

islands. The harvesting can be done in evening hours but early morning harvesting is not suggested as presence of dew on leaves which encourage breakage of leaves.

The crop becomes ready for first cutting in about 3-4 weeks after sowing. Only well grown, green succulent and tender leaves should be trimmed at the height of 5-7 cm above the ground. Subsequent cuttings can be done at tile interval of 15-18 days depending upon the variety. For multi-cutting, harvest the leaves except baby leaf when plants have five or six leaves or for higher yields the harvest can be delayed until plants have 10 to 12 leaves. The average yield of edible green material is about 9-12 tones per hectare with single harvest while 28 to 35 tones with multi-cuttings.



Harvesting of healthy leaves and preparing for market

Marketing

After harvesting, the diseased and pale leaves are discarded and healthy succulent leaves are bundled in bunches of convenient sizes or market preferences. The size of bundles can be 1 kg, 500g and 250 g for different group of consumers. They are put in wooden baskets and taken to the local market or transported through ship. For local market the leaves should preferably be harvested immediately. It is not possible to store the green leaves under ordinary conditions for more than few hours.

Crop protection from heavy rains

The rainshelter technology has great promise for palak cultivation during rainy season when open cultivation is not possible due to heavy rains. These



Low cost structures for palak cultivation

structures are made up of agro-shadenet (50%) and top is covered with Ultra-violet (UV) stabilized polysheet (200 micron). The frame of the structure can be prepared from Galvanized (GI) pipe or local wooden materials like bamboo, arecanut or others.

Crop diversification

The palak is high value, nutrient rich and early crop with high remunerative potential than any other leafy vegetable in islands. The investigations showed encouraging results for intercropping of palak in coconut plantations at farmers field in South Andaman. This component added around Rs. 21000/acre/2 months from coconut plantation. Therefore, farmers can diversify their plantation based farming system with palak as a component for higher returns.



Palak as intercrop in coconut



Palak as intercrop in cucurbits

Disease and pest

Damping-off (*Pythium* spp. and *Rhizoctonia solani*)

It mostly occurs at seeding and in post emergence stage. They primarily cause is a pre-emergence rot of seeds and seedlings, but if soils are very moist, then post-emergence rot of roots, stems and leaves can occur. For this use fresh seeds, follow crop rotation and use bavistin @ 2g/lit for soil drenching or sprinkling during early crop stage. Besides, soil solarisation during March-April months also help in reducing the pathogen inoculum the field.

Anthraxnose (*Colletotrichum dematium*)

Fall plantings are more susceptible to this disease, which is favored by wet conditions and cooler temperatures. It has many alternate host in islands and infect palak in open conditions. The incidence spread with rain splash which spreads spores to healthy plants. Symptoms of this disease are small, round, water-soaked spots on leaves. These spots develop into larger yellow or tan areas with distinct margins that coalesce to form brown lesions that become thin and dry like paper. Tiny black fruiting bodies on diseased tissue

distinguish this pathogen from other leaf spot pathogens. Maintain proper spacing, follow crop rotation, use healthy seeds and possibly spray carbendazim @ 2 g/lit water at time of initial symptoms.

Insect management

Palak crop is infested with aphid, leaf minor, leaf eating caterpillar and leaf hopper. It can infect crop right from seedling to harvest stage and deteriorate quality and yield of palak leaves. Use of insect proof nets and spray of neem based biopesticides are suggested to check the infestation.

Economics

The palak cultivation is very remunerative enterprise in islands as its open cultivation during dry months yield around 10.5 t/ha which give net returns of Rs. 150000 (the price of the palak is Rs. 15/kg is taken for calculation). The first step intervention in terms of intercropping of palak in coconut plantations generates additional net income of around Rs. 190000. The second step intervention in form of adoption of rainshelter technology gave opportunity to grow round the year palak. With this technology, around 9-10 crops can be harvested which yield around 80 tones in one hectare area plot. The economic analysis of cost and returns shows that palak cultivation in rainshelter provides net returns of Rs. 690000 in one year period. If prices go up for palak than the net profit from the crop also increases accordingly.

Points to remember

- Prepare the soil properly with adding good amount of organic manures
- Avoid excess nitrogen but give enough for healthy crop
- Avoid excess irrigation or water stagnation and never allow water to touch leaves of palak
- Once disease or pest appears immediately take appropriate measures
- Harvest the crop when it is right stage
- Avoid harvesting in morning hours for long transport



Scientific cultivation of Palak in Bay Islands



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Palak or Spinach beet is botanically known as *Beta vulgaris* var. *bengalensis* and a member of *Chenopodiaceae* family. It is one of the most common leafy vegetables in tropical and subtropical regions including in Andaman and Nicobar Islands. Palak cultivation is most preferred in polyhouse cultivation during rainy season due to high yield and early return. It is rich in many of the dietary micronutrients (calcium and iron) and natural antioxidants (vitamin A, vitamin C and carotenoids). Its leaves are rich in mineral and hence can be called as "Minerals of minerals". Beside this, soft fibrous matter is specially in providing necessary roughage in diet. It performs well in partial shade conditions and suitable as pot herb, therefore, has great potential for island farmers.

Botanically it is a close relative of beetroot but edible portion of palak is the leaf whereas in the case of beetroot, the roots are used as vegetable. The palak is also different from spinach (*Spinacia oleracea* L.) in the sense that the former have succulent leaves with entire margin while the spinach is known as vilayati palak and have lobed leaf margin.

Nutritive value

Palak leaves are rich source of micronutrients and vitamins. It also has high quantity of vitamin A, iron and calcium and 100 g of leaves supply as much of essential amino acids as 100g of any non-vegetarian food like meat and fish. The stages also affect the micronutrient content in palak leaves as iron and manganese content increases with maturity while zinc and copper content decreases. The overall nutritive value of palak leaves is given hereunder:

The nutritive values of palak leaves (100g leaves)

| Sl.No | Nutrients | Palak leaves |
|-------|--------------------------|--------------|
| 1 | Energy (Kcal) | 46.0 |
| 2 | Moisture (%) | 90.7 |
| 3 | Carbohydrate (%) | 6.5 |
| 4 | Protein (%) | 3.4 |
| 5 | Fat (%) | 0.1 |
| 6 | Mineral matter (%) | 0.8 |
| 7 | Fibre (%) | 0.7 |
| 8 | Carbohydrate (%) | 13.6 |
| 9 | Calcium (%) | 380.0 |
| 10 | Phosphorus (%) | 30.0 |
| 11 | Iron(mg/100g) | 16.2 |
| 12 | Vitamin A (IU) | 5862.0 |
| 13 | Vitamin C (mg/100g) | 78.0 |
| 14 | Thaimin (mg/100) | 0.26 |
| 15 | Riboflavin (mg/100) | 0.56 |
| 16 | Nicotinic acid (mg/100g) | 3.3 |

Origin and distribution

Palak is probably the native of Indo-Chinese region. It is grown in most of the states in India, particularly in plains of northern states during winter season but not very popular in South India. It is also grown in all the three districts of the Andaman and Nicobar Islands.

Description of the plant

Palak leaves are green to dark green, large to very large, thick, slightly crinkled or smooth leaves, and tender and juicy, succulent, crispy with entire margin. Some varieties have strong flavour. The leaves can grow to 50 cm length and 20 cm wide. The plant has a moderate deep root system. The stalks resemble those of spinach but are fleshy and whitish green in colour.

Climate

Palak is a winter season crop which also performs well in tropical conditions. It grows well during moderate winter season at temperatures ranging from 17 to 24 °C. At high temperature the plant lead to pre-maturing bolting making the plant unfit for producing edible leaves.

Soil

Palak can grow in any well drained soil provided it is well supplied with organic manure, but loamy to sandy loams are ideal. it can also tolerate moderate alkaline and saline soils, Better quality with high yields are produced in neutral soils having a pH in between 6 and 7. It is extremely susceptible to water logging and poor drainage.

Cultivars

Improved varieties of palak were collected from IARI, New Delhi and evaluated in island conditions. The following three varieties were found to be most suitable for island conditions.

All Green: It produces uniform green tender leaves with 6-7 cuttings at 15-20 days interval in a period of 3-5 months, It yields about 9-12 tonnes/ha.

Pusa Jyoti: Its leaves are very big, succulent, thick and tender leaves with higher content of potash, calcium, sodium, iron and ascorbic acid than All Green. leaves are dark in green colour. It has good regeneration capacity, late bolting. and yield with about 50 tonnes/ha in 6-8 cuttings

Pusa Bharati:It produces green and tender leaves. It has higher vitamin C and β -carotene than Pusa Jyoti. yields about 50 tonnes/ha.

Land preparation

Palak grow well in well fertile and drained soils. For this, 15-20 days before sowing, Farm yard manure or compost applied @ 20-25 tones per hectare

and mix it properly by 2-3 ploughings with desi plough or cultivator or power tiller. Apply vermicompost @ 5 tones per hectare in case of organic production while inorganic sources of N, P and K for non-organic production of palak just before sowing to make it suitable for proper seed germination.

Raised bed technology

The prepared field is then divided into convenient sizes of plots. The beds are raised with of 15-20 cm height and 30 cm width from ground level. The length of beds can be kept as per slope and convenience for proper cultural operation. The furrows around 20-30 cm width are used as irrigation channels. This method is more advantageous than flat plot cultivation as it facilitate mutli-cuttings, superior quality of leaves, proper drainage, save irrigation water and labour, less incidence of diseases and gives high yield.



Flat bed cultivation of palak



Raised bed cultivation of palak

Crop season

The main season of palak in the islands is during dry season (December to March) but it can be cultivated during rainy season as well but crop need some protection from heavy rains. So, palak can grow throughout the year in islands by open (December to March) and protected (May to December) conditions.

Sowing

Sowing is usually done by broadcasting the seeds in the leveled plots or beds. it may also be done in the rows about 15-20 cm apart. Later on thinning can be done to maintain 5-6 cm plant to plant distance within the rows. About 25 to 30 kg of seed will be required for sowing one hectare of field. Sowing depth should be 2-3 cm. Soaking of seeds in water before 24 hours of sowing increase germination percentage. In case of insufficient soil moisture, a light irrigation should be given just after sowing in rows to ensure good germination. The seed germinates in about 8- 10 days if proper soil moisture and temperature are available. Line sowing is better for multi-cutting and proper weeding and intercultural operations in raised bed techniques.

Manures and Fertilizers

To promote quick foliage growth, a high state of soil fertility is required. About 25 tones of farmyard manure per hectare is applied as a basal dressing at the time of land preparation. Besides, 90 kg of nitrogen, 50 kg each of phosphorus and potash doses are suggested for one hectare area for 4-6 cuttings. The complete doses of phosphorus and potash and one-third dose of nitrogenous fertilizers are applied just before sowing and remaining two doses of nitrogenous fertilizers in equal amounts are applied after first and second cuttings. However, organic cultivation is gaining popularity in islands, therefore, chemical fertilizers can be replaced with application of vermicompost or vermiwash.



Irrigation

Palak is a leafy vegetable and moisture status of soil directly affects the yield and quality of palak leaves. In light soils, it is desirable to give irrigation soon after the sowing, but in heavier soils, sowing should be done when enough soil moisture is available. Subsequent irrigations should be given at 2-3 days interval depending upon the soil moisture availability. It should be ensured that the soil does not dry out to less than 50% available water. However, in rainy season the crop does not require irrigation in shadenet while crop needs to be irrigated every 2nd or 3rd day in polyhoues to achieve high yield of quality leaves.

Use of growth hormones

Foliar spray of urea (1.5%) + GA3 (15 ppm) produce large leaves and higher yield and also increase vitamin C and calcium content in the leaves. However, excess or frequent sprays deteriorate the quality and shelf-life leaf.

Intercultural Operation

Regular hoeing and hand weeding should also be done to keep the field free from weeds. Generally 2-3 hoeing cum hand weeding are required to control weeds and maintain proper aeration in the soil. Frequent cleaning and maintenance of furrows with hand hoe is necessary for proper irrigation in raised bed method.

Harvesting and Yield

Among two harvesting methods, the uprooting of entire plant for single harvest crop is common in islands. This method is acceptable for inter-island transport of palak but leaf cut method is very appropriate for local market in