GROWTH AND FODDER YIELD OF THE *Gliricidia sepium* PROVENANCES IN FENCE SYSTEM IN DRYLAND FARMING AREA IN BALI, INDONESIA

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Summary

The field experiment was carried out to study the growth and fodder yield of the *Gliricidia sepium* provenances in fence system in dryland farming area in Bali, Indonesia for 24 months. The design of the experiment was a completely randomized block arrangement, consisted of 16 treatments (*Gliricidia sepium* provenances) and 12 blocks with 10 plants per provenance. Of the 16 gliricidia provenances, six were from Mexico (M), four were from Guatemala (G), and one each was from Colombia (C), Indonesia (I), Nicaragua (N), Panama (P), Costa Rica (R) and Venezuela (V). After 40 weeks establishment the gliricidia were lopped regularly 4 times a year, twice during the four month wet season and twice during the eight month dry season at 150 cm height. There were variations ($p < 0.05$) in stem elongation from 10 to 121 cm, leaf retained from 48 to 105%, leaf shedding from 53 to 86%, branch number from 4 to 7, fodder yield from 281 to 648 g DW/plant, and wood yield from 53 to 179 g DW/plant; and such variations were affected by the seasons. Retalhuleu provenance of Guatemala (G14), Belen provenance of Nicaragua (N14) and Bukit Bali provenance of Indonesia (I) were ranked first, second and third, respectively, measured in terms of stem elongation, leaf retention, fodder and wood yields during the wet and dry seasons.

(**Key Words**: Gliricidia Provenances, Seasonal Variation, Branch Distribution, Leaf Retention, Shoot Yield, Fodder Supply)

Introduction

Gliricidia sepium (Jacq.) Walp., a deep rooted shrub legume, native of Central America, is now wide spread in Asia, South-east Asia, the Caribbean and West Africa (Wiersum and Nitis, 1992). Recently *G. sepium* becoming popular as alternative to *Leucaena leucocephala* due to its resistance to the defoliating psyllid (*Heteropsylla cubana*) which has devastated *L. leucocephala* in many parts of the tropics (Brewbaker, 1987; Simons and Stewart, 1994).

G. sepium has been used for high quality forage supplements to low quality roughages, contributing rich organic mulches to improve cropping land, stabilisation of sloping landscapes from erosion, rehabilitation of degraded or saline lands, providing fire wood or poles for contruction and shade plants or fence boundary (Gutteridge and Shelton, 1994). The utilization of gliricidia fodder for farm animals has been tested in Central America, Africa, and Asia (Devendra, 1990). It is also being tested in the Three strata forage system (Nitis et al., 1989) and in the alley cropping system (Nitis et al., 1991).

Growth and yield of gliricidia is affected to a varying degrees by frequency and interval of cutting (Glover, 1987), by association with other plant species (Nitis et al., 1989), by plant density (Ella et al., 1989), by topography, land utilization and climatic zones (Nitis et al., 1980) and by provenances within the species (Nitis et al., 1991).

Oxford Forestry Institute (OFI), United Kingdom, has collected and preserved 29 provenances (accessions) of *G. sepium* from eight Latin American Countries covering different time of harvest, altitude, latitude, rainfall, temperature and soil (Hughes, 1987). The 100 trials carried out in the tropics showed that there were marked differences among the provenances in biomass production within and between sites (Simons and Dunsdon, 1992).

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However, the Retalhuleu provenance from Guatemala showed stable and superior fodder and wood productions accross a wide range of sites.

In smallholder dryland farming area in Bali, farmers grow gliricidia as fence boundary, as alley cropping and/ or as guard row. It has been shown that when expressed per plant the leaf yield was the highest in the guard row system; while when expressed per 100 m row the highest leaf yield was in fence system (Nitis et al., 1991).

The objective of this experiment was to study leaf and stem growth characteristics, fodder yield and wood yield of 16 provenances of *Gliricidia sepium* during the wet and dry seasons.

Materials and Methods

Location

The experiment was located in dryland farming area at Bukit Peninsula of Southern Bali (8° 45′ -8° 49′ S; 115° 5′ -115° 13′ E), Indonesia, at 100 m elevation and 3° sloping gradient. The soil is classified as red-brown Mediteran type with 10-25 cm soil depth, calcareous-based limestone with pH varied from 7.2-8.4 (Nitis et al., 1989). The mean daily temperature varied from 25 to 29℃ with relative humidity varied from 65 to 86%. The average annual rainfall was 1,681 mm with 96 rainy days distributed during the four month wet season (December to March) and eight month dry season (April to November).

Gliricidia sepium provenance seeds

The 15 *Gliricidia sepium* provenances supplied by Oxford Forestry Institute (OFI) were collected from seven Latin American Countries with altitude varied from 0-1,100 m and with annual rainfall varied from 650-3,500 mm (table 1). One provenance (I) was collected from Bukit peninsula, Bali. Of the 15 provenances, six were from Mexico (M), four were from Guatemala (G), one each was from Colombia (C), Nicaragua (N), Panama (P), Costa Rica (R) and Venezuela (V). The *G. sepium* seeds were planted in the nursery for 8 weeks.

TABLE 1. PARTICULARS OF THE 16 *GLIRICIDIA SEPIUM* PROVENANCES[1]

Provenance code	Origin		Harvest Year	Altitude (m)	Rain fall (mm)	Temperature (℃)	Soil
	Country	Site					
G13	Guatemala	Volcan	1984	950	1,060	22.5	Sandy loam
G14	Guatemala	Retalhuleu	1984	330	3,500	27.5	Sandy gravel
G15	Guatemala	Gualan	1984	150	700	26.8	Very sandy
G17	Guatemala	Monterrico	1984	5	1,650	27.1	Saline sand
M33	Mexico	Los Amates	1985	1,100	650	24.6	Regosol
M34	Mexico	Palmasola	1985	10-50	1,130	27.5	Regosol
M35	Mexico	San Mateo	1985	10-30	950	27.2	Unstratified sand
M38	Mexico	Playa Azul	1985	0-30	900	27.5	Coarse regosol
M39	Mexico	San Jose	1985	30	1,400	27.5	Unstratified regosol
M40	Mexico	Arriaga	1985	30	1,796	27.6	Alluvial
V1	Venezuela	Mariara	1986	520	800	24.6	Deep black clay
R12	Costa Rica	Playa	1986	0-10	1,927	24.8	Saline sand
P13	Panama	Pedasi	1986	0-20	860	26.7	Drained sand
N14	Nicaragua	Belen	1986	75	1,650	26.6	Heavy clay
C24	Colombia	Pontezuelo	1986	20-50	950	27.7	Black vertisol
I	Indonesia	Bukit Bali	1987	0-150	1,000	27	Red-brown Mediteran

[1] Adapted from Nitis et al. (1991).

Design

The fence line was established on the upper, lower, left and right sides of a sloping plot. The gliricidia were planted in the fence line with a completely randomized block design arrangement, consisted of 16 treatments (*G. sepium* provenances) and 12 blocks (figure 1). The 16 provenances were randomly assigned in each block. Each side of the plot consisted of 3 blocks. Each block was 16 m length consisted of 16 gliricidia provenances with 1 m length for each provenance. Each prevenance consisted of

10 plants, planted at 10 cm spacing between the two plants. The spacing between blocks in a row direction was 4 m.

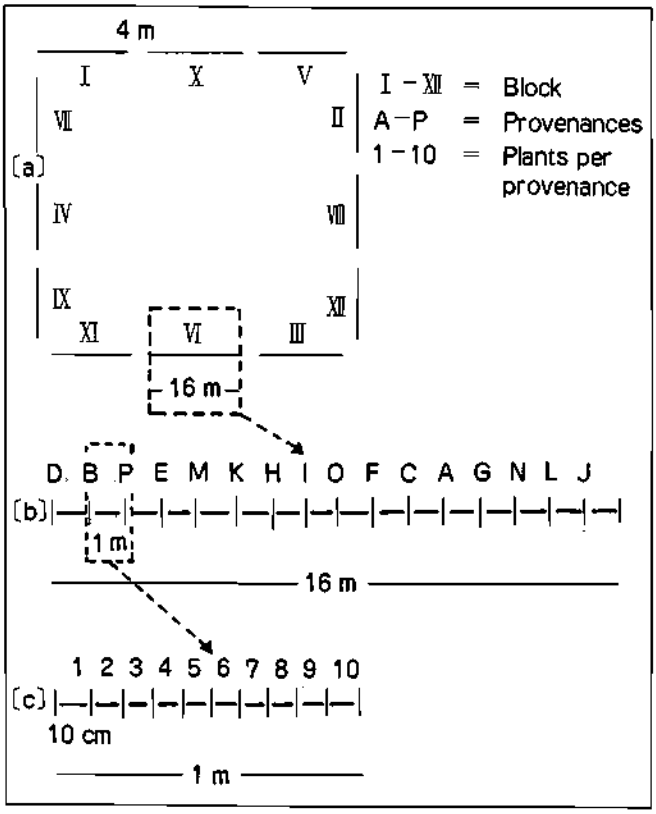

Figure 1. Position of the blocks in the plot (a), the 16 provenances in a block (b) and number of plants per provenance (c).

Observation

Eight-week old gliricidia in plastic bag pots were transplanted to the field in the early wet season. At the eight weeks after transplanting, the gliricidia were thinned into one plant per hill; and then were let to establish for 40 weeks. In the first harvest, at the end of the dry season, each plant was lopped at 150 cm height and the branches were lopped at 25 cm from both sides of the gliricidia row. Subsequent lopping was carried out regularly 4 times a year, twice during the four-month wet season (January and March) and twice during eight-month dry season (July and November). Number of primary branches at 30, 60, 90, 150 cm heights were recorded at the same time. Sub samples of branch and leaf rachis were dried in a forced drought oven at 70℃ to constant dry weight (DW).

The 92 week experiment consisted of 40 week growth period and 52 week production period.

Statistical analysis

Data were analysed with analysis of variance and when the values among the treatment means differed ($p < 0.05$), such values were further analysed with new Duncan's multiple range test (Steel and Torrie, 1960).

Results

Growth

During the wet season the longest stem elongation was in provenance M38 and the shortest was in M33, with the mean (± SD) value of 57.45 ± 19.44 cm (table 2); while during the dry season the elongation of stem become shorter (21.56 ± 8.10 cm) than that of the wet season, the longest was in G14 and the shortest was in M40.

TABLE 2. STEM ELONGATION OF *GLIRICIDIA SEPIUM* DURING THE WET AND DRY SEASONS IN THE FENCE SYSTEM

Provenance code	Stem elongation (cm)[1]	
	Wet season Dec. '87 (E) to March '88 (L)	Dry season April (E) to Nov. '88 (L)
G13	56.08^{cd}[2]	23.09^{ab}
G14	60.79^{bc}	43.59^{a}
G15	58.43^{bcd}	18.46^{ab}
G17	49.88^{de}	14.86^{ab}
M33	35.07^{f}	22.33^{ab}
M34	39.27^{f}	20.31^{ab}
M35	37.49^{f}	20.31^{ab}
M38	120.24^{a}	23.82^{ab}
M39	56.31^{cd}	25.00^{ab}
M40	49.04^{de}	10.55^{b}
V1	67.97^{b}	10.97^{b}
R12	57.22^{cd}	20.65^{ab}
P13	45.97^{ef}	22.14^{ab}
N14	67.76^{b}	22.08^{ab}
C24	59.15^{bcd}	13.97^{ab}
I	58.56^{bcd}	32.89^{ab}
Mean ± SD	57.45 ± 19.44	21.56 ± 8.10
SEM[3]	3.22	9.46

[1] L (Late) - E (Early)

[2] Values in the same column with different superscripts differed ($p < 0.05$).

[3] SEM = Standard error of the treatment means.

The leaf retention during the wet season varied from 48 to 105% in which the highest and the lowest values were in provenances G17 and M40, respectively; while the leaf shedding during the dry season went down to as low as 53% (G14) to as high as 86% (R12) (table 3). In addition, it was observed that during the wet season there were no leaf shedding, while during the dry season all the gliricidia shed their leaves. Both during the wet and dry seasons the leaf retention and leaf shedding of provenance I was lower than the mean value from all provenances.

TABLE 3. LEAF RETAINED DURING THE WET SEASON AND LEAF SHEDDING DURING DRY SEASON OF *GLIRICIDIA SEPIUM* IN THE FENCE SYSTEM

Provenance code	Leaf retained (%) Dec. '87 (E) to March '88 (L)	Leaf shedding (%)[1] April (E) to Nov. '88 (L)
G13	89.82	58.11
G14	100.54	53.32
G15	79.48	62.85
G17	105.27	70.67
M33	65.65	69.88
M34	71.57	77.77
M35	60.06	69.71
M38	82.73	74.64
M39	83.90	74.64
M40	48.03	69.17
V1	70.16	78.71
R12	72.84	85.82
P13	76.93	67.09
N14	76.89	55.00
C24	81.59	64.73
I	60.03	60.43
Mean ± SD	76.59 ± 14.74	68.28 ± 8.97

$$^{1}\,(\%) = \frac{\text{L (Late)} - \text{E (Early)}}{\text{E (Early)}} \times 100$$

For the 40 week growth, there was a trend of branching habbit among these provenances (table 4), that is provenances P13, I and C24 were ranked first, second and third to produced branches in the bottom (0-30 cm); provenances G17, P13 and M40 in the middle (30-90 cm); provenances G17, C24 and V1 in the top (90-150 cm); and provenances G14, N14 and V1 above 150 cm, respectively. Based on the highest number of branches at the bottom, middle and top, provenances P13, G17 and C24 had evenly distributed branches along the stem. In terms of branch number, G14 produced the most and M38 produced the least of branches.

TABLE 4. BRANCH NUMBER AND DISTRIBUTION AT 12 MONTHS GROWTH OF *GLIRICIDIA SEPIUM* IN THE FENCE SYSTEM

Proven-ance code	Branch location on the stem (cm from the ground)				Whole plant
	0-30	30-90	90-150	> 150	
G13	0.50	0.72	0.83	2.95	5.00[bcdel]
G14	0.62	0.98	1.02	4.05	6.67[a]
G15	0.10	1.00	0.81	2.58	4.49[bcde]
G17	0.56	1.33	1.36	2.05	5.30[abcde]
M33	0.33	0.86	0.79	1.87	3.85[de]
M34	0.29	0.83	0.96	1.75	3.83[de]
M35	0.42	0.81	0.82	1.86	3.91[de]
M38	0.25	0.83	0.80	1.88	3.76[e]
M39	0.50	0.92	0.98	2.43	4.83[bcde]
M40	0.63	1.28	1.00	2.57	5.48[abc]
V1	0.25	1.08	1.24	3.31	5.88[ab]
R12	0.59	0.82	0.95	1.81	4.17[cde]
P13	0.96	1.29	1.06	2.07	4.05[abcd]
N14	0.54	0.80	0.93	3.33	5.60[ab]
C24	0.75	1.10	1.33	2.85	6.03[ab]
I	0.84	1.25	1.18	2.63	5.90[ab]
Mean ± SD	0.51 ±0.23	0.99 ±0.20	1.00 ±0.19	2.50 ±0.67	4.92 ±0.94
SEM[2]	–	–	–	–	0.48

[1] Values in the same column with different superscripts differed ($p < 0.05$).
[2] SEM = Standard error of the treatment means.

Yield

At the end of the 40 week establishment period, mean (± SD) value of the leaf yield was 7.01 ± 4.78 g DW/plant in which the highest value was in provenance G14 and the lowest was in P13 (table 5); while mean (± SD) branch yield was 9.10 ± 6.22 g DW/plant, the highest yield was in provenance N14 and the lowest was in P13. In addition, the mean (± SD) value of shoot (leaf + branch) yield of these provenances was 16.11 ± 10.81 g DW/plant, with the highest value in N14 and the lowest value in P13. It was found that the highest shoot yield of provenance N14 was mainly due to the highest branch yield, whereas higher shoot yield of G14 was due to its higher leaf yield. Provenance I was ranked third either for the leaf and shoot yields and ranked second for the branch yield.

For the 12 months strategic lopping, the mean (± SD) value of leaf yield during the early wet season (January)

TABLE 5. YIELD OF *GLIRICIDIA SEPIUM* AT THE END OF THE 40 WEEKS ESTABLISHMENT PERIOD IN THE FENCE SYSTEM

Provenance code	Yield (g dry weight /plant)		
	Leaf	Branch	Shoot (Leaf + Branch)
G13	9.97	9.61	19.58[bc1]
G14	17.71	18.03	35.74[a]
G15	5.44	7.74	13.19[cd]
G17	4.40	3.98	8.38[cd]
M33	2.46	4.15	6.61[cd]
M34	3.02	4.29	7.31[cd]
M35	3.13	4.29	7.42[cd]
M38	4.47	6.36	10.83[cd]
M39	7.22	9.58	16.80[bcd]
M40	3.43	4.45	7.88[cd]
V1	8.58	12.01	20.59[bc]
R12	7.27	8.27	15.54[bcd]
P13	1.56	1.93	3.49[d]
N14	16.87	23.55	40.42[a]
C24	6.51	8.13	14.64[bcd]
I	10.08	19.21	29.29[ab]
Mean ± SD	7.01 ±4.78	9.10 ±6.22	16.11 ±10.81
SEM[2]	–	–	29.29

[1] Values in the same column with different superscripts differed ($p < 0.05$).
[2] SEM = Standard error of the treatment means.

was 379.38 ± 69.91 g DW/plant in which the highest yield was in G14 and the lowest was in P13, while during the late wet season (March) the mean (± SD) value was 23.30 ± 6.21 g DW/plant having the highest yields in provenance C24 and the lowest in M33 (table 6). On the other hand, during the early (July) and late (November) dry seasons, the mean (± SD) values of leaf yield were 31.49 ± 23.25 and 17.64 ± 16.29 g DW/plant, respectively, with provenances N14 and G14 had the highest leaf production in early and late dry seasons; while M34 and M40 had the lowest in each season, respectively. For the whole year period, the mean (± SD) leaf yield was 453.05 ± 106.86 g DW/plant, with the yields of the highest in G14 and the lowest in P13.

In terms of branch yield, the mean (± SD) value was 67.88 ± 22.49 and 7.96 ± 3.28 g DW/plant both during the early and late wet seasons, in which provenances I and N14 produced the highest; while G17 and P13 produced the lowest, respectively (table 7). Furthermore, during early and late dry seasons, the mean (± SD) values were 17.26 ± 14.74 and 9.84 ± 6.41 g DW/plant, respectively. The provenance G14 showed the highest yield in both period, while M35 and M38 showed the lowest in early and late dry seasons, respectively. For the whole year period, the mean (± SD) branch yield was 101.69 ± 41.99 g DW/plant which having the values of the highest in provenance G14 and the lowest in M34.

TABLE 6. LEAF YIELD OF *GLIRICIDIA SEPIUM* DURING THE WET AND DRY SEASONS IN THE FENCE SYSTEM

Proven-ance code	Leaf yield (g dry weight /plant)				
	Wet season		Dry season		Whole year (1989)
	January	March	July	No-vember	
G13	363.04	25.81	26.62	28.48	443.95[c1]
G14	515.59	26.81	40.81	64.81	648.02[a]
G15	361.40	21.71	35.27	10.50	428.88[c]
G17	335.37	26.29	16.34	10.73	388.73[c]
M33	330.40	13.06	12.68	3.94	360.08[cd]
M34	291.62	17.78	6.22	5.46	321.08[cd]
M35	342.82	20.86	8.10	5.61	377.39[cd]
M38	331.82	24.46	7.81	4.17	368.26[cd]
M39	422.84	22.34	24.94	15.12	485.24[bc]
M40	390.60	20.06	42.03	3.69	456.38[c]
V1	419.18	22.09	36.50	24.81	502.64[abc]
R12	385.09	20.06	37.92	16.58	459.65[c]
P13	239.83	13.89	22.13	6.10	281.95[d]
N14	458.49	29.70	87.43	37.14	632.76[ab]
C24	412.76	37.64	21.50	17.00	488.90[abc]
I	469.15	30.16	77.50	28.14	604.95[ab]
Mean ± SD	379.38 ±69.91	23.30 ±6.21	31.49 ±23.25	17.64 ±16.29	453.05 ±106.86
SEM[2]	–	–	–	–	98.5

[1] Values in the same column with different superscripts differed ($p < 0.05$).
[2] SEM = Standard error of the treatment means.

During the early and late wet seasons the highest shoot yields were in provenances G14 and C24, while the lowest were in P13 and M33, with mean (± SD) values of 446.00 ± 88.88 and 31.26 ± 9.11 g DW/plant, respectively (table 8). Moreover, during the early and late dry seasons, the highest shoot yields were in provenances N14 and G14 and the lowest were in M34 and M38, with

TABLE 7. BRANCH YIELD OF *GLIRICIDIA SEPIUM* DURING THE WET AND DRY SEASONS IN THE FENCE SYSTEM

Provenance code	Branch yield (g dry weight /plant)				
	Wet season		Dry season		Whole year (1989)
	January	March	July	November	
G13	74.80	7.10	40.95	20.11	142.96^{abc1}
G14	91.89	11.47	52.35	23.54	179.25^{a}
G15	55.86	6.51	9.86	7.57	79.80^{de}
G17	34.06	7.01	8.73	6.46	56.26^{e}
M33	54.85	3.51	7.36	5.13	70.85^{de}
M34	36.91	6.78	6.02	3.35	53.06^{e}
M35	46.85	4.66	4.70	6.11	62.32^{de}
M38	56.02	6.32	4.92	2.88	70.14^{de}
M39	79.32	7.25	7.08	6.31	99.96^{bcde}
M40	66.13	6.43	5.20	4.53	82.29^{cde}
V1	67.54	10.62	27.93	14.52	120.61^{abcd}
R12	67.05	7.28	13.24	10.51	98.08^{cde}
P13	51.68	3.31	8.05	5.39	68.43^{de}
N14	106.27	13.62	33.72	18.76	172.37^{a}
C24	87.63	12.50	22.15	8.47	110.75^{bcde}
I	109.16	13.01	23.90	13.85	159.92^{ab}
Mean ± SD	67.88 ±22.49	7.96 ±3.28	17.26 ±14.74	9.84 ±6.41	101.69 ±41.99
SEM[2]	–	–	–	–	22.4

[1] Values in the same column with different superscripts differed ($p < 0.05$).
[2] SEM = Standard error of the treatment means.

TABLE 8. SHOOT YIELD OF *GLIRICIDIA SEPIUM* DURING THE WET AND DRY SEASONS IN THE FENCE SYSTEM

Provenance code	Shoot yield (g dry weight /plant)				
	Wet season		Dry season		Whole year (1989)
	January	March	July	November	
G13	437.84	32.91	67.57	48.59	586.91^{abc1}
G14	607.48	38.28	93.16	88.35	827.27^{a}
G15	417.26	28.22	45.13	18.07	508.68^{be}
G17	369.43	33.30	25.07	17.19	444.99^{c}
M33	385.25	16.57	20.04	9.07	430.93^{c}
M34	328.53	24.56	12.24	8.81	374.14^{c}
M35	389.67	25.52	12.80	11.72	439.71^{c}
M38	387.84	30.78	12.73	7.05	438.40^{c}
M39	502.16	29.59	32.02	21.43	585.20^{abc}
M40	456.73	26.49	47.23	8.22	538.67^{abc}
V1	486.72	32.71	64.43	39.39	623.25^{abc}
R12	452.14	27.34	51.16	27.09	557.73^{abc}
P13	291.51	17.20	30.18	11.49	350.38^{c}
N14	564.76	43.32	141.15	55.90	805.13^{ab}
C24	480.39	50.14	43.65	25.47	599.65^{abc}
I	578.31	43.17	101.40	41.99	764.87^{ab}
Mean ± SD	446.00 ±88.88	31.26 ±9.11	50.00 ±36.37	27.49 ±22.40	554.74 ±146.22
SEM[2]	–	–	–	–	94.80

[1] Values in the same column with different superscripts differed ($p < 0.05$).
[2] SEM = Standard error of the treatment means.

the mean (± SD) values of 50.00 ± 36.37 and 27.49 ± 22.40 g DW/plant, respectively. The mean (± SD) value of the shoot yield for the whole year period was 554.74 ± 146.22 g DW/plant, ranging the highest value in provenance G14 and the lowest value in P13.

Discussion

Variation in response measured in terms of the 27 parameters investigated in the present experiment indicated that there were differences in genetic capability among the provenances to utilize soil nutrients both during the wet and dry seasons. Furthermore, provenances G14, N14 and I was ranked first, second and third in that order measured in terms of the 27 parameters (table 9). Since G14 and N14 were originally came from higher rainfall area and better soil condition (vide table 1), their higher responses were probably due their genetic capability to adapt quickly the new environment. Better response of G14 and N14 than I (which has been grown in Bukit area for 24 years) confirmed this suggestion.

Even though G14, N14 and I produced the highest fodder when grown in fence system as shown in the present experiment, the yield was still lower than those grown as alley cropping as shown by Sukanten et al. 1995. This is probably due to more intense competition for light, water and nutrients, since the spacing distance between the plants in the row in the fence system was 10 cm, while those in the alley cropping system was 50 cm. Ella et al. (1989) showed that the leucaena yield decreased as the plant row spacing reduced, confirmed this suggestion. Nitis et al. (1991) showed that the gliricidia leaf yield when expressed per plant was the highest when grown in guard row system (100 cm spacing); but when expressed per 100 m row the leaf yield was the highest when grown in fence system (10 cm spacing).

TABLE 9. THE HIGHEST RANKING ORDERS OF THE 27 GROWTH AND PRODUCTION PARAMETERS IN EACH PROVENANCE DURING THE WET AND DRY SEASONS

Provenance code	Ranking order[1]		
	1	2	3
G13	–	1	4
G14	13	2	3
G15	–	–	–
G17	3	–	–
M33	–	–	–
M34	–	1	–
M35	–	–	–
M38	1	–	1
M39	–	–	1
M40	–	–	2
V1	–	2	2
R12	1	–	–
P13	1	1	–
N14	5	9	6
C24	2	2	2
I	1	9	6
n	27	27	27

[1] Highest 3 ranking orders of the 16 provenances.

When grown in fence system as shown in the present experiment, provenance G14, N14 and I was the first, second and third ranking order in terms of the fastest growth and the highest yield; when grown in alley cropping system the ranking order was N14, G14 and I (Sukanten et al., in 1995); while when grown in guard row system the ranking order was C24, G14 and N14 (Nitis et al., 1991). This indicated that out of 16 provenances tested, G14 and N14 showing its potential for multipurpose uses, while C24 and I showing its potential for specific uses.

Puger et al. (1993) suggested that the provenances with more branches at the bottom might be more effective as weed control, those with more branches in the middle might be more effective as wind breaks, those with more branches on the top might be more effective as support for estate crops, while those evenly branching along the stem might be more effective as live fence. The present experiment supported such suggestion, even though the specificity of the provenances for such function differed to those shown by Puger et al. (1993).

Variation in the fodder yield of the *Gliricidia sepium* was not only due to variation among the provenances within the gliricidia species and different planting system (Nitis et al., 1991), but may also due different management (Cobbina and Atta-Krah, 1992), and variation in soil acidity and different rainfall (Bray et al., 1993).

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