APPLICATIONS OF GROWTH RETARDANTS

A Review by J. N. Hawtree

Though mainly concerned with cereals this review, which has been abbreviated, will be of interest to those concerned with grass where research into possible uses of these materials in greenkeeping has so far been limited.

Over the past few years, a number of chemical substances have been developed, which reduce or suppress the elongation of one or more internodes in plants. Such substances have been called growth retardants. One of these, known commercially as cycocel or CCC has received a considerable amount of attention recently in connection with increasing yield in cereal crops. Others such as B.995 and phosphon have been studied on a smaller scale, and may have some application in increasing yields in potatoes and root crops. There are several other uses to which growth retardants may be put, in agriculture and horticulture.

A number of basic properties are shown by all growth retardants, but there is considerable variation between the different types and their effects on different crops. This review will deal mainly with CCC, since this has been experimented with more than any other and appears to have the widest application.

In cereals the reduction of straw length by CCC has been demonstrated by many workers in several countries. In wheat, this reduction may be up to 50 per cent of the normal length. Tillering starts earlier in treated plants and is stronger: individual tillers grow almost as rapidly as the main shoot. There is an increase in shoot number at final harvest, but ear emergence may be delayed and grain size is often less than normal. The number of leaves per shoot is not altered, although they are on the whole broader and greener (Tolbert, 1960, Humphries et al 1965, Mayr & Presoly, 1963).

There may also be some anatomical effects in treated plants; for instance cell walls are normally thicker and the number of vascular bundles increases (Mayr & Presoly, 1963). In growth analysis experiments (Humphries et al, 1965), it was found that the leaf area index was decreased due to shortening of the sheath but the leaf area duration was increased due to delayed senescence. The net assimilation rate was generally decreased by the CCC treatment, particularly at high nitrogen levels, presumably due to denser growth and hence increased shading.

Tougher stems

The uses of CCC in the growing of wheat are firstly to reduce lodging and consequently the losses so caused; secondly to increase yield by allowing greater levels of nitrogen to be applied. In many trials, lodging has been entirely suppressed due to the reduced straw length and greater straw stiffness.

Reports of the effect on total dry matter yield when no lodging occurred in untreated plots have been inconclusive. Fajerson (1965) found that total yield was increased in some varieties, which decreased in others. Primost (1965) and Linser and Kühn (1963) found that there was little change in short yield, but root yield was increased. Presumably the dry weight of individual tillers was decreased, but the increase in tillering possibly due to less shading, made up for this decrease giving a yield similar to or greater than untreated plants.

The second major use of CCC, as stated above is to enable greater levels of nitrogen to be applied, without the normal high incidence of lodging occurring under these conditions. Lecompt (1966) found that in winter wheat the response to CCC increased with the amount of nitrogen applied. However the majority of workers have found that increasing nitrogen levels reduced effectiveness of CCC (De Vos 1964, Caldicott & Lindley 1965, Linger & Kühn 1962).

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Influence of Water

It has been suggested above that water regime may be important in determining the effectiveness of CCC and this problem has been investigated specifically. CCC has apparently no effect on transpiration coefficient of total dry matter yield at various levels of water stress (El damaty, Kühn, Linser 1965). It has been found that grain yield may be increased under moisture stress, and that the higher the stress, the greater the increase. However it appears that straw length is reduced more at low moisture stress (Barbier & Mayr, 1966). Experiments at Rothamsted (unpublished) indicate that root growth may be stimulated and hence drought resistance on sandy soils might be increased.

As to the practical details of application, soil dressings and sprays are both effective; seed dressings however are poor, owing to the hygroscopic nature of CCC, which makes handling and sowing difficult. One application is normally enough. Primost (1965) found that if seedlings were sprayed they became diseased within a week (the symptoms were not described).

An aspect of CCC of more recent discovery is its effects on disease incidence in cereals. Jung & Sturm (1966) provided evidence that infections of *Septoria* and *Erysiphe graminis* were more pronounced in CCC treated plants. The incidence of damage due to *Cercosporella* (eye spot) was however decreased.

In grass seed production CCC may have a use. Stoddert (1964) found that treatment with CCC reduced culm lengths, maximum effectiveness being obtained from those treatments given at earliest growing stages. The number of heads and head length per plant were increased by the treatment.

In U.S.A. experiments have shown that CCC usually retards growth in the grass *Cynodon dactylon*, but under low light intensities induces dense growth.

Apart from agriculture, there are a number of uses to which CCC might be put in horticulture. Flower initiation is usually earlier in treated plants: this effect has been exploited in the U.S.A. with early flowering azaleas (Cathey, 1964). Halevy and Wittwer (1966) reported that dipping cut flowers in CCC delayed senescence.

A list of references is available from the Editorial offices.