In vitro hybridisation of *Isoetes*

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Species of *Isoetes* from northeastern North America are sometimes difficult to identify because their diagnostic characters intergrade. It is hypothesised that interspecific hybridisation, which obscures species distinctions, is responsible for this intergradation. To test this hypothesis, experimental crosses were made with spores in culture.

Results indicate that spores of aquatic species of *Isoetes* in northeastern North America are easily germinated in sterile, demineralised water and crosses are readily made. Large, easily removable microsporangia and megasporangia facilitate the segregation of male and female gametes. It was also found that vernalisation of spores is important for spore germination or sporophyte formation in some species. Further, among the various taxa cultured, megagametophytes differ in archegonium and rhizoid development.

Suspected hybrid taxa produce polymorphic megaspores that vary in size, shape, and surface ornamentation. Less than 1% of these polymorphic megaspores germinate in culture, while normal-looking, uniform megaspores from most species approach 100% germination within 50 days. Megagametophytes which do develop from polymorphic spores bear abnormal archegonia or no archegonia.

Species of *Isoetes* can be crossed in the laboratory, but it appears that hybrid sterility, indicated by the production of polymorphic, non-viable spores, isolates species in nature.

Phloem transport in *Equisetum*

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The mechanism of phloem transport has for years been a subject of much controversy. While a great deal of work has been carried out on Angiosperms, other plant groups have been almost totally ignored. In the Angiosperms, pressure flow as proposed by Münch (1930) is currently thought to be the likely mechanism for the transport. In this system, sugars are loaded at the source causing osmotic influx of water and a higher turgor. At the sink, the reverse occurs; sugars are unloaded and the turgor of the sieve elements is reduced.

The aim of this research project is to determine whether Münch pressure flow could occur in *Equisetum*, where the conducting pathway—the sieve cells—would appear to offer a greater resistance to mass flow than that of Angiosperms.

In order to make this assessment three parameters of transport are being investigated: (1) the velocity of translocation—using radiotracer techniques; (2) the dimensions of the sieve cells—using a variety of microscopical techniques; (3) the

turgor gradient (if this is possible)—using both direct and indirect methods of measurement.

Results of radiotracer work on *Equisetum giganteum* indicate that the rate of translocation is variable but can be of a speed comparable to Angiosperms, i.e. rates of up to 25 cm/hr have been found.

An investigation into the products translocated (using chromatography and autoradiography) suggests that sucrose is the major translocate.

Münch, E. 1930. *Die Stoffbewegen in der Pflanze*. Jena: Fischer.

Potential allelopathy in *Equisetum*

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Allelopathy probably occurs in many species of flowering plants (Rice 1979). However, there have been very few reports of this phenomenon in pteridophytes (Duckett 1979; Glass 1976). Nevertheless, it seems plausible to suppose that *Equisetum* spp. may be allelopathic. The reasons for this are:

(i) *Equisetum* spp. have a tendency to form large, monospecific stands. This could be due to allelopathy, probably enhanced by a vigorous growth habit.

(ii) *Equisetum* spp. are known to produce a wide range of secondary compounds, in particular, flavonoids (Saleh *et al.* 1975) and phenolics (Syrchina *et al.* 1975). Both these groups of chemicals have been implicated as agents of allelopathy in other plants (Rice 1979).

(iii) Zelenchuk and Gelemei (1967) showed that water extracts of *E. arvense* L. have a strong inhibitory effect on seed germination and seedling vigour of 30 species of meadow grass.

(iv) Duckett and Duckett (1980) note that on reservoir mud, *E. fluviatile* L. gametophytes are not found near stands of the sporophytes, even though the habitat is apparently quite suitable. This, they suggest, may be due to allelopathy.

(v) Experiments by Duckett (1979) suggest that rapid death of gametophytes following fertilisation is at least partly due to chemicals produced by the sporophyte, that are toxic to the gametophyte.

Our preliminary experiments described below further explore the suggestions of allelopathy in *Equisetum*.

Under axenic conditions, spores of *E. sylvaticum* L. were sown on plates of Parker's medium (Duckett 1979) and a surface-sterilised 4 cm section of *E. sylvaticum* sporophyte was placed in the centre. After 4 weeks of growth, gametophytes nearest the sporophyte consisted of rounded cells with few plastids, showing little differentiation. Gametophytes progressively further from the sporophyte had an increasing number of the lamellae characteristic of *Equisetum* gametophytes (Duckett and Duckett 1980). Differentiation of rhizoids was also inhibited by proximity to the gametophyte. This strongly supports the suggestion of Duckett (1979) and Duckett