Effect of seaweed concentrate on the growth of wheat under conditions of water stress

In field trials using seaweed extracts, close correlations have been demonstrated between applications of the extract and increased crop yields,[1,2] the production of flowers,[3] and prolonging shelf-life of fruit.[4] As wheat crops are often subject to drought, it is widely believed that yield could be improved by breeding for increased drought tolerance. To this end considerable effort has been spent in identifying physiological and morphological characters that are important for achieving high and stable yields under conditions of water stress.[5-7] Since the breeding of a plant for a specific morphological or physiological character is a laborious and time-consuming process, the ability to induce increased drought tolerance through foliar sprays of specific chemicals or a seaweed concentrate presents an interesting proposition and solution, even if only on a short-term basis. This study was undertaken to determine the effect of the seaweed concentrate Kelpak 66* on the yields of winter wheat grown under conditions of water stress.

Triticum aestivum L. em. Thell cv. Inia plants were cultivated under greenhouse conditions with 16 h of light at 18°C and 8 h of dark at 12°C. The caryopses (seeds) were sown in a perlite medium in 5 dm^3 black plastic potting bags.

The experiments included three treatments: (a) undroughted plants (T0), (b) plants droughted during the vegetative phase of growth (T1) by withholding water from 24 h after the first application of seaweed concentrate, and (c) plants droughted during the flowering phase of growth (T2) by withholding water from 24 h after the second application of seaweed concentrate. This was maintained until the plants in one or more of the seaweed application treatments exhibited marked signs of wilting. In addition to a control (CO), three concentrations of the seaweed concentrate were tested in each treatment. The seaweed was applied as foliar sprays in the ratios of 1:750 (C1), 1:500 (C2) and 1:250 (C3) (seaweed concentrate:water). The volumes applied were 1 dm^3/ha (C1), 1.5 dm^3/ha (C2) and 3 dm^3/ha (C3). The plants were sprayed twice during their growth cycle. The first application was made when the seedlings were at stages 1 – 2, and the second application at stages 17 – 19 of inflorescence differentiation. Each treatment was conducted in triplicate and the experiment repeated once.

The undroughted plants were watered once a week with one quarter strength Hoagland's nutrient solution, and four times a week with tap water. Plants were harvested three months after planting.

Yields from undroughted (control) plants treated with the seaweed concentrate and grown under water stress-free conditions, showed overall higher yields than the control plants (Fig. 1). This indicated that application of the seaweed concentrate enhanced the growth of the plants under normal growing conditions. The straw and grain yields produced by 1:250 (C3) applications were significantly greater than those produced by 1:750 (C1) and 1:500 (C2) applications. The mass of roots yielded by C1 seaweed concentrate dilution was significantly greater than at the higher seaweed concentrate applications. Foliar application of the seaweed concentrate thus increased the yield of *Triticum aestivum*. At the concentrations used, the best grain yields were obtained with the 1:250 concentration of the seaweed concentrate.

The mean growth yields and thus the effect of Kelpak 66 on the drought tolerance levels of *Triticum aestivum* are presented in Figs 2 and 3. (The drought tolerance of a plant is expressed as a function of mass, since the ability to survive a period of water stress will be reflected in the eventual dry mass of that plant.) The results of both drought treatments showed similar trends to those of the undroughted control plants. Plants treated with the highest seaweed concentrate, C3, had significantly higher straw and grain yields than the lower C1 and C2 applications.

For seaweed concentrates C1 (1:750) and C2 (1:500) used on plants droughted during the flower phase of growth (T2), there was a marked loss in percentage straw yield (Table 1), in rela-

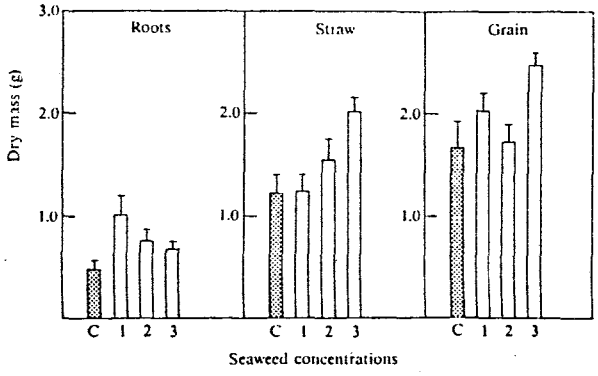

Fig. 1. Undroughted control. Effect of seaweed concentrate application on the root, straw and grain yields of winter wheat (dry mass, g). Plants were never placed under conditions of water stress. C = control, 1 = 1:750, 2 = 1:500 and 3 = 1:250 (seaweed concentrate: water).

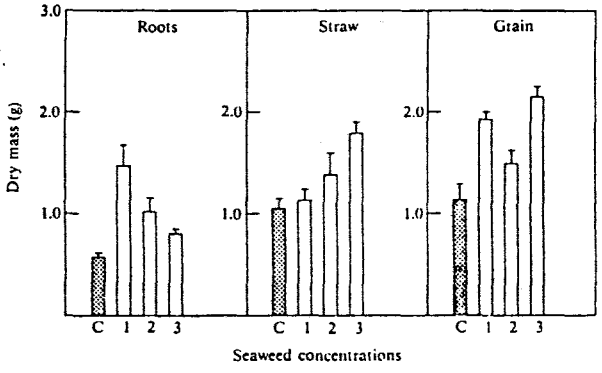

Fig. 2. Drought treatment 1. Effect of seaweed concentrate application on the root, straw and grain yield of winter wheat (dry mass, g). Plants were placed under drought conditions 24 h after the first seaweed concentrate application. Drought conditions were maintained for 19 days. C = control, 1 = 1:750, 2 = 1:500 and 3 = 1:250 (seaweed concentrate:water).

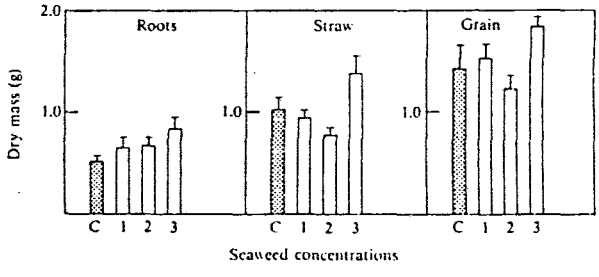

Fig. 3. Drought treatment 2. Effect of seaweed concentrate application on the root, straw and grain yields of winter wheat (dry mass, g). Plants were placed under drought conditions 24 h after the second foliar spray (flowering stage). Drought conditions were maintained for 14 days. C = control, 1 = 1:750, 2 = 1:500 and 3 = 1:250 (seaweed concentrate:water).