

Cultivation Practices of Underutilized Vegetables Crop: Chinese Cabbage (*Brassica rapa* var. *Pekinensis*)

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Chinese cabbage is an annual or biennial leafy vegetable, although it is generally cultivated as an annual crop for commercial production. Depending on the cultivar and environmental conditions, the crop reaches maturity within 55 to 100 days after sowing. Loose-leaf varieties mature approximately two to three weeks earlier than compact heading types. This vegetable is widely cultivated and consumed throughout East and Southeast Asia due to its pleasant flavor, crisp texture, and high nutritional value. Unlike common cabbage, which develops a round and compact head, Chinese cabbage produces an elongated cylindrical or barrel-shaped head with broad, fleshy white midribs. At maturity, the head becomes firm, although it is comparatively less compact than ordinary cabbage. The outer wrapper leaves are generally light green, while the inner leaves remain creamy white because of natural blanching during head formation.



Origin and Taxonomy

Chinese cabbage is believed to have originated in China. Historical records dating back to the fifth century indicate that this crop likely developed through natural hybridization between Pak choi, which was cultivated in southern China, and turnip, commonly grown in northern China. Experimental breeding studies have supported this theory by successfully reproducing similar hybrids under controlled conditions. The crop possesses a chromosome number of $2n = 20$. Based on head shape and growth habit, Chinese cabbage is classified into three major groups:

1. Cylindrical-headed type (Chihili) – *Brassica rapa* subsp. *pekinensis* var. *cylindrica*, characterized by elongated cylindrical heads.
2. Compact round-headed type (Chefoo) – *Brassica rapa* subsp. *pekinensis* var. *cephalata*, producing dense and rounded heads.
3. Loose-headed type – *Brassica rapa* subsp. *pekinensis* var. *laxa*, which forms open heads with loosely arranged leaves.

Composition and Uses

Chinese cabbage is considered a nutritious leafy vegetable because it contains appreciable amounts of vitamins B1, B2, vitamin C, carotene, minerals, and dietary fiber. Its vitamin C content is higher than that of lettuce. Among the organic acids present, citric acid is the predominant acid contributing to its flavors.

Nutritional Value (Per 100 g Edible Portion)

Component	Amount
Moisture	95.0 g
Protein	1.2 g

Component	Amount
Fat	0.1 g
Carbohydrates	3.0 g
Energy	14 kcal
Calcium	43 mg
Phosphorus	40 mg
Potassium	253 mg
Sodium	23 mg
Iron	0.6 mg
Thiamine	0.05 mg
Riboflavin	0.04 mg
Niacin	0.6 mg
Carotene	126 µg

Climatic Requirements

Chinese cabbage performs best under cool and humid environmental conditions. During the initial vegetative growth stage, the optimum temperature is approximately 20°C, whereas 15°C is considered ideal during head development. Nevertheless, satisfactory growth can be achieved within a temperature range of 12–22°C. Photosynthetic activity is highest at around 25°C during the early stages of head formation. The light compensation point increases as leaf temperature rises, while the light saturation point increases between 15°C and 25°C but declines when temperatures exceed 25°C.

Soil Requirements

Chinese cabbage adapts well to different soil types, ranging from sandy loam to heavy loam. However, deep, fertile, and well-drained soils are preferred because excessive moisture around the roots increases the risk of root rot diseases. The ideal soil pH for cultivation ranges between 5.5 and 7.0. When soil pH falls below 5.5, liming is recommended to improve nutrient availability, particularly calcium, and to reduce the incidence of club root disease. The crop performs best under soil electrical conductivity (EC) of approximately 1.5 dS cm⁻¹.

Cultivated Varieties

In India, Chinese cabbage is mainly cultivated in two forms: leafy (non-heading) and heading types. The leafy cultivars are grown primarily for their tender leaves, whereas the heading cultivars produce compact heads suitable for fresh consumption and marketing.

Open-Pollinated Varieties: Leafy Types

Chinese Sarson No. 1

Chinese Sarson No. 1 is a non-heading variety developed by Punjab Agricultural University, Ludhiana. It possesses field resistance to Alternaria leaf spot and produces broad green leaves with a semi-erect growth habit. The white midrib is thick, succulent, and tender, making it suitable for leafy vegetable production. The first harvest is generally ready about 30 days after transplanting, and the average yield is approximately 40 quintals per hectare.

Palampur Green

Palampur Green was developed by Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur. It is a late-flowering cultivar that bears tender green leaves with creamy white stems. The first cutting can be taken 25–30 days after transplanting, followed by additional harvests at intervals of around 15 days. Under proper crop management, five to six cuttings can be obtained.

Pusa Sag

Pusa Sag is a variety released by the Indian Agricultural Research Institute (IARI), New Delhi through hybridization between Wong Bok (Suttons) and Turnip. The leaves possess a flavour similar to traditional Indian mustard greens, making the variety popular among consumers.

Solan Selection

Developed by Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (Himachal Pradesh), Solan Selection produces smooth, light-green leaves with thick and fleshy petioles. The variety is mainly cultivated as a leafy vegetable because of its good eating quality.

Heading Types

Solan Band Sarson

Solan Band Sarson is a heading variety developed by Dr. Y.S. Parmar University of Horticulture and Forestry, Solan. It produces semi-compact, barrel-shaped heads that are light green in colour. The heads generally measure 20–25 cm in length and 10–15 cm in diameter. Under recommended cultivation practices, the variety yields approximately 350–400 quintals per hectare.

Optike

Optike is an early-maturing hybrid introduced by Bejo Sheetal Seed Private Limited. It develops short, compact, barrel-shaped heads with attractive light-green leaves and vigorous plant growth. The hybrid is known for its excellent taste and tolerance to Fusarium wilt, making it suitable for commercial cultivation.

Sowing Time

The sowing period for Chinese cabbage varies according to climatic conditions.

- In the North Indian plains, seeds are generally sown in nursery beds during September to October, while transplanting is carried out from October to November.
- In hilly regions, sowing and transplanting are usually performed during March and April, when climatic conditions are favourable for crop establishment. Selecting the correct sowing season ensures proper vegetative growth and better head formation.

Raising of Seedlings

Healthy seedlings are essential for obtaining a vigorous crop. Nursery beds may be either raised or flat, depending on seasonal conditions and drainage requirements. Raised nursery beds measuring approximately 300 cm × 100 cm × 20 cm are commonly recommended. The upper layer of the bed should consist of a well-prepared growing medium made by mixing fertile soil, well-decomposed farmyard manure (or compost), and sand in a ratio of 2:1:1. This mixture provides suitable aeration, drainage, and nutrient availability for young seedlings. Seeds are sown in rows spaced 5 cm apart at a depth of approximately 1.5 cm. Adequate irrigation and proper nursery care promote healthy and uniform seedling development.

Seed Rate

The quantity of seed required depends on the method of cultivation.

- Approximately 500 g of seed per hectare is sufficient for raising seedlings intended for transplanting.
- When the crop is established through direct seeding, about 2.5 kg of seed per hectare is required to achieve an optimum plant population.

Using quality seed ensures uniform germination and vigorous crop establishment.

Transplanting

Chinese cabbage can be established either by direct sowing or transplanting. Direct sowing is more commonly adopted for leafy cultivars, whereas heading varieties are generally transplanted to obtain a uniform plant stand. For heading cultivars, row spacing of 30–50 cm and plant spacing of 30–40 cm are commonly followed. A spacing of 30 cm between plants and 40 cm between rows generally produces heads weighing about 1 kg. For cultivars such as Wong Bok, a spacing of 40 cm × 35 cm is



recommended, whereas Michihili performs well at 40 cm × 30 cm, producing heads weighing 1–1.8 kg. When leafy types are directly sown, thinning becomes necessary to maintain the desired plant population. Seedlings are usually thinned at the five- to six-leaf stage, approximately three weeks after sowing, ensuring sufficient space for healthy growth.

Manurial Requirements

Chinese cabbage has a relatively high nutrient requirement compared with many other leafy vegetables. To improve soil fertility and structure, 15–20 tones of well-decomposed farmyard manure (FYM) per hectare should be incorporated into the soil about two to three weeks before transplanting or during land preparation.

The recommended fertilizer dose consists of:

- Nitrogen (N): 125 kg/ha
- Phosphorus (P₂O₅): 75 kg/ha
- Potassium (K₂O): 75 kg/ha

The entire quantity of phosphorus and potassium, along with one-third of the nitrogen, should be applied as a basal dose before planting. The remaining two-thirds of nitrogen should be supplied in two equal split applications: In leafy cultivars, after the second and fourth harvests. In heading cultivars, approximately 30–45 days after transplanting. Balanced nutrient management promotes vigorous vegetative growth, proper head development, and higher marketable yield.

Irrigation Requirements

Chinese cabbage possesses a relatively shallow root system, with most roots concentrated within the upper 30 cm of the soil, although a few roots may extend to depths of 60–70 cm. Because of this shallow rooting habit, the crop requires a continuous and adequate supply of soil moisture throughout its growing period. The first irrigation should be provided immediately after transplanting to ensure successful establishment of the seedlings. Subsequent irrigations are generally given at 10–15 day intervals, depending on soil type, weather conditions, and crop requirements. Maintaining adequate moisture is especially important during the head formation stage. Water stress at this period can delay maturity, reduce head size, and decrease marketable yield. Insufficient irrigation may also lead to physiological disorders such as tip burn, while excessive watering can damage the root system, encourage root rot, and produce loose or poor-quality heads. Therefore, irrigation should be carefully managed to maintain optimum soil moisture without causing waterlogging.

Intercultural Operations

Proper intercultural practices are essential for obtaining healthy plant growth and maximizing crop productivity. These operations mainly involve weed control, soil aeration, and earthing-up, all of which contribute to better root development and nutrient uptake. Weed competition is most severe between two and seven weeks after transplanting. Therefore, the field should be kept free from weeds during this critical period to minimize competition for moisture, nutrients, and sunlight. Generally, two to three hand weeding are sufficient to maintain a clean field, although the exact number depends on weed infestation and local growing conditions. Timely weeding prevents excessive weed growth and promotes vigorous crop development. Earthing-up around the base of the plants is particularly beneficial in early-planted crops. This practice provides better support to the plants, improves soil aeration, encourages healthy root growth, and helps conserve soil moisture.

Harvesting

Chinese cabbage should be harvested when the heads have attained their characteristic size and become firm but before flower stalk initiation. Delayed harvesting may result in bolting, reduced quality, and lower market value. Harvesting is usually carried out manually by cutting the heads at the base using a sharp knife. The damaged outer leaves are removed, and the stem is trimmed neatly to improve appearance and facilitate marketing. To preserve

freshness and quality, harvesting should preferably be carried out during the cooler hours of the day, such as early morning or late evening. Since the heads are tender and easily bruised, they should be handled carefully during harvesting, grading, packing, and transportation. Immediately after harvest, the heads should be cooled as quickly as possible to temperatures close to 0°C. Rapid cooling helps maintain freshness, reduces moisture loss, and extends storage life. In non-heading (leafy) cultivars, harvesting involves removing fully developed leaves individually from the base of the plant without damaging the central growing point. This allows continued production of new leaves for subsequent harvests. Generally, heading varieties are ready for harvest 65–80 days after transplanting, whereas leafy cultivars can be harvested approximately 45–55 days after transplanting.

Yield

The productivity of Chinese cabbage depends on several factors, including the cultivar grown, soil fertility, climatic conditions, irrigation practices, and overall crop management. Under normal cultivation practices, the average yield ranges from 20 to 50 tones per hectare. However, the use of improved hybrid varieties combined with recommended production technologies can substantially increase productivity, with yields reaching up to 100 tones per hectare under favorable conditions. Among the open-pollinated cultivars, Solan Band Sarson, when planted at a spacing of 50 × 50 cm, has been reported to produce head yields ranging from 320 to 418 quintals per hectare. Adoption of improved varieties, balanced nutrient management, efficient irrigation scheduling, timely weed control, and effective pest and disease management all contribute significantly to obtaining higher yields and better-quality produce.

Insect Pests

Diamondback Moth: The diamondback moth is regarded as one of the most destructive insect pests affecting Chinese cabbage and other cruciferous vegetables worldwide. The adult moth is capable of travelling long distances, enabling rapid spread from one field to another. The larval stage is responsible for most of the crop damage. Young caterpillars feed on the green tissues of the leaves, scraping the mesophyll while leaving the opposite epidermis intact. As feeding continues, larger larvae consume extensive portions of the foliage, producing a characteristic skeletonized appearance in which only the veins and midribs remain. Severe infestations reduce the photosynthetic area, weaken plant growth, and lower both yield and market quality.

Management

- Spray 4% Neem Seed Kernel Extract (NSKE) twice at weekly intervals to effectively suppress larval populations.
- Timely monitoring and early control measures help prevent severe infestations and minimize crop losses.

Aphids: Aphids are common sap-sucking insects that attack the tender leaves and developing shoots of Chinese cabbage. They extract plant sap using their piercing mouthparts, causing curling, yellowing, and weakening of the foliage. Heavy infestations can rapidly reduce crop vigour and adversely affect yield. The pest becomes particularly severe under warm weather conditions. Besides direct feeding damage, aphids also act as vectors for several viral diseases, making them economically important pests in Chinese cabbage cultivation.

Management

- Apply two foliar sprays of Dichlorvos at 1 ml per litre of water at weekly intervals to control aphid populations effectively.

Diseases

Club Root: Club root is one of the most serious diseases affecting Chinese cabbage and other cruciferous crops. The disease is caused by a soil-borne pathogen that infects young plants through root hairs or wounds present on roots and stems. Infected plants develop swollen, malformed, and distorted roots, which interfere with the absorption of water and mineral

nutrients. As a result, affected plants become stunted, wilt easily, and often fail to produce marketable heads. The pathogen spreads through contaminated soil, irrigation water, infected seedlings, farm equipment, and even soil attached to workers' footwear. One of its major characteristics is its long survival period, as it can remain viable in soil for many years, even in the absence of host plants.

Management

1. Apply agricultural lime in acidic soils to maintain the soil pH above 5.5, thereby reducing disease incidence.
2. Drench the soil around each plant with Benomyl at 0.1 g active ingredient in 200 ml of water per plant.
3. Alternatively, apply Mancozeb at 3.0 kg active ingredient per hectare or Flusulfamide at 2.4 kg active ingredient per hectare as recommended.

Downy Mildew and Powdery Mildew: Both downy mildew (*Peronospora parasitica*) and powdery mildew (*Erysiphe polygoni*) may infect Chinese cabbage at different stages of crop growth. Although these diseases are comparatively less common under Indian conditions, they may become severe under favourable environmental conditions. Downy mildew causes yellow patches on the upper leaf surface accompanied by greyish fungal growth on the underside of leaves. Powdery mildew appears as white powdery fungal growth on leaves and stems. In mature heads, infections developing within the compact leaves may reduce market quality. Secondary invasion by soft rot bacteria may further increase losses.

Management

- Apply Karathane (0.1%) or suitable sulphur-based fungicides to control powdery mildew.
- Spray Mancozeb (0.2%) for effective management of downy mildew.
- One or two timely fungicide applications are generally sufficient under favourable disease conditions.

Viral Diseases: Several viral diseases affect Chinese cabbage, with Turnip Mosaic Virus (TuMV) being one of the most important. The virus is primarily transmitted by aphids. Infected young plants exhibit stunted growth, mottling, leaf distortion, and poor head development, often making them unsuitable for harvest. Since aphids can transmit the virus quickly while moving between plants, insecticide applications alone cannot completely prevent disease spread.

Management

1. Grow seedlings inside coarse net tunnels during the first 30–40 days after planting to reduce virus infection by limiting aphid entry.
2. Use aluminium reflective mulch, which repels aphids and significantly reduces their population.
3. Protect young plants with cheesecloth or spun-bond sheet tunnels (0.22 mm thickness) for approximately 35–40 days after planting to minimize virus transmission.

Conclusion

Chinese cabbage is an important vegetable crop due to its nutritional benefits, short growing duration, and good market demand. Successful cultivation depends on selecting suitable varieties and adopting proper agronomic practices such as timely sowing, balanced nutrient management, adequate irrigation, weed control, and effective pest and disease management. Following these recommended practices helps improve both the quality and yield of the crop while reducing production losses. Therefore, scientific cultivation and integrated crop management can ensure sustainable production, higher economic returns for farmers, and a consistent supply of nutritious vegetables to consumers.

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