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Soil-Free Success: Hydroponic Cultivation of Green Onions

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A cutting-edge and water-efficient technique for growing fresh, premium leafy crops without soil is hydroponic green onion farming. Under controlled conditions, this method ensures year-round output, improved fertiliser management, and quicker growth. For urban and peri-urban farmers, hydroponics presents a lucrative potential due to the growing demand for crops free of residue and the scarcity of available land. Higher yield and higher-quality green leaves are mostly dependent on environmental control, pest monitoring, and appropriate nutrition solution management.

Keywords: Hydroponics, Green onion, Nutrient management, Soilless cultivation, Urban farming.

Introduction & Importance

Excellent water utilisation, quick growth of plants, and great production make hydroponics a productive and eco-friendly farming technique. Hydroponic systems offer a promising alternative for vegetable production amid the growing demand for sustainable, high-quality food. Small family farmers usually cultivate green onions (*Allium fistulosum* L.), an important global condiment crop that is high in minerals, bioactive compounds, and antioxidants with antifungal, antihypertensive, and anti-obesity properties. Compared with conventional soil farming, hydroponics improves agriculture through better nutrient management, fewer soil-borne diseases, and faster growth. Optimising nutrient solution concentration is essential to maximising output and financial returns in hydroponic green onion farming since it influences plant development, yield, and production costs. (Santhos *et al.*, 2021).

From Channels to Cultivars: Building a Successful Hydroponic Model

Green onion (*Allium fistulosum* L.) hydroponic systems employ channel-based arrangements with recirculating nutrient solutions, beginning seedlings in trays before moving them to channels for continuous root nutrition. Compared to soil cultivation, they provide consistent nutrients, optimal spacing, and stable conditions that encourage superior vegetative development and quicker harvests. The strength of nutrient solutions has a direct effect on fresh biomass, tillering, height, and leaf number, highlighting the necessity of efficient management to optimize yields. Vigorous, soilless-adapted cultivars are perfect for hydroponics, particularly the "Tokio Kuro" cultivar, which exhibits outstanding adaptation, robust growth, and consistent performance.

Seedling Production and Growing Media

Growing strong, vigorous seedlings is the first step towards successful hydroponic green onion production. Use plug trays or pro-trays that are filled with a sterile, lightweight material such as perlite, vermiculite, cocopeat, or their mixtures to plant seeds. These components guarantee uniform germination support, regulated moisture, and superior aeration. Strong roots and shoots can be encouraged by raising seedlings in regulated

conditions with enough light, warmth, and humidity. They are ready for transplantation into hydroponic channels once they have three to four true leaves and strong roots after eighteen to twenty-five days. To avoid damaging them, handle roots carefully while transferring them to net pots or holders. Strong seedlings adapt to the nutritional solution fast, which leads to uniform establishment, speedy development, and higher yields.

Nutrient and Environmental Management

In hydroponic green onion (*Allium cepa*) cultivation using a DeepWater Culture (DWC) system integrated with the Smart Hydro Kit, precise control of nutrients and environmental factors optimised growth and yield. The nutrient solution maintained a pH of 6.0-6.4, EC of 1-2.2 mS/cm, and TDS of 600-750 mg/L; levels below 600 mg/L prompted nutrient additions, while those above 750 mg/L required dilution with water. The N-P-K ratio started at 10-20-10 and shifted to 20-5-5 in later stages, supplemented by sulfur and magnesium. Environmental conditions included temperatures of 29-32°C, humidity of 64-72%, CO₂ below 900 ppm, and oxygen above 19% to support root respiration. These optimized parameters enabled faster sprouting (3-4 days), earlier bulb formation (28-32 days), longer shoots (21.5 cm), extended roots (15 cm), higher fresh biomass (2.376 ton/ha), greater dry yield (1.191 ton/ha), and superior ET water productivity (0.71 kg/m³) compared to soil-based methods-highlighting the benefits of controlled hydroponic management. (Dutta *et al.*,2025).

Pest & Disease Control:

Compared to soil-based approaches, hydroponic gardening significantly reduces the incidence of pests and diseases since it completely avoids soil, which means that the majority of soil-borne pathogens and weeds are eliminated. The hydroponic system did not contain any weeds, according to the study. Additionally, growing plants indoors or in semi-controlled environments lessens their exposure to external pests. Root illnesses associated with low oxygen levels are prevented by adequate oxygenation of the nutrient solution, and nutrient deficits that could cause physiological problems are avoided by continuous pH and EC monitoring. As a result, hydroponic green onions demonstrated better shoot length (21.5 cm vs. 16 cm in soil) and root growth (15 cm vs. 7 cm in soil), using far fewer chemical pesticides.

Harvesting, Yield and Economics

In a DeepWater Culture (DWC) hydroponic setup for green onions (*Allium cepa*), plants reached harvest sooner, thanks to fast germination in just 3-4 days versus around 15 days in soil, and bulb development by 28-32 days, supporting faster crop rotations. Optimised nutrients and environment drove better growth metrics: shoots averaged 21.5 cm and roots 15 cm in hydroponics, outperforming soil's 16 cm shoots and 7 cm roots. Yields excelled too, with fresh biomass at 2.376 t/ha, dry matter at 1.191 t/ha, and evapotranspiration water productivity at 0.71 kg/m³, highlighting strong resource efficiency. Economically, upfront costs for equipment like tanks, pumps, and sensors are needed, but benefits outweigh them: no weeds, minimal pesticides from lacking soil pathogens, cut labour, water savings, and short 30-day cycles for several harvests yearly, boosting net profits.

Conclusion

Green onions (*Allium fistulosum* L. and *Allium cepa* L.) can be grown hydroponically, which is a very effective, sustainable, and profitable substitute for traditional soil farming. This technique guarantees faster growth, larger yields, and superior water productivity through accurate nutrient management, regulated environmental conditions, and low occurrence of pests and diseases. Optimized parameters lower labor expenses and chemical inputs while increasing crop quality and biomass production. Despite the higher initial setup costs, hydroponic green onion growing is a promising paradigm for urban and peri-urban agriculture since it can produce year-round, have numerous harvests, and improve resource use efficiency.

Summary

Hydroponic growing of green onions (*Allium cepa* and *Allium fistulosum*) offers a highly efficient, sustainable option compared to traditional soil farming. It provides exact nutrient control, stable environments, and fewer pests and diseases without needing soil. Key optimized conditions pH (6.0-6.4), EC (1-2.2 mS/cm), TDS (600-750 mg/L), temperature (29-32°C), and humidity (64-72%) led to quick sprouting (3-4 days), early bulb development (28-32 days), better shoot length (21.5 cm) and root growth (15 cm), increased fresh biomass (2.376 t/ha), higher dry yield (1.191 t/ha), and superior water efficiency (0.71 kg/m³). No weeds and fewer soil-related illnesses cut pesticide needs and labour expenses, while faster cycles allow several harvests annually. Despite upfront costs for setup, the boosted yields, quality, and resource efficiency render hydroponic green onion production profitable and eco-friendly, especially for urban and suburban setups.

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