Polyploidy in Relation to Sexual Dimorphism in Charophyta

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Polyploidy indicates the multiplication of basic set of chromosomes and may be natural or artificially induced. The polyploid races show greatest endurance to the unfavourable conditions and indicate advancement over other forms having low ploidy level. The occurrence of polyploid forms in any genus shows an evolutionary trend. Polyploidy can be used successfully in speciation. Wood and Imahori (1965), while bringing up their Monograph and Iconograph on 'A Revision of the Characeae', considered that the sexual dimorphism reflects minor genetic variations and the dioecious taxa always possess half the chromosome number of its monoecious counterparts. This interpretation of Wood and Imahori (1965) was not supported by Sarma and Khan (1967), Sarma and Ramjee (1971), Sawa (1965), Proctor and Hotchkiss (1968), Ramjee and Bhatnagar (1978) and Bhatnagar (1981) on cytological grounds. Present paper deals with the correlation between polyploidy and sexual dimorphism in Charophyta.

Discussion

As revealed by Table 1, monoecious taxa of *Chara corallina*, *Nitella furcata* and *Nitella gracilis* have the chromosome numbers more than double than their dioecious counterparts thus refute the generalization of Wood and Imahori (1965).

In the genus *Tolypella*, the dioecious forms (*T. nidifica* var. *porteri* and *T. nidifica* var. *glomerata*) have the same chromosome number as their monoecious forms (*T. nidifica* var. *glomerata*) have. It indicates that dioecism and monoecism are not governed simply by the chromosome numbers but they must have some genetic diversity which may be understood by studying their karyotypic organisations.

Sawa (1965) attempted 'karyotypic analysis method' for understanding the validity of dioecism and monoecism in the taxonomy of charophytes. He pointed out that the monoecious forms of *Nitella flexilis* ($n=12$) have originated through hybridization between the two dioecious taxa having $n=6$ out of which one is *N. opaca* ($n=6$). He suggested that *N. opaca* (a dioecious form) may not be considered as a counterpart of *N. flexilis* (monoecious form) but an independent specific status should be given to it.

The author, while dealing with the cytology and cytotaxonomic studies in Charophytes of Rohilkhand division, investigated in *Chara corallina*, *C. corallina* var. *wallichii*, *Nitella furcata*, *N. mirabilis*, *N. superba*, *Tolypella prolifera*, *T. glomerata* var. *nidifica* and *T. intricata*. The chromosome numbers reported in monoecious and dioecious forms have been presented in Table 1. It was reported during present investigations that the monoecious and dioecious forms of *Chara*, *Nitella* and *Tolypella* do not have 2:1 ratio of chromosome numbers thus indicating that they are not the counterparts of each other and may be treated as valid taxonomic criteria. For instance, the monoecious forms of *Chara corallina* have chromosome numbers three times than their dioecious counterparts viz. *C. corallina* var. *wallichii* ($n=14$). The chromosome ratios between monoecious and dioecious forms were reported as 1:1, 2:1 and 3:1 in the present study.

In the genus *Tolypella*, monoecious and dioecious forms have the similar chromosome numbers (Table 1) but in the monoecious forms of *T. glomerata*, $n=11$ and 33 were reported from India (Ramjee and Bhatnagar 1978) and U. S. A. (Sawa 1974) respectively. It clearly exhibits that the dioecious and monoecious forms of *Tolypella* may have similar chromosome numbers whereas the monoecious forms or the dioecious forms may have 'chromosome multiples' within themselves. In *T. glomerata*, Sawa (1974) reported the chromosome numbers three times than its dioecious counterpart.

Table 1. Polyploidy and sexual dimorphism in Charophyta

Name of taxa	Sexuality	Chromosome number (n)	Authority
A. <i>Chara</i>			
1 <i>C. corallina</i>	Monoecious	14 42	Hotchkiss (1965), Khan and Sarma (1967), Ramjee and Sarma (1971), Sinha and Noor (1967), Ramjee and Bhatnagar (1978), Chatterjee (1971)
2 <i>C. corallina</i> var. <i>wallichii</i>	Dioecious	14	Khan and Sarma (1967), Bhatnagar (unpublished)
B. <i>Nitella</i>			
1 <i>N. furcata</i>	Monoecious	18, 36	Ramjee and Bhatnagar (1978)
2 <i>N. furcata</i> subsp. <i>flagelliformis</i>	Dioecious	9	Khan and Sarma (1967)
3 <i>N. flexilis</i>	Monoecious	12	Sawa (1965)
4 <i>N. opaca</i> (= <i>N. flexilis</i>)	Dioecious	6	Sawa (1965)
5 <i>N. gracilis</i> var. <i>leptosoma</i> f. <i>globulifera</i> (= <i>N. globulifera</i>)	Dioecious	9	Khan and Sarma (1967)
6 <i>N. mirabilis</i>	Dioecious	6, 9	Ramjee and Bhatnagar (1978), Bhatnagar (1981)
7 <i>N. superba</i>	Dioecious	9	Bhatnagar (1981)
8 <i>N. gracilis</i> var. <i>annandalei</i> (= <i>N. annandalei</i>)	Dioecious	9	Khan and Sarma (1967)
9 <i>N. gracilis</i> var. <i>confervacea</i> (= <i>N. batrachosperma</i>)	Monoecious	18	Khan and Sarma (1967)
C. <i>Tolypella</i>			
1 <i>T. nidifica</i> var. <i>porteri</i>	Dioecious	11	Hotchkiss (1966)
2 <i>T. nidifica</i> var. <i>glomerata</i> (<i>T. hispanica</i>)	Dioecious	10	Guerlesquin (1967)
3 <i>T. nidifica</i> var. <i>glomerata</i>	Monoecious	11 33	Ramjee and Bhatnagar (1978), Bhatnagar (1981), Bhatnagar and Johri (1986) Sawa (1974)
4 <i>T. intricata</i>	Monoecious	11	Bhatnagar (1985)
5 <i>T. prolifera</i>	Monoecious	11	Bhatnagar (unpublished)

In view of Hotchkiss (1958), the dioecious forms have lesser chromosome numbers (not exactly half) than the monoecious one but it has not been supported because *Tolypella glomerata* (dioecious and monoecious both) and *Chara corallina* (dioecious and monoecious both) possess similar chromosome numbers irrespective of the sexual dimorphism. Ramjee (1969) however emphasized that polyploidy plays an important role in the diversification of dioecious taxa similar to the monoecious forms.

An overall conclusion of the present discussion highlights the taxonomic validity of dioecism and monoecism on cytotaxonomic grounds.

Summary

Present paper deals with the cytological studies of monoecious and dioecious forms belonging to three Charophyte genera viz *Chara*, *Nitella* and *Tolypella*. The taxonomic validity of sexual dimorphism has been discussed refuting the generalization of Wood and Imahori (1965).

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