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# A Synopsis of the Genus *Cuscuta* L.: A review

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**ABSTRACT**

*Cuscuta* is a genus of about 180 species of holoparasitic angiosperm obtaining both water and organic nutrients from its host plants. It is almost cosmopolitan in distribution, leafless yellow or reddish, twining and annuals. Stems are slender, sometimes filiform. Flowers are small, white or rose-colored, sessile or pedicellate, solitary or in lateral fascicles or short racemes. Calyx usually deeply divided, segments five rarely four and distinct or connate at the base. Corolla campanulate, ovoid or globose, usually with fimbricate or lobed scales near the base or below the stamens within, lobes five or four, short, imbricate in bud. Stamens five or four, inserted in or below the throat of the corolla-tube, filaments short, anthers short, obtuse, partially exerted. Ovary perfect or imperfectly two celled ovules two in each cell, styles one or two and stigmas are two. Capsule globose or ovoid, dry or succulent, circum-sessile or irregularly breaking up, four or two seeded. Seeds are glabrous, albumen fleshy, embryo slender, spiral and cotyledons absent or obscure.

**Keywords**: Synopsis, Genus, *Cuscuta*

## INTRODUCTION

Functional vascular cambia are absent from the primitive members such as *Cuscuta australis*, *Cuscuta chinensis*, *Cuscuta hyaline* and *Cuscuta obtusiflora*. However, it is distinct in the advanced tropical members like *Cuscuta reflexa* and *Cuscuta sharmanum*. The medullary rays are prominent in them. Haustorium of the primitive taxa is parenchymatous but in the climax members haustorium is always associated with the imperforate tracheary elements (Bhattacharyya, 1988). The seedling anatomy of *Cuscuta pedicellata* shows that the epidermis has slightly radially elongated cells with chloroplasts. The cortical cells are isodiametric with starch-containing chloroplasts. There is no distinct bordering cell layer between cortex and stele. Three groups of proto-phloem elements with wall thickening

differentiate close behind the green apex. In *Cuscutacampestris* a single epidermal idioblast of unknown structure and function has been observed. The cortex consists of three layers; outer layer is two or three cells thick and consists of almost isodiametrical parenchyma cells.The median layer is one or two cells thick with angular, thin walled and often compressed cells.The inner layer is similar to the outer one(Lyshede, 1985).

**Floral Anatomy:**

The vasculature in the pedicel is more prominent in *Cuscuta calycina, Cuscuta europaea*than in *Cuscuta hyalina and Cuscuta chinensis.*In*Cuscuta hyaline* and *Cuscuta chinensi s*the petal bundles do not traversed into the petals while in *Cuscuta europaea and Cuscuta calycina*, they are branched and traversed into the petals.The stamina bundles are more prominent and concentric in nature. They traverse into the corolla tube and separate into the filaments at the insertion of the stamens. The stamina supply ends at the base of the anther. The scales are more prominent in *Cuscuta calycina,* but are feeble in *Cuscuta chinensis* and *Cuscuta europaea*and absent in *Cuscuta hyaline.* In *Cuscuta europaea*the central vasculature divides and gives out many traces for the disc present at the base of the ovary. The two styles are separate and are equal in size in *Cuscuta hyaline* and *Cuscuta europaea* but of unequal length in *Cuscuta calycina* and *Cuscuta chinensis* (Govil and Lavania,1980). The initiation and development features of floral organs of *Cuscuta australis* exhibits the bisexual flower is protandrous because the anthers are well developed very earlier than the gynoecium. The features of the fimbriate scales are not common in the members of the Convolvulaceae. Another feature is also not found in the Convolvulaceae. It is that the ovules are exposed before the fusion of two carpel apexes. The combination of an apical septum with a congenital basal septum is a feature similar to some of the Convolvulaceae. The placentation is basal and it shares some feature if the axile placentation (Kuoh,1993). The radicular tubers show, Plastids have few thylakoids, but contain peripheral vesicles. Endoplasmic reticulum appears as single sheets in almost all cells. Dictyosomes often bud off very large golgi vesicles. Fat containing globules are present in large numbers in many cells. The radicular tuber is probably the rudiment of a once existing root. Stelar structure is simplified and the conducting elements differ from their usual structure in higher plants (Lyshede, 1986).

**Seed Anatomy:**

The seed anatomy shows, testa composed of rather large cuboid cells with slightly thickened outer wall, the dark contents with much starch, palisade layer as a single layer of prismatic cells with thick lignified and brownish walls. Endosperm starchy and embryo coiled (Corner, 1976)

**Palynology:**

*Cuscuta*presents some puzzling results when considered in light of the sex allocation theory, as only some infrageneric lineages demonstrate the predicted pollen size-number tradeoff, while *Cuscuta gracillina* complex (in subgenus *Grammica*) displays an unexpected negative relationship between pollen size and style length (Wright, 2012). The 3-zonocolpate pollen is ancestral, while grains with more colpi have evolved only in two major lineages of *Cuscuta*. Complex morphological intergradations occur between species when their tectum is described using the traditional qualitative types- imperforate, perforate and micro-reticulate. This continuous variation is better expressed qualitatively as “percent perforation” namely the proportion of perforated area from the total tectum surface. Tectum imperforation is likely the ancestral condition, while pollen grains with increasingly larger perforation areas have evolved multiple times. The reticulate tectum, unknown in other Convolvulaceae, has evolved in *Cuscuta* only in two lineages. Overall, the morphology of pollen support *Cuscuta* as a sister to either the “bifid-style” Convolvulaceae clade. Pollen characters alone are insufficient to reconstruct phylogenetic relationship, however, palynological information is useful for the species-level taxonomy of *Cuscuta* (Wesh *et al*, 2010).

**Embryology:**

The tapetal cells in *Cuscuta europaea* become binucleate earlier even at microspore mother cell stage while in *Cuscuta calycina* the binucleate condition is achieved later. In *Cuscuta calycina* in some cases the upper one again divides to produce two spores which later on degenerate. The endosperm is nuclear. The nuclear divisions in the endosperm are much rapid in *Cuscuta europaea* than in *Cuscut acalycina.* The endosperm is multi-nucleate when the zygote in *Cuscuta calycina* embarks upon its first division.The starch grains constitute the reserved food of the developing embryo, and also at the time of germination. Because in *Cuscuta* the embryo is undifferentiated and cannot synthesize its food till it

established on its host (Govil and Lavania, 1980). Gwenda L. Davis (1966) gave the status to the genus *Cuscuta* in separate family Cuscutaceae. According to his observations on embryology of Cuscutaceae, the anther is tetrasporangiate and its wall development follows the Dicotyledonous type. The endothecium develops fibrous thickening, the middle layer is ephemeral, and the cells of the glandular tapetum become 2-4 nucleate, the 1-nucleate condition being restored by fusion in *Cuscuta epithymum*. Ubisch granules have been reported in several species. Simultaneous cytokinesis in the microspore mother cells follows meiosis and the microspore tetrads are tetrahedral, iso-bilateral or decussate. Pollen grains are usually 3-celled when shed, but those of Cus*cuta monogyna*and *C*usc*uta reflexa*are 2-celled. Multinucleate pollen grains and polyspory have been reported in Cus*cuta epithymum* and *Cuscuta reflexa.* The ovule is anatropous, unitegmic and tenuinucellar. The archesporial cell functions directly as the megaspore mother cell where usually cytokinesis accompanies meiosis and the chalazal megaspore of a linear tetrad develops into a Polygonum type embryo sac. In *Cuscuta reflexa*, however, wall formation following the homotypic division is suppressed and an Allium type embryo sac forms from the chalazal dyad cell. The synergids are beaked and in *Cuscuta reflexa* one enlarges and persists into embryogeny with a suspected haustorial function. Starch grains are present in the embryo sac and a placental obturator develops in *Cuscuta reflexa*. In *Cuscuta reflexa* the inner endosperm cells gelatinize and become mucilaginous. Embryogeny in different species suggests either the Caryophyllad or the Solanad type but it does not conform satisfactorily to either. The fully developed embryo shows no development of cotyledons. The suspensor consists of a few uninucleate cells in *C*us*cuta epithymum*, Cuscuta hyaline, and *Cuscut aplanifolia* but in *Cuscuta monogyna* it forms an aggressive haustorium of large multinucleate cells whereas in *Cuscuta reflexa*bith suspensor types occur as well as intermediate forms. Polyembryony is of occasional occurrence in *Cuscuta reflexa*, where the additional embryo is of supposedly synergid origin.

**Physiology:**

*Cuscuta subinclusa*, *Cuscuta gronovii* and*Cuscuta campestris* possess thylakoids and contain both chlorophyll a and b especially in the growth tips of the seedlings. Plastids of *Cuscuta grandiflora* and *Cuscuta odorata* do not contain chlorophyll, the enzyme Rubisco and developed thylakoids. *Cuscuta reflexa* possesses a number of photosynthesis-related genes with significant homology to those found in higher plants. It was generally accepted that *Cuscuta europaea* is mostly adapted to a parasitic lifestyle with no detectable levels of chlorophylls(Svubova *et al*, 2013).

**Cytogenetics:**

*Cuscuta* is a widely distributed genus of holoparasitic plants. Holocentric chromosomes have been reported only in *Cuscuta* Subg. *Cuscuta*. The mitotic chromosomes showed neither primary construction nor Rabl orientation where the meiotic ones exhibited the typical quadripartite structure characteristic of holocentrics, supporting the assumption of holocentric chromosomes as a synapomorphy of *Cuscuta* Subg. *Cuscuta*. Choromosomes and interphase nuclei display many heterochromatic blocks than attained deeply with hematoxylin. The banded karyotype showed terminal or sub-terminal bands in all chromosomes and central bands in some of them. The noteworthy giant nuclei of glandular cells of petals and ovary wall exhibited large chromo-centers typical of polytenic nuclei (Guerra, 2004). The plastid genome structural rearrangements in parasitic and non-parasitic Convolvulaceae are considered in a molecular phylogenetic frame work, three categories of rearrangements in *Cuscuta* are revealed: plesiomorphic, autapomorphic and synapomorphic. The synapomorphic rearrangements are most likely to correlate with the parasitic lifestyle, because they represent changes found in *Cuscuta* exclusively (Stefanovic, 2005).

**Phytochemistry:**

*Cuscuta racemosa* is used in popular medicine as an anti-inflammatory and diuretic, for stomach and hepatic disorders and for treating fresh wounds. It was chemically investigated and tested for its antimicrobial activity and cytotoxicity. The flavonoids and tannin content of the dried plant were 2.79 % and 2.01% respectively. Furthermore, the 4`- methoxyquercet inflavanoid compound was isolated from the ethanolic fraction. The minimum inhibiting concentration in the antimicrobial test was 2.0 mg/ ml for *Staphylococus aureus*, and a DL50 of 0.231 mg/ ml was obtained in the cyto-toxicity experiment. The fraction directed to alkaloids was able to eliminate 100% of the brine shrimp used for the test (Ferraz, et al 2010).

*Cuscutacampestris*possess to have anthelmintic activity. The ethanol extract of plant also proved Analgesic, antipyretic and anti-inflammatory activity on different host (Ghule*et al* 2011).

Chromatographic profiles of ergoline alkaloids, glycoresins and kauranoic glucosides considered as taxonomic markers of the Convolvulaceae, were determined in *Cuscuta americana*, *Cuscuta arvensis, Cuscuta corymbosa* and *Cuscuta tinctoria.* In these species markers of the three groups of compounds were found. These results support the idea of considering Cuscutaas a genus of the family Convolvulaceae and not as a family by itself(Perez-Amador e*t al*, 1996).

**Phylogeny and Evolution:**

*Cuscuta umbellata* is polyphyletic.Discordances between phylogenies derived from plastid and nuclear data strongly suggest that at least four independent hybridization events have occurred in the evolution of this species group, rendering relationships among its members more complex than previously thought (Costea, 2010). Hybridization may play an important role in the evolution of *Cuscuta*. It is based on plastid and nuclear sequences obtained for an extensive sampling of species from a broad taxonomic and geographic range, carefully chosen to represent the phylogenetic inferences are well resolved and robust, including significant support for almost all of the higher-level relationship along the spine of the tree. Within *Cuscuta,* four major, well supported, and distinct clades can be seen and refer as four subgenera these are *Subgenus Monogynella*, *Subgenus Cuscuta*, *Subgenus Pachystigma* and *Subgenus Grammica*. These four well supported major clades are resolved. Two of them correspond to subgenera *Monogynella* and *Grammica*. Subgenus *Cuscuta* is paraphyletic, with section *Pachystigma* sister to subgenus *Grammica*. Previously described cases of strongly supported discordance between plastid and nuclear phylogenies, interpreted as reticulation events are confirmed here and three new cases are detected. Dehiscent fruits and globose stigmas are inferred as ancestral character states, whereas the ancestral style number is ambiguous (Garcia,2014). Within the parasitic genus *Cuscuta*, three subgenera have been recognized based on characters of the styles and stigmas. *Cuscuta*subgenus *Cuscuta*, with free styles and conical to elongated stigmas, is the most diversified in the Old World with about 25 species. The first phylogenetic study of the subgenus using nuclear ITS rDNA and chloroplast trnl intron sequences. The monophyly of the subgenus could not be tested with our sampling but using three species of subgenus *Monogyna*as outgroup, the South African section *Pachystigma* was sister to the remaining species of subgenus *Cuscuta*. Section Epistigma plus *Cuscuta capitata* are resolved as monophyletic in all analyses. The distinctive *Cuscuta babylonica* was sister to that clade on the ITS trees but it was not resolved on the trnL trees. Two monophyletic groups within section *Cuscuta* , first identified here, included the species of tropical African distribution in one case and *Cuscuta europaea*, *Cuscuta approximata* and *Cuscuta balansae* in the other. Factors influencing the taxonomic difficulty of many species in the subgenus include lack of morphological characters, parallelism and gene flow between closely and not so closely related species. Evidence of reticulation events or within species recombination were obtained by both polyphyletic intra-individual ITS sequences and conflicting topologies of the nuclear and plastid trees (Garcia, 2007).

**Morphology:**

*Cuscuta* is a leafless, Chlorophyll-less total parasite attacking other Angiosperms, it sucks food from its host by means of special root-like bodies (Suckers). The germination of seed of *Cuscuta* is peculiar, the seedling is a long filamentous structure with very undeveloped cotyledons and without any root which dies very rarely. The seedling makes movements of its free filamentous tip in wide circles, so inevitably any plant available as a host that may grow within its reach, if the search for host become unsuccessful for time being, the filament lengthens making movements for days at the expense of the food stored in the filament, and if the filament comes in contact with a host it immediately coils round the host sending forth haustoria. Ultimate failure in getting host results in the death of the seedling

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**REFERENCES**

Bhattacharyya PK (1988) The vascular cambia of Dodder and its allies. Bulletin of the Botanical survey of India. 30:149-155.

Corner EJH (1976) The Seeds of Dicotyledons. Cambridge University Press, Cambridge.

Costea M and Stefanovic S (2010) Evolutionary history and taxonomy of the Cuscuta umbellate complex ( Convolvulaceae): Evidence of extensive hybridization from discordant nuclear and plastid phylogenies. *Taxon.* 18: 112-130.

Davis GL (1966) Systematic Embryology of the Angiosperms. John Wiley & Sons, Inc. New York.

Ferraz HO, Silva MG, Carvalho Rui, Suffredini IB, Kato ETM, Arkaki Fernanda and Bacchi, EM (2010) Phytochemical study and evaluation of the antimicrobial activity and cytotoxicity of *Cuscutaracemosa* Mart., Convolvulaceae. Bra.J. of Pharmacog.11:47-54.

Garcia M and Martin MP (2007) Phylogeny of Cuscuta subgenus Cuscuta (Convolvulaceae) based on nrDNA ITS and Chloroplasts trnL Intron Sequences. *Syst. Bot*. 32 (4): 899-916.

Garcia MA, Costea M, Kuzmina M and Stefanovic S (2014) Phylogeny, Character Evolution, and Biogeography of *Cuscuta* (Dodders; Convolvulaceae) Inferred from Coding Plastid and Nuclear Sequences. *American J. of Bot.* 101 (4): 670-690.

Ghule RS, Venkatnarayanan R, Thakare SP and Ghule PR (2011) Analgesic activity of *Cuscutacampestris* Yuncker a parasitic plant grown on *Neriumindicum* Mill. *J. of Advan.Pharma.Edu.& Res.* 1: 45-51.

Govil CM and Lavania Seshu (1980) Floral anatomy and embryology of some species of *Cuscuta* L. *Porc. Indian Acad. Sci*. (Palnt Sci.), 89: 219-228.

Guerra M and Garcia MA (2004) Heterochromatin and rDNA sites distribution in the holocentric chromosomes of *Cuscuta approximate Bab*. (Convolvulaceae). Genome, 47 (1): 134-140.

Kuoh CS and Liao G I (1993) Flower initiation and development in *Cuscutaaustralis* R.Br. (Convolvulaceae). *Taiwania*. 38:99-108.

Lyshede OB (1985) Morphological and anatomical features of *Cuscutapedicellata* and *C.campestris*. *Nord.J. Bot*.5 :65-77.

Lyshede OB (1986) Fine-structural feature of the tuberous radicular end of the seedling of *Cuscutapedicellata*.*Ber.Deutsch.Bot.Ges. Bd*.99:105-109.

Perez-Amador MC, Arreola L, Guzman MJ and Garcia-Argaez A (1996) Taxonomic markers of the family Convolvulaceae in four species of *Cuscuta*. *Phyton*. 58 (1/2): 115-118.

Stefanovic S and Olmstead RG (2005) Down the Slippery Slope: Plastid Genome Evolution in Convolvulaceae. *J. Mol. Evol*. 61: 292-305.

Svubova R, Ovecka M, Pavlovic A, Slovakova L and Blehova A (2013) *Cuscutaeuropaea* plastid apparatus in various developmental stages. Plant Signaling & Behavior: 8:5 e 24037-1-4.

Welsh M, Stefanovic S and Costea M (2010) Pollen evolution and its taxonomic significance in *Cuscuta* (dodder, Convolvulaceae).*Plant Syst. Evol*. 285: 83-101.

Wright MAR, Ianni MD and Costea M (2012) Diversity and evolution of pollen-ovule productionin *Cuscuta* (dodders, Convolvulaceae) in relation to floral morphology. *Plant Systevol.* 10: 14-18.