BIOSYSTEMATICS OF INDIAN PLANTS

III. *Veronica anagallis* Complex

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ONE of the commonest species of the genus *Veronica*, is *V. anagallis* Linn. It is almost cosmopolitan in distribution and, in India, extends from the Deccan Peninsula to the Himalayas, ascending up to 15,000 feet in Tibet. It occurs commonly in the Punjab plains and in Kashmir, where it ranges from 5–7,000 feet above sea-level. The populations in the two regions (Punjab plains and Kashmir), though conforming to the broad description of the species (Hooker, 1884), nevertheless, differ in several well-marked characters. These differences in morphology are correlated with difference in chromosome number, the plants growing in Srinagar are tetraploid ($n = 18$), while those growing in the Punjab plains are hexaploid ($n = 27$). The voucher specimens are in the Herbarium, Panjab University, Chandigarh.

OBSERVATIONS

Habitat

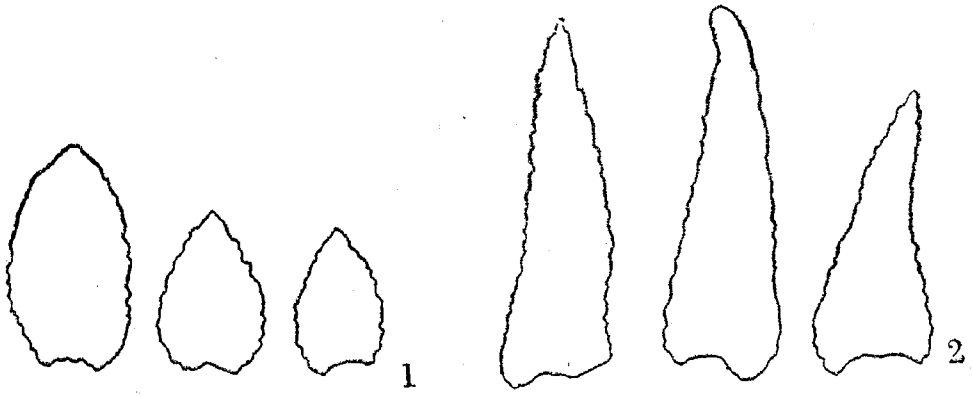
The two races (tetraploid and hexaploid), though geographically isolated, occur in essentially the same kind of habitat, *i.e.*, marshy, varying, on either side, from aquatic to mesophytic and semi-dry conditions.

Stem

The stem is very variable in height, ranging from 23·1 to 40·6 cm. in the tetraploid (Plate IV, Fig. 1) and from 48·5–54·3 cm. in the hexaploid (Plate IV, Fig. 2) when grown under uniform conditions. In nature, the plants, particularly those of the hexaploid race, show greater diversity, the height falling down to about 10 cm. in the late-season plants. In their branching pattern, however, the two races show a discernible difference. Branches arise from the lower one-third of the main stem in the tetraploid, while in the hexaploid, they arise from all over the stem. In the tetraploid, the stem is hairy all over, while in the hexaploid, it is glabrous in the lower region and only sparsely hairy in the upper region.

Leaf

The tetraploid is characterized by more or less ovate leaves (Text-Fig. 1), while those of the hexaploid are ovate-lanceolate (Text-Fig. 2).



TEXT-FIGS. 1–2. Outline of leaves of tetraploid and hexaploid respectively, ×½.

Flower

Unlike the vegetative parts, the floral parts show a progressive decrease in dimensions with increase in the degree of polyploidy. The flower, as a whole, is visibly smaller in the hexaploid than in the tetraploid. The colour of the corolla, too, varies in the two races, though only slightly. In the hexaploid it is white or light-pink, while in the tetraploid it is pink with streaks of a deep-pink.

Pollen-size shows a great range of variation in both the races. However, the peak-size in the tetraploid is slightly greater (32·0 μ) than in the hexaploid (28·2 μ). Seeds are usually larger in the tetraploid (0·54 mm. × 0·34 mm.) than in the hexaploid (0·36 mm. × 0·3 mm.). Both the races produce cent per cent. stainable pollen and good seed.

The distinguishing characters of the two races have been summarised in Table I.

Meiosis

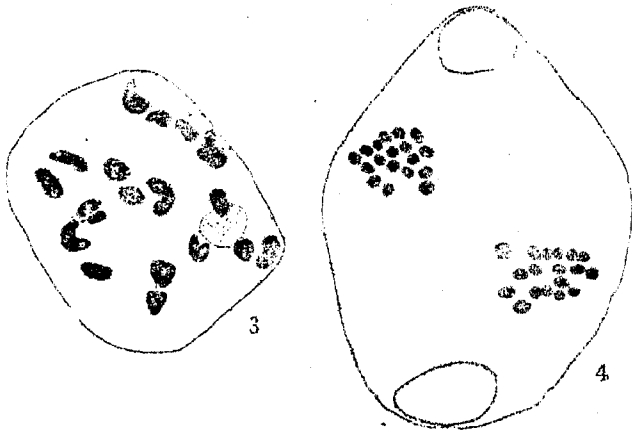
Meiosis is perfectly normal in both the races. In the tetraploid, eighteen bivalents were counted at diakinesis (Text-Fig. 3). The subsequent stages are normal, leading to a normal distribution of 18: 18–18: 18 at anaphase-II (Text-Fig. 4).

In the hexaploid, 27 bivalents were counted at diakinesis (Text-Fig. 5) and at anaphase-I (Text-Fig. 6), these disjunct normally.

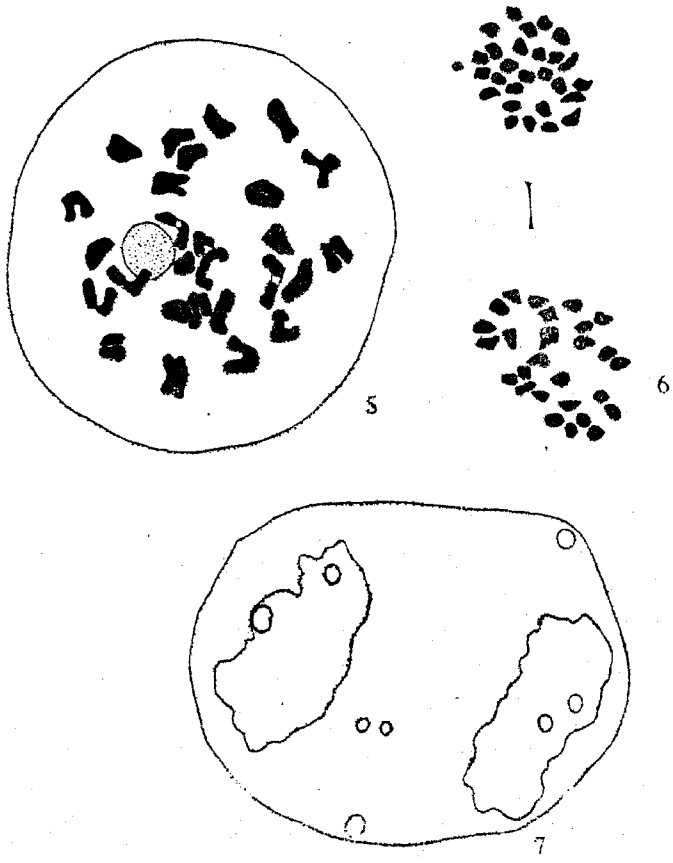
TABLE I

Summary of distinguishing characters of the races

Character	Tetraploid	Hexaploid
	Stem	
Height (cm.)	23·1–40·6	48·5–54·3
Branching pattern	Alternate or opposite; branches from lower one-third of the stem	Opposite, all over the stem
Colour	Green to purplish-green	Lower region purple, upper green
Hairiness	Hairy all over	Lower region glabrous, upper sparsely hairy
	Leaf	
Lamina L×B (cm.)	3·5–3·9×1·7–2·3	4·1–8·2×1·6–2·1
Stomatal size (μ)	20–*23·2*–26×14–*18*–20	20–*24·2*–28×14–*20*
Hairiness	Hairy on lower surface	Sparsely so
	Flower	
Flower length (mm.)	4·5–6–7	4·5–5–6
Pedicel length (mm.)	2–*3*–4	2·5–*3*–4
Bract L×B (mm.)	1·5–*2·5*–3×0·5–*0·75*–1	*2·5*–3×0·5–*0·75*
Sepal L×B (mm.)	2·25–2·75×0·75–1	2–2·5×0·5–0·75
Petal L×B (mm.)		
Large lobe	2–2·5×1·5	1·5×1·25
Small lobe	1·5–2×0·75	1·25×0·75
	Fruit	
Pedicel L×B (mm.)	3·5–5–6×0·24–0·25	4·5–5–6×0·2–*0·23*–0·26
Hairiness	Sparsely hairy	Hairy
Bract L×B (mm.)	3–3·5×1–1·5	4·5–6–7·5×0·75–1·75
Fruit L×B (mm.)	3–3·5×3	3×2·5–3
Sepals in fruit L×B (mm.)	3–4×1·5–2	4–5×1·5–2



TEXT-FIGS. 3–4. Diakinesis and anaphase-I in tetraploid race ($n = 18$), ×1,300.



TEXT-FIGS. 5–7. Diakinesis, anaphase-I and telophase-I in hexaploid race ($n = 27$). Note the nucleolus-like bodies at telophase, ×1,300.

Normally, a single nucleolus was observed at diakinesis in both the races. In the hexaploid, however, in some pollen mother-cells, certain nucleolus-like bodies were observed at telophase I (Fig. 7). These vary greatly in number from cell to cell and also in size and staining capacity within the same cell.

Discussion

Nature of Polyploidy

As is clear from the foregoing account, the races within this species are significantly different in morphology. These differences are mostly qualitative. Furthermore, no multivalent formation was observed in any of the natural polyploid races of the two species and all these are characterized by normal, 100% pairing and show no irregularity of any sort in meiosis in the pollen mother-cells. All these features suggest that the polyploid races are, in all probability, of an alloploid constitution.

Nothing can at present be said about the probable ancestry of the various races, because of the insufficient data available. Some tentative suggestions might, however, be worth considering.

Although the diploid form of *V. anagallis* complex is not, at present, known, it is perhaps of some significance to note that *V. oxycarpa* Boiss. (treated by Hooker, 1884, as one of the varieties of *V. anagallis*), is reported as a diploid with $2n = 18$ (Schlenker, 1936). In addition, another seemingly, closely related species, *V. anagalloides*, is also reported as a diploid (Schlenker, 1936). One or both of these forms may have been involved in the origin of the present allotetraploid race of this species-complex. This assumption, however, is only tentative and needs experimental verification by appropriate hybridisations within the complex.

As for the probable origin of the hexaploid race, some helpful clues could be sought from morphology. The tetraploid is characterized by ovate type of leaf, while those of the hexaploid are ovate-lanceolate. In his description of *V. anagallis*, Hooker (1884, p. 293) has given the various forms of leaf in the species as oblong, oblong-lanceolate and linear-oblong. Some of these forms might be diploid. Furthermore, if the tetraploid is one of the parents of the hexaploid, then the other ancestor could be pictured as one with more or less lanceolate type of leaf. It is rather significant that this type of leaf has been reported in the British representatives of *V. anagallis-aquatica* (Melderis and Bangerter, 1955).

Taxonomic Considerations

A correct taxonomic treatment of the Indian forms of this complex is possible only after comparison with the type material. Pending that, the following points may be considered:

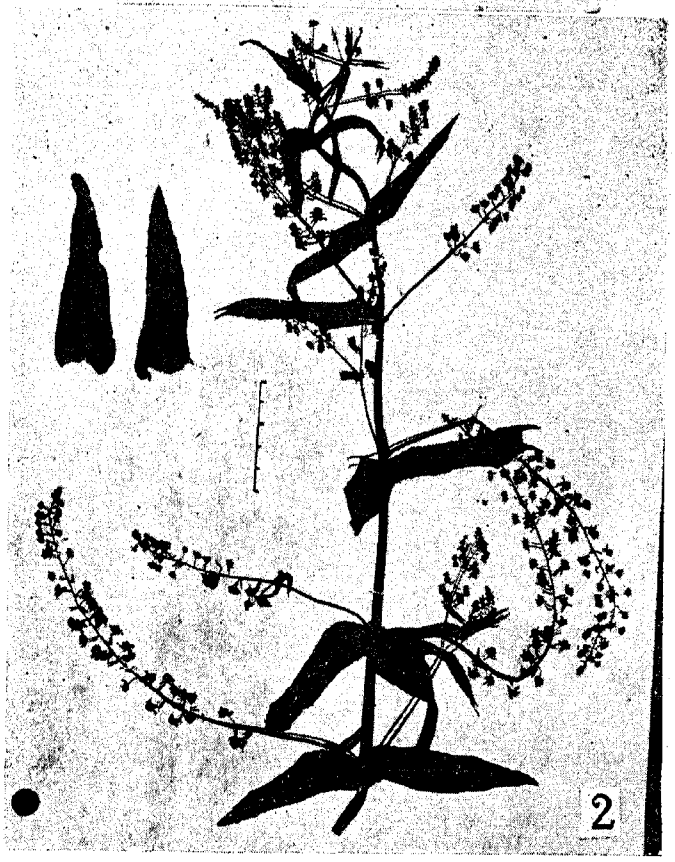
V. anagallis Linn. complex (Hooker, 1884, p. 193), in a broad sense, embraces both the cytological races (tetraploid and hexaploid), because they fall within the range of its morphological variation. The ovate-serrulate leaf, so characteristic of the tetraploid, however, is significantly different from the various forms of leaf met with in the species proper. But in *V. punctata* Ham. (treated by Hooker as one of the varieties of *V. anagallis*), ovate type of leaf may also be found. The tetraploid, under consideration, resembles this form in this character, but differs from it in its tall habit and sessile, stem-clasping leaves (var. *punctata* is described as dwarf with petiolate leaves). It cannot, therefore, be included under *punctata*, obviously, because it entirely lacks the distinctive features of this form, nor does it completely resemble any of the other varieties of *V. anagallis*, described by Hooker.

In view of these distinctive features, to which may be added its geographical isolation and the probable alloploid nature, the form, under consideration, seems to be a distinct entity and, thus, merits consideration as a separate subspecies of the parent species. It might be designated as ssp. *ovata*, in view of its characteristically ovate leaf.

The characters of the hexaploid are mostly intermediate between the tetraploid, and *V. anagallis* proper as described by Hooker. However, in view of the fact that it is geographically isolated and cytologically distinct, its treatment as a separate subspecies would again be justified.

Polyploidy in Relation to Geographical Distribution of the Races

The tetraploid race of *V. anagallis* complex is widely distributed in Kashmir, experiencing a cold temperate climate and ascends up to 7,000 feet but does not extend below 5,000 feet. *V. anagallis-aquatica*, a closely related species, also at tetraploid level ($2n = 36$, Ehrenberg, 1945) has been reported from the north-temperate region. The diploid relatives (*V. anagalloides* and *V. oxycarpa*) of this alliance have a wider geographic distribution, extending from the north-temperate region to Greece and Persia. The hexaploid, however, has so far been recorded only in the warm sub-tropical region (Punjab plains). It does not extend northward beyond Jammu, which has practically the same climate as the Punjab plains. If these observations are borne out by further sampling, then in India the polyploid races of this species-complex follow the distributional pattern from colder to warmer climates.



FIGS. 1–2