Chromosome variation in relation to leaf structure of *Psoralea corylifolia* Linn.

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Abstract

Karyotype of three chromosomal biotypes of *Psoralea corylifolia* are compared. Evolutionary statii have been discussed. The study shows that these chromosomal variations within a species are not mere accidental. The cytotypes have definite morphological distinctions.

INTRODUCTION

Similar to the chromosomal biotypes found in many economic species, *Psoralea corylifolia*, which is of much therapeutic value (seed stomachic, deobstruent, anthelmintic, diuretic, diaphoretic, and used in leprosy, leucoderma and for scorpion-sting and snakebite; vide Chopra, Nayar and Chopra 1956) and economic importance as a fodder crop (Wlth. Ind. 1969), also represents chromosomal biotypes. Datta and Maiti (1968) described the karyotype of *Psoralea corylifolia* collected from Subhasgram (district 24-Parganas of West Bengal, India). The present paper describes the karyotypes of two other biotypes.

Datta and Das (1970) have studied the detailed pharmacognostic characters of the seed of *Psoralea corylifolia* for distinguishing from *Tephrosia purpurea* which is likely to occur as an admixture. The present investigation aims at assessing the impact of the chromosomal difference of the biotypes on leaf characters. For this purpose two cytotypes, one described by Datta and Maiti 1968 and the other described here have been selected for comparison for their very distinct chromosome characters.

MATERIAL AND METHODS

Different collections of *Psoralea corylifolia* from eastern India were grown in the University garden. Somatic chromosomes from root tips were studied by the usual aceto-orcein technique after pretreatment with aesculine (saturated). The chromosomal biotype described by Datta and Maiti (1968) has been referred here as cytotype I. Two other collections, one from Howrah West Bengal, India (Sample No. PS. 3) and one from Lucknow, India (Sample No. PS. 2) (here referred as cytotypes II and III respectively), represent distinct karyotypes. For microscopical study of different structures of leaves thin razor-cut sections and cleared leafpieces (obtained by boiling in water, ethanol and saturated aqueous chloral hydrate) were used. Chromosome study of each type was based on 5 clear somatic metaphase plates.

OBSERVATION

Chromosome Study

Chromosomes are generally medium in length, varying from 1.1 to 4.2 μ . Number of chromosomes bearing secondary constrictions is four (two pairs) in type II and eight (four pairs) in type III. One pair of type III has a supernumerary constriction. It is worth mentioning in this connection that type I (Datta and Maiti 1968) has four pairs of chromosomes having secondary constrictions, supernumerary constrictions being located in two pairs. The total chromosome length (n) is 34.7 in type II and 22.2 in type III, while it is 13.2 in type I (Datta and Maiti 1968). Number of chromosomes also differs in the biotypes, $2n=24$ in type II, $2n=22$ in type III, while it is $2n=20$ in type I (Datta and Maiti 1968). The following chromosome types occur in these biotypes (Fig. 1).

A — Two constrictions forming three segments, the shortest and the longest at two ends.

B — Two constrictions forming three segments, middle longer than the other two.

C — Two constrictions forming three segments, one of the terminal longest and the other two equal.

D — Three constrictions forming four segments, one terminal and its adjacent much longer than the other two.

E — Three equal segments formed by two constrictions.

F — Median primary constrictions forming equal arms.

G — Submedian primary constriction forming unequal arms.

Details of the karyotype are represented in Table 1 and Figs. 2, 3 and 4.

Figs. 1 and 2. Karyotype study of *Psoralea corylifolia*. 1 — Diagrammatic representation of the chromosome types found in different cytotypes. 2 — Idiogram of cytotypes I (described by Datta and Maiti 1968), II and III.

Table 1
Analysis of karyotype of the three cytotypes of *P. corylifolia*

Types	2n	Size range μ	Chrom.	Complements	Position of Prim. Constr.
I	20	2.2—1.3—1.0	With constr. Without constr.	2E 2 18F 18	sm } According to m } Datta & Maiti 1968
II	24	1.8—2.9—4.2	With constr. Without constr.	2A } 2B } 4 2F } 18G } 20 2B } 2C } 2D } 8 2E } 8F } 14 6G }	m sm m sm sm sm sm m m sm
III	22	1.1—2.0—3.2	With constr. Without constr.	2A } 2B } 4 2F } 18G } 20 2B } 2C } 2D } 8 2E } 8F } 14 6G }	m sm m sm sm sm sm m m sm

Figs. 3 and 4. Photomicrographs of somatic metaphase plates of cytotypes II and III, respectively

Leaf characters

Among the macroscopical characters, length and breadth of lamina differ significantly (Fig. 5). Length of petiole, $25.2 (\pm 1.5)$ and $24.4 (\pm 0.6)$ in cytotypes I and II, respectively is not distinct. The cytotypes do not differ much in the diameter of petiole also, which is $3.0 (\pm 0.05)$ and $2.7 (\pm 0.12)$ in I and II, respectively.

Among the microscopical characters of leaf, palisade ratio, stomatal index of the abaxial surface, frequency of gland cells on the abaxial surface, frequency of hairs on the abaxial surface, and length of stomata differ markedly (Figs 5 and 6).

Fig. 5. Comparison of quantitative macroscopic and microscopic characters of leaves of cytotypes I and II.

LA. L. — lamina length; LA. B. — lamina breadth; PAL. R. — palisade ratio; SI. AB. — stomatal index of abaxial surface; GL. AB. AB — gland abundance per mm^2 on abaxial side; H. AB. AB — abundance of hairs on the abaxial side (per mm^2); ST. LEN — stomata length

Horizontal bars indicate mean values. The height of vertical boxes on any one side of the bars is equal to the value of standard error. The vertical lines from horizontal bar on either side are equivalent to the values of standard deviations

Fig. 6. Stomata and palisade:epidermal cell ratio as represented by camera lucida drawing in cytotypes I and II

Other measurements, such as vein-islet number per mm^2 (15.5 ± 0.5 in I; 15.1 ± 0.6 in II), stomatal index of the adaxial surface (14.0 ± 0.7 in I; 14.8 ± 0.2 in II), frequency of glands per mm^2 on the adaxial surface (8.9 in I; 6.2 in II), frequency of hairs on the adaxial surface (2 in

I, 1.9 in II), length of hairs on the abaxial surface (73.2-416.3-579.5 μ in cytotype I; 91.5-432.1-610.0 μ in cytotype II) length of hairs on the adaxial surface (27.4-36.6-45.7 μ in cytotype I; 24.4-34.3-45.7 μ in cytotype II), and breadth of stomata (15.2-20.2-24.4 μ in cytotype I; 9.5-19.3-24.4 μ in cytotype II), are not much different.

DISCUSSION

It is clear from the description that the same species, *Psoralea corylifolia* Linn., when adapting with different ecological conditions, has evolved as different chromosomal biotypes. They differ both in chromosome number ($2n=20, 22, 24$) and karyotype. Chromosomes bearing secondary constrictions are four in cytotype II and eight in cytotype III and I. Chromosomes bearing supernumerary constrictions are two in cytotype III and four in I.

Of these three types, cytotype II appears as most primitive for its longest chromosomes (total haploid length 34.8 μ and mean chromosome length 2.9 μ) and the lowest number of secondary constrictions (Sharma 1964; Stebbins 1966). Cytotype III represents the next evolved state, for shorter chromosomes (total haploid length 22.2 μ and mean chromosome length 2.0 μ) and higher number of secondary constrictions (four pairs). Cytotype I, described by Datta and Maiti (1968) represents the most evolved condition, for the shortest chromosome (total haploid length 13.2 μ and mean chromosome length 1.3 μ) and for the chromosomes bearing secondary constrictions being more specialized by the presence of supernumerary constrictions in two pairs.

These chromosomal differences are related to morphological differences of the cytotypes, e.g. length and breadth of lamina, palisade ratio, stomatal index, abundance of glands and hairs, and length of hair and stomata.

It is clear from the study that the cytotypes differ not only in chromosome morphology and number, but also in quantitative microscopical and macroscopical characters. This has an immense significance in a medicinal plant species. The impact of chromosomal difference may also naturally be profound on the therapeutic value.

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Różnice chromosomów w liściach trzech biotypów Psoralea corylifolia L.

Streszczenie

Porównywano kariotypy trzech biotypów chromosomalnych *Psoralea corylifolia* L. Przeprowadzone badania wskazują, iż chromosomalne różnice między omawianymi gatunkami nie są przypadkowe, lecz są ewolucyjnie uzasadnione. Wskazują na to nie tylko liczby i morfologia chromosomów, lecz również jakościowe cechy mikro- i makroskopowe cytotypów.