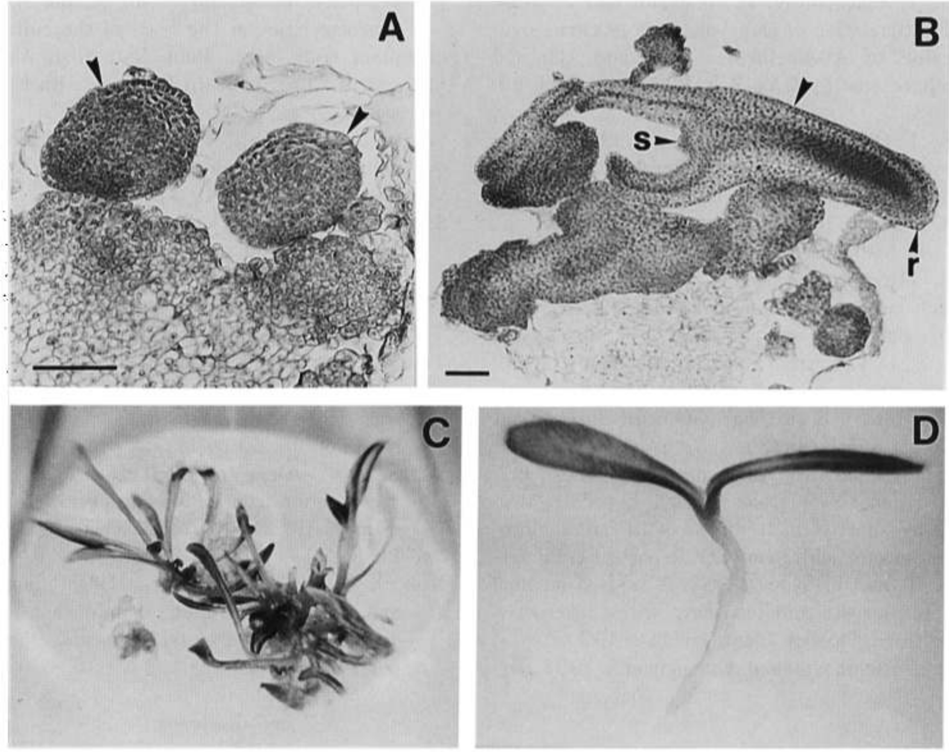

Fig. 1. Plantlet regeneration through somatic embryogenesis from root explants of spinach (*Spinacia oleracea* L.). A: Globular somatic embryos (arrowheads) regenerated on surface of root-derived callus; B: Developing torpedo-shaped embryo (arrowhead) having shoot (s) and root (r) apices on the same axis; C: Numerous plantlets developed from somatic embryos formed after 2 weeks on a secondary culture which followed 4 weeks of primary culture with 10 μM NAA and 10 μM GA_3; D: An isolated plantlet with fully expanded cotyledons. Bars represent 100 μm in A and B.

and D). No adventitious shoot formed on any combinations of auxins and GA_3. These results show that spinach somatic embryogenesis is most facilitated on the culture medium containing NAA and GA_3.

It has been recognized that adventitious shoot formation in spinach were influenced by concentrations of GA_3 added to the culture medium (Al-Khayri et al., 1992). In our experiment, GA_3 evidently stimulated somatic embryogenesis from root segments of spinach rather than natural cytokinins. Consequently, GA_3 seems to play an important role in plant regeneration of spinach.

These results lead us to conclude that combining auxins and cytokinins or GA_3 is essential for plant regeneration through somatic embryogenesis from root tissues of spinach, and that the combinations of NAA and GA_3 fostered embryogenesis and yielded the maximum number of embryos. The effective combinations of growth regulators described here would be useful for establishing a tissue culture system suitable for somatic embryogenesis in spinach.

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