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MEETINGS OF THE ROYAL BOTANICAL SOCIETY OF THE NETHERLANDS

SYMPOSIUM "WATERPLANTEN" ON NOVEMBER 22, 1975

P. H. BEST *(Limnologisch Instituut, Nieuwersluis)*

The reaction of Ceratophyllum demersum on exogenous phytohormones in the course of the year

Ceratophyllum demersum, a submerged aquatic macrophyte, is able to form distinct dormant organs during given periods of the year. The dormant form consists of a stem with short internodes and whorls of thick, brittle leaves; the normal vegetative form of a stem with long internodes and slender leaves. In temperate regions the dormant form occurs in winter, the normal vegetative form in summer.

Several factors affect the initiation of and the emergence from dormancy.

Dormant organs are not induced by low temperatures in combination with a short photoperiod only, although growth stops entirely. According to CARR (1969) *Ceratophyllum* initiates dormant tips as a reaction on cold or heat. VEGIS (1948) showed a relation between high temperatures late in summer and the initiation of dormancy, and low temperatures early in winter and the disappearance of dormancy in *Stratiotes aloides.*

STEWART (1969) showed that the growth inhibiting hormone abscisic acid promotes the formation of turions in *Lemna polyrhiza.*

In the case of *Ceratophyllum* low temperature/short photoperiod/abscisic acid followed by high temperature/long photoperiod/gibberellic acid induce strong growth in dormant plants. These conditions may simulate winter followed by spring. Abscission occurs frequently when plants are grown under a long photoperiod, high temperature and abscisic acid – this situation may occur late in summer.

Abscisic acid stimulates the production of storage substances such as sugar and starch. Growth is inhibited by high concentrations (10^{-5} M); it is promoted by low concentrations (10^{-9} M) of abscisic acid. The same was found by VAN STADEN & BORNMAN (1969) in *Spirodela oligorhiza.*

Treatment of dormant tips with gibberellic acid or indoleacetic acid does not always induce growth. Both hormones are able to induce growth in the plants earlier compared to plants grown outdoors. IAA may stimulate growth in length and initiation of adventitious buds in December already, with a maximum in the period from February until April. The effect of GA is comparable to that of IAA. GA may cause a maximal stimulation of growth earlier.

As the visible reactions of the plants on exogenous hormones depend upon the endogenous quantities, determinations of the IAA and ABA contents were carried out in the course of the year. Both the IAA and ABA contents in *Ceratophyllum* are season dependent – IAA shows one maximum in June/July, ABA several maxima in summer and winter.

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STADEN, J. VAN & C. H. BORNMAN (1969): Inhibition and promotion by abscisic acid of growth in Spirodela. *Planta (Berl.)* **85**: 157–159.

STEWART, G. R. (1969): Abscisic acid and morphogenesis in Lemna polyrhiza L. *Nature* **222**: 61–62.

VEGIS, A. (1948): Einfluss tageperiodisch wechselnder Aufbewahrungstemperatur auf die Streckungsbereitschaft der ruhenden Winterknospen von Stratiotes aloides. *Physiol. Plant.* **1**: 216–235.

L. DE LANGE *(Hugo de Vries-Laboratorium, Amsterdam)*

Indicative value of macrophytes for the assessment of the water quality

DE LANGE & VAN ZON (1973, and in press) have proposed a system for the biological assessment of the water quality based on the local stand of macrophytic vegetation. This system contains a quantitative element based on the structural characteristics of the phytocoenosis, and a qualitative one based on its floristic composition. The quantitative evaluation consists of an assessment number for the percentage cover of each vegetation level (submerged, floating, or emerged), one for the number of species, and one for the amount of filamentous algae present. In this way the structure, the degree of filling of the body of water, and the niche-differentiation within the latter are evaluated.

The qualitative evaluation consists of the indication value, per species, for the degree of pollution and/or degree of trophism of the water on the one hand, and its uniqueness index (on a country-wide basis) on the other. The index figures per species were based on, a.o., ELLENBERG 1974 and VAN DER MAAREL 1971, and on personal investigations. The mean of the specific values was taken for each phytocoenosis so as to avoid, among other things, that indicators of an increasing eutrophication would nevertheless increase the total score. The use of negative indication values for such species was deemed unpractical since in cases of a decreasing degree of trophism the species in question rather provide a positive indication. The qualitative assessment index can only be applied in a limited geographical area.

The system proposed here has in the meantime been put to the test in the field. The following experience was gained: (1) a high quantitative as against a relatively low qualitative index number is found in eu- to mesotrophic waters; the stands of aquatic vegetation exhibit a more or less intricate structure, which is favourable for other biological components of the local ecosystem but they are botanically speaking not so interesting; (2) a low quantitative and a high qualitative index value is characteristic of, e.g., oligotrophic fen lakes; the development of the ecosystem is rather poor, but the botanic value is high; (3) the hygrosere of bog lakes shows the highest quantitative index value in the middle of the zonation ("contact zone"), and the qualitative evaluation decreases from the deeper water towards the edges; (4) there is a satisfactory correlation between the assessment rates and the plant communities and groups of relevés distinguished on a floristic basis, and (5) the indices are very useful for the evaluation of waters in a given area, in relation to management and planning.

ELLENBERG, H. (1974): Zeigerwerte der Gefässpflanzen Mitteleuropas. *Scripta Geobotanica* **9**: 1–97.

LANGE, L. DE & J. C. J. VAN ZON (1973): Proposal for a numerical description of the development of aquatic macrophytic vegetation as an aid for the assessment of water quality. *Wasser und Abwasser Forschung* **6**: 125–128.

LANGE, L. DE & J. C. J. VAN ZON, in press. Beoordeling van waterkwaliteit op basis van het macrofytenbestand. In: *Werkgroep Biologische Waterbeoordeling, Biologische waterbeoordeling*, Chapter 4.

MAAREL, E. VAN DER (1971): Florastatistieken als bijdrage tot de evaluatie van natuurgebieden. *Gorteria* **5**: 176–188 + separate mimeography.

MEETING OF THE SECTION FOR PLANT MORPHOLOGY AND ANATOMY ON MARCH 30, 1976

G. J. FEITSMA-TALSTRA *(Biologisch Centrum, afdeling Plantensystematiek, Rijksuniversiteit Groningen, Haren)*

A comparison of the vascular pattern in the ovary of some representatives of two subfamilies of the Mesembryanthemaceae

This report must be regarded as a further study of Mrs. VAN DER MEULEN-BRUIJNS (1975), whose report is held at the meeting in autumn 1974. Some additional observations are obtained concerning *Aptenia cordifolia* and other species as well.

The Ruschioideae are assumed to be derived from the Mesembryanthemoideae, for in some genera of the Ruschioideae the placentation shifts ontogenetically from axile to basal or parietal (IHLENFELDT 1961).

This statement is confirmed in this study by comparison of the vascular pattern in the ovaries of the following representatives:
Sphalmanthus nothus (N.E.Br.) Schwant. and *Aptenia cordifolia* (L.f.) Schwant. (subfamily Mesembryanthemoideae, and *Delosperma ecklonis* (Salm.) Schwant., *Trichodiadema rogersiae* L. Bol., *Lampranthus flexifolium* Haw. L.f. (Haw.) N.E.Br. and *Dorotheanthus bellidiformis* (Burm. f.) N.E.Br. (subfamily Ruschioideae).

In both subfamilies the vascular bundles supplying the placentae are located in the central column; in the representatives of the Ruschioideae these bundles are also found in the bottom and the wall of the ovary. These placental bundles are situated in between the septal radii. This last observation is in accordance with that of IHLENFELDT (1961), but is contrary to the observation of VAN DER MEULEN-BRUIJNS (1976), who helds that the placental bundles in *Aptenia* and *Dorotheanthus* are situated in the septal radii. Only in *Dorotheanthus* there are found placental vascular bundles in between the septal radii and also in the septal radii.

The vascular pattern in the ovary of the representatives of the subfamilies I have studied, do not demonstrate many essential differences, except *Dorotheanthus*, as is indicated above.

Apart from the disagreement in interpreting the placental bundles of the Caryophyllaceae, in the flower of this family two systems of placental bundles can be observed (BOCQUET 1959, ROHWEDER 1967 and 1970, MOELIONO 1970). Both vascular systems van be discriminated by lying in between the septa and by lying in the radii of the septa. According to MOELIONO these systems will be called respectively the peripheral and the axial system.

In comparing the vascular pattern in the ovary in *Sphalmanthus* and *Melandrium rubrum* (Garcke) it is concluded, that the placental vascular bundles in *Sphalmanthus* should be interpreted as homologous with the peripheral vascular system in *Melandrium*; i.e. the axial vascular system is absent in *Sphalmanthus*. The same applies to *Aptenia* (both are representatives of the subfamily Mesembryanthemoideae). This conclusion is based upon the assumption that the Centrospermae is accepted as a homologous taxon and applying the criterion of homology of the vascular bundles.

The vascular pattern in the ovary of the representatives of the subfamily Ruschioideae can typologically be derived from that of *Sphalmanthus*; the placental vascular bundles in these species also should be interpreted as representing the peripheral placental system. However the placental vascular bundles in the septal radii in *Dorotheanthus* should not be interpreted as homologous with the axial vascular system in *Melandrium*.

These conclusions are contrary to those of VAN DER MEULEN-BRUIJNS (1975), who helds that the placental vascular bundles in *Aptenia* and *Dorotheanthus* should be interpreted as the axial vascular system. The peculiarity of those placental bundles in *Dorotheanthus*, which lie in the radii of the septa and in the ovary wall, can probably be interpreted as the result of the ontogeny of the ovary.

Bocquet, G. (1959): The structure of the placental column in the genus Melandrium (Caryophyllaceae). *Phytomorphology* **9**: 217–221.

Ihlenfeldt, H. D. (1961): Entwicklungsgeschichtliche, morphologische und systematische Untersuchungen an Mesembryanthemen. *Feddes Rep.* **63**: 1–104.

Meulen-Bruijns, C. van der (1975): The vascular pattern in the ovary of some Mesembryanthemaceae, compared with that of Melandrium (Caryophyllaceae). *Acta Bot. Neerl.* **24** (2): 248.

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J. L. VAN WENT *(Botanisch laboratorium, Wageningen)*

Pollen germination and pollen tube growth of Impatiens

Ungerminated *Impatiens* pollen show numerous vesicles in their (vegetative) cytoplasm. In between amyloplasts, mitochondria, liquid globuli and smooth endoplasmatic reticulum are present. Some strands of rough endoplasmatic reticulum are located near the plasmamembrane and around the vegetative nucleus and generative cell. Of both cells the nuclei show a very contracted chromatine.

Only in the generative cell numerous ribosomes are present, the vegetative cell contains few ribosomes. Because of a very quick germination the vesicles may be directly connected with the pollen germination and tube growth. Especially since the cytoplasm ultrastructure indicates the absence of protein synthesis equipment and stored protein (van Went 1974). In a pollen tube of a length of 200 μm the population of vesicles remains present in the tube, some of them are fusing, others show a contact with the small vacuoles. However, especially in the tip of the tube a new population of smaller and more electron dense vesicles is present, produced by SER in relation with dictyosomes. The cytoplasm in the tip region differs clearly from the rest of the tube cytoplasm by lacking plastids, RER, vacuoles and larger vesicles. In the rest of the tube, besides the normal organelles there is a mixed population of vesicles. In germinated pollen and pollen tubes the nuclei of the vegetative and generative cells show less contracted chromatine. From the presented data, it is proposed that the larger, electron-transparent vesicles are involved in the expansion process of pollen grain and tube, whereas the smaller dense vesicles are involved in pollen wall formation.

Went, J. L. van (1974): The ultrastructure of Impatiens pollen In: *Fertilization in Higher Plants*, 81–88. Ed.: H. F. Linskens. North-Holland Publishing Company– Amsterdam.

MEETING OF THE SECTION FOR PHYTOPATHOLOGY ON MAY 12, 1976
Theme: The role of ethylene in plant diseases

J. BRUINSMA *(Botanisch Laboratorium, Afdeling Plantenfysiologie, Landbouwhogeschool, Wageningen)*

Ethylene as a plant hormone

Round about the turn of the century, ethylene was discovered as a plant pathogenic agent in illumination gas and combustion fumes. Ever since it is an increasingly important factor in air and soil pollution.

During the last decade the hormonal nature of the mode of action of ethylene in higher plants has been established. The substance probably attaches to oxidized sites in the plant cell. The way in which this attachment results in interference with the genetically controlled enzyme synthesis is still unknown.

The production of ethylene from methionine, along an oxidative pathway, is very variable and can be considerably augmented by stress conditions and by growth regulators, particularly auxins. Ethylene levels in the tissue can be reduced by absorption and by flushing with air, very efficiently at reduced atmospheric pressure.

The physiological effects of ethylene are twofold: next to influences on the growth of young tissues, e.g. in seedling growth, ehylene affects the development of mature plants. On the one hand, it plays a role in the initiation and realization of flowers, e.g. in sex expression. On the other hand, it exerts gerontological influences by inducing senescence and abscission of leaves, flowers, and fruits.

E. C. HISLOP *(Long Ashton Research Station, Bristol, England)*

How important is ethylene in plant pathology?

Ethylene is produced in considerably greater quantities from many diseased tissues compared with their healthy counterparts. Therefore it is not surprising that plant pathologists aware of the importance and multiple roles of the gas in healthy plant physiology should be concerned about its involvement in host and pathogen interactions.

Bacterial and fungal pathogens grown on defined media may produce considerable amounts of ethylene, thus complicating studies on the source of the gas in diseased tissues. However, there are good reasons for believing that in disease most of the gas is produced by the host rather than the pathogen. The biosynthetic mechanisms for the production of this "stress" ethylene are unknown, but some data indicate that they may differ from the pathways operative in healthy tissues.

A true functional hypothesis for the involvement of ethylene in plant diseases implies that the gas should impart a degree of selective advantage upon the producing organisms. But limited and often tentative data indicate that even in the same disease syndrome the gas may at one time be involved in host resistance and at another in increased susceptibility to colonization. This apparent paradox may be explicable, at least for vascular diseases, in terms of the time of application or release of ethylene in relation to colonization.

Alternatively, ethylene production may be an inseparable and unavoidable result of protoplasmic disorganization.

Whatever the reason for ethylene production it is now well established that the gas can produce some of the symptoms of disease although there is little evidence for a true cause and effect relationship in infected plants.

G. A. KAMERBEEK, W. J. DE MUNK, B. H. H. BERMAN and
J. C. M. BEIJERSBERGEN *(Laboratorium voor Bloembollenonderzoek, Lisse)*

Some phytopathological problems in flower bulbs in relation to ethylene factor

The fungus *Fusarium oxysporum* Schlecht f.sp. *tulipae* Apt. causes a disease in tulip bulbs ("zuur"), which usually becomes manifest during storage. This pathogen produces exceptionally large amounts of ethylene, both *in vivo* and *in vitro*. A comparative study on the *in vitro* production of ethylene of a number of *Fusarium* species and formae speciales showed that the tulip *Fusarium* can produce about 5000 times more ethylene than 18 other *Fusarium* strains investigated. Recent experiments have shown that the tulip *Fusarium* does not produce substantial amounts of ethylene as long as glucose is available as a substrate.

Ethylene can pollute the atmosphere in store rooms causing several physiological disorders in tulips, such as gummosis in bulbs, bud necrosis and flower-bud blasting. Ethylene produced by the tulip pathogen may be involved in pathogenesis for the following reasons.

1. It can inhibit the formation of an antifungal toxin (tulipalin) in some cell layers of the outer scale of the bulb after lifting.
2. Anaerobic conditions inhibit ethylene production and reduce infection, but do not greatly affect fungal growth. Addition of ethylene to an atmosphere of moist nitrogen permits numerous infections.
3. Ethylene causes local disorganization of cell contents and formation of gum exudates which are a very suitable substrate for the fungus.

B. SCHIPPERS *(Phytopathologisch Laboratorium "Willie Commelin Scholten", Baarn)*

Ethylene and soil fungistasis

See Boerwinkel, D. J., B. Schippers & H. Konings (1976): *Acta Bot. Neerl.* **25**: 253.

L. C. VAN LOON *(Botanisch Laboratorium, Afdeling Plantenfysiologie, Landbouwhogeschool, Wageningen)*

Effects of ethylene on pathogenesis and symptom expression in virus-infected tobacco plants

Many of the biochemical and physiological alterations induced in plants by viruses resemble those found during natural or artificial ageing, or those resulting from environmental stresses. Since ethylene accelerates plant senescence and its production is stimulated by stress or injury, the effects of this hormone mimick many of those resulting from virus infection. However, a general involvement of ethylene in the induction or the expression of virus symptoms is far from clear.

In tobacco varieties reacting to tobacco mosaic virus with systemic mosaic symptoms, chlorosis and retardation of growth, ethylene production is not changed during sympton development. Neither does application of exogenous ethylene significantly affect virus multiplication or pathogenesis, although senescence is enhanced in infected tissues.

In hypersensitively reacting tobacco varieties, ethylene production sharply increases with the appearance of necrotic local lesions and is proportional to both the number and the size of the lesions. Artificial necrosis due to chemical injury likewise stimulates ethylene production. However, enhanced ethylene production of local lesion hosts is also regarded as resulting from an advanced extent of local tissue senescence, resembling artificial ageing. Like ageing, ethylene synthesized during lesion development contributes to continued lesion enlargement. On the contrary, application of exogenous ethylene may either stimulate or inhibit lesion enlargement, depending both on the time of application with regard to inoculation and on the age of the leaves. Inhibition due to ethylene is connected with increased peroxidase activity, thus resembling systemic acquired resistance.