TARC Note

An Improved System of Nutrient Solution Circulation for Studying N Transfer from Legumes to Grasses

The author and coworkers developed a simple and inexpensive system of nutrient solution circulation[2].

This system was made up of three subsection; pot and growth media, tubing for nutrient circulation, and the air supply. The air lift perfusion principle was employed to continuously circulate the solution within individual pot[1,3]. This system, however, required much of labour for its maintenance when operated for a long period due to occasional troubles which begin to occur approximately three weeks after the initiation of experiment.

The author tried to remove these troubles to meet a loag period usage. The readily available components utilized in the newly improved nutrient solution circulation system are listed below:

Pot and growth media a) Wagner's pot, 1/2000 a and 1/5000 a; b) river sand; c) styrofoam plate; d) nylon filter paper, Whatman #4; e) rubber stopper with one-hole and two-holes; and f) glass tube, 4.0 mm I.D.

Tubing for nutrient circulation a) black fluorine rubber turbing, 6.0 mm I.D.; b) T-shape plastic connector, 6.0 mm I.D.; c) glass capillary tube, 1.0 mm I.D.; d) glass tube 3.0 mm I.D.; and e) silicone rubber tubing, 6.0 mm I.D.

Air supply a) light duty aquarium pump; b) P.V.C. pipe, 2.5 cm I.D.; c) glass capillary tube, 0.5 mm I.D.; and d) silicone rubber tubing, 4.0 mm I.D.

Others a) black paint; b) wire, 2.0 D.; c) aluminum foil; and d) automatic time controller, if needed.

A schematic drawing of the improved system is shown in Fig. 1 and a general view in Plate 1.

Pot and growth media The size of the pot can be varied according to the need of the experiment. The growth media is also subject of choice among various materials, but it must be sufficient porous to allow both good areation and free flow of the solution. A one-hole rubber stopper at the base of the pot (1/2000 a pot) for growing a legume allows the insertion of a glass tube for supplying solution to the pot (1/5000 a pot) for growing a grass below. A silicone rubber tubing whose inlet is covered with a nylon filter paper is fitted to the bottom of the pot for growing a grass for returning the solution to the reservoir (1/5000 a pot) below. A two-holes

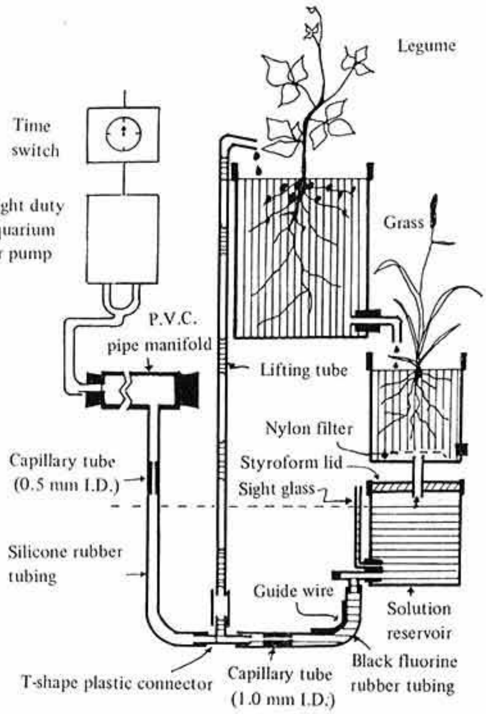

Fig. 1. Schematic drawing of the improved system of nutrient solution circulation for studying N transfer from legumes to grasses

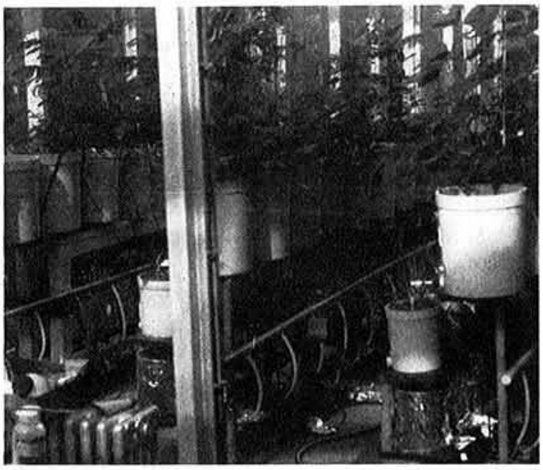

Plate 1. A view of the improved system in operation

rubber stopper at the base of the reservoir allows the insertion of the L-shape sight glass, covered with aluminum foil to prevent the growth of algae except when checking the level of solution, and of an outlet for supplying solution to the tubing of circulation system. The reservoir should be wrapped with aluminum foil to prevent the growth of algae after putting a styrofoam lid on the top of the reservoir.

Circulation system This is a subsection largely improved from the previous system. Solution from the base of the reservoir flows through a black fluorine tubing into an inlet of the T-shape plastic connector at the base of the lifting tube. A short glass capillary tube is inserted into the fluorine rubber tubing at the point closely adjacent to the T-shape connector. It serves to regulate the volume of solution flow into the lifting tube and to prevent the back-flow of solution into the reservoir. Compressed air is then introduced into the base of lifting tube from the other inlet of T-shape plastic connector and serves to lift solution up through lifting tube into the pot for growing a legume.

Air supply Air from the pump is channeled through a P.V.C. pipe for the first and then through a silicone rubber tubing connected to the T-shape plastic connector which is placed below the level of solution in the reservoir. A short glass capillary tube is inserted into the silicone rubber tubing to regulate the volume of air to be delivered. Fixing the capillary tube at a point above the highest level of solution in the reservoir is important to keep the capillary tube dry while the level of solution is raised up by accidents and thereby the growth of algae will be prevented. An automatic time controller can be installed if an intermittent solution supply is needed.

The previous system required much of labour for its maintenance: Since needle tips which regulate air supply are exposed to nutrient solution, a clogged needle due to corrosion occurs approximately after three weeks and rubber tubing cracks easily at a point where polyethylene micro-tubing is inserted, resulting in occasional leakage of solution. These troubles are overcome in the newly improved system: instead of plastic syringe and polyethylene micro-tubing, glass capillary tubes were inserted in a silicone rubber tubing for regulating air supply and in black fluorine rubber tubing for regulating solution flow rate and preventing back-flow of solution into the reservoir. However, the subsection for solution circulation should be coated with opaque paint or wrapped with aluminum foil to prevent the growth of algae.

The improved nutrient solution circulation system has proven to be very endurable and satisfactory for long term studies on N transfer from legumes to grasses or plant allelophacy (Plate 1). Occasional troubles, which occurred in the previous system, were not observed in the new system during a five-month experimental period.

The new system is sufficiently flexible, simple, and handy so that it can easily be rearranged in many ways and carried place to place depending on the purpose of experiments.

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Yukio KITAMURA *Okinawa Branch, Tropical Agriculture Research Center*
(Maesato, Ishigaki, Okinawa, 907–01 Japan)

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