

The Effect of Seaweed Concentrate on Growth of Nutrient-stressed, Greenhouse Cucumbers

W.R. Nelson and J. Van Staden¹

Department of Botany, University of Natal, Pietermaritzburg, 3200, South Africa

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Abstract. A commercially available seaweed concentrate (Kelpak 66) was applied to nutrient-stressed plants of cucumber (*Cucumis sativa* L. cv. Pepinova) as a root dip at transplant or as a weekly foliar spray. Overall plant dry mass was increased by the seaweed treatment. Those plants receiving higher levels of seaweed treatment showed greatly increased root growth.

Seaweeds have long been known to induce growth responses when applied to terrestrial plants (2), especially with regard to increased energy utilization (11). While the principal active component of seaweed is unknown, it is likely that a number of factors each play an important role. Of these factors, cytokinins have been singled out as being of particular importance (1).

Seaweed products have been recommended for general cucumber growth (15). Due to the intensive nature of cucumber production, seaweed treatments may be included easily in the management program. It would seem, furthermore, that seaweed concentrate is compatible with other chemical sprays (5).

Greenhouse 'Pepinova' cucumbers were treated with Kelpak 66, a commercially available seaweed concentrate produced from the brown seaweed *Ecklonia maxima* (Osbeck) Papenf. Seedlings were transplanted into a pine bark medium one week after germination and allowed to grow in a plastic tunnel subject to a temperature variation of 12° to 40°C. A low level of supplemental feeding was given in the form of 1 ml Li-quinure, a plant nutrient solution, applied once fortnightly per pot before normal watering.

Two methods of seaweed application were employed: 1) seedling roots were dipped for 5 min in a 1:250 dilution of Kelpak 66 at transplanting, and 2) weekly foliar spray applications until runoff of 1:500 Kelpak 66 plus Tween 20 (¼%). Three treatments were given: 1) root dip, 2) foliar sprays, and 3) combined root dip and foliar sprays. Half the plants were harvested 5 weeks from transplanting and the remainder at 10 weeks. Five plants were grown per treatment.

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¹To whom correspondence should be addressed.

No differences among treatments were detected in leaf and stem dry mass and leaf area after 5 weeks, but seaweed applications resulted in increased root mass over the control (Table 1). The root/shoot ratio was increased in all seaweed-treated plants. Total plant dry mass accumulation was increased marginally as a result of seaweed applications.

All seaweed-treated plants showed an increase in total dry matter accumulation after 10 weeks, although the root dip treatment was not significantly higher than the control (Table 2). The root/shoot ratio changed in favor of the roots in the 2 treatments receiving spray applications.

Dried leaves of 10-week-old plants were analyzed for P (16) and N content (9). Seaweed treatment tended to increase the P level

while the N level was decreased (Table 2).

Seaweed treatment had a noticeable effect on cucumber root growth. The roots appeared to have been stimulated to act as a strong sink for photosynthates and nutrients. Sub-optimal levels of N reduce the rate of cytokinin export from roots (10), while N incorporation in the shoot is decreased and retranslocation from the shoot to the roots may occur (13). Cucumbers subjected to nutritional stress have been observed to allocate a greater proportion of total dry mass to the roots (3), possibly due to reduction of cytokinin export and subsequent accumulation of N in the roots. Seaweed treatment also induced an imbalance in root/shoot growth but increased overall dry mass at the same time. An initial inhibition of fruit growth was noted in the seaweed-treated plants. This probably relates to the stimulation of root growth by the seaweed, this effect being the converse of the observed inhibitory effect of fruit growth on simultaneous root growth (4). Since the seaweed treatment induced an increase in total plant dry mass, cessation of root growth stimulation may be expected to release photosynthates from the roots to the fruits, during a later production period. This suggests that seaweed treatments must be timed to coincide with suitable growth stages of the plant rather than a regular treatment throughout the growing period.

Seaweed treatment increased both the root/shoot ratio and accumulation of plant dry mass. This suggests a 2-fold action of seaweed concentrate. First, to stimulate root growth at the expense of shoot growth, and second, to increase the overall photosynthate accumulation efficiency of the plant. Metabolic stimulation and increased dry matter

Table 1. Effect of seaweed concentrate on dry mass accumulation of nutrient-stressed greenhouse cucumbers 5 weeks from transplanting.¹

Time and method of application	Root dry mass (g)	Total plant dry mass (g)	Root/shoot ratio
Control	2.16 a ²	4.03 a	1.16 a
Root soak at transplant	3.46 b	5.35 b	1.98 b
Weekly spray	4.23 b	6.25 c	2.05 b
Combined	2.67 a	4.57 ab	1.41 c
SE	0.28	0.30	0.15

¹Means are of 5 replications each.

²Mean separation in columns by *t* test, 5% level.

Table 2. Effect of seaweed concentrate on dry mass and leaf area of nutrient-stressed, greenhouse cucumbers, 10 weeks from transplanting.¹

Time and method of application	Root dry mass (g)	Total plant dry mass (g)	Root/shoot ratio	Leaf area (mm ² × 1000)	Leaf N (%)	Leaf P (%)
Control	28.6 a ²	48.0 a	2.26 a	31.9 a	1.90 a	0.74 a
Root soak at transplant	27.7 a	48.8 a	2.10 a	31.1 a	1.62 b	0.78 ab
Weekly spray	56.8 b	74.9 b	3.80 b	33.5 ab	1.68 b	0.89 c
Combined	45.8 c	62.2 c	3.08 c	37.1 b	1.81 c	0.83 b
SE	5.3	5.2	0.33	2.641	0.07	0.04

¹Means are of 5 replications each.

²Mean separation in columns by *t* test, 5% level.