The effect of calcium nitrate was examined further, assuming that either constituent ion, or the two in concert, could be responsible for reversal of salt inhibition. Accordingly, the effects of several appropriate salts on the extension of roots in 0·10 M sodium chloride were compared (Table 3). At $pO_2 = 15$ mm and 50 mm (optimum for root elongation), only $Ca(NO_3)_2$ had a significant effect, whereas at the oxygen-level of air, both calcium salts were active, the chloride being somewhat more so than the nitrate. Thus, if at lower oxygen levels $NO_3^-$ is serving as an electron acceptor, it apparently can do so only in the presence of $Ca^{++}$. Conversely, if $Ca^{++}$ acts, conceivably at the membrane, to counteract the effects of excess $Na^+$, it also can only do so when $NO_3^-$ is present. Under strictly anaerobic conditions, $KNO_3$ at concentrations of $10^{-3}$ to $5 \times 10^{-2}$ M can stimulate rye germination[1], whereas calcium salts (other than nitrate) ordinarily have no effect.

Calcium salts other than the nitrate can have unique effects in certain rather unusual cases of oxygen-limited germination (Table 4). When rye seeds are submerged in 15 cm of water or 0·7 M sucrose, their germination is slow but otherwise normal and essentially complete. In 0·5 M sodium and potassium chloride, germination is severely suppressed, although these solutions are approximately isosmotic with the sugar. Further, magnesium and calcium chloride are comparable in ionic strength to potassium chloride, yet the magnesium solution is highly inhibiting whereas the calcium solution permits nearly normal germination.

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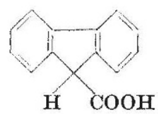
## Morphactins, a Novel Group of Plant-growth Regulators

In 1960 some interesting effects of fluorene-9-carboxylic acids on plants were observed at the biological research laboratories of E. Merck AG, Darmstadt, Germany. An intensified research programme on these compounds and on a great many derivatives was initiated by this company, which, during the following years, led to the discovery of a large-numbered group of compounds of substantial interest, some of which show an extremely strong action on the growth and development of plants[1]. This particular action has novel and somewhat unique features, and was reported first in 1964 by Schneider[2].

Compared with the known types of plant-growth substances[3], the new fluorene-regulators do not fit into the existing scheme of such growth-regulating activities and, therefore, they really constitute a novel class of plant-growth substances.

Their overall activity is growth retardation, resulting in stunted and often malformed dwarf plants: bushy-stunted growth type or otherwise peculiar habits. Typical symptoms were already briefly summarized[2]. Out of the new regulators, some have a remarkably broad spectrum of activity over a very wide range of concentrations (corresponding to that of the gibberellins), essentially free from phytotoxic side effects. Treated plants often become gradually darker green in colour[2].

These and other outstanding features established the new group's name, namely *morphactins* (*morph*ogenetic *act*ive substa*nces*)[2]. A more detailed account on basic work with these compounds will be presented elsewhere[4].



Fluorene-9-carboxylic acid, basic structure of the morphactins

The broad activity spectrum combined with low phytotoxic side effects to the plants treated, even at high dosage-levels, makes certain members of the morphactins interesting for slowing down the growth of mixed vegetations, where to a certain extent plant coverage of soil is essential for prevention of soil erosion by wind and/or rainfall. These substances, for example, methyl-2-chloro-9-hydroxy-fluorene-(9)-carboxylate, seem to be useful agents for growth retardation and suppression, respectively, for example, along highways, railroads, ditch banks, sporting areas, and even in special perennial crops such as orchards and vineyards, too. In this connexion, it should be mentioned that residual activity of the new compounds in soils is strongly limited; these will be broken down in most soil types within a few weeks after application, mainly by microbial attack[5,6].

Besides growth retardation, other members of the group offer new possibilities for broad-spectrum control of weeds in cereals and grassland (pastures and meadows), because of synergistic action with known herbicides of different kinds[1], such as phenoxy compounds[5,7]. For example, suitable formulations containing the morphactins *n*-butyl-9-hydroxy-fluorene-(9)-carboxylate or salts of 9-hydroxy-fluorene-(9)-carboxylic acid together with MCPA and/or 2,4-D and/or another phenoxy compound in optimal proportions give good control of a variety of weeds which are difficult to control, such as *Galeopsis*, *Galium*, *Stellaria*, *Polygonum*, *Matricaria*, *Chrysanthemum*, *Lamium*, *Veronica*. Proper timing of application, that is to say, spraying at early developmental stages of the weeds, is essential for complete success[5,7].

Moreover, besides growth retardation and broad-spectrum weed control, morphactins offer some other features and advantages, which make this new experimental group an attractive one. Toxicity in mammals and fish is very low, for example, in rats (Wistar) $LD_{50}$ oral acute is greater than 5,000 mg/kg body-wt.[7].

In the meantime research on a variety of fundamentals in plant growth and development and also on a range of practical aspects is in progress. Basic information on the morphactin group is now available[7].

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## Winter Scale Rings in *Lates niloticus* (Pisces: Centropomidae) from Lake Chad

The formation of scale rings in tropical fishes has usually been ascribed to some form of physiological stress producing a temporary check in the growth-rate. Holden[1] thus proved that in *Tilapia* spp. from Lake Victoria ring