

**NUMERATION AND ASSESSMENT OF THE UNIVERSITY OF HYDERABAD CAMPUS  
PLANT RESOURCES**

**A DISSERTATION SUBMITTED IN PARTIAL  
FULFILMENT FOR THE DEGREE OF  
MASTER OF PHILOSOPHY**

**BY  
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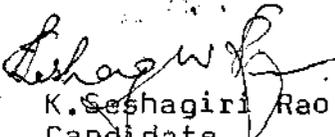
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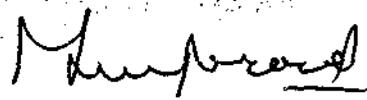
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D E C L A R A T I O N

I hereby declare that the work presented in this dissertation has been carried out by me under the supervision of Dr.M.N.V.Prasad, School of Life Sciences, University of Hyderabad and that this work has not been submitted for a degree or diploma of any other University.

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A C K N O W L E D G E M E N T S

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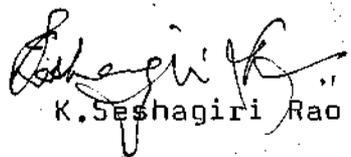
I thank Miss T.Vani and all of my senior colleagues and batch mates for their encouragement and timely help whenever I sought,

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Date:

Place:Hyderabad

  
K.Seshagiri Rao

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## INTRODUCTION

The University of Hyderabad campus is unique for having an area of 2,300 acres ( probably the largest campuses of all the Indian Universities). Hithertobefore, checklist of the campus flora has not been done. An adequate information of the campus flora is useful not only for academic interest but also to assess the plant resource potential, land use and in planning for environmental conservation.

Phytogeography of the Indian sub-continent is notable in the South East Asia for its rich plant wealth and diversity. Accordingly India has been devided into distinct Ecobotanic regions distributed under diverse climatic and physiographic conditions.(Puri et al.,1983) The only floristic account of the country is known from the monumental work of Sir J.D.Hooker through his 'Flora of British India'(1872-1897),which was about a century old. Since then the native flora changed considerably because of rapid urbanization,Industrial development and excessive exploitation of the plant wealth. Thus,the current floristic knowledge of our country is immediately warranted.

Inview of the significance of the subject, the Department of Environment (DOE) in 1983 launched an 'All India Co-ordinated Research Project on District Floras'

(monitored through Botanical Survey of India) to fillup the gaps in many areas that are still under explored/unexplored. In this context regional floras on a smaller grid are of greater importance. Furthermore, because of the growing concern about environmental protection and Eco-development programmes, the precise and current floristic data is very essential.

Floristic studies are also deeply related to the production and availability of biomass, where it forms the crux of Bioenergy subject. Due to shortage of fossil fuels much attention is being paid to Biomass\* based energy sources. Among renewable resources, bioenergy from Phytomass\*\* is of special significance, since plants have the unique property of fixing and forming carbon compounds by harnessing solar energy. Therefore, with the sound knowledge of floristic ecology fast growing plant species that grow on marginal/fallow/waste lands can be identified and raised in the form of energy plantations for green energy, social forestry etc. (Anonymous 1980, 1983, Sharma et al., 1985)

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\* Biomass is an ecological term for the total amount of living matter present at any time in a population or a given area. In Bioenergy context, it is loosely used to mean biologically produced material

\*\* Phytomass is the more appropriate term than 'Biomass' when energy is derived from plants.

The following are the major areas in the field of Bioenergy:

- a) Production and availability of biomass as a source of biofuel viz., raising Energy Plantations, Energy crops and Energy weeds.
- b) Identification of fast growing indigenous trees, shrubs, grasses and a variety of other plants that are hardy enough to grow on waste/fallow/marginal lands mainly for social forestry and afforestation programmes.
- c) Identification of native petrocrops as a source of hydrocarbons and other botanochemicals.
- d) Conversion of Biomass to biofuels.

Realizing the importance of alternative sources of energy from biomass, recently Government of India established organizations like Department of Non-conventional Energy Sources (DNES), Commission for Additional Sources of Energy (CASE). Yet, another namely, National Wasteland Development Board (NWDB) is meant specifically for reclamation of marginal and waste lands. This can be accomplished through the identification of fast growing plant species suitable to the nature of soil and water resources of a particular region. In this context, an inventory of indigenous plant resources on a regional basis is necessary before launching plantations of exotics like Eucalyptus hybrids.

## LOCATION, GEOLOGY, SOILS, VEGETATION AND METEOROLOGY

The University of Hyderabad campus consists of 2,300 acres of undulating landscape with a granitic camp<sup>o</sup>und wall (Figure 1). The University campus is about 20 kms away from the city towards SW on old Bombay highway close to 17<sup>o</sup>.26' N Latitude and 78<sup>o</sup>.27' E longitude. It is in the middle of the Deccan plateau situated at an altitude of 1772 ft above mean sea level. The undulating rock formation is made up of peninsular gne<sup>i</sup>ssic complex with intrusive granites. These are intruded by dykes and vein quartz. The dykes are generally of doleritic composition. The soils are of red loamy type with varying thickness. The campus is having a few small annual lakes with luxuriant marsh vegetation on periphery, and floating and submerged plants in the lake proper. ↗

The vegetation of the campus represents 'Southern thorny scrub' with scattered trees (Champion & Seth, 1962), viz., Azadiracta<sup>h</sup> indica Juss, Tamarindus indica, L., Wrightia tinctoria R.Br., Terminalia bellerica Roxb., Diospyros melanoxylon Roxb., Acacia nilotica (L.) Del. sub sp. indica (Benth.) Brenam. At several places the thorny thickets are up to 6 m high and closely covered.

The dominant shrubs encompass Zizyphus xylopyrus Willd., Capparis zeylanica L., Canthium dicoccum Merr. var.

umbellatum (Gamb.) Sant & Merch., Flacourtia indica (Burm.f) Merr., Securinega leucopyrus (Wills) Muell.Arg., Gymnosporia montana Benth., Bauhinia racemosa Lamk., Dichrostachys cinera W&A., Albizia amara Boiv., Mimosa hamata Willd. Acacia caesia W&A., A.chundra (Roxb) Willd., Dodonea viscosa (L) Jacq. and Zizyphus oenoplia Mill

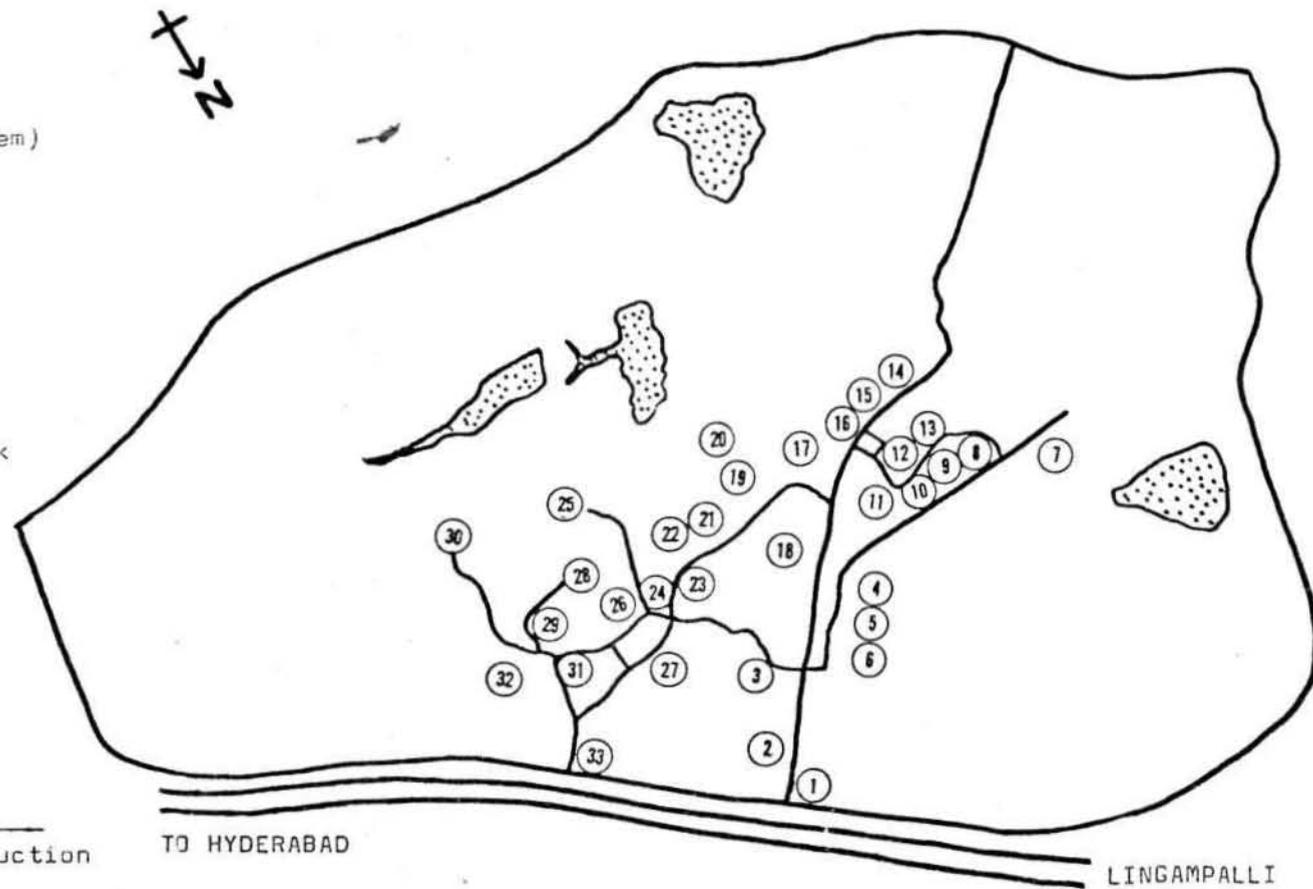
The vegetation of a region is determined by several factors, of which climatic factors are very important. The important factors which effect the vegetation are temperature, rainfall and humidity etc. Therefore, the meteorological data for Hyderabad city for the period May 1985 to May 1986 is given in table-1 which would give a clear picture of climate of the area in general.

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UNIVERSITY OF HYDERABAD

FIGURE 1

- 1. Main gate
- \*2. Admn. block
- \*3. Health centre
- 4,5,6. Men's hostels  
A, B, C respectively
- 7. N. Qrts
- 8. Primary school
- 9. Two-shed bldg (Phy, Chem)
- 10. Admn. offices
- 11. Life Sci./Chem.
- 12. Library/Post office
- 13. Workshop/stores
- 14. Bank
- 15. Canteen
- 16. V.C's office
- 17. Maths & CIS
- \*18. Science complex
- \*\*19. Library Bldg
- \*\*20. Humanities &  
social sciences block
- 21. Lecture hall complex
- 22. Central Inst. Lab
- \*23. Computer centre
- 24. Open air auditorium
- 25. V.C's lodge
- 26. Research sch. hostel.
- 27. Teachers qrts.
- 28. womens hostel
- 29. Teachers' flats
- 30. Nursery
- 31. Sports complex
- \*32. Officers qrts.
- 33. Masid bands gate



\* Bldgs. under construction

\*\* Proposed sites

Total area of the campus : 2300 acres

Table 1:Meteorological data of Hyderabad city:

	Temperature (mean) (°C)		Total Rainfall(mm)	Relative humidity (%)	
	Max.	Min.		08.30 hrs.	17.30 hrs.
<u>1985</u>					
May	40.2	26.5	000.8	50	27
June	32.7.	23.0.	119.2	75	59
July	30.8	22.1	116.7	81	63
August	30.6.	22.3	042.5	77	60
September	32.4	22.7	023.9	77	56
October	29.9	19.2	098.1	69	53
November	29.9	16.2	000.0	58	37
December	29.1	16.0	004.7	68	41
<u>1986</u>					
January	27.1	15.6	036.4	75	42
February	30.6	18.9	016.5	74	39
March	35.7	22.4	000.0	53	30
April	38.7	24.6	052.3	56	29
May	40.5	27.1	000.0	47	22

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Source: Meteorological observatory, Begumpet Air port, Hyderabad.

## FIELD AND HERBARIUM METHODS

The present study was taken up in August 1985.

The aim of the task is to prepare a check list of the campus flora and to develop herbarium in the School of Life Sciences.

The plant collections are <sup>made</sup> /althrough the seasons till the end of May 1986. In the field replicates of the specimens were collected and are numbered by affixing a label to the herbarium sheet. The following field data was collected and entered in the field note book:

Habit, habitat, occurrence of plants, associated plants if any, flower colour, and any other details that can be used in identification of the plants.

The plant specimens were identified with the help of Flora of Madras Presidency (Gamble, 1935), Flora of Bombay Presidency (Cook, 1901-1908), Synoptic flora of Mysore District (Rao & Razi, 1981), Flora of the Indian desert (Bhandari, 1978), and other relevant floristic works (Tadulingam & Venkatanarayana, 1932; Toby & Patricia, 1982; Varadpande, 1973; Terry, 1983)

In brief, the methods of collection, herbarium preparation, poisoning of the specimens is in accordance with the procedures recommended by Jain & Rao (1977). The specimens were mounted on international size hand made herbarium sheets purchased from Maharashtra State Khadi and Village Industries Board, Handmade paper Institute, Pune.

TAXONOMIC TREATMENT OF THE FAMILIES OCCURRING IN THE  
UNIVERSITY OF HYDERABAD CAMPUS (AFTER CRONQUIST, 1968)

MAGNOLIOPHYTA\*

MAGNOLIOPSISIDA\*

MAGNOLIIDAE\*

MAGNOLIALES\*

Magnoliaceae\*

Annonaceae

LAURALES

Lauraceae

ARISTOLOCHIALES

Aristolochiaceae

NYMPHAEALES

Nelumbonaceae

Nymphaeaceae

Ceratophyllaceae

RANUNCULALES

Menispermaceae

PAPAVERACEAE

Papavaraceae

HAMMELIDAE

URTICALES

Moraceae

CASUARINALES

Casuarinaceae

CARYOPHYLLIDAE

CARYOPHYLLALES

Nyctaginaceae

Aizoaceae

Cactaceae

Amaranthaceae

Portulacaceae

Molluginaceae

POLYGONALES

Polygonaceae

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\*) The grammatical endings -phyta, -opsida, -idae, -ales, -aceae represent the taxonomic ranks i.e., Division, Class, Subclass, Order and Family respectively.

PLUMBAGINALES	FABALES
Plumbaginaceae	Mimosaceae
DILLENIIDAE	Caesalpinaceae
THEALES	Fabaceae
Clusiaceae	MYRTALES
MALVALES	Lythaceae
Tiliaceae	Punicaceae
Sterculiaceae	Myrtaceae
Bombacaceae	Combretaceae
Malvaceae	PROTEALES
VIOLALES	Proteaceae
Flacourtiaceae	CORNALES
Violaceae	Alangiaceae
Passifloraceae	SANTALALES
Caricaceae	Loranthaceae
Cucurbitaceae	CELASTRALES
CAPPARALES	Celastraceae
Capparidaceae	EUPHORBIALES
Brassicaceae	Euphorbiaceae
Moringaceae	RHAMNALES
EBENALES	Rhamnaceae
Ebenaceae	Leeaceae
Sapotaceae	Vitaceae
ROSIDAE	POLYGALALES
ROSALES	Malpighiaceae
Crassulaceae	Polygalaceae
Rosaceae	

## SAPINDALES

Sapindaceae  
 Burseraceae  
 Meliaceae  
 Rutaceae  
 Zygophyllaceae  
 Anacardiaceae

## GERANIALES

Oxalidaceae  
 Balsaminaceae

## ASTERIDAE

## GENTIANALES

Loganiaceae  
 Gentianaceae  
 Apocynaceae  
 Asclepiadaceae

## SOLANALES

Solanaceae  
 Convolvulaceae  
 Cuscutaceae

## LAMIALES

Boraginaceae  
 Verbenaceae  
 Lamiaceae

## SCROPHULARIALES

Oleaceae  
 Scrophulariaceae  
 Acanthaceae  
 Pedaliaceae  
 Bignoniaceae

## RUBIALES

Rubiaceae

## ASTERALES

Asteraceae

## LILIOPSIDA

## ALISMATIDAE

## HYDROCHARITALES

## Hydrocharitaceae

## ARECIDAE

## ARECALES

## Arecaceae

## PANDANALES

## Pandanaaceae

## ARALES

## Araceae

## Lemnaceae

## COMMELINIDAE

## COMMELINALES

## Commelinaceae

## CYPERALES

## Cyperaceae

## Poaceae

## TYPHALES

## Typhaceae

## ZINGIBERIDAE

## ZINGIBERALES

## Musaceae

## Cannaceae

## LILIIDAE

## LILIALES

## Liliaceae

## Aloeaceae

## Agavaceae

## Dioscoreaceae

## SALIENT STATISTICS ON THE FLORA

Four hundred and twenty species (420) of flowering plants belonging to 93 families and 294 genera have been reported in the present work. The family Fabaceae tops the list with 22 genera and 33 species followed by Asteraceae with 19 genera and 22 species in Magnoliopsida. In Liliopsida family Poaceae is represented by 17 genera and 22 species followed by Liliaceae having 11 genera and 12 species.

The details are shown below

## MAGNOLIOPSIDA (=Dicotyledons)

	No. present	%
Families	78	83.87
Genera	246	83.61
Species	353	84

## LILIOPSIDA (=Monocotyledons)

	No. present	%
Families	15	16.12
Genera	48	16.38
Species	67	15.99

## KEY TO FAMILIES

(This key is applicable to only flora of the University of Hyderabad campus. Some of the families may appear more than once)

Artificial key to classes of Magnoliophyta (Flowering Plants):

- 1 a. Leaves with reticulate venation, alternate or opposite; flowers 5 or 4 merous; seeds with 2 cotyledons; vascular bundles in the stem arranged in a ring enclosing a pith (exceptions in some primitive genera) ... Magnoliopsida (=Dicotyledons)
- 1 b. Leaves with parallel venation, alternate; flowers 3-merous; seeds with one cotyledon; vascular bundles in the stem mostly scattered. ... Liliopsida (=Monocotyledons)

Artificial key to the groups of Magnoliopsida\*

- 1 a. Flowers with distinct calyx and corolla
- 2 a. Petals free. ... Polypetalae (Group-I)
- 2 b. Petals united. ... Gamopetalae (Group-II)
- 1 b. Calyx and corolla not distinguished (perianth), often perianth completely absent... Monochlamydeae (Group-III)

\*) The grouping proposed here is purely artificial and do not mean anything except convenience.

## Key to group-I: POLYPETALAE

1 a. Flowers actinomorphic

2a. Carpels many, free (apocarpous)

3 a. Aquatic herbs; leaves large; petioles long

4 a. Leaves with smooth petiole, peltate with  
sagittate base, dentate margin, floating;  
carpels confluent into a many celled ovary  
... Nymphaeaceae

4 b. Leaves with rough-prickled petiole;  
peltate and emerged; carpels irregularly  
sunken in a turbinate torus... Nelumbonaceae

3 b. Terrestrial plants

5 a. Stamens mostly laminar, stipules deciduous  
leaving stipular ring at each node; fruit  
follicle... Magnoliaceae

5 b. Stamens otherwise; stipules 0; fruit aggre-  
gate or berry ... Annonaceae

2b. Carpels united (Syncarpous)

6 a. Plants with unisexual flowers

7 a. Scandents or climbers

8 a. Scandents, dioecious... Menispermaceae

8 b. Climbers, monoecious... Cucurbitaceae

7 b. Shrubs, dioecious ... Flacourtiaceae

6 b. Plants with bisexual flowers

- 9 a. Flowers with disc
  - 10 a. Stamens equal to petals
    - 11 a. Carpel 1
      - 12 a. Trees with panicle inflorescence; stems with resin
        - ... Anacardiaceae
      - 12 b. Trees with axillary clusters of flowers; stems without resin but possess prickles
        - ... Rhamnaceae
    - 11 b. Carpels 2 - more
      - 13 a. Leaves simple
        - 14 a. Seeds arillate; shrubs with spines
        - 14 b. Seeds non-arillate
          - 15a. Disc glandular
            - fruit trilocular syncarpous
            - fruit capsule, winged.
            - ... Sapindaceae
          - 15b. Disc non-glandular; fruit berry
            - ... Vitaceae
      - 13 b. Leaves pinnately compound, deciduous; often leaving scars on stems

- 16 a. Leaflets with serrate margin; fruit depressed, globular berry ... Leeaceae
- 16 b. Leaflets with entire margin; fruit a globose fleshy berry with 1-5 pitted pyrenes ... Burseraceae
- 10 b. Stamens twice to petals or numerous
  - 17 a. Herbs
    - 18 a. Leaves pinnately compound; stipulate; style 1; fruit divided into 2-10 often winged spinous cocci ... Zygophyllaceae
    - 18 b. Leaves trifoliolate, exstipulate; styles-5; fruit loculicidal capsule ... Oxalidaceae
  - 17 b. Other than herbs
    - 19 a. Leaves simple
      - 20 a. Trees or under trees with spines; stamens twice to petals; fruit berry ... Alangiaceae
      - 20 b. Trees or scandants without spines; stamens double to petals ; fruit drupe ... Combretaceae
    - 19 b. Leaves compound
      - 21 a. Pinnately compound
        - 22 a. Staminal tube present; stamens twice to petals; fruit buccate ... Meliaceae
        - 22 b. Staminal tube absent; stamens numerous; fruit berry... Rosaceae

- 21 b. Digitately compound
  - 23 a. Leaves and other plant parts with glands; fruit berry or hesperidium ... Rutaceae
  - 23 b. Leaves and other parts without glands; fruit drupe ... Sapindaceae
- g b. Flowers without disc
  - 24 a. Stamens numerous
    - 25 a. Ovary unilocular
      - 26 a. Fruit legume; stamens numerous or twice to petals ... Mimosaceae
      - 26 b. Fruit otherwise
        - 27 a. Plant succulent, cladode stem; ovules many on axile placentation; fruit berry ... Cactaceae
        - 27 b. Plants non-succulents
          - 28 a. Herbs, scandents; ovules parietal placentation; fruit silique or drupe ... Capparidaceae
          - 28 b. Trees, ovule 1; fruit drupe ... Clusiaceae
      - 25 b. Ovary 2-many locular
        - 29 a. Ovary superior
          - 30 a. Stamens delphous condition (in
            - 31 a. Stamens monodelphous; <sup>bundles</sup>anthers 1 celled

- 32 a. Leaves simple; anthers bean shaped;  
pistils more than 1 ... Malvaceae
- 32 b. Leaves digitately compound; anthers  
otherwise ... Bombacaceae
- 31 b. Stamens di-polydelphous; anthers 2 celled
  - 33 a. Stamens didelphous in 2 whorls; staminodes  
present ... Streculiaceae
  - 33 b. Stamens polydelphous; staminodes absent  
... Tiliaceae
- 30 b. Stamens free condition
  - 34 a. Plants with yellow latex; capsule spinous  
... Papavaraceae
  - 34 b. Plants without latex; capsule circumscissile  
... Aizoaceae
- 29 b. Ovary inferior or perigynous
  - 35 a. Leaves gland dotted; sepals and petals imbricate;  
intramarginal vein present ... Myrtaceae
  - 34 b. Leaves without gland dots; sepals and petals  
valvate ... Punicaceae
- 24 b. Stamens definite
  - 26 a. Ovary unilocular
    - 37 a. Parasitic plants; leaves 0; stamens 3+3;  
fruit globose berry ... Lauraceae
    - 37 b. Non-parasitic plants (free living)
      - 38 a. Succulent leaves; stamens opposite to  
petals ... Protulacaceae
      - 38 b. Non-succulent leaves; stamens di or  
tetradynamous.

- 39a. Plants with hairs or glands
  - ... Capparidaceae
- 39 b. Plants glabrous ... Brassicaceae
- 35 b. Ovary 2-many locular
  - 40 a. Climbers;stamens on gynandrophore
    - ... Passifloraceae
  - 40 b. Herbs or under trees
    - 41 a. Herbs;petals 0 ... Mulluginaceae
    - 41 b. Herbs or under trees;petals present;
      - stamens twice to petals
      - ... Lythraceae
- 1 b. Flowers zygomorphic
  - 42 a. Fruit legume
    - 43 a. Corolla papilionaceous;descendingly imbricate
      - aestivation ... Fabaceae
    - 43 b. Corolla otherwise;ascendingly imbricate aesti-
      - vation ... Caesalpinaceae
  - 43 b. Fruit otherwise
    - 44 a. Ovary unilocular
      - 45 a. Tricarpellary syncarpous;fruit capsule
        - seeds not winged ... Violaceae
      - 45 b. Uniseriate ovules;fruit 3 valved capsule;
        - seed winded ... Moringaceae
    - 44 b. Ovary 2 - many locular
      - 46 a. Flowers with a corolla spur
        - ... Balsaminaceae
      - 46 b. Flowers without corolla spur

47 a. Leaves compound;climbers;capsule trilocular

... Sapindaceae

47 b. Leaves simple

48 a. Ovary 2 locular;stamens connate at base;style 1;

ovule 1 in each locule ... Polygalaceae

48 b. Ovary more than 2 locules;styles as many as

locules; ovules 2-more in each locule

... Malpighiaceae

## Key to group-II ; GAMOPETALAE

## 1 a. Ovary inferior

2a. Inflorescence involucrate heads;stamens synginecious;  
style bifurcated;fruit an achene ... Asteraceae

2b. Inflorescence varies;stipules conspicuous;inter-  
intrapetiolar stipules ... Rubiaceae

## 1 b. Ovary superior

## 3 a.Parasites

4a. Root parasites ... Scrophulariaceae

4b. Stem parasites;leafless,complete parasites;  
twiny climbers;stems yellow ... Cuscutaceae

## 3 b.Non-parasites

## 5 a. Flowers actinomorphic

## 6 a. Carpels 2

## 7 a. Unilocular

8 a. Trees;leaves 3-5 nerved;fruit  
berry ... Loganiaceae

8 b. Herbs;leaves otherwise;fruit  
septicidal capsule ...Gentianaceae

## 7 b. Bilocular

## 9 a. Stems with laticifers

10 a. Corolla tubular;seeds with-  
out coma... Convolvulaceae

10 b. Corolla otherwise;seeds  
with coma

11 a.Pollen does not form  
pollinia;corona absent

... Apocynaceae

- 11 b. Pollen form pollinia;  
corona present  
... Asclepiadaceae
- 9 b. Stems without laticifers
  - 12 a. Scandant shrubs; fruit berry  
... Oleaceae
  - 12 b. Stems otherwise (not scandant)
    - 13 a. Flowers helicoid or  
scorpioid cymes; style  
mostly gynobasic; stigma  
capitate or 2 lobed; ovule  
1 in each locule  
... Boraginaceae
    - 13 b. Flowers solitary or cyme;  
ovules many; Gynoecium  
zygomorphic to floral  
parts ... Solanaceae
- 6 b. Carpels more than 2
  - 14 a. Herbs with terminal spikes; calyx conspic-  
uous; glandular ... Plumbaginaceae
  - 14 b. Trees or shrubs
    - 15 a. Latex present in plant parts
      - 16 a. Leaves palmately lobed;  
monoecious; 5-carpels, uni-  
locular ... Caricaceae

16 b. Leaves simple;bisexual;5 carpels  
 multilocular ... Sapotaceae

15 b. Latex absent ... Ebenaceae

5 b. Flowers zygomorphic

17 a. Parasites ... Scophulariaceae

17 b. Non-parasites

18 a. Leaves compound;flowers large;anthers  
 divaricate ... Bignoniaceae

18 b. Leaves simple

19 a. Terminal style

20 a. Fruit capsule

21 a. Plants glabrous or rushlike;  
 often aquatic... Scophulariaceae

21 b. Plants pubiscent.. Pedaliaceae

20 b. Fruit berry or drupe ... Verbenaceae

19 b. Gynobasic style,aromatic leaves;  
 fruit of 4 nutlets ... Lamiaceae

## Key to group - III : MONOCHLAMYDAE

1 a. Parasites ... Loranthaceae

1 b. Non-parasites

2 a. Aquatic or marshy herbs

3 a. Stipules 0; leaves in whorls; flowers minute,  
solitary; submerged plants ... Ceratophyllaceae3 b. Not submerged; stipules large, connate in a tubular  
ocrea; flowers in terminal spikes ... Polygonaceae

2 b. Terrestrial plants

4 a. Flowers unisexual, monoecious

5 a. Leaves reduced to scales ... Casuarinaceae

5 b. Leaves otherwise; plants with latex

4 b. 6 a. Inflorescence cyathium, rarely spike  
... Euphorbiaceae6 b. Inflorescence hypanthodium, rarely a  
condensed spike ... Moraceae

4 b. Flowers bisexuals

7 a. Flower zygomorphic

8 a. Trees, leaves pinnately dissected;  
fruit follicle ... Proteaceae8 b. Scandents, leaves simple; fruit capsule;  
flowers trumpet shaped... Aristolochiaceae

7 b. Flower actinomorphic

9 a. Perianth limb funnel shaped; bracteole  
modified into bright colourful petal  
like appendage ... Nyctaginaceae9 b. Perianth 5, free, hyaline or scarious;  
bracteoles often modified into hooked  
bristles... Amaranthaceae

## Key to Liliopsida:

## 1 a. Ovary superior

2 a. Perianth absent or reduced to scale like or bristle like structures or lodicules

3 a. Flowers on a spadix subtended by spathe

4 a. Shrubs with long leaves; often aerial roots; flowers dioecious, crowded and catkin like ... Pandanaceae

4 b. Aquatic herbs; flowers bisexual or monoecious... Araceae

3 b. Flowers seldom on a spadix

5 a. Stems often triangular; leaves 3 ranked with sheaths closed; anthers basifixed; ligule absent; flower subtended by a single bract; perianth represented by bristles. ... Cyperaceae

5 b. Stems hollow, round; leaves 2 ranked with often sheaths, ligule generally present; bracts of lemma and palae; anthers dorsifixed, versatile... Poaceae

6 a. Leaves minute, scale like, rootless, stem less; style short, stigma truncate funnel shaped... Lemnaceae

6 b. Leaves large, linear, with creeping rhizomes clothed with scales ... Typhaceae

2 b. Perianth present

7 a. Woody trees, leaves large fan shaped; spathe often present... Areaceae

## 7 b. Succulent herbs

8 a. Flowers spikes; perianth tubular, leaf  
arrangement rosulate... Aloeaceae

8 b. Flowers solitary or in racemes with green sepals  
and blue petals... Commelinaceae

## 1 b. Ovary inferior

9 a. Climbers; root stock tuberous; fruit winged and  
angled ... Dioscoriaceae

## 9 b. Herbs or shrubs

10 a. Flowers unisexual, fruit berrylike; perianth  
petaloid; staminodes present ... Musaceae

10 b. Perianth tubular or spathaceous; anthers 1 celled  
laterally adnate to a broad petaloid staminode  
... Cannaceae

11 a. Aquatic herbs; flowers unisexual, perianth  
in 2 series both coralline... Hydrocharitaceae

## 11 b. otherwise

12 a. Flowers showy, sepals petaloid, anthers  
open by lengthwise slits; stipules  
spiny; bulbs present... Liliaceae

12 b. Succulent xerophytes; leaf ending and  
margin spinulose; bulbs not present  
... Agavaceae

## ENUMERATION OF THE UNIVERSITY CAMPUS FLORA

A checklist of the plants encountered in this study are mentioned here. The families are arranged according to Cronquist's system (1968). Genera and species are treated alphabetically in each family. Habit, flower colour and occurrence of each plant species is given in an abbreviated form as mentioned below:

### Habit:

AH - Aquatic herb	SC - Scandent
H - Herb	TS - Thorny shrub
TH - Thorny herb	C - Climber
PH - Prostrate herb	PC - Prickly climber
SH - Succulent herb	SS - Succulent shrub
WH - Woody herb	T - Tree
S - Shrub	UT - Under tree

### Flower Colour:

B - Blue	G - Green	P - Pink	Pr - Purple
V - Violet	O - Orange	W - White	Y - Yellow
C - Cream	Br - Brown	Ro - Rose	R - Red

### Occurrence:

F - Frequent (common)	A - Abundant
E - Escape	O - Occasionally seen
C - Cultivated (introduced)	

MAGNOLIACEAE	Habit (1)	Flower colour(2)	Occurrence (3)	Voucher specimen(4)
1. <u>Michelia champaca</u> L	T	Y	C	-
ANNONACEAE				
2. <u>Annona reticulate</u> L	T	G	C	160
3. <u>A.squamosa</u> L	T	GY	F	16
4. <u>Artobotrys odoratissimus</u> R.Br	C	G	C	-
5. <u>Polyalthia longifolia</u> Thw.	T	GY	C	181
LAURACEAE				
6. <u>Cassytha filiformis</u> L (Plate 6, fig.40)	C	G	A	47
ARISTOLOCHIACEAE				
7. <u>Aristolochia indica</u> L	C	Pr	O	70
NELUMBONACEAE				
8. <u>Nelumbo nutifera</u> Gaertn.	AH	Ro	C	121
NYMPHAEACEAE				
9. <u>Nymphaea nouchali</u> Burm.f	AH	R	C	120
MENISPERMACEAE				
10. <u>Cocculus hirsutus</u> (L)Diels	SC	GY	A	182
11. <u>Cissampelos pareira</u> L	C	GY	A	371
12. <u>Tinospora cordifolia</u> (Willd)Meirs	C	GY	A	372
PAPAVERACEAE				
13. <u>Argemone mexicana</u> L	H	Y	A	69
MORACEAE				
14. <u>Artocarpus altilis</u> (Park) Fosb.	T	G	C	-
15. <u>A.heterophylla</u> Lamk.	T	G	C	-
CERATOPHYLLACEAE				
9a. <u>Ceratophyllum demersum</u> L	AH	W	A	-

	(1)	(2)	(3)	(4)
16. <u>Ficus benghalensis</u> L	T	R	F	137
17. <u>F. drupaceae</u> Thunb. var. <u>pubescens</u> (Roth) Corner	T	Br	D	183
18. <u>F. elastica</u> Roxb.	T	-	C	-
19. <u>F. hispida</u> L.f	T	Y	F	184
20. <u>F. racemosa</u> L	T	P	F	185
21. <u>F. religiosa</u> L	T	P	F	135
CASUARINACEAE				
22. <u>Casuarina equisetifolia</u> Forst	T	Br	C	57
NYCTAGINACEAE				
23. <u>Boerhavia diffusa</u> L	WH	Ro	A	66
24. <u>Bougainvillea spectabilis</u> Willd.	TS	Variable	C	67
AIZOACEAE				
25. <u>Trianthema portulacastrum</u> L	PH	P	A	107
CACTACEAE				
26. <u>Opuntia elatior</u> Mill	SS	Y	D	186
AMARANTHACEAE				
27. <u>Achyranthes aspera</u> L	WH	G	F	11
28. <u>Aerva lanata</u> (L) Juss	WH	W	F	113
29. <u>A. monsonia</u> Mart	H	W & P	F	115
30. <u>Almania nodiflora</u> (L.f) R.Br-H		Br, Y, G	A	12
31. <del>Alternanthera</del> <u>zungen</u> H.B & K. Nov.	PH	W	A	112
32. <u>A. sessilis</u> (L) R.Br ex DC	PH	W	A	18
33. <u>Amaranthus blitum</u> L	H	G	A	187
34. <u>A. gracilis</u> Desf.	H	G	A	17
35. <u>A. spinosus</u> L	H	G	F	14

	(1)	(2)	(3)	(4)
36. <u>Celosia argentea</u> L	WH	W	A	114
37. <u>Digeria muricata</u> (L) Mart	H	P	F	189
38. <u>Gomphrena celosioides</u> Mart	PH	W	A	13
39. <u>G. globosa</u> L	H	P&W	C	170
40. <u>Pupalia lappacea</u> (L) Juss.	WH	G	F	189
PORTULACACEAE				
41. <u>Portulaca oleraceae</u> L.	SH	Y	A	190
42. <u>P. pilosa</u> sub sp. <u>grandiflora</u> (Hk) Geesink.	SH	P	C	-
43. <u>P. quadrifida</u> L.	SH	Y	F	373
44. <u>P. suffruticosa</u> Wt.	SH	P&Y	F	106
MOLLUGINACEAE				
45. <u>Glinus lotoides</u> L.	PH	W	F	191
46. <u>G. oppositifolius</u> (L) A. DC	H	W	F	192
47. <u>Mollugo cerviana</u> Ser.	H	W	F	108
POLYGONACEAE				
48. <u>Polygonum glabrum</u> Ser.	S	P	A	145
PLUMBAGINACEAE				
49. <u>Plumbago zeylanica</u> L.	WH	W	F	152
CLUSIACEAE				
50. <u>Calophyllum inophyllum</u> L.	T	W	C	193
TILIACEAE				
51. <u>Corchorus aestuans</u> L.	WH	Y	A	21
52. <u>C. fascicularis</u> Lamk.	WH	Y	F	22

	(1)	(2)	(3)	(4)
53. <u>C. olitoides</u> L.	WH	Y	A	49
54. <u>C. tridens</u> L.	WH	Y	F	50
55. <u>C. trilocularis</u> L.	WH	Y	F	51
56. <u>C. urticaefolius</u> W&A	WH	Y	F	52
57. <u>Grewia abutifolia</u> Vent ex Juss.	S	Y	F	194
58. <u>G. emerginata</u> W&A	S	Y	F	195
59. <u>Triumfetta pilosa</u> Roth.	S	Y	F	196
60. <u>T. rhomboidea</u> Jacq.	S	Y	A	197
STERCULIACEAE				
61. <sup>b</sup> <u>Domeya wallichii</u> Bt et Hk.	S	Ro	C	-
62. <u>Guazuma ulmifolia</u> Lamk.	T	Y	F	118
63. <u>Waltheria indica</u> L.	WH	Y	A	198
BOMBACACEAE				
64. <u>Ceiba pentandra</u> (L) Gaertn.	T	W	C	-
MALVACEAE				
65. <u>Abutilon indicum</u> Sweet.	S	Y	A	71
66. <u>Althea rosea</u> (L) Cav.	S	P	C	-
67. <u>Hibiscus rosa-sinensis</u> L.	S	R	C	144
68. <u>Malvastrum coromandelianum</u> (L) Garcke.	S	Y	F	5
69. <u>Pavonia odorata</u> Willd.	S	W	F	105
70. <u>P. zeylanica</u> Cav.	S	W/P	F	148
71. <u>Sida acuta</u> Burm.f.	S	Y	A	3
72. <u>S. cordata</u> (Burm.f.) Borss.	WH	Y	A	129
73. <u>S. rhombifolia</u> L.	WH	Y	F	130
74. <u>S. glutinosa</u> Cav.	H	Y	F	131

	(1)	(2)	(3)	(4)
FLACOURTIACEAE				
75. <u>Flacourtia indica</u> (Burm.f.) Merr.	TS	W	A	376
VIOLACEAE				
76. <u>Hybanthus enneaspermus</u> (L) F. Muell.	H	P	A	199
PASSIFLORACEAE				
77. <u>Passiflora edulis</u> Sims.	CS	B	C	65
CARICACEAE				
78. <u>Carica papaya</u> L.	T	W	C	-
CUCURBITACEAE				
79. <u>Citrullus vulgaris</u> Schrad.	C	Y	E	200
80. <u>Coccinia grandis</u> (L) Voigt.	C	W	E	377
81. <u>Cucumis sativa</u> L.	C	Y	C	-
82. <u>Luffa acutangula</u> (L) Roxb.	C	Y	C	201
CAPPARIDACEAE				
83. <u>Cadaba fruticosa</u> (L) L. Druce.	CS	W	O	204
84. <u>Cleome aspera</u> Koen.	H	Y	F	378
85. <u>C. chelidonii</u> L.	H	Ro	O	203
86. <u>C. gynandra</u> L.	H	W	F	44
87. <u>C. viscosa</u> L.	H	Y	A	43
BRASSICACEAE				
88. <u>Brassica juncea</u> Hk.f. et Thoms	H	Y	C	-
89. <u>Raphanus sativus</u> L.	H	W	C	-
MORINGACEAE				
90. <u>Moringa oleifera</u> Lamk.	T	W	C	87

	(1)	(2)	(3)	(4)
EBENACEAE				
91. <u>Diospyros melanoxylon</u> Roxb.	T	Br	A	205
92. <u>D. peregrina</u> (Gaertn) Gurke.	S	W	A	379
SAPOTACEAE				
93. <u>Achras zapota</u> L.	T	W	C	-
94. <u>Mimusops elengi</u> L.	T	W	C	-
CRASSULACEAE				
95. <u>Aichryson dichotomum</u> (DC) Webb et Berth.	SH	Y	C	-
96. <u>Kalanchoe pinnata</u> (Lamk) Persoon.	SH	P	E	206
97. <u>K. tubeflora</u> (Herbey) Hamet.	SH	P	E	207
ROSACEAE				
98. <u>Rosa brunonii</u> Lindl.	TS	W&Ro	E	209
MIMOSACEAE				
99. <u>Acacia auriculiformis</u> A. Cunn ex Bth	T	Y	C	159
100. <u>A. caesia</u> W&A.	PC	W	A	208
101. <u>A. chundra</u> (Roxb) Willd.	T	Y	A	210
102. <u>A. nilotica</u> (L) Del sub sp <u>indica</u> (Bth) B.	T	Y	A	212
103. <u>Albizia amara</u> (Roxb) Boiv.	T	W	D	211
104. <u>A. lebbeck</u> (L) Willd.	T	WY	A	72
105. <u>Calliandra inaequilatera</u> Ruby.	T	R	C	216
106. <u>Dichrostachys cinera</u> (L) Wet et Arn.	TS	YP	A	220
107. <u>Enterolobium saman</u> Prain.	T	R	A	73
108. <u>Mimosa hamata</u> Willd.	TS	Ro	A	231
109. <u>M. pudica</u> L.	WH	Ro	F	142
110. <u>Prosopis chilensis</u> (Molina) Schuntz.	T	Y	D	227

	(1)	(2)	(3)	(4)
111. <u>Xylia xylocarpa</u> Taub.	T	W	C	-
CAESALPINIACEAE				
112. <u>Caesalpinia pulcherrima</u> (L)SW.	S	R&Y	A	104
113. <u>Cassia auriculata</u> L.	S	Y	A	91
114. <u>C. fistula</u> L.	T	Y	A	92
115. <u>C. javanica</u> L.	T	P	C	213
116. <u>C. occidentalis</u> L.	WH	Y	A	93
117. <u>C. obtusifolia</u> L.	WH	Y	A	98
118. <u>C. pumila</u> Lamk.	PH	Y	F	374
119. <u>C. surrattensis</u> Burm.	T	Y	A	94
120. <u>Delonix elata</u> (L)Gamble	T	Y	C	215
121. <u>D. regia</u> (Doj)Rafin.	T	R	C	214
122. <u>Peltophorum pterocarpus</u> (DC) Bak.	T	Y	A	122
123. <u>Tamarindus indica</u> L.	T	Y	F	30
FABACEAE				
124. <u>Abrus precatorius</u> L.	SC	W	O	219
125. <u>Alysicarpus bupleurifolius</u> (L)DC.	H	Pr	A	235
126. <u>A. racemosus</u> Bth.	H	Pr	A	236
127. <u>Arachis hypogaea</u> L.	H	T	E	218
128. <u>Butea monosperma</u> (Lamk)Taub.	T	R	F	221
129. <u>Canavalia gladiata</u> (Jacq)DC.	SC	P	O	223
130. <u>Clitoria ternatea</u> L.	SC	B	F	90
131. <u>Crotalaria ovalifolia</u> Wall ex Fyson.	S	Y	F	237
132. <u>C. pallida</u> Ali.	S	Y	F	230
133. <u>C. pusilla</u> Heyne ex Roth	H	Y	A	248
134. <u>Dalbergia lanceolaria</u> L.f.	T	W	C	224

	(1)	(2)	(3)	(4)
135. <u>D. sissoo</u> Roxb.	T	W	C	174
136. <u>Derris scandens</u> (Roxb) Bth.	SC	W	F	225
137. <u>Desmodium triflorum</u> (L) DC.	H	Pr	A	369
138. <u>Gliciridia sepium</u> (Jacq) Kunth ex Steud.	T	P	F	242
139. <u>Indigofera cordifolia</u> Heyne ex Roth	H	P	A	234
140. <u>I. glandulosa</u> Willd.	H	R	A	239
141. <u>I. linifolia</u> (L.f.) Retz.	PH	P	A	232
142. <u>I. linnaei</u> Ali.	PH	R	A	238
143. <u>Lablab purpurea</u>	SC	P	C	-
144. <u>Lens esculenta</u> Moench.	H	W	E	-
146. <u>Mellettia peguensis</u> Ali.	H	Pr	C	245
147. <u>Pongamia pinnata</u> (L) Pierre	T	W	F	146
145. <u>Melilotus indica</u> All.	H	P	O	240
148. <u>Rhynchosia rufescens</u> (Willd) DC.	SC	Y	A	241
149. <u>Rothia indica</u> (L) Druce.	H	W	O	233
150. <u>Tephrosia hirta</u> Buch.	WH	P	F	243
151. <u>I. leptostachya</u> DC.	WH	P	A	179
152. <u>I. purpurea</u> (L) Pers.	WH	P	F	35
153. <u>I. tinctoria</u> Pers.	WH	P	F	244
154. <u>Vigna aconitifolia</u> (Jacq) Marechal.	H	Y	O	228
155. <u>V. trilobata</u> (L) Verdcourt.	H	Y	O	89
156. <u>Zornia gibbosa</u> Span.	H	Y	A	177
MYRTACEAE				
157. <u>Callistemon lanceolatus</u> Sweet.	T	R	C	-
158. <u>Eucalyptus citriodora</u> Hk.f.	T	W	C	-



	(1)	(2)	(3)	(4)
159. <u>Psidium guajava</u> L.	T	W	C	-
160. <u>Syzygium cumini</u> (L) Skeel.	T	W	F	226
PUNICACEAE				
161. <u>Punica granatum</u> L.	T	R	C	-
COMBRETACEAE				
162. <u>Cobretum ovalifolium</u> Roxb.	SC	W	F	246
163. <u>Quisqualis indica</u> L.	SC	R or W	F	41
164. <u>Terminalia bellerica</u> (Gaertn) Roxb.	T	W	O	36
LYTHRACEAE				
165. <u>Ammania baccifera</u> L.	H	Gr	F	247
166. <u>Lagerstromia speciosa</u> . Pers.	T	Ro	C	-
167. <u>Rotala rotundifolia</u> (D. Don) Koehne	PH	Ro	F	250
PROTEACEAE				
168. <u>Grevillea robusta</u> A. Cunn.	T	Y	C	-
ALANGIACEAE				
169. <u>Alangium salvifolium</u> Wang.	TS	W	F	166
LORANTHACEAE				
170. <u>Dendrophthoe falcata</u> (L.f.) Ellingsh.	S	P	O	248
CELASTRACEAE				
171. <u>Gymnosporium montana</u> Bth.	TS	W	A	249
EUPHORBIACEAE				
172. <u>Acalypha indica</u> L.	H	G	A	7
173. <u>A. lanceolata</u> Willd.	H	G	A	251
174. <u>Cicca distica</u> L.	T	G	C	-
175. <sup>ae</sup> <u>Codium variegatum</u> Bl.	S	W	C	253

	(1)	(2)	(3)	(4)
176. <u>Croton bonplandianum</u> Baill.	WH	W	A	254
177. <u>Euphorbia antiquorum</u> L.	SS	Y	O	161
178. <u>E. erythroclada</u> Boiss.	H	W	F	256
179. <u>E. heterophylla</u> L.	H	G	A	74
180. <u>E. hirta</u> L.	H	G	A	2
181. <u>E. indica</u> Lamk.	H	W	F	255
182. <u>E. milii</u> Desm.	SS	R	C	162
183. <u>E. prostrata</u> Ali.	PH	G	A	76
184. <u>E. pulcherrima</u> Willd ex Kl.	S	R	C	81
185. <u>E. thymifolia</u> L.	PH	G	A	75
186. <u>E. tirucalli</u> L.	SS	G	O	163
187. <u>Jatropha glandulifera</u> Roxb.	S	R	O	257
188. <u>J. podagrica</u> WJ Hk	S	R	C	-
189. <u>Kirgenellia reticulata</u> (Poir) S Baill.	S	R	F	140
190. <u>Pedilanthus tithymaloides</u> (L) SS Poir.	SS	R	F	147
191. <u>Phyllanthus amarus</u> Schum et. H	H	G	A	9
192. <u>P. emlica</u> L.	T	Y	C	-
193. <u>P. maderaspetensis</u> L.	H	Y	A	258
194. <u>P. virgatus</u> Forst. f.	H	Y	A	259
195. <u>Sebastiania chamaelea</u> (L) Muell.	H	Y	F	260
196. <u>Securinega leucopyrus</u> (Willd) S. Muell-Arg.	S	W	F	-
197. <u>Synadenium grantii</u> Hk. f.	SS	R	C	269
RHAMNACEAE				
198. <u>Ziziphus oenoplia</u> Mill.	TS	Y	A	274
199. <u>Z. xylopyrus</u> Willd.	TS	Y	A	270

	(1)	(2)	(3)	(4)
LEEACEAE				
200. <u>Leea edgeworthii</u> Sant.	T	Y	F	272
VITACEAE				
201. <u>Cissus pallida</u> (W&A) Planch.	C	Y	F	271
202. <u>Vitis woodrowii</u> Stapf	A	P	A	370
MALPIGHIACEAE				
203. <u>Thryallis glauca</u> Kuntz.	S	Y	E	273
POLYGALACEAE				
204. <u>Polygala chinensis</u> L.	WH	Y	F	279
SAPINDACEAE				
205. <u>Cardiospermum helicacabum</u> L.	C	Y	F	54
206. <u>Dodonia viscosa</u> L.	S	Y	A	102
207. <u>Sapindus laurifolius</u> Vahl.	T	Y	F	59
BURSERACEAE				
208. <u>Garuga pinnata</u> Roxb.	T	Y	F	278
ANACARDIACEAE				
209. <u>Anacardium occidentale</u> L.	T	W	C	-
210. <u>Buchanania lanzan</u> Spr.	T	Y	O	368
211. <u>Mangifera indica</u> L.	T	Y	E	-
212. <u>Semicarpus anacardium</u> L.f.	T	Y	O	152
MELIACEAE				
213. <u>Azadirachta indica</u> Juss.	T	Y	A	110
214. <u>Melia azadirachta</u> L.	T	W	C	109
RUTACEAE				
215. <u>Aegle marmelos</u> (L) Corr.	T	W	O	-
216. <u>Citrus aurantium</u> L.	T	W	C	-
217. <u>C. limon</u> Burm.	T	W	C	-

	(1)	(2)	(3)	(4)
218. <u>Murraya koenigii</u> (L) Spreng.	T	W	C	-
219. <u>M. paniculata</u> (L) Jacq.	S	W	C	276
ZYGOPHYLLACEAE				
220. <u>Tribulus terrestris</u> L.	PH	Y	A	31
OXALIDACEAE				
221. <u>Oxalis corniculata</u> L.	PH	Y	F	277
222. <u>O. latifolia</u> HB&K.	PH	B	F	181
BALSAMINACEAE				
223. <u>Impatiens balsamina</u> L.	H	R	C	168
LOGANIACEAE				
224. <u>Strychnos nux-vomica</u> L.	T	W	D	282
GENTIANACEAE				
225. <u>Enicostemma hyssopifolium</u> (Willd) H Verdoorn.	H	W	F	77
226. <u>Limnanthemum cristatum</u> Griseb. (Plate 6, fig. 46)	A	W	F	280
APOCYNACEAE				
227. <u>Carissa carandas</u> L.	TS	W	A	375
228. <u>Catharanthus pusillus</u> (Murr) G. Don.	H	W	F	281
229. <u>C. roseus</u> (L) D. Don.	WH	P or W	F	95
230. <u>Nerium indicum</u> Gard.	S	W	C	-
231. <u>N. oleander</u> L.	S	Ro or W	C	37
232. <u>Plumaria rubra</u> L. f. forma <u>acuminata</u> Sant et Irani ex Shah	T	W	F	42
233. <u>Ervatamia coronaria</u> Stapf.	S	W	C	-
234. <u>Rejous dichotama</u> Gamble n. comb.	S	W	C	-
235. <u>Vallaris solanacea</u> (Roth) D. Ktz.	SC	W	E	24
236. <u>Wrightia tinctoria</u> RBr.	T	W	A	278

	(1)	(2)	(3)	(4)
<u>ASCEPIADACEAE</u>				
237. <u>Calotropis gigantea</u> (L) RBr.	S	W or P	A	263
238. <u>C. procera</u> RBr.	S	P	A	45
239. <u>Carallema villetii</u> Luckh.	SS	P	C	-
240. <u>Cryptostegia grandifolia</u> RBr.	SC	P	O	103
241. <u>Decalepis hamiltonii</u> W & A	SC	P	O	283
242. <u>Hemidesmus indicus</u> RBr.	SC	P	A	25
243. <u>Leptadenia reticulata</u> (Retz)	SC	Y	A	128
244. <u>Pergularia daemia</u> (Frsk) Chiov.	SC	W	O	28
245. <u>Sarcostemma acidum</u> (Roxb) Voigt.	SS	W	O	133
<u>SOLANACEAE</u>				
246. <u>Capsicum annuum</u> L.	WH	W	E	285
247. <u>Cestrum nocturnum</u> L.	S	W	C	126
248. <u>Datura metel</u> L.	S	W	A	101
249. <u>Lycopersicum esculentum</u> Mill.	H	Y	E	-
250. <u>Petunia nyctaginiflora</u> Juss.	H	Varies	C	-
251. <u>Physalis minima</u> L.	H	W	F	124
252. <u>Solanum grandiflorum</u> Ruiz et Pavon.	T	B	C	60
253. <u>S. melongena</u> L.	S	B	C	-
254. <u>S. nigrum</u> L.	H	W	F	125
255. <u>S. surrattense</u> Burm.	PH	B	A	229
<u>CONVOLVULACEAE</u>				
256. <u>Convolvulus arvensis</u> L.	SC	Y	A	286
257. <u>C. auricomus</u> (A. Rich) Bhandari.	SC	Y	F	290
258. <u>Evolvulus alsinoides</u> L.	PH	B	A	80
259. <u>Ipomaea fistulosa</u> Mart ex Choisy	S	Pale P	A	139
260. <u>I. coptica</u> (L) Roth.	PH	Y	F	287

	(1)	(2)	(3)	(4)
261. <u>I. obscura</u> (L) Roth.	PH	Y	F	288
262. <u>I. reptans</u> (L) Poir.	A	Pale P	A	138
263. <u>I. eriocarpa</u> RBr.	SC	Y	A	289
CUSCUTACEAE				
264. <u>Cuscuta reflexa</u> Roxb.	SC	G	A	291
BORAGINACEAE				
265. <u>Cordia dichotoma</u> Forst. f.	T	W	A	292
266. <u>Helitropium ovalifolium</u> Forsk.	PH	G	F	149
267. <u>H. scabrum</u> Retz.	PH	W	F	171
268. <u>H. zeylanicum</u> Lamk.	WH	W	A	1
269. <u>Trichodesma indicum</u> RBr.	PH	B	F	32
270. <u>T. sedgwickianum</u> Benerji.	S	B	F	34
VERBENACEAE				
271. <u>Clerodendrum inerme</u> (L) Gaertn.	S	W	C	293
272. <u>C. neriifolium</u> Wall.	S	W	C	294
273. <u>Holmskioldia sanguinea</u> Retz.	S	R	C	-
274. <u>Lantana camara</u> L. var. <u>aculeata</u> (L) Moldenke.	S	R or Y	A	6
275. <u>L. indica</u> Roxb.	S	W	C	298
276. <u>L. sellowiana</u> Link. et Otto.	S	B	C	85
277. <u>Phyla nodiflora</u> (L) Greene.	PH	W	F	119
278. <u>Premna latifolia</u> Roxb.	T	W	F	296
279. <u>Stachytarpheta jamaicensis</u> (L) Vahl.	WH	B	F	297
280. <u>Tectona grandis</u> L. f.	T	W	C	-
281. <u>Vitex negundo</u> L.	T	B	F	298
LAMIACEAE				
282. <u>Anisochilus carnosus</u> Wall.	WH	B	F	299

	(1)	(2)	(3)	(4)
283. <u>Coleus ambiornicus</u> Lour.	H	B	D	300
284. <u>Hyptis suaveolens</u> (L)Poir.	S	B	A	150
285. <u>Leucas aspera</u> (Willd)Spreng.	H	W	F	84
286. <u>L. urticaefolia</u> RBr.	H	W	F	301
287. <u>Ocimum basilicum</u> L.	WH	B	F	302
288. <u>O. gratissimum</u> L.	WH	B	F	151
289. <u>O. sanctum</u> L.	WH	B	F	88
290. <u>Orthosiphon spiralis</u> (Lour) Merrill.	WH	W	F	303
291. <u>Plectranthus mollis</u> Spreng.	WH	W	F	304
292. <u>Salvia coccinea</u> Juss ex Murr.	S	B	C	-
293. <u>Mentha viridis</u> L.	S	B	C	-
OLEACEAE				
294. <u>Jasminum rigidum</u> Zenker.	SC	W	F	68
295. <u>J. sambac</u> Ait.	S	W	C	-
SCROPHULARIACEAE				
296. <u>Bacopa monnieri</u> (L)Wettst.	H	W	F	305
297. <u>Russelia juncea</u> Zucc.	S	R	C	-
298. <u>Sopubia delphinifolia</u> Don.	WH	Pr	F	306
299. <u>Striga asiatica</u> (L)Ktz.	H	W	F	134
ACANTHACEAE				
300. <u>Andrographis echioides</u> (L)Nees.	WH	B	F	111
301. <u>A. paniculata</u> Nees.	WH	B	F	158
302. <u>Barleria prionitis</u> L.	TS	Y	F	307
303. <u>Blepharis boerhaaviaefolia</u> Pers.	PH	B	F	308
304. <u>B. repens</u> (Vahl)Roth.	PH	B	F	309
305. <u>Hygrophila auriculata</u> (Schum) Heine.	TH	B	F	157
306. <u>Justicia prostrata</u> Gamble n.comb.	PH	B	A	82

	(1)	(2)	(3)	(4)
307. <u>J. simplex</u> D. Don.	H	B	F	314
308. <u>Lepidagathis mitis</u> Dalz.	WH	B	A	141
309. <u>Peristrophe bicalyculata</u> (Retz) Nees.	H.	P	F	310
311. <u>Rungia repens</u> (L) Nees.	PH	B	O	311
310. <u>Ruellia tuberosa</u> L.	H	B	F	153
PEDALIACEAE				
312. <u>Martynia annua</u> L.	S	Pale Pr	O	312
313. <u>Sesamum indicum</u> L.	WH	B	E	313
BIGNONIACEAE				
314. <u>Jacandra mimosifolia</u> D. Don.	T	B	C	315
315. <u>Millingtonia hortensis</u> L. f.	T	W	C	-
316. <u>Spathodea campanulata</u> Beauv.	T	O	C	-
317. <u>Tabebuia argentea</u>	T	Y	C	317
318. <u>Tecoma stans</u> (L) HB et K	T	Y	F	316
319. <u>Tecomaria capensis</u> (Lind) Seem. et Merr.	SC	C	C	-
RUBIACEAE				
320. <u>Borreria ariculata</u> (L. f.) F. N. Will.	H	W	A	19
321. <u>B. stricta</u> (L. f.) Sch.	H	B	A	20
324. <u>Gardenia gummifera</u> L.	S	W	F	169
322. <u>Canthium dicoccum</u> Merr. var. <u>umbellatum</u> (Gamble) Sant. et Merch.	TS	W	A	319
323. <u>C. parviflorum</u> Lamk.	TS	W	A	64
325. <u>Hamelia patens</u> Jacq.	T	C	C	318
326. <u>Ixora coccinea</u> L.	S	R	C	-
327. <u>Mussaenda glabrata</u> (Hk. f.) Hutch. ex Gamble.	S	W	C	-
328. <u>Oldenlandia umbellata</u> L.	H	W	A	62
329. <u>O. wightii</u> Hk. f.	H	W	A	172

	(1)	(2)	(3)	(4)
ASTERACEAE				
330. <u>Acanthospermum hispidum</u> DC.	H	Y	A	116
331. <u>Ageratum conyzoides</u> L.	H	W	A	320
332. <u>Blainvillea acmella</u> (L) Philippon	H	W	A	380
333. <u>Blumea amplexans</u> DC.	H	Y	A	329
334. <u>B. hieracifolia</u> (Don) DC.	H	Y	F	328
335. <u>Caesulia axillaris</u> Roxb.	H	W	F	321
336. <u>Carthamus oxyacantha</u> Bieb.	TH	P	A	322
337. <u>Echinops echinatus</u> Roxb.	TH	W	A	164
338. <u>Eclipta alba</u> Hassk.	PH	W	A	78
339. <u>Eupatorium adenophorum</u> Spreng.	S	W	O	323
340. <u>E. triplinerve</u> Vahl.	S	B	E	165
341. <u>Flaveria australasica</u> Hk.	H	Y	F	136
342. <u>Glossocardia bosvallea</u> (L.f.) DC.	PH	Y	A	117
343. <u>Grangea maderaspatana</u> (L) Poir.	PH	P	F	324
345. <u>Lagascea mollis</u> Cav.	WH	W	A	381
346. <u>Parthenium hysterophorus</u> L.	WH	W	A	10
347. <u>Sonchus oleraceus</u> L.	H	Y	F	326
348. <u>Sphaeranthus indicus</u> L.	PH	P	F	325
349. <u>Tridax procumbens</u> L.	PH	Y	A	4
350. <u>Vernonia cinera</u> (L) Less.	H	P	A	39
351. <u>V. elaeagnifolia</u> DC.	SC	W	C	38
352. <u>Xanthium strumarium</u> L.	H	Y	F	327
HYDROCHARITACEAE				
353. <u>Hydrilla verticillata</u> (L.f.) Royle.	AH	W	F	330

	(1)	(2)	(3)	(4)
ARECACEAE				
354. <u>Borassus flabellifer</u> L.	T	W	O	-
355. <u>Caryota urens</u> L.	T	G	C	-
356. <u>Cocos nucifera</u> L.	T	W	C	-
357. <u>Phoenix sylvestris</u> Roxb.	T	W	O	-
PANDANACEAE				
358. <u>Pandanus candelabrum</u> Beauv.	T	W	C	-
ARACEAE				
359. <u>Pistia stratiotes</u> L.	AH	G	O	331
LEMNACEAE				
360. <u>Lemna perpusilla</u> Torr.	AH	G	O	-
COMMELINACEAE				
361. <u>Amischophacelus axillaris</u> (L) Rolla Rao et Kammathy.	H	B	F	33
362. <u>Commelina benghalensis</u> L.	H	B	A	97
363. <u>C. diffusa</u> Burm.f.	H	B	F	333
364. <u>C. erecta</u> L.	H	B	F	334
366. <u>Cyanotis fasciculata</u> Schult.f.	H	P, B, Ro	A	55
365. <u>C. arachnoidea</u> Cl.	H	P	A	332
367. <u>C. tuberosa</u> (Roxb) Schult.f.	H	B	A	56
CYPERACEAE				
368. <u>Cyperus alopecuroides</u> Rottb.	H	Br	F	335
369. <u>C. cyperoides</u> (L) Kuntz.	H	Br	F	336
370. <u>C. hyalinus</u> Vahl.	H	G	F	382
371. <u>C. kyllinga</u> Endl.	H	W	F	338
372. <u>C. laevigatus</u> L.	H	Br	F	383
373. <u>C. pilosus</u> Vahl.	H	Br	F	384
374. <u>C. rotundus</u> L.	H	Br	A	337
375. <u>C. sanguinolentus</u> Vahl.	H	Br	F	385

	(1)	(2)	(3)	(4)
376. <u>C. triceps</u> (Rottb) Endl.	H	W	F	339
377. <u>Fimbristylis ovata</u> (Burm. f.) Kern.	H	Br	A	340
378. <u>F. tetragona</u> RBr.	H	Br	F	386
POACEAE				
379. <u>Aristida adscensionis</u> L.	H	G	A	353
380. <u>A. setacea</u> Retz.	H	P	A	70
381. <u>Alloterpsis cimicina</u> (L) Stapf.	H	G	A	351
382. <u>Andropogon pumilus</u> Roxb.	H	G	A	352
383. <u>Arundinella pumila</u> (Hochst) Steud.	H	P	A	367
384. <u>Brachiaria reptans</u> (L) Gard et CEHubb.	PH	G	A	365
385. <u>Chloris barbata</u> Sw.	H	P	A	363
386. <u>C. virgata</u> Sw.	H	P	A	364
389. <u>Dactyloctenium aegyptium</u> (L) P Beauv.	PH	G	A	27
387. <u>Cymbopogon coloratus</u> Stapf.	H	G	A	100
388. <u>Cynodon dactylon</u> (L) Pers.	PH	G	A	99
390. <u>Digitaria ciliaris</u> (Retz) Koel.	PH	G	A	360
391. <u>D. granularis</u> (Trin) Henr.	H	G	A	361
392. <u>D. stricta</u> Roth ex Roem et Schult.	PH	G	A	362
393. <u>Echinochloa colonum</u> (L) Link.	H	G	A	359
394. <u>Eleusine indica</u> (L) Gaertn.	PH	G	A	97
395. <u>Eragrostis ciliaris</u> (L) RBr.	PH	G	A	356
396. <u>E. gangetica</u> (Roxb) Steud.	H	P	A	357
397. <u>Iperata cylindrica</u> (L) P Beauv.	PH	G	F	387
398. <u>Isachna globosa</u> (Thumb) D Ktze.	H	G	A	358
399. <u>Leptochloa chinensis</u> Nees.	H	G	A	83
400. <u>Setaria tomentosa</u> (Roxb) Kunth.	H	G	A	355

	(1)	(2)	(3)	(4)
TYPHACEAE				
401. <u>Typha angustata</u> Bory etChaub.	AH	Br	F	343
MUSACEAE				
402. <u>Musa paradisiaca</u> L.	S	W	C	-
403. <u>Ravenala madagascensis</u> Sonn.	S	W	C	-
CANNACEAE				
404. <u>Canna indica</u> L.	S	R, Y	C	344
LILIACEAE				
405. <u>Asparagus reemosus</u> Willd.	PC	W	A	341
406. <u>Cordyline terminalis</u> (L)Kunth.	SH	W	C	-
410. <u>Curculigo orchoides</u> Gaertn.	H	Y	A	388
407. <u>Chlorophytum heynei</u> Baker.	H	W	F	349
408. <u>C. tuberosum</u> Baker.	H	W	A	346
409. <u>Crinum defixum</u> Ker.	H	W	F	-
411. <u>Gloriosa superba</u> L.	C	R	F	15
412. <u>Hippeastrum vittatum</u> Herb.	H	W	F	-
413. <u>Iphigenia mysorensis</u> Arekal et Swamy.	H	Pr	F	345
414. <u>Pancratium triflorum</u> Roxb.	H	W	F	389
415. <u>Scilla hyacinthina</u> (Roth)Macbr.	H	Pr	A	348
416. <u>Urginea indica</u> Kunth.	H	W	A	347
ALOEACEAE				
417. <u>Aloe vera</u> L.	SH	V	D	-
AGAVACEAE				
418. <u>Agave americana</u> L.	SS	G	O	-
DIOSCOREACEAE				
419. <u>Dioscorea bulbifera</u> L.	SC	W	O	342

SCANNING ELECTRON MICROSCOPY OF STARCH GRAINS FROM LATEX OF CERTAIN TAXA IN EUPHORBIACEAE

Biocrude producing plant species are known as petrocrops and they are scattered in a number of flowering plant families. The following are some important petrocrops: Euphorbia antiquorum, E. tirucalli, E. lathyris, E. caudicifolia, E. nerifolia, E. nivulia, E. royleana, E. trigona, E. antisiphilitica Pedilanthus tithymaloides etc., are potential sources of hydrocarbons that can be used for biocrude production. Biocrude (low molecular weight non-polar extractables from plants) is a complex mixture of liquids, triglycerides, waxes, terpenoids, phytosterols and other modified isoprenoid compounds that can be catalytically converted for use as liquid fuel.

Biocrude can be obtained from the plant species by tapping the latex followed by coagulation or by extraction of the dry biomass in a Soxhlet (or using a suitable method) in cases where latex tapping is not possible.

Recently Clark et al (1985) used NIR -spectroscopy for the analysis of hexane extractables (non-polar extractables) from plants belonging to different families viz., Euphorbiaceae, Asclepiadaceae, Agavaceae, Boraginaceae, Chenopodiaceae, Fabaceae, Fagaceae, Fourquieriaceae, Liliaceae, Loganiaceae, Onagraceae, Poaceae, Polemoniaceae, Polygonaceae, Ranunculaceae, Scrophulariaceae and Verbenaceae.

Among all Euphorbiaceae appears to be the potential source of hydrocarbons. Studies conducted in USA showed that

Euphorbia tirucalli and E. lathyris gave an annual yield of 20-25 barrels/hectare of crude oil (Kingsolver, 1982; Lewis, 1983). The Euphorbia latex hydrocarbon molecular weight range from 10 000 - 20 000 and close similarity to a crude mixture of petroleum. Weisz et al (1979) were successful in the production of high grade fuel (gasoline) from the latex of Hevea braziliensis, Ricinus comunis (seed oil) etc., using Zeolite catalyst of the ZSM-5 type.

The aim of this topic is to report and describe the typology of the starch grains from the latex of some Euphorbiaceae taxa encountered in the present study.

The starch grains from the latex have have a characteristic shape and differ with the starch grains of the cells other than laticifers. Their distinct shape was first reported by Rafn (1798), later a few studies have been made, and the worth mentioning are Molisch (1901) and Mahelberg (1973, 1975).

#### Materials and methods:

In this study 13 species of Euphorbia and Pedilanthus tithymaloides have been worked out. They are Euphorbia antiquorum, E. tirucalli, E. milli, E. neriifolia, E. nivulia, E. serpens, E. indica, E. thymifolia, E. heterophylla, E. prostrata, E. pulcherrima, E. erythroclada and E. hirta and Pedilanthus tithymaloides. E. neriifolia and E. nivulia are collected from Hyderabad City and E. serpens from Nagarjuna Nagar-522 510, A.P.

Latex was collected and fixed in 2.5% glutaraldehyde for  $\frac{1}{2}$  - 1 hour. Then the starch grains were isolated by centrifugation with 2 M sucrose at 2 000 rpm for 30 minutes using REMI - R-8 centrifuge. Starch grains were settled to the bottom. The supernatant was discarded. The sediment of starch grains were washed 3X with phosphate buffer (0.2 M, p<sup>H</sup> 7.2) and finally washed with distilled water. This starch material was used for both light microscopy and SEM. Light microscopy was carried out with tincture iodine staining. KI-I staining was also found to be suitable for instantaneous observation. However, upon drying KI crystals cause interruption with starch grains. SEM studies were conducted by transferring the material on stubs, dried in silica desiccator for about 3 hours. Finally it was subjected to Gold-Palladium coating. The starch grains were scanned with JEOL JSM-35 model SEM at 15 Kv. Photographs were taken on INDU- N.P. 22 negative film.

#### Observations:

Microscopic observation (LM/SEM) showed distinct starch grains in different taxa. The starch grains grow by apposition. Originally the starch granule is round or ovoid, but as it grows it takes a distinct shape (French, 1984). Thus in early stages the grains are either round or oblong and at maturity they assume characteristic shapes such as rod, spindle, osteoid, dumb-bell and discoid. The diagrammatic representation

of the starch grains is shown in Figure 2. The typology of the starch grains obtained from latex of different taxa is shown below in Table 2

Table - 2

Taxon	Length* (in $\mu\text{m}$ )	Width* (in $\mu\text{m}$ )		Habit
		Mid region	End	
<u>Rod shape:</u>				
<u>E.hirta</u>	48.05	6.07	10.3	H
<u>E.prostrata</u>	49.15	5.05	4.7	H
<u>E.erythroclada</u>	63.65	6.45	6.2	H
<u>E.pulcherrima</u>	60.55	4.3	3.7	H,S
<u>Spindle shape:</u>				
<u>E.heterophylla</u>	106.9	6.9	4.1	H
<u>E.thymifolia</u>	48.35	4.9	4.55	H
<u>Osteoid shape:</u>				
<u>E.serpens</u>	42.05	5.35	7.4	H
<u>E.indica</u>	60.95	5.4	8.7	H
<u>E.nivulia</u>	43.35	8.55	15.36	H,S
<u>Pedilanthus tithymaloides</u>	43.7	6.5	12.96	S
<u>Dumb-bell shape:</u>				
<u>E.tirucalli</u>	65.15	7.35	19.3	S
<u>E.milli</u>	45.95	7.35	21.35	S
<u>E.neriifolia</u>	46.75	13.6	28.1	S
<u>Discoid shape :</u>				
<u>E.antiquorum</u>	43.75	(across)		S

\* average of 25 measurements

Discussion:

Laticifers are known to occur in a large number of species and genera belonging to about 20 families of flowering plants. (Metcalfe, 1967). Laticifers are prominent in the family Euphorbiaceae. The latex is commercially tapped from certain members for rubber production (Hevea brasiliensis). However, the function of the latex in plant is not known. In this context several views have been expressed. Some consider the latex to be of nutritional value/as a reserve material. The most accepted view point is that the latex contain metabolic byproducts. Substances that are considered as end products, rather than reserve material accumulate in the laticifers. However, if it is merely a by product it is difficult to explain the quick regeneration of the laticifers at definite intervals (Fahn, 1982).

In Euphorbiaceae, the taxa viz., Euphorbia, Pedilanthus and Synadenium are having starch grains of various types in the latex. Starch is generally stored in higher plants as storage material. The morphology of the latex starch grains in the studied taxa is as follows: Rod shaped grains in Euphorbia hirta (Plate 2, fig.8; Plate 5, fig.28; Figure 2, fig.31) E.pulcherrima (Plate 2, figs 9-11; plate 3, fig.13; Figure 2, fig.32) E.erythroclada (Plate 2, fig.12; Figure 2, fig.34); E.prostrata (Plate 3, fig.16; Figure 2, fig.35); Spindle shaped grains in

E.heterophylla (Plate 2, fig.7; Plate 4, fig.22; Figure 2, fig.30),  
E.thymifolia (Plate 4, fig.23,24; Figure 2, fig.33); Osteoid  
grains in E.nivulia (Plate 3, fig.15,18; Figure 2, fig.42);  
E.indica (Plate 1, fig.4; Plate 4, fig.27,29; Figure 2, fig.36,37);  
E.serpens (Plate 2, fig.6, Figure 2, fig.39); Pedilanthus  
tithymaloides (Plate 3, figs.14,17; Figure 2, fig.40); dumb-bell  
shaped grains in E.tirucalli (Plate 1, fig.1, Figure 2, fig.38).  
E.milli (Plate 1, fig.5; Plate 5, fig.26; Figure 2, fig.41);  
E.neriifolia (Plate 4, figs.19-21; Plate 5, fig.25; Figure 2, figs  
44,45) and discoid grains in E.antiquorum (Plate 1, figs 2,3;  
Figure 2, fig.43).

It is also observed that milky latex of Moraceae  
Apocynaceae and Asclepiadaceae members are devoid of starch  
grains in latex. Therefore, the occurrence of starch grains  
only in a few taxa might suggest phylogenetic relationship.  
The occurrence of osteoid starch grains in Synadenium grantii  
Hk.f and Pedilanthus tithymaloides (L) Poir (E.tithymaloides L.)  
favours their placement in Euphorbia proper. The presence of  
starch grains in E.pulcherrima Willd. ex Kl strengthens its  
revision (Poinsettia pulcherrima Graham)

Furthermore, based on the typology of the starch  
grains, it is possible to separate the Indian species of  
Euphorbia sensu lato sect. Anisophyllum to Euphorbia and Chamae-  
syce proper. The Indian Chamaesyces are defined by Raju &  
Rao (1977) based on morphological and floral characters.

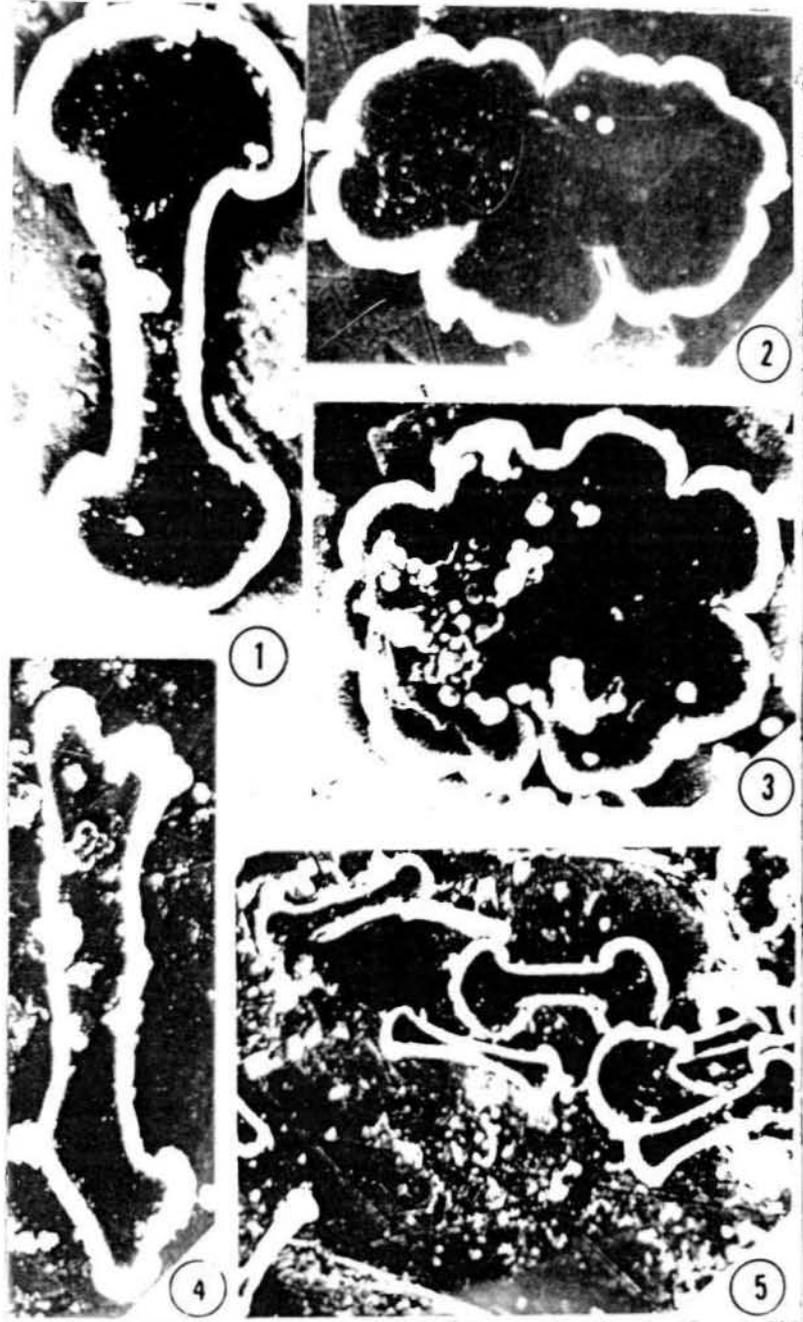
The present study recognizes Chamaesyce S.F Gray to be distinct from that of Euphorbia L. The starch grains are of simple type in Chamaesyce, either rod or spindle shaped. Whereas, in Euphorbia sensu stricto the starch grains attain high degree of specialization and are osteoid, dumb-bell and discoid.

Detailed studies are being taken up on starch grains from latex in Euphorbiaceae members to understand the taxonomic and phylogenetic relationships of various taxa.

Explanation of Plate 1 Figs 1-5:

1. Typical morphology of somewhat dumb-bell shaped starch grain distinctly developed terminal ends in Euphorbia tirucalli. x3200.
- 2,3. Discoid starch grains in E. antiquorum. x3600, x3000
4. Mature, somewhat osteoid starch grain with terminal bifurcating ends in E. indica. x3600.
5. Somewhat dumb-bell shaped starch grains (mature and immature forms) in E. milli. x1400.

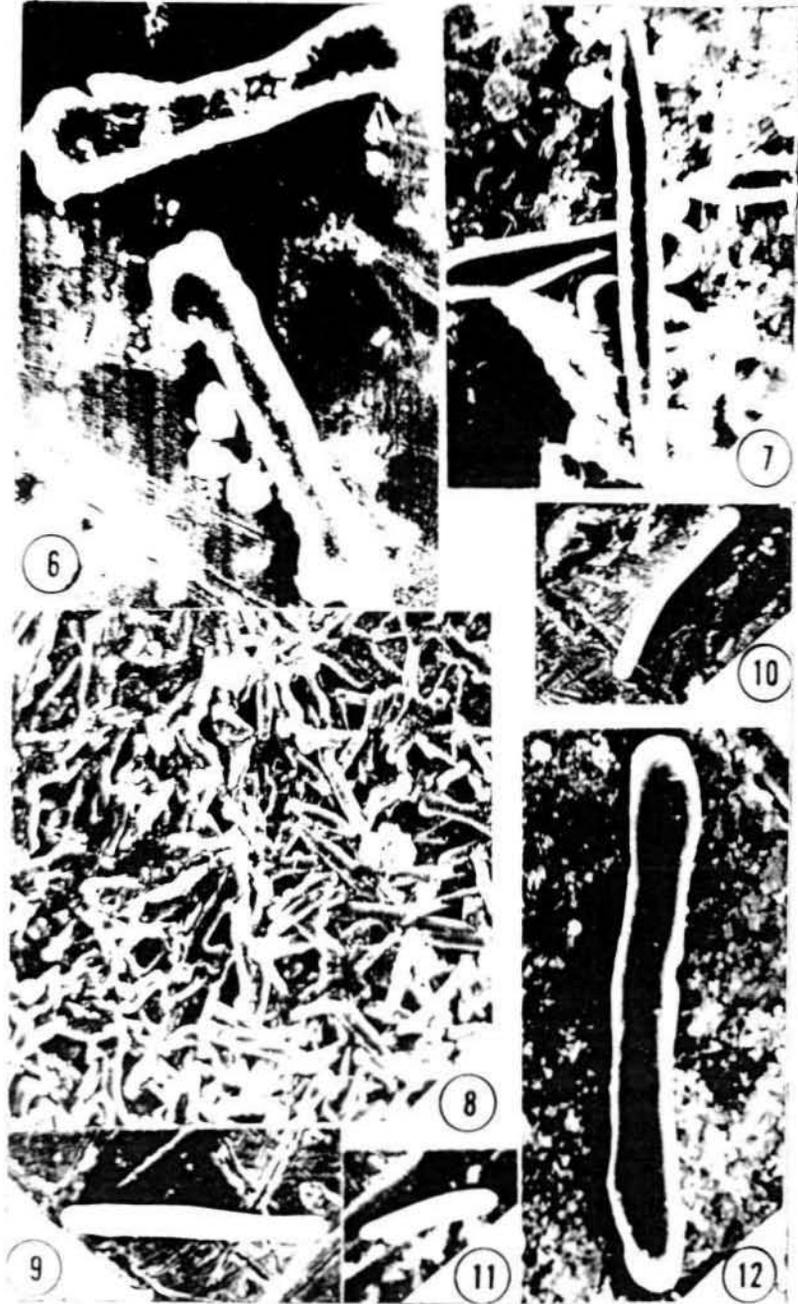
PLATE I



Explanation of Plate 2 Figs 6-12:

6. Osteoid starch grains with bulging heads in Euphorbia serpens. x3200.
7. Spindle shaped starch grains with tapering ends in E.heterophylla. x2400.
8. Rod shaped starch grains with blunt ends in E.hirta. x1000.
- 9,11. Slender, rod shaped starch grains in E.pulcherrima. x 2000.
12. Typical rod shaped starch grain in E.erythroclada. x 3600.

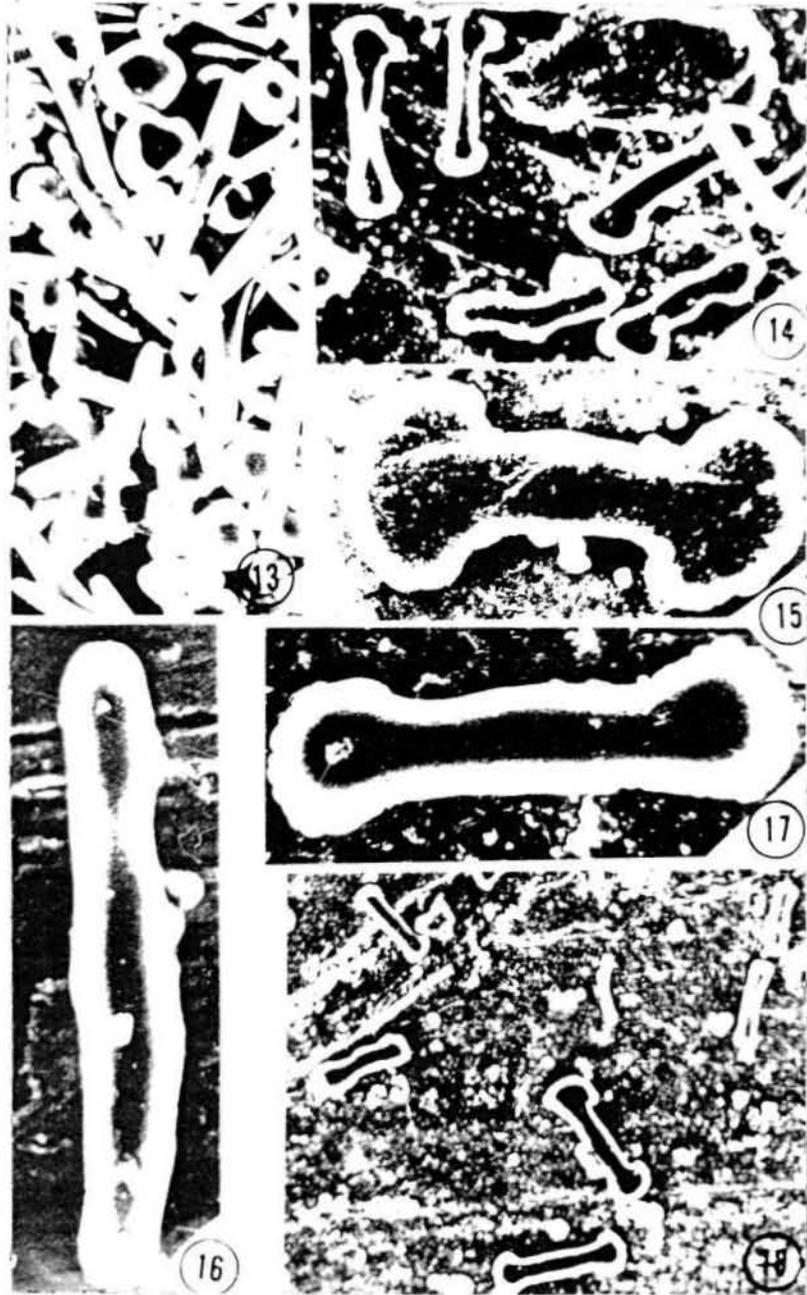
PLATE 2



Explanation of Plate 3 Figs 13-18:

13. A group of slender, rod shaped starch grains in Euphorbia pulcherrima. x1800.
- 14,17. Osteoid starch grains possessing irregular terminal lobes in Pedilanthus tithynaloides. x1800,x6000.
- 15,18. Osteoid-somewhat osteoid starch grains(mature and immature) in Euphorbia nivulia. x3200,x1000.
16. Rod shaped starch grain with blunt tips in E.prostrata. x6000.

PLATE 3



Explanation of Plate 4 Figs 19-24:

- 19-21. Somewhat dumb-bell shaped (immature) starch grains in Euphorbia neriifolia. x6000, x3600, x3600.
22. Spindle shaped starch grains in E.heterophylla. x2000.
- 23,24. Spindle shaped starch grains in E.thymifolia. x6000,x3200.

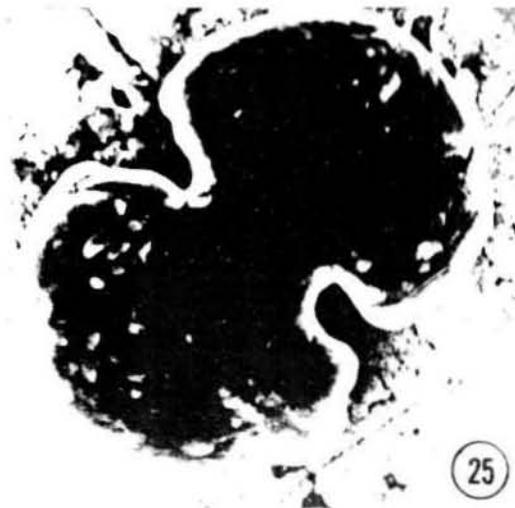
PLATE 4



Explanation of Plate 5 Figs 25-29:

25. Typical dumb-bell shaped (mature) starch grain with deep constriction in Euphorbia neriiifolia. x3200.
26. Somewhat dumb-bell shaped starch grain in E.milli. x3200.
- 27,29. Rod shaped (immature) starch grains in E.indica. x3000,  
x 3200.
28. Typical rod shaped starch grains in E.hirta. x 3600.

PLATE 5



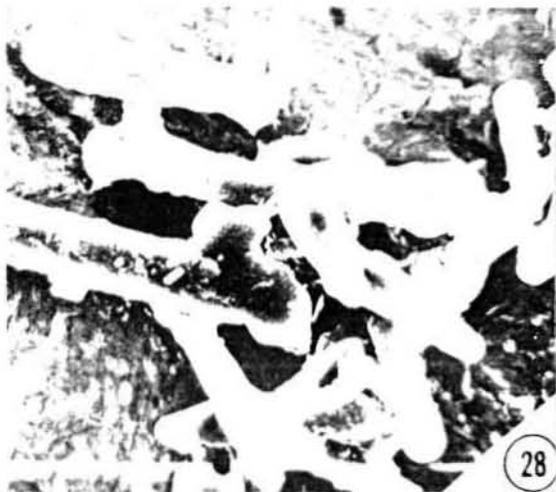
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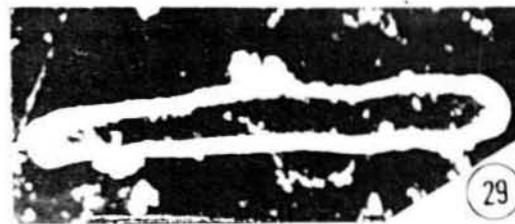
26



27



28



29

Typology of starch grains in certain taxa of Euphorbiaceae

Figure 2 (Diagrammatic representation)

A. Rod shape:

Fig. 31. Euphorbia hirta

Fig. 32. E.pulcherrima

Fig. 34. E.erythroclada

Fig. 35. E.prostrata

B. Spindle shape:

Fig. 30. E.heterophylla

Fig. 33. E.thymifolia

C. Osteoid :

Fig. 36,37. E.indica

Fig. 39. E.serpens

Fig. 40. Pedilanthus tithymaloides

Fig. 42. E.nivulia

D. Dumb-bell shape :

Fig. 38. E.tirucalli

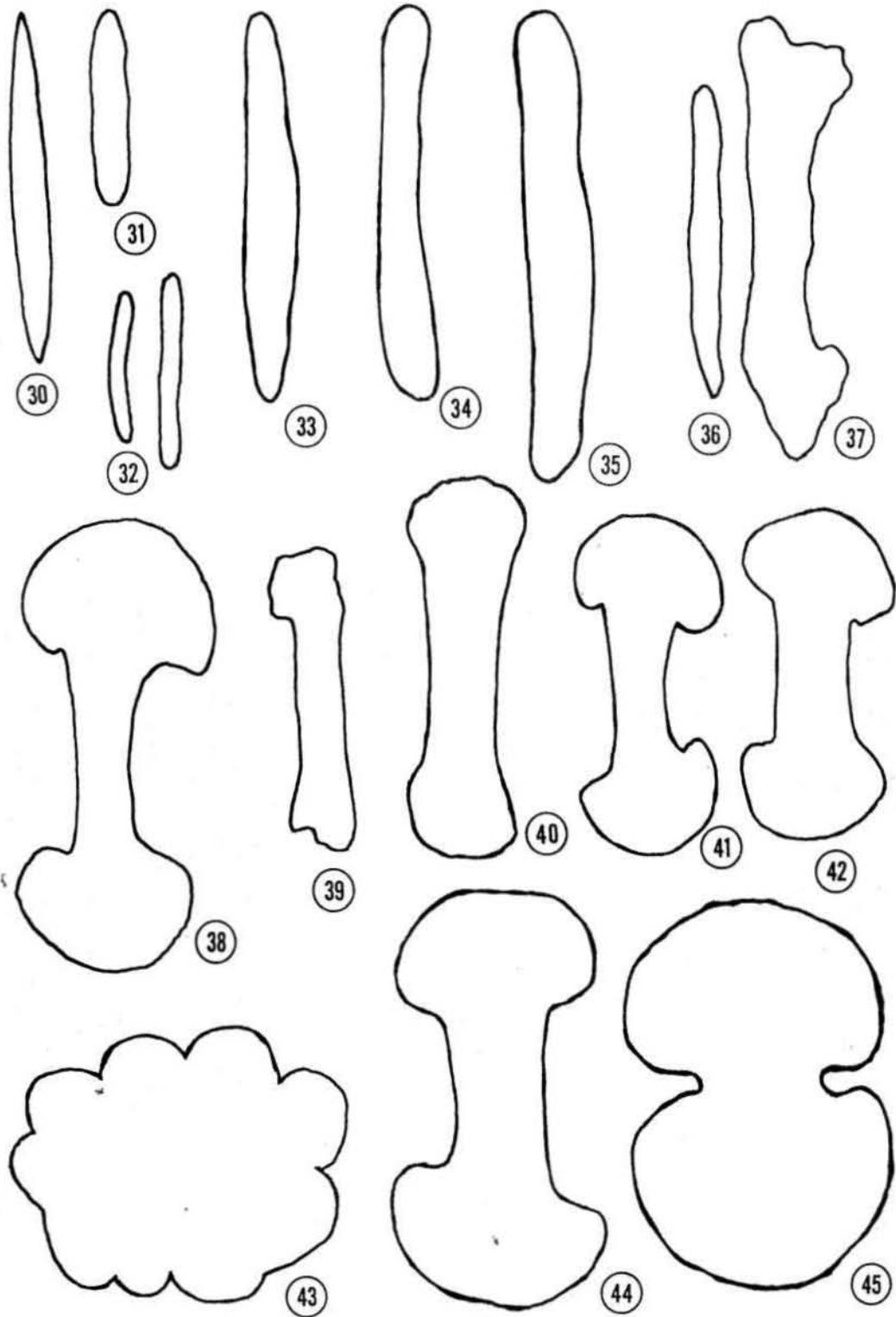
Fig. 41. E.milli

Fig. 44,45. E.neriifolia

E. Discoid :

Fig. 43. E.antiquorum

FIGURE 2



## POTENTIAL BIOENERGY PLANTS

A large number of plant species of bioenergy potential have been identified in this work. Bioenergy is solar energy harnessed during photosynthesis by plants and stored as chemical energy usually as carbohydrate. It also refers to the energy content of fuel derived from biomass by conversion process such as fermentation, gasification etc.

The plants suitable for Energy Plantation Programme can broadly be grouped as follows: (Energy Plantation/Energy Farms/Fuel Plantations are areas of land/fresh water/sea demarkated to the cultivation of plant species specifically for fuel production)(Anonymous 1980; Sharma et al., 1985; Lewis, 1983)

- a) Trees
- b) Shrubs
- c) Energy weeds (annuals)
  - i) Terrestrial
  - ii) Aquatic
- d) Petrocrops (Hydrocarbon producers)
- e) Energy crops

In this account only the list of potential bioenergy plants occurring in the University of Hyderabad campus are enumerated

The following is the list of potential bioenergy plants:

a) Trees

Moraceae

1. Ficus benghalensis L
2. F.elastica Roxb.
3. F.hispida L.f
4. F.racemosa L
5. F.religiosa L

Casuarinaceae

6. Casuarina equisetifolia Forst

Mimosaceae

7. Acacia auriculiformis A.Cunn ex Benth
8. A.chundra Roxb. Willd.(Plate 8, figs.57,58)
9. A.nilotica (L) Del sub sp. indica (Benth)B
10. Albizia amara (Roxb) Boiv.
11. A.lebbek (L) Willd.
12. Calliandra inaequilatera Ruby
13. Enterlobium saman Prain
14. Prosopis chilensis (Molina)Schuntz.

Caesalpiaceae

15. Cassia fistula L
16. C.javanica L
17. Peltophorum pterocarpum (DC)Bak.

Fabaceae

18. Butea monosperma (Lamk) Taub
19. Dalbergia lanceolaria L
20. D.sissoo Roxb.

21. Gliciridia sepium (Jacq)Kunth ex Steud.

22. Pongamia pinnata (L) Pierre

Combretaceae

23. Terminalia bellerica (Gaertn)Roxb

Proteaceae

24. Grevillea robusta A.Cunn

Meliaceae

25. Azadirachta indica Juss.

26. Melia azadirachta L

Bignoniaceae

27. Tecoma stans (L) HB & K

Moringaceae

28. Moringa oleifera Lamk.

b) Shrubs

Mimosaceae

29. Dichrostachys cinera (L) Wet & Arn.

Caesalpinaceae

30. Caesalpinia pulcherrima (L) SW

31. Cassia auriculata L

Alangiaceae

32. Alangium salvifolium Wang

Sapindaceae

33. Dodonia viscosia L

c) Energy weeds

i) Terrestrial

Amarantha ceae

34. Alternanthera sessilis (L) R.Br ex DC

Asteraceae

35. Parthenium hysterophorus L (Plate 7, fig.53)

Boraginaceae

36. Heliotropium zeylanicum Lamk(Plate 7, fig.52)

Verbenaceae

37. Lantana camera L. var. aculeata (L) Moldenke

Poaceae

38. Imperata cylindrica (L) P.Beauv.

Fabaceae

39. Canvalia gladiata (Jacq) DC

ii) AquaticPolygonaceae

40. Polygonum glabrum Willd.(Plate 6, fig.46)

Typhaceae

41. Typha angustata Bony & Chaub

d) Petrocrops (Hydrocarbon producers)Asclepiadaceae

42. Calotropis gigantea R.Br

43. C.procera R.Br

44. Crypt ostegia grandiflora R.Br

45. Pergularia daemia (Frsk)Chiov.

Moraceae

46. Artocarpus altilis (Park)Fosb

Sapotaceae

47. Mimusops elengi L.

Papavaraceae

48. Argemone mexicana L

Euphorbiaceae

49. Euphorbia antiquorum L (plate 7, fig.50)
50. E.erythroclada Boiss
51. E.heterophylla L
52. E.hirta L
53. E.indica Lamk
54. E.milli Desm
55. E.prostrata Ali
56. E.thymifolia L
57. E.pulcherrima Willd ex Kl
58. E.tirucalli L (Plate 7, fig.51)
59. Jatropha glandulifera Roxb.
60. Pedilanthus tithymaloides (L) Poir (Plate 7, fig.51)

Apocynaceae

61. Nerium oleander L
62. Plumaria rubra L.f
63. Wrightia tinctoria R.Br

Aloeaceae

64. Aloe vera L

Agavaceae

65. Agave americana L

## ECONOMIC BOTANY OF SELECTED PLANTS

- Economic botany of selected plant species are listed below (after Anonymous 1948-76, Jain 1968, Mooss, 1978) with Telugu names in parenthesis

1. Acacia nilotica (L) Del sub sp. indica (Benth) Brenam ( Nalla thumma): Important fuel wood tree. Gum is extracted by tapping the trunk. A dark brown dye is obtained from the bark.
2. Aerva lanata (L) Juss ( Tellapindi Kura): The whole plant has diuretic and lithontriptic property. The dried plant is exported to U.S.S.R under the trade name 'Polpola' where the extract is consumed replacing tea.
3. Alangium salviifolium (L.f) Wang.(Udugu): An alkaloid alangine is obtained from the bark. If administered in small doses the alkaloid lowers blood pressure temporarily, depresses the heart and produces irregular respiration. It also increases peristaltic movements of the intestine.
4. Andrographis paniculata Nees (Nela vemu): One of the ingredients of "Tefroli" an ayurvedic medicine which is an efficient liver corrective and protective.
5. Annona squamosa L (Seethaphalam) : Fruits are edible and nutritious. Seeds are reported to be having insecticidal property.
6. Azadirachta indica A.Juss (Vepa): Bark, leaves, flowers and fruits are used in medicine for treating jaundice, skin diseases, ulcers.. Seed oil is used in several cosmetic and drug industries.

7. Calotropis gigantea (L) R.Br (Jilledu): The latex has anti-biotic property. Stems yield fibers.
8. Catharanthus roseus (L)D.Don (Billaganneru): Vincristine and vinblastine extracted from the leaves are used in the treatment of leukaemia and Hodgkin's disease and also other types of cancer. The alkaloids of the plant possess hypotensive sedative and tranquilising properties.
9. Datura metel L (Ummetta): The whole plant is astringent , antihelminthic, parasiticide and narcotic. Used in the treatment of asthma, cough, fever, skin diseases and ulcers.
10. Diospyros melanoxylon Roxb. (Tumi or Tumiki): Leaves are used in 'Beedi' industry. Stem wood is used in making agricultural implements.
11. Eclipta alba Hassk (Gunta kalagara): It is one of the ingredients of "Tefroli" an ayurvedic medicine which is an effective liver corrective and protective.
12. Ficus racemosa L (Medi or Bodda): The hypanthodium is very delicious and edible.
13. Gloriosa superba L (Kondanabhi): A beautiful ornamental plant. An alkaloid "Colchicine" is extracted from tubers which is administered for doubling the chromosomes.
14. Hemidiscus indicus Br (Sugandhapala): The roots are dried and the powder is used as drug. It is used as a blood purifier and in rheumatism.
15. Oscimum basilicum L (Rudrajada, Kasturitulasi): Juice of the leaves used as a drug to kill worms in stomach. Seeds when consumed internally relieve constipation and piles.

16. Oscimum sanctum L (Tulasi): Oil obtained from the leaves has the property of destroying bacteria and insects. The juice of the leaves is useful in bronchitis, digestive disorders and in relieving earache.
17. Pongamia pinnata (L) Pierre (Ganuga): Seed oil is used in soap and drug industries.
18. Sapindus laurifolius Vahl (Kunkudu): Fruits are used as soap and in several ayurvedic medicines.
19. Semicarpus anacardium L.f (Jeedi or Nallajeedi): Juice extracted from seed mesocarp called "Bhilawanol" is mixed with lime and used as marking ink. Bhilawanol is known to have anticancer properties. (Plate 6, fig.47)
20. Sphaeranthus indicus L (Hapusa): The root is an ingredient in various ayurvedic medicines and are used in indigestion, piles etc.
21. Strychnos nux-vomica L (Mushidikachettu): Seeds are poisonous. An alkaloid 'Strychnine' is extracted from seeds and used in medicine in minute doses.
22. Syzygium cumini (L) Skeels (Neredu): Fruits are edible.
23. Tamarindus indica L (Chinta): Aril is edible and sour in taste. Used in preparations of various Indian foods.
24. Tephrosia purpurea Pres (Vempali): One of the major ingredients of "Tefroli" ayurvedic medicine which is an effective liver corrective and protective.
25. Terminalia bellerica (Gaertn) Roxb. (Ballari Karakkai): One of the ingredients of "Triphala" an ayurvedic medicine. Dye obtained from the fruit is a substitute of myrobalam.

## FIELD OBSERVATIONS ON PLANT INSECT INTERACTION

Plant insect interactions are of quite significant in view of the following two points:

- a) They act as agents in the bio-control of weeds. For e.g., Opuntia infestation was controlled by introducing the cactus moth to Australia.
- b) They cause damage to the host plant parts. For e.g., in case of Diospyros melanoxylon ('Beedi leaf') where the leaf is important in Beedi manufacturing industry. Gall formation cause damage to the leaf.

Herbivores obtain their food from plants either through grazing or browsing. Some insects graze viz., locusts and caterpillars eat leaf blades of plants. However, several insects have a more sophisticated method of feeding. Many groups of insects pierce through the surface of leaves and feed directly on the liquid contents, which have a much higher nutritional value than the whole leaf. Some times insects live underneath the leaf and thus gain food as well as shelter. Several plants respond to the stimulus induced by the feeding of phytophagous insects by producing abnormal growths, often result in the formation of galls (Cecidogenesis). The following are known to be the cecidogenous insects: Hymenoptera (gall wasps, saw flies), Diptera (gall midges), Homoptera (aphids, coccids, phyllids) Thysanoptera (thrips, mites) and Lepidoptera (Ananthakrishnan, 1984).

During the course of field work insect induced leaf galls were noticed in the following plant species:

1. Alangium salvifolium ( Plate 8,fig.54)
2. Diospyros melanoxylon( Plate 8,fig.55)
3. Ficus racemosa ( Plate 8,fig.56)
4. Acacia chundra (Plate 8,figs 57,58)(stem galls by ants)
5. Pongamia pinnata
6. Canthium parviflorum

Incase of Acacia chundra the relationship between the plant and the ants is very interesting. Ants protect the trees by forming galls/nests against invaders and other plants. Inturn the plant provides shelter for ants and food produced by the nectaries. It is further interesting to note that wherever ants are not seen the tree is covered with climbers/parasites.

PLATE 6

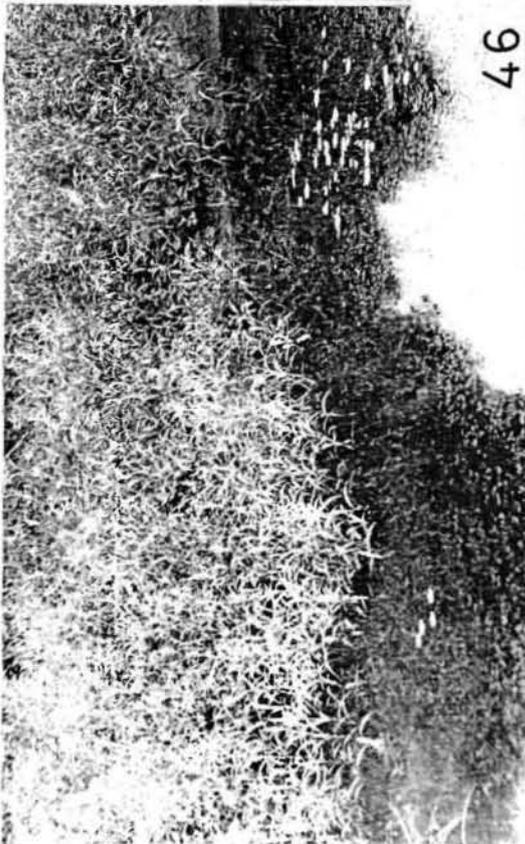
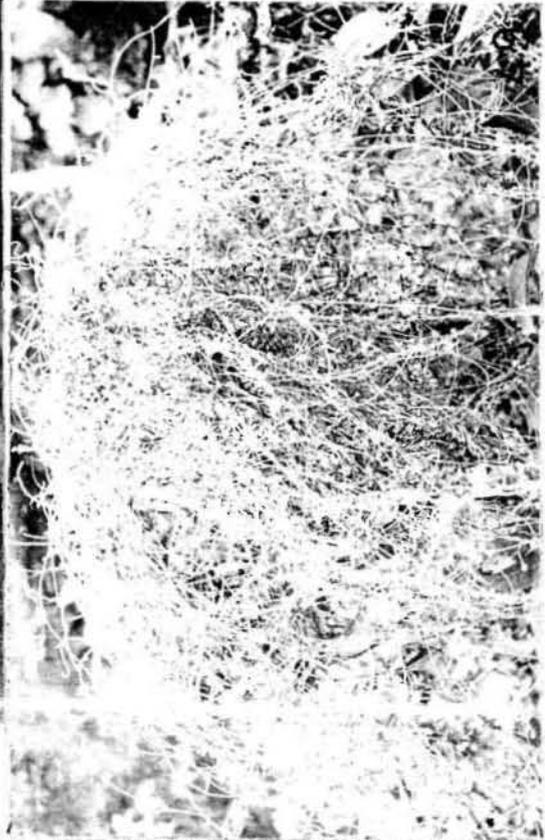
Fig.46. Pond showing aquatic vegetation viz. Polygonum  
glabrum Willd. and Limnanthemum cristatum Griseb.

Fig.47. Semicarpus anacardium L.f twig.

Fig.48. Derris scandens (Roxb.) Benth a scandent legume

Fig.49. Cassytha filiformis L an abundant parasite  
on tree/shrub canopy.

PLATE 6



46

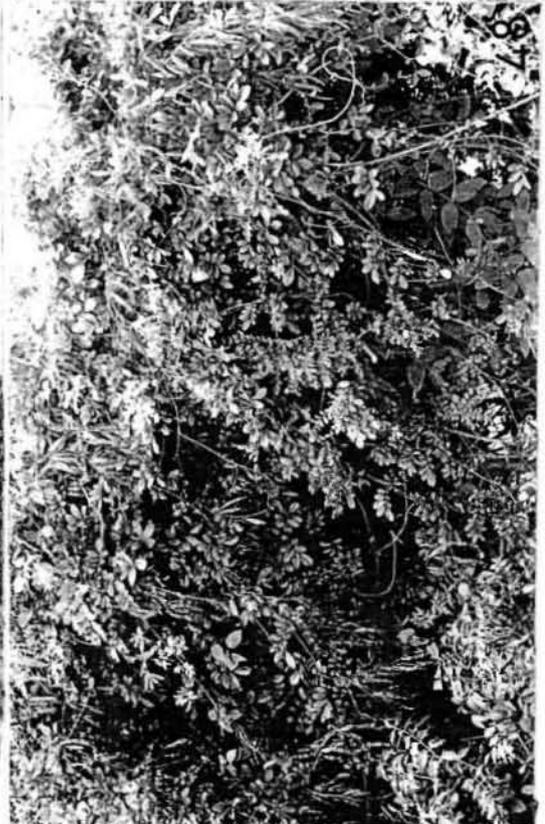


PLATE 7

Fig. 50. Euphorbia antiquorum L (angular stems with marginal spines)

Fig. 51. E. tirucalli L (with cylindrical stems) and  
Pedilanthus tithymaloides(L) Poir (with succulent  
leaves) on the foreground.

Fig. 52. Heliotropium zeylanicum Lamk the most abundant  
weed during monsson period.

Fig. 53. Parthenium hysterophorus L an abundant weed throughtout  
the year.

PLATE 7



PLATE 8

Fig. 54. Alangium salvifolium Wang. leaves showing insect galls.

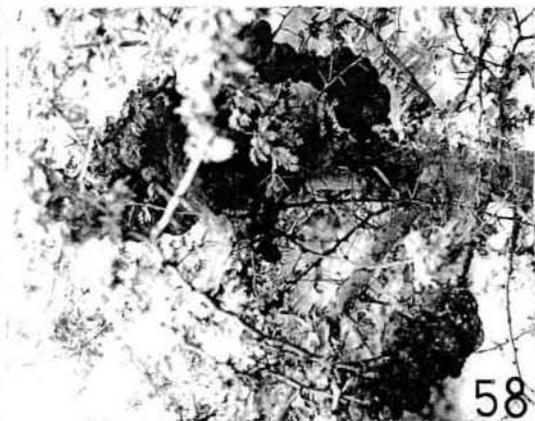
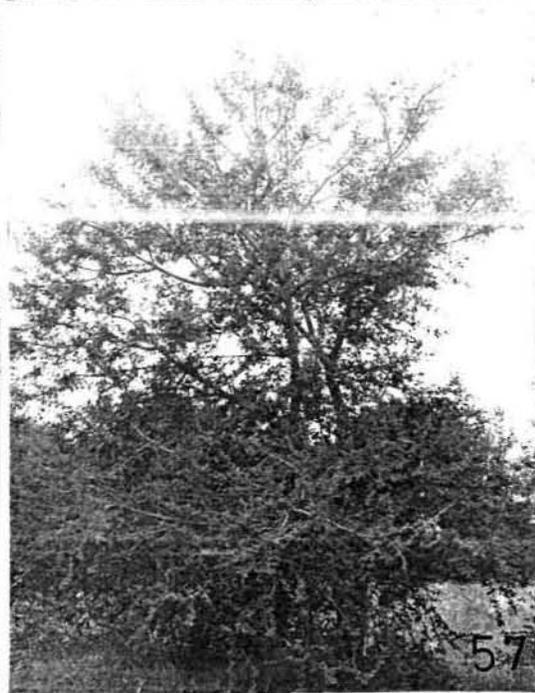
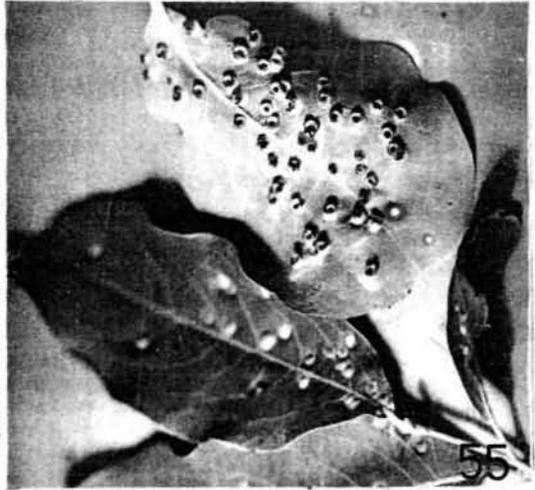
Fig. 55. Diospyros melanoxylon Roxb. leaves with insect galls.

Fig. 56. Ficus racemosa L leaves with insect galls.

Fig. 57. Acacia chundra (Roxb.)Willd exhibiting assymetrical branching and galls on stems formed by ants.

Fig. 58. A portion of fig.57 enlarged showing large galls/  
ant nests on the stem.

PLATE 8



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