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HYDROPONICS PRODUCTION OF ITALIAN BASIL CROP

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Introduction

Today, Basil (*Ocimum basilicum*) grows in many places around the world. Many people even grow basil in their kitchens or gardens. This fragrant herb is used as a seasoning in a variety of dishes, and plays a key role in Italian and Thai cuisine. Originally native to India, Asia, and Africa, basil was held to be a sacred and noble herb. In fact, the word "basil" comes from the ancient Greek "basilikhon" which means "royal" plant. There are more than 60 varieties of basil, with sweet basil being one of the most widely used. The herb has rounded leaves that are often pointed. It's a bright green plant, although some varieties have hints of purple or red in their leaves. Sweet basil has a very strong smell and a recognizable flavor. Different varieties of basil offer slightly different flavors. For instance, lemon basil has a tangy lemon taste, while mint basil has a refreshing minty taste.

In India, Basil is cultivated over an area of 25,000 ha and it accounts for annual production of about 250- 300 tonnes of oil. Many species of Ocimum contain various economically important essential oils used in perfumery and cosmetics industries. The major constituents in Ocimum oils include linalool, geraniol, citral, camphor, eugenol, methyl chavicol, safrol, thymol, methyl cinnamate etc. Ocimum species are used as herbs and find diverse uses in the indigenous systems of medicine in countries like India, Africa, Arabia, Australia, Malaya, pacific islands and Sri Lanka. The oil of certain species of Ocimum has the antifungal, bactericidal and insecticidal properties too as the demand for our aromatic industry is growing high, concerns are raising over the improved production and quality of raw materials used.

Basil is an herb in the mint family. It adds flavor to meals, and its nutrients may

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provide health benefits. Scientific name: Ocimum basilicum (sweet basil) Indian variety: holy basil Ocimum sanctum also known as Tulsi. Provide vitamins, minerals, and a range of antioxidants. Essential oil may also have medicinal benefits. It is rich in secondary metabolites and essential oils. Safe to use, economical, effective and easy availability. O. sanctum is an erect, herbaceous, bi & triennial plant with height upto 30-75 cm. Leaf structure is serrate, pubescent on both sides. Flowers are purplish or crimson. Its fruits are ellipsoid, slightly compressed, pale brown or reddish.

The plant contains mainly phenols, aldehydes, tannins, saponin and fats. The essential oils from Ocimum genus find diverse uses in perfumery and cosmetic industries as well as indigenous systems of medicines. The essential oil components are Eugenol - 71%, Eugenol methyl ether - 20%, Carvacrol - 3% and minor portions - Nerol, Caryophyllene, Selinene, α-pinene, ß-pinene and other chemicals found are Camphor, Cineole, Linalool.

Basil Health Benefits

Basil contains many vitamins and minerals, as well as antioxidants such as lutein, zeaxanthin, beta-carotene, and beta-cryptoxanthin. Many of its health benefits come from these antioxidants, as well as its essential oils. These compounds mostly disappear during the drying process, so opt for fresh basil, when possible, to gain the most benefits.

Antioxidants like flavonoids, polyphenols, and vitamins A and C are rich in basil leaves. Free radicals are neutralized by antioxidants, which reduces oxidative stress and the risk of chronic diseases such as diabetes, heart disease, and cancer. Essential oils, including eugenol, citronellol, and linalool, which have anti-inflammatory properties, are contained in basil. These properties help reduce inflammation in the body, alleviating conditions like arthritis and inflammatory bowel disease, and promoting overall joint and muscle health. Supports digestive health. Basil leaves contain eugenol, which can help balance acid within the stomach and improve digestive function. Improved digestion can prevent issues like bloating, acid reflux, and constipation, ensuring better nutrient absorption and gut health. The essential oils in basil have antibacterial properties that can inhibit the growth of harmful bacteria. Consuming basil can help protect against bacterial infections, promoting overall health and reducing the risk of illness. Basil is adaptogenic, helping the body manage stress and anxiety. Regular consumption can improve mood, reduce stress levels, and enhance mental clarity and focus, contributing to better mental health. Promotes

heart health with basil, which is rich in magnesium and beta-carotene, which support cardiovascular health. These nutrients help regulate blood pressure, reduce cholesterol levels, and improve overall heart function, reducing the risk of cardiovascular diseases. Basil contains vitamins A, C, and E, along with other immune-boosting compounds. These nutrients strengthen the immune system, enhancing the body's ability to fight off infections and diseases.

Anti-cancer properties in basil: the antioxidants and phytochemicals in basil can help protect cells from damage and inhibit the growth of cancer cells. Regular consumption may reduce the risk of various cancers by protecting DNA and reducing the proliferation of malignant cells. Maintains skin health with basil; it contains antibacterial and anti-inflammatory properties that help clear skin infections and reduce acne. Consuming basil can improve skin health, leading to clearer, more radiant skin and reducing the incidence of skin issues. Basil has compounds that can help regulate blood sugar levels by improving insulin function. This helps manage diabetes and reduces the risk of blood sugar spikes, contributing to overall metabolic health. And the important uses of basil: Tribals use the plant in cholera, cough, postnatal complaints, hemorrhagic septicemia, and dog bites. The volatile oil possesses antibacterial and insecticidal properties. It inhibits the in vitro growth of Mycobacterium tuberculosis and Micrococcus pyrognes var. aureus. It has marked insecticidal activity against mosquitoes.

Keeping the above points in mind, here explained the best growing of exotic Italian Basil crop in soil less cultivation method.

Raising of nursery

For growing of nursery, proportion of 60% cocopeat, 20% perlite and 20% vermiculite is mixed thoroughly. The plug trays having 105 cells of size 2.7 cm in diameter and 3.37 cm depth used to grow nursery **Fig.1**. These trays were filled with the premixed cocopeat upto 1½ inches. The sowing was done by placing each seed in a hole at a depth of 0.5 cm and covered with thin layer of cocopeat/growing medium. The trays were watered lightly and placed in a sheltered place. The plastic sheet was covered on the trays up to 3 days **Fig.2**, after 3 days the plastic cover is removed and water is sprayed with spray cans in the morning/ evening daily without disturbing the seed. Different stages of nursery was shown in **Fig. 3 to 6**. For growing seedlings in rockwool, rockwool is to soaked for 5 min. The surplus water from the rock wool was drained and then placed on portrays. The seeds were placed in the centre of the rock wool. The seedlings were kept damp condition at room temperature in the germinating area.

The temperature around the seedlings was kept at least 13-21 °C at night and up to 25 °C during the day.

Spray cans were used to spray water. The trays were then removed from room after three days and kept in a polyhouse.

Fig.1 Filling of portrays for nursery

Fig.2 Covering with plastic cover

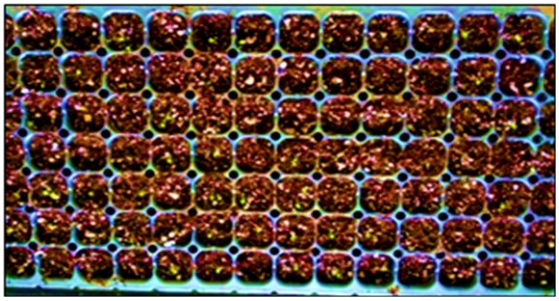

Fig.3 After 3 days of sowing

Fig.4 After 5 days of sowing

Fig.5 After 1 week of sowing

Fig.6 After 10 days of sowing

Fig.7 Basil after 15 days of sowing

Nutrient solution for nursery

For making the nursery's nutrition solution, 5 mL of stock solution "A" and 5 mL of stock solution "B" were put into a bucket containing 1 L of water and mixed thoroughly. After 10-15 min the pH of solution was checked, and adjusted to 5.5 to 6.5. If pH is at higher side, added pH downsolution drop by drop. After one week, the nutrients solution was sprayed until the plant roots reach the bottom of the cube in about fifteen days. The seedlings were ready for transplanting 15 days after sowing as shown in **Fig.7.**

Transplantation of nursery into NFT channels

Before transplantation, basil seedlings were allowed to reach a height of at least 3 inches. Basil seedlings were ready for transfer after 15 days. The germinated seedlings were transplanted into hydroponic A-frame along with net cups were placed in the platform where thin film of various nutrient solution circulates.

The net cups were filled with media (Rock wool, clay ball, perlite and vermiculite) was around the seedling. The plants within net cups that were inserted into the NFT channels as shown in **Fig.8**.

Nutrient Film Technique (NFT)

The reservoir (tank) was placed at the bottom of the A-frame (**Fig.9),** connected to the top of the rectangular channels by a pump. The nutrient solution was pumped up from the reservoir to the top channel of the frame with 0.1 hp electric pump. The channels were sloped slightly in zig-zag manner and all channels were connected at the ends so that the nutrient water flows from top channel to the bottom channel. The nutrient solution flows from one side to another side of channel, the surplus nutrient solution will stream/flow out of this pipe and move into bottom channel or tube, and finally to the solution tank/reservoir where it is recirculated through the system again. The plants were transplanted in net cups with growing media into holes provided in the

Fig.8 Plant supported with media in net cups and transplantation in NFT channel

top of the tube (growing channels). The roots of the plants were suspended down to the channel where they make contact with the shallow film of the nutrient solution. The shallow film of the nutrient solution allows the plants to absorb nutrients and have access to oxygen in the air without being water logged.

The shallow nutrient solution flows all the way through each of the channel having plants in it to the other side, passing by each plant and wetting the roots on the bottom of the channel.

After completion of each season crop, NFT channels were cleaned to prevent any

Fig.9 A-frame Nutrient Film Technique system and after transplantation of Basil crop

Fig.10 Plant height after 10 days

Fig.11 Plant height after 20 days

pathogens moving on to next crop. For cleaning the channels, make up mixture of water with a half cup of bleach was added to kill organisms and then rinsed with fresh water. Cleaning the channels will not transport bacteria or pathogens from one crop to the next.

Fig.12 Plant height after 30 days

The 10, 20, 30 days after transplantation (DAT) **Fig.10,11 and 12.** The observations such as plant height, number of leaves, number of branches per plant, stem diameter, and root lenth.

Basil leaves cutting

Leaves were cut middle of the plant shown in **Fig.13**. Leaves were separated from stem shown in **Fig.14**.

Basil leaves were harvested by tipping, *i.e.,* plucking out the growing points of the shoots throughout the growing season, but as soon as the plant starts to flower, it should be cut back to approximately 150 mm above the medium level, after which it will again form branches and leaves.

Fig.13 Cutting of Basil crop

Fig.14 basil leaves separated from stem

Baisil crop grown in this way is pure with no pesticides, chemicals and rich in nutrients and phenolic compounds. This is useful for therapeutic potentials. Basil can be consumed either directly as wet or dry leaf. Basil powder can be consumed with hot water or hot milk for digestion and immunity. It is used widely as a flavouring confectionary, baked foods and meat products, culinary and an ornamental herb. Used in both Unani and Ayurvedic system of medicine. Rich and spicy, mildly peppery flavour with a trace of mint and clove.