

Taxonomic status of the *Solanum nigrum* complex found in India

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Abstract. An attempt has been made, with the help of modern taxonomic treatments, to determine the correct taxonomic status of the *Solanum nigrum* L. complex in India. On the basis of comparative morphological and cytological studies, it is concluded that the diploids, tetraploids and hexaploids are in fact, *Solanum americanum* Mill. var. *patulum*; *Solanum villosum* Mill. subsp. *miniatum* (Bernh. ex Willd.) Edmonds, and *Solanum nigrum* L. subsp. *nigrum*, respectively.

Keywords. *Solanum nigrum* L.; *Solanum villosum* Mill.; *Solanum americanum* Mill.; polyploidy; taxonomy; nomenclature.

1. Introduction

One of the most widespread and variable species groups of the genus *Solanum* L. (Solanaceae) is that contained in the section *Solanum* (also known as section *Morella*), centering around the species *Solanum nigrum* L., the black nightshade (Edmonds 1977). Members of this species group are highly variable and form a polyploid series based on $x = 12$ chromosomes (Bhaduri 1933; Stebbins and Paddock 1949).

The problems of nomenclature are common within this section and, at times, they are confusing because some earlier botanists were not aware of the unusual variability of species in this section. Many names were proposed for a relatively few true species, and furthermore different species were treated under the single epithet, that is, homonyms (Dunal 1813, 1852; Bitter 1912, 1922; Edmonds 1977, 1979a).

Even though much has been published on cytogenetics of the indigenous Indian taxa (Magoon *et al* 1962; Tandon and Rao 1966a, b; Chennaveeraiah and Patil 1968; Venkateswarlu and Krishna Rao 1972), little has been done to relate this to the classification. Recently the nomenclatural problems of this species group were well documented and the correct names for different cytotypes have been suggested (Hawkes and Edmonds 1972; Henderson 1974; Edmonds 1971, 1972, 1977a, 1984a, b), but many Indian taxonomists in particular and botanists in general are apparently not aware of these facts (Santhapau 1948; Deb 1979; Nair and Hendry 1983; Rao 1981; Edmonds 1984a) and they are still using the one name *S. nigrum* for diploid, tetraploid and hexaploid forms. The objectives of the present investigation are the identification of the cytotypes of *S. nigrum* described from India and to provide a diagnostic key to them.

2. Materials and methods

Diploid, tetraploid and hexaploid forms collected from different floristic regions were grown in the experimental garden for detailed morphological and cytogenetical

studies. The voucher specimens were deposited in the Botany Department, Bharathidasan University, Tiruchirapalli.

The characters studied for the species were growth habit, stem branching and ridging, pubescence, leaf margin type and apex type, inflorescence and infructescence arrangement, pedicel type, flower and fruit number, corolla shape, anther and style length, style posture, berry shape and colour, seed number and size, chromosome number and pollen grain diameter. Modern taxonomic treatments were consulted to find the correct nomenclature of indigenous taxa.

3. Results and discussion

The occurrence of diploid, tetraploid and hexaploid cytotypes has been observed in India in the present investigation. The important morphological features of the 3 cytotypes are as follows:

3.1 *Diploid cytotypes*

Annual or short lived perennial up to 1.0 m height, leaves and stem usually subglabrous with curved eglandular hairs, usually green, but rarely with purple spots on the nodal region, narrowly winged by decurrent leaves or becoming terete with age. Leaf, simple, ovate, acute with undulate to dentate margin, petiole marginate. Inflorescence umbelliform, 3–5 flowered. Pedicels ascending to decurved in flower, decurved to pendulous in fruit. Calyx in flower campanulate, in fruit flattened and recurved, lobes semielliptic to triangular and obtuse. Corolla stellate, white with yellow star, lobes narrowly ovate to narrowly triangular.

Stigma protrudes beyond the tip of anther ring. Anthers 1.05 (0.9–1.2) mm long. Mature fruit shiny bluish-black, globose or slightly depressed, with a diameter of 7.5 (5.0–8.1) mm, seeds 35–55. Pollen grain diameter 22 (18–23) μm . Chromosome number $2n = 24$. Common in both temperate and tropical climatic regions, especially on waste lands.

3.2 *Tetraploid cytotypes*

Annual or short lived perennial becoming bushy with age, up to 0.5 m tall with branches ascending. Leaves and stem subglabrous with eglandular curved hairs. Leaves green to purplish green, blades narrowly ovate to broadly ovate with acuminate to obtuse tip, regularly toothed, inflorescence racemiform, extra-axillary, 4–6 flowered; corolla lobes becoming strongly reflexed at anthesis. Calyx in flower campanulate, in fruit becoming moderately to strongly reflexed, lobes triangular and acute. Corolla rotate, white, lobes narrowly to broadly triangular acute or obtuse. Anthers 1.26 ± 0.11 mm long, pollen 25 (21–26) μm across. Stigma level with tips of anthers. Mature fruit ellipsoid, somewhat longer than broad with a diameter of 6.3 (5.0–7.5) mm, orange-red, seeds 38 (20–40), chromosome number $2n = 48$. Common in both tropical and temperate climatic regions especially on waste lands.

3.3 *Hexaploid cytotypes*

Tall and erect with spreading branches, up to 1.0 m height, stem purplish-green,

glabrescent with eglandular hairs, ribs prominent. Leaves simple, ovate-lanceolate with sinuate to dentate margin, acute. Inflorescence extra-axillary racemiform with 6 (3–8) flowers. Calyx in flower campanulate, in fruit flattened, rarely spreading, somewhat recurved, lobes broadly triangular, obtuse. Corolla stellate, lobes narrowly ovate. Pedicel decurved to ascending in flower, pendulous to decurved in fruit. Fruit purplish-black with a diameter of 7.9 (7.0–9.5) mm, opaque and globose with 40 (25–56) seeds per fruit. Anthers 1.9 (1.8–2.0) mm long. Stigma slightly protrudes beyond the tip of anther ring. Pollen grain diameter $30.3 \pm (25.5-31.2) \mu\text{m}$. Chromosome number $2n=72$. Uncommon throughout, restricted to temperate climatic regions only.

3.4 Nomenclature

The nomenclatural confusion in this complex is very apparent when considering the diploid species. Nakamura (1937) separated diploid and hexaploid species and coined the new name *S. photeinocarpum* for diploid species. Bhaduri (1951) compared *S. photeinocarpum* Nak. with diploid *S. nigrum* of India and indicated that they were similar in most of the characters. Stebbins and Paddock (1949) stated that *S. photeinocarpum* is merely a form of *S. nodiflorum* Jacq. and further suggested that this species is related to *S. americanum* Mill. Henderson (1974) and Heiser *et al* (1979) treated *S. americanum* and *S. nodiflorum* as two separate species. Edmonds (1971, 1972) compared the specimens of Miller's *S. americanum* and Jacquin's *S. nodiflorum* at the British Museum (Natural History) and considered that these are identical except for the presence or absence of hairs. She further stated that Miller's name *S. americanum*, being earlier had precedence over *S. nodiflorum*. Indian workers made significant attempts to solve the taxonomic problem in this species group. Rao *et al* (1978a, b), on the basis of cytomorphological studies and statistical comparisons of mean values of morphological characters of plants tentatively identified as *S. nodiflorum* 'Indian diploid *S. nigrum*' and *S. americanum*, and their ready crossability with each other to produce fertile hybrids, concluded that these 3 taxa seem to constitute one species. Therefore *S. americanum*, 'diploid *S. nigrum*' and *S. nodiflorum* are conspecific and *S. americanum* Mill. is the correct name for these diploid forms.

There are two divergent opinions regarding the infraspecific subdivisions within *S. americanum*. Henderson (1974) on the basis of pedicel position recognized two subspecies; they are *S. nodiflorum* subsp. *nodiflorum* (with erect pedicels) and *S. nodiflorum* subsp. *nutans* (with pendulous pedicels). But Edmonds (1972) used the nature of indumentum as a criterion for infraspecific subdivisions, recognizing *S. americanum* var. *americanum* (pubescent) and *S. americanum* var. *patulum* (L.) Edmonds (glabrescent). According to her classification (Edmonds 1971, 1972), Henderson's subspecies *nodiflorum* is her var. *patulum* and his subspecies *nutans* is her var. *americanum*.

In the present investigation all samples of *S. americanum* collected from different localities (Dehradun, Delhi, Dharwar, Goa, Gujarat, Howrah, Lucknow, Mysore, Nilgiris, Palgat, Palani hills, Pune and Visakhapatnam) were glabrescent, thereby indicating that the *S. americanum* growing in India is *S. americanum* Mill. var. *patulum* Edmonds.

The taxonomic status of the orange-red berried tetraploid taxon described from India is not clear. The name *S. nigrum* has been used for this taxon. Bhaduri (1945, 1951) and Tandon and Rao (1966a) compared the orange-red berried Indian species with yellow and orange-red berried forms from different geographical regions of the world, and concluded that these may be geographical races of one and the same species. Henderson (1974) and Edmonds (1979a, 1984b) studied and discussed extensively the nomenclatural problems in this complex and reported that *S. villosum* Mill. is the correct name for the orange-red and yellow berried tetraploid species. Henderson (1974) has given the reasons for selecting the epithet *villosum* Mill. over *luteum* Mill. Recently the distinction between yellow fruited *S. villosum* and orange-red fruited *S. luteum* has been dropped (Edmonds 1979a) and it is now considered that *S. villosum* Mill. includes forms with different fruit colours. Edmonds (1979a) is of opinion that *S. alatum* Moench, *S. flavum* Kit., *S. luteum* Mill., *S. ochroleucum* Bast., *S. roxburghii* Dun., *S. rubrum* Mill., and *S. miniatum* Bernh. are synonyms of *S. villosum* Mill.

Two subspecies have been recognized under *S. villosum* (Hawkes and Edmonds 1972; Edmonds 1979a, b; 1984b). One is a smooth stemmed taxon which is conspicuously pubescent with patent glandular hairs and is identical to Miller's type specimen of *S. villosum* which thereby is *S. villosum* Mill. subsp. *villosum* (Edmonds 1979a). The other one is a glabrescent form with appressed eglandular hairs. The correct subspecific name for the latter has proved to be difficult to establish. In Flora of Europaea, the eglandular-haired taxon was called *S. luteum* subsp. *alatum* (Moench) Dostál (Hawkes and Edmonds 1972). This later, was changed to *S. villosum* subsp. *alatum* (Moench) Edmonds (Edmonds 1977, 1979b), and still later, to *S. villosum* subsp. *puniceum* (Kirschl.) Edmonds (Edmonds 1977). Recently, Edmonds (1984b) reported that *S. villosum* subsp. *miniatum* (Bernh. ex Willd.) Edmonds, is the correct name for the eglandular haired subspecies of *S. villosum* Mill. It is found that the samples collected from different regions of India (Dehradun, Delhi, Dharwar, Goa, Howrah, Lucknow, Mysore, Nilgiris, Paigat, Palani hills, Pune and Visakhapatnam) are of eglandular nature, thereby indicating that the tetraploid taxon growing in India is *S. villosum* subsp. *miniatum* (Bernh. ex Willd.) Edmonds.

The binomial *S. nigrum* L. is now confined to the hexaploid taxon (Nakamura 1937; Edmonds 1971) within which two subspecies, namely subsp. *nigrum* (eglandular) and subsp. *schultesii* (Opiz) Wess. (glandular) have been recognized (Hawkes and Edmonds 1972). The samples of *S. nigrum* collected from different parts of India (Dehradun, Delhi, Howrah, Nilgiris and Palani hills) are of an eglandular type, thereby proving that the plants growing in India are *S. nigrum* L. subsp. *nigrum*. Therefore, future Flora of India should record *S. americanum* Mill., and *S. villosum* Mill. in addition to *S. nigrum* L.

3.5 Key to the Indian species of *S. nigrum* complex

- (i) Fruits orange-red or yellow, ellipsoid, longer than broad, translucent; corolla lobes rotate; plants short with spreading branches; pedicels deflexed and descending; pollen diameter 25 (21–26) μm ; chromosome number $2n = 48$ *S. villosum* Mill.
- (i) Fruits black, plants erect and tall; corolla lobes stellate. ii
- (ii) Fruits shiny bluish-black; globose, but slightly depressed, 7.5 mm in diameter; seeds small 0.8–1.2 mm long and 0.6–0.9 mm wide. Inflorescence umbelliform, fruiting pedicels pendulous. Flowers small, corolla 5–7 mm diameter. Pollen grain

- 22 (18–23) μm across, chromosome number $2n = 24$ *S. americanum* Mill.
(ii) Fruits dull purplish-black, globose, longer than broad, 8 mm in diameter; seeds large 1.3–1.8 mm long, and 1.1–1.4 mm wide. Fruiting pedicels deflexed or descending. Flowers large, corolla diameter 8–11 mm. Pollen grain 30.3 (25.5–31.2) μm across. Chromosome number $2n = 72$ *S. nigrum* L.

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