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Original article**Package of Practices for Soil Health Management in Vegetable Crops through Organic Nutrients in Sikkim****Shaon Kumar Das*, Tshering Lhamu Bhutia and Sudip Kumar Dutta***ICAR RC for NEH Region, Sikkim Centre, Gangtok, Sikkim (737102), India***Corresponding Author: shaon.iari@gmail.com**Received: 27/02/2025**Published: 02/03/2025***ABSTRACT**

Okra can be cultivated in a variety of soil types, including clay and sandy loam. High yields, however, can be achieved in fertile, loose, friable loam soils with improved drainage and irrigation capabilities. Okra should be planted in an area that is high in organic matter. In areas where rainfall is guaranteed, green manuring can be carried out. The amount of nitrogen, phosphorus, and potassium that potato need depends on the type of soil, nutrient status, variety, cropping pattern, and fertiliser sources. Tomato lengthy manufacturing mechanism and quick growth make them "heavy feeders." During the fruit formation stage, a 0.2-0.4 percent borax spray aids in healthy fruit development. Baby corn can be grown in soils that are suitable for growing regular maize. From the seedling stage to the grain filling stage, baby corn needs a controlled and guaranteed supply of nutrients, especially N. Chayote grows well in a range of soil types, from heavy clay to sandy loam. It is advised to use FYM or compost at the base. Seven to eight weeks after planting, and then every three months after that, side-dress each plant with 2-4 kg of FYM or compost. Additionally, a variety of soil types can be used to grow broccoli. Soils ought to be suitably fertile and well-drained. In the final field preparation, it is often advised to apply 150 kg of rock phosphate and 10 tonnes of FYM or vermicompost at a rate of 5 t/ha in order to harvest a productive crop of leafy mustard.

Keywords: Okra, Potato, Tomato, Leavy vegetables, Cole crops, Leavy mustard, Organic, Sikkim

INTRODUCTION

Due to their high vitamin and fibre content, vegetables are a vital component of a balanced diet. They can enhance gut health, reduce the risk of heart disease, and aid with weight management. Fresh and edible parts of herbaceous plants, vegetables are a good source of vitamins, minerals, dietary fibre, and antioxidants. The WHO advised consuming about 400 g of fruits and vegetables daily, and they are low in fat, sugar, and sodium ions. In addition to having several mineral nutrients including potassium, dietary fibre, folic acid, vitamin A, and vitamin C, most vegetables are low in fat and calories. Foods high in potassium, including spinach, kidney beans, soybeans, lima beans, sweet potatoes, white potatoes, white beans, tomato products, beet greens and lentils, aid to keep

blood pressure in a healthy range. Vegetable dietary fibre lowers the risk of cardiovascular disease and lowers blood cholesterol levels. Vitamin C helps heal cuts and wounds, maintains healthy teeth and gums, and helps absorb iron. Vitamin A-rich vegetables help keep eyes and skin healthy and help prevent infections.

1. Okra (*Abelmoschus esculentus* Moench.)

Okra is a significant vegetable crop that can be canned, dried, and used in soups, curries, and stews with meat. The pods are a good source of vitamin A and flavonoid antioxidants such as lutein, xanthin, and beta carotenes. Niacin, vitamin B (pyridoxine), thiamin, and pantothenic acid are among the B-complex vitamins that are abundant in okra.

Soil requirement

Any type of soil, from clay to sandy loam, can be used to cultivate okra. However, loose, friable, fertile loam soils with improved drainage and irrigation capabilities can produce large harvests. Plants may drown (have low oxygen) in poorly drained soils. Okra grows well in slightly acidic soils (pH 5.8 to 6.5). Since most Sikkim soils are acidic, it is advised to apply lime or dolomite at a rate of 200g/m² every other year to keep the pH stable. Since seedlings have trouble emerging on clay soils, transplanting is advised. Compaction of the soil can significantly limit plant growth, and okra is quite susceptible to hard pan soils.

Organic nutrient management

Organic matter should be abundant at the location chosen for okra planting. In areas with guaranteed rainfall, green manuring can be carried out. Generally speaking, okra grows well in both rainfed and irrigated locations when manure and biofertilizer are used. Okra has a lengthy fruiting season, so during field preparation, 15 to 20 t/ha farmyard manure should be applied together with 200 g/m² of neem cake. Spread the FYM/biofertilizer equally across the planting area and thoroughly mix it into the top three to four inches of soil. Azospirillum + PSB culture (2.0 percent) should be applied to seedlings for 15 minutes prior to transplantation under transplant conditions. After one month of planting, vermicompost at a rate of 1 kg/m² is added, which enhances okra growth and yield (Das et al., 2018).

2. Potato (*Solanum tuberosum* L.)

The most significant vegetable food is the potato (*Solanum tuberosum* L.). It offers a variety of B-group vitamins, minerals, proteins, carbs, vitamin C, and high-quality dietary fibre. On a fresh weight basis, they are composed of 20.6 percent carbs, 2.1 percent protein, 0.3 percent fat, 1.1 percent crude fibre, and 0.9 percent ash. Leucine, tryptophan, and isoleucine are among the necessary amino acids that are present in good amounts in them.

Soil requirement

A variety of soil types, including sandy loam, silt loam, and loam, can be used to grow potatoes. Potato soil should be rich in organic content, friable, well-aerated, and reasonably deep. Potatoes grow best on well-drained, sandy loam and medium loam soils that are high in humus. The quality of the tuber is significantly impacted by the texture and structure of the soil. Because they tend to encourage more consistent soil temperatures and facilitate crop harvesting, light soils are

recommended. Potatoes cannot be grown in saline or alkaline soils. Acidic soils (pH 5.0 to 6.5) are ideal for potatoes because they prevent scab disease. In order to avoid the need for pre-sowing irrigation, sufficient moisture must be present at the time of sowing. When field preparation is underway, FYM should be applied at a rate of 20–25 t/ha or 2-2.5 kg/sq m (Das 2014).

Organic nutrient management

The type of soil, nutritional status, variety, cropping pattern, and nutrient sources all affect the amount of nitrogen, phosphorus, and potassium that potatoes need. According to reports, 20.7 percent of the elements that contribute to yield in potatoes are directly related to good soil fertility management. During land preparation, apply well-decomposed and dried FYM or compost at 25–30 t/ha, vermicompost at 5-10 t/ha, and neem cake at 2 t/ha.

3. Tomato (*Lycopersicon esculentum*)

The most significant and lucrative vegetable crop is the tomato (*Lycopersicon esculentum*), which has a high nutritional value and is an excellent source of vitamins and minerals. Either fresh or cooked fruits are consumed. Large amounts of tomatoes are used to make paste, powder, ketchup, puree, soup, and juice.

Soil requirement

Although tomatoes can be produced in a variety of soil types, including heavy clay and sandy loam, all ideal tomato soils need to have enough drainage. A successful tomato harvest requires a well-drained, somewhat light, fertile loam with a fair capacity to hold moisture. The most important factor is the soil's good texture. If properly maintained, even medium- and poor-quality land yields a good early crop. The ideal pH range for tomato crops is between 6.0 and 7.0, however they can also withstand somewhat saline and acidic soil. Liming works well on acidic soils. Due to the acidic nature of Sikkim soils, dolomite addition at a rate of 200 g/sq m is advised for improved crop quality.

Organic nutrient management

Tomatoes are referred to as "heavy feeders" due of their lengthy production cycle and quick development. Given their somewhat high nutritional requirements, tomatoes respond well to fertiliser additions. Biofertilizers are a natural source of plant nutrients that boost productivity in addition to being crucial for preserving the health of plants. In addition to applying neem cake at 200 g/sq m, FYM should be applied at 4 to 8 kg/sq m (Reza, S. K. 2014. Pers. Communication). Azospirillum + PSB (2 percent) should be applied to seedlings for 15 minutes prior to planting. Production is further enhanced by the addition of vermicompost at a rate of 1 kg/sq m. Zinc and boron are crucial micronutrients for tomatoes. Borax is used to apply boron to soil at a rate of 20-25 kg/ha. Proper fruit development is aided by spraying 0.2-0.4 percent borax during the fruit formation stage. When there is a zinc shortage, well-decomposed FYM should be combined with water-soluble organic granules called Bio-zinc, which should then be applied to the soil at a rate of 5 kg/ha.

4. Baby corn (*Zea mays*)

A type of maize called baby corn is cultivated for use in vegetable soups and salads. Shortly after or before silk appears, the immature, finger-like ears are picked. It has a high phosphorus

concentration (197.89 mg/100 g) compared to other popular vegetables that have a phosphorus content of 21-57 mg/100 g. It is a visually appealing vegetable that is low in calories, high in fibre, and cholesterol-free.

Soil requirement

Baby maize can be grown in soils that are suitable for growing regular maize. The optimum soil for baby corn is clay loam to sandy loam, but it needs to be well-drained, well-aerated, have enough organic matter, and be well-supplied with nutrients. The optimal pH range for its cultivation is between 5.5 and 7.5. Soils that are extremely acidic or alkaline are not good for growing baby maize.

Organic nutrient management

Vermicompost, biofertilizers, farmyard manure and various oil cakes are all crucial to the development of baby maize as nutritional supplements. Green manuring options for integrated nutrition supplementation in the organic production system include Tephrosia, Leucaena leucocephala (subabul), Fagopyrum spp. (buckwheat), Vigna umbellata (rice bean), Sesbania aculeata (dhaincha), and Crotalaria juncea (sun hemp). From the seedling stage to the grain filling stage, baby maize needs a controlled and guaranteed supply of nutrients, especially N. Phosphorus solubilising bacteria (PSB) at a rate of 20 g/kg seed and N-fixing nonsymbiotic microorganisms such as Azospirillum and Azotobacter, among others, should be added to baby maize. Apply well-decomposed FYM at a rate of 10–15 t/ha 20 days before to crop sowing. In the organic farming system, crop residue management can also be utilised for nutrient purposes. It is advised to apply 2 t/ha of dolomite to elevate the pH of the soil to 6.0 (Das and Avasthe 2017).

5. Chayote (*Sechium edule* (Jacq.) Sw.)

Because it is a great source of minerals, dietary fibre, protein, vitamins, carotenoids, polysaccharides, phenolic and flavonoid compounds, and other nutrients, chayote (*Sechium edule*) is used in the food, cosmetic, and pharmaceutical sectors. Immature fruit is consumed raw, steamed, stir-fried, boiled, baked, pickled, or curried; tender branches, leaves, and tendrils are consumed boiled or stir-fried.

Soil requirement

Chayote grows well in a range of soil types, from heavy clay to sandy loam. However, the optimum soil for producing high-quality fruits is sandy loam soil that drains well and has a decent capacity to hold moisture. It is planted in elevated hills or mounds in regions with high rainfall. The ideal pH range for the plant is 5.5 to 6.5. Shallow soils are less able to hold water and restrict root growth, which makes plants and crops smaller.

Organic nutrient management

The crop benefits from organic fertilisers. It is advised to use FYM or compost at the base. Seven to eight weeks after planting, and then every three months after that, side-dress each plant with 2-4 kg of FYM or compost. Vermi-waste, biodynamic liquid manure, green manure, etc., should be used to meet the extra nutritional requirement. In a 150-day growing cycle, chayote was shown to extract the following nutrients from soil in Brazil: N-20, P-3.5, K-5.5, Ca-122.7, and Mg-4 pounds per acre. Chayote was shown to absorb the most potassium between 150 and 165 days after planting, and

the most nitrogen and phosphorus between 105 and 135 days throughout a 200-day growing season.

Chayote extracted 48 pounds of nitrogen, 9.5 pounds of phosphorus, and 10 pounds of calcium per acre over the 200-day growth cycle. As a result, getting the best yield requires proper nutrient management (Das and Avasthe 2018).

6. Cole crops (*Brassica* spp.)

Mustard greens, crucifer greens, collards, kale, and cabbage are all considered brassica/cole crops. Vegetables that grow best in temperatures between 15 and 20 degrees Celsius are known as cool-season crops. Temperatures above this cause crops to lose quality.

Soil requirement

Cole crops grow best on deep, well-drained loamy soil that has a pH of 5.5 to 6.5 and sufficient organic matter (>2.0 percent). But it can also be cultivated in acidic soils by using dolomite at a rate of 1-2 t/ha to recover acidic soils. A variety of soil types, from heavy clay loams to light sandy loams, can be used to grow cabbage. It can tolerate a pH as low as 5.5 with some degree of tolerance. Although sandy loam soil is thought to be the ideal, cauliflower may be produced in a variety of cultivable soil types, with the exception of swampy lands. The output from clay soil is relatively lower. The soil needs to be well-drained, rich in organic matter, and productive. For early cauliflower, medium-to-heavy soils work best because they are cool and hold onto moisture well.

The ideal pH range for soil is 6 to 7. Dolomite at a rate of 2 t/ha should be administered at least one month prior to transplanting if the pH of the soil is less than 5.5. Additionally, a variety of soil types can be used to grow broccoli. Soils ought to be suitably fertile and well-drained. Deep, loamy soil is ideal for the crop. For proper and quick growth, it needs wet soil. In dry soil, the shoots get more fibrous. Although it can tolerate some acidity, 5.0 to 6.5 pH is the ideal range for growing it (Das et al., 2020).

Organic nutrient management

Cole crops have a somewhat high fertiliser need and respond well to external nutrient administration. At the time of final land preparation, apply 1.5–2.0 kg/sq. m of well-decomposed FYM or compost and 200 g/sq. m of neem cake. When planting, seedlings' roots should be soaked in 20% Azospirillum + PSB for 15 minutes. The yield of cole crops is further enhanced by the addition of vermicompost at a rate of 1 kg/sq. m. It is advised to apply 25–30 kg N/ha, 50–75 kg P/ha, and 25–30 kg K/ha using water-soluble granules derived from plant extracts at the time of transplanting.

7. Leafy mustard (*Brassica juncea* var. *rugosa*)

The broad, deep green colour of mustard greens is accompanied by chemicals that have anti-inflammatory, antioxidant, cancer-preventive, and natural detoxifying qualities. Depending on their ripeness, mustard greens can be utilised in both raw and cooked recipes.

Soil requirement

Although a variety of soil types, including clay loam and sandy loam, are appropriate, light loam soils with a pH range of 5.5 to 7 are ideal for Raya saag growth and development. They are unable to grow on thick soils or under conditions of water logging.

Organic nutrient management

It is often advised to apply 150 kg of rock phosphate and 10 tonnes of FYM or vermicompost at a rate of 5 t/ha during the final field preparation in order to obtain a productive crop of leafy mustard. The soil should be treated with FYM, compost, green manure (*Sesbania aculeata*), and other animal wastes ten to fifteen days before transplantation. Using *Azotobacter* or *Azospirillum* can save 20–30 kg of nitrogen per hectare. Applying various kinds of oil cakes at a rate of 0.5 to 1.0 t/ha will satisfy the crop's needs for sulphur and micronutrients.

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