REVIEW OF LITERATURE

The genus Crotalaria has attracted the attention of several biologists because of its economic importance and the biochemical role, and consequently the literature on its various aspects is vast and varied. Here only the important or major contributions to its different aspects are presented.

Taxonomy :

It was Sir George Bentham (1865) who for the first time made an attempt to classify this genus into eight sections. Arenariae, Diffusae, Alatae, Calycinae, Glaacae, Frectas, and Eriocarpae. He however admitted the difficulties in circumscribing these sections. Baker (1914) added three more groups of compound leaved Crotalarias to the eight sections of Bentham-Trifoliatae, dispermae, Trifoliatae polyspermae and multi foliatae to make total eleven divisions of sectional rank within the genus.

The ground wotk of species delimitation and reasonable natural sequence of certain species within the genus has been further worked out by Verdoorn (1928), Wilczek (1953), Hepper (1958), Torre (1962) and Schreiber (1970).

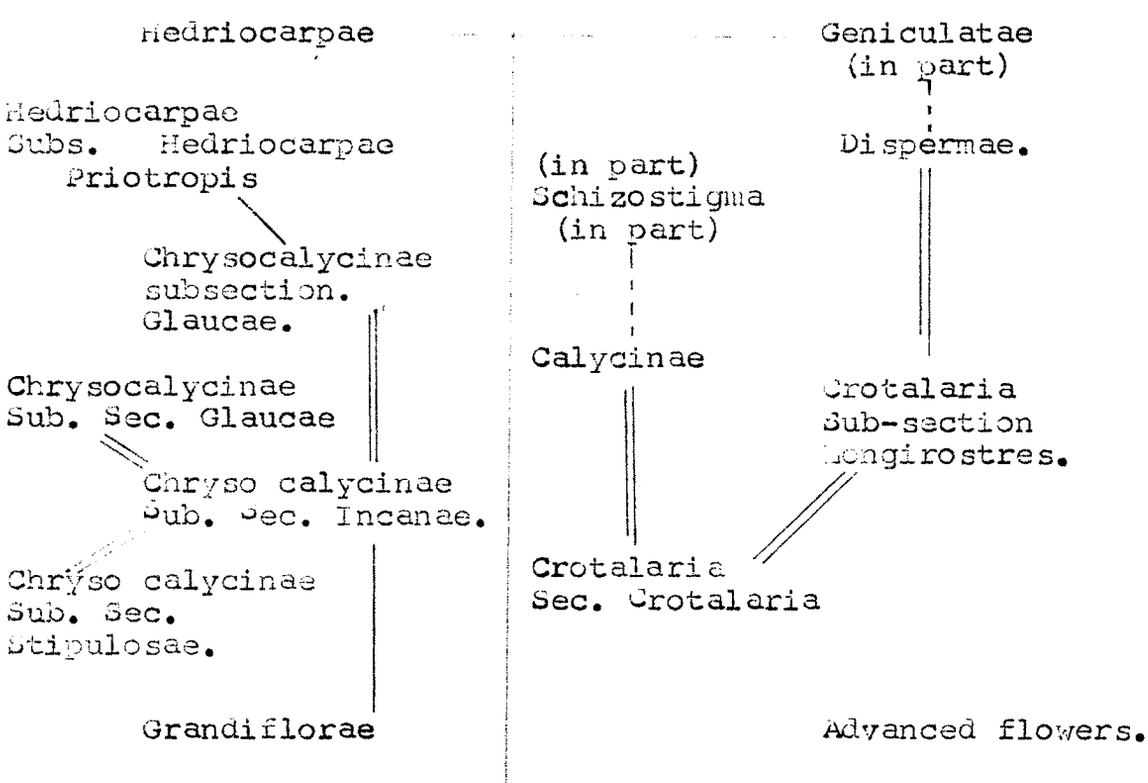
Polhill (1968) while dealing with 434 African species of genus proposed eleven sections with in the genus based mainly on floral morphological characters.

The sections were further arranged in an evolutionary sequence exhibited by this floral specializations. Boulter et al. (1970) determined chromosome number and seed protein, globulin distribution in 33 species of Crotalaria and found correlation between two major types of protein distribution pattern and chromosome morphology with generic subdivisions of the genus proposed by Polhill (1968). They further made an oft repeated demand for elevation of subsection Incanae to the sectional status, as the member of this subsection have 2n=14 condition as against 2n=16 status prevalent in all other sections of the genus.

Bisby (1970, 1973) and Bisby and Polhill (1973) evaluated the earlier classification of the genus proposed by Polhill (1968) on the taximetric ground employing single link clustering, median clustering and principal co-ordinate analysis as true procedures and found that single link clustering method resulted in a classification closely comparable with that of Polhill (1968). However it was noticed that section Chrysocalycinae was hardly recognizable and its members showed clustering with members of subsection Glaucae of section Incanae. As a result, it was proposed to merge section Incanae with Chrysocalycinae and to regard stipulosae, Incanae and Glaucae with members of Chrysocalycinae as subsections of section

Chryso calycinae. Similarly it was suggested that subsections Priotropis and Hedriocarpae of section Hedriocarpae be merged to form one subsection Hedriocarpae, and the section Macrostachye be treated as subsection Hedriocarpae. Section Purpureae comprising a single species, C. purpurea was found to be least connected with other species of this genus, suggesting the removal of this species from the genus as proposed earlier by Dhalgren (1972). Thus, eleven sections of Polhill (1968) were reduced to eight sections.

Section Grandiflorae claims undoubted status of most primitive group within this genus further reticulate relation of different groups as revealed by taximetric approach is shown below.



Most recent study of Pilbeam and Bell (1979) on free amino acids in seeds of Crotalaria also s supports the above classification, though revision of Chrysocalycinae is suggested. Structure of trichomes occuring on floral parts is described in 18 Spp. of Crotalaria of which C. juncea is one, and the key for identification of the Spp. on the basis of trichomes studied is given by Gupta, (1980). Nair et al., (1982) reported Crotalaria willdenowiana DC which has not been discovered since 1914. Thulin, (1982) reported new species of Crotalaria from Ethiopia C. jijigensis sp. nov., C. Polhillii sp. nov. and C. awasensis sp. nov. A new species C. paraguayensis is described by Windler, and Skinner (1982).

Anatomy :

Reference to the early work on the anatomy of the genus are cited by Metcalfe and Chalk (1954). Pillai et al., (1970) have studied root and shoot apical organisation and vegetation anatomy in C. burhia. Shah and Gopal (1974) have studied ontogeny of stomata on foliar and floral organs of eight species of this genus. Seedling anatomy has been described in C. juncea and C. burhia by Bairathi and Nathawat (1974) and Narang (1978) respectively. Miller (1967) has made an attempt to differentiate 47 species of Crotalaria on seed morphology and anatomy. Shailaja and Trivedi (1982)

studied the antogeny of apical meristems in C. juncea.

Embryology :

The embryology of Crotalaria juncea was worked out by Samal (1936), and that of C. intermedia by Paul and Datta (1950 a,b). Remberten (1969) gave a comparative account of megasporogenesis in the family Papilionaceae where in he has compared the megasporogenesis of the previously investigated C. intermedia and C. juncea with the other members of the family. Randelia (1980) studied the histochemical changes induced by irradiation in C. retusa and C. Striata and also the effect of ploidy in C. verrucosa. Anatomical and cytochemical details of the stigma and style of Crotalaria juncea were studied by Ghosh, et al.(1982).

Palynology :

Morphological studies of the pollen in the genus were made by Sen (1939), Selling (1947), Erdtman (1952), Bakker (1956), Ikuse (1956) and Datta and Biswas (1967). Chandra (1968) described the pollen morphology of 41 species of the genus. Datta and Bagchi (1969) made bio-systematic studies in a few taxa of the genus through their pollen grains. Tewari and Nair (1978) traced the trends in evolution of the apertural forms in the genus. Pollen variability due to induced

polyploidy and mutagenes treatment has been studied by Gupta and Gupta (1978 a).

Ecology and Physiology :

Effects of sodium salts, Gibberllic acid, phosphorus and potash on the growth and fibre yield of C. juncea have been worked out by Yadav and Mehta. (1963, 1964), Appalanaidu and Murty (1964) and Iruthayaraj et al., (1974). Wilt disease in Cajanus cajan caused by Fusarium udum was suppressed under mixed cropping with Crotalaria medicaginea. The incidence of wilt disease also decreased in case of soil amended with the leaves of C. medicaginea reported by Upadhyay and Rai (1981).

Bose and Singh (1979) studied the structure of a polysaccharide from seeds of Crotalaria juncea. Seeds composed of D-galactose, D-mannose and Xylose (traces). Bhandal and Malik (1980) studied biosynthesis of lipid during pollen tube growth in Crotalaria juncea. Pandey and Sinha (1980) studied the effect of temperature on growth of C. juncea and C. sericea. Ersson, (1980) described the procedure for large scale preparation of lectin from sunnhemp seeds. Bhardwaj, et al., (1981) studied the aspect of economizing nitrogen by green manures (sunnhemp) in rice, wheat rotation. Patterson,

(1982) studied the effect of shading and temperature on showy Crotalaria (C. spectabilis).

Effect of boric acid on some oxido reductases and hydrolases in Crotalaria juncea pollen suspension cultures was reported by Bhandal, et al., (1982). 41 different germplasms of sunnhemp were screened to determine their resistance or susceptibility against Fusarium wilt disease by Bandopadhyay, et al., (1983). None of the germplasm were immune or fully resistant to disease.

Bacteriological Association :

The importance of root nodules of Leguminous plants in agriculture is now well recognized and considerable work has been carried out on many aspects of symbiotic nitrogen fixation in legumes (Saxena, 1976). Effects of phosphate on the nitrogen fixing power of root nodule bacteria and on the rhizosphere microflora of sunnhemp have been studied by Sankaran et al., (1963) and Shetty et al., (1969). Yadav (1971) reported a stimulation in growth proportion and reduction in C. juncea by B-995 - a growth retardant. Balasubramanian and Rangaswami (1973) studied the effects of foliar application of chemicals like sodium nitrate, diathene, disodium hydrogen phosphate and 2, 4-D on the root

exudation and rhizo-sphere microflora of Sorghum vulgarae and Crotalaria juncea. Sodium nitrate and 2,4-D sprays were found to enhance the bacterial population in C. juncea rhizosphere initially.

Alkaloids :

Mears and Mabr (1971) have reviewed the previous literature on the nature of alkaloids found in Crotalaria. Later reports on isolation of the different alkaloids from various species of the genus have been made by Sawhney and Atal (1971), Smolenski et al., (1972) and Rao et al., (1975). Rao, et al., (1980) reported the antifertility effect of Crotalaria juncea (leaves, seeds), on early pregnancy in albino rats. Synthesis of Crobarbatine acetate, a macrocyclic pyrrohizindine alkaloid was done by Huang, Jamin et al., (1981). The chemical properties of Crotalaria juncea seed gum and its use in petroleum industry and as a new source for the hydraulic fracturing fluids of hydrogel was carried out by Zhao, et al., (1981). Toxic effect of monocrotaline a alkaloid derived from Crotalaria spp. mainly on pulmonary structure was studied by Ghodsi, et al., (1981).

Cytogenetics

(A) Chromosome number and Karyotype :

Kawakani (1930) for the first time reported the

haploid chromosome number in five species and the diploid chromosome number in one species of *Crotalaria*, since then Sen (1938), Rao (1950), Atchison (1950), Frahm Leliveld (1960), Kempanna and Chandrashekharian (1960), Magoon *et al.*, (1963), Datta and Choudhury (1966), Nadkarni (1968), Polhill (1968), Datta and Ghoshal (1969), Boulter *et al.*, (1970), Chennaveeraiah and Patil (1973) Gupta and Gupta (1978 b) and Raina and Verma (1979) have reported the chromosomes number in several species of the genus.

Atchison (1950) was the first to study chromosome morphology of *C. incana* and *C. mucronata*. Detailed karyotype analysis within the genus have been worked out by Magoon *et al.*, (1963), Datta and Biswas (1963), Datta and Choudhury (1966), Nadkarni (1968), Datta and Ghoshal (1969), Chennaveeraiah and Patil (1973) Gupta and Gupta (1978) and Raina and Verma (1979). Randelia (1980) studied karyomorphology of 15 species and attempted to correlate morphological specialization with karyotypic evolution. She also concluded that structural alterations and gene mutations have played an important role, while euploidy and aneuploidy have a minor role in speciation with in the genus.

Gupta and Gupta (1977 b) for the first time reported the occurence of B-chromosomes in five species of this genus. Supernumerary nucleoli observed in C. agatiflora by Verma and Raina (1981). Diurnal variations in mitotic index of the vegetative shoot apex of C. juncea was studied by Shailaja and Trivedi (1981).

(B) Meiosis :

The first report of meiotic studies in the genus was of Roy and Sinha (1959) in C. sericea. Later reports on the microsporogenesis in the genus were by Kempanna and Chandrasekhariah (1960), Sybenga, (1960), Bourhaymont (1961), Datta and Biswas (1962), Magoon et al., (1963), Datta and Choudhary (1964, 1965) and Choshal and Datta (1964).

Pachytene analysis has been carried out by Gupta and Gupta (1978 c). Male meiosis in 8 spp. of Crotalaria was studied by Verma, and Raina (1980), meiosis in C. breviflora and C. brownei is reported for the first time. Chiasma frequency, position and univalent benaviour in a partially synaptic mutant of C. juncea was studied by Verma and Raina (1982).

(C) Polyploidy :

Bourharmont (1961) was first to induce polyploidy in C. goreensis. Gupta and Gupta (1975, 1976) studied the colchiploids of C. juncea, C. retusa, C. brownei and C. sericea. Fulzele (1966), Kempanna et al., (1969) and Malkhandale (1966) have made cytological studies of autotetraploids of C. juncea. Randelia (1980) attempted to get colchiploids and concluded the high genetic stability in the genus.

(D) Irradiation :

Radiation effects have studied in C. intermedia by Sybenga (1960 and 1964), Bhatia and Sybenga (1965) and Bhatia (1967). Gupta and Gupta (1977 a) studied the structural changes in chromosomes of C. juncea following γ-rays and EMS treatment. Cytohistological response of sunnhemp root meristems to gamma rays and DES was studied by Bairathi and Nathawat (1980). Randelia (1980) studied the radiosensitivity of C. retusa and C. striata and found that C. retusa is more radiosensitive than C. striata. Also studied the effect of radiation on fibre quality and alkaloid content.

(E) Male sterility and self-incompatibility :

Problems related to induction of male sterility and fertility restoration have been discussed by

Kempanna (1958) in C. juncea Kempanna and Krishna Sastry (1958) in C. striata and by Edwardson (1967) in C. mucronata.

(F) Hybridization :

There are no reports of naturally occuring interspecific hybrids in Crotalaria. Attempts to obtain interspecific hybrids in the genus were first carried out by Atchison (1950) between C. pumila and C. maxillaris. Though the pod development was stimulated no mature viable seeds were produced. Hybrids from the cross between C. striata and C. mucronata were successfully obtained and studied by Chandrashekhariah and Parameshwar (1961) and Parmeshwar (1966). Singh (1961) observed a parthenocarpic development of fruit in a cross involving C. juncea with C. intermedia. After attempting crosses in between 15 species of Crotalaria, Nagoon et al., (1963) obtained seed production only from a cross involving C. retusa and C. sericea but the hybrid seeds were nonviable.