrosema virginianum	91142	38	2.8(1.81)	2.8(1.82)	2.3(1.68)	2.0(1.57)	2.2(1.65)
Clitoria ternatea	48337	16	F	3.1(1.90)	-	1.3(1.34)	2.6(1.76)
Desmanthus virgatus	40071	10	2.2(1.62)	2.1(1.61)	2.1(1.62)	1.6(1.44)	2.4(1.69)
Desmanthus virgatus	55719	96	1.5(1.37)	1.7(1.49)	-	-	-
Desmanthus virgatus	65947	84	0.7(1.06)	1.2(1.29)	-	-	-
Desmanthus virgatus	78373	75	2.1(1.61)	2.0(1.57)	1.9(1.55)	-	-
Desmanthus virgatus	83570	58	1.8(1.50)	2.1(1.61)	-	1.3(1.31)	1.2(1.31)
Desmanthus virgatus	84508	86	1.7(1.48)	1.9(1.53)	-	-	-
Desmanthus virgatus	58178	12	1.5(1.41)	1.8(1.51)	-	-	-
Desmanthus virgatus	90750	27	1.5(1.42)	1.9(1.53)	-	-	-
Desmanthus virgatus	91146	31	1.6(1.46)	2.3(1.67)	1.8(1.51)	-	-
Desmanthus virgatus	91326	51	2.0(1.56)	1.9(1.53)	2.2(1.64)	1.4(1.38)	2.1(1.59)
Desmanthus virgatus	92818	90	2.1(1.60)	1.4(1.36)	-	1.5(1.38)	1.9(1.54)
Desmanthus dichototum	47186	100	0.8(1.12)	0.8(1.15)	-	-	-
Desmodium intortum	cv. Greenleaf	4	2.8(1.81)	0.7(1.09)	3.2(1.91)	1.8(1.51)	2.2(1.65)

Legume species	CPI[1]	Accno. No.[2]	Exp. 1 Katumani	Exp. 1 Kiboko	Exp. 2 Katumani	Exp. 3 Katumani	Exp. 3 Ithookwe
Desmodium intortum	91135	18	2.3(1.64)	0.3(0.87)	-	-	-
Desmodium pringlei	37232	77	1.4(1.30)	1.3(1.28)	-	-	-
Desmodium prostratum aff	91232	56	1.3(1.32)	0.1(0.80)	-	-	-
Desmodium setigeruam	52431	61	1.6(1.43)	0.2(0.84)	-	-	-
Desmodium subsericeum	78402	70	2.3(1.66)	0.3(0.89)	-	-	-
Desmodium wigginsii	990418	64	2.7(1.79))	2.6(1.75)	-	-	-
Desmodium sp. D	91186	106	-	-	0.5(0.98)	-	-
Desmodium sp. D	91212	48	1.2(1.28)	0.3(0.87)	-	-	-
Dolichos sp.	24973	101	2.6(1.76)	1.3(1.33)	2.8(1.81)	-	-
Dolichos sericeus aff	-	128	-	-	-	1.4(1.36)	1.3(1.32)
Lablab purpureus	30702	110	-	-	3.0(1.87)	-	-
Lablab purpureus	41222	3	2.6(1.76)	2.9(1.84)	2.0(1.58)	-	-
Lablab purpureus	cv. Highworth	29	1.7(1.84))	2.4(1.66)	-	-	-
Lablab purpureus	cv. Rongai	98	2.9(1.82)	4.1(2.14)	-	2.4(1.69)	2.9(1.83)
Lespedeza striata	cv. Kaloe	140	-	-	-	0.5(1.01)	0.8(1.15)
Lotononis angolensis	62202	9	2.5(1.73)	1.0(1.18)	-	2.5(1.73)	2.5(1.72)
Lotononis bainesii	cv. Miles	71	2.4(1.69)	0.5(0.96)	2.3(1.67)	-	-
Macroptilium atropurpureum	84989	111	-	-	1.6(1.43)	0.9(1.15)	3.2(1.92)
Macroptilium atropurpureum	84999	68	1.1(1.24)	1.0(1.26)	-	-	-
Macroptilium atropurpureum	90748	112	-	-	1.8(1.52)	1.5(1.42)	3.6(1.97)
Macroptilium atropurpureum	90776	146	-	-	-	1.0(1.21)	3.2(1.91)
Macroptilium atropurpureum	90821	147	-	-	-	0.8(1.15)	-
Macroptilium atropurpureum	cv. Siratro	25	2.6(1.76)	2.99(1.83)	3.2(1.92)	2.2(1.64)	3.4(1.97)
Macroptilium heterophyllum	90448	148	-	-	-	0.5(0.97)	0.6(1.04)
Macroptilium heterophyllum	91144	149	-	-	-	0.7(1.08)	-
Macroptilium heterophyllum	91222	113	-	-	0.5(0.99)	-	-
Macroptilium lathyroides	cv. Murray	36	1.9(1.55)	2.4(1.70)	1.9(1.54)	-	-
Macroptilium longipendunculatum	557751	59	1.8(1.49)	2.6(1.79)	1.2(1.29)	-	-
Macroptilium martii	49780	23	1.9(1.50)	3.1(1.89)	2.1(1.60)	2.4(1.68)	3.8(2.06)
Macroptilium prostrata	48450	114	-	-	0.6(1.02)	-	-
Macrotyloma africanum	24972	95	2.4(1.70)	2.1(1.63)	2.0(1.55)	-	-
Macrotyloma africanum	60207	115	-	-	1.3(1.34)	-	-
Macrotyloma axillare	cv. Archer	117	-	-	3.9(2.10)	2.8(1.82)	3.2(1.92)
Macrotyloma daltonii	60303	81	1.4(1.33)	1.4(1.38)	2.0(1.59)	-	-
Macrotyloma daltonii	94496	116	-	-	2.2(1.66)	-	-
Macrotyloma uniflorum	cv. Leichardt	15	0.8(1.13)	1.3(1.33)	-	-	-
Macrotyloma sp.	-	129	-	-	-	2.6(1.75)	4.0(2.12)

Legume species	CPI[1]	Accno. No.[2]	Exp. 1 Katumani	Exp. 1 Kiboko	Exp. 2 Katumani	Exp. 3 Katumani	Exp. 3 Ithookwe
Medicago rugosa	cv. Paraponto	151	-	-	-	0.6(1.03)	F
Medicago rugosa	cv. Sapo Gama	152	-	-	-	0.7(1.07)	F
Medicago sativa	cv. H. River	139	-	-	-	1.2(1.30)	1.8(1.47)
Medicago scutella	cv. Sava	153	-	-	-	0.6(1.03)	0.2(0.84)
Medicago truncalata	cv. Jemalong	154	-	-	-	1.5(1.41)	0.4(0.94)
Mucuna pruriens aff	-	119	-	-	4.0(2.13)	2.1(1.60)	3.0(1.88)
Neonotonia wightii	-	67	3.3(1.95)	2.4(1.70)	-	-	-
Neonotonia wightii	cv. Cooper	35	3.1(1.90)	1.5(1.39)	2.2(1.64)	1.9(1.54)	2.7(1.79)
Neonotonia wightii	-	150	-	-	-	1.8(1.51)	F
Rhynchosia densiflora	52690	49	1.9(1.54)	2.3(1.64)	1.8(1.49)	-	-
Rhynchosia edulis	52127	30	1.1(1.20)	0.8(1.12)	-	-	-
Rhynchosia malacophylla	-	121	-	-	3.6(2.02)	2.6(1.77)	3.4(1.97)
Rhynchosia minima	52713	34	1.3(1.34)	2.9(1.84)	1.8(1.51)	-	-
Rhynchosia minima	84953	73	2.7(1.74))	2.8(1.80)	-	-	-
Rhynchosia minima aff	-	120	-	-	1.89(1.50)	-	-
Rhynchosia minima aff	-	41	F	1.9(1.54)	-	-	-
Rhynchosia minima aff	-	45	F	F	-	-	-
Rhynchosia sp.	-	125	-	-	1.4(1.38)	-	-
Rhynchosia totta	52742	107	-	-	3.0(1.86)	2.1(1.60)	2.1(1.55)
Stylosanthes capitata	55843	69	2.8(1.81)	2.4(1.69)	2.3(1.68)	1.2(1.32)	1.4(1.34)
Stylosanthes fruticosa	41219A	32	2.9(1.84)	2.2(1.64)	2.4(1.70)	1.9(1.55)	2.8(1.81)
Stylosanthes fruticosa	-	33	2.7(1.79)	2.3(1.66)	-	-	-
Stylosanthes gracilis	-	104	F	1.0(1.18)	-	-	-
Stylosanthes guianensis	79637	55	3.5(2.01)	2.2(1.64)	2.9(1.84)	2.2(1.65)	2.4(1.69)
Stylosanthes guianensis	-	85	3.9(2.09)	3.0(1.88)	3.2(1.93)	3.0(1.88)	3.4(1.98)
Stylosanthes guianensis	-	92	F	1.6(1.44)	-	-	-
Stylosanthes guianensis	cv. Cook	127	-	-	3.4(1.97)	2.5(1.72)	3.2(1.91)
Stylosanthes guianensis	cv. Graham	40	2.8(1.79)	2.5(1.74)	-	-	-
Stylosanthes guianensis	cv. Oxley	141	-	-	-	1.5(1.40)	2.1(1.61)
Stylosanthes hamata	49080	6	3.2(1.93)	3.1(1.89)	2.2(1.63)	-	-
Stylosanthes hamata	70522	94	2.6(1.78)	2.1(1.62)	-	-	-
Stylosanthes hamata	73507	83	2.3(1.65)	2.2(1.66)	-	-	-
Stylosanthes hamata	cv. Verano	53	3.2(1.93)	3.3(1.94)	2.6(1.76)	2.5(1.73)	2.9(1.83)
Stylosanthes humilis	61674	11	2.8(1.82)	2.7(1.80)	-	-	-
Stylosanthes humilis	cv. Greenvale	44	2.4(1.70)	1.5(1.42)	2.1(1.62)	-	-
Stylosanthes scabra	55856	74	2.9(1.83)	2.6(1.75)	-	-	-
Stylosanthes scabra	cv. Fitzroy	19	3.5(1.99)	3.1(1.91)	-	2.6(1.76)	3.0(1.88)
Stylosanthes scabra	cv. Seca	65	3.6(2.04)	3.0(1.88)	3.1(1.89)	2.2(1.64)	3.2(1.93)
Stylosanthes scabra	-	78	3.4(1.97)	2.8(1.80)	-	-	-
Stylosanthes scabra	-	21	3.0(1.76)	3.0(1.88)	-	-	-
Stylosanthes scabra	-	39	3.3(1.95)	2.6(1.76)	-	-	-
Stylosanthes subsericea	38605	62	3.0(1.86)	2.1(1.61)	2.0(1.58)	-	-
Styslsanthes sympodialis	67704 (B)	28	2.6(1.77)	2.9(1.84)	2.0(1.58)	-	-
Stylosanthes viscosa	34904	14	3.0(1.87)	2.0(1.59)	-	-	-
Stylosanthes sp.	85895	52	1.8(1.50)	0.9(1.19)	-	-	-
Stylosanthes sp.	85899	102	1.8(1.52)	1.6(1.45)	-	-	-
Stylosanthes sp.	86137	79	1.2(1.31)	0.4(0.97)	-	-	-
Stylosanthes sp.	87469	97	2.6(1.75)	2.1(1.53)	-	-	-

Legume species	CPI[1]	Accno. No.[2]	Exp. 1 Katumani	Exp. 1 Kiboko	Exp. 2 Katumani	Exp. 3 Katumani	Exp. 3 Ithookwe
Stylosanthes sp.	87479	88	2.1(2.62)	1.4(1.39)	-	-	-
Stylosanthes sp.	87485	2	2.0(1.58)	1.1(1.25)	-	-	-
Stylosanthes sp.	87487	156	-	-	-	-	1.4(1.38)
Stylosanthes sp.	91138	8	1.5(1.38)	0.5(1.02)	-	-	-
Trifolium repens	cv. Haifa	142	-	-	-	0.7(1.11)	1.2(1.27)
Trifolium sp.	-	26	0.6(1.02)	0.4(0.93)	-	-	-
Vigna ambacensis	47188	99	0.6(1.01)	0.8(1.11)	-	-	-
Vigna frutescens	-	126	-	-	1.8(1.47)	-	-
Vigna luteola	ILCA 133	155	-	-	-	1.6(1.42)	2.6(1.76)
Vigna oblongifolia	60430	57	1.4(1.35)	0.6(0.06)	-	-	-
Vigna trilobata	13671	76	1.0(1.22)	1.3(1.33)	-	-	-
Vigna unguiculata	60442	72	F	0.8(1.13)	-	-	-
Vigna unguiculata	60452	80	2.4(1.70)	2.0(1.59)	2.1(1.58)	2.1(1.61)	2.5(1.83)
Vigna unguiculata	cv. Red Caloona	60	F	1.1(1.27)	F	-	-
Vigna unguiculata	-	168	-	-	-	-	-
Vigna vexillata	-	122	-	-	2.6(1.75)	1.9(1.53)	2.1(1.62)
Voandzeia subterranea	-	162	-	-	-	-	1.8(1.50)
Zornia sp.	-	123	-	-	0.3(0.91)	-	-
LSD (P <0.05)			- (0.26)	- (0.20)	- (0.18)	- (0.20)	- (0.19

[1]Commonwealth plant introduction numbers unless otherwise stated; CQ, Central Queensland; ILCA, International Livestock Centre for Africa number.
[2]Project accession number.
* Visual bulk rating values from 0-5 where 0 is the lowest and 5 highest
F, accessions that failed to establish

Table 6. Incidence of insect damage on forage legume accessions in experiments at Katumani, Kiboko and Ithookwe [data are the number of rows (out of a possible 6) which had some evidence of damage on the date shown]

Exp.	Site[1]	Legume species	CPI[2]	Accn.[3]	1985 19/12	----- 30/12	1986 29/1	---- 27/2	---- 27/3	---- 28/4	---- 28/5	---- 25/6	---- 29/7	1986 29/8	Insect damage index[4]
1	1	*Dolichos sp*	24973	101	6	2	6	0	0	6	6	2	0	0	47
1	1	*Lablab purpureus*	cv. Rongai	98	6	4	4	0	0	4	4	2	0	0	40
1	1	*Lablab purpureus*	cv. Highworth	29	5	5	6	0	0	2	4	0	0	0	37
1	1	*Lablab purpureus*	41222	3	4	2	2	2	0	6	2	2	0	0	33
1	1	*Stylosanthes sympodialis*	67704 (B)	28	0	2	0	0	1	1	5	6	2	2	32
1	1	*Stylosanthe subsericea*	38605	62	0	0	0	0	0	2	6	2	3	4	28
1	1	*Vigna unguiculata*	60452	80	0	0	4	2	0	6	4	0	0	0	27
1	1	*Vigna oblongifolia*	60430	57	2	2	6	0	0	2	3	0	0	0	25
1	1	*Lotononis angolensis*	62202	9	4	2	2	2	0	0	0	0	2	2	23
1	1	*Cassia rotundifolia*	Q10057	7	0	0	0	0	0	4	4	4	0	1	22
1	1	*Desmodium subsericeum*	78402	70	0	0	2	0	0	5	6	0	0	0	22
1	1	*Stylosanthes humilis*	cv. Greenvale	44	0	0	0	2	0	5	4	0	0	2	22
1	1	*Centrosema brasilianum*	55698	91	0	0	0	0	0	0	3	4	4	2	22
1	1	*Centrosema schottii*	82271	43	0	0	0	0	0	2	4	4	1	1	20
1	1	*Macrotyloma uniflorum*	cv. Leichardt	15	3	6	3	0	0	0	0	0	0	0	20

Exp.	Site[1]	Legume species	CPI[2]	Accn.[3]	1985 19/12	----- 30/12	1986 29/1	---- 27/2	---- 27/3	---- 28/4	---- 28/5	---- 25/6	---- 29/7	1986 29/8	Insect damage index[4]
1	1	*Stylosanthes hamata*	49080	6	0	0	0	0	0	6	3	2	0	1	20
					1986								1987		
					8/1	5/2	6/3	11/4	15/5	9/6	9/7	12/8	22/1		
1	2	*Lablab purpureus*	cv. Rongai	98	0	2	0	0	5	5	0	0	0		24
					1986					1987					
					12/6	17/7	18/8	15/9	28/11	12/1	16/2	25/3			
2	1	*Lablab purpureus*	41222	3	2	4	4	0	6	5	4	0			52
2	1	*Lablab purpureus*	30702	110	2	0	6	0	6	5	5	0			50
2	1	*Rhyncosia malacophylla*	-	121	2	0	0	4	4	4	3	0			35
2	1	*Vigna unguiculata*	60452	80	2	0	0	0	6	3	4	0			31
2	1	*Mucuna pruriens*	-	119	0	0	0	0	4	6	4	0			29
2	1	*Vigna vexillata*	-	122	0	0	0	2	4	6	0	0			25
2	1	*Dolichos sp.*	24973	101	0	0	0	0	2	6	1	2			23
					1987										
					13/1	16/2	26/3	21/5	26/6	3/9	9/9				
3	1	*Vigna unguiculata*	60452	80	2	0	0	6	3	4	0				36
3	2	*Lablab purpureus*	cv Rongai	98	0	2	0	0	6	6	0				33
3	1	*Macroptilium atropurpureum*	cv. Siratro	25	0	0	0	0	6	6	0				29
3	1	*Cassia pilosa*	57503	87	0	0	0	0	5	6	0				26
3	1	*Centrosema virginianum*	91142	38	0	0	0	0	5	4	2				26
3	1	*Neonotonia wightii*	-	150	0	0	0	0	4	6	0				24
3	1	*Cassia rotundifolia*	86172	137	0	0	0	0	5	5	0				24
3	1	*Cassia rotundifolia*	cv. Wynn	17	0	0	0	0	2	6	2				24
3	1	*Alysicarpus rugosus*	52351	82	0	0	0	0	5	5	0				24
3	1	*Alysicarpus vaginalis*	34149	63	0	0	0	0	3	6	0				21
					1987										
					5/1	9/2	19/3	6/5	24/6	9/9					
3	3	*Vigna luteola*	ILCA-113	155	0	2	0	2	6	0					28

[1]Site 1, Katumani; Site 2, Kiboko; Site 3, Ithookwe.

[2]Commonwealth plant introduction number unless otherwise stated; CQ, Central Queensland, ILCA; International Livestock Centre for Africa.

[3]Project accession number.

[4]Insect damage index is the total overall dates, expressed as a percentage of the maximum possible total (number of dates x 6). The accessions shown are those with insect damage indices ≥ 20

Table 7. Incidence of disease damage on forage legume accessions in experiments at Katumani, Kiboko and Ithookwe [data are the number of rows (out of a possible 6) which had some evidence of damage on the date shown]

Exp.	Site[1]	Legume species	CPI[2]	Accno[3]	1985 19/12	1985 30/12	1986 29/1	---- 27/2	---- 27/3	---- 28/4	---- 28/5	---- 25/6	---- 29/7	1986 29/8	Disease damage index[4]
1	1	*Dolichos sp.*	24973	101	6	2	6	0	0	0	0	0	0	0	23
1	1	*Lablab purpureus*	cv Rongai	98	4	2	4	0	0	0	2	2	0	0	20
1	1	*Vigna unguiculata*	60452	80	0	2	4	2	0	0	4	4	0	0	20
					1986							1987			
					8/1	5/2	6/3	11/4	15/5	6/9	12/8	22/1			
1	2	-	-	-	-	-	-	-	-	-	-	-			-
					1986					1987					
					12/6	17/7	18/8	15/9	28/11	12/1	16/2	25/3			
2	1	*Vigna unguiculata*	60452	80	6	6	6	6	6	2	4	0			75
2	1	*Centrosema schotii*	82271	43	0	0	0	0	0	6	2	2			21
					1987										
					13/1	16/2	26/3	21/5	26/6	3/9	9/9				
3	1	*Vigna unguiculata*	60452	80	4	0	0	4	5	6	0				45
3	1	*Lablab purpureus*	cv Rongai	98	2	2	0	6	2	0	0				29
					1987										
					5/1	9/2	19/3	6/5	24/6	9/9					
3	3	*Vigna unguiculata*	60452	80	6	6	2	6	2	4					72
3	3	*Vigna luteola*	ILCA-113	155	4	2	0	0	0	4					28

[1]Site 1, Katumani; Site 2, Kiboko; Site 3, Ithookwe
[2]Commonwealth plant introduction number unless otherwise stated; CQ, Central Queensland, ILCA; International Livestock Centre for Africa.
[3]Project accession number.
[4]Disease damage index is the total overall dates, expressed as a percentage of the maximum possible total (number of dates x 6). The accessions shown are those with insect damage indices ≥20

DISCUSSION

Establishment

The study demonstrated considerable variation in establishment of accessions in different sites. Generally the genus *Stylosanthes* had more accessions with high plant survival than the other genera in all the experiments. Most accessions in this genus attained a mean population of over 14 plants per row; an indication of a high potential in the semi-arid region of Kenya. Other accessions outside this genus which were outstanding were the Wynn Cassia and *Cassia pilosa* (57503), with an average of over 15 plants per row in majority of the experiments. The study has also shown a considerable diversity within the genera in the plant survival in response to environment adaptability. For example the genus *Desmodium* had establishment problem at the drier site of Kiboko with only one accession (*D. wigginsii* 90418) that attained a mean population of over 10 plants per row as compared in Katumani site which had 3 accessions that attained that plant number (Table 4). The largest number of accessions that failed to establish were in Experiment 1, at Katumani. The exact cause of poor establishment or death is not known except for *V. unguiculata* cv. Red Caloona where the seed were eaten by rodent. Failure of other accessions could be possibly due to poor adaptation to the environment. Seedling regeneration was sufficient for majority of small seeded SLA such *M. africanum* (Accno. 95) and this is reflected by the good population mean (14.9 plants per 2m row) at the end of second wet season. The ability to set large amount of seeds enable plants to persist for extended period and is a useful adaptation characteristic.

Visual bulk rating

The genus *Stylosanthes* was consistently superior to the other genera in VBR in all experiments except at Ithookwe where the *Macroptilium* were rated highly. Some species in this genera have been reported to produce high DM (3.5 t/ha) in semi-arid areas by Njarui and Wandera (in press). A high VBR during dry season is a major issue when selecting accession for adaptability since it implies that they have a high herbage material available to livestock. However some of the accessions in the *Stylosanthes* have been released as cultivars in other countries, an indication of their wide adaptability. Edye *et al.* (1991) has indicated that *S. hamata* cv. Verano is an adopted pasture for seasonally dry tropical environments of Australia while Tarawali (1994) has also reported that this cultivar is an important pasture in northern Nigeria. Hall *et al*. (1995) has reported that Seca stylo is widely used as a pasture legume in Australia.

The low mean VBR (<2.0) for the SLA after the two growing seasons was due to their low individual mean VBR observed at the dry period when they shed most of their leaves after maturity. This can cause a reduction in both the quality and quantity of the herbage. Some of the perennials shed their leaves too but this is basically a survival mechanism in response to water stress. This different behaviour is important since it indicate that the SLA would be useful in areas with short growing season while the perennials would require a longer growing season to attain adequate time to establish. The mean VBR of SLA was lower in Kiboko than in the other sites. This site, generally is drier (annual rainfall 595 mm) compared to the other sites and this is an indication of low tolerance of SLA to dry conditions. Of the SLA only *Macrotyloma sp.* (Accno 129) gave a comparative performance in term of VBR with the high rated perennials. Another important SLA was *V. unguiculata* (Accno 80) that received a high VBR in Experiment 3, at Katumani and a moderate mean VBR (2.0 – 2.5) in other sites. A few accessions in the LLA were rated highly notably; *Cassia, Mucuna, Alysicarpus rugosus* (52351) and cv. Rongai but majority of legumes in this group received a moderate VBR at all the sites. Good performance of Wynn Cassia in subhumid Nigeria has been reported by Peters *et al*. (1994).

The performance (VBR) of some of the cultivars was greatly inferior to that of some of the introductions but there were variation between sites. For example *Macrotyloma uniflorum* cv. Leichardt, *L. striata* cv. Kaloe and cultivars in the genus *Medicago*, were among the accessions that had very low rating. Although these cultivars are used as pasture in other parts of the world, they can be regarded as not particularly being potential forage for this environment. These results agree perfectly to those of Sands *et al.* (1970) who evaluated a range of *Medicagos* in Katumani. The genus *Medicago* is primarily adopted as a pasture to the temperate region. Greenleaf desmodium performed poorly in Kiboko (mean VBR 0.7) than a range of introductions. At Katumani the performance (mean VBR 2.8) of this line was considerably good; an indication that it would require wetter environment for it to thrive better.

Pest and disease incidence

Throughout the experiment no major pests and diseases were recorded for majority of the forage legumes (index <20). High pest and disease incidences were restricted to the genera *Lablab* and *Vigna.* Plants from these genera play an important part in the small-holder farming systems and are widely cultivated within the semi-arid region of region of Kenya. The grains are eaten as food while the residue after threshing is fed to livestock. The extent of attack was not measured but this is likely to lead in decline of the herbage and or amount of grain. There was a limited insect pest and disease incidence of some of the accessions in the genera *Stylosanthes* and *Cassia* but this was mainly termites during the dry season where in some cases they resulted to death of plant.

CONCLUSION

From these studies, a good range of well adapted forage legumes have been identified and could have a high potential for use in pasture. The studies also showed a considerable diversity with genera examined and identified three maturity group, (SLA, LLA and perennials) based on time taken to complete life cycle. The fact that the legumes evaluated vary in growth habits is of great importance and those with suitable characteristics can be used in the varied farming systems of the semi-arid Kenya. A good number of accessions especially in the genus *Stylosanthes* showed a wide environmental adaptability and did well in all sites. Other main important genera include the *Cassia, Rhynchosia and Macrotyloma. Macroptilium* have a considerable potential at Ithookwe while *Lablab purpureus* cv. Rongai performed exceptionally good at Kiboko. However there is need to evaluate species in these genera further to determine their herbage yield and identify where they could fit and the specific benefits they can contribute in the various farming systems within semi-arid region of Kenya. Specifically there is need to conduct trials to investigate the productivity either as a pure stand or in combination with suitable grasses and their nutritive value if they are to be adopted for animal feed. The role of these legumes to improve soil fertility should also be studied. The performance of the *Medicago* genus was poor and this should not be tested further in this region. Insect pests and diseases attack did not seem to have a big problem for majority of legumes except for a few accessions in the *Vigna* and *Lablab* genera. Since these are widely grown by the small scale farmers of this region, the extent of damage need to be investigated.

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