The effect of seaweed concentrate on seedling transplants

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Accepted 22 January 1987

Seaweed concentrate applied either as a root drench or a foliar spray at transplanting significantly improved seedling growth of both cabbage and marigold. Both root and shoot growth were stimulated. In the case of marigolds, flowering was greatly accelerated.

Seewier-konsentraat aangewend of as 'n grond-benatting of blaar-bespuiting met verplanting het die groei van kool- en afrikaner-saailinge betekenisvol gestimuleer. Wortel- sowel as loofgroei is bevorder. In die geval van die afrikaner-saailinge is blomvorming baie bevorder.

Keywords: Cabbage, marigold, seaweed concentrate, transplants

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Introduction

Increased use is being made of seaweed products to manipulate plant growth (Blunden & Wildgoose 1977; Abetz 1980). Recent reports have shown that low levels of seaweed concentrate, prepared from *Ecklonia maxima*, improved root growth of certain crop plants (Featonby-Smith & Van Staden 1983a, b, 1984b; Nelson & Van Staden 1984). This effect was achieved irrespective of whether the seaweed was applied as a foliar spray or root drench. Application of the seaweed concentrate to *in vitro*-cultured tomato roots also stimulated their growth (Finnie & Van Staden 1985). This effect could be simulated by application of low levels of cytokinins which increased both root extension and lateral root development. The stimulatory effect of seaweed concentrate has been attributed to the presence of endogenous cytokinins (Featonby-Smith & Van Staden 1983a, 1984b) which have been tentatively identified in the product manufactured from *Ecklonia maxima* (Featonby-Smith & Van Staden 1984a). The fact that this effect is lost if the seaweed concentrate is ashed at 550°C indicates that the promotive effect could be due largely to the presence of organic molecules (Finnie & Van Staden 1985). The beneficial effect of seaweed concentrate on root development during the early stages of vegetative growth (Nelson & Van Staden 1984) holds considerable potential if it could reduce transplant shock of vegetables and ornamentals. This aspect was investigated using cabbage and marigold transplants as experimental material.

Materials and Methods

Seedlings of both cabbage (*Brassica oleracea* var *capitata*) and dwarf marigold (*Tagetes patula* var. *Janie*) were grown in styrofoam seedling trays to the 4-leaf stage.

In the first experiment, uniform seedlings of cabbage (40 per treatment) were selected, treated with seaweed concentrate (commercially available as Kelpak 66 and prepared from *Ecklonia maxima*) and then immediately transplanted into 12,5 cm pots containing a medium of sand : loam : peat (1:2:1). Root balls were submerged for 5 min in (a) distilled water (control); (b) a 1:500 seaweed concentrate dilution; and (c) a 1:250 seaweed concentrate dilution. Foliar sprays were not included as previous experiments have indicated that such treatment was not beneficial to cabbage seedlings, probably as a result of the waxy texture of the leaves (Kotze & Joubert 1980). After treatment and transplanting, the cabbage seedlings

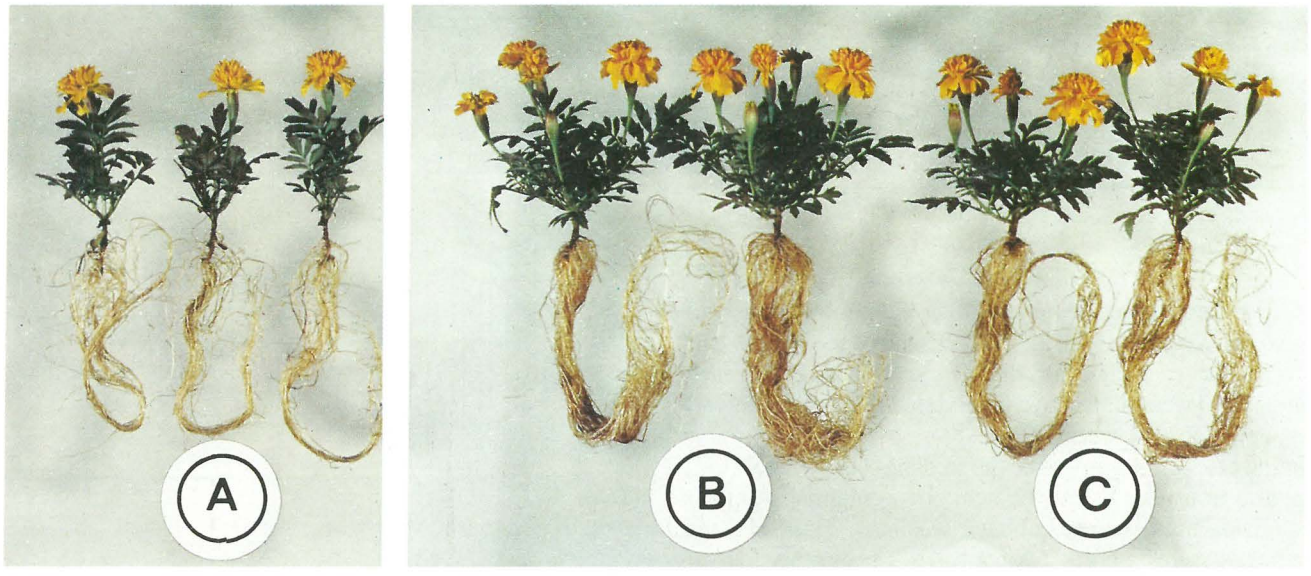

Figure 1 Marigolds 6 weeks after applying seaweed concentrate at transplanting. A = control; B = 1 cm^3 seaweed concentrate applied to the soil; C = 2 cm^3 seaweed concentrate applied as a foliar spray.

Table 1 Effect of seaweed concentrate applied as a root dip on the growth of cabbage transplants

Character recorded	Time after transplanting (weeks)	Treatment			
		Control	Root dip (1:500)	Root dip (1:250)	*LSD* (P = 0,05)
Root fresh mass (g)	0	0,5	–	–	0,5
	1	0,7	1,2	1,0	
	2	0,9	1,2	1,2	
	3	1,8	2,9	1,7	
	4	2,4	3,0	2,1	
Shoot fresh mass (g)	0	1,4	–	–	2,4
	1	3,1	3,2	3,6	
	2	7,0	8,1	7,8	
	3	14,7	18,6	13,8	
	4	19,9	25,0	18,8	
Root dry mass (g)	0	0,05	–	–	0,06
	1	0,04	0,5	0,07	
	2	0,08	0,10	0,09	
	3	0,19	0,27	0,17	
	4	0,22	0,32	0,24	
Shoot dry mass (g)	0	0,16	–	–	0,28
	1	0,25	0,29	0,29	
	2	0,54	0,61	0,57	
	3	1,19	1,51	1,09	
	4	1,86	2,45	1,66	
Stem length (cm)	0	4,1	–	–	1,1
	1	6,7	7,4	6,3	
	2	8,4	9,9	8,1	
	3	11,8	12,9	10,8	
	4	13,6	15,7	12,6	
Stem diameter (mm)	0	2,0	–	–	0,3
	1	2,1	2,0	2,2	
	2	2,6	2,7	2,5	
	3	3,4	3,6	3,2	
	4	3,4	4,0	3,5	
Leaf number	0	4,5	–	–	0,7
	1	4,5	4,4	4,9	
	2	6,9	7,3	7,2	
	3	8,7	8,5	8,5	
	4	9,2	9,5	9,1	
Moisture content (%)	0	88,5	–	–	1,2
	1	92,2	92,3	93,0	
	2	92,1	92,7	92,8	
	3	91,7	91,7	91,8	
	4	90,7	90,1	90,9	

were grown in a greenhouse providing 9-h photoperiods and diurnal temperatures of ± 25/15°C. Each pot received 50 cm^3 of tap water each day. Of the 40 seedlings used for each treatment 10 were destructively harvested at weekly intervals over a period of 4 weeks.

In the case of the marigolds, the seedlings (42 per treatment) were also transplanted into 12,5 cm pots containing a similar medium as used for the cabbage seedlings. The following treatments were applied: (a) control — plants watered or sprayed with water; (b) soil drench treatments where 5 cm^3 of dilutions of seaweed concentrate at 1:10; 1:5 and 1:2,5 were applied to the soil around the stems; and (c) foliar sprays where 2 cm^3 of dilutions of seaweed concentrate at 1:4; 1:2 and 1:1 were sprayed onto the foliage. By using these dilutions it was ensured that the seedlings were subjected to similar dilution series of seaweed concentrate. The potentially available seaweed concentrates thus were 0; 0,5; 1,0; and 2,0 cm^3 respectively. The seedlings were maintained under greenhouse conditions with a photoperiod of 12 h and diurnal temperatures of ± 27/20°C. Plants were watered every second day with 50 cm^3 tap water and harvested destructively at weekly intervals over 6 weeks.

Plants were randomized and arranged within the greenhouse according to a random digit table. The results obtained for the different growth characters or variables measured were analyzed according to the Duncan Multiple Range test at a variance level of 0,05.

Results and Discussion

Apart from leaf number and moisture content, the dipping of cabbage roots in 1:500 seaweed concentrate for 5 min before transplanting significantly increased the growth of the seedlings (Table 1). The higher application rate of 1:250 did not improve growth and gave results which were not statistically different from the controls. The overall vigour of the 1:500 seaweed-treated cabbage seedlings was improved. This was reflected in significant increases in the fresh and dry root and shoot mass, as well as stem length and diameter. In all instances, apart from stem diameter, the beneficial effects of the 1:500 seaweed application were reflected within the first 3 weeks after application. In the case of stem diameter the beneficial effect was only manifested after 4 weeks.

Marigold seedlings treated with seaweed concentrate were more robust and healthier in appearance than the controls (Figure 1). Analysis of the data collected showed that differences between the controls and seaweed treatments were already manifested 3 weeks after transplanting (results not shown). These differences became more pronounced with time and were significant when the experiment was terminated after 6 weeks. The results presented in Figures 2 to 4 indicate that seaweed concentrate application improved the root and shoot fresh mass, root and shoot dry mass, the number of leaves, the stem diameter and number of flowers and flower buds

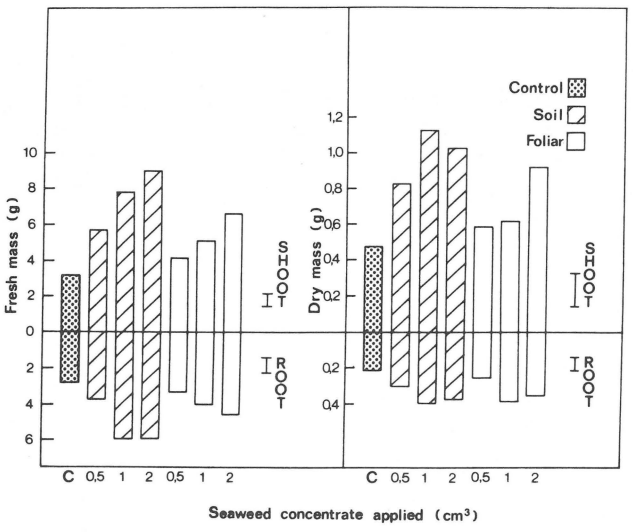

Figure 2 The effect of seaweed concentrate applied at transplanting on the root and shoot fresh and dry mass of marigold seedlings 6 weeks after application. Bar represents *LSD* at P = 0,05.

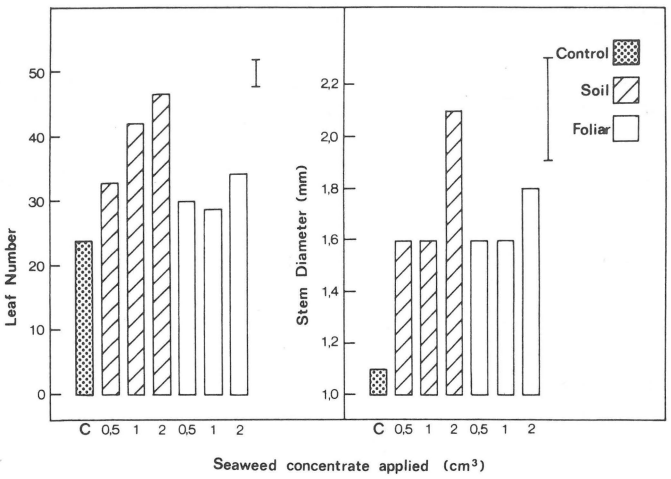

Figure 3 The effect of seaweed concentrate applied at transplanting on the number of leaves and stem diameter of marigold seedlings 6 weeks after application. Bar represents *LSD* at $P = 0,05$.

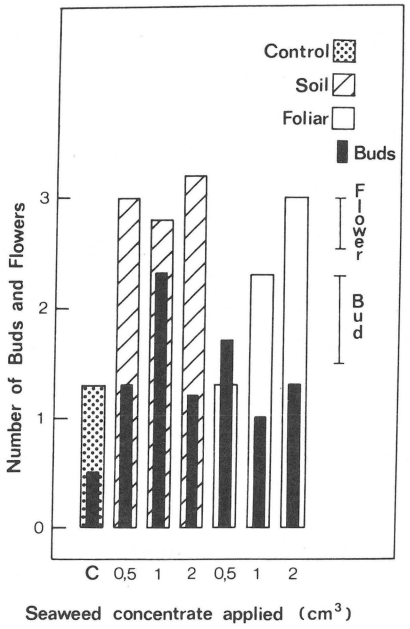

Figure 4 The effect of seaweed concentrate applied at transplanting on flowering of marigolds 6 weeks after application. Bar represents *LSD* at $P = 0,05$.

produced. Soil application had a more pronounced effect than foliar application. Irrespective of the mode of application an application of 2 cm^3 seaweed concentrate proved to be the most beneficial.

The present results confirm previous reports that seaweed concentrate applied at low concentrations either as a foliar spray or root drench stimulate plant growth (Featonby-Smith & Van Staden 1983a, b, 1984b; Nelson & Van Staden 1984). The beneficial effect of the seaweed concentrate manifested itself rapidly and was detectable 3 weeks after application to transplants. Previous results suggest that the beneficial effect of the seaweed treatment is due to organic constituents (Finnie & Van Staden 1985). To what extent the beneficial effect is attributable to plant hormones which have been found in seaweed concentrate (Featonby-Smith & Van Staden 1984a; Nelson & Van Staden 1985) and seaweed extract (Tay *et al.* 1985) remains to be established. Of importance however, is the fact that such preparations can be applied to seedlings at transplanting and that this improves not only seedling vigour but also subsequent seedling performance.

Acknowledgements

The C.S.I.R. is acknowledged for financial assistance.

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