



DEPARTMENT OF AGRICULTURE
BUREAU OF PLANT INDUSTRY

LETTUCE

PRODUCTION GUIDE



Lettuce
Lactuca sativa



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The LETTUCE Plant

Description

Lettuce (*Lactuca sativa*) is an annual plant of the aster or sunflower family (*Asteraceae*) and considered one of the high value commercial crops in the country. It is usually grown as a leaf vegetable with a height up to 30 cm. Lettuce has loose to compact leaves, usually green and red in color but some are variegated and others with yellowish or gold tinge, depending on variety. The plants grow as a rosette of leaves on the ground or on a short stalk. As the plant matures, the leaves increase in number.



Lettuce is a fairly hardy, cool-weather vegetable that thrives when the mean daily temperature is between 60 and 70 degrees F. It should be planted in early spring or late summer. At high temperatures, growth is stunted, the leaves may be bitter and the seedstalk too elongated. Some types and varieties of lettuce withstand heat better than others.

There are five distinct types of lettuce – leaf (also known as loose-leaf), Cos or romaine, crisphead, butterhead and stem (also called asparagus lettuce or celtuce). Leaf lettuce is best adapted to Arkansas conditions and produces crisp leaves loosely arranged on the stalk. Nearly every gardener has at least a short row of lettuce, making it the most widely planted salad vegetable. Cos or romaine forms an upright, elongated head and is an excellent addition to salads and sandwiches. The butterhead varieties are generally small, semi-heading types that have tender, soft leaves and a delicate flavor. Stem lettuce forms an elongated seedstalk used mainly in stewed, creamed and Chinese dishes. Crisphead varieties are the least adapted to Arkansas conditions and require the most care. They are extremely sensitive to heat and rain and must be grown from transplants that are started early.

Origin and major types

The wild predecessor of modern lettuce, *Lactuca serriola* can be seen all over Europe and temperate parts of Asia.

Lettuce was first cultivated in ancient Egypt for the production of oil from its seeds. This plant was probably selectively bred by the Egyptians into a plant grown for its edible leaves, with evidence of its cultivation appearing as early as 2680 BC. Lettuce was considered a sacred plant of the reproduction god Min, and it was carried during his festivals and placed near his images. The plant was thought to help the god "perform the sexual act untiringly." Its use in religious ceremonies resulted in the creation of many images in tombs and wall paintings. The cultivated variety appears to have been about 30 inches (76 cm) tall and resembled a large version of the modern romaine lettuce. These upright lettuces were developed by the Egyptians. It spread to the Greek then Romans where it was named "lactuca" then termed lettuce in English. Circa 50 AD, Roman agriculturalist Columella described several lettuce varieties- some of which may have been ancestors of today's lettuces.

Lettuce appears in many medieval writings, especially as a medicinal herb. Hildegard of Bingen mentioned it in her writings on medicinal herbs between 1098 and 1179, and many early herbals also describe its uses. Lettuce was first brought to the Americas from Europe by Christopher Columbus in the late 15th century. Between the late 16th century and the early 18th

century, many varieties were developed in Europe, particularly Holland. In the 16th to the 18th century, many cultivars were produced and Europe and North America dominated the market. However, in the 1900's the consumption had spread throughout the world.

In 1586, Joachim Camerarius provided descriptions of the three basic modern lettuces: head lettuce, loose-leaf lettuce and romaine or cos lettuce.

Production Trends

The Food and Agriculture (FAO) of the United Nations (UN) estimates that total global commercial production of lettuce was 23.6 million metric tons (mmt) in 2010, harvested from 1.1 million hectares. China led production with 12.6 mmt, just over half the world's total, while the second-ranked U.S. produced 4.0 mmt, accounting for another 17%. Italy, India, and Spain were the other countries with harvests of more than 800,000 metric tons. (FAO tracks statistics for lettuce production together with chicory, which includes both *Cichoriumendivia* L. (endive) and *Cichoriumintybus*, chicory - both of which are used as salad greens).

In the Philippines, lettuce is predominantly grown in Benguet, Bukidnon and Cavite (Tagaytay). The production in the Cordillera region in 2010 was 1,486.15 MT from a production area of 160 hectares and the country had produced 3,634.12 MT from 465.98 hectares (BAS, 2010).

Nutritional Values

Iceberg and Romaine lettuce are both great choices when it comes to calories - both have less than 10 calories per cup of fresh leaves. They're also well-suited for both low-fat and low-carb diets. But when it comes down to total nutritional value, Romaine lettuce is probably the better choice. Romaine lettuce has darker green leaves -- the deeper the color the better the nutrition. Romaine lettuce has more folate, vitamin K and lutein than iceberg lettuce.

One cup of lettuce has:

Nutrient	Iceberg Lettuce	Romaine Lettuce
calories	8.0	8.0
protein	0.5gram	0.58 gram
fiber	0.7gram	1.0gram
calcium	10 milligrams	16 milligrams
potassium	78 milligrams	116 milligrams
vitamin C	1.5 milligrams	11.3 milligrams
folate	16 micrograms	64 micrograms
vitamin K	13.3 micrograms	48.2 micrograms
beta carotene	164 micrograms	1637 micrograms
lutein + zeaxanthin	152 micrograms	1,087 micrograms

It also contains lactucarium, a narcotic similar to opium which induces sleep (hypnotic). Likewise, ancient civilizations observed that it is not only hypnotic but also an appetizer (Hamilton, 2005). The more bitter taste and pigmented leaves contain more antioxidants. Further, lettuce becomes bitter during hot weather and when harvested later or near bolting or flowering stage.

Uses

Medicinal

Wild lettuce is used for whooping cough, asthma, urinary tract problems, cough, trouble

sleeping (insomnia), restlessness, excitability in children, painful menstrual periods, excessive sex drive in women (nymphomania), muscular or joint pains, poor circulation, swollen genitals in men (priapism), and as an opium substitute in cough preparations. The seed oil is used for “hardening of the arteries” (atherosclerosis) and as a substitute for wheat germ oil. Some people apply wild lettuce latex directly to the skin to kill germs. Some people inhale wild lettuce for a recreational "high" or hallucinogenic effect.

Culinary

Lettuce is a popular salad vegetable and sometimes used as an appetizer. Likewise, it is an ingredient for soups, sandwiches and used as food wrappers. The leaves are one of the very low caloric green-vegetables. Nonetheless, they are the store house of many phyto-nutrients that have health promoting and disease prevention properties.

Health

Vitamins in lettuce are plentiful. Fresh leaves are an excellent source of several Vitamin A and beta carotenes. These compounds have antioxidant properties. Vitamin A is required for maintaining healthy mucus membranes and skin, and is also essential for vision. Consumption of natural fruits and vegetables rich in flavonoids helps to protect the body from lung and oral cavity cancers.

It is a rich source of vitamin K which has a potential role in the bone metabolism where it thought to increase bone mass by promoting osteotrophic activity in the bone cells. It also has established role in Alzheimer's disease patients by limiting neuronal damage in the brain.

Fresh leaves contain good amounts folates and vitamin C. Folates require for DNA synthesis and therefore, vital in prevention of the neural tube defects in-utero fetus during pregnancy. Vitamin C is a powerful natural antioxidant; regular consumption of foods rich in vitamin C helps the body develop resistance against infectious agents and scavenge harmful, pro-inflammatory free radicals.

Zea-xanthin, an important dietary carotenoid in lettuce, is selectively absorbed into the retinal macula lutea, where it thought to provide antioxidant and filter UV rays falling on the retina. Diet rich in xanthin and carotenes is thought to offer some protection against *age-related macular disease (ARMD)* in the elderly.

It also contains good amounts of minerals like iron, calcium, magnesium, and potassium, which are very essential for body metabolism. Potassium is an important component of cell and body fluids that helps controlling heart rate and blood pressure. Manganese is used by the body as a co-factor for the antioxidant enzyme, *superoxide dismutase*. Copper is required in the production of red blood cells. Iron is essential for red blood cell formation.

It is rich in B-complex group of vitamins like thiamin, vitamin B-6 (pyridoxine), riboflavins.

Regular inclusion of lettuce in salads is known to prevent osteoporosis, iron-deficiency anemia and believed to protect from cardiovascular diseases, ARMD, Alzheimer's disease and cancers.

Types and Varieties

1. Crisphead or Iceberg type - has tight, dense heads that resembles cabbage and valued more for their crunchy texture than for flavor. Varieties: Great Lakes, Iceberg, Ithaca and others.





2. Summer Crisp or Batavian type - it produce moderately dense heads with a crunchy texture and intermediate between iceberg and loose leaf types. Varieties are in red or green color: Batavia, Matador, Lauren.



3. Butterhead or Boston or Bibb - it has small loose dense head with tender, soft leaves and sweet flavor or buttery texture. It is matured when the leaves begin to cup inward to form a loose head, the heads will never become compact. Varieties: Marsala, Ballerina, Nadine, Okayama.



4. Romaine or Cos - it is head forming with upright, elongated leaves and excellent for salads and sandwiches. Romaine type is further classified into size: baby (small size), medium and large sizes. Varieties: Balloon, Green Tower, Triton, Cimarron, Tyrol and Xanado.

5. Looseleaf - forms tender leaves that are delicate and mildly flavored. Varieties come in green and red and green or purple color: Waldmann's Green, Grand Rapid, Red Rapid, Red Wave, LolloRossa, LolloRossa Matador, LolloRossa Nicola, Rosette, Fabala, Sierra, RapidmorOscura, Red Fire, Red Sails and Ruby.



6. Oak leaf type - resembles like looseleaf type but forms narrow leaves with lobes like a leaf of an oak tree. Varieties: Flamenco, Mondai, Kristine

Climatic Requirement

All types of lettuce grow best in cool areas. Optimum temperature ranges from 15 to 18 °C. Head types require cooler temperatures ranging from 10 °C to 18 °C; heading and seeding are prevented at 21 °C and above. Tip burning also occurs at high temperatures. Lettuce is also adapted in areas with relative humidity of 65 to 85 %. Under open field, the crop grows best in moderate rainfall than consistent heavy rain. Lettuce varieties can be selected for their tolerance to the different environmental conditions.

Soil Requirement

Lettuce grows best in soils with a pH of 6 to 6.8 and in a silty clay loam, loam and clay loam soils. Soils with high organic matter are preferred for good water holding capacity. When the soil is

clay (heavy/sticky soil), it is recommended to apply and mix soil conditioners such as coconut coir dust, rice hulls or carbonized rice hulls (burned rice hulls) to make the soil friable for easy root penetration and water percolation.

Cultivation

1. Seedbed Preparation, Sowing and Maintenance

Seeds are sown in seedling trays or seedbed, under greenhouse or open field with grass or plastic roofing. It is recommended to use seedling trays for earlier recovery of plants during transplanting because soil medium is still in tacked compared to uprooted/bare root seedlings.

Seedbed is prepared by cleaning the area and pulverizing the soil thoroughly. An adequate amount of organic fertilizer is mixed if necessary. Likewise, soil conditioners such as perlite, coconut coir dust, rice hulls or carbonized rice hulls can also be mixed in the seedbed to make the soil friable for easy rooting and water percolation especially when seedbed has clay soil. Seeds are sown in lines at least 1.5cm distance and covered with very thin layer of soil. When seedling/spadling trays are used, a prepared soil medium (1 part soil: 1 part compost: 1 part sand) is put in the trays then seeds are individually sown per hole.



It is recommended that a net should be placed over the seedbed or seedling trays after sowing until germination in order that seeds are intact during watering and to avoid birds from eating the sown seeds.

With the use of a sprinkler, watering is done three times a week to provide moisture for seed germination and faster growth of seedlings. Weeding and spraying should be done as needed. Seedlings should be transplanted 14 days after sowing or when there are 4 leaves.

2. Field Preparation

Clean and pulverize the soil thoroughly then prepare plots of 1 meter wide with desired length.

3. Fertilizer Application

Fertilizer applications should be based on crop requirement and soil analysis. Organic fertilizers are broadcasted in plots before or at planting time at the rate of 3 to 10 tons per hectare (300 grams to 1 kg per 10 square meters plot) depending on the kind of organic fertilizer, then mixed into the soil. Organic fertilizer application improves the physical properties of the soil such as water holding capacity and soil structure, thus easy percolation of water and easy root penetration for better root growth.



Inorganic fertilizers can also be applied as basal fertilizer and side dressing. If urea is used for side dressing as fertigation, 1 tablespoon in 1 gallon of water is sufficient every two weeks.

4. Transplanting

When seedlings are uprooted from seedbed, avoid damage of roots. Seedlings are transplanted at distances of 15 to 30 cm between hills and rows in a plot, depending on types. Heading and large varieties are spaced farther than small types.



5. Irrigation/Watering

Lettuce is adapted in moist environment but do not tolerate continuous rain. Watering is done three to four times per week, done in the morning to dry excess moisture in the late afternoon so as to prevent plants from rotting. Watering is carried out either through water hose, watering cans, sprinklers or irrigation system.

6. Weeding

Removal of weeds is necessary to give way to the growing crop. Weeds compete with crop for absorption of nutrients and sunlight (shading) and space thus, slow growth of crop.

7. Mulching

Mulching is done to conserve soil moisture as well as prevent the growth of weeds. Mulches could be dried cogon grass, dried rice straws or plastic sheet.

Crop Protection

A. Insect Pests

1. Aphids – soft-bodied, pear-shaped insect with color ranging from green, orange to pink. Adult winged and wingless lettuce aphids have black markings on the joints of the legs, antennae and many black markings on top of abdomen of some wingless aphids. Adults feed in colonies and suck the juice of the plant and cause discoloration or mottling of foliage and excrete honeydew on which sooty mold grows.
2. Leaf miner – small black to gray flies with yellow markings. Females puncture leaves to feed on plant sap and lay eggs within the leaf tissues. After 2 to 4 days eggs hatch and larvae feed between the upper and lower surface of the leaves, making distinctive winding, whitish tunnels.
3. Cabbage loopers– green with longitudinal white stripes; body measures up to 30 mm long, tapers toward the head; three pairs of legs near head; three pairs of fleshy prolegs; young larva on underside of leaf; mature larva deep within head. Loopers consume tender leaf tissue, leaving most veins intact.



Aphids



Cutworm

4. Cutworms - fat, basically gray, brown, or black with 40 to 50 mm long when fully grown; three pairs of legs near head; five pairs of fleshy prolegs; young larva on underside of leaf; mature larva deep within head; Cutworms usually cut the stems of newly transplanted lettuce at soil level and some can consume tender leaves during the night and hide under the soil at day time.

Control Measures

1. The entry of insect pest is lessened under greenhouse condition.
2. Cultivation, weeding and sanitation
3. Use of yellow sticky traps for leaf miner
4. Spray biological pesticides. Azadirachtin or the Entrust formulation of spinosad is organically acceptable against leaf miner

B. Diseases

1. Bacterial leaf spot – caused by *Xanthomonas campestris* pv. *Vitians*. Early symptoms are with small (less than 0.25 inch in diameter) and water-soaked spots on the older leaves. These lesions are typically bordered by leaf veins and angular in shape then quickly turn black (a diagnostic character of this disease). If severe, numerous lesions may coalesce, resulting in the collapse of the leaf. Older lesions dry up and become papery in texture, but retain the black color. Lesions rarely develop on newly developing leaves.



Leaf spot

2. Lettuce Drop – caused by *Sclerotinia minor*, *S. sclerotiorum*.



stems and infection brown, the plant and later usually



Sclerotinia minor only infects the leaves in contact with the soil. Once takes place, the fungus will cause a soft decay that eventually destroys crown tissue. Older leaves then wilt the entire plant will wilt and collapse near maturity, making it unharvestable. Profuse amounts of to 0.125 inch or 3mm), black, hard, form on the outside of the decayed

white mycelia and small (up resting bodies (sclerotia) crown.

Sclerotinia sclerotiorum can also infect lower leaves and stems, causing symptoms similar to those of *S. minor*. In addition, it has an aerial spore that can infect any of the upper leaves. Spores usually infect damaged or senescent tissue when the weather is cool and moist. Infection results in a watery, soft rot that is accompanied by white mycelial growth and formation of sclerotia. *S. sclerotiorum* forms sclerotia that are larger (0.25–0.50 inch) than those of *S. minor*.

3. Anthracnose – caused by *Microdochium panattonianum*. Anthracnose causes small (less than 0.125 inch or 3 mm), water-soaked spots on outer leaves. Spots enlarge, turn yellow, and are usually irregular and angular in shape. Under cool, moist conditions, white to pink spore masses of the fungus will be visible in the center of the lesions. If disease is severe, the lesions will coalesce and cause significant dieback of the leaf and in some cases result in stunting of the plant. As spots age, the affected tissue will dry up and become papery.



Anthracnose lesions are often clustered along the midribs of lower leaves. Romaine cultivars exhibit severe disease along leaf midribs. Seedlings could die if infected severely.

4. Tipburn

Tipburn is a physiological disorder characterized by browning of leaf margins. The brown area may be limited to small spots near or at the leaf margin or the entire leaf may be affected. Brown veins may occur near the brown lesions.

Control Measure

1. Use tolerant varieties
2. Use pathogen-free seed
3. Crop rotation
4. Regulate watering or watering is done in the morning to dry up excess water until afternoon.
5. Widerplantingdistances
6. Use copper-based fungicides for bacterial leaf spot
7. Fortipburn, supply enough irrigation and there should be enough calcium content in the soil

Harvesting

Harvesting is done 45 to 90 days after transplanting, usually early morning or late afternoon to lessen transpiration and wilting. Looseleaf lettuce is usually harvested earlier than head lettuce. Late harvesting or near bolting stage (flowering) tends the crop a bitter taste. There are 4 to 8 plants to make one kilogram, depending on type and variety.



Post-harvest

Harvested lettuce are cleaned and packed either in plastic crates, cartons or transparent polyethylene plastics then brought to the market at dawn or early morning. Refrigerated van is highly recommended for transporting lettuce to distant markets to reduce transpiration and wilting thus, maintaining the freshness.

Cost of Production

A. Labor Cost

Operation/Activity	M-Day**	Value (PhP)
1. Seedling tray preparation and care of seedlings	18	4,500
2. Plastic roofing installation for seedling protection	1	250
3. Land clearing	30	7,500
4. Plowing/plot preparation	20	5,000
5. Transplanting	40	10,000
6. Care and maintenance (weeding, fertilization & watering)	80	20,000
7. Harvesting	20	5,000
8. Sorting and packing	10	2,500
Sub-Total	219	54,750

B. Cost of Inputs, Supplies and Materials

	Quantity	Value (PhP)
Inputs		
1. seeds (@1,500/50g)	200g	6,000
2. Processed chicken manure @ 280/sack	45 sacks	12,600
3. Urea (@ 1500/sack)	3 sacks	4,500
4. Carton (@ 10/pc)	1500 pcs	15,000
5. Herbicide (@ 500/li)	3 li	1,500
6. Garden hose (@ 1700/roll)	5 pcs	8,500
7. Plastic twine (@ 65/roll)	10 rolls	650
8. Bamboo posts (for roof @ 20/pc)	10 pcs	200
9. Wire (for roof @ 75/kg)	1 kg	75
8. Plastic sheet (roofing @ 200/kg)	15 kg	3,000
Sub-Total		52,025
Tools and Equipment	Depreciation Cost	
1. Knapsack sprayers (@ 2,500/unit)	2 units	500
2. Rake (@ 250/pc)	5 pcs	125
3. Grub hoe with handle (@ 350/pc)	8 pcs	280
4. Shovel (@ 650/pc)	3 pcs	195
5. Scythe (@ 175/pc)	8 pcs	140
6. Trowel (@ 175/pc)	8 pcs	140
7. Knife (@ 50/pc)	5 pcs	25
Sub-Total		1,405
D. Land rent, 10,000 sq.meters @ 25,000/3 months		25,000
Total Cost of Production		133,180

* Modified from cost and return analysis of major commodities for onfarm diver-sification (1990).

Cost of labor, inputs & equipment were based on 2011 prices.

** Man-day computed at PhP250/day

II. Economic Analysis

A. Total Cost of Production	133,180
B. Gross Sales (Ave. yield of 28,000 kg/ha at PhP15/kg)	420,000
(Less 10% for spoilage and price fluctuation; 2800kg)	378,000
C. Net Profit (378,000-133,180)	244,820
D. Return on Investment (ROI),(244,820/133,180 X 100)	183.82%

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