# SPATIAL DISTRIBUTION OF DICOTYLEDONOUS WEED ARCHITECTURES IN A SHRUB VEGETATION OF MENGGALA, CENTRAL JAVA

B. SUNARNO * & F. HALLE **

*Faculty of Biology, Jenderal Soedirman University, Purwokerto Now *} Balitbang Botani Puslitbang Biologi JJPI, Bogor and **) Laboratoire de Botanique, Institut de Botanique Montpellier, France*

*ABSTRACT*

B. SUNARNO & F. HALLE. 1986. Distiibusi spasial model arsitektur gulma dikotil di daerah vegetasi semak, Menggala, Jawa Tengah. *Berita Biologi* 3(6): 253 - 260. Ketapatan dan frekuensi kehadiran model-model arsitektur gulma dikotil di daerah vegetasi semak Menggala, Jawa Tengah telah dipelajari. Model CHAMPAGNAT yang di-wakili oleh *Mimosa invisa* dan *Rubus chrysophyllus* merupakan model yang nilai kerapatannya paling tinggi (17,97%) dan merupakan pola pertumbuhan yang umum dijumpai di setiap stratum. Semakin tinggi tingkat stratumnya semakin rendah jumlah model dan jumlah individunya. Perbandingan antara gulma masa mendatang dengan gulma masa kini di daerah semak ini, adalah 3 : 2, menunjukkan a,danya proses suksesi yang sedang berjalaa

*INTRODUCTION*

Much of our knowledge of the-distribution of weed species is concerned with their roles on the early successions in the forest establishment. No attempt has been made to study the distribution of weed architectural models in relation to early successions, although many architectural weed model have been analyzed (Ha'le *et al.* 1978; Jeannoda-Robinson, 1977). Boojh & Ramakhrishnan (1982) states that the pattern of growth and architectural development of early and late successional species are well suited to their strategies of niche occupancy in the forest ecosystem. But those species are obviously trees of humid montane, evergreen forest. The present study, is aimed at investigating the distribution of weed models in the field and providing information that an architectural model distribution may be correlated with succession.

*STUDY AREA AND METHODS*

Observation were taken in a 65 ha of shrub vegetation in Menggala, Central Java, located in the Western slope of Mt. Slamet on 109° - 110° E and 7° - 8° S, and 777 m above the sea level. The climate is of B type with the mean annual rainfall being 4246 mm, the Q value of 21,9% (Schmidt & Ferguson, 1951). The soil in the area is brown andosol, associated with brown regosol, the structure is crumbled, and the texture is dusty to sandy loam, pH 6.00 — 7.00 (Supraptohardjo, 1960).

The transect method (Oldeman, 1979) was used. A main transect of about 600 m was established, using a plastic rope, from a randomized starting point around the centre of the area. Six (75 x 3 m) blocks were laid down perpendicular to the main transect. Each block was further divided into 25 plots of 3 x 3 m. Thus, 150 plots with a total area of 1350 $m^2$ or less than 0.2% of the whole area were established (Figure 1).

The frequency and density values of the weed models were calculated. Height variation performed by the individual weed growth lead to a stratification. Strata A, B, C and D represent layers of weeds above 150 cm, 100 - 150 cm, 50 - 100 cm, and below 50 cm, respectively. The relationship between the model distribution in the vegetation as a whole and within strata were determined by frequency analysis of models, using G-test of association (Sokal & Rholf, 1973) with f Ln f date transformation (f represents the absolute density of any model). As regards to the formation of the present vegetation which may involve the process of early secondary succession, the set of weeds and the occurence of chablis (in general terms) in the area were accounted according to Halle *et al.* (1978), Weed identification was based on Backer & Bakhuizenv.d. Brink Jr. (1963,1965,1968).

*RESULTS AND DISCUSSION*

There were 40 dicotyledonous weeds in the area conforming to 12 architectural models

(**Table** 1). TOMLINSON'S, STONE'S, SCARRONE'S, ATTIMS', and CHAMPAGNAT'S models **had a** high relative frequencies (9,67%), indicating **tbat** Ihose occurred in almost all plots. The relative **density** values of CHAMPAGNAT'S, STONE'S, **and** LEEUWENBERG'S models were 17,97%, **17,32%,** and 15,91%, respectively. CHAMPAGNATS model having the highest frequency and density values is considered important in the relationship between model distribution and vegetation formation in the area. This is quite different with Boojh and Ramakhrishnan (1982) finding that RAUffS and ATTIMS' models play an important role in developing forest communities in ' humid, subtropical montane ecosystem. It is possibly due to the difference of plant community type* between the two area involving geographical, latitudinal, and altitudinal factors.

The CHAMPAGNAT'S model in this study is represented by *Mimosa invisa* (Figure 2 A) and *Rubus chrysophyllus* (Figure 2 B). These species had seedlings with orthotropic and continuous growth. The axes are characterized by phyllotaxy of radial symmetry and those gradually became pendulous after the plant height developed over 0.5 m. The equivalent and identical branches mostly arise on the upper surface on the initial curve of the pendulous axis. The stems and branches of these weeds are provided with densely sharp spines, and infloresences lateral.

In a pure alang-alang *(Imperata cylindrical* field, the seedlings of *M. invisa* can not maintain the underground competition as their root systems are shallow and unable to penetrate over the rhizomatous layer of the former species. However, the establishment of competitif prolific woody weeds, which have big main roots or big tap roots going down through the alang-alang rhizome layer such as *Chromolaena odorata* (STONE'S model), *Ctibadium surinamense* (LEEUWENBERG'S model), *Lantana camara* (ATTIMS model), *Melastoma affine* (SCARRONE'S model) can supress the growth of alang-alang by shading, and create a favourable circumstance to support *M. invisa* seedlings to grow up without interference of alang-afang (Eussen & Wirjahardja, 1973).

Table 2 shows that strata C and D were the layers which contained all of the observed growth patterns in the field (12 models). The absent of 3 models (TOMLINSON, HOLTTUM, and CHAMBERLAIN) in a strata A and B is due to the maximum growth of there presented weeds, i.e., *Centella asiatica* and *Eryngium foetidum* (TOMLINSON'S model), *Crepis japonica* (HOLTTUM'S model), and *Drosera indica* (CHAMBERLAIN'S model) can not grow over the limit of the strata. McCLURE'S model which presents in stratum A but absents in stratum B is an exception. This model is represented by *Polygonum caespitosum* and *P. chinense.* Some individuals of the latter species can grow beyond 5 m in height. Therefore, they are belonging to stratum A. Frequency analysis of the distribution of weed models within strata with G - test of association indicates that the architectural model distribution is significantly associated with stratification (Table 3), G value = 4601.940 at $p < 0.005$. The higher the weed stratum level, the lower the number of models and their individual members therein, as shown in table 3. This condition is owing to the individual weed conforming to the models remain under growing process, which is convenient to the community growing process in the area.

Table 4 shows that there were 89 chablis covering approximately 59.33% of the observed plots. In this context, chablis refers to the spaces that occurred in the area due to the destruction of prolific woody weeds by a strong wind during January 1982, as seen from the broken stems or branches with detached leaves. After the area had been destroyed, a favourable condition with sufficient light intensity was created and, therefore, stimulated the seeds of *M. invisa* and other weeds to grow in the absent of alang-alang interference. Chablish without alang-alang will be densely crowded with seedlings, especially *M. invisa* as shown in figure 3. Consequently the above condition results in a higher density of weeds of the future than weeds of the present (Table 4). The ratio between those weeds was 3 : 2, implying that the process of early secondary successsion occurred in the observed area.

It may be concluded that in any case the distribution of dicotyledonous weed architectural models may vary from area to another, depending upon the formation of the community. The sets of weeds may function as indicators of ongoing succession in the field. The architectural models can be used as modified systems of life form analysis in weed community.

Table 1. Dicotyledonous weeds found in the obseived area and their aichitectuial models

| Species | Family | Model |
|---|---|---|
| *Ageratum conyzoides* L. | Asteraceae | STONE'S |
| *A. houstonianum* Mill. | — » — | — " — |
| *Blutnea lacera* (Burm. f.) DC. | - " - | _ " _ |
| *Bidens pilosa* L. | - " - | SCARRONE'S |
| *B. biternata* (Lour.) Sheri. | — "— | - " - |
| *Centetta asiatica (L.)* Uib. | Apiaceae | TOMLINSON'S ? |
| *Crepis japonica* Bth. | Asteiaceae | HOLTTUM'S |
| *Clidemia hirta* (L.) D. Don. | Melastomaceae | LEEUWENBERG'S |
| *Drosera incUca* L. | Dioseraceae | CHAMBERLAIN'S |
| *Desmodium heterophyllum* DC. | Papilionaceae | ATTIMS' |
| *D. triquetrum* DC. | - " - | STONES'S |
| *Emilia sonchifolia* (L.) Wight. | Asteraceae | — " — |
| *Eupatorium inulifolium* H.B.K. | — " — | _ " _ |
| *Eryngium foetidum* L. | Apiaceae | TOMLINSON'S |
| *Chromolaena odorata* (L.) R.M. King & Rob. | Asteraceae | STONE'S |
| *Hedyotis auricularia* L. | Rubiaceae | ATTIMS' |
| *Hyptis rhomboidea* Mart. & Gal. | Lamiaceae | — »»— |
| *Impatiens platypetala* Lindl. | Balsaminaceae | — " — |
| *Lantana/camara* L. | Verbenaceae | — " — |
| *Melastoma affine* D. Don. | Melastomaceae | SCARRONE'S |
| *Mimosa invisa* Mart. | Mimosaceae | CHAMPAGNAT'S |
| *M. pudica* L. | - " - | TROLL'S |
| *Phyllanthus urinaria* L. | Euphorbia ceae | COOK'S |
| *Piper aduncum* L. | Piperaceae | PETIT'S |
| *Poly gala paniculata* L. | Polygalaceae | LEEUWENBERG'S |
| P. *glomerata* Lour. | — " — | ATTIMS' |
| *Polygonum chinense* L. | Polygonaceae | MCCLURE'S |
| /». *caespitosum* Bl. | - " - | - " - |
| *Pueraria phaseoloides* Bth. | Papilionaceae | ATTIMS' |
| *RosteUulariapbtusa* Nees. | Acanthaceae | LEEUWENBERG'S |
| Ru&us *Chrysophyllus* Miq. | Rosa ceae | CHAMPAGNAT'S |
| *Sdaacutah.* | Malvaceae | TROLL'S |
| *S. retusa* L. | — " — | - " — |
| £ *rhombifolia* L. | — " — | — " — |
| *Solarium torvum* L. | Solanaceae | LEEUWENBERG'S |
| *Clibadium surinamense* L. | Asteraceae | LEEUWENBERG'S |
| *Stachytarpheta jamaicensis* (L.) VahL | Verbenaceae | — " — |
| *Triumfetta rndica* (L.) Back. | Tiliaceae | ATTIMS' |
| ffrena *lobata* L. | Malvaceae | _ " — |
| *Vernonia cinerea* (L.) Less. | Asteraceae | STONE'S |

*ACKNOWLEDGEMENT*

One of the authors, B.S., would like to express **his** gratitude to Dr, Mien A. Rifai, Herbarium Bogoriense, Bogor, for his encouragements and suggestions of the study. He also much indebted to Dr. Kuswata Kartawinata, and Dr. K.L. Mehra, F.A.O. forage collector in Indonesia for reading and correcting the english through the manuscript.

*BIBLIOGRAPHY*

BACKER, C.A. & BAKHUIZEN VAN DE BRINK JR., R.C. 1963. *Flora of Java I.* NVP Noordhoff, Groningen, The Netherlands, 648 p.

———&—————..1965. *Flora of Java II.* NVP Noordhoff, Groningen, The Netherlands, 642 p.

———*SL*—————. 1968. *Flora of Java III.* NVP Noordhoff, Groningen, the Netherlands, 660 p.

BOOJHj R. & RAMAKHRISHNAN, P.S. 1982. Growth strategy of trees related to successional status; I. Architecture and extension growth. *Forest Ecology and Management* 4 : 359-374.

EUSSEN, J.H.H. & WIRJAHARDJA, S. 1973. Studies of an alang-alang vegetation *(Imperata cyttndrica* (L.). Beauv.). *Biotrop Bulletin* 6 : 1-28.

HALLE, F. OLDEMAN, R.A.A. & TOMLINSON, P.B. 1978. *Tropical trees and Forest; an architectural analysis.* Springier verlag, Berlin, Heidelberg, New York, 441 p.

JEANNODA-ROBINSON, V. 1977. *Contribution etude de L' architecture des Herbes.* These de Specialite, Montpellier (Unpublished).

OLDEMAN, R.A.A. 1979. *Field guide for research group; scale drawing and architectural analysis of vegetations.* Institute of Ecology Padjadjaran University, Bandung, 51 p.

SOKAL, R.H. & RHOLF, F.J. 1973. *Introduction to Biostatistics.* W.H. Freeman & Co., San Francisco, 368 p.

SUPRAPTOHARDJO, R. 1960. *Peta tanah eksplorasi Djawa — Madura.* Lembaga Penelitian Tanah.dan Pemupukan, Bogor.

SCHMIDT, F.H. & FERGUSON, J.H.H. 1951. Rainfall types based on wet and dry period ratios for Indonesia with Western New Guinea. Djawatan Meteorologi dan Geofisika, Djakarta, *VerhandeUngen* no. 42.

Table 2- Distribution of Dicotyledonous weed models within strata (Absolute density values). In brackets; individual model occurrence in each stratum (%). Total area 1350 $m^2$

| Stratum | A (Above 150 cm) | | B (100-150 cm) | | C (50-100 cm) | | D (below 50 cm) | | Total (Mean) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Model | (indi-vidual) | (%) | (indi-vidual) | (%) | (indi-vidual) | (%) | (indi-vidual) | (%) | (indi-vidual) | (%) |
| TOMLINSON'S | – | – | – | – | 29 | ( 1.06) | 2713 | (98.94) | 2742 | ( 5.66) |
| HOLTTUM'S | — | - | - | - | 35 | (22.29) | 122 | (77.71) | 157 | ( 0.32) |
| CHAMBERLAIN'S | — | - | - | - | 104 | (17.56) | 593 | (82.46) | 697 | ( 1-44) |
| LEEUWENBERG'S | 874 | (11.34) | 1147 | (14.89) | 2182 | (28.32) | 3501 | (45.44) | 7704 | (15.91) |
| MCCLURE'S | 7 | ( 1.28) | - | - | 142 | (26.05) | 396 | (72.66) | 545 | ( 1-13) |
| PE TIT'S | 507 | (14.87) | 625 | (18.33) | 975 | (28.60) | 1302 | (38.19) | 3409 | ( 7-04) |
| COOK'S | 243 | ( 6.17) | 327 | (8.30) | 720 | (18.28) | 2648 | (67.24) | 3938 | ( 8.13) |
| SCARRONE'S | 764 | (15.70) | 804 | (16.53) | 1317 | (27.08) | 1979 | (40.69) | 4864 | (10.05) |
| STONE'S | 1313 | (15.65) | 1893 | (22.57) | 2198 | (26.21) | 2983 | (35.57) | 8387 | (17.32) |
| ATOMS' | 963 | (15.52) | 1062 | (17.14) | 1436 | (23.15) | 2741 | (44.19) | 6202 | (12.81) |
| CHAMPAGNAT'S | 1278 | (14.69) | 1668 | (18.18) | 2208 | (25.38) | 3544 | (44.19) | 8698 | (17.97) |
| **TROLL'S** | 195 | (14.69) | 151 | (14.09) | 274 | (25.56) | 452 | (42.16) | 1072 | ( 2.21) |
| Total **(Mean)** | 6144 | (12.69) | 7677 | (15.85) | 11620 | (24.00) | 22974 | (47.45) | 48415 | (99.99) |

Table 3. Data transformation of architectural model distribution for frequency analysis using **G-test of** association according to Sokal & Rholf (1973).*)

| STRATA / MODELS | A above 150 cm | B 100 - 150 cm | C 100 - 50 cm' | D below 50 cm | Total |
|---|---|---|---|---|---|
| TOMLINSON | – | — | 97.652 | 21421.786 | 21773.630 |
| HOLTTUM | – | — | 124.437 | 586.091 | 793.831 |
| CHAMBERLAIN | – | - | 483.017 | 3786.420 | 4563.109 |
| LEEUWENBERG | 5919.672 | 8072.525 | 16757.886 | 28561.870 | 68801.193 |
| McCLURE | 13.621 | — | .703.727 | 2368.640 | 3433.928 |
| PETIT | 3157.855 | 4023.595 | **6710.377** | 9321.170 | 27738.586 |
| COOK | 1334.814 | 1893.317 | 4737.061 | 20870.524 | 32619.064 |
| SCARRONE | 5071.866 | 5378.438 | 9402.916 | 14943.032 | 41302.801 |
| STONE | 9427.395 | 13885.274 | 16844.764 | 23839.088 | 75702.064 |
| ATTIMS | 6615.861 | 7384.006 | 10389.588 | 21689.094 | 54140.380' |
| CHAMPAGNAT | 9076.693 | 12307.216 | 16931.700 | 28928.514 | 78918.510 |
| TROLL | 1028.235 | 757.609 | 1537.997 | 2763.384 | 7479.611 |
| TOTAL | 53595.448 | 68678.303 | 108769.010 | 230641.480 | 522103.120 |

G=46Q1.94O.
p 0.005 at Df 33 = 57.649 (p = critical value of $X^2$)
Thus, distribution of the models in the area significantly associated with stratification.
*) The transformed data are derived from the absolute density value of the models (see table 2).

Table 4. Weeds of the present, the past and the future in the observed area (individual number).

| Sub - transect | Set of weeds: Present | Future | Past*) | Total | Chablis |
|---|---|---|---|---|---|
| 1 | 2944 | 3177 | – | 6121 | 11 |
| 2 | 3019 | 4190 | – | 7209 | V 16 |
| 3 | 3743 | 6394 | – | 10137 | . 15 |
| 4 | 4012 | 6326 | – | 10338 | 19 |
| 5 | 3481 | 5265 | – | 8746 | 15 |
| 6 | 2516 | 3345 | – | 5864 | 13 |
| Total | 19718 | 28697 | – | 48415 | 89 |

*) not determined

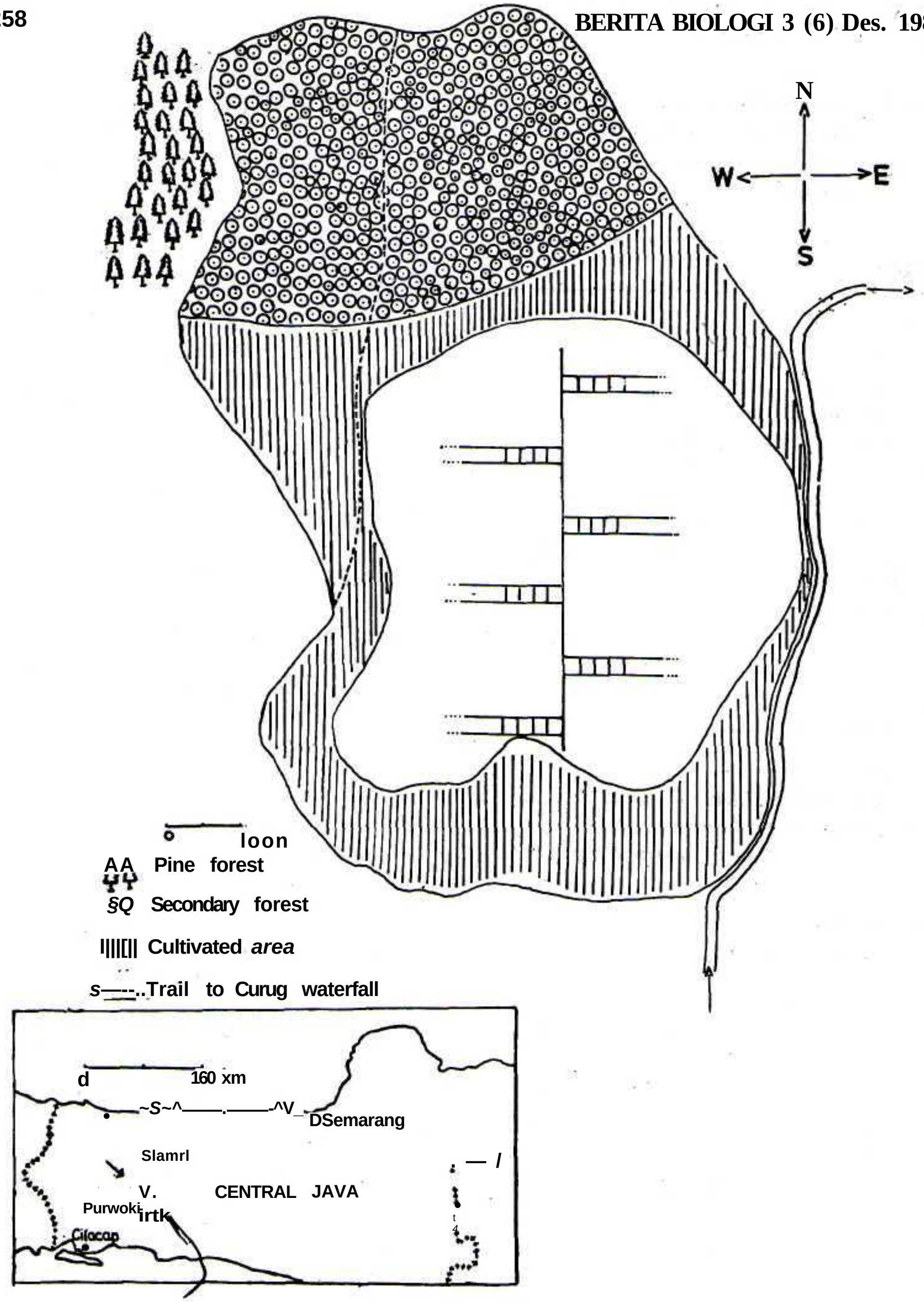


Figure 1. Sampling pattern of the transect method used in the study and the location map of the shrub vegetation in Menggala, Central Java.

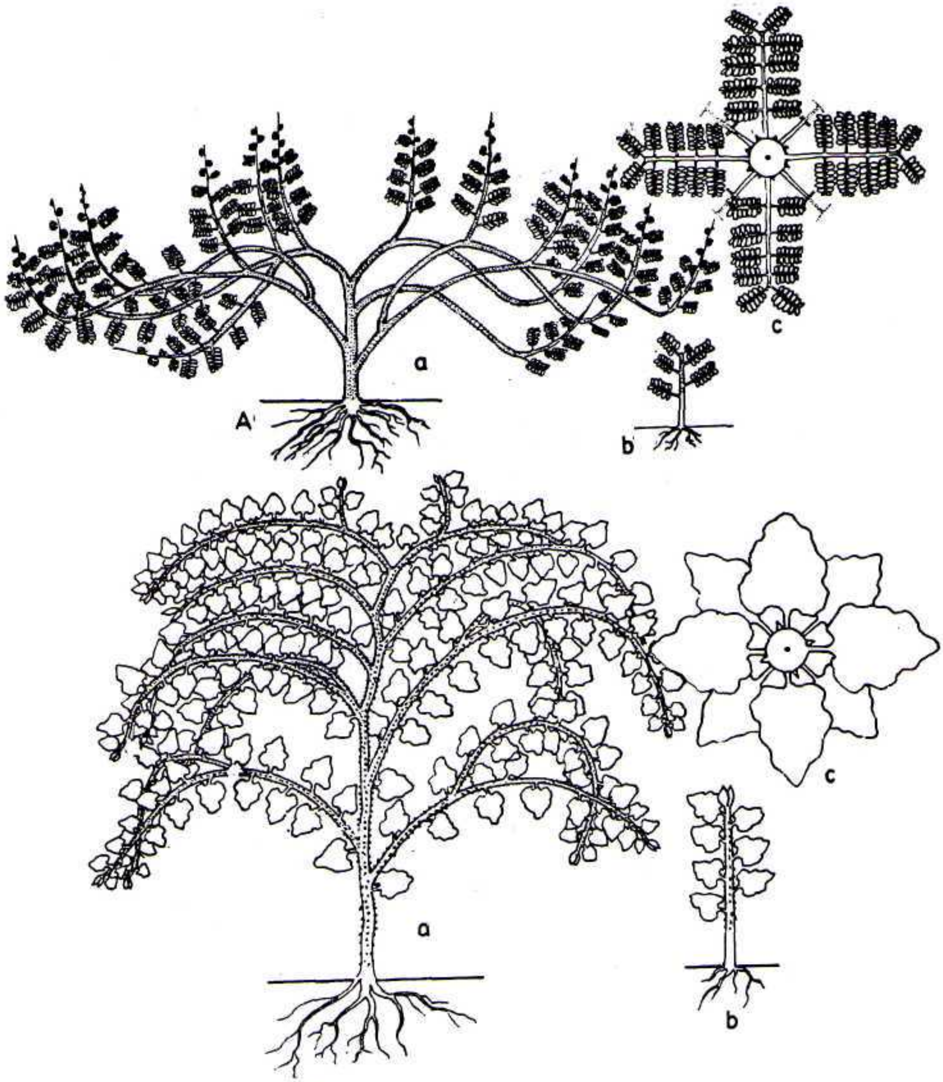


Figure 2. CHAMPAGNAT'S model (A. *Mimosa invisa* Mart; B. *PMbusxhrysdphyllus* Miq.) showing a mixed orthotropic axes;

a. Architecture of the mature plants
b. Seedlings
c. Radial symmetry of the phyllotaxies which characterize the orthotiopic axes.

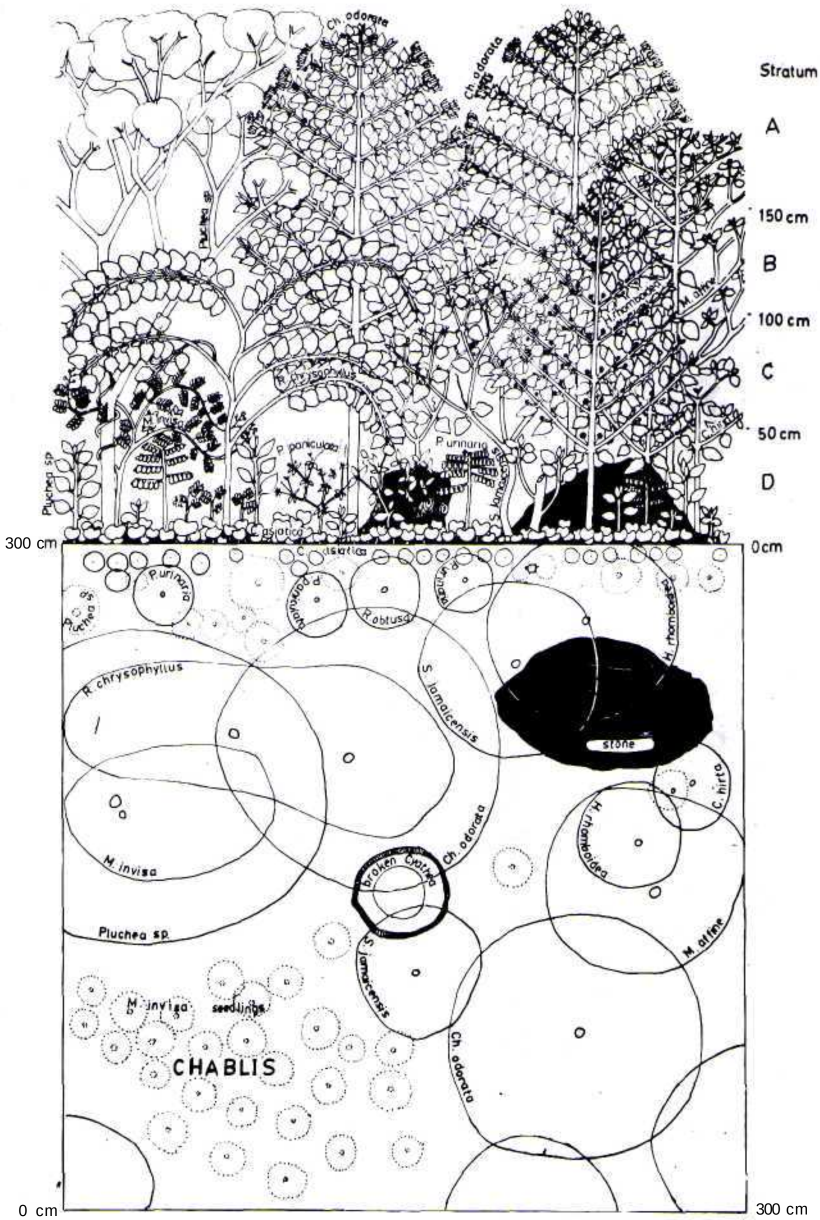


Figure 3. Profile diagram of an observed plot (3 x 3 m) in shrub vegetation of Menggala. Only dicotyledonous weeds were drawn. Outline represent weeds of the present, stripples represent weeds of the future. Further explanation in the text