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Effect of CCC Seed Treatment on the Growth of Rice and Wheat

Manzoor H Soomro[a]* and N G M Hague[b]

[a] *Pakistan Science Foundation, Constitution Avenue, P O Box 1121, Islamabad, Pakistan*

[b] *Department of Agriculture, University of Reading, Reading RG6 2AT, England*

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Effects of CCC seed treatment on the growth of rice and wheat seedlings were assessed in controlled conditions. Seeds were soaked for 24 h in 0, 10, 25, 50, 100 and 200 ppm CCC solutions. The growth of rice seedling, particularly the number of axes was enhanced significantly by CCC, maximum enhancements being caused by higher concentrations of 100 and 200 ppm. The number of laterals and total root length of rice seedlings was also increased considerably. In contrast, shoot as well as root growth of wheat was suppressed by the CCC treatment. With an increase in CCC concentration, a corresponding and highly significant retardation in shoot height and shoot and root dry weight of wheat seedlings was observed.

Key words: Seed treatment, Rice, What, CCC.

Introduction

The main use of CCC (2-chloroethyl trimethyl ammonium chloride = chlormequat = cycocel) is to shorten internodes in cereals thus lessening the risk of yield losses from lodging, but it has also been used on numerous other crops for different purposes under various environmental conditions. There is evidence that it can enable plants to withstand unfavourable conditions, e. g. application of CCC can increase root growth, water use efficiency drought tolerance, high soil salinity, cold, low soil pH and diseases (El-Damaty *et al* 1965; Humphries 1968; Singh *et al* 1981). However, it may also reduce germination, root growth and yield of cereals (Wunsche 1974; Tschen and Shih 1983; Deveson 1987).

Since roots play a major role in plant growth and the number of nodal roots is related to the number of tillers in winter wheat (Klepper *et al* 1983), spring barley (Anderson-Taylor and Marshal 1983) and rice (Yoshida and Hesegawa 1982), CCC could possibly affect the pattern of root growth and alter the root:shoot ratios. There are very few studies on the effects of early applications of CCC on the growth and development of cereals and very little work is reported on rice (Anon 1985) in particular.

The purpose of this work was to assess the response of rice (*Oryza sativa* L.) and wheat (*Triticum aestivum* L.) to CCC as seed treatment.

Materials and Methods

CCC used was 'Arotex' Extra, a liquid containing 644g per liter chlormequat with added choline chloride (ICI, UK) and the required concentrations were made in distilled water.

Rice. Seeds of rice cv. Jaya were soaked in 0, 10, 25, 50, 100 and 200 ppm CCC solutions for 24 h at room temperature (18-24°C) in the dark. The seeds were placed between two filter papers kept in petridishes containing 20 ml of CCC solution. Before sowing, excess solution was removed by placing seeds on filter paper for one hour. Seeds were then sown individually in 9 cm plastic pots containing sterilized soil (loam + sand 2:1) at a similar depth by making wood-probe and watered as required. The experiment was conducted in Fisons Growth Cabinet (Model 600G3/TL) at 30-22°C day-night temperature with 15 h artificial light. Replication was 4-fold for two harvests at 14 and 21 days after sowing.

Wheat. Wheat seeds were soaked in various CCC solutions for 24 h and sown individually in pots as mentioned above. The pots were kept in Growth Cabinet at 20-15 C day-night temperature with 15 h artificial light. Replication was 7-fold for three harvests at 7, 14 and 21 days after sowing.

At each harvest, various shoot and root parameters were measured. Total root length was measured by a modified line interesect method as used by Soomro and Hague (1992). Roots were spread under water in a perspex tray with 1.27 cm (0.5") grid marked on it (Spaull 1981) which gives direct length in centimeters according to the formula : Root length = 11/14 x No. of Intercepts x Grid unit.

Results and Discussion

Rice. Generally, the growth of rice seedlings was enhanced with the increase in CCC levels but the differences were significant ($p<0.05$) only at first harvest 14 days after sowing.

* Author for correspondence. E-mail: ms@psf.sdnpk.undp.org

Shoot height and dry weight of seedlings growing from CCC treated seeds were greater than those from untreated. The highest increase (13%) in shoot height was caused by 100 ppm followed by 200ppm (12%) whereas, the largest enhancement (33%) in shoot dry weight was caused by 200ppm CCC when observed 14 days after sowing. These results are in contrast to Tschen and Shih (1983) who reported a reduction in shoot height of rice due to CCC seed treatment at 1-100ppm. However, they further reported that the seedling growth in terms of fresh weight was increased by 1-100ppm and decreased by 1000ppm CCC. Similarly, root dry weight of rice seedlings was also increased by CCC, highest increase (32%), although not statistically significant, was by 200ppm 14 days after sowing.

Root growth of rice was also enhanced by CCC seed treatments and the increase was very prominent and significant ($p<0.05$) in the number of axes at 14 days after sowing (Fig 1). This is more important as the number of axes is related to the number of tillers in rice (Yoshida and Hesegawa 1982). As a result of increase in number of axes and laterals, the total root length of seedlings from CCC treated seeds particularly by 200ppm was considerably larger than the untreated (Fig 1), which is in agreement with Hou -- cited by Moody (1986), whereas Tschen and Shih (1983) reported a reduction in number of laterals following CCC seed treatment. An increase of 53% in number of axes by 100ppm CCC was very encouraging as it enabled the young seedling to establish early in its life, though the increase disappeared after one week. Other root parameters were also enhanced but the effects particularly of lower concentrations were generally not significant statistically.

Wheat. The overall growth (shoot height, shoot dry weight,

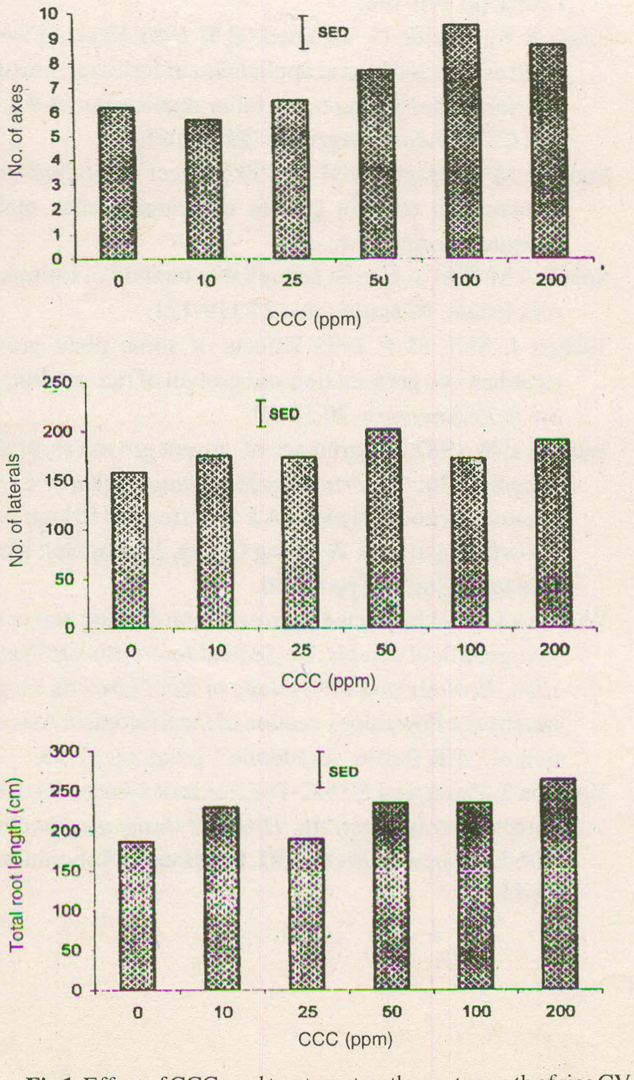

Fig 1. Effect of CCC seed treatment on the root growth of rice CV Jaya 14 days after sowing (means of 4 reps)

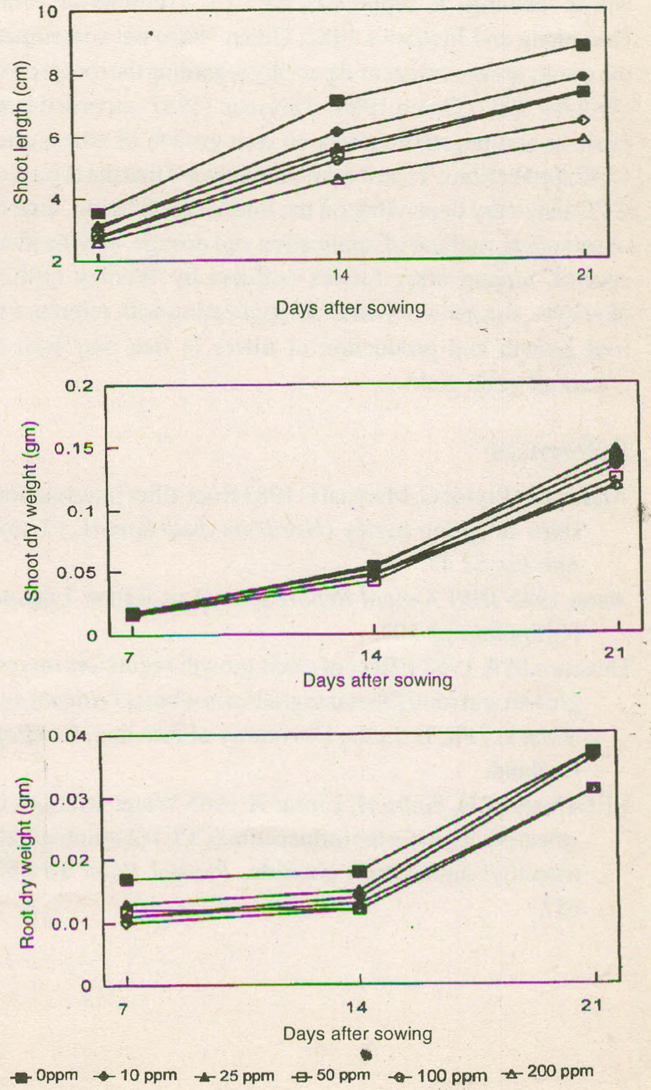

Fig 2. Effect of CCC seed treatment on the growth of wheat.

root dry weight) of wheat seedlings was significantly retarded by the CCC application ($p<0.01$) and there was a significant interaction ($p<0.01$) between the CCC concentrations and the time of observation for shoot height and shoot and root dry weight. Shoot height of plants was reduced with an increase in CCC levels, displaying a rather linear relationship which was more pronounced 21 days after sowing (Fig 2). Shoot and root weight was also reduced by CCC application with one exception after 21 days when shoot weight of the seedlings from 25ppm CCC treatment was 6% heavier than the untreated.

Root growth of wheat was also suppressed by the CCC application, but the differences were not significant statistically. However, in case of 25 ppm treatment, there was a slight increase in number of laterals which contributed to a slightly increased root length.

A review of literature suggests that often the shoot height of wheat seedlings is suppressed by CCC (Humphries 1968; Koranteng and Mathews 1982; Green 1986) but sometimes, the results are inconsistent especially regarding the root growth (Wooley 1982; Green 1986). Deveson (1987) recorded both positive and negative effects on root growth of wheat after CCC applications. Thus it may be concluded that the effects of CCC may vary depending on the time of application, time of observation, method of application and dosage, and the plant species, among other factors outlined by Wooley (1982). However, further work on CCC application with reference to root growth and production of tillers in rice may lead to enhanced grain yield.

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