

leak past the piston seals into the lower cylinder volume, so that it would eventually be necessary to repeat the initial bottoming of the piston to restore the atmospheric/vacuum differential pressure.

Alternatively, a vacuum could be generated and maintained by use of a small manual or electric vacuum

pump. Still another alternative is to connect the lower cylinder volume to the combination of a low-pressure storage tank, pressure regulator, and vacuum pump. This combination could be used to maintain the lower cylinder volume at a subatmospheric pressure (partial vacuum) that could be controlled to set the differential pressure

and thus the output-cable tension at a desired level.

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Production of Tuber-Inducing Factor

This substance regulates the growth of potatoes and some other plants.

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A process for making a substance that regulates the growth of potatoes and some other economically important plants has been developed. The process also yields an economically important by-product: potatoes.

The particular growth-regulating substance, denoted tuber-inducing factor (TIF), is made naturally by, and acts naturally on, potato plants. The primary effects of TIF on potato plants are reducing the lengths of the main shoots, reducing the numbers of nodes on the main stems, reducing the total biomass, accelerating the initiation of potatoes, and increasing the edible fraction (potatoes) of the overall biomass. To some extent, these effects of TIF can override environmental effects that typically inhibit the formation of tubers. TIF can be used in the potato industry to reduce growth time and increase harvest efficiency. Other plants that have been observed to be affected by TIF include tomatoes, peppers, radishes, eggplants, marigolds, and morning glories.

In the present process, potatoes are grown with their roots and stolons immersed in a nutrient solution in a recirculating hydroponic system. From time to time, a nutrient replenishment solution is added to the recirculating nutrient solution to maintain the required

nutrient concentration, water is added to replace water lost from the recirculating solution through transpiration, and an acid or base is added, as needed, to maintain the recirculating solution at a desired pH level. The growing potato plants secrete TIF into the recirculating solution. The concentration of TIF in the solution gradually increases to a range in which the TIF regulates the growth of the plants.

In a procedure for concentrating TIF, no attempt is made to separate TIF from the nutrient and other solutes in the solution. Instead, the solution is simply poured onto flat trays at a depth between 0.5 and 1.0 cm, then concentrated by drying for 12 to 24 hours in a forced-air oven at a temperature of 70 °C. The concentrated solution is stable at and below room temperature and in the presence of ultraviolet light. Optionally, one can freeze-dry the solution to remove all the water, leaving a water-soluble dry powder. The concentrated solution or dry powder is stored in a dry environment. Thereafter, one simply adds deionized water to the concentrated solution or dry powder to make a TIF-containing nutrient solution having the desired lesser concentration.

Results of laboratory tests suggest that TIF-containing solutions made in

this way are suitable for use in diverse settings, including fields, green houses, and enclosed environments containing natural- and artificial-soil-based as well as hydroponic plant-growth systems. Potential commercial applications include the following:

- Hydroponic, aeroponic, or field production of seed potatoes;
- Dwarfing of bedding plants in controlled environments;
- Dwarfing of ornamental plants in fields and in controlled environments; and
- As a quasi-natural regulator (in this case, as a suppressor) of the growth of weeds.

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Title to this invention, covered by U.S. Patent No. 5,992,090 has been waived under the provisions of the National Aeronautics and Space Act (42 U.S.C. 2457 (f)). Inquiries concerning licenses for its commercial development should be addressed to:

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