Chapter 7

Discussion

Genus Tephrosia is well defined genus having combination of characters like obtuse standard petal, flat not jointed and many seeded pods, subequal sepals, calyx lobes not connate and muticous and basifixed anthers. Leaves or leaflets when cut, they always cut into a fork or horn like structures. This feature is the diagnostic character of genus Tephrosia which was not mentioned in any earlier published literature or flora. Genus Tephrosia is represented in India by 29 taxa (27 species, 1 subspecies and 1 variety).

Genus Tephrosia shows broad range of variation in the habit and morphological features. The taxa are annual herbs to perennial woody shrubs, height ranges from 15-20 cm to 4 meters. Prostrate habit is reported in T. pumila, procumbent habit in T. maxima and remaining taxa shows erect habit. Unifoliolate or simple leaves are found in T. strigosa and T. calophylla. Five leaflets are reported in T. pentaphylla, Seven leaflets are reported in T. coccinea and 9 or mire leaflets are reported in remaining taxa. Pubescent leaves have been reported in T. candida, T. coccinea, T. hamiltonii, T. leptostachya, T. maxima, T. pentaphylla, T. pumila, T. purpurea, T. purpurea var. maritima, T. strigosa, T. tinctoria, T. pulcherima, T. villosa, T. vogelii. Axillary inflorescence have been reported in T. pentaphylla, T. pumila, T. strigosa, T. purpurea var. maritima, extra axillary inflorescence in T. purpurea, T. candida, T. coccinea, T. tinctoria, T. pulcherima, T. vogelii and leaf opposed in T. hamiltonii, T. maxima, and T. villosa. One to two flowers per inflorescence axis reported in T. strigosa, T. pumila, and large number of flowers per inflorescence axis found in T. candida and T. vogelii. Calyx hairy, densely pubescent or silky, sepal length variable in 2-13 mm.

Corolla papilionaceous, colour ranges from white, pink, lilac, purple, dark purple, violet. Stamens 10, didelphous 9+1. Pod ranges from 1 cm to 10 cm long. 10 cm long in T. vogelii. Pods are peculiar to particular species.

There are 22 chromosomes found in somatic cell. Therefore 2n = 22 and n = 11. The chromosome ranges from 1 – 5 µm. The smallest found in T. purpurea and longest in T. hamiltonii. The ratio of longest / shortest is found highest in T. purpurea E 02 i.e 2.8 and lowest 1.66 in T. villosa. T. coccinea has four metacentric, sixteen submetacentric with one nucleolar and two acrocentric chromosomes. The karyotype formula is 4V+1Ln*+15L+2J. T. hamiltonii has four metacentric and eighteen submetacentric chromosomes. The karyotype formula is 4V+18L. Three ecotypes of T. maxima has6 metacentric, 13 submetacentric, 2 acrocentric and 1 telocentric; 6 metacentric, 14 submetacentric and 2 acrocentric; 2 metacentric, 18 submetacentric and 2 acrocentric chromosomes respectively. The karyotype formula is 6V+13L+2J+1I, 6V+14L+2J, 2V+18L+2I respectively. T. pentaphylla has 10 metacentric, 10 submetacentric and 2 acrocentric chromosomes. The karyotype formula is 10V+10L+2J. T. pumila has 4 metacentric, 14 submetacentric with 1 satellite and 4 acrocentric chromosomes. The karyotype formula is 4V+13L+1Ln*+4J. Six ecotypes of T. purpurea has 1 metacentric, 2 submetacentric (satellite) and 19 submetacentric; 3 metacentric, 11 submetacentric, 7 acrocentric and 1 telocentric; 6 metacentric, 14 submetacentric and 2 acrocentric; 3 metacentric, 12 submetacentric and 7 acrocentric; 4 metacentric, 16 submetacentric and 2 acrocentric; and 6 metacentric, 14 submetacentric
and 2 acrocentric chromosomes observed respectively. The karyotype formula is 1V+2L+n*+19L, 3V+11L+7J+1L, 6V+14L+2J, 3V+12L+7J, 4V+16L+2J, 6V+14L+2J respectively. T. strigosa and T. villosa have 6 metacentric, 12 submetacentric, 4 acrocentric and 2 metacentric and 20 chromosomes submetacentric respectively. The karyotype formula is 6V+12L+4J, 2V+20L respectively. Raina and Shrivastav (1983) have studied the karyotype and idiograms of 22 taxa. Among these 22 taxa the similar type of karyotype and karyotype formulae were observed in 2 taxa i.e. T. noctiflora, T. cineria and T. purpurea with 2 nucleolar chromosomes, T. subtriflora and T. falsiformis. The karyotypes of T. adunca, T. cineria and T. hamiltonii are observed similar to T. maxima E 01 and T. villosa and T. hamiltonii. The only difference in between them is presence of nucleolar chromosome. The karyotype and karyotype formula of T. purpurea, T. strigosa and T. villosa is completely different than observations of Raina and Shrivastav (1983). 10 taxa show variation in karyotype and karyotype formulae studied by present author. T. coccinea and T. purpurea shows similarity in karyotype formulae however, some slight variation of nucleolar chromosomes observed amongst them. Even similar karyotype formulae was observed in T. maxima E 02, T. purpurea E 03 and E 08. Presence of satellite in T. pumila and T. purpurea E 01 may be the advanced criteria. The similarity must be showing the close relation of taxa amongst them and karyotype variation in other taxa may be indicating species difference as each has different karyotype. Even karyotype variation in ecotype studies may be showing advancement. While considering the classification according to their degree of asymmetry, 4 groups are formed. Only T. strigosa falls in 2A which is most primitive class. Ecotype 02, 03 and 08 of T. purpurea falls in next category i.e 2B which is less advanced one. 2 taxa, T. maxima E 02 and T. villosa E 02 falls in advanced category i.e 3A and remaining all falls in 3B category which is most advanced than earlier ones. It indicates that the taxa are slightly evolved.

The preliminary molecular analysis proved monophyly of the genus, however two markers matK and rbcL exhibited conflicting topologies. Various ecotypes of T. purpurea have been appeared as distinct entities in molecular aspects. T. villosa and T. vogelii are very closely related and have common ancestors. T. cooccinea, T. purpurea and T. hamiltonii are closely related and are the descendents of a common ancestors. T. maxima has been appeared as distinct species. T. purpurea ecotype 01, 02 and 05 and T. strigosa showed close relationship where as ecotype 04 of T. purpurea showed affinity with T. candida. T. calophylla nestsles with T. villosa ecotype 02 and T. pentaphylla.

There are 2 groups and 5 clades appeared by both the markers. It is difficult to split the genus Tephrosia into subgenus or sections merely on the basis of this preliminary molecular data.

The genetic distance between the taxa of genus Tephrosia have been considered to distinguish between them. The genetic distance between ecotype 01 of T. purpurea and ecotype 02 is 6.4; ecotype 03 is 6.3; ecotype 04 is 9.1 and ecotype 05 is 5.7. It clearly indicated the difference at genetic level.

The genetic distance between ecotype 02 of T. maxima and its ecotype 03 is 1.6; The genetic distance between ecotype 01 of T. strigosa and its ecotype 02 is 2.6; The genetic
distance between ecotype 01 of T. tinctorea and its ecotype 02 is 6.4; ecotype 03 is 5.6. The genetic distance between ecotype 01, 02 and 03 of T. villosa is 3.3.

The least genetic distance was observed between T. hamiltonii, T. coccinea and T. purpurea ecotype 02 is 0.2; T. pulcherima and T. coccinea is also 0.2. The highest genetic distance was found in T. purpurea ecotype 01 and T. tinctorea ecotype 01 was 10.9. The remaining taxa showed the intermediate genetic distance ranging 0.2 to 10.9.
Conclusions:

It was observed that, all the species of Tephrosia show variations in their morphological features, karyotype and Idiograms, molecular data and genetic distance.

There are 04 groups of the Karyotypes of the 15 taxa of Tephrosia on the basais of their degree of asymmetry. The 04 groups of the Karyotype of genus Tephrosia are – 2A (1 taxon), 2B (3 taxa), 3A (2 taxa) and 3B (9 taxa).

The cytological data like Karyotype and Idiogram of the selected species is not sufficient to delimit the particular species.

It is difficult to correlate between morphological features and cytological data by means of Karyotype and Idiograms of species of Tephrosia.

The DNA Barcode of 14 taxa of Tephrosia have been prepared and submitted to NCBI and BOLD system.

The genetic distance between different species of Tephrosia have been determined, the range is 0.2 to 10.9.

The data is insufficient to revise the genus Tephrosia. The palynological, anatomical, dermatological, phytochemical, testa topographical features of all the species of India have to be considered.