

## I. INTRODUCTION

The family Leguminosae is the second largest of dicotyledons with 500 genera and 13,000 species of (Lawrence 1961). It is divided into three subfamilies namely Mimosoideae, Caesalpinioideae and Papilionatae or Papilionoideae (or Lotioideae as validated by Soder 1945). Many Botanists treat the three subfamilies as distinct families Mimosaceae, Caesalpinaceae or Cassiaceae and Papilionaceae or Fabaceae. Among these subfamilies Papilionatae is considered to be the most advanced one (Hendle 1959).

Papilionoideae is also the largest subfamily containing 375 genera (Lawrence 1963) in 19 tribes (Hooker 1839, Hendle 1959). Majority of the legumes belong to this subfamily and are of temperate regions of both northern and southern hemispheres in distribution. It is characterised by gamocephalous calyx and papilionaceous corolla. The corolla is of 5 unequal petals, the posterior petal is outermost and is known as the standard (vexillum). The lateral pair of similar petals is distinct, each usually long clawed, and together they comprise the wings (alae). The two innermost petals are closely appressed, usually coherent or connate along their adjoining margins and generally



envelop the stamens and pistil. They comprise the keel (carina) of the corolla. The stamens enclosed within the keel are usually 5 or 10, commonly monadelphous or diadelphous.

The medicinal usage of Crotalaria was long and recognised in India in the Vedic Periods. The descriptions of Crotalaria species (C. verrucosa, in Sanskrit known as 'Sonapushpi', 'Dhavani', 'Vrihatpushpi' and C. juncea as 'Janapavara', 'Pulivanji') are seen in the Ayurvedic books.

The word "Crotalaria" is a Greek word 'ΚΡΟΤΑΛΟΝ' (a child's rattle) appears in Linnaeus's Genera Plantarum (1737) but it is there quoted as coming from "Johannius (Hort. Elth. 1732). The latter author figures two species of Crotalaria of which one is true Crotalaria and other belongs to the genus Baptisia (Aiton, 'Hortus Kewensis' 1811).

Earlier Botanists like Hermann (1647) figures four species of Crotalaria now known as C. labrunifolia L., C. verrucosa L., C. retusa L. and C. hirsuta. Chorda (1683) in his "Hortus Malabaricus" figures three species of Crotalaria. These three species are being now known as C. retusa L., C. labrunifolia L. and C. quinquefolia L. Plukenet (1696) in his "Alamcintus" has a Crotalaria now known as C. juncea L. Sir Hans Sloane (1725) in his

"History of Jamaica" depicts a Crotalaria which is known as C. lotifolia L.

In 1737 Rumphus figures in his "Thesaurus Seylanicus" a Crotalaria known as C. verrucosa L. Linnaeus (1753) in "Species Plantarum" has 13 species of Crotalaria. In 1760 Linnaeus published his "Plantae Africanae Rariores" where he described three species of Crotalaria, but they do not belong to this genus. Same may be said of the four species described by Bergius (1767) in his "Descriptiones Plantarum ex Capite Bonae Spei."

Linnaeus in 1753 has attempted to classify this large genus on the basis of simple and compound leaves. De Candolle (1825) follows Linnaeus with further subdivisions. Endlicher (1830) relied entirely upon the characters and the shape of the pods for his sections.

In 1834 Wight and Arnott have classified the genus. The main divisions are made on the leaves, but there are twelve sub-divisions founded on the characters drawn from the habit, the character of stipules, pod etc.. This is the most important contribution towards the classification of this genus. Later in 1843 Benthams in Hooker's "London Journal of Botany" has classified the species of Crotalaria, following the lines of Wight and Arnott (1834) depending mainly on foliage and habit to characterise his groups.

Crotalaria is one of the 43 genera in the tribe Genisteae of the subfamily Papilionatae. Hooker (1877) in his "Flora of British India" has reported 7 genera of the tribe Genisteae. The largest genus among these genera is Crotalaria with about 550 species (Polhill 1968). It is further subdivided into 10 sections on the basis of habit, leaf, stipule, calyx, and pod characters and also on number of seeds in a pod. The sections are *Lenariae*, *Diffusae*, *Alatae*, *Calycinae*, *Erectae*, *Criocarpae*, *Trifoliatae* *Dispermae*, *Trifoliolatae* *Polyaspermae* and *Multifoliolatae*.

Crotalaria consists of chiefly annuals, perennial herbs, sub-shrubs and shrubs with simple leaves or 3-foliate, rarely imparipinnate, with or without stipules. Flowers are in terminal or leaf opposed racemes, usually yellow and often showy. Calyx tube is short, teeth 4 or lanceolate, subequal or coherently connate into 2 lips. Corolla is equalling or exceeding the calyx; standard orbicular (rarely ovate), shortly clawed; wings obovate or oblong, shorter than the standard; keel broad, equalling the wings, its petals joined down the back, such incurved distinctly beaked. Stamens are 10, monadelphous and anthers being dimorphic. Ovary is sessile (rarely stalked), usually multiovulate (rarely 2), style long, abruptly incurved at the base more or less bearded upwards; siliqua minute, and oblique. Pod which is the most

important and reliable character in this taxon is sessile or stalked, straight, linear, oblong lurgid or inflated, continuous, usually many seeded.

The largest number and diversity of Crotalaria species appears to be concentrated in tropical Africa, with outlying centres of variations in South Eastern Asia and Central America. About 80-90 species have been reported occurring in various habitats (plains to 2430 metres) of both Northern and Southern India. Many species of Crotalaria are weeds (C. verrucosa, C. nana, C. prostrata, C. triquetra.) often found in gardens, fields of dry crops, on plain grass lands, on dry waste lands, dry stony lands, coast sides on sandy tracts, in dry forest undergrowths, open forest lands, on hills in grass and on road sides of the forests etc.. They are often found associated with Alysicarpus, Indigofera, Lupinus and Oenone. Some of the species of Crotalaria are mistaken for Indigofera, Lupinus, and Oenone species, if the pods are not there. Crotalaria can adopt to varied ecological situations, but prefer acidic soils. If they are grown in odd seasons like summer, growth will be very much stunted and flowering will be within 2-3 months without a few flowers (C. juncea, C. verrucosa, C. striata, etc.).

Only Baker (1876) undertook the floristic work in British India (then including Burma, Ceylon and

Pakistan and he recognised 77 species in ten sections of the genus Crotalaria occurring on our soil in Hooker's "Flora of British India" (1876). Cook (1903) in his "Flora of Bombay Presidency" has described 32 species without considering any sections and later Gamble (1935) on the "Flora of the Presidency of Madras" which covers the major portions of South India included 75 species of Crotalaria in 8 sections. Ellis (1964) has reported a new subspecies namely C. willdenowiana DC. sep. glabrifoliata Ellis. A new species C. deasperma Naik is reported from Oomanabad District (Naik 1966). No further work on the systematics of Crotalaria is known.

In the year 1914 Baker in a monograph on the African Crotalaria has corrected some of the major defects of the overlapping characters which made some previous workers to include species from other genera under this genus. Later, Senn (1938, 1939) has worked on the cytology and taxonomy of the North American species of Crotalaria. Recently, Polhill (1968) has reclassified the species of African Crotalaria in a more natural arrangement.

The classification has been based mainly on a few morphological characters. This has resulted in categories that overlap each other to a larger extent. Many earlier workers mistook the species due to overlapping of the characters e.g.,

- 1) C. biflora Linn. has been identified as Astragalus biflorus Linn., C. nummularia Willd., C. hirta Roth. Nov., C. Rothiana DC., C. Rothii Spreng. and Cicer nummulariaefolium.
- 2) C. retusa Linn. as Lupinus cochinchinensis Lour.
- 3) C. peniculata Willd. as C. chinensis Link. and Ononis glutinosa Mart.
- 4) C. medicaginea Link. as C. procubens Roxb., C. foliosa Willd., C. divaricata Griseb., C. virgata Mart. and Indigofera capitata Griseb. and
- 5) C. laurifolia Linn. as C. pendula Bert., C. pedunculosa Desv., Clavulium pedunculatum Desv. etc..

Further there is no unanimity among the authorities of the species e.g.,

- 1) C. prostrata Roxb., C. prostrata Vahl.
- 2) C. hirsuta Willd., C. hirsuta Vahl. Cat.
- 3) C. rubiginosa Willd., C. rubiginosa Roxb., C. rubiginosa Bak.
- 4) C. Fichtiana Griseb., C. Fichtiana Vahl.
- 5) C. sericea Retz., C. sericea Benth. etc.

It is clear that whatever earlier systematic work was done, it does not give the clear picture about the genus Crotalaria. Moreover this classification throws no light on their relationship, evolutionary history and speciation in the genus.

Today's taxonomy is not just a science of recognition of similarities and dissimilarities between the individuals with common characters and geographic distribution. There is now a growing consciousness among the workers to interpret a large number of anomalies which crept into the so called "Natural Classification" of seed plants, for which the answer must naturally be sought in the experimental science, variously known as Experimental Taxonomy (Clements and Hall 1920), Genealogy (Turesson 1923), Biosystematics (Camp and Gilly 1943) and Synthetic Taxonomy (Furrill 1954), and here is the importance of that "Infinitely small herbarium" in the nucleus of the cell so aptly described by Amal (1952). In this nucleus, the plant carries not only its individuality but also its racial history recorded in the number, morphology and behaviour of the chromosomes or "Gene Strings." But one must remember the statement of Love (1960) that "the chromosomes are not just another character comparable to the superficial morphological characters taxonomists are forced to use for the identification of herbarium material. The chromosomes determine the characters, whereas the characters do not determine the chromosomes. It is evident ----- that to describe the chromosomes as only another useful character, comparable to the hairiness of the stem or the colour and form of the flower, is hardly a slight but a serious misunderstanding of the principles of

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evolutionary biology." Thus the role of cytology in modern taxonomy (Cytotaxonomy) is by no means meagre and is best exemplified by classical works of Babcock et al., (1942) in Crepidinae, Goodspeed (1954) in Nicotiana, Fernandes (1951, 1953, 1959) in Narissus, Chennaveeraiah (1960, 1962) in Aegilops etc..

Several species of Crotalaria are economically important and may carry genes for resistance or immunity to many diseases and insect pests and also possess unexploited reservoirs of genetical variation which have a promise of high potential value if transferred to cultivated species, especially C. juncea commercially known as Gunhemp. Many species are important because of forage and cover crops (C. mucronata Desv, C. angulata Will, C. maritima Cha.) alkaloids (C. juncea), medicinal (C. burhia, C. prostrata, C. alida, C. verrucosa.) and fibre yielding (C. juncea, C. Brownei, C. retusa). Therefore, there is a need of immediate attention for understanding the inter-relationship of taxonomic species from cytogenetical point of view.

Considering the need of such studies, the present investigation was undertaken. For this projected study an extensive collection of 80 species of Crotalaria was made especially from different parts of South-Western India. Seeds were also obtained from other parts of India and abroad. Critical karyomorphological studies

were made to ascertain the cytological inter-relationships. Meiotic studies also were made in considerable detail, which are necessary in understanding the nature of speciation. Inter- and Intraspecific hybridization was tried but without success. Morphological characters were critically studied using polygraphs and correlating them with cytological investigations.

It is expected that the present investigation would provide a clear picture of the speciation, variation and evolution among the species of Crotalaria of the tribe Genistene and help in a proper taxonomic evolution of the species.