ETHNIC HERBS AND GREENS

CROP PRODUCTION MANUAL

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ASIAN INDIAN GREENS AND HERBS

PURSLANE OR VERDOLAGA

(***Portulaca oleracea***)
Family: *Portulacaceae*
Common Names: Pusley, Pigweed, Pitwa (Indian: Hindi),
Pulicha Keerai (Indian: Tamil) Gongura(Indian: Telugu)

INTRODUCTION

Purslane also known as Verdolaga, Pigweed, Little Hogweed or Pusley, is an annual succulent. A native of India, it is now found almost all over the world. Although it is considered a weed in the USA, it is eaten as a leafy vegetable in other parts of the world. It is a fast growing plant reaching a height of about 15 – 40 cm. The leaves are succulent, smooth, stalk less, oval shaped measuring about ½ to 2 inches in length, alternate and cluster at stem joints. The stem may be green or reddish in color. It has a deep taproot with several secondary fibrous roots. The flowers are yellow with 5 petals, about 5 mm wide and open for only a few hours on sunny mornings. The seeds are tiny, oval, reddish brown to black color and formed in tiny pods that open when the seeds are ready for harvesting.

USES

Purslane has a slight sour and salty taste. The stems, leaves and flower buds are edible. Purslane contains more omerga-3 fatty acids than any other leafy vegetable plant. It can be used raw in salads or used in soups and stir fry. It can also be cooked similar to spinach. It is said to provide relief for cold, fever and stomach aches.

Purslane is also an excellent plant to be used as a rotation crop. It helps keep insects away and brings up the minerals from the deep soil. When used as a companion plant it provides ground cover and stabilizes ground moisture. It is said to be a good companion plant to be grown along with corn since the roots of Purslane plants aids the roots of corn plants to easily penetrate through hard soil.

PICTURES

Pictures Source-internet (From Left to Right) :http://www.plant.photos.net/index.php?title=Purslane, http://www.coconutandquinoa.com/2010/06/12/purslane-salad-with-flax-chive-dressing/, http://www.wildmanstevebrill.com/Plants.Folder/Purslane.html, http://www.plant-biology.com/Portulaca-Purslane.php, http://flponent.atspace.org/flora/flo/fam/portulacacies/portulaca_por.htm

VARIETIES

Golden Purslane also known as "Goldberg" and the Red or Common Purslane also known as "Gruner" is the most commonly cultivated varieties in the USA. "Gruner" has small green

leaves with red stems while "Goldberg" has larger leaves with better flavor when compared to the common Purslane. Many farmers in the north eastern parts of USA harvest the common weed Purslane.

CLIMATE

Purslane prefers a dry and hot weather. It needs full sun and cannot tolerate cold and damp conditions. Seeds require a minimum temperature of 70°F to germinate.

SOIL

Purslane can be grown on any type of soil but prefers well drained soils with a pH level between 6.0 and 7.8. Since it has tap root that can penetrate deep into the soil and several secondary fibrous roots it adapt itself to any type of soil.

FIELD PREPARATION

Thoroughly till the field. Incorporate compost or farm yard manure into the field during the last till.

SOWING

Propagation may be made by direct seeding or transplanting.

Direct Seeding: Plant seeds about a ¼ inch deep and 1 inch apart directly into the soil after the danger of the last frost has passed. Seeds may also be broadcasted over a small area. Cover the seeds with a thin layer of soil and keep the soil moist. The seeds will germinate in about 7-10 days. Once the seedlings are well established, initially thin the plants to about 3 inches apart. As the plants grow bigger and stronger, thin the plants to about 12 inches apart.

Transplanting: Propagation by transplantation saves time and money. Seedlings can be raised in greenhouses in winter and transplanted directly onto the field in spring after the danger of the last frost has passed. Well established seedlings can be planted about 3-4 inches apart and later thinned to be about 12 inches apart as they grow bigger and wider.

IRRIGATION

Purslane prefers well drained soil and cannot tolerate water logging. Water requirements are minimal and it is sufficient to just keep the soil evenly moist.

FERTILIZATION

Fertilizer requirements are determined based on the results of the soil test. Generally leafy vegetables when grown in soils rich in nitrogen are healthy and green.

PLANT PROTECTION AND WEED CONTROL

No significant pests and diseases seem to affect Purslane cultivation. Weeding and hoeing can be undertaken as and when necessary.

HARVEST AND YIELD

The first harvest of Purslane can be undertaken in about 20-30 days after planting or as soon as 4 – 5 leaves emerge. The plants must be cut low to allow for new stems to grow. Since Purslane is a quick growing plant a long production period can be established by staggered sowing at an interval 2-3 weeks. Purslane like any other leafy vegetable has a very short shelf life which can be prolonged to about 2 weeks when stored at 32°F and 95 to 100% relative humidity. The average yield is about 90 tons/ha.

NUTRITION

Reference: Nutritive value of Indian foods. 2002. S no 100 (ref # 2). Values with * see ref # 1.

Nutrient	**Nutrient Composition/100g** **(edible portion)**
Leaves	
Moisture, g	90.5
Energy, Kcal	27
Protein, g	2.4
Fat, g	0.6
Carbohydrate, g	2.9
Fiber, g	1.3
Ash, g	2.3
Vitamin A, RE-µg	591
Vitamin A, RAE-µg	295
Beta carotene, µg	400*
Total carotene, µg	6,690*
Vitamin C, mg	29
Thiamin, mg	0.10
Riboflavin, mg	0.22
Niacin, mg	0.7
Calcium, mg	111
Iron, mg	14.8
Phosphorus, mg	45

Purslane (*Portulaca oleracea*), raw, fresh, Nutritive value per 100 g. (Source: USDA National Nutrient data base)		
Principle	**Nutrient Value**	**Percentage of RDA**
Energy	16 Kcal	1.5%
Carbohydrates	3.4 g	3%
Protein	1.30 g	2%
Total Fat	0.1 g	0.5%
Cholesterol	0 mg	0%
Vitamins		
Folates	12 µg	3%
Niacin	0.480 mg	3%
Pantothenic acid	0.036 mg	1%
Pyridoxine	0.073 mg	5.5%
Riboflavin	0.112 mg	8.5%
Thiamin	0.047 mg	4%
Vitamin A	1320 IU	44%
Vitamin C	21 mg	35%
Electrolytes		
Sodium	45 mg	3%
Potassium	494 mg	10.5%
Minerals		
Calcium	65 mg	6.5%
Copper	0.113 mg	12.5%
Iron	1.99 mg	25%
Magnesium	68 mg	17%
Manganese	0.303 mg	13%
Phosphorus	44 mg	6%
Selenium	0.9 µg	2%
Zinc	0.17 mg	1.5%

http://www.nutrition-and-you.com/purslane.html

NIGHTSHADE

(***Solanum nigrum L***)

Family: *Solanaceae*

Common Names: Black Nightshade, Garden Huckleberry (English) Makoi (Indian: Hindi) Manathakkaali (Indian:Tamil) Kamanchi(Indian:Telugu) Mako (Urudu) Hei qiezi(Chinese) Kanper makoo(Pakistani) Mnavu (Tanzanian, Kenyan) herbea calalou (French) Solano Nero (Italian) Yerba Mora (Spanish) Toem tok (Thailand)

INTRODUCTION

Black Nightshade a native of Eurasia is considered to be a weed in some parts of the world and as an indigenous/traditional leafy vegetable in other parts of the world. These plants can be grown in tropical to temperate regions and at altitudes ranging from sea level to an altitude of 3500 m above sea level.

Several species of black nightshade exist and there is a general tendency to group these as Solanum nigrum. Some of the species within the Solanum nigrum complex are Solanum nigrum, Solanum americanum, Solanum scabrum and Solanum villosum. This document contains information related to Solanum nigrum.

Black Nightshade is a perennial leafy vegetable that is well branched and grows to a height of 2 - 4 feet. It is sometimes confused with the deadly nightshade, a different Solanaceae species. The leaves of black nightshade are ovate and about 6 cm long and 3 cm wide. The flowers have greenish/whitish petals and bright yellow anthers. The stems are slender when young but turn woody as they age. The plant bears tiny berries that are about 6-8 mm in diameter, and are round, smooth skinned, borne in clusters and are green in color to begin with and are black or deep purple in color when ripe.

USES

The leaves of black nightshade are used as a leafy vegetable and/or as a potherb in several parts of the world. The berries are consumed when ripe and are also used for cooking in their dried form. The berries are sometimes used in preserves and pies. The leaves and berries are highly nutritious and are a rich source of fiber, iron and vitamins.

The leaves are considered to have medicinal value and are used to treat mouth ulcers. In India, the juice of the plant is used to cure ulcers and skin related diseases. The berries are used as a laxative and to make dyes and food color. The tea extracted by boiling the leaves and berries of black nightshade are used to treat liver related illnesses.

PICTURES:

Pictures: Source – Internet (From Left to Right): http://www.henriettesherbal.com/pictures/p13/pages/solanum-nigrum-1.htm, http://www.rbgsyd.nsw.gov.au/science/Evolutionary_Ecology_Research/Ecology_of_Cumberland_Plain_Woodland/woodland_plants/solanum_nigrum,http://www.rbgsyd.nsw.gov.au/science/Evolutionary_Ecology_Research/Ecology_of_Cumberland_Plain_Woodland/woodland_plants/solanum_nigrum, http://commons.wikimedia.org/wiki/File:Solanum_nigrum_seeds,_Zwarte_nachtschade_zaden.jpg

VARIETIES

There are no known varieties of cultivars available in India for black nightshade other than the indigenous variety cultivated.

CLIMATE

The ideal temperature to grow nightshade is between 65 and 85°F. In areas where they are grown throughout the year, optimum yields are generated when they are grown in full sun during the winter months and in partial shade when grown during the summer months.

SOIL

It grows well in soil that is highly rich in nitrogen and organic matter. Well drained soil with a pH level of 6.0 – 6.5 is ideal for growing black nightshade. They grow well on land covered with ash from recently burned vegetation.

FIELD PREPARATION

Land should be thoroughly prepared and enriched with decomposed organic manure. The soil should be loosened. Spacing of 30 – 60 cm between rows and 20-50 cm between plants is essential for generating optimum yield in leaves.

SOWING

Propagation is by direct seeding or transplanting.

Direct Seeding: Approximately 400 g of seeds per ha is needed for sowing. Seeds should be mixed with sand and/or ash. Seeds are sown at a space of about foot between plants and at depth of about 0.25 cm in rows that are about 30-60 cm apart or by broadcasting in beds. The seeds thus sown should be covered with a thin layer of sand to prevent the seeds from being blown away by strong winds. Sow seeds after the danger of the last frost has passed. Seeds germinate in about 10 -14 days when the temperature ranges between 68°F - 90°F. Thin

Transplanting: In case of direct seeding the chances of the seeds being blown away by strong winds and/or the seeds being washed away due to irrigation or heavy rain are high. So, it is highly recommended to raise the seedlings in nurseries or greenhouses and then transplant them to the fields. The seeds germinate within 15 to 30 days when they are raised in glass houses. Seedlings can be transplanted 25 to 30 days after germination.

IRRIGATION

Regular and frequent irrigation results in good green matter yields. Black Nightshade is intolerant to water stress.

FERTILIZATION

Adding urea or NPK in the ratio of 20:10:10 kg/ha at the time of the last plow is highly recommended. A top dressing of nitrogen also results in good yield of leaves.

PLANT PROTECTION AND WEED CONTROL

Aphids are major pests that affect black nightshade cultivation. Diseases that are common to potatoes and tomatoes are also prevalent in black nightshade. As the leaves of these plants are used as vegetables, caution should be exercised regarding the type and the time of use of herbicides to contain pest infestation. To reduce pest infestation, crop rotation with other crops like Amaranthus is recommended. Thorough preparation of the field by plowing and harrowing helps in controlling weeds. Using mulch to cover the plowed field also helps in weed control.

HARVEST AND YIELD

Tender shoots with well developed leaves can be harvested 45 to 60 days after transplanting. Clippings can be taken 2 to 3 times a month. When the plant becomes too old, fruits are collected to raise seedlings again. On an average there is a yield of 15 - 20 ton/ha of green leafy matter.

NUTRITION FACTS

Reference: Nutritive value from NIN analysis, UCF project 2002-2003 (ref # 3).

Nutrient	**Nutrient Composition/100g (edible portion)**
Leaves	
Moisture, g	81.4
Energy, Kcal	62
Protein, g	4.6
Fat, g	1.7
Carbohydrate, g	7.1
Fiber, g	2.4
Ash, g	2.8
Vitamin A, RE- µg	2342
Vitamin A, RAE-µg	1171
Beta carotene, µg	14050
Calcium, mg	367
Iron, mg	7.1
Phosphorus, mg	79

FENUGREEK

(***Trigonella foenum-graecum L***)
Family: *Leguminosae*
Common Names: Bird's foot, Greek hayseed, Sickle fruit fenugreek,
Methi patta (Indian: Hindi), Vendhayam (Indian: Tamil)
Menthi Kura(Indian: Telugu)

INTRODUCTION

Fenugreek is a leafy vegetable. The plant is believed to have originated in South Eastern Europe. Fenugreek plant may grow up to 50 cm which may be branched. The leaves are trifoliate and the leaflets are oblong-lanceolate. It bears yellowish flowers that are about 12 -18 mm long. The fruits are almost straight and flattened with a pronounced beak. The seeds are brownish, about 1/8 inches long, rhomboidal, with a deep furrow dividing them into two unequal lobes. About ten to twenty seeds are found in each pod that are long and sickle shaped. There are about 50,000 seeds per kg.

USES

The green leaves are used as a leafy vegetable and the fully matured grains are used as a condiment. The leaves taste bitter when eaten raw and hence are not suitable for salads. They can be cooked with lentils or sautéed with potatoes and other vegetables. The leaves can also be used to flavor Indian breads. The green leaves are a rich source of minerals, protein and vitamin A. The leaves and also the seeds in particular have medicinal value. In India the seeds are used in the treatment of diarrhea and many other ailments. Sprouted fenugreek seeds are said to bring down the blood glucose level in diabetics. Fenugreek seeds are believed to increase milk production in lactating mothers. The leaves can also be dried and used for flavoring. Since it is a leguminous plant, it fixes atmospheric nitrogen and enriches the soil.

PICTURES

Pictures Source – Internet (from Left to Right): http://www.theatlantic.com/health/archive/2010/06/from-yemen-to-greece-fenugreek-obsession/58451/,http://mynutramart.com/blog/2011/10/14/herb-fenugreek-could-be-natural-viagra-new-study-finds/, http://www.analyticalarmadillo.co.uk/2011/09/spotlight-on-fenugreek-does-natural.html, http://www.soniyaskitchen.com/fenugreekseeds.html

VARIETIES

There are two main groups of fenugreek. The one with scented leaves like Kasuri Methi (T. corniculata) or Champa Methi is primarily grown and used for flavoring. The other is the non-

scented kind, the common fenugreek, with white flowers (T.foenum graecum). There are several varieties of the non-scented fenugreek, like Lam selection, Pusa Early Bunching, CO 1, Methi No. 47 and Methi No. 14.

CLIMATE

Fenugreek is a cool season crop but easily adapts to hot climate. It can tolerate freezing temperature to a certain extent. Heavy and continuous rain will affect the growth and output of fenugreek.

SOIL

Fenugreek grows best in clay loams. A soil pH level of 6.0 – 7.0 is considered to be optimum for growing this plant.

FIELD PREPARATION

The farm land should be thoroughly prepared by plowing and harrowing. Farm yard manure at 20 to 25 tons/ha and N, P, K at 30:25:40 kg/ha is applied and incorporated during the last plow. If planting in beds, beds of size 12 X 5 feet are formed. If planting in rows, create rows 25 cm apart.

SOWING

Seeds are sown by broadcasting and then raking the bed surface. Line sowing is considered to be better than broadcasting. In case of row sowing, rows may be spaced 25 cm apart and the seeds sown at 10 cm spacing. The seeds germinate in about 7 to 10 days under rain fed condition and in about 4 to 5 days if irrigated. Seeding rate is 12 kg/ha. Before sowing, treat the 12 kg of seeds with 1.5 kg of Azospirillum to prevent damping off disease. Fenugreek seeds have a 98% germination rate and 70% purity.

IRRIGATION

Irrigate lightly immediately after sowing. The second irrigation should be done on the third day and subsequently at 7 to 10 days interval. Care should be taken to avoid water stagnation, as it might lead to damping off disease.

FERTILIZATION

Farm yard manure, neem cake and N, P, K are incorporated into the soil during the last plow before preparing the beds for cultivation. Top dressing of 20 kg of N should be applied after the first harvest, which is about 30 days after sowing.

PLANT PROTECTION AND WEED CONTROL

The young crop is prone to damping off disease caused by fungus Rhizoctonia. Seed treatment with Trichoderma viride @ 4g/kg or drenching with Carbendazim at 0.5g/l or copper oxychloride at 2 g/lt and incorporation of 150 kg/ha of neem cake during the last plow helps in preventing and controlling this disease. It is advisable not to use any chemical pesticides since the green matter is used as vegetable. In case of severe powdery mildew, another serious disease affecting the crop, a dusting of 15 kg/ha of sulphur (5% dust) is recommended. This should be done, at least one week prior to the clipping. Weeds are controlled by mechanical methods and/or by creating a weed free seed bed. Pre-emergence spray of Fluchloralin 700 ml in 500 lit of water/ha and subsequent hand weeding should be undertaken as and when necessary.

HARVEST AND YIELD

The first clipping of green matter can be done in about 20 -25 days after sowing. Subsequent clippings can be made at an interval of 12 – 15 days. After 3-4 cuttings, the plants can be allowed to flower. The seeds are harvested 30-35 days after flowering or approximately 120-140 days after sowing. The yield in case of common fenugreek is 7-8 tons/ha in 3-4 clippings while that of the scented or kasuri fenugreek is 9-10 tons/ha. In case of grains, the yield is about 700-900 kg/ha.

NUTRITION

Reference: Nutritive value of Indian foods. 2002. S no 79 (ref # 2).Values with * see ref # 6.

Nutrient	**Nutrient Composition/100g (edible portion)**
Leaves	
Moisture, g	86.1
Energy, Kcal	49
Protein, g	4.4
Fat, g	0.9
Carbohydrate, g	6.0
Fiber, g	1.1
Vitamin A, RE-µg	1,750
Vitamin A, RAE-µg	875
Beta carotene, µg	9,200
Vitamin C, mg	52
Thiamin, mg	0.04
Riboflavin, mg	0.31
Niacin, mg	0.8
Calcium, mg	395
Iron, mg	1.93
Phosphorus, mg	51

INDIAN SORREL SPINACH

(***Rumex vesicarius spp***)
Family: *Polygonaceae*
Common Names: Ruby Dock, Rosy Dock, Bladder Dock,
Khatta Palak (Indian: Hindi), Chukka Kura(Indian: Telugu)

INTRODUCTION

Indian Sorrel Spinach is a native of India and to some parts of North Africa, and South Western Asia. It thrives in the semi-arid and desert regions. This leafy vegetable plant grows up to a height of 30 cm. The leaves are triangular or arrow shaped. The stems are elongated and hollow. It branches from the root. The whitish pink to pink flowers are borne in clusters at the tip of the stems. The fruits have a papery feel and are brown in color.

USES

The leaves are sour and are considered to have medicinal value and are used in the treatment of digestive flatulence, constipation, asthma, bronchitis etc. It is also used as an analgesic. The leaves of the sorrel plant are sometimes used to treat fevers, scurvy, itchy skin and ringworm. The leaves, fresh or in the dried form, helps in clearing the system by serving as a diuretic or laxative. Rumex vesicarius is generally considered as a field weed but it is used as a leafy vegetable in many parts of India. It may be boiled and used in dishes or used raw in salads.

PICTURES

Pictures: Source-internet (From Left to Right) http://www.sailusfood.com/2008/02/05/chukkakura-khatta-palak-pachadi/, http://forums.gardenweb.com/forums/load/asianveg/msg052216394286.html,http://www.ausemade.com.au/nt/destination/c/central-australia/flora-fauna/flora/wild-flowers/wf-rosy-dock.htm, http://www.ausemade.com.au/nt/destination/c/central-australia/flora-fauna/flora/wild-flowers/wf-rosy-dock.htm

VARIETIES

Currently there are no listed varieties available for commercial cultivation of Indian Sorrel Spinach.

CLIMATE

These plants are not cold weather plants. They prefer hot and dry weather. A minimum temperature of about 70°F is best suited for growing Indian Sorrel. They should be grown in areas which receive direct sunlight.

SOIL

Sorrel plants prefer rich moist well-drained soil. However, they can easily adapt to all kinds of well-drained soil. Soil with a pH level varying between 6.3 – 6.8 is ideal for growing sorrel.

FIELD PREPARATION

Field should be thoroughly plowed and a bed prepared for planting sorrel. The bed should ideally be in full sun. However, sorrel will tolerate and grow in at least some amount of shade.

SOWING

Propagation is by direct seeding. Sow seeds at ½ inch below the surface, cover with light soil or sand and keep the soil moist until the seeds germinated. Ensure a spacing of 15-18 cm between plants. Seeds germinate in about a week to 10 days. Thin the seedlings when they are 2 inch high, maintaining a space of 4 inches between plants.

IRRIGATION

Lightly irrigate immediately after planting to keep the soil moist. Irrigate again on the third day and subsequently at 10-14 day intervals dependent on the moisture content in the soil. Water deeply but ensure that there is no water logging and that the soil is dry for a few days before the next irrigation.

FERTILIZATION

Incorporate 15-20 ton/ha of farm yard manure at the last plow. Apply NPK at 25:25:50 kg/ha just before sowing. Once in 3 weeks side dress with nitrogen and potassium.

PLANT PROTECT AND WEED CONTROL

Use pesticides to control aphids and leaf eating caterpillars based on the recommendations of the county agents. As this is a leafy vegetable, use pesticides sparingly and avoid the use of any chemical at least 2 weeks prior to harvest. Undertake weeding and hoeing as and when necessary.

HARVEST AND YIELD

The leaves are harvested when they are 4-6 inches high. Cut at least one inch above the soil to encourage growth for subsequent harvesting. Successive planting at fortnightly intervals will

result in a prolonged harvest. When flowers emerge from the plant, the flowers need to be cut off to encourage more leaf growth for harvesting. Yield data for commercial cultivation is unavailable at this time.

NUTRITION

Reference: Nutritive value of Indian foods. 2002. S no 58 (ref # 2).

Nutrient	**Nutrient Composition/100g (edible portion)**
Leaves	
Moisture, g	95.2
Energy, Kcal	15
Protein, g	1.6
Fat, g	0.3
Carbohydrate, g	1.4
Fiber, g	0.6
Ash, g	0.9
Vitamin A, RE-µg	1 250
Vitamin A, RAE-µg	625
Beta carotene, µg	2 300
Total carotene, µg	12700
Vitamin C, mg	12
Thiamin, mg	0.03
Riboflavin, mg	0.06
Niacin, mg	0.2
Folate, µg	125
Calcium, mg	63
Iron, mg	0.8
Phosphorus, mg	17

INDIAN SORREL (ROSELLE)

(***Hibiscus sabdariffa***)
Family: *Malvaceae*
Common Names: Rosella, Florida cranberry, Red Sorrel, Jamaican Roselle, Spinach Dock, Pitwa (Indian: Hindi), Pulicha Keerai (Indian: Tamil), Gongura(Indian: Telugu)

INTRODUCTION

Roselle, also known as Rosella, Indian Sorrel, Florida cranberry is a green leafy vegetable native to India. It is widely cultivated in the tropical and sub-tropical regions. The stems, branches, leaf veins and leaf stems are reddish purple. The leaves of young seedlings and the upper leaves of a well grown plant are oblong. The lower leaves of a grown plant are 3, 5 lobes with toothed margins.

USES

Roselle is an aromatic, astringent, cooling herb primarily grown in India to be consumed as a vegetable. The leaves are very mucilaginous and are used to treat skin problems and as a remedy for cough. Roselle leaves are green and have a very sour taste. They are cooked with spices as vegetable dish by itself or it can be cooked with other vegetables, sea food and meat. Roselle leaves are a rich source of iron, vitamins, folic acid and antioxidants. The leaves of this herb are useful in the prevention and treatment of scurvy.

PICTURES

Pictures Source- internet (From Left to Right): http://plantfreak.wordpress.com/2012/03/05/eat-a-hibiscus-roselle/, http://delicious-bhojanam.blogspot.in/2011/09/gongura-chutney-andhra-style.html, http://plantfreak.wordpress.com/2012/03/05/eat-a-hibiscus-roselle/, http://www.thehindu.com/life-and-style/metroplus/article2783042.ece

VARIETIES

Roselle is commonly grown in India in two varieties, green stemmed leaf and red stemmed leaf.

CLIMATE

Tropical and sub-tropical climate is best suited for growing Roselle. It is very sensitive to frost. It prefers sunlight and will not grow in shade.

SOIL

It requires a well drained soil and grows well in sandy, loamy and clayey soils. It prefers acid, neutral and basic (alkaline) soils.

FIELD PREPARATION

Thoroughly till the land and create rows that are 6 to 8 ft apart.

SOWING

Propagation can be made by seeds, by transplants and by cuttings.

Direct seeding: Seeds are directly sown in the prepared land. Small mounds that are 5 ft apart are made in each row. 3 or 4 seeds are then directly set into these mounds. Germination is fairly rapid. Thin the seedlings to 50% per mound when 3 or 4 leaves develop.

Transplanting: Seedlings may be raised in nursery beds or in containers in green houses and transplanted when they are about 4 inch tall.

Cuttings: Propagation by cuttings is preferred when Roselle is grown as an inter cultivation crop and solely for the purpose of green matter.

IRRIGATION

Adequate frequent irrigation is necessary since this is a leafy vegetable with high water content. Wilting of leaves during noon time is a clear indication that the plants require immediate watering.

FERTILIZATION

Any common fertilizer used for the cultivation of leafy vegetables can be used. An NPK application of 40:60:70 kg/ha results in good yield. Growing the plants in ammonia rich soil encourages good vegetative growth.

PLANT PROTECTION AND WEED CONTROL

Common pests of the plant are root knot nematode and beetles such as *Nisotra breweri, Lagris cyanea and Rhyparida discopunctulata*. Since Roselle is susceptible to root knot nematodes, it cannot be grown in the same place year after year. To conserve water in the soil and to punish the nematode, mulching has to be undertaken. Frequent weeding during the early stages of the growth of the plant is necessary. Weeds tend to be less problematic as they get shaded out and grow less, as and when the Roselle plants reach a height of about 2 feet.

HARVEST AND YIELD

The firs harvest of the leaves can be done in about 6 weeks after transplanting. The stems should be cut just above the ground leaving only about 8-10 cm of the plant. This sets the plant for re-growth. Two subsequent cuttings can be made at an interval of 4 weeks between cuttings. On an average 3 cuttings of green matter results in a total yield of about 17 ton/ha.

NUTRITION FACTS

Source of nutrient data: Nutrient data is sourced from ASEAN FCT 2000, Asean ID AAD111 (ref # 1).

Nutrient	**Nutrient Composition/100g (edible portion - leaves)**
Moisture, g	85.6
Energy, Kcal	57
Protein, g	1.7
Fat, g	0.1
Carbohydrate, g	12.4
Ash, g	0.2
Vitamin A, RE - µg	133
Vitamin A, RAE - µg	66.5
Beta-carotene, µg	797
Thiamine, mg	0.01
Vitamin C, mg	44
Calcium, mg	9

MALABAR SPINACH

(***Basella alba "Rubra"***)
Family: *Basellaceae*
Common Names: Red Ceylon Spinach, Vine Spinach, Chukka Bhaji (Indian: Hindi) Pasalai Keerai (Indian: Tamil), Bachali Kura(Indian: Telugu)

INTRODUCTION

Basella Rubra, a native of India and Indonesia, also commonly referred to as Malabar Spinach, Ceylon Spinach, Malabar Nightshade or Poi, is a tender and fast growing, succulent climbing tropical vine with thick fleshy bright red/dark purple stems with green leaves. It is used extensively in Thai cuisine. It tastes very similar to spinach. It grows up to 12 feet tall. The succulent heart shaped leaves with petioles and tender stems are three to seven inches in length and are bright glossy green on both sides. The stems and the veins in the leaves are purple-red in color while the leaves are dark green. The flowers are white, purple or red and are followed by small purple colored berries.

USES

The leaves can be used raw in salads, stir-fried, steamed, boiled and cooked with other vegetables, omelet, meat, tofu and sea food. Similar to beets, the leaves seem to lose their color when cooked, so these leaves may not be a good choice for dishes where the food color of other ingredients need to be retained. Since the leaves have succulent mucilage, it can be used as a thickener while making soups. Only the leaves and young stems are eaten. It is a rich source of Vitamin A, protein and iron. The leaves are used as an analgesic, antifungal, to sooth burns and skin irritations, as a treatment for anemia, to treat diarrhea, cough and cold. The berries are used to make dyes and food color.

PICTURES

Pictures: Source-internet(From Left to Right): http://www.seedman.com/malabar.htm, http://artshotz.com/image.php?id=4930, http://www.learn2grow.com/plants/basella-alba-rubra-images-large-113671/ , http://www.learn2grow.com/plants/basella-alba-rubra-images-large-89057/

VARIETIES

There are 2 known types of cultivars, the red stemmed cultivar and the green stemmed cultivar.

CLIMATE

Basella grows very well in warm moist climate. It can tolerate high rainfall and is extremely heat tolerant. However, it cannot tolerate extreme cold temperatures. It can also be grown under partially shady regions. A minimum daytime temperature of 60°F is required to grow these plants.

SOIL

Sandy loam with sufficient organic matter is best suited for growing Basella. It can also be grown in a wide range of soil types from sandy soil to clayey soil. However the soil must be rich and well drained. A soil pH of 4.5 to 7.8 is best suited.

FIELD PREPARATION

Incorporate organic matter and thoroughly plow the field. Form rows or beds dependent on the type of propagation. The size of rows or beds is dependent on the type of harvest. Narrow spacing is recommended if the plants are grown for a one time harvest and wide spacing is recommended when grown for multiple harvests.

SOWING

Basella is propagated by seeds, by transplanting and by stem cuttings.

Direct Seeding: 12-15 kg/ha of seeds will be required for sowing. Basella seeds have 60% purity and 96% germination rate. Seed coat is thick so soak the plants before sowing. Plant seeds 1 inch deep and 6 inch apart in rows 2.5 feet apart. Cover the seeds with compost. When two to three leaves develop, thin the seedlings to be 12-18 inch apart.

Transplanting: Grow the seedlings in plastic containers with potting mix that has good water holding capacity and good drainage. The seedlings can be started about eight weeks before the last frost. Thin to one seedling per cell after 3 leaves have developed. Seedlings are ready to be transplanted when they develop 5 leaves. If seedlings have been grown in shade, harden them off by gradually exposing them to sun for about 4-5 days before they can be transplanted in the fields. Narrow spacing is used if the plants are grown for only one harvest. Wide spacing should be used if the plants are grown for multiple harvests or cuttings. Transplant the seedlings late in the afternoon or on a cloudy day to reduce transplant shock. Place transplants in holes that are 10 cm deep, cover the roots with soil and lightly press to firm up the soil around the seedling. Irrigate immediately after planting.

Stem Cutting: Stem cuttings from existing Basella plant can also be used to start new growth. Stems with 3-4 internodes and about 20-25 cm in length from the first harvest are usually used for starting new plants. In using cuttings, the leaves are usually removed

before planting so as to reduce water loss through transpiration. The cuttings are usually soaked in water for 1-3 days to develop roots before they can be transplanted in the fields. Dig holes 10-15 cm deep, place 2-3 cuttings per hole; cover the hole with soil and press lightly around the cuttings to firm up the soil. Wider spacing is required when stem cuttings are used. 20-30 cm spacing between rows and 15-20 cm spacing between holes is recommended. Irrigate immediately after planting.

For trailing on the ground, a spacing of 60 cm X 60 cm should be adopted. If it is trained on trellises a spacing of 60 cm X 30 cm should be adopted. Trellising is recommended as it helps in keeping the foliage clean. In tropical areas where the dry season is not too severe, a planting will persist for about 2 years. But in sub-tropics and temperate regions new plantings must be made each year.

IRRIGATION

In case of transplanting of seedlings or stem cuttings, immediate irrigation is required. Frequent irrigation is necessary for good quality and optimum yield. The frequency can be low during rainy season. Irrigate thoroughly to maintain good plant growth. As a rule, plants should be irrigated if wilting occurs during noon time. To prevent the onset of diseases, late evening irrigation should be avoided. Care should be taken to avoid water stagnation. Raised beds, clean furrows and large drainage canals help in quick drainage of excess water after heavy rains.

FERTILIZATION

A basal dressing of 20-30 tons/ha of farm yard manure and 60:60:40 kg of NPK/ha has to be applied before transplanting/sowing. Nitrogen is essential for optimal growth.

PLANT PROTECTION AND WEED CONTROL

Damping off, leaf spot and mosaic disease are the most common diseases that affect Basella. The seeds can be treated and the soil sterilized before sowing/planting. It is best to avoid the use of any chemical pesticide. Crop rotation, field sanitation and adequate plant spacing also helps in reducing the onset of plant diseases. Thorough preparation of land helps in controlling weed growth. Since Basella seeds are slow to germinate, early weed control is required when direct seeding. Good quality seeds should be used. Shallow hoeing in between plants should be undertaken as and when necessary.

HARVEST AND YIELD

Basella is usually ready for harvest in 40-50 days after planting. Plants can be harvested once or multiple times. One time harvesting is adopted for quick growing and fast maturing varieties. 5-20 cm long stems and shoots are cut, cleaned and tied is bundles to be marketed in farm markets and grocery and departmental stores. In case of varieties grown for multiple harvests, young leaves and stems are harvested every week. Frequent harvest helps stimulate growth of side shoots and delays producing of flowers. A quantity of 15-20 tons/ha of green matter can be harvested in a crop duration of 120-150 days.

NUTRITION FACTS

Source on nutrient data: Nutrient data is sourced from ASEAN FCT 2000, Asean ID # AAD121 (ref # 1)
Reference: Nutritive value of Indian foods. 2002. S no 93 (ref # 2). Values with * see ref # 1.

Nutrient	**Nutrient Composition/100g (edible portion)**
Leaves	
Moisture, g	90.8
Energy, Kcal	32
Protein, g	2.8
Fat, g	0.4
Carbohydrate, g	4.2
Ash, g	1.8
Vitamin A, RE-µg	1,632
Vitamin A, RAE-µg	816
Beta carotene, µg	2,270*
Total carotene, µg	17,310*
Vitamin C, mg	87
Thiamin, mg	0.03
Riboflavin, mg	0.16
Niacin, mg	0.5
Calcium, mg	200
Iron, mg	10
Phosphorus, mg	35

RADISH GREENS

(***Raphanus sativas L***)
Family: *Brassicaceae*
Common Names: Mooli (Indian: Hindi) Mullangi Keerai (Indian: Tamil)
Mullangi Aku(Indian: Telugu)

INTRODUCTION

Raphanus sativas known as Radish to the common man is an edible root vegetable that is popular all over the world. Radish is a member of the Brassicaceae family. Radishes can taste mild and sweet or peppery and pungent or in any of those combinations. The taste depends on the variety, soil in which it is grown and the age of the plant. The tangy flavor of all types of radishes is due to the mustard oil found in cruciferous plants.

Radish, a native of Asia, is fairly easy to grow and is a rapidly maturing crop with many varieties that reach maturity within 60 days. The most popular eating part of radish is the tuberous root. However the radish greens, a rosette of oblong serrated leaves that are found just above the ground, is also edible and used as leafy vegetable. The stem is reddish in color towards the base and green as it progresses upwards. The leaves are rough, the outer ones being broader than the inner ones. The central stem grows up to a height of 3 feet, bearing a lightly dispersed cluster of white to pink to purple flowers at the tip of the stem.

Radishes come in a variety of sizes, ½ inch to about 1 ½ feet, and shapes, small and round, large and round, oval, oblong and long. They also come in a variety of colors ranging from red, white, red and white, pink, purple, or green and to many shades in between. It is a low maintenance and easy to grow vegetable.

USES

The greens can be used raw in salads, and as an ingredient in soups, pesto and can be cooked just like any other leafy vegetable. Radish greens have six times the amount of Vitamin C found in the root and is also rich in calcium, iron and thiamine. It is also a good source of folic acid and molybdenum that helps in the development of the nervous system.

PICTURES




Pictures: Source – internet(From Left to Right): http://veganvisitor.wordpress.com/2009/06/09/dont-toss-those-radish-greens/, http://www.ehow.com/how_5620696_use-radish-greens.html, http://kasj0.deviantart.com/art/Radish-Field-121521227 , http://www.wellsphere.com/healthy-eating-article/daikon-with-daikon-tops/457734

VARIETIES

Radish as a vegetable is not new to the USA and is currently grown in several parts of the country. Use of radish greens as a leafy vegetable is relatively new. Several varieties are available in the market that is season dependent.

- Spring time varieties include Burpee White, Champion, Cherry Belle, Cherry Queen Hybrid, Early Scarlet Globe, Easter Egg, Fuego, Plum Purple, Snow Belle, Red Boy. These varieties come in a wide range of shape, size and color.
- Summer varieties include French Breakfast, White Icicle, Scarlet King, All Season and Silver Dollar.
- Winter varieties which are primarily grown for storage include Chinese Rose, Chinese White, Round Black Spanish, Black Luxury and Tama Hybrid.

CLIMATE

Radish is a cool season crop. The leaves tend to bolt in warm temperature. So, the ideal temperature to grow radish is 68°F. However there are several different varieties of radishes that can be grown during different seasons of the year.

SOIL

Radish grows best in thoroughly prepared, composted, loose crumbly soil. Rich well drained sandy loam soils with high organic matter and a pH level between 5.5 and 6.8 is best suited.

FIELD PREPARATION

Radish grows well in almost any soil that is thoroughly prepared and adequately enriched with manure during the last plow before planting. The soil needs to be loosened to aid the growth of roots. Form rows that are 12 to 18 inches apart.

SOWING

Propagation is by seeds. The seed rate is 10 kg/ha. The seeds have 98% purity and a germination rate of 70%. Sow the seeds thinly at a depth of ¾ inch. The seeds start to germinate in about 3 days and the seedlings with true leaves that are about 3 inches long appear in about 10 days. Spring and summer varieties should be thinned to be 1 inch apart within the rows. The winter varieties need to have a larger space all around to grow and should be thinned to be 2 to 3 inches apart between plants. If necessary hill the soil around the stems as the plants begin to grow.

Spring radishes can be planted as soon as the soil can be worked on and until mid-spring. Successive plantings of short rows can be made every 2 weeks. Summer radish varieties can be planted in late spring for a summer harvest. Winter varieties are planted midsummer to late summer and will be ready for harvest when the first frost sets in.

IRRIGATION

Water evenly every week. Do not let the soil to dry out. To prevent root split reduce watering when the roots appear to be mature.

FERTILIZATION

In case the plants are cultivated for both the vegetable and the green, apply a basal dressing of farm yard manure at 25 ton/ha and NPK at 50:100:50 kg/ha. For a good vegetable harvest fertilize with a high phosphate, high potash fertilizer a month after planting. For harvesting radish greens fertilize with 25 kg/ha of N 30 days after sowing. If the plants are cultivated for generating seeds 50 kg/ha of N has to be applied just before flowering. In case of seed harvest, to increase the yield and quality of seeds a foliar spray of DAP at 2 kg/ha thrice at ten day intervals during flowering is recommended.

Crinkled and brittle leaves, drying leaf tip, pale yellow leaves at initial stages and bluish green leaves at later stages are indications of deficiency in Boron. A foliar application of 0.05 – 0.10% Copper sulphate solution is recommended remedial measure. Intervenal chlorosis often appears as yellow mottling between the veins in younger leaves at the initial stage and drying of leaves at later stages indicating deficiency of zinc. As a remedy spray 0.25 – 0.50% Zinc sulphate solution in the nursery/green house five weeks after germination and a foliar application of 0.1% Zinc sulphate in the field. Pales Yellow leaves, wilting of leaves with onward crinkling is an indication of deficiency of Molybdenum. To remediate this situation spray 625g Ammonium molybdate in 400 lit of water as foliar spray just before flowering.

PLANT PROTECTION AND WEED CONTROL

Spray Malathion 50 EC 1 ml/lit twice or thrice at 10 day intervals to control Aphids, flea beetles and mustard saw fly. Spray Mancozeb 2 g/lit or Copper oxychloride 2 g/lit to treat infestation of White rust. Root maggots, a major problem for radish cultivation, can be discouraged by making sure that radish is not grown on the soil where a member of the cabbage family has been grown in the past 3 years. If maggots have been a problem in the past, an application of suggested soil insecticide before planting would help prevent the problem. If maggots, wireworms or borers are active, rake in large quantities of wood ash or mature compost along the rows. Leafhoppers will attack leaves only if they have been allowed to dry out. Hence ensure that the leaves don't dry out. Radishes are sometimes planted as a trap crop to attract root maggots away from onions. Maggot infested radishes are then removed and discarded. Liberal amounts of mature compost will also discourage pests.

Weeding and hoeing should be undertaken as necessary. Thinning of thickly sown plants should be done at the second weeding. Care must be exercised to make sure that there is no damage to the roots while weeding, as this may lead to plant diseases. An application of pre-emergence Metolachlor 1.0 – 2.0 kg/ha or Alachlor 1.5 – 2 kg/ha or Isoproturon 1-1.25 kg/ha or Pendimethalin 1.2 kg/ha or Fluchloralin 0.9-1.35 kg/ha helps in controlling weed growth.

HARVEST AND YIELD

Micro-greens are greens, lettuces, and herbs that are harvested when they are quite young, generally when they are approximately an inch or two tall. Radish greens can also be harvested as micro-greens. Micro-greens can be grown in green houses all year around. Radish greens can be harvested as early as 7-8 days as micro-greens. Radish greens taste the best if harvested when they are about 4- 6 inches tall. Seedlings that are removed while thinning can also be marketed as radish greens. Harvest the greens by cutting off the leaves one inch above the soil, or pick each leaf and cut them, leaving the growing tip intact. By leaving the growing tip intact, a second harvest of the greens within a few weeks is possible. Micro-greens can also be grown in green houses during winter. Each flat of radish seeds yields about 1 lb of micro-greens.

Radish as a vegetable matures rapidly under favorable conditions. Pull the radishes out when they are of usable size. Delaying the harvesting of radish renders the vegetable pithy and leads to the growth of seed stalks. Summer varieties can be harvest in about 5 to 6 weeks. Spring and summer varieties yield about 25-30 tons/ha. Winter varieties mature more slowly and can be harvested in about 9 weeks or left until the first frost hits the ground. This results in the winter varieties to be of a considerably large size as compared to the spring and summer varieties.

Seeds mature in 35-40 days after flowering. Harvest the pods when they are dry and turn creamy straw color. Drying of pods intact in the plant enables a single harvest and does not affect quality. Thresh the seeds with a pliable bamboo stick to extract the seeds. The plants yield about 600-700 kg/ha of seeds. The viability of seeds is 1.5 years.

NUTRITION FACTS

Reference: Nutritive value of Indian foods. 2002. S no 100 (ref # 2). Values with * see ref # 1.

Nutrient	**Nutrient Composition/100g** **(edible portion)**
Leaves	
Moisture, g	91
Energy, Kcal	28
Protein, g	4
Fat, g	0
Carbohydrate, g	2
Fiber, g	1
Calcium, mg	265
Iron, mg	0
Phosphorus, mg	59

AMARANTHUS SPP.

(***Amaranthus spp***.)
Family: *Amaranthaceae*
Common Names: Amaranth, Pigweed (USA) Chauli (Indian: Hindi)
Thandu Keerai (Indian: Tamil) Kodi Thota Kura(Indian:Telugu)
ntungu (Tanzania) phak hom (Thailand) hinn choy (Chinese) hiyu (Japanese)

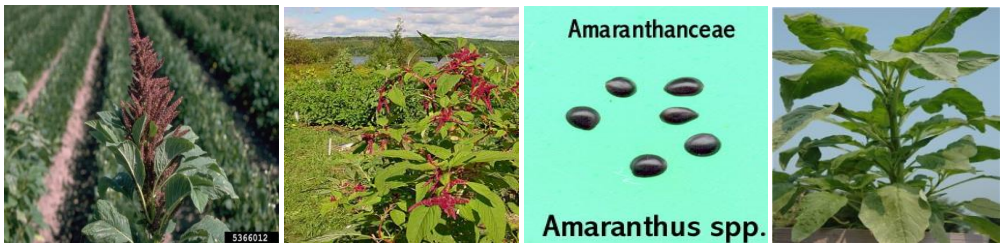
INTRODUCTION

Amaranth, one of the oldest food crops in the world is currently grown as a leafy green vegetable in many temperate and tropical regions in the world. However, it is considered as a weed in some parts of the world. This annual leafy green vegetable is widely grown in the tropics throughout the year and is considered to be a native of India. The plant grows to a height of 6-8 feet. The leaves alternate and have long petioles. The plant bears tiny green or red flowers in elongated tiny clusters at the tip of the branches. The seeds are shiny, black in color and very tiny about 1 mm in diameter.

USES

The leaves and the succulent stems of this plant are edible and are a good source of iron, calcium, Vitamin A and Vitamin C. The leaves can be cooked and used similar to spinach. Since the leaves have a bland taste, peppers, onions and other spices are used while cooking to enhance the flavor of the dish. In some parts of the world, roasted seeds of amaranths are also used to enhance flavor and texture to baked goods. This is a fast growing plant and can be easily cultivated in home gardens and farms. It is used to treat mouth and intestinal ulcers and also as an astringent.

PICTURES



Picture Source – Internet (from Left to Right): http://www.forestryimages.org/browse/detail.cfm?imgnum=5366012, http://www.4windsspirit.com/herbs.htm, http://www.oardc.ohio-state.edu/seedid/single.asp?strId=2, http://www.seedsofindia.com/item/Amaranthus-Callaloo-67

VARIETIES

There are several varieties of this leafy vegetable that are commonly cultivated in India but the common cultivar that are cultivated to be used as leafy vegetable are Amaranthus tricolor and Amaranthus dubius. The seeds are black in color in leafy Amaranthus.

CO 1: It belongs to *A.dubius*. It is suitable for growing tender greens (mulaikeerai in Tamil) and immature stems (thandukeerai in Tamil) that are thick and fleshy. The leaves of this variety are broad, thick and dark green in color. The first harvest can be made at 25 days after sowing. The seeds are very small and black in color.

CO 2: Some of the most common commercial amaranths are selections of A. tricolor in various leaf colors such as light green, dark green, red, purple, and variegated. The leaves are lanceolate (shaped like the head of the lance). The stems remain tender and succulent and hence it suitable to be harvested in 30 days after sowing. Both the leaves and stems of this plant can be used as vegetable.

CLIMATE

Amaranthus grows well in both hot humid and hot dry climates. The ideal temperature to grow it is between 68° - 86° F.

SOIL

Amaranthus is best grown in plains but can also be grown in a wide range of soil conditions. However, the best soil condition to grow this is sandy loam that is lightly acidic in nature with good water holding capacity. It is best to avoid growing this plant in heavy clay and sand. Soil pH level of 4.5 to 8.0 is considered to be ideal for growing this leafy green vegetable.

FIELD PREPARATION

Amaranthus requires thorough land preparation and a well prepared bed for good growth. The field is plowed two to three times and beds and channels of 2 X 1.5m are formed.

SOWING

Propagation is by direct seeding or by transplantation. The choice of planting method depends on the cost of labor and seeds. Approximately 2.5 kg seeds are required for a hectare. Soaking the seeds in Ethrel 200 ppm for 12 hours will enhance germination.

Direct Seeding: This planting method is preferred when the seeds are available in plenty, there is a shortage of labor, and planting is done during the dry season when the risk of flooding due to rain is minimal. Seeding rate is 2 kg per hectare. Mix 2 kg of seeds with 20 kg of fine sand and 5kg of BHC 10% dust and broadcast uniformly over the prepared beds. To prevent the seeds from being blown away, sprinkle a thin layer of compost, sand or soil and cover the broadcasted seeds. To prevent the seeds from being eaten by ants, apply BHC 10% dust to the borders of the sown beds. The seeds usually germinate in 5 to 7 days.

Transplanting: This planting method is preferred when there is a need to shorten the crop duration, the availability of seeds is limited, there is no shortage of labor and the seeds are to be sown during the wet season.

Seedlings can be grown in seed beds, pulled out (bare-rooted) and then transplanted in the field. Seedlings can also be raised in plastic seedling trays using potting mix and then transplanted with the potting mix. Seedlings thus grown are usually raised in green houses. Seedlings are ready for transplantation when they have about 5 or 6 leaves or about 3 weeks from the date the seeds are sown in the seed bed/seedling tray. Gradually expose the seedlings to direct sunlight before transplantation to reduce the effect of transplantation shock on the plants.

The seedlings are transplanted in the raised beds prepared in the field. Plant the seedlings in individual pits at a depth of 10 cm and close the pit by firmly pressing the soil around the seedling. Ensure a minimum spacing of 10 cm between plants. Irrigate the field immediately after transplantation. To minimize the shock of transplantation, it is recommended to do the transplanting later in the day or on a cloudy day when the intensity of the sun is less.

IRRIGATION

In case of direct seeding, irrigate immediately after sowing. The field should then be irrigated on the third day and subsequently once a week. Care should be taken to make sure that the irrigation does not wash off the seeds, resulting in an uneven stand of the crop. In case of transplanting, the first irrigation is given immediately after transplanting, on the third day after transplanting and subsequently once a week.

Plants should be irrigated if wilting of leaves occurs during noon time. The beds and furrows should be prepared in such a manner that there is no stagnation of water during irrigation and/or during rainy season. Over-irrigation should be avoided as it leads to disease promotion and leaching of nutrients from the soil. In case of sprinkler irrigation, late evening irrigation should be avoided to prevent disease.

FERTILIZATION

Amaranthus being a low management crop can be grown even in poor soil conditions. However, the yield can be increased by applying appropriate organic and inorganic fertilizers. The quantity of fertilizer to be applied depends on soil type, soil fertility etc. It is recommended that 25 tons of farm yard manure be applied per hectare at the last plow, before the beds are formed. For CO1 and CO2 varieties, a combination of 50:50:20 kg of NPK/ha along with Azospirillum at 2 kg/ha and Phosphobacteria at 2 kg/ha is recommended to be applied as a basal dose.

PLANT PROTECTION AND WEED CONTROL

As the leaves and stems of the Amaranthus plant are harvested within 25 to 30 days of sowing, it is best to avoid the use of any pesticide. However if pests like leaf wabbler or caterpillar occur, it is advisable to spray Malathion at 1.5 ml/lit or Carbaryl 50 WP at 2g/lit. In the instance of severe white rust Dithane M-45 can be sprayed at the rate of 2 g/lit. To control ants, termites and other burrowing insects an application of Lindane 1.3% dust at 10 kg/ha around the beds is recommended. After the application of any type of pesticide, it is generally advisable to wait for

at least a week before the stems and leaves can be harvested. If the plants are grown to generate seeds, a foliar application of DAP 2% at flowering and 10 days after the first spray improves seed quality and yield.

Since Amaranthus is small seeded and slow to germinate, adequate weed control is essential early in the season. In case of direct seeding, good quality seeds and thorough land preparation free of weeds helps in effective weed control. In case of seedling transplantation, mulching could be used as an effective measure to control weeds. Mulching also helps in moisture retention and prevention of soil erosion. However, care must be taken to make sure that the mulch is free of weed seeds. Mulching can also be used in case of use of direct seeding method, after the plants have reached a height of about 10 to 15 cm. Hand and hoe weeding can be performed as needed.

HARVEST AND YIELD

Amaranthus leaves can be harvested anytime between 25 to 40 days from sowing. Based on the variety sown, it can be harvested once or multiple times. With multiple harvests, subsequent harvest of tender leaves and stems can be made at an interval of 2 to 3 weeks. As Amaranthus is a leafy vegetable, to prevent water loss, it is advisable to harvest the greens either early in the morning or late in the evening when the temperature is cooler compared to the rest of the day. CO 1 yields about 7 to 8 tons/ha and CO 2 yields about 16 tons/ha.

Sometimes the plants are grown past the green matter harvest stage to flower and generate seeds. Seeds attain maturity 35 – 45 days after flowering and are ready for harvest when the plumes turn brown and seeds turn black in color. Seeds are extracted by beating with pliable bamboo sticks and dried to 7-8% moisture content. This results in a yield of 200 kg of seeds per hectare. Graded seeds are treated with Carbendazim 50% WP @ 2g/kg of seeds and Halogen formulation at 3 g/kg of seeds and stored for 10 months in a cloth bag or for 18 months in moisture vapor proof containers.

NUTRITION FACTS

Reference: Nutritive value of Indian foods. 2002. S no 54 (ref # 2).

Nutrient	**Nutrient Composition/100g (edible portion)**
Leaves	
Moisture, g	80.6
Energy, Kcal	57
Protein, g	4.5
Fat, g	0.6
Carbohydrate, g	8.5
Fiber, g	1.6
Calcium, mg	321
Iron, mg	18
Phosphorus, mg	71

AMARANTHUS TRISTIS

(***Amaranthus tristis***)
Family: Amaranthaceae
Common Names: Pigweed (English) Chauli or Saag (Indian:Hindi), Arai Keerai (Indian:Tamil), Thota Kura or Koyya Kora(Indian:Telugu)

INTRODUCTION

Amaranthus tristis native to tropical America and India, is now widely cultivated throughout the tropical regions of the world. The plant grows up to a height of 3 feet. The stems are slender and branched, the leaves are green and oval shaped. The plant produces green flowers.

USES

The leaves and succulent stems are good sources of iron, calcium, Vitamin A and Vitamin C. The leaves and stems are cooked with onions, salt and green chilies to form a dish on its own or is combined with other vegetables to be served alongside with rice or bread. As the leaves are high in nutrients it is best suited to be served to children and lactating mothers. These greens help reduce anemia and treat kidney problems.

PICTURES

Pictures: Source – Internet From Left to Right: http://chettinadusamayal.blogspot.in/2009/06/nutritional-greens.html, http://www.orugallu.net/vinDu/?p=120, http://www.anothersubcontinent.com/forums/index.php?showtopic=2248&st=200&k=bb2fe024f8a71424996db6d9af08c1fc&settingNewSkin=1, http://saapadu.wordpress.com/2006/08/,

VARIETIES

CO 3 is the commonly grown A.tristis cultivar in India.

CLIMATE

Ideal temperature for growing *A.tristis* is in the range of 68° - 86° F.

SOIL

Even though *A.tristis* can be grown in a wide range of soil types, sandy loam soil that are lightly acidic in nature are the best suited for growing *A.tristis.* Heavy clay and sand are not suitable for growing *A.tristis.*

FIELD PREPARATION

Thoroughly plow the field to loosen the soil and bring up the nutrients in soil. Incorporate farm yard manure and other fertilizers while tilling and preparing the field for sowing the seeds. 4 X 6 feet beds are then formed.

SOWING

As the crop duration for *A.tristis* is very short, propagation is almost always by direct seeding. Seeding rate is about 2.5kg of seeds per hectare. Mix the seeds and fine sand in the ratio of 1:10 for every hectare. Mix the seed-sand mixture with 5 kg of BHC 10% to prevent the seeds from ants. The mixture is then broadcasted uniformly in the 4 X 6 ft beds. Cover the broadcasted seeds with a thin layer of sand to prevent it from being blown away by wind. Lightly spray the beds with water. The seeds usually germinate in about 5-7 days. Once the seeds germinate and have about 3-4 true leaves, thin the seedlings to a have a spacing of 12-15 cm between each plant on all sides.

IRRIGATION

Once the fields are plowed and beds formed, irrigate the field just before the seeds are sown. The field is also irrigated immediately after the seeds are sown and on the third day after the seeds are broadcasted. Subsequently, the field should be irrigated once every week. Care should be taken to ensure that the seeds are not washed off during irrigation.

FERTILIZATION

Apply 25 tons/ha of farm yard manure, 2 kg/ha of Azospirillum and Phosphobacteria (each), 75 kg/ha of N and 25 kg/ha of K as a basal dose. Apply a side dressing of N after the first harvest.

PLANT PROTECT AND WEED CONTROL

As A.tristis is a short duration leafy green vegetable crop that is harvested within 25-30 days from the time the seeds are sown, it is recommended to avoid using any insecticides. However, the plant is prone to infestation by pests like leaf webber or caterpillar, white rust and can be affected by termites, ants and other insects. A spray of Malathion or Carbaryl is used to contain the loss caused by leaf webber or caterpillar, Diathane is sprayed for treating white rust. Applying lindane dust around the plant beds helps to control the onslaught of ants and termites. It is recommended to wait for at least one week from the date the insecticides were sprayed before the greens can harvested. Hand and hoe weeding is recommended at the appropriate timings. Ensure that there is no damage to the plants while weeding.

HARVEST AND YIELD

The first harvest (clipping) can be made 25 days from the date of sowing. 10 clippings of tender green leaves can be made at weekly intervals for about 3 months. The total yield during the duration of 3 months from the first clipping results in an average yield of about 30 tons/ha.

NUTRITION FACTS

Reference: Nutritive value of Indian foods. 2002. S no 56 (ref # 2).

Nutrient	**Nutrient Composition/100g (edible portion)**
Leaves	
Moisture, g	87
Energy, Kcal	44
Protein, g	2.8
Fat, g	0.4
Carbohydrate, g	7.4
Ash, g	2.4
Calcium, mg	364
Iron, mg	38.5
Phosphorus, mg	52

TURMERIC "INDIAN SAFFRON"

(*Curcuma longa*)
Family: Zingiberaceae
Common Names: Haldi (Indian: Hindi) Manjal (Indian: Tamil)
Paupu kommu(Indian: Telugu)

INTRODUCTION

Turmeric, a rhizome native to India; also known as the "Indian Saffron" is a perennial with pulpy, orange, and tuberous root. The plant has long, broad and bright green leaves that resemble the leaves of the lily plant and is about 3 feet tall when fully grown. It has funnel-shaped yellow flowers borne on dense spikes. It is an important commercial spice grown in India. Turmeric powder is the powder derived from the dried root of the turmeric plant.

USES

Turmeric has been used in India for centuries for its medicinal properties and as a food coloring agent. It is a primary ingredient in every Indian kitchen and is an important ingredient of curry powder. It is used for flavoring and also as a coloring agent. It is a natural antibiotic, a good anti-oxidant and when consumed regularly improves body immunity and acts as an anti-cancerous agent. It is widely used in the food, pharmaceutical and cosmetic industry.

PICTURES

Pictures: Source- internet From Left to Right: http://www.paprikaoleos.com/other-spices.php, http://jayaramanms.multiply.com/journal/item/233/233, http://findmeacure.com/2009/05/11/turmeric-curcuma-longa/, http://www.acupuncturebrooklyn.com/herbs/turmeric-sweet-turmeric, http://elteeindia.com/products/TURMERIC+POWDER.html

VARIETIES

Several varieties are being cultivated in India. Some of them are Allepey, Armoor, BSR 1, BSR 2, Chaya Pasupa, CO 1, Duggirala, Lakadong, Kanthi, Kodur, Krishna, Madras, Prabha, Prathibha, Roma, Ranga, Rashmi, Rajendra, Sobha, Sona, Swarna, Sudharshana, Suguna, Sugandham, Suroma and Varna.

The variations in curcumin content, size, and color of rhizomes are the characteristics that primarily differentiate the varieties from each other. Madras and Allepey are the major varieties that are being exported by India. The intense, brighter and lighter yellow color Madras type with

2% curcumin and 2% volatile oils is preferred by the British and Middle Eastern markets. The orange-yellow fleshy finger type Allepey has 4% -7% curcumin and 3.5% - 5.5% volatile oils and is the preferred variety imported by the USA. The Lakadong variety has a curcumin content of 5% to 5.05%.

CLIMATE

Turmeric is a 7-9 month crop. It grows best in warm and humid climate. A temperature range of 68 to 86°F during that period is ideal for cultivating turmeric.

SOIL

Rich loamy soils with good drainage and irrigation facilities are best suited for growing turmeric. However, turmeric can also be grown in other soil types ranging from light black loam, red soils to clayey soils. Care must be taken to avoid water stagnation and high alkalinity in the field where turmeric is grown.

FIELD PREPARATION

Minimum tilling is all that is required for preparing the land for turmeric cultivation. Incorporate 10 ton/ha of farm yard manure, 200 kg/ha of neem or groundnut cake, NPK at 25:60:18 kg/ha, 30 kg/ha of Ferrous Sulphate and 15 kg/ha of Zinc Sulphate into the field while tilling.

Beds as high as 15 cm, 1 m wide and of convenient length need to be prepared with 50 cm spacing between beds. An alternative to this is the creation of ridges and furrows in case of cultivation by irrigation. The rhizomes are planted in the shallow pits on the top of ridges. 45-60 cm spacing between ridges and 15-20 cm spacing plants is the general norm adopted for cultivation of turmeric in India.

SOWING

Well preserved seed rhizomes free of pests and diseases should be used for propagation. Mother rhizomes and fingers can be used for sowing. However, mother rhizomes have a better yield than the finger rhizomes. The fingers are cut into 4-5 cm long pieces and the mother rhizomes can be split into two rhizomes having at least a good bud each and planted as 2 rhizomes or they can be planted as a single rhizome. To break the dormancy in the seed material, the seed rhizomes are soaked in 50% sulphuric acid for 10 min and then thoroughly washed daily for 15 – 17 days. This process results in 90% germination. The seed rhizomes are sometimes sprouted under moist straw before sowing. About 1500 – 2000 kg of rhizomes is required to plant one hectare of land.

The seed rhizomes should be dibbled in the sides of ridges at 15 cm spacing and a depth of 4 cm. The finger rhizomes should be planted flat with buds facing upwards and covered with soil or dry powdered cattle manure or compost mixed with Trichoderma.

IRRIGATION

Irrigate red loamy soils at 5 day intervals. Black loamy soils should be irrigated at 7-9 day intervals, clayey soils at 2 – 3 week intervals and sandy soils at 1 -2 week intervals. Frequent irrigation is necessary during rhizome development and maturity.

FERTILIZATION

Mulch at the rate of 12-15 ton/ha of green leaves immediately after planting the rhizomes and a second mulching after an interval of 50days at the same rate of green leaves. Cow dung slurry poured on the beds after each mulching enhances microbial activity and nutrient availability. N, K at the rate of 25 and 18 kg/ha respectively has to be applied on 30, 60, 90, 120, and 150 days from the date of planting. An application of 375 g of Ferrous Sulphate, 375 g of Zinc Sulphate, 375 g of Borax and 375 g of Urea mixed in 250 lit of water/ha and sprayed twice at an interval of 25 days during the rhizome development stage would help correct deficiency in micronutrients of Boron, Iron, and Zinc. The above micronutrients should be dissolved in Super phosphate slurry, where 15 kg of Super Phosphate is dissolved in 25 lit of water and stored overnight.

PLANT PROTECTION AND WEED CONTROL

Turmeric is not exposed to any major pests or diseases. If there is an incidence of shoot borer, the shoots should be cut open; the larvae picked out and destroyed. If required neem oil 0.5% should be sprayed at fortnightly intervals.

An application of Trichoderma at the time of planting, or a pre- planting treatment of drenching the seed rhizomes in Bordeaux mixture 1% or Copper oxychloride 0.25% helps to control and/or prevent an incidence of rhizome rot. Treating seed rhizomes with 0.3% Copper oxychloride for 30 minutes before storage can also help restrict the onset of rhizome rot.

A restricted use of Bordeaux mixture 1 % can help control Leaf spot and leaf blotch. Spraying of Carbendazim 500 g/ha or Mancozeb1lg/ha or Copper oxychloride 1.25 kg/ha controls the disease of leaf spot. Thrips can be controlled by spraying dimethoate 30 EC or methyl demeton 25 EC 2 ml/lit.

To prevent the onset of nematodes, avoid planting turmeric after a cultivation of solanaceous vegetables. To control and prevent rhizome scale, apply 2 splits, one basally and other at earthing up, of well rotten sheep manure or poultry manure at 10 t/ha followed by drenching of dimethoate 30 EC 2 ml/lit or phosalone 35 EC 2 ml/lit or an application of Carbofuran 3 G at 1.5 kg a.i/ha.

First weeding takes place in 3 weeks followed by weeding and hoeing as necessary. Depending on the weed intensity the crop is weeded thrice at 60, 120 and 150 days after planting. Soil solarisation also helps prevent and control weed growth and enhance nutrition in the soil.

INTERCULTIVATION

In fields where turmeric is the primary crop, Onion and green chilies can be planted as intercrops 10 cm apart on the ridges. A seed rate of 250 kg/ha of onion seeds are required. Red gram and Castor can also be planted as intercrops but with much wider spacing and along the edges.

Turmeric can also be grown as an intercrop in coconut and areca nut plantations.

HARVEST, CURING AND YIELD

The crop is usually ready for harvest in about 7 – 9 months. The aromatic types mature in about 7 months, the intermediate types in about 8 months and the late types in about 9 months. The lower leaves turning yellow or drying up is a clear indication that the crop is ready for harvest.

The land is usually plowed and the rhizomes are handpicked or the clumps are carefully lifted with a spade. The fresh turmeric thus harvested is usually cured to obtain dry turmeric and is subject to several processes before they are sold in the market.

Cleaning: The harvested rhizomes are usually covered with mud and other extraneous materials. These rhizomes have to be cleaned clear off the mud and other materials, within 2-3 days of harvesting.

Boiling: The rhizomes thus cleaned will have to be segregated into mother and finger rhizomes. Some of the mother rhizomes are usually saved as seed material for the next season. The mother and finger rhizomes should be boiled separately.

The cleaned rhizomes are soaked with just enough fresh water to cover them and are boiled in copper or galvanized or earthen vessels. Boil the rhizomes till they become soft. A needle pierced on one side of the rhizomes coming out with ease on the other inside is an indication that the rhizome has reached the right consistency of softness. The turmeric thus boiled is lifted out of the vessel with the use of troughs, draining the water into the vessel itself. The same hot water is used to boil the next batch of fresh turmeric.

Drying: The rhizomes thus boiled and drained are spread out on bamboo mats or dry concrete floors and left to dry in direct sunlight. These rhizomes should be covered at night time. Depending on the intensity of the heat of the sun, it may take about 10-15 days for the rhizomes to be completely dry. The boiled turmeric can also be dried artificially by using a cross-flow of hot air at a maximum temperature of 140°F. Artificial drying enhances the color of the turmeric.

The dried turmeric has a poor appearance and a rough dull color outside the surface with scales and root bits still attached to the rhizomes. To improve the appearance of the turmeric before it is marketed, it has to be smoothened and polished.

Polishing: The boiled and dried turmeric has a rough and hard outer surface. Polishing is undertaken to smoothen the outer surface and to improve the color of the turmeric. There are two types of polishing, hand polishing and machine polishing.

Hand Polishing: Hand polishing consists of rubbing the turmeric fingers on hard surface or wrapping them in jute bags and trampling them under the feet. Hand operated drums mounted on a central axis is also used to polish the turmeric. Polishing happens when the drum filled with turmeric is manually rotated. At that time the rhizomes rub against each other and/or rub against the surface of the mesh, resulting in polished turmeric.

Machine Polishing: Under this method, a barrel or a drum mounted on a central axis and operated by power, is filled with the dried turmeric. Polishing happens when the drum filled with turmeric begins to rotate and the rhizomes rub against each other and/or when the abrasion of the surface against the mesh happens.

Coloring: The color of the turmeric is one of the major features that attract buyers. Turmeric suspension in water is added to the polishing drum during the last 10 minutes of polishing. The rhizomes thus uniformly coated with the turmeric suspension are dried in the sun. An alternative to this kind of coloring is to take the boiled, dried and half polished rhizomes in a bamboo basket, sprinkle them with turmeric powder and shake them well. When the rhizomes are uniformly coated with turmeric they are dried in the sun. Half polished turmeric is better suited for this type of coloring process since the color sticks best with half polished turmeric than with full polished turmeric that has a very smooth surface. 200 g of turmeric powder is required to coat every 100 kg of half polished turmeric.

The turmeric thus cultivated usually results in a yield of 25 – 30 ton/ha of fresh rhizomes and 5 – 6 ton/ha of cured rhizomes. On an average 20 – 25 percent of the cleaned fresh rhizomes cultivated is obtained as cured rhizomes.

The polished turmeric is then powdered and made available for consumption.

NUTRITION FACTS

Reference: Nutritive value of Indian foods. 2002. S no 237 (ref # 2).

Nutrient	**Nutrient Composition/100g (edible portion)**
Rhizome	
Moisture, g	13.1
Energy, Kcal	349
Protein, g	6.3
Fat, g	5.1
Carbohydrate, g	69.4
Fiber, g	2.6
Ash, g	3.5
Vitamin A, RE-µg	2.5
Vitamin A, RAE-µg	1.3
Total carotene, µg	30
Vitamin C, mg	0

Thiamin, mg	0.03
Riboflavin, mg	0
Niacin, mg	2.3
Folate, µg	18
Calcium, mg	150
Iron, mg	67.8
Phosphorus, mg	282

CHINESE GREENS AND HERBS

SHANGHAI BOK CHOY

(***Brassica rapa var. chinensis***)
Family: *Brassicaceae (Cruciferae)*
Common Names: Chingensai (Japanese), Baby Bok Choy, Chinese Chard, Chinese Mustard, Chinese Cabbage

INTRODUCTION

Shanghai Bok Choy is a leafy vegetable with light green stalks and green leaves that has a bulbous base. The plant, a member of the cabbage family, is native to China but is now cultivated all over the world and used in various cuisines. Similar to celery, it has white stalks that are crunchy and green leaves tasting like cabbage. It is also referred to as spoon cabbage.

USES

It is used in soups, salads, stir-fry, spring rolls and dumplings. It can also be cooked as a stand-alone dish. It is a nutrient-dense vegetable that contains rich anti-cancer compounds and is also rich in calcium (with more than 50% absorbency rate), Vitamins A and C, fiber, folic acid and nitrogen compounds. It is said to improve metabolism and relieve urinary problems.

PICTURES

Picture source: internet From Left to Right: http://www.cifarm.com/products.html, http://www.buzzle.com/articles/how-to-grow-bok-choy.html, http://www.elysianfarm.com/photos.html,http://seedbiology.osu.edu/seed_id/brassicaceae/brassica_rapa_spp_chinensi.html, http://www.allposters.com/-sp/Bok-Choy-Variety-Shanghai-Brassica-Rapa-Var-Chinensis-Native-to-China-Posters_i6011700_.htm

TYPES AND VARIETIES

Several varieties of Bok Choy exist. Some cultivars have large leaves with short stems and some cultivars have circular leaves with slender, longer stems. Some are of the dwarf varieties that do not grow more than 20 cm tall. Canton Dwarf, Green-Stemmed, Prize Choy, White-Stemmed, Chin-Chiang, Mei Qing Choi, Dynasty and Shanghai Green are some of the common varieties grown in the United States.

CLIMATE

Shanghai Bok Choy a cool season crop grows well in temperatures between 59°F to 68°F. The plant is relatively hardy but temperatures above 75°F may result in burnt tips and temperatures below 55°F may initiate flowering in the plants. If the plants are exposed to a week of night time temperatures below 50°F, it may result in bolting. It can tolerate only light frost. The length of

the day also has an impact on the growth of the plant. Short days promote good plant growth whereas longer days promotes flowering.

SOIL

Shanghai Bok Choy grows well in well drained, fertile soil rich in organic matter and good water retention level with a pH level from 5.5 – 7.0

FIELD PREPARATION

The land should be tilled, leveled, beds formed and irrigated prior to planting the seeds or seedlings. Prior to planting; if an herbicide application is undertaken, it must be applied prior to forming the beds and if a fungicide application is undertaken, it must be applied after the formation of the beds. 44 inches wide beds are prepared with 4 rows per bed that are 11 inches apart.

SOWING

Propagation is by direct seeding or by transplanting.

Direct Seeding: Plant seeds at a depth of ¼ to ½ inch and about an inch apart. It takes about 4 to 7 days for the seeds to germinate when the temperature is the range of 50 – 80°F. Once the seedlings are about 10 cm tall, thin them to a spacing of 6 to 12 inches in a row. Thinned out plants can be used for transplanting or sold as baby greens.

Transplanting: Start transplant about 4 to 6 weeks prior to planting them in the field. Set transplants in the field 6 to 12 inches apart in a row. It is important to harden off the seedlings prior to transplanting to minimize transplant shock and prevent premature bolting due to transplant stress.

Seedlings or seeds thus planted (and thinned) result in a total of about 29000 to 44000 plants per acre.

IRRIGATION

Shanghai Bok Choy requires consistent moist soil to encourage good growth of the plant. For drip and sprinkler irrigation, small, frequent applications should be scheduled to maintain adequate soil moisture that would result in optimum growth and yield. The land should be irrigated at least 4 times per week with a minimum of one inch of water per week. In case of seepage irrigation, measures must be taken to maintain adequate field water table that does not lead to excessive wetness in the root zone. Too much of water also is not good for the plants. As is the case for all other greens, it is best to irrigate the fields early in the morning.

FERTILIZATION

Fertilizer application should be undertaken based on the results of a soil test. If a soil test is not done, a base fertilizer of 5-10-10 is recommended at a rate of 3 pounds per 100 square feet. This fertilizer should be worked well into the soil while the field is being prepared for planting, else it

would result in root burn. All of the phosphorous and potassium should be applied prior to planting. About two to four side dressing of Nitrogen at the rate 30 to 40 lbs / acre per application is recommended.

PLANT PROTECTION AND WEED CONTROL

Excessive soil moisture results in bacterial soft rot. Irrigation should be undertaken frequently with just the right quantity of water to prevent excessive soil moisture. Insects like aphids, ants, flea beetles and diamond black moth can affect the growth of Shanghai Bok Choy. Use of chemicals to control plant diseases and attack of insects while growing greens and herbs should be avoided. If chemicals have to be used to protect the plants, only chemicals recommended for the specific plants should be used.

Controlling weed growth is very important until the plants are well established. Use of good quality seeds ensures minimum or no weeds. Hand weeding should be undertaken as and when necessary. Use of chemicals to control weeds is not recommended in case of greens and herbs. Maintaining adequate field sanitation also helps in controlling the growth and spread of weeds. Disking while preparing the field for planting can also help minimize weed growth.

HARVEST AND YIELD

If propagation is by direct seeding, the plants are ready for harvest in about 40 to 80 days (depending on the type of cultivar). In the case of propagation by transplantation, the plants are ready for harvest in about 30 to 50 days. Harvest the greens when the leaves are about 6-10 inches high. The plants should be harvested before the outer leaves turn yellow to prevent them from becoming fibrous. Cut the plant off just above the ground level and make sure that the head remains intact. If planning for a subsequent harvest, the leaves are cut off at about 3 cm above the ground level. Trim off any roots at the base of the stem and remove all damaged leaves. Bunch together 2 to 3 heads and fasten with a rubber band to hold them together. Loosely pack about 20 to 25 bunches into wooden crates.

The greens should be harvested either early in the morning or late in the evening when the temperatures are cooler. The harvested greens would keep fresh for about 3 weeks if shipped and/or stored at a temperature of 32°F and at a relative humidity of 95-100%. The average yield of Shanghai Bok Choy is about 250 - 400 crates per acre. Each crate would contain about 30 to 50 heads weighing about 45 lbs/crate.

NUTRITION

This general nutrition information is for one serving of any variety of raw bok choy.

Serving Size: Raw 1 cup shredded = 70 gm

Nutrient	Units	
Proximates		
Water	g	66.72
Energy	kcal	9
Protein	g	1.05
Total lipid (fat)	g	0.14
Carbohydrate, by difference	g	1.53
Fiber, total dietary	g	0.7
Sugars, total	g	0.83
Minerals		
Calcium, Ca	mg	74
Iron, Fe	mg	0.56
Magnesium, Mg	mg	13
Phosphorus, P	mg	26
Potassium, K	mg	176
Sodium, Na	mg	46
Zinc, Zn	mg	0.13
Copper, Cu	mg	0.015
Manganese, Mn	mg	0.111
Vitamins		
Vitamin C, total ascorbic acid	mg	31.5
Thiamin	mg	0.028
Riboflavin	mg	0.049
Niacin	mg	0.350
Vitamin B-6	mg	0.136
Folate, total	µg	46
Folic acid	µg	0
Folate, food	µg	46
Vitamin B-12	µg	0.00
Carotene, beta	µg	1877
Vitamin A, IU	IU	3128
Vitamin E (alpha-tocopherol)	mg	0.06
Vitamin E, added	mg	0.00
Vitamin D (D2 + D3)	µg	0.0
Vitamin D	IU	0
Vitamin K (phylloquinone)	µg	31.9
Lipids		
Cholesterol	mg	0

Source: USDA National Nutrient Database for Standard Reference

CHINESE BROCCOLI

(***Brassica oleracea var. alboglabra***)
Family: *Brassicaceae* (*Cruciferae*)
Common Names: Gai-Lan/Kai-Lan (Cantonese), Phakkhana (Thai)
Jie Lan (Mandarin), Kailaan (Japanese), Cai ro (Vietnamese)

INTRODUCTION

Chinese Broccoli a cool-season crop, commonly known as Gai-Lan or Kai-Lan or flowering Chinese kale is a leafy vegetable popular in Asia and increasingly gaining popularity in the Western households. This plant has thick, flat, glossy blue-green leaves with thick stems and a small number of tiny flower heads similar to that of Broccoli. The leaves taste best when they are harvested before the flowers open. Its flavor is very similar to that of Broccoli but a bit more on the bitter side. This leafy vegetable is primarily found in Asian markets and to a small extent in mainstream American grocery stores.

USES

The stalks, leaves and unopened flower buds are used for culinary purposes. They can be steamed, used in stir-fry and soups. The leaves are a good source of Dietary Fiber, Vitamin A, Vitamin C, Vitamin B6, Vitamin K, Iron, Calcium and Folate.

PICTURES

Pictures- Source Internet (from Left to Right): http://www.dpi.nsw.gov.au/agriculture/horticulture/vegetables/commodity/asian/gai-lan-embrassica-oleracea-var.-alboglabraem, http://en.wikipedia.org/wiki/Kai-lan, http://www.westcoastseeds.com/productdetail/vegetable-seeds/broccoli/Gai-Lan-Midwater-/, http://www.worldcrops.org/crops/Chinese-broccoli.cfm, http://www.worldcrops.org/crops/Chinese-broccoli.cfm

VARIETIES

Several varieties of Chinese Broccoli are grown in Asia. The length of the stem and the color of leaf may vary from light to medium depending on the variety of Chinese Broccoli grown. Although several varieties such as Hon Tsai Tai, Summer Jean, Happy Rich, Gai Lohn, Kailaan and Green Lance exist, Kailaan and Green Lance are the most popular varieties grown in the United States. Dill, Celery, Sage and Rosemary can be grown as companion plants.

CLIMATE

This cool weather crop is grown as an annual in Asia but can be grown as a perennial in the United States. The plant prefers full sun but may bolt (flower prematurely) in extreme hot weather. It can be sown in early spring for an early summer harvest and in late summer for a late fall harvest. In places with relatively moderate climate, it can be harvested throughout summer. The optimum temperature to grow Chinese Broccoli is between 65°F - 80°F.

SOIL

Chinese Broccoli grows well in well-drained clayey, loamy and sandy soil. It tolerates salt well and a soil with a pH balance of 6.0 to 6.8 is considered to be ideal for growing this plant.

FIELD PREPARATION

To help reduce plant disease, it is best to grow Chinese Broccoli in the location where no Cole crops have been grown in the past three or four. Chinese Broccoli seeds will germinate is soil temperatures as low as 40°F. So, field preparation activities can commence as soon as the soil can be worked on.

The field needs to be prepared thoroughly and 44 inch wide beds created with a distance between rows set at about 12 inches and about 4 rows per bed. The plants can be grown in raised beds with or without mulch. Mulching helps in retaining soil moisture and in controlling the growth of weeds.

SOWING

Though direct seeding is the preferred method for growing Chinese Broccoli, propagation may be made by direct seeding or by transplanting.

***Direct Seeding*:** Seeds are directly sown in the soil. Seeds will germinate at 45 to 85°F and even at soil temperatures as low as 40°F. Place 3-4 seeds in clumps, ½ to ¾ inch deep and about 6 – 12 inches cm apart. It takes about 4 – 7 days for the seedlings to emerge. Once the seedlings emerge, thin to the strongest plant. Plant seeds in late April/ early May for spring planting - summer harvesting. Direct seed late May/ early June for summer planting – fall harvesting. In moderate climate to grow plants over winter, plant seeds late June/ early July for summer planting – spring harvesting.

***Transplanting*:** Seedlings may be raised in nursery beds and/or containers in green houses. Plant seeds about ½ inch deep in nursery beds or containers. When the seedlings emerge in about 3 weeks, separate them into individual pots or containers that are about 3 cm in size. The seedlings are ready for transplantation in about 4 – 6 weeks, when they have 6 – 8 true leaves and are 8 – 10 inches tall. To encourage the growth of large side shoots, make sure to push soil around stems up to the bottom of the first big leaf while transplanting. Start indoors in late March/early April for spring planting - summer harvesting; in late May/early June for summer planting – fall harvesting; and to grow

over winter, start indoors in late June/early July for summer planting – spring harvesting. Plant densities can average about 110,000 plants per acre.

IRRIGATION

Chinese Broccoli grows best when the soil retains uniform moisture. Ensure to schedule irrigation frequency to maintain soil moisture throughout the growing period. It is important that the irrigation provides sufficient water to moisten the soil to a depth of at least 6 inches.

Drip, sprinkler or subsurface seepage irrigation methods can be adopted. In case of subsurface seepage irrigation, care must be exercised throughout the growing season to maintain adequate soil moisture by maintaining the field water table sufficiently high. In case of drip or sprinkler irrigation, frequent applications for a smaller duration should be scheduled throughout the growing season. Excessive wetness in soil will lead to loss of soil nutrition in the plant root zone. Mulching helps to conserve water and also to reduce weeds. It is best to irrigate the plants in the morning.

FERTILIZATION

On an average, four to five applications of N and K at the rate of 30 – 40 lb/acre per application during cultivation is recommended. Higher planting densities require higher levels of Nitrogen.

Chinese Broccoli has a high lime requirement, so lime application should be considered if the soil pH level is below 6.3. Lime should be mixed into the seed bed several weeks before seeding/transplanting. Based on the results of the soil test about 1 to 4 tons of lime needs to be applied per acre.

Based on the soil test results approximately 80 to 200 lbs of Phosphorous, 150 to 200 lbs of Nitrogen and 60 to 200 lbs of Potassium, 25 to 40 lbs of Sulphur, and ½ to 4 lbs of Boron per acre are recommended. P and K should be applied to the soil before direct seeding or transplanting. Regarding N, half the recommended quantity should be broadcast before direct seeding or transplanting and the remaining quantity should be applied about 1 to 2 weeks before the first cutting. Higher planting densities require higher levels of Nitrogen. Excessive fertilization may result in hollow stems, soft rot and plant tip damage.

PLANT PROTECTION

To reduce the effect of diseases in the plants, plant Chinese Broccoli or other Cole crops in the same location only once in every three or four years. The plants are susceptible to clubroot, downy mildew and white rust. Lime application and crop rotation helps control clubroot. Ensuring proper spacing between plants and avoiding overhead irrigation helps control downy mildew. Crop rotation and the removal of cruciferous weeds in a timely manner, helps control white rust. Slugs, snails, flea beetles, cabbage root maggot, cabbage aphids, cabbage worms, and fall armyworms are some of the pests that affect Chinese Broccoli plants. Broken eggshells can be placed around plants to deter slugs and snails. Cabbage aphids can be removed by applying a hard stream of water on the plants. In case of cabbage worms, they have to be handpicked and

destroyed. Row covers will help reduce flea beetles, cabbageworms and also helps in weed control. Hand weeding is the best way to control weeds.

HARVEST AND YIELD

The leafy vegetable is ready for harvest in about 8 – 10 weeks from planting. Shoots with unopened buds and small leaves that are about 20 cm long are harvested before the flower buds begin to open. Subsequent harvests should be done before the stems turn woody and flowers bolt. As recommended for all leafy green vegetable, harvests must be made early in the morning or later in the evening to minimize water stress for the vegetables. Post harvest, the harvested plants are tied into bunches of about 5 – 6 plants per bunch, packed in plastic bags and topped with crushed ice before being sent to the storage or the market. Storing the harvested bunches at a temperature of 32°F and a relative humidity of 95 – 100% would extend the shelf life of the harvested Chinese Broccoli. Approximately 3 – 4 harvests can be undertaken during a growing season resulting in a yield of about 15 tons/ha. The number of harvests and the resulting yield varies dependent on the type of cultivar.

NUTRITION

Serving Size: 100 gm cooked Chinese Broccoli

Nutrient	Unit	Serving Size 100g
Water	g	93.54
Energy	kcal	22
Protein	g	1.14
Total lipid (fat)	g	0.72
Carbohydrate, by difference	g	3.81
Fiber, total dietary	g	2.5
Sugars, total	g	0.84
Calcium, Ca	mg	100
Iron, Fe	mg	0.56
Magnesium, Mg	mg	18
Phosphorus, P	mg	41
Potassium, K	mg	261
Sodium, Na	mg	7
Zinc, Zn	mg	0.39
Vitamin C, total ascorbic acid	mg	28.2
Thiamin	mg	0.095

Nutrient	Unit	Serving Size 100g
Riboflavin	mg	0.146
Niacin	mg	0.437
Vitamin B-6	mg	0.070
Folate, DFE	mcg_DFE	99
Vitamin B-12	µg	0.00
Vitamin A, RAE	mcg_RAE	82
Vitamin A, IU	IU	1638
Vitamin E (alpha-tocopherol)	mg	0.48
Vitamin D (D2 + D3)	µg	0.0
Vitamin D	IU	0
Vitamin K (phylloquinone)	µg	84.8
Fatty acids, total saturated	g	0.110
Fatty acids, total monounsaturated	g	0.050
Fatty acids, total polyunsaturated	g	0.330
Cholesterol	mg	0

Source: USDA National Nutrient Database for Standard Reference

CHIVES AND FLOWERS

(***Allium schoenoprasum***)
Family: *Liliaceae*
Common Names: Green Onions, Spring Onions, Green Shallots

INTRODUCTION

Chives, a member of the Allium family and native to the Asian continent, are bulb-forming hardy perennial plants. Chives look like grass. The grassy leaves are round hollow stems and grow up to 50 cm long and have a diameter of 2-3 mm. Chives produce beautiful lavender colored flowers. The flowers are star-shaped with six petals, with a width of 1-2 cm. Due to its beautiful flowers, chives are also grown as border plants in home gardens. The bulbs grow in dense clusters, and are small, conical in shape with a width of 1 cm and a length of 2-3 cm. Its pinkish lavender fragrant flowers can be used in salads and in flower arrangements. The flowers have both the male and female organs and are pollinated by self, bees, and flies. The seeds are small, black in color and are very similar to onion seeds.

USES

This herb has culinary and medicinal properties. Finely chopped chives are used to flavor soups, butter, cheese, and used in salads and other dishes as it imparts a mild onion-like flavor. Chives are rich in iron, calcium, phosphorous, Vitamin A, and Vitamin C. Due to its sulphur content, chives are also used as a natural antibiotic. Chive oil extract is said to help lower blood levels of low-density lipoproteins.

PICTURES

Picture source: internet From Left to Right: http://www.sowvegetables.co.uk/herbs_chives.htm, http://en.wikipedia.org/wiki/Chives, http://luirig.altervista.org/schedeit/ae/allium_schoenoprasum.htm, http://www.dolphinvillage.com/2010/10/1-oz-chives/, http://en.wikipedia.org/wiki/Chives

TYPES AND VARIETIES

Chives come in variations of height, flower color and flavor. The commonly available chives grow to a height of 50 cm and have purple colored flowers. Other varieties that are grown are:

- *Curly Mauve* with grayed-lavender color florets
- *Marsha* with very deep colored purple flowers growing up to a height of 60 cm
- *Pink Chives* with pale pink flowers growing to a height of only 20 cm

- *Fine Leaved Chives* with pink globular flowers, growing up to a height of 20 cm and has narrow cylindrical leaves compared to other varieties
- *Snowcap* with white flowers growing up to a height of 40 cm.

CLIMATE

Chives thrive well in sunny to partially shady regions. If sown outside, the soil needs to be warm enough for the seeds to germinate. Chive seeds need a minimum temperature of 66°F to germinate. They tolerate light shade, but require at least 6-8 hours of sun light.

SOIL

Chives grow well in moist, well-drained soil rich in organic matter. They can tolerate poor quality soil but not acidic soil. They grow well in USDA hardy zones 3a to 9b. A pH level of 6.0 – 6.8 is considered ideal for growing chives, however it tolerates a pH in the range of 5.2 to 8.3

FIELD PREPARATION

If the acidity of the soil is high, agricultural lime at the rate of 3 to 5 tons per hectare should be incorporated into the soil at least 2 months before planting. In case of sandy soil, organic matter at the rate of 30-40 tons per hectare should be incorporated. In case of clayey soil organic matter should be incorporated to improve soil structure and fertility.

All existing weeds especially perennial weeds should be removed before the land is prepared for cultivation. Since chives are shallow rooted plants, land preparation should also be shallow, about 25-30 cm, and not very deep. In case of continuously cultivated land, the land should be forked and raked; and just raked in case of virgin land. The land must shallow plowed twice to a depth of 25-30 cm before planting.

SOWING

Propagation is by direct seeding, transplanting or by bulbs. Propagation in the northeast usually takes place in spring when the weather begins to get warmer.

Direct Seeding: Propagation by seeds can either be done directly by scattering them in the fields or by starting the seeds indoors. Since chives do not compete well with weeds until they are well established, ensure that the land to be used for cultivation of chives is free from weeds. Scatter the seeds over small sections of land at a time, cover them with ¼ to ½ inch of loose soil and them compact the soil either with hands or with agricultural tools. Chive seeds require minimum warmth of 70°F to germinate. The seeds will germinate in about 15 to 20 days. Thin the seedlings that are about a month old, into bunch of 5 or 6 and space them about 9 inches apart.

Transplanting: If starting the seeds indoors, start them in small containers filled with potting soil, at least six weeks before planting them outdoors. The seeds take about 15 to

20 days to germinate. When the seedlings are about 4 weeks old and no longer look like delicate grass, transplant them, in bunches of 5 or 6, about 9 inches apart and 2 inches deep.

Bulbs: For propagation by bulbs, trim the green tops and plant them in bunches of 5 or 6, and make sure that they are about one inch above the soil surface. Cover the entire planting with ½ inch of soil. Since chives are perennial evergreen plants, they reproduce the bulbs, and spread and enlarge the bulb size by self propagation. Approximately 2300 kg/ha of bulbs are required as planting material.

A spacing of about 9 inches between rows and across rows must be maintained. Increasing plant density results in lower yield due to overcrowding of plants. Decreasing plant density also results in lower yield due to under utilization of land resources.

Propagation by seeds is not recommended for commercial cultivation since they have a long crop cycle. It takes about 2 years for the chive plant to grow to a considerable size if it is started from seeds. If growing chives from seeds, it is advisable to do the first harvest after at least a year in order to give the plants an opportunity to develop a good root system. For a quick turnover, propagation by clumps of bulbs is the preferred method. However, once in every 2 to 3 years, the clumps need to be divided into smaller bunches of 5 or 6 bulbs to promote vigorous growth.

IRRIGATION

The land must be irrigated well before planting the bulbs. After the bulbs are planted, irrigate the land thoroughly to aid the soil around the bulbs to settle well and to provide moisture for new growth. Since chives are shallow-rooted, they thrive even with minimal water resulting in low yields. However, frequent irrigation for shorter periods is highly recommended for good yields. As in the case of cultivation of other greens and herbs, watering in the morning is highly recommended.

FERTILIZATION

As fertilizer requirements are directly dependent on the nutrient quality of the soil, a soil analysis would reveal the type of fertilizer application required for the soil. Chives grow best on soil with a pH of 6.0 – 7.0. Lime requirements vary with different soil types. If required, liming must be undertaken at least six weeks before planting and worked into the soil at a depth of at least 15 cm. In the absence of a soil analysis it is recommended that NPK (15:15:15) at the rate of about 420 kg/ha should be applied two weeks before planting. Urea at the rate of 140 kg/ha and muriate of potash at the rate of 105 kg/ha should be applied six weeks after planting. As with other herbs and greens, chives benefit from a side dressing of organic fertilizer. Light fertilization is required if the leaves appear yellow. Newly established plants should be fertilized at least 3 times per season.

PLANT PROTECTION AND WEED CONTROL

Like most plants, chives are also subject to attacks by pests. Daily inspection during early morning or late afternoon helps in detecting the problem at an early stage. Aphids and thrips seem to be the pests that minimally affect chives. Removal of aphids and thrips by hand at an early stage might help protect the plants. If the problem is severe, it can be controlled by an organic pest control spray.

Unlike other herbs and greens, chives are minimally affected by diseases. Insufficient nutrients in soil, especially calcium might result in burnt tips. Water stress conditions also might result in burnt tips. Cut off the burnt tips and remove all dead stems. Burnt tips can be controlled by liming the soil, to an adequate level based on soil analysis, prior to planting.

Use of pest free propagation materials, seeds and/or bulbs, would result in better plant protection during growth. Adequate sanitation of the fields also results in less pests and diseases, as it would eliminate the breeding sites in the field.

Chives compete poorly with weeds for soil and water nutrients. Portulaca oleracea is one of the many weeds that have a major economic impact on the growth of Chives. Portulaca oleracea grows vigorously and if not contained in the initial stages, will have an adverse effect on the growth of chives. Mulching and hand picking of weeds at an early stage are highly recommended for the control of weeds. Adequate soil inversion also helps in controlling weeds and destroying insects by exposure to sun and heat in the early stages of their life cycle.

HARVEST AND YIELD

If propagated by direct seeding, chives would be ready for harvest in about 75 to 90 days and within 6 to 8 weeks after planting if propagation is by bulbs or by transplant of seedlings raised in greenhouses. Harvest the chives by snipping off the leaves. While harvesting, snip the leaves about 5 cm above the soil. This helps the chives to grow back more vigorously. Chives can be harvested several times during the harvest season. Always cut the chives early in the morning to avoid heat stress. Begin harvesting the leaves from outside and then work towards harvesting inside. Snip off the flowers before they mature to avoid self propagation of seeds.

If chive plants are grown from seeds (not from bulbs), allow the plants to establish a good root system before the first harvest. However, snip off any flowers that might emerge before the first harvest. Flowers of chives are also harvested before they mature and are used in salads and in flower arrangements.

If seed material is to be gathered in the current growing season, do not do a final harvest of greens and flowers. Instead allow the flowers to develop for seeds and the colony to expand by root division. For seed material, trim the greens about 5 cm from the soil and remove the bulbs and group them into bunches of 5 or 6. The bulbs thus removed should be replanted within 5 to 7 days.

Chives are highly perishable and have a very short shelf life. Harvested chives when stored at 34°F and a relative humidity of 95-100% extend the shelf life by 7 to 14 days. Chives can also be dried and frozen for later use. Dried chives lose their flavor and are not mostly opted for use in cooking. To freeze the chives, place the chopped chives in ice cube trays. These frozen chives can be used in soups, salads etc just like freshly chopped chives. However, chives taste the best when used fresh.

Multiple harvest of the greens during the growing season, results in a yield of approximately 32000 kg/ha.

NUTRITION

Serving size: 100 gm raw chives

Nutrient	Unit	Serving Size 100g
Water	g	90.65
Energy	kcal	30
Protein	g	3.27
Total lipid (fat)	g	0.73
Carbohydrate, by difference	g	4.35
Fiber, total dietary	g	2.5
Sugars, total	g	1.85
Calcium, Ca	mg	92
Iron, Fe	mg	1.60
Magnesium, Mg	mg	42
Phosphorus, P	mg	58
Potassium, K	mg	296
Sodium, Na	mg	3
Zinc, Zn	mg	0.56
Vitamin C, total ascorbic acid	mg	58.1
Thiamin	mg	0.078
Riboflavin	mg	0.115
Niacin	mg	0.647
Vitamin B-6	mg	0.138
Folate, DFE	mcg_DFE	105
Vitamin B-12	µg	0.00

Nutrient	Unit	Serving Size 100g
Vitamin A, RAE	mcg_RAE	218
Vitamin A, IU	IU	4353
Vitamin E (alpha-tocopherol)	mg	0.21
Vitamin D (D2 + D3)	µg	0.0
Vitamin D	IU	0
Vitamin K (phylloquinone)	µg	212.7
Fatty acids, total saturated	g	0.146
Fatty acids, total monounsaturated	g	0.095
Fatty acids, total polyunsaturated	g	0.267
Cholesterol	mg	0

Source: USDA National Nutrient Database for Standard Reference

GARLAND CHRYSANTHEMUM

(***Chrysanthemum Coronarium L***)
Family: *Asteraceae*
Common Names: Chop-Suey Greens, Edible Chrysanthemum, Chrysanthemum Greens, Tong Ho Choy (Cantonese), Tong Hao Cai (Mandarin), Shingiku (Japanese), Ssukgat (Korean) Tan o cai cui (Vietnamese)

INTRODUCTION

Garland Chrysanthemum, native to Asia, is an annual herb that grows up to a height of 30 to 60 cm. It is a very popular herb used in the Chinese, Taiwanese and Japanese cuisines and has a mixed flavor of mustard and anise. It is commonly used as an herbal medicine and as a cooked vegetable in these cultures. The leaves are bluntly lobed, rough and uniformly green. The flowers look very similar to daisy and are about 3-6 cm in diameter. Yellow colored blooms are the common variety of garland chrysanthemum flowers. However, the flowers may be in varied colors like white, orange, and creamy yellow. The flowers have both the male and female organs and are pollinated by bees, flies, beetles etc.

USES

These greens are rich in Vitamin B and mineral salts. Leaves and stems are succulent and eaten raw in salads, cooked as a vegetable and also used in soups. The petals of the flowers may be blanched and used in salads. The leaves when consumed are said to provide relief from indigestion. It is also used as an expectorant.

PICTURES

Picture source: internet From Left to Right: http://www.flickr.com/photos/joeysplanting/2418555796/, http://www.calflora.net/bloomingplants/garlandchrysanthemum.html, http://www.pfaf.org/user/plant.aspx?LatinName=Chrysanthemum+coronarium, http://www.damseeds.ca/productcart/pc/viewcategories.asp?idCategory=1188, http://munchadoaboutnothing.blogspot.in/2011/09/chrysanthemum-leaves-and-how-to-cook-it.html

VARIETIES

There are two types of garland chrysanthemums, Small Leaf and Broad Leaf. The small leaf types have small, serrated or lobed leaves, grow faster and bolt slowly. The broad leaf types have less serrated, more rounded, thicker and larger leaves. The broad leaf type is cold tolerant and less aromatic than the small leaf type. Since the broad leaf type is milder and less aromatic than the small leaf type, this type is more widely used for cooking and the small leaf type is used as an accent vegetable. Tong Ho VCe007 (Oasis), Tong Ho FCe006 (Gao Gan F1) of the small leaf type and Tong Ho VCe012 (Broad Leaf), Tiger Ear, of the broad leaf type are the some of the commonly cultivated varieties of garland chrysanthemum.

CLIMATE

Garland chrysanthemum is a weather tolerant plant that prefers cool conditions. The optimal temperature to raise garland chrysanthemum plants is 68°F but they can tolerate temperatures as low as 32°F. However the quality of the plant will be compromised if grown in temperatures below 54°F and above 84°F. The plant cannot tolerate snow but can tolerate occasional freezing. The plant is hardy to zone 9.

SOIL

Garland chrysanthemum requires moist, well-drained, sandy, clayey and loamy soil. It prefers acid, neutral and basic alkaline soils. The plant grows well in soil with a pH range of 5.2 to 7.5.

FIELD PREPARATION

Normal tilling before sowing is required to prepare the land for cultivation. Create beds with a space of 1 foot between rows.

SOWING

Propagation by direct seeding is the normal practice. Sow the seeds thinly and evenly at a depth of about ½ inch. Cover the seeds with soil. The soil must be kept moist for the seeds to germinate. It takes anywhere from 7 to 18 days for the seeds to germinate. When the seedlings are about 3 inches tall thin them to 4 inches apart. Overshadow the area for summer or early fall sowing to prevent the plants from direct sun light and high temperatures. The seeds can be soaked in water for 24 hours and kept at a temperature range of 58°F – 68°F to promote speedy germination. Approximately 26 lbs of seeds are required for sowing an acre of land. Successive sowing of seeds can be undertaken at regular intervals of few weeks to ensure constant supply of young greens.

IRRIGATION

Irrigate the field to keep the soil moist. Too much water is not good for germination of seeds and growth of plants.

FERTILIZATION

Adequate fertilization based on an analysis of the soil can be undertaken before sowing. A top dressing of nitrogen is required when the plant is about 10 cm tall. If going in for a second harvest, fertilize after the first harvest.

PLANT PROTECTION AND WEED CONTROL

Garland Chrysanthemums are mostly disease tolerant when grown under normal conditions. If they are grown in humid and/or high temperature regions a spray of fungicide should be

undertaken as and when needed. As with any greens, the use of pesticides on the plant itself should be minimal. Mulching helps in the prevention and control of weed growth. Hand weeding should be done when needed.

HARVEST AND YIELD

Like all greens and herbs, garland chrysanthemum tastes best if harvested when young. If the plants and flowers are left to mature, the plant will self sow. It takes about 4-5 weeks from the time the seeds are sown to the time the plant is ready for the first harvest. Harvest them when the plants are about 20 cm tall. Harvest the entire plant if it is grown for a one time harvest. If planning for a second harvest, cut the stems the first time about 2-3 cm above the soil and then apply fertilizer. This stimulates growth of side branches for a later harvest. The plant must be ready for a second harvest in about another month or so. Unless the flowers are grown to collect seeds or for sale as flowers, nip the flower buds before they develop into flowers.

Once the stems are nipped, tie them up into small bunches. Allow the stems and leaves to air-dry before bunching them for storage and/or sale. Allow the bunched greens to cool down to 41°F before packing. Pack the cooled bunches in plastic bags to prevent water loss and yellowing of leaves. The plastic bags should then be kept in low temperature storages until they are sent to the markets for sale. Like all greens and herbs the shelf life for garland chrysanthemum greens is only about a week or so.

NUTRITION FACTS

This general nutrition information is for one serving of any variety of garland chrysanthemum.

Serving Size: Raw, uncooked 25 gm

Nutrient	Units	Serving Size 25g
Proximates		
Water	g	22.85
Energy	kcal	6
Energy	kJ	25
Protein	g	0.84
Total lipid (fat)	g	0.14
Ash	g	0.42
Carbohydrate, by difference	g	0.76
Fiber, total dietary	g	0.8
Minerals		
Calcium, Ca	mg	29
Iron, Fe	mg	0.57
Magnesium, Mg	mg	8

Phosphorus, P	mg	14
Potassium, K	mg	142
Sodium, Na	mg	30
Zinc, Zn	mg	0.18
Copper, Cu	mg	0.034
Manganese, Mn	mg	0.236
Vitamins		
Vitamin C, total ascorbic acid	mg	0.3
Thiamin	mg	0.033
Riboflavin	mg	0.036
Niacin	mg	0.133
Vitamin B-6	mg	0.044
Folate, total	µg	44
Folic acid	µg	0
Folate, food	µg	44
Vitamin B-12	µg	0.00
Vitamin A, RAE	µg_RAE	29
Carotene, beta	µg	345
Carotene, alpha	µg	0
Vitamin A, IU	IU	580
Vitamin D (D2 + D3)	µg	0.0
Vitamin D	IU	0
Vitamin K (phylloquinone)	µg	87.5
Lipids		
Cholesterol	mg	0

Source: USDA National Nutrient Database for Standard Reference

LYCIUM LEAF

(***Lycium sp.* chinense**)
Family: *Solanaceae*
Common Names: Chinese Boxthorn, Chinese Wolfberry,
Chinese Matrimony Vine, Kuko, Gojiye, Chinese Desert-Thorn

INTRODUCTION

Lycium sp. chinense, a native of eastern Asia, China and Japan in particular, is popularly known as Wolfberry or Goji in China. They are primarily grown for their berries but almost all parts of the plant, including the stems, leaves, seeds and root bark are consumed. The berries, considered to be a super food with a lot of nutritious content packed into the small berries, are extensively used in Chinese herbal medicine. Wolfberry or Goji is a woody deciduous shrub that grows tall, erect or sprawling, to about 5 feet. The lance shaped leaves, about 2 inches long, formed in alternating arrangements are solitary or found in clusters of 3 -4. The stems are branched and have thorns. The flowers are small, blue in color, trumpet-shaped, and are hermaphrodite. The fruits are oblong, about 10 mm long and are orange-red in color when ripe. The seeds are numerous, yellow in color and measure about 3 mm.

USES

The leaves of Lycium chinense with a peppermint-like flavor are used for culinary purposes in its fresh form and in the dried form. The fresh leaves and young shoots are used raw in salads or is used as a potherb in soups, sauces, and other meat dishes. The dried leaves are used to make tea. The leaves are rich in Vitamin A and other nutrients. Lycium leaves have traditionally been used for its medicinal properties in Chinese herbal medicines. Tea made out of Lycium leaves are said to reduce the risks associated with hypertension, diabetes, night blindness, whooping cough, to improve stamina and to reduce pain. Lycium plants are also grown to stabilize soil by preventing erosion of soil from wind, rain and other natural agents.

PICTURES

Picture **source**: http://www.fruitipedia.com/chinese_boxthorn_Lycium_chinense.htm

TYPES AND VARIETIES

There are no recorded cultivars for Lycium chinense.

CLIMATE

Lycium is a very hardy plant and can tolerate heat, drought and wind. It is frost hardy once it is established and grows well in temperatures ranging from -10°F to 110°F. However, it cannot tolerate full shade and should be planted in sunny or partial shade area.

SOIL

Lycium can be grown in any type of soil; sandy, loamy or clayey; but prefers a rich well-drained soil with a soil pH level between 6 and 8.

FIELD PREPARATION

Several weeks before the planned date of planting Lycium, add about 2 – 3 inches of organic manure to the soil. Lime may be added dependent on the results of the soil analysis. Plow the field thoroughly so as to loosen the soil and incorporate the manure to about 8 -10 inches into the soil. Create rows that are about five feet apart. In case of heavy clayey soil, form beds to prevent water logging.

SOWING

Propagation may be made from seeds, from cuttings or by layering.

If propagation is from seeds; sow seeds in the greenhouse in spring. The seeds would germinate in about 2 weeks. Transplant the seedlings into individual containers and grow them in the greenhouse for a year. Transplant these plants on to the field, next spring, at a space of about 3 feet between plants.

If propagation is from wood cuttings; take 5 -10 cm cuttings of half-ripe or mature wood in late summer or early fall. Plant these cuttings into individual pots and care for them till early spring. In spring, transplant these cuttings on to the field leaving a space of about 3 feet between plants.

Propagation may also be made by layering. In winter, bend branches of well grown plants so that it touches the soil. Cover part of the stem with soil. The adventitious stems will start developing roots at the spots where the stems are covered in soil. By spring, these stems would have developed roots at parts where the stems touch the soil. Severe these stems from the main plant in spring and transplant them directly into the field.

IRRIGATION

Lycium is a hardy plant and is drought hardy. However, they should be irrigated regularly and the soil kept moist during the first year after they are planted out on the fields. Weekly heavy

soaking with water is preferred to light watering of the plants on a daily basis. Once the plants are well established, at least a year after they are planted out, they are hardy and become tolerant to drought or infrequent irrigation. Ensure to remove weeds and unwanted plants from the base of the plant that might compete with the Lycium plants for water and other nutrients.

FERTILIZATION

Incorporate organic matter into the soil a few weeks before planting. Based on the results of the soil analysis, apply lime and/or any other nutrient before planting. Addition of any fertilizer or any other stimulant after planting is not recommended until the plants are established as it may result in root burn and impede plant growth. Once the plants are established, an application of a light top dressing may be undertaken. Side dressing with nitrogen may be applied during harvest season.

PLANT PROTECTION AND WEED CONTROL

Once the plants are established, pruning on a regular basis is recommended. Pruning helps in promoting new growth which increases the yield of fruits. Pruning also helps in controlling thorns as thorns are more prevalent in mature stems. Pruning helps in maintaining the height of plants at a standard level, which makes it easy to harvest leaves and berries.

Lycium plants are susceptible to diseases like powdery mildew, fusarium and phytophthora. These diseases can be controlled easily and not considered to be major cultivation issue.

HARVEST AND YIELD

The first harvest of leaves can be made in about 50 – 60 days from planting. Subsequent harvests can be undertaken at weekly intervals. Bundles of 10-12 inch fresh young stems are sold to be used as potherb. The harvested stems should not be washed if it is intended for sale as fresh potherb or leafy vegetable. Leaves for use should be stored unwashed in the refrigerator and should be washed before use on an as and when needed basis. Storing the freshly harvested stems and leaves in loosely packed closed plastic bags at 32°F prevents weight loss, loss of nutrition and extends the shelf life of the leafy vegetable. Young leaves stripped from the leaves are sun dried or dried in a dehydrator and stored in a cool dry place to be used as tea. Matured leaves may be stripped, dried, powdered and stored in the powered form to be used as a potherb. The average yield of Lycium leaves is 2 – 4 tons/ha.

NUTRITION

Serving Size: 100 grams leaves (dry weight)

Calories	279
Water	0%
Protein	39.4 g
Fat	5.8 g
Carbohydrate	38.5 g
Fibre	12.5 g
Ash	16.3 g
Calcium	1423 mg
Phosphorous	414 mg
Iron	51.9 mg
Magnesium	0 mg
Sodium	1836 mg
Potassium	4981 mg
Zinc	0 mg
Vitamin A	43 mg
Thiamine (B1)	0.77 mg
Riboflavin (B2)	2.98 mg
Niacin	7.69 mg
Vitamin B6	0 mg
Vitamin C	77 mg

Source: http://www.pfaf.org/user/Plant.aspx?LatinName=Lycium+chinense

MAMAN/MALABAR SPINACH

(Refer to Malabar Spinach under Asian Indian Herbs and Greens)

POTHERB MUSTARD

(***Brassica juncea var. japonica***)
Family: *Brassicaceae*
Common Names: Common Mustard Greens,
Mizuna, Kyona, Japanese Greens, California Peppergrass

INTRODUCTION

Potherb Mustard a member of the cabbage family is also known as Chinese mustard. It is an easy to grow, cool season annual that grows to a height of 12-18 inch. The greens vary in leaf shape, size, color and flavor. The leaves may be smooth, curly, deeply notched, feathery, broad or narrow. The color of the leaves may range from light green to burgundy. Depending on the oil content of the leaves the flavor of the leaves may range from mild to hot. A single plant may have a compact bunch of as many as 180 leaves clustered together. Inflorescence is yellow in color. As the weather gets warmer and the length of the day increases, these plants grow taller and develop yellow flowers consisting of 4 yellow petals.

USES

The greens are widely used in Asian cuisines and in other cuisines like South American. Young tender leaves of the mustard greens are used raw in salads. The mature leaves may be eaten fresh, cooked, canned or frozen. Potherb Mustard is primarily grown for its greens, but it can also be grown for it seeds that is used to make condiments or to extract essential oil. Mustard greens are an excellent source of iron, minerals, calcium, dietary fiber and many vitamins including Vitamin K, Vitamin A, Vitamin C, Vitamin B1, Vitamin B2, and Vitamin B3.

PICTURES

Pictures Source – Internet(from Left to Right): http://www.canadiangardening.com/gardens/fruit-and-vegetable-gardening/grow-asian-vegetables-in-your-garden/a/22203/3, http://www.pflanzen-im-web.de/pflanzen/saatgut-samen/Alte-Kulturpflanzen/Brassica-juncea-var-japonica-Japanischer-Salat-Mizuna.php, http://www.examiner.com/article/vegetables-101-seen-seattle-farmers-markets-what-is-mizuna, http://hospitalcafeteria.blogspot.in/2010/08/growing-winter-greens.html, http://lmscommunitygarden.wordpress.com/page/2/

VARIETIES

Potherb mustard greens vary in shape, size, color and flavor. The commonly cultivated varieties in the United States are: Savanna, Tender Green, Osaka Purple, Green Wave, Vitamin Green, Golden Frill, Red Giant, Southern Giant Curled, Early Mizuna, Florida Broadleaf, Large Smooth Leaf, Bamboo Leaf, Peacock Tail and Red Leaf. Many other varieties and types of potherb mustard are available with different textures, leaf shapes and colors.

CLIMATE

Potherb mustard is a cool season crop that can tolerate light frost and yields good quality greens when grown in temperatures between 45°F - 65°F. Prolonged periods of temperature above 75°F will result in slow growth and low quality of greens. Long, warm days will result in early bolting.

SOIL

Potherb mustard can be grown in a wide variety of soil but grows best in well-drained, sandy loam soil that is rich in organic matter. Potherb mustard can be grown in soils with a pH of 5.5-7.5 but soil with a pH of 6.0-6.8 results in maximum yield.

FIELD PREPARATION

A fresh layer of rich compost should be added to the top soil. The land should then be tilled to work in the compost and to loosen the soil. The land should then be leveled to prevent water stagnation. Create 70-80 inch wide beds with 4-6 rows per bed or double plant rows in 35-40 inch raised beds or create single rows that are 12-18 inch apart.

SOWING

Propagation may be made by direct seeding or by transplanting.

> ***Direct Seeding*:** Sow seeds in raised beds or rows at a depth of ½ inch with 2 inch in-row spacing. Cover the seeds with soil. Thin seedlings when they are 3-4 inch tall to about 6 inch apart. Excessive thinned seedlings can also be sold in the market to be used in salads. Plant seeds 3 weeks before the last frost date. For a steady and successive harvest, plant seeds in intervals of 3 weeks.
>
> ***Transplanting*:** If growing the greens from seedlings, the seedlings can be started indoors about 6 weeks before the last frost date. The seedlings can be transplanted on to the soil 3 weeks before the last frost date with a spacing of 6 inch in-rowing spacing. For a steady and successive harvest, new seedlings can be transplanted at an interval of 3 weeks.

Irrespective of whether the propagation is made by direct seeding or by transplanting, about 3-4 lbs of seeds would be required per acre. Use of certified or hot-water treated or fungicide treated seeds helps protect the seeds from several seed-borne diseases and results in good yields. Since growing mustard from seeds is very easy, propagation by direct seeding is the generally preferred method compared to propagation by transplantation of seedlings.

IRRIGATION

Potherb mustard greens plant need about 2 inches of water a week. Maintenance of uniform soil moisture is imperative for retaining optimum nutrients in the greens and to promote tender

growth. Frequency of water application depends on the type of soil. Lighter soils require more frequent water application with less water used per application. Heavier soils require less frequent water application but with more water used per application.

FERTILIZATION

Soil tests would reveal the type of fertilizers to be used. In the absence of soil test, apply about 2 inches of compost to the top soil along with 50-70-100 lbs/acre of NPK and till the soil so as to work the compost and the fertilizers into the soil. P and K should only be applied prior to planting. Apply 40-50 lbs/acre of Nitrogen as side dressing about 25 days after planting. To aid the mustard plants to grow rapidly and at a regular pace, adequate fertilization along with proper weed control and regular irrigation is essential. Liming should be undertaken at recommended levels depending on the pH level of the soil.

PLANT PROTECTION AND WEED CONTROL

Aphids, cabbage looper, alfalfa looper, leafhoppers, leafminers, cabbage flea beetle, caterpillars are some of the insects that affect the growth of potherb mustard plants. To control these insects use of approved insecticides is recommended.

White spot, downy mildew, bacterial leaf spot, and anthracnose are some of the common diseases that affect the growth of potherb mustard. Proper fertilization based on the soil test, long crop rotation (3 to 4 years) of growing non-cruciferous crops prior to growing potherb mustard, proper preparation of field prior to planting, improved soil drainage, used of certified clean seeds and healthy transplants, isolating transplanted fields from direct-seeded fields, good weed control, immediate removal of any diseased plants, avoidance of overhead irrigation, proper use of recommended fungicide/insecticide at the early stage of the disease are some of the measures that could be followed to control diseases.

Weeds pose a major problem to the growth of healthy greens resulting in low quality and less than optimum yields. Weeds such as lambsquarter, pigweeds, Canada thistle, and mayweed are some of the common weeds found alongside the potherb mustard plants. If adequate control measures are not undertaken at the early stages to control the weeds, they rob the much needed nutrients and moisture from the greens. Proper mulching along with hand weeding and hoeing are some of the recommended ways to control the growth of weeds.

HARVEST AND YIELD

Potherb mustard greens can be harvested anytime from 25 to 60 days from planting, depending on the variety of cultivar used for planting. The leaves should be harvested when they are young and tender. Pick leaves from the outer side first and work towards inside for harvesting. If the plants are grown for one time harvest the entire plant can be cut at the ground level. If they are grown for subsequent harvests, the leaves are cut about an inch above the ground level to enable growth of new leaves. The greens are harvested by hand or by machines. Greens meant for fresh market are usually hand harvested. Whereas, greens meant for processing are machine harvested and sent in bulk to the processing plant.

The greens should be refrigerated as soon as they are harvested. The harvested greens are normally bunched together into 1 lb bunches, put into plastic bags and packed into cartons that hold about 24 bunches. Since potherb mustard is a cool season crop, near freezing temperature at the time of harvest increases the quality and yield of the greens and temperatures above 75°F at the time of harvest results in low quality and decreased yield of greens. The harvested greens will have a shelf life of 3 weeks if they are stored at 32°F with a 90-95% relative humidity.

One time harvest of mustard greens for the fresh market results in about 12000 – 15000 lbs/acre and in about 8-10 tons/acre if meant for processing. Additional harvests may result in additional yields of 4-5 tons/acres for each harvest.

NUTRITION

This general nutrition information is for one serving of any variety of raw mustard greens.

Serving Size: Raw, 100 g

Nutrient	Unit	Serving Size - 100.0g
Water	g	90.80
Energy	kcal	26
Protein	g	2.70
Total lipid (fat)	g	0.20
Carbohydrate, by difference	g	4.90
Fiber, total dietary	g	3.3
Sugars, total	g	1.60
Calcium, Ca	mg	103
Iron, Fe	mg	1.46
Magnesium, Mg	mg	32
Phosphorus, P	mg	43
Potassium, K	mg	354
Sodium, Na	mg	25
Zinc, Zn	mg	0.20
Vitamin C, total ascorbic acid	mg	70.0
Thiamin	mg	0.080
Riboflavin	mg	0.110
Niacin	mg	0.800
Vitamin B-6	mg	0.180

Nutrient	Unit	Serving Size - 100.0g
Folate, DFE	mcg_DFE	187
Vitamin B-12	µg	0.00
Vitamin A, RAE	mcg_RAE	525
Vitamin A, IU	IU	10500
Vitamin E (alpha-tocopherol)	mg	2.01
Vitamin D (D2 + D3)	µg	0.0
Vitamin D	IU	0
Vitamin K (phylloquinone)	µg	497.3
Fatty acids, total saturated	g	0.010
Fatty acids, total monounsaturated	g	0.092
Fatty acids, total polyunsaturated	g	0.038
Cholesterol	mg	0

Source: USDA National Nutrient Database for Standard Reference

SPINACH

(*Refer to Spinach under Asian Indian Herbs and Greens*)

SUGAR PEA TOPS

(*Pisum sativum*)
Family: Fabaceae
Common Names: Dou Miao (Chinese), Pea Vines, Pea Tips, Pea Shoots

INTRODUCTION

Sugar Pea tops also known as "Pea Vines", "Pea Tips" are the tender tips of the edible sugar peas that consists of the top 2- 4 pairs of leaves, young tendrils and may or may not include pea buds or blossoms. The leaves are dark green in color, oval in shape and grow in pairs at a distance of an inch or so, on the stem till the end of the vine. The stem is hollow all the way till the end of the tendril.

USES

The greens have a mild pea pod flavor and are eaten raw or cooked. Pea tops are low in calories, contain no fat, rich source carotenes, Vitamin C and K and also contain minerals such as calcium, iron, phosphorous and amino acids. Due to its popularity farmers are now harvesting the young stems, leaves and tendrils for vegetable uses, instead of harvesting it as part of the more mature plants grown for the purpose of harvesting sugar peas. It is believed that the pea shoots rich in carotene and phytochemicals that help fight several diseases and prevent cancer.

PICTURES

Pictures Source – internet(From Left to Right): http://ask.metafilter.com/140748/At-least-the-question-isnt-should-I-eat-it, http://viroquafood.coop/our-store/produce/bid/105477/Fresh-and-Local-Hon-Tsai-Tai-Pea-Vine-Seed-Potatoes-Goldenseal-Bareroot-and-Chestnut-Trees, http://wallingfordfarmersmarket.wordpress.com/2011/06/08/wednesday-june-8th-chef-jason-brzozowy-sugar-snap-peas-washington-wine-bagels-gluten-free-goodies-local-salmon-pea-vines/, http://www.tainongseeds.com/PeaSeedling.html

VARIETIES

Though many varieties of peas exist, those with tender leaves and stems with tendrils that are sweet and succulent are best suited for sale as greens. Oregon Giant, Oregon Sugar Pod, Dwarf Grey Ginger, Sandy, Usui, Sugar Snap, Sugar Rae, Sugar Daddy are some of the well known varieties that are grown for pea tops.

CLIMATE

Peas being a cool weather crop grow best in temperatures 55 – 65°F. They should be planted in early spring or late summer. Peas can tolerate temperatures as low as 28°F.

SOIL

Peas grow best in loamy soil. They can however tolerate sandy and clay soils. A soil pH of 6.0 – 7.0 is ideal for growing peas. As peas are highly sensitive to soil acidity, a soil test is highly recommended before planting peas.

FIELD PREPARATION

It is recommended to conduct a soil test in fall for a spring planting of peas. If the soil test reveals that an application of lime is necessary, work the lime about 5 to 6 inches deep into the soil in fall. Apply about 2 inch of compost and work into the soil. If the peas are to be grown in beds, create beds that have 2 – 6 rows per bed with between-row spacing of 6 inch. Else, create rows with between-row spacing of 6 -18 inches. Ensure proper drainage when creating beds/rows as peas do not grow well in waterlogged conditions.

SOWING

Propagation is by direct seeding. Plant seeds 3 inches apart and about 1 ½ inches deep into the soil. The seeds will germinate in about 10 days. Approximately 150 pounds per acre of seeds is required for planting. Peas can also be grown in green houses where a minimum temperature of 40°F is maintained.

IRRIGATION

Rainfall is adequate for pea shoots grown as a spring or fall crop. Water requirements for a summer crop depend on the type of soil. Irrigation requirements depend on the type of soil and temperature. An inch of water once every two weeks is adequate for a medium weight soil and the frequency can be reduced for a heavy weight soil. More frequent irrigation is required at temperatures above 80°F. If the plants are grown exclusively for harvesting pea shoots, adequate irrigation during the vegetative period increases the yield of pea shoots. If the plants are grown for both the shoots and the pods, adequate irrigation during flower formation and pod formation is more important than during the vegetative period. As water logging leads to root rot and other diseases, it is important to ensure proper water drainage in the field.

FERTILIZATION

A soil test would indicate the fertilizer requirements for the field where the pea plants are to be grown. If the test results indicate the requirement for a lime application, incorporate the suggested lime levels into the soil in the fall for a succeeding spring planting. If required, apply compost to the soil and incorporate into the soil at a depth of 5-6 inches from soil surface before planting the seeds. Peas, being a legume, have the ability to fix nitrogen from the atmosphere. However, if the soil tests indicate a requirement for Nitrogen, Potassium and Phosphorous apply about 20-30 lbs of N, 80 lbs of P and 6o lbs of K and plow them into the soil before planting. If there is an additional requirement for P and K, side dress them about 6-8 weeks after planting.

PLANT PROTECTION AND WEED CONTROL

Pea aphids, Root maggots and Pea enation viruses are some of the common pests that affect pea plants. Washing off the leaves during the early stages of infestations and/or use of insecticides intended for aphids will help control aphid infestation. In case of root maggots, plant seeds in warmer temperatures. To avoid pea enation virus, plant peas early in spring when temperatures are cooler. Use of pea varieties that are resistant to aphids, root maggots and pea enation virus also helps in providing better yields. Root rot is another major disease that affects pea growth. A well-drained field where peas are cultivated helps in preventing root rot.

Weed control is very important for good pea farming. Cultivate peas during cool season to control weeds. Mulching is a good weed preventive measure that also helps in moisture retention in the soil. A cover crop sown in late summer or fall and turned over about a month before planting in the following spring also helps in increasing the organic matter in the soil and to control weeds. Hand weeding and/or shallow hoeing is a better option to control weeds compared to use of herbicides.

Adequate fertilization based on soil test, well-drained field, use of pest/disease resistant seeds, and the practice of growing peas in the same field only once in five years all contribute to better plant protection and good yields.

HARVEST AND YIELD

Pea plants germinate in about 7-10 days. Snip off the tops when the pea plants have at least a couple of pairs of true leaves and are about 2-6 inches tall. This will be the first harvest of the pea shoots and also helps the stems to branch out. Subsequent harvests can be made once in every 3-4 weeks by snipping off the top 2-6 inches of the stems that have at least 2-3 pairs of tender leaves, tendrils and buds or blossoms. All blossoms should be cut and removed to prevent the plants from producing pods and to continue harvesting pea tops. Multiple harvests of pea tops can be made during the entire growing season and needs to be stopped when the tops are no longer tender and taste bitter. It is best at this point to let the plants develop pods. Store pea tops immediately after harvest at 32°F and at 98-100% relative humidity. Since pea tops are highly perishable it is best if they are used within 2 days of harvest. No information is available at this time regarding the yield of pea tops grown as a commercial crop.

NUTRITION

Serving size: Raw leaves, 100 gm

Nutrient	Per 100 g
Calories	18
Vitamin C(mg)	69
Vitamin A (µg)	407
Folic Acid (µg)	57
Protein (g)	3.1

Carbohydrates (g)	0.2
Sugar (g)	0.2
Total Fat (g)	0.6
Saturated Fat (g)	0.1
Fiber (g)	2.0
Sodium (g)	0.02

Source: http://www.peashoots.com/peashoots-nutrition.htm

YEN CHOY (GREEN AMARANTH)

(*Refer to Amaranth under Asian Indian Herbs and Greens*)

MEXICAN GREENS AND HERBS

AMARANTH GREEN

(*Amaranthus hybridus*)
Family:Amaranthaceae
Common Names: Quintonil (Mexican), phak khom (Thailand), bayam (Malaysia, Indonesia), urai (Philippines), Smooth amaranth, Slender amaranth, pigweed

INTRODUCTION

Amaranth meaning "life everlasting" a native of central Mexico is currently being grown and used in almost all parts of the world. It is an annual plant that grows to a height of 1-6 feet. The leaves alternate vary in size and color, slender and taper at the end. The tiny flowers are usually green and are formed in clusters at the end of the branches. The seeds are very tiny and black in color. This plant a nutritious leafy vegetable in Mexico and Asian countries is considered to be a weed in the United States.

USES

The leaves are highly nutritious and is used similar to spinach. The leaves can be steam cooked, boiled, stir fried or used in soups. The seeds can be used to make bread. Consumption of Amaranth leaves is said to provide relief for intestinal bleeding and diarrhea.

PICTURES

Pictures source-Internet (From Left to Right) - http://www.missouriplants.com/Greenalt/Amaranthus_hybridus_page.html, http://www.discoverlife.org/20/q?search=Amaranthus+hybridus, http://extension.missouri.edu/p/ipm1007-103, http://uprisingorganics.com/flowers/amaranth-39-opopeo-39-heirloom-/prod_61.html, http://www.insectimages.org/browse/detail.cfm?imgnum=5138058

CLIMATE

Amaranth seeds germinate when soil temperatures are between 64°F and 77°F. Optimum growth is attained in warm and sunny conditions. Frost terminates the plant's growth. However, it can tolerate temperatures as high as 95°F. Lower temperatures and shorter days induce bolting which in turn reduces the yield of leaf.

SOIL

Green Amaranth adapts to a wide variety of soils. However it grows best in well drained soil that may be sandy, loamy or clayey that is rich in organic matter. Amaranth prefers a soil with a pH between 5.5 and 7.5.

VARIETIES

There are two varieties of Amaranthus hybridus, one with green colored leaves and green fluorescence and the other with reddish-green colored leaves and reddish-maroon fluorescence.

FIELD PREPARATION

Plow the field well. Incorporate organic manure or inorganic fertilizers into the soil, based on the results of the soil tests, prior to planting seeds. Create rows that are 30 inches apart.

SOWING

Propagation may be made by direct seeding or by transplanting.

> ***Direct Seeding*:** Plant seeds firmly into rows that are about 30 inches apart. In-row spacing should be about 30 cm. Cover the seeds with soil and water them twice daily until seedlings emerge, which is usually about a few days.
>
> ***Transplanting*:** Seeds can be planted in seed trays and allow to germinate in greenhouses. The seedlings will be about 15 cm tall in about 4 weeks. It is then ready for transplanting in the fields. Poke holes about 30 cm apart and pour water into these holes and wait for the water to seep into the soil. Place the seedling into the watered hole and firm up the seedling with soil.

IRRIGATION

Amaranth is drought resistant but results in optimum yield if irrigated adequately. Irrigate once in 4 to 5 days. Increase the frequency during dry season to prevent the plant from bolting and to stimulate growth of leaves. As the amaranth plant consumes less water, adequate measures should be taken to prevent water logging.

FERTILIZATION

Fertilizer requirements vary depending on the results of the soil test, which is recommended before planting. Nitrogen is one of the most important elements for good growth of leafy green vegetables. High level of nitrogen is important for re-growth of leaves after each harvest. Approximately 50 to 200 kg of Nitrogen/ha may be required based on soil analysis. Organic manure or fertilizers can be used to increase nitrogen content. A side dressing of nitrogen and/or organic manure applied during active growth will improve the yield. Phosphorous and potassium should also be applied at recommended levels based on the results of the soil test. A fertile soil will result in a good yield of harvest once every two weeks.

PLANT PROTECTION AND WEED CONTROL

Leaf hoppers, leaf miners, grasshoppers, leaf eating beetles are some of the pests that affect the growth of amaranth greens. The effect of these pests can be contained by checking for them frequently, snipping off the leaves at the initial stages of onset, and by using the recommended herbicide. Prevalence of fungal diseases due to water logging can be prevented by ensuring that the seed beds receive adequate sun light and are well drained. Fungicides can also be used as recommended to contain the impact of the fungal diseases.

Weeds are considered to be one of the major problems that affect the growth and yield of amaranth greens. Apart from the use of good quality seeds and maintenance of optimum plant density, control of weed growth during early stages of growth of amaranth is very important since the growth of amaranth during the first few weeks is very slow.

HARVEST AND YIELD

Amaranth greens are normally harvested by hand. If the greens are grown for a one time harvest; the young plants are uprooted when they are about 20 cm tall. This happens in about 20-30 days if the propagation is by transplantation or in about six to eight weeks if they are propagated by direct seeding. If the plants are grown for multiple harvests, in about four weeks from transplantation or in about eight weeks after the seeds are sown, and when the plants are about 20 cm tall, cut the leaves and stems leaving about 5 cm from the ground to promote lateral re-growth. Subsequent harvests can be made in intervals of about 2 – 3 weeks.

The harvested greens are quickly bundled, roots washed (in case of the whole plant being uprooted) and transported to the market. Placing ice on top of the amaranth bundles during transportation helps retain moisture and freshness. The storage life of the greens is approximately 2 weeks if appropriately stored at 32°F and at a 95-100% relative humidity.

Amaranth greens yields average about 10 tons/ha in a 30-40 day harvest period. With adequate care and fertilization, especially nitrogen, yields can go as high as 40 tons/ha.

NUTRITION

Amaranth greens are said to be rich in Iron, calcium, vitamins A and C. We are unable to collect nutrition specifically for Amaranthus hybridus at this time. However, it is generally considered that the nutrition content of Amaranthus hybridus is almost the same as that is available in Amaranthus spp.

CHARD

(***Beta vulgaris cicla***)
Family: *Chenopodiaceae*
Common Names: Swiss chard, Sea Kale, Swiss beet, Silver beet, Perpetual Spinach, Spinach Beet, Crab Beet

INTRODUCTION

Chard, a member of the beet family, is a cool-season annual grown for its edible leaves. Chard is native to the Mediterranean but is now widely consumed in Europe and the Americas. The plant has large, shiny, crinkly green leaves with varied colored stalks. The color of the stalk varies based on the cultivar. Chard is closely related to beetroot and is sometimes called 'spinach beet' or 'leafy beet'. Plants grow up to 16 inches tall and can be harvested multiple times during the growing season.

USES

Young chard leaves can be used raw in salads while the matured chard leaves are cooked or sautéed. In olden days, the juice of chard was used as a decongestant. Chard is rich in phytonutrients and is said to help regulate blood sugar levels. Chard is a good source of fiber, iron, calcium, folate, protein, and is rich in Vitamins A, C, and K.

PICTURES

Pictures: Source – internet (From Left to Right): http://uprisingorganics.com/vegetables/chard-beta-vulgaris-/rainbow-chard/prod_7.html, http://en.wikipedia.org/wiki/Chard, http://mainefoodandfarms.com/?p=537, http://www.kalynskitchen.com/2010/08/friday-night-photos-saving-swiss-chard.html, http://www.discover-lake-geneva-switzerland.com/swiss-chard-recipes.html,

VARIETIES

The leaves may be either smooth or crumpled and the color of the petioles may vary, depending on the type of the cultivar. The well-developed petioles may be green, red, yellow, white, orange, purple or pink.

Argentata, Fordhook Giant, White King, Rainbow, Ruby Red, Giant Lucullus, Lucullus, Swiss Chard, Bright Lights, Rhubarb Chard, Rainbow Chard, and Golden Sunrise are the some of the commonly cultivated varieties.

CLIMATE

Chard is a cool season crop. It requires full sun for optimum growth but can tolerate partial shade. It grows best in temperatures between 50 – 64°F. Seeds germinate best when soil temperatures are between 55-75°F. However, the seeds will germinate at soil temperature as low as 41°F and as high as 80°F. Soil temperatures outside this range will affect the rate of seed germination. Higher summer temperatures may also reduce growth, decrease quality and may result in bitter tasting greens.

SOIL

Chard grows best in a deeply cultivated, loose and well-drained soil that is rich in organic matter. Incorporating plenty of organic matter into the soil ensures that the leaves do not taste bitter. A soil pH of 6.0-6.8 is ideal for growing chard.

FIELD PREPARATION

Incorporate well composted organic matter or pelleted fertilizer into the top 4-6 inches of soil prior to planting chard. The field should be deeply tilled, beds formed and irrigated prior to planting. If a pre-plant herbicide is required, it should be applied prior to forming rows and in case a pre-plant fungicide is required, it should be applied after forming rows but prior to planting. Form rows that are spaced apart by 18 to 24 inches.

SOWING

Propagation may be made by direct seeding or by transplanting. Seeding rate is about 6-8 lbs/acre.

> ***Direct Seeding*:** Direct seeding is the preferred method of propagation as it results is less or no root disturbance. Soaking seeds in warm water for 24 hours before sowing results in good germination rate and helps prevent soil rot and seed maggot problems. Sow seeds 2-4 weeks after the last frost. Plant seeds ½ - 1 inch deep with an in-row spacing of about 3-4 inches. Thin the seedlings, when they have 3-4 true leaves, to leave a final spacing of 9-12 inches between plants. The thinned seedlings can be replanted or used as baby greens.
>
> ***Transplanting*:** Propagation by transplants is used to provide an early harvest. Sow chard seeds indoors in seed beds or trays in a green house. Begin this process about 3-4 weeks before the anticipated last frost date in spring. It takes about 5-6 weeks for the seedlings to be about 3-4 inches tall, have 4-6 mature leaves and a well developed root system. Seedlings that meet these requirements are ready for being transplanted in the field. Set transplants 9-12 inches apart.

Ensure that the plants are not crowded as they may result in smaller leaves, have a tendency to bolt and seed more quickly.

IRRIGATION

Water requirements depend on the soil type and temperature. Chard has a moderately deep root system and requires a consistent water supply of at least 1-2 inches of water per week. Irrigation should be even and frequent. The soil should be kept evenly moist and not allowed to suffer from moisture stress. Leaves of plants suffering from moisture stress are tough in texture and have off-flavors. Furrow irrigation or drip irrigation can be used to irrigate the chard fields.

FERTILIZATION

Fertilizer requirements vary based on the results of the soil analysis. Based on the results of the soil analysis, initially well composted organic matter or fertilizer should be incorporated into the top 4-6 inches of the soil before planting. If a pre-plant herbicide is required, it should be applied prior to forming rows and in case a pre-plant fungicide is required, it should be applied after forming rows but prior to planting. If necessary fertilize with calcium nitrate every fortnight. Periodic side dressing of nitrogen also enhances the yield.

PLANT PROTECTION AND WEED CONTROL

Aphids, slugs and flea beetles are some of the pests that affect chard. Use of appropriate insecticides and/or a spray of water on both sides of the leaves also help control the damage created by the pests. Practicing crop rotation and planting chard away from the beetroot fields helps prevent soil borne diseases.

Use of good quality seeds free of weed seeds is essential to control the onset of weeds. Thoroughly plowing the fields and irrigating the field prior to planting ensures that weed seeds if any would germinate before the chard seeds are sown. In situations where weeds germinate, spraying the field prior to planting with herbicide would ensure eradication of weeds and that chard will not have to compete with the weeds for nutrients. Hand weeding is recommended in case of emergence of weeds once the chard plants are established.

HARVEST AND YIELD

Chard is usually harvested by hand. It is harvested at different stages of growth to cater to the market requirements. The thinned seedlings and/or young seedlings can be harvested and marketed as chard sprouts to cater to the salad segment of the markets. The greens harvested about 21 days after seeding or when they are about 4-5 inch is marketed as baby chard. Either just the outer leaves or the entire chard plant harvested approximately 50 days after seeding is bunched together and marketed as a leafy vegetable similar to other greens. If only the mature outer leaves are harvested, subsequent harvests can be made when the inner young leaves mature. In situations where the entire chard plant is harvested at the soil level, the plant can be allowed to re grow for a subsequent harvest. The harvested chard should be trimmed, cleaned and appropriately packed. Harvested chard when stored at 32°F and at a relative humidity of 95-100% has a shelf life of 2 weeks. On an average 20-30 ton/ha of chard is obtained. If chard is grown under the best conditions the resulting yield can be 40 or more tons/ha.

NUTRITION

This general nutrition information is for one serving of any variety of raw Swiss Chard greens.

Serving Size: Raw, 1 cup, chopped = 100 g

Nutrient	Unit	Serving Size 100g
Water	g	92.66
Energy	kcal	19
Protein	g	1.80
Total lipid (fat)	g	0.20
Carbohydrate, by difference	g	3.74
Fiber, total dietary	g	1.6
Sugars, total	g	1.10
Calcium, Ca	mg	51
Iron, Fe	mg	1.80
Magnesium, Mg	mg	81
Phosphorus, P	mg	46
Potassium, K	mg	379
Sodium, Na	mg	213
Zinc, Zn	mg	0.36
Vitamin C, total ascorbic acid	mg	30.0
Thiamin	mg	0.040
Riboflavin	mg	0.090

Nutrient	Unit	Serving Size 100g
Niacin	mg	0.400
Vitamin B-6	mg	0.099
Folate, DFE	mcg_DFE	14
Vitamin B-12	µg	0.00
Vitamin A, RAE	mcg_RAE	306
Vitamin A, IU	IU	6116
Vitamin E (alpha-tocopherol)	mg	1.89
Vitamin D (D2 + D3)	µg	0.0
Vitamin D	IU	0
Vitamin K (phylloquinone)	µg	830.0
Fatty acids, total saturated	g	0.030
Fatty acids, total monounsaturated	g	0.040
Fatty acids, total polyunsaturated	g	0.070
Cholesterol	mg	0

Source: USDA National Nutrient Database for Standard Reference, Release 24 (2011)

COMMON LAMBSQUARTER

(***Chenopodium album***)
Family: Chenopodiaceae
Common Names: White Goosefoot, Fat Hen, Pigweed, Bathua (Indian: Hindi), Chakkravarthi Keerai (Indian: Tamil), Pappukura (Indian: Telugu), Kaduoma (Indian: Kannda), Vastuccira (Indian: Malayalam)

INTRODUCTION

Common Lambsquarter is native to Europe. It is cultivated in some parts of the world as a leafy vegetable but is considered a weed in many countries. Lambsquarter is found all over the world from sea level up to an altitude of 3600m. This annual grows up erect up to a height of about 6 feet. The stem and leaves are covered with a white wax like substances. Sometimes the stems may have purple streaks. The leaves alternate and vary in size and shape (ovate to lanceolate) and may grow up to a length of 8 cm. The flowers do not have petals, are arranged in spikes at the tip of the stems and are grayish-white to green in color. The seeds are tiny, measure about 1.5 mm in diameter, shiny, are black or brown in color, and covered by a thin papery coat.

USES

Young lambsquarter leaves can be eaten raw as salads. They can also be cooked and/or sautéed similar to other leafy green vegetables. As lambsquarter acts as a good storehouse of ascorbic acid, they are used to treat scurvy, burns and intestinal problems. The juice of the stems and leaves are used to treat sunburns and bug bites. The juice of stems and leaves are also used to make a green dye. Dehydrated lambsquarter leaves can be substituted for fresh lambsquarter leaves in recipes that call for the use of fresh leaves. Similar to many other greens, lambsquarter also contain oxalic acid. So, the greens themselves should be consumed in moderation. Lambsquarter leaves are a rich source of Vitamin A, Vitamin C, iron, B complex Vitamins, calcium and fiber. The seeds are also rich in nutrients likes protein, calcium, potassium and vitamin A. The seeds can be cooked similar to other grains like rice or oatmeal.

Leaves and seeds of lambsquarter are also used to feed poultry. Since it is high in oxalic acid, it is poisonous for cattle if ingested in large quantities for a prolonged period. The air-borne pollens of lambsquarter sometimes cause hay fever.

PICTURES

Pictur es: Source-internet From Left to Right: http://www.ipm.iastate.edu/ipm/icm/2006/6-19/lambsquarters.html , http://www.herbsfor.net/lambsquarterchenopodium-album.html , http://www.modernbeet.com/archives/174 , http://livingafield.com/Plants_LambsQuarters.htm, http://botanyjohn.org/gallery/v/ubcbgseed/2006_680_0509.jpg.html?g2_imageViewsIndex=1

VARIETIES

Magentaspreen is a type of lambsquarter cultivar that is available in the market. The young leaves and stems of this cultivar have a tint of magenta color.

CLIMATE

Lambsquarter is commonly found as a weed in the temperate and tropical regions of the world. It grows best in sunny areas and do not prefer shade.

SOIL

Lambsquarter is a very adaptable plant and can grow in any kind of soil. However, the yields are good when grown in moist, well-drained soils that are rich in organic matter and nitrogen. They grow best in soils with a pH level that ranges from 4.5 to 8.5.

FIELD PREPARATION

Field should be exposed to full sun. It should be thoroughly plowed and a raised bed prepared for planting lambsquarter.

SOWING

Propagation may be made by direct seeding or transplanting. The seeding rate is about 40 kg/ha.

> ***Direct Seeding*:** Sow seeds at a depth of 0.1 inch or broadcast seeds on a raised bed. The seeds usually germinate within a few days. Thin the seedlings, when they have about 3 or 4 true leaves, at a spacing of 30 X 30 cm.
>
> ***Transplanting:*** Seedlings are raised in green houses or nursery beds and are transplanted to the fields when they are about 35 days old. Transplant them at a spacing of 30 X 30 cm.

FERTILIZATION

Incorporating a basal dressing of 25 ton/ha of farmyard manure along with 25 kg/ha of Nitrogen, 25kg/ha of Phosphorous and 25 kg/ha of Potassium and 25 kg/ha of Magnesium Sulphate into the last plow while preparing the field for planting results in good yields.

PLANT PROTECTION AND WEED CONTROL

Lambsquarter is generally resistant to pests and weeds, so no plant protection or weed control measures are necessary.

HARVEST AND YIELD

Lambsquarter greens can be harvested in approximately 50 to 55 days from seeding. To harvest greens, cut the youngest branches from the top and sides of the plant. To harvest the seeds, the plants are harvested, dried, threshed and the grains winnowed, in about 135 -145 days. The average yield of green leaves is approximately 30 – 40 tons/ha and that of seeds is about 1.2 tons /ha

NUTRITION

Serving size: 100 grams raw lambsquarter leaves

Nutrient	Units	Value per 100 grams
Proximates		
Water	g	84.30
Energy	kcal	43
Energy	kJ	180
Protein	g	4.20
Total lipid (fat)	g	0.80
Carbohydrate, by difference	g	7.30
Fiber, total dietary	g	4.0
Minerals		
Calcium, Ca	mg	309
Iron, Fe	mg	1.20
Magnesium, Mg	mg	34
Phosphorus, P	mg	72
Potassium, K	mg	452
Sodium, Na	mg	43

Zinc, Zn	mg	0.44
Copper, Cu	mg	0.293
Manganese, Mn	mg	0.782
Selenium, Se	µg	0.9
Vitamins		
Vitamin C, total ascorbic acid	mg	80.0
Thiamin	mg	0.160
Riboflavin	mg	0.440
Niacin	mg	1.200
Vitamin B-6	mg	0.274
Folate, total	µg	30
Vitamin B-12	µg	0.00
Vitamin A, IU	IU	11600
Vitamin D (D2 + D3)	µg	0.0
Vitamin D	IU	0
Lipids		
Fatty acids, total saturated	g	0.059
Fatty acids, total monounsaturated	g	0.150
Fatty acids, total polyunsaturated	g	0.351
Cholesterol	mg	0

USDA National Nutrient Database for Standard Reference, Release 24 (2011)

EPAZOTE

(Chenopodium ambrosioides spp.)
Family: ***Chenopodiaceae***
Common Names: Skunkweed, Wormseed, Mexican Tea,
West Indian Goosefoot, Jerusalem Parsley, Hedge Mustard,
Sweet Pigweed, Jesuit's Tea

INTRODUCTION

Epazote, a green leafy herb, is native to Mexico, Central and South America. It can be found in the wild in the subtropical zones throughout the world. This plant can grow as tall as 5 feet. It has multiple branches, red stems and pungent smelling green leaves. The leaves are serrated and can be as long as 12.5 cm. The flowers appear in clusters and are green in color. The flowers produce fruits clusters which in turn produces thousands of tiny black seeds. The seeds spread easily resulting in the growth of new plants, making these plants to be categorized as invasive weeds in North America.

USES

Epazote, also known as "bean herb", is used for its carminative properties and as a flavoring agent in bean dishes. It can also be used in soups and salads to enhance flavor. Medicinal properties inherent in Epazote are believed to act as a pain reliever and the juice of the plant has been used in the past as a medicine to control intestinal parasites like hookworms and tapeworms in humans and livestock. It is a good source of Vitamins A, C, D, B6, dietary fiber, iron, calcium and protein. However, caution must be exercised while using this herb, as it may turn poisonous and can cause problems like sweating, vertigo, deafness, incontinence when consumed in large quantities

PICTURES

Pictures: Source – internet From Left to Right (1,2 ,3) : http://aidanbrooksspices.blogspot.in/2007/10/epazote.html, http://www.worldcrops.org/crops/Epazote.cfm

VARIETIES

No information is available on the named variety of Epazote is available. However Epazote seeds, Epazote (OG) and Epazote-Glossy, are available for purchase at www.Johnnyseeds.com and www.Sowtrueseed.com

CLIMATE

Epazote grows well in subtropical climates. Soil temperature of 70 - 75°F is essential for seed germination. It cannot tolerate frost and cold weather, and so can be easily damaged by cold weather. The seeds should be planted in a sunny area.

SOIL

Epazote can be grown in any type of soil provided there is good drainage. Epazote can be grown in USDA zones 6 – 11.

FIELD PREPARATION

The field must be thoroughly plowed. Incorporate organic manure into the field during the last plow. Form rows that are 18 inches apart.

SOWING

Propagation may be made by direct seeding or by transplanting.

Direct Seeding: Sow 2 seeds at a depth of ¼ inch when the soil temperatures reach 70-75°F and cover the seeds. Maintain an in-row spacing of an inch. The seeds will germinate within 1-2 weeks. When 4 – 5 true leaves appear, thin the seedlings 12 inches apart.

Transplanting: Sow the seeds in seed trays and raise them in greenhouses. The seeds germinate within 1-2 weeks. Transplant the seedlings, 12 inches apart, after the last frost.

IRRIGATION

Moderately water the epazote plants. Adequate steps should be taken to ensure proper water drainage. These plants prefer dry weather with medium amount of rainfall but are not drought hardy.

FERTILIZATION

Enriching the soil with a light application of organic manure prior to planting is all that is required for growing epazote. Additional fertilizers of any kind may result in the production of less flavorful leaves.

PLANT PROTECTION AND WEED CONTROL

Ensuring adequate water drainage helps in the prevention of root decay in plants. Inadequate information is available about pests and diseases that affect the growth of epazote.

HARVEST AND YIELD

Epazote plants are ready for harvest in about 55 days from the date the seeds are sown. Harvest the young leaves of the center stem of the plant each time to encourage bushing and to prevent the plant from flowering. Subsequent frequent harvest ensures a continuous supply of fresh herbs. Post harvest shelf life for epazote is generally about 2 to 3 days. If stored under proper refrigeration of about 40°F, the shelf life could be extended to about 3 weeks. As this herb is mostly found in the wild, grown in home gardens or on a small scale, yield data is unavailable at this time for large scale cultivation.

NUTRITION

Serving size: 100 gm raw.

Nutrient	Units	Value per 100 grams
Proximates		
Water	g	89.21
Energy	kcal	32
Energy	kJ	134
Protein	g	0.33
Total lipid (fat)	g	0.52
Fiber, total dietary	g	3.8
Minerals		
Calcium, Ca	mg	275
Iron, Fe	mg	1.88
Magnesium, Mg	mg	121
Phosphorus, P	mg	86
Potassium, K	mg	633
Sodium, Na	mg	43
Zinc, Zn	mg	1.10
Copper, Cu	mg	0.190
Manganese, Mn	mg	3.098
Selenium, Se	µg	0.9
Vitamins		
Vitamin C, total ascorbic acid	mg	3.6
Thiamin	mg	0.028

Riboflavin	mg	0.348
Niacin	mg	0.639
Pantothenic acid	mg	0.179
Vitamin B-6	mg	0.152
Folate, total	µg	215
Folic acid	µg	0
Vitamin B-12	µg	0.00
Retinol	µg	0
Carotene, beta	µg	38
Vitamin A, IU	IU	57
Vitamin D (D2 + D3)	µg	0.0
Vitamin D	IU	0
Lipids		
Cholesterol	mg	0
Other		
Alcohol, ethyl	g	0.0

Source: USDA National Nutrient Database for Standard Reference, Release 24 (2011)

LEMON VERBENA

(*Aloysia triphylla*)
Family: *Verbanaceae*
Common Names: Luisa, Hierba luisa, Yerbaluisa,
Lemon Beebrush, Herb Louisa, Limonetto

INTRODUCTION

Lemon Verbena, a native of South America, is a deciduous shrub that grows as tall as 5 feet in temperate regions and even taller in tropical and sub-tropical regions. The leaves of this herb are green in color, are lance shaped and have a lemon flavor. The plant bears clusters of tiny white or lavender color flowers at the end of each stem. The seeds, produced infrequently, are tiny, tear shaped and dark brown in color.

USES

Lemon Verbena is said to have medicinal quality. Tea made of Lemon Verbena leaves are said to reduce fever, serves as an expectorant, has anti-spasmodic effects, ability to strengthen the nervous system, and aid digestion. Oil extracts of Lemon Verbena is used as a flavoring agent in cooking and as an aromatic in the perfume industry. Lemon Verbena leaves in the dried form are said to have the same lemony flavor as the fresh leaves and are used to make potpourri and room fresheners.

PICTURES

Pictures Source-Internet From Left to Right: http://fr.wikipedia.org/wiki/Fichier:Aloysia_triphylla1.jpg, http://www.about-garden.com/se/en/fotoa-aloysia+triphylla/, http://www.brooklynfeed.com/2009/10/cooking-with-lemon-verbena/, http://blog.theenduringgardener.com/tag/french-beans/

VARIETIES

Information is unavailable regarding the varieties for this herb.

CLIMATE

Lemon Verbena is an annual in warm weather zones and is an annual in cool/cold weather zones. It likes hot temperatures and requires plenty of sunlight but prefers a little midday shade in warm weather zones. It grows well in USDA hardiness zone 10 and 11. Mature plants can survive brief exposures to 6°F temperatures if properly trimmed and mulched. The plant tends to shed its leaves in cooler temperatures.

SOIL

Lemon Verbena prefers rich, loamy, well-drained soil that is just moist and not soggy. Soil pH level of 6-8 is ideal for growing lemon verbena.

FIELD PREPARATION

Thoroughly plow the field prior to planting. Incorporate fertilizer/organic matter into the soil prior to planting, if required on the basis of soil analysis. Ensure a spacing of 12 -24 inches on all four directions between plants.

SOWING

Propagation of lemon verbena is made from soft wood cuttings. Portions, 3- 5 inches long and having at least one leaf node, of the stem that are neither woody nor new growth are cut, planted in nursery beds or pots and is allowed to establish roots. Prevent the cuttings from exposure to direct sunlight. Water these cuttings to keep the soil moist but not soggy. The cuttings are ready for transplantation, in about 2-3 weeks; once they establish roots and new leaves start to grow. Transplant these cuttings onto the field ensuring a spacing of 12-24 inches between plants. Cuttings taken in spring or summer and off the main branch of an existing lemon verbena plant are the ideal candidates for the cuttings to establish roots and ensure optimum growth in the new plants.

IRRIGATION

Lemon verbena is not drought hardy. It needs moderate. Adequate measures must be taken to ensure that neither the soil is too dry nor it is too soggy. It should be just moist at all times to ensure optimum growth. Too much water will result in root damage and too dry a soil might result in the wilting of the leaves.

FERTILIZATION

Fertilization prior to planting should be undertaken based on the results of a soil analysis. It is important to incorporate several inches of compost into the field during the last plow if the soil is found to be less fertile. Regular application of a slow releasing fertilizer at least once a month, irrespective of the results of the soil analysis; is required throughout the growing period to ensure a continuous supply of good quality harvestable foliage.

PLANT PROTECTION AND WEED CONTROL

Lemon Verbena plants generally do not need any extra protection as they are not normally prone to any serious diseases. However, they need to be monitored, on the underside of the leaves, frequently at regular intervals for aphids, spider mites and stinkbugs. Infestation of aphids and spider mites can be removed by spraying the underside of the leaves with a steady stream of

water. In case of stinkbugs, collect them, by shaking the plants or with a use of a brush, and destroy them before they move on to infest other plants. A spray of sulphur also helps in controlling the infestation of mites and bugs.

HARVEST AND YIELD

Stems may be cut from mature plants, starting from the lower stems, and the leaves collected for use. Leaves can be harvested every other week. This also helps to keep the plants healthy. Leaves can be used fresh or in a dried form. If stored properly, the dried leaves will retain their flavor and nutrition for a period of up to 3 years.

No information is available regarding the yield data for this herb.

NUTRITION

No information is available regarding the nutrients contained in the lemon verbena herb.

LIPPIA

(*Lippia graveolens*)
Family: Verbenaceae
Common Names: Mexican Oregano, Puerto Rican Oregano,
Sonoran Oregano, Redbrush Lippia, Scented Lippia, Scented Matgrass

INTRODUCTION

Lippia graveolens commonly known as Lippia or Mexican Oregano is a native of Mexico and Central America. It is also found in the wild in the southwestern United States. This woody shrub, with an average life span of 5 – 10 years, grows up to a height of about 6 feet. The stems are woody and brittle. The leaves are fragrant, dark green, small, oval shaped and have toothed edges. The leaves have a rough finish and are not smooth to the touch. The flavor of leaves is dominated with the flavor of the Greek oregano intermingled with the flavors of lemon and camphor. However, the flavor of camphor is lost during the process of drying the leaves, leaving the end result of the dried leaves to be a combination of flavors of lemon, Greek oregano and a very milder flavor of camphor. Clusters of fragrant white or yellow flowers are formed at leaf axils. These flowers result in the formation of small, round, brown color fruits.

USES

Lippia or Mexican Oregano is used as a flavoring agent in the preparation of several Mexican dishes likes soups, salsas, bean preparations, and tomato sauces. It is also used for its medicinal properties in the Central American countries. Mexican oregano is used as a stress reliever, expectorant, to relive spasms, stomach aches, to treat asthma, bronchitis and also for its carminative properties. Its extract is also used to flavor beverages.

PICTURES

Pictures: Source – internet from left to right

1. http://www.thedauphins.net/rgv_native_trees_shrubs.html, 56-OregonoCimarron-LippiaGraveolens-4.jpg
2. http://www.celtnet.org.uk, mexican-oregano.gif
3. http://www.cobraheadllc.com, Mexican-Oregano-Leaves.jpg
4. http://aidanbrooksspices.blogspot.com, mexican oregano leaves.jpg

TYPES AND VARIETIES

There are no known varieties or cultivar for Lippia.

CLIMATE

Lippia graveolens prefers full sun, can tolerate partial shade, is drought tolerant but not frost tolerant. It can bear temperatures only as low as 30°F. It is affected by very wet and high humidity conditions. It can be grown in plant hardiness zones of 9 -11.

SOIL

Lippia prefers loamy, sandy, well-drained soils. It can be grown in soils with a pH level of 6-8. It can be grown in a medium fertile soil. It can withstand wet conditions but require proper drainage.

FIELD PREPARATION

Lightly loosen the soil by tilling. Incorporate a light dose of organic manure during the last plow. Dig holes about 4 feet apart. Ensure that the holes are not too deep but are wide enough to accommodate a group of plants.

SOWING

Propagation may be made from seeds, soft-wood cuttings and by letting the branches to root.

Plant several seeds into each planter, place them in a sunny spot and irrigate them uniformly. The seeds will germinate in about 2 - 4 weeks. Transplant the seedlings on to the field when 4-5 true leaves emerge.

Take about 8 inch cuttings of softwood from new growth, remove about a third of the leaves from the bottom and dip the cuttings in a rooting solution. The cuttings should then be placed in a pot which contains a mixture of sand and peat. Water the cuttings as needed to prevent the existing leaves from wilting. The cuttings will root in about 2 months at which point they are ready for transplanting. Ensure that the cuttings are from the tender new growth as they root easily compared to cuttings from matured growth. Collect the cuttings early in the morning as it helps the cuttings to stay hydrated longer and also prevents the leaves from wilting due to heat.

The easiest way to propagate Lippia is to allow its branches to root. Bend and bury its branches in soil, making sure that the branches are still intact with the mother plant. Keep the soil moist and these branches will root in about 2 months. Once the branches root, they can be severed from the mother plant and then transplanted to a new location.

IRRIGATION

Lippia is a drought tolerant plant. So, once the plants are established, they require minimum amount of water. Water regularly, but slowly and deeply. Over watering can lead to root diseases.

FERTILIZATION

As with most herbs very little fertilization is required for Lippia. Excessive application of fertilizers results in the loss of concentration of flavor and natural herbal oil. If fertilization is required, NPK can be applied in the ratio of 3:2:3.

PLANT PROTECTION AND WEED CONTROL

Lippia when grown outdoors in Zones 10 and above, have to be pruned down to a height of 1-2 feet in fall. This would encourage new and vigorous growth in the spring. Occasionally water the plants in winter when the soil is really dry. If plants are grown in zones below 10, they can survive outside temperatures only as long as they are above 40°F. When temperatures fall below 40°F, the plants need to be covered with burlap or blankets and ensured that the cover is not blown away by wind. Extended days of temperatures below 40°F is not good for the plant.

Root rot and leaf spot are some of the common diseases that affect Lippia plants. These can be prevented by ensuring that the soil is well-drained and that they are not irrigated with excess water.

Aphids, leaf miners and spider mites are some of the pests that affect these plants. In case the plants are affected by these pests, treat them with the recommended pesticides. Ensure that the leaves are not harvested immediately after an application of the pesticide.

HARVEST AND YIELD

Mexican oregano leaves can be harvested anytime of the year, as long as the new plant is at least 2-3 feet tall and before the flowers bloom. Leaves harvested before the flowers bloom are said to be rich in flavor and herbal natural oil. The leaves can be harvested by just stripping the leaves from the plant or the branches may be pruned /cut and then the leaves stripped from them. If Lippia leaves are to be stored in their dried form, the leaves are laid out in the sun to dry as soon as they are harvested. The dried leaves if stored properly in a cool and dry place retain their flavors for a long time.

Since most of the Mexican Oregano available in the market is harvested from the wild, inadequate information is available at this time regarding their yield when grown for commercial cultivation.

NUTRITION

Though Mexican Oregano is well known for its culinary and medicinal uses, little or almost no documentation is available regarding the breakdown of its nutrition content. This is due to the fact that Mexican Oregano is almost many times used synonymously with its Greek counterpart, the Mediterranean or the original oregano.

PÁPALO

(*Porophyllum ruderale spp. Macrocephalum*)
Family: Asteraceae
Common Names: Papaloquelite, Bolivian Coriander, Summer Cilantro
Butterfly Herb, Killi, Buzzard's breath, Chipaca, Quilquina

INTRODUCTION

Pápalo a tropical and sub-tropical herb is a native of Mexico, Central America, South America and South-Western USA. The flavor of this herb is similar to cilantro but is said to have additional flavors of lemon, arugula and rue all mixed together. It is mostly harvested from the wild and is best served when fresh. Restaurants in many parts of Mexico place fresh sprigs of this herb as centerpieces on tables to aid the customers to pick fresh leaves of pápalo off the sprigs and add it to their food as desired.

It is also known as butterfly herb, since its leaves resemble butterfly wings and the plant also attracts butterflies. In warm climates, it can grow as tall as 6 feet. The stems branch out quite well. The leaves are blue-green in color with scalloped edges. Brown spots at the scallops may be visible in many leaves. These are not indications of any disease of fungus. They are pores that emit essential oils that bring out the natural flavor of pápalo. The flowers are purple to brownish-white starbursts and look similar to the dandelions found in the USA. It produces fluffy seeds that are easily spread by wind.

USES

Pápalo is considered to be a weed in many parts of the world and but it used for culinary purposes in some parts of the world. In Mexico, Central and South America it is used to enhance the flavor of beans, soups, seafood, salsas, meats, cheeses, salads and sandwiches. It is used raw or added at the last moment to cooked dishes. Caution must be exercised when adding this herb to cooked dishes. The more mature the leaves are, the stronger the flavor. It can be used as an alternative to cilantro in recipes that call for the use of cilantro. However, only about a third of the measure of pápalo should be used in recipes that require the use of cilantro.

Pápalo is also used for its medicinal properties. In Mexico, Central and South America it is believed that when it is consumed daily, it helps lower blood pressure. It is also used to treat stomach disorders; reduce swelling in infections, and to treat liver ailments.

PICTURES

Pictures: Source – From Left to Right:

Pictures 1& 2 : http://store.underwoodgardens.com/Papalo_Quilquia_Papaloquelite-Porophyllum-ruderale-ssp-acrocephalum/productinfo/H1036/
Picture 3: http://flavorsofthesun.blogspot.in/2012/02/papalo-intriguing-mexican-herb.html
Picture 4: http://culture.wnyc.org/articles/last-chance-foods/2011/sep/16/last-chance-foods-growing-popularity-papalo/
Picture 5: http://www.worldcrops.org/crops/Papalo.cfm

VARIETIES

There are 2 types of pápalo. One has the long oval shaped scalloped edge leaves and the other has thin stems and leaves. The type with supple leaves identified as *Porophyllum ruderale* is most commonly used for culinary and medicinal purposes compared to the one with the thin stems and leaves.

CLIMATE

It prefers full sun and warm climates. It can tolerate partial shade but is extremely sensitive to frost. Damages to the plant can be noticed when the temperatures drop below 40°F. It can be grown year round in warm places but in places with colder temperatures in winter it has to be planted every spring.

SOIL

It can grow in any type of soil, on dry slopes, ravines, rocks and even road sides. However, it cannot tolerate water logging and needs well drained soil.

FIELD PREPARATION

Thoroughly plow the field and incorporate organic manure, if required, at the last plow. Mark spots that are 2 feet apart to sow seeds or plant the young transplants.

SOWING

Propagation may be made by direct seeding or by transplanting.

Direct Seeding: There are approximately 3000 seeds in an ounce. The seeds can be sown directly after the last frost. Dig holes that are 3 times the depth of the seed. Plant the seeds horizontally. Keep the soil moist and warm until the seeds germinate. The seeds germinate in about 2-3 weeks.

Transplanting: Since the germination rate is generally very low, it is best to raise the seedlings in a green house or nursery and transplant the seedlings. Start the transplant in seed trays in green houses at least 6 - 8 weeks before the last frost. Once the seedlings are at least 6 inch tall and the ground outside is warm, transplant the seedlings 2 feet apart onto well-drained soil and water them regularly.

Germination is erratic. The germination rate is very low and is only about 50%. Once the plants reach a height of at least a foot, pinch out the young leaves to enable the plant to branch out.

IRRIGATION

Pápalo requires minimum water, but needs to be watered on a regular schedule. Ensure that the plants are not over watered. They are drought tolerant.

FERTILIZATION

As with most herbs minimum or no fertilizers should be applied to bring out the natural flavors of the herb. If required, apply minimum organic manure.

PLANT PROTECTION

In general the plants are considered to be free from the damage caused by pests. The oil excreted from the pores on the scalloped edges of the leaves is considered to act as natural pest repellents.

HARVEST AND YIELD

The plants are ready for harvest in about 50-80 days from planting. Harvest sprigs of young leaves for a milder flavor. Mature leaves are not preferred as they have a very strong flavor. Multiple harvests can be made as long as the weather remains warm. Pápalo leaves are not used in the dried form and are only used when fresh. So, the shelf life of the harvested stems is only about a day or two. The shelf life can be extended to a week or two if they are stored at 32°F and at a relative humidity of 95-100% humidity. As pápalo is mostly harvested in the wild with the exception of those grown in home garden and by small farmers on a relatively small scale, no yield data is available at this time for commercial cultivation.

NUTRITION

Serving Size: 3 ounces
Amount per serving: Calories: 21, Calories from fat: 2

		%DV
Total Fat	0.2 g	0%
Saturated Fat	0 g	0%
Trans Fat	0 g	0%
Cholesterol	0 mg	0%
Sodium	0 mg	0%
Total Carbohydrates	3 g	1%
Dietary Fiber	0 g	0%
Sugars	0 g	
Protein	2 g	
Vitamin A		11%
Vitamin C		27%
Calcium		31%
Iron		11%

Source: http://www.everydayhealth.com/food-fitness/calories-in-papaloquelite

PURSLANE/VERDOLAGA

(*Refer to Purslane under Asian Indian Herbs and Greens***)**

ROSELLE

(*Refer to Indian Sorrel under Asian Indian Herbs and Greens*)

VINE VEGETABLES

(***Cucurbita sp.*)**
Family: *Cucurbitaceae*
Common Names: Pumpkin, Winter Squash, Crookneck Squash, Calabaza, Guias

INTRODUCTION

Vine vegetables that belong to the family Cucurbitaceae are interchangeably referred to as pumpkin, squash or gourd. They are sub-tropical annual vines that prefer a long growing season with warm temperatures. They are primarily grown for their fruit/vegetable. This fact sheet focuses on the vine vegetable pumpkin that is cultivated not only for their fruit but also for their young leaves and tendrils that are classified as a delicacy in Mexico, Africa, Asia and other parts of the world.

Pumpkins are said to have originated in South America. They are one among the several crops cultivated by the native Indians. They are now grown in almost all parts of the world. Typically, pumpkins are annual vines with branched tendrils that spread out on the ground. There also exist some varieties where they grow as bushes and not as vines. The vines can grow as long as 30 feet. The pumpkin vines bear large, dark green, 3 or 5 lobed leaves that are about 10-20 cm long and 20-30 cm wide. The vines bear both the male and female flowers that have a very short life span of only one day. The flowers are golden yellow- orange in color and are pollinated by bees. The fruits are large, round, slightly flat at the bottom and have ribbed skin. Their flesh is orange in color and the center of the fruit contains several seeds that are almost white/ beige in color. The rind of the mature fruit is very thick.

The young shoots, flowers, and fruit of the pumpkin plant are all edible. The tendrils, tender uppermost shoots, tender leaves and stems are categorized as pumpkin shoots. They are considered as a delicacy in many parts of the world. The top 3 to 4 inches on the growing end of the vine are harvested as pumpkin shoots. The vines that have been harvested for pumpkin shoots will continue to produce new growth after the harvest.

USES

Pumpkin leaves and shoots are used for both culinary and medicinal purposes. The flavor of fresh young pumpkin leaves is said to consist of a combination of flavors of spinach and pumpkin. They are best when eaten fresh. They do not have a long shelf life and should be consumed within a day or two after harvesting. The leaves are also sometimes dried and stored for later use. The fresh leaves are rich in protein, calcium and Vitamin C. Some of the Vitamin C is lost in the dried form.

Mature leaves and stems are discarded from the harvested shoots. The fuzzy layer covering the stem is removed, the stems cut into small pieces and is used along with the young leaves and tendrils in soups and stews. They can also be prepared as standalone dish similar to that of spinach. Tea prepared with the use of pumpkin leaves is said to reduce fever. In some parts of

the world, the juice extracted from the pounding of pumpkin leaves is used as a poultice to heal wound.

PICTURES

Pictures: Source - http://tasteofnepal.blogspot.in/2011/11/garden-fresh-pumpkin-shoots-pharsi-ko.html

VARIETIES

Pumpkins come in various sizes and weight. Their weight varies from one pound to a few hundred pounds and can be categorized as small, medium, large and giant based on their size and weight.

Baby Boo, Munchkin, Gold Dust, Spooktacular, Super Freak, School Time, Solid Gold, Moonshine, Cinderella, Gold Rush, Midas Touch, Big Max, Big Moon, Lumina, Atlantic Giant, and Connecticut Field are some of the varieties of pumpkin grown in the USA. No matter what variety of pumpkin is grown, the pumpkin shoots can be used as a leafy green vegetable.

CLIMATE

Pumpkins prefer warm sunny climates. They are highly sensitive to frost, high heat and humidity. They should not be planted until the average daily temperature is at least 70°F and the soil temperature at a depth of 4 inch is at least 60°F. They should be planted in sunny spots that receive at least 6 hours of direct sunlight on a daily basis.

SOIL

Pumpkins require organic rich, loose and well-drained soil. They grow best in soils with a pH level between 6.0 and 7.0. It is ideal to not grow pumpkins in a field where there has been any kind of vine cultivation in the past 2 years.

FIELD PREPARATION

Choose a field where vine cultivation was not undertaken in the past 2 years. Plow the field deeply prior to planting to loosen the soil that would aid in promoting good root growth. Incorporate organic manure about an inch deep into the soil while tilling the soil prior to sowing the seeds. Ensure that the soil is not compacted and the manure used is well composted. If soil tests indicate the requirement of additional fertilizers prior to planting, incorporate those fertilizers into the soil prior to planting. Create mounds or hills in a row with spacing of 3 to 5

feet between the mounds and with 6-8 feet of spacing between the rows. The mounds should have a diameter of about 4 feet. Create a moat around the mound that is about 4 inches deep and 4 inches wide. This moat would help in holding the water for the roots to absorb.

SOWING

Propagation may be made by direct seeding or by transplanting. About 3 – 5 pounds of seeds are required per acre.

***Direct Seeding*:** Seeds can be planted directly into the soil after the danger of the last frost has passed, the temperature of the soil at a depth of 4 inches is at least 60°F and the average day time temperatures reach at least 70°F. Soak the seeds at least 12 hours prior to planting to soften the thick outer shell. Treat the soaked seeds with fungicide and herbicide. Plant 3-5 seeds in each mound at a depth of about one to two inch. Cover the seeds loosely with moist soil. The position of the seed does not affect germination. Water the mounds with just enough water to keep the soil moist. In about a week or two, the seeds germinate and 2 baby leaves will be visible above the soil. The seedlings take about 2 weeks to establish from the time they sprout. At this time, thin the seedlings to about 1-2 young plants per mound.

Transplanting: Direct seeding is the preferred method of propagation for pumpkins. However seedlings can also be raised in greenhouses and/or nurseries. Sow individual seeds in 3 inch pots or containers. Maintain an average room temperature of 65 - 75°F where the potted seeds are placed. Maintain the moisture in the pots. Harden off the seedlings till the pots are filled with roots. Transplant the seedlings onto the field when the outside temperature averages 70°F and the soil temperature at a 4 inch depth is at least 60°F. Place 1-2 seedlings per mound. Ensure that the roots are not disturbed while transplanting. Water the seedlings to maintain moisture to encourage rooting and growth.

IRRIGATION

Pumpkin vines need to be irrigated adequately as 80-90% of pumpkin is made up of water. Care should be taken to ensure that the leaves do not get wet, as they may lead to fungal diseases. Drip irrigation is best suited for pumpkins as this would avoid the leaves getting wet and the plants can be watered deeply near the roots. Irrigate just enough to moisten the soil immediately after planting. In the initial stages, 1 to 2 inches of water are required for the vines to grow. Subsequent to that irrigate deeply at weekly intervals or more often dependent on the weather and the type of soil. Water stress will result in smaller fruit sizes and lower yield. It is advisable to water the plants early in the morning to ensure that if the leaves do get wet, they are dry by the evening.

FERTILIZATION

Fertilizer requirements have to be deciphered based on the results of the soil test. Generally, pumpkins are heavy feeders and thrive well in soil enriched with compost and manure. Prior to planting, apply a basal dressing of about 1000 pounds per acre of NPK in the ratio of 5:10:10.

Apply a side dressing of 20 to 30 pounds of Nitrogen per acre and 60 to 100 pounds of Potassium per acre at the third and sixth week after the emergence of the seedling. At the time of side dressing, apply the fertilizer on both sides of the plant at about 6-8 inch from the plant. In general, apply higher doses of nitrogen at the early stages of growth to provide for root, vine and leaf growth. Higher doses of phosphorous can be applied during the stage when the fruits begin to form and higher doses of potassium at a later stage to promote fruit growth. Results of a leaf analysis conducted on a mature leaf after a few weeks from planting would provide a guidance regarding the application of appropriate fertilizers.

PLANT PROTECTION AND WEED CONTROL

Random checks have to be conducted at the pumpkin patch to scout for weeds, pests and diseases. Powdery mildew, downy mildew, black rot, bacterial wilt, anthracnose and viruses are some of the diseases that affect the pumpkin plants. Vines infected with these diseases have to be treated with fungicides at regular intervals of 7 to 14 days and inspected periodically to assess the situation. Aphids, seed corn maggots, squash vine borer, cucumber beetle, nematodes and white flies are some of the insects that affect the pumpkin vines. Insecticides recommended by the county agents should be used to control these insects.

Weed control during the first six weeks after the emergence of the seedling is very important. Application of pre-emergence herbicide prior to planting helps in controlling weed growth. Shallow cultivation, mulching, hand hoeing and the usage of drip irrigation, also help to control weed growth.

HARVEST AND YIELD

Pumpkin vines are vigorous growers after the emergence of the seedlings. Each pumpkin plant has a main and secondary vine that grows in opposite directions. Each of these two vines produces shoots. These shoots can be pruned to regulate the growth and strengthen the plant. It is from these tertiary vines young shoots, leaves and tendrils are harvested for use as green leafy vegetable. The top 3 to 4 inches on the growing end of the tertiary vines are harvested as pumpkin shoots. Pumpkin leaves should be harvested only after the plant bears fruit. Since pumpkin plants are cultivated primarily for their fruits, harvesting the leaves prior to the plant bearing fruit would affect the yield of the fruit. Harvesting of pumpkin leaves can be undertaken several times until the plant grows old. Increased frequency of harvesting the leaves will have a detrimental effect on the size and quality of the pumpkin fruit. Adequate measures must be undertaken to ensure good harvest of pumpkin leaves without compromising the quality of the fruit. Like every leafy vegetable, pumpkin leaves taste their best when they are young and fresh. Their shelf life is very short and they are usually consumed within a day of the harvest. Sometimes the leaves are smoked or sun-dried and stored for later use.

Cultivation of pumpkins is primarily undertaken for their fruit. Harvest of pumpkin leaves to be used as a leafy vegetable is generally not undertaken on a large scale as they would have a negative effect on the size and quality of the pumpkin. Due to this factor, no data is currently available regarding the yield of pumpkin leaves.

NUTRITION

Serving size: **100 grams, Pumpkin leaves, Raw**

Nutrient	Unit	Value Per 100 g
Water	g	92.88
Energy	kcal	19
Energy	kJ	79
Protein	g	3.15
Total lipid (fat)	g	0.40
Carbohydrate, by difference	g	2.33
Calcium, Ca	mg	39
Iron, Fe	mg	2.22
Magnesium, Mg	mg	38
Phosphorus, P	mg	104
Potassium, K	mg	436
Sodium, Na	mg	11
Zinc, Zn	mg	0.20
Copper, Cu	mg	0.133
Manganese, Mn	mg	0.355
Vitamin C, total ascorbic acid	mg	11.0
Thiamin	mg	0.094
Riboflavin	mg	0.128
Niacin	mg	0.920
Vitamin B-6	mg	0.207
Folate, total	µg	36
Folic acid	µg	0
Folate, food	µg	36
Vitamin B-12	µg	0.00
Vitamin A, IU	IU	1942
Vitamin D	IU	0
Fatty acids, total saturated	g	0.207
Fatty acids, total monounsaturated	g	0.052
Fatty acids, total polyunsaturated	g	0.022
Cholesterol	mg	0

USDA National Nutrient Database for Standard Reference, Release 24 (3/30/2012)

Serving Size: **100 grams, Pumpkin leaves, cooked, boiled, drained, with salt**

Nutrient	Unit	Value Per 100 g
Water	g	92.51
Energy	kcal	21
Energy	kJ	88
Protein	g	2.72
Total lipid (fat)	g	0.22
Carbohydrate, by difference	g	3.39
Fiber, total dietary	g	2.7
Sugars, total	g	0.69
Calcium, Ca	mg	43
Iron, Fe	mg	3.20
Magnesium, Mg	mg	38
Phosphorus, P	mg	79
Potassium, K	mg	438
Sodium, Na	mg	244
Zinc, Zn	mg	0.20
Copper, Cu	mg	0.133
Manganese, Mn	mg	0.355
Vitamin C, total ascorbic acid	mg	1.0
Thiamin	mg	0.068
Riboflavin	mg	0.136
Niacin	mg	0.850
Vitamin B-6	mg	0.196
Folate, total	µg	25
Folic acid	µg	0
Folate, food	µg	25
Vitamin B-12	µg	0.00
Vitamin A, RAE	mcg_RAE	80
Carotene, beta	µg	960
Vitamin A, IU	IU	1600
Lutein + zeaxanthin	µg	1747
Vitamin E (alpha-tocopherol)	mg	0.96
Vitamin E, added	mg	0.00
Vitamin D (D2 + D3)	µg	0.0
Vitamin D	IU	0

Nutrient	Unit	Value Per 100 g
Vitamin K (phylloquinone)	µg	108.0
Fatty acids, total saturated	g	0.114
Fatty acids, total monounsaturated	g	0.029
Fatty acids, total polyunsaturated	g	0.012
Cholesterol	mg	0

USDA National Nutrient Database for Standard Reference, Release 24 (3/30/2012)

PUERTO RICAN GREENS AND HERBS

AMARANTH

(*Refer to Amaranth under Asian Indian Herbs and Greens***)**

CORN SALAD

(***Valerianella locusta***)
Family: *Valerianaceae*
Common Names: Mâche, Fetticus, Lamb's lettuce, Field salad, Nut lettuce, Rapunzel

INTRODUCTION

Corn Salad, a green leafy vegetable, a native of Europe is now naturalized almost all over the world. It is also commonly known as mâche, lamb's lettuce in Europe. It is considered as a weed in many places but is cultivated in Europe and grows in the wild in the USA. It is a hardy plant that can be grown as a winter green. It grows low to the ground as a low rosette with spatulate leaves that grows up to 6 inches long. The leaves are smooth, tender and slightly succulent. The plant bolts during warm temperatures. The flowers are bisexual, small, found in clusters, and white/light blue in color. Each flower bears an oval shaped fruit that has a single seed. The roots are white, slender branching taproot.

USES

Corn Salad with its sweet, nutty flavor is primarily used raw in salads. It can also be cooked lightly like spinach, combines with other vegetables and meat. Corn Salad is also said to have some medicinal properties and is used to soothe nerves, reduce fever, serves as a purgative and is said to contain anti-scurvy properties. It is used as a forage crop in Europe primarily to for sheep.

PICTURES

Source: Internet – from left to right
http://store.underwoodgardens.com/Corn-Salad_-Lambs-Lettuce_Mache-Valerianella-locusta/productinfo/V1055/,
http://www.growveg.com/growguideplant.aspx?id=75, http://www.thetortoisetable.org.uk/site/plants_19.asp?catID=594,
http://www.southpacificseeds.co.nz/corn-salad.html

TYPES AND VARIETIES

Corn Salad can be categorized based on the shape of the leaves, round shaped (curly) or spoon shaped (blond). Grosse Graine, Coguille de Louviers, Verte de Cambrai, Verte d' Etampes, Broad Leaved, Vit, and Bistro are some of the common cultivars of Corn Salad. Broad Leaved is more heat tolerant where as Verte de Cambrai and Verte d' Etampes are quite cold tolerant.

CLIMATE

Corn Salad a cold hardy annual can tolerate frost and freezing temperature. They can survive colder temperatures to 10°F and can be overwintered by mulching with straw. The plant would bolt and produce seeds when the air temperature goes beyond 80°F. Seeds can be sown even at soil temperatures as low as 40°F but will become dormant when the soil temperature exceeds 70°F.

SOIL

Corn Salad tolerates a wide range of soils but prefers a nutrient rich light soil with a pH level of 7.5. It requires well drained dry or moist soil. It has to be planted in a full sun but can tolerate partial shade in places where average temperatures are high at most times during the day.

FIELD PREPARATION

Thoroughly plow the field that will be used to grow Corn Salad. Incorporate compost or manure into the soil at the last plow. Create rows that are 12-18 inches apart and space the plants about 6 inches apart.

SOWING

Propagation may be made by direct seeding or by transplanting. The seeding rate is about 6 pounds per acre.

> ***Direct Seeding*:** Sow seeds about ½ - 1 inch deep at a space of about 6 inches between seeds in rows that are about 18 inches apart, about 2-4 weeks before the last frost. The seeds can also be broadcasted on beds. Cover the seeds with fine soil and keep the soil moist. The seeds will germinate in 2 weeks. The seeds can be planted in intervals of 14 to 21 days to ensure a continuous supply of greens throughout the growing season.
>
> ***Transplanting*:** If propagation is by transplanting, the seeds can be sown directly in the green house earth or in cell trays about 4 to 6 weeks prior to planting. Once the seedlings bear 2-4 true leaves, they can be transplanted on to the field. Propagation by transplants results in better germination and shorter time period for harvest.

IRRIGATION

Water requirements for growing Corn Salad are medium. The soil should be kept moist. Irrigating the Corn Salad fields should be undertaken when the top 1 to 2 inches of the soil feels dry.

FERTILIZATION

An application of 250 kg per ha of NKP at the ratio of 2:1:2 prior to planting is generally recommended. Any further fertilization should be undertaken based on the results of the soil analysis.

PLANT PROTECTION AND WEED CONTROL

Corn Salad being a cool season crop is less susceptible to pests and plant diseases. However, it might be affected by winds and frost. Use of plastic bed covers helps protect the plants from frost, high winds and too much sunlight as they very much act similar to green houses. Timely laying and removal of plastic covers is crucial for a good harvest.

HARVEST AND YIELD

Corn Salad plants are ready for the first harvest in about 45 to 55 days after germination. Individual leaves can be harvested by cutting at about 5 cm above the ground to allow for subsequent multiple harvests or the entire rosette can be harvested when the flowers begin to emerge. The greens should be cooled to 32°F immediately after harvesting to remove field heat and packed in fiberboard cartons that are lined with perforated polyethylene bags or small sealed plastic bags. Adequate care should be taken to ensure that the leaves are drained of any excess moisture from the greens that are washed after the harvest. The greens thus harvested and packed would remain fresh for about 10 days if they are stored at 32°F and at a 95 to 100% relative humidity. On an average, corn salad plants yield about 20 grams of green matter per plant.

NUTRITION

Serving size: 100 g, Corn salad, raw

Nutrient	Unit	Value per 100 gram
Water	g	92.80
Energy	kcal	21
Protein	g	2.00
Total lipid (fat)	g	0.40
Carbohydrate, by difference	g	3.60
Calcium, Ca	mg	38
Iron, Fe	mg	2.18
Magnesium, Mg	mg	13
Phosphorus, P	mg	53
Potassium, K	mg	459

Nutrient	Unit	Value per 100 gram
Sodium, Na	mg	4
Zinc, Zn	mg	0.59
Vitamin C, total ascorbic acid	mg	38.2
Thiamin	mg	0.071
Riboflavin	mg	0.087
Niacin	mg	0.415
Vitamin B-6	mg	0.273
Folate, DFE	mcg_DFE	14
Vitamin B-12	µg	0.00
Vitamin A, RAE	mcg_RAE	355
Vitamin A, IU	IU	7092
Vitamin D (D2 + D3)	µg	0.0
Vitamin D	IU	0
Cholesterol	mg	0

Nutrition Source: **USDA National Nutrient Database for Standard Reference, Release 24 (2012)**

CULANTRO

(***Eryngium foetidum***)
Family: *Apiaceae*
Common Names: Recao, Spiny Coriander, Mexican Coriander, False Coriander, Long Coriander, Fitweed, Spiritweed, Jia Yuán(Chinese), Ngò Gai (Vietnamese), Ketumbar Jawa (Malay), Culantro Cimarrón (Cuba), Wild Culantro (Costa Rica), Bhandhanya (Hindi), Black Benny, Shado Beni, Stinkweed.

INTRODUCTION

Culantro a native of Continental Tropical America and the West Indies is now cultivated and consumed all over the world. This pungent smelling biennial herb popularly known as Recao in Puerto Rico is one of the most important herbs used in Puerto Rican cuisine. This plant can be grown as an annual in most areas of the United States. The aroma, a little on the stronger side, of this herb is similar to Cilantro and is easily used interchangeably in several recipes that list either of these herbs as one of its ingredients. This tap rooted herb has a basal rosette of lanceolate leaves that have spiny-toothed edges and are about 4 cm wide and 25-30 cm long. A well-branched cluster of tiny blue-greenish white flowers are formed on a long stalk that shoots up from the center of the rosette of leaves. The seeds are very tiny and brownish black in color.

USES

Culantro leaves are used as a seasoning in the preparation of a variety of vegetable and meat dishes like chutneys, preserves, sauces, salsas, stews, curries and soups. The roots are also used in Thai cuisines. Fresh culantro leaves are also used in salad.

Culantro leaves are said to have medicinal properties. It is used to treat epilepsy, fever, high blood pressure and flu. The tea made from culantro leaves is used to treat constipation, nausea, diabetes, pneumonia, indigestion and malaria. The root is used to treat stomach ache and scorpion stings. Due to its anticonvulsant property it is also used to treat fits and hence is called fitweed.

PICTURES

Pictures Source: from left to right - http://www.freshcutherbs.com/herbofthemonthculantro.htm, http://withasoutherntwist.com/2010/08/what-is-culantro/, http://www.uni-graz.at/~katzer/engl/Eryn_foe.html, http://thedemogarden.org/2012/04/12/seed-starting-more-mexican-vegetables/

VARIETIES

It appears that no named varieties exist for Culantro at this time.

CLIMATE

Culantro grows best in tropical and semi-tropical conditions. They are extremely sensitive to high heat and frost. They tend to bolt when temperatures are and days are longer. Hence, they are usually grown under shades. It is hardy to zones 8 to 11.

SOIL

Culantro can be grown in a wide variety of soils but prefers a moist well-drained soil with partial shade and a pH level between 5.5 and 6.5. It can survive in poor soil when enriched with organic matter and fertilizers.

FIELD PREPARATION

The field needs to be thoroughly plowed and required fertilizer incorporated into the soil prior to planting. If the field receives direct sun light throughout the day, provisions must be made to provide shade for the Culantro plants at a later stage, as partial shade would prevent premature bolting of the plants and provide for a prolonged harvest. Rows need to be formed at a space of 6 to 12 inches.

SOWING

Propagation may be made by direct seeding or by transplanting.

***Direct Seeding*:** Sow soaked seeds into moist soil when soil temperature is about 75°F and at a depth of 1/8 inch and at an in-row spacing of 1 inch. Keep the soil moist. The seeds would germinate in about 25 – 30 days. Thin the seedlings to provide a spacing of about 6 to 7 inches between plants.

Transplanting: As the soil temperature for the seeds to germinate is about 75°F, it is best to grow the seedlings in green houses and transplant them after the night time temperatures are above 50°F. Transplant the seedlings at a space of 6 inches making sure to minimize the disturbance to the roots. Provide adequate shade and keep the soil moist after the transplant.

IRRIGATION

Irrigate the field as needed to keep the soil moist and the plants healthy. Do not expose the plants to water stress. Water logging should be prevented and the soil well-drained. Water requirements for cultivation of Culantro are medium.

FERTILIZATION

Fertilize with nitrogen and organic matter as required. Nitrogen promotes good growth of leafy matter.

PLANT PROTECTION

Culantro is relatively pest and disease free. However, long-lived plants (plants that are 2-3 years old) grown in tropical climates are susceptible to root-knot nematode and leaf spot problems like bacterial black rot. These problems will most unlikely be met by farmers in the northeast as Culantro will be grown as an annual.

HARVEST AND YIELD

Individual Culantro leaves will be ready for harvest in about 60 to 70 days after germination. When individual leaves are harvested care must be exercised to leave the top three leaves intact. Subsequent harvests may be undertaken at 1-2 week intervals, resulting in about 8-10 harvests per growing season. The entire rosette may also be harvested at soil level or the entire plant can also be harvested along with the roots. Adequate measures should be taken to provide shade to the plants, to prevent them from bolting. Culantro leaves taste best before the flower stalks shoot up. Flower stalks should be pruned on a regular basis to allow for new growth, subsequent harvests and to maximize yield. Individual leaves may be tied up in bundles or entire plants can be bundled together for sale. Normal shelf life for harvested Culantro is 4 days. The shelf life can be extended up to 2 weeks when packed in polyethylene bags and stored at 50°F and a relative humidity of 95%. Culantro can also be dried and stored. It retains its flavor and color even in the dried format. Blanching the leaves before drying helps retain its green color. The average yield of Culantro per growing season is about 40 tons per hectare.

NUTRITION

Culantro leaves are a rich source of Vitamins A, B_1, B_2, C, Calcium, Iron, Carotene, and Riboflavin. Fresh leaves are 86–88% moisture, 3.3% protein, 0.6% fat, 6.5% carbohydrate, 1.7% ash, 0.06% phosphorus, and 0.02% iron. Leaves are an excellent source of vitamin A (10,460 I.U./100 g), B_2 (60 mg %), B_1 (0.8 mg %), and C (150–200 mg %) (Bautista et al. 1988).

DANDELION GREENS

(***Taraxacum officinalle***)
Family: *Asteraceae*
Common Names: Irish Daisy, Lion's Teeth, Blow ball, Cankerwort, Milk Gowan, Priest's Crown, Puffball, and Yellow Flower Earth Nail

INTRODUCTION

Dandelion known as "dent-de-lion" by old French, meaning teeth of lion since it has jagged leaves, is primarily considered as a weed almost all over the world. However, the leaves are also used as a leafy green vegetable in many cultures around the world. This perennial plant has no stems but has deeply serrated leaves clustered as a rosette at the base of the plant. The leaves are oblong, can grow up to 14 inches long and 3 inches wide. The thick, tough, carrot-like taproot can grow up to 3 feet long into the ground, making it almost impossible to control this weed. It is for this reason that it is referred to as "Earth's Nail" by the Chinese. The hollow flowering stalk may be 6 to 24 inches long with a cluster of tiny yellow flowers, numbering several hundred, at the end of the stalk to resemble a ball. The tiny flowers are independent of each other. The flowers close at night and open up again at sunrise. These tiny flowers turn into tiny white fluffy seeds that resemble a puff ball. Each seed has a tiny parachute that may be disbursed far and wide by wind.

USES

Dandelion greens are used for culinary and medicinal purposes. Young leaves and flowers are used raw in salads. The leaves are cooked similar to spinach. The more mature dandelion leaves have a bitter taste. Blanch the leaves in water to reduce the intensity of bitterness. The leaves may be dipped in batter and fried like fritters. The leaves may be cooked as a standalone dish or combined with other vegetables to make a vegetable dish. The roots are ground and used to make herbal tea and the flowers are used to make dandelion wine. Dandelion greens are high in potassium, vitamin A, calcium and iron when compared to those present in bananas, carrots, milk and spinach. The greens are used to treat heart problems, eye conditions, liver diseases, and to purify blood. Tea made out of dandelion roots and leaves is used to relieve indigestion problems, to reduce jaundice and liver swelling, and as a laxative. The leaves milky white sap is said to soothe bee stings and is used to remove warts and pimples. The greens are also considered to be a nutritious fodder for the cattle and when composted is said to enrich the organic manure with phosphorous, iron, potash and magnesium.

PICTURES

Pictures source from left to right: 1,**http://www.spokane-county.wsu.edu/spokane/eastside/Weed_Information/weed_text/Dandelion.pdf** 2,3,4,5**http://libnts.avrdc.org.tw/fulltext_pdf/ebook1/10-54%20dandelion.pdf**

VARIETIES

French dandelion, Arlington dandelion, Montmagny, thick leaved dandelion, and broad leaved dandelion are some of the popular cultivated varieties of dandelion. The cultivated dandelion leaves are much longer, tender, taste milder and do not go to seed quickly when compared to the ones found in the wild.

CLIMATE

Dandelions are very hardy plants and are drought and cold tolerant. It can be grown in all growing zones in the USA. However they prefer full sun and also may do well in partial shade.

SOIL

Dandelion is one of the hardiest plants and can be grown in any kind of soil irrespective of soil conditions. However they yield better when cultivated in well-drained, rich fertile soil.

FIELD PREPARATION

Prepare the field by thoroughly tilling the land to loosen the soil when the soil temperature is at least 50°F. Additional fertilizers may be incorporated at this time if required. Create rows at least 8 inches apart.

SOWING

Propagation is by direct seeding. When soil temperature is at least 50°F plant a few seeds 1 cm deep per hill that are 8 inches apart on rows that are spaced out at least 8 inches. Thin seedlings to one per mound in about 14-21 days when the first true leaves appear. Alternatively 2 year old root pieces that are about 18 inches long may also be planted per hill with the larger piece of the root pointing upwards. Keep the soil moderately moist until the plants are established.

IRRIGATION

Dandelions are said to be drought hardy. But it is important to irrigate the plants from time to time to prevent the leaves from becoming too bitter due to long periods of drought.

FERTILIZATION

Spread about 2-3 inches of compost or other organic matter on the soil and till the soil to incorporate the compost and enrich the soil. If the results of soil analysis require, N and K at the rate of about 80 kg/ acre can also be incorporated into the soil prior to planting. Dandelions generally do not require any additional fertilizers.

PLANT PROTECTION AND WEED CONTROL

Worms can be a problem in spring for dandelions. White files and aphids are some of the other pests that may affect cultivated dandelions. Hose off these pests with water, and if further treatment is required, the plants may be subject to a chemical treatment recommended for herbs and greens. Ensuring adequate space between plants provides good air circulation and prevents the easy spread of pests. Hand weeding is generally undertaken at the time of thinning of seedlings and immediately before the harvest to control weeds. If required, additional hand weeding may be undertaken at the appropriate time.

HARVEST AND YIELD

The first harvest can be undertaken in about 50 days from the date of sowing the seeds. Subsequently the dandelions greens can be harvested once in every three to four weeks. The greens taste best if harvested young and before the plant begins to bolt. All the leaves in the plant are gathered together as a bunch and the entire rosette can be cut in one harvest or individual leaves may also be harvested. The leaves are washed to remove the dirt and tied together into bundles. Since the dandelion greens wilt quickly, the harvested greens must immediately be stored in a cooler. The greens have a shelf life of one week if properly stored in the refrigerator. The roots may also be harvested and can be stored for about a year in a cold, moist place. On an average, the yield of dandelion greens is about 15000 kg/ha and that of the roots is about 1500 kg/ha.

NUTRITION

Dandelion Greens, raw.

Serving Size: 100 gm

Nutrient	Unit	Value per 100 g
Water	g	85.60
Energy	kcal	45
Protein	g	2.70
Total lipid (fat)	g	0.70
Carbohydrate, by difference	g	9.20
Fiber, total dietary	g	3.5
Sugars, total	g	0.71
Calcium, Ca	mg	187
Iron, Fe	mg	3.10
Magnesium, Mg	mg	36

Nutrient	Unit	Value per 100 g
Phosphorus, P	mg	66
Potassium, K	mg	397
Sodium, Na	mg	76
Zinc, Zn	mg	0.41
Vitamin C, total ascorbic acid	mg	35.0
Thiamin	mg	0.190
Riboflavin	mg	0.260
Niacin	mg	0.806
Vitamin B-6	mg	0.251
Folate, DFE	mcg_DFE	27
Vitamin B-12	µg	0.00
Vitamin A, RAE	mcg_RAE	508
Vitamin A, IU	IU	10161
Vitamin E (alpha-tocopherol)	mg	3.44
Vitamin D (D2 + D3)	µg	0.0
Vitamin D	IU	0
Vitamin K (phylloquinone)	µg	778.4
Fatty acids, total saturated	g	0.170
Fatty acids, total monounsaturated	g	0.014
Fatty acids, total polyunsaturated	g	0.306
Cholesterol	mg	0
Caffeine	mg	0

Nutrition Source: USDA National Nutrient Database for Standard Reference, Release 24(2012)

LAMBSQUARTER

(*Refer to Common Lambsquarter under Mexican Herbs and Greens***)**

LEMON BALM

(***Melissa Officinalis***)
Family: *Lamiaceae*
Common Names: English Balm, Garden Balm, Balm Mint, Melissa, Sweet Balm, Heart's Delight, Honey Plant, Bee Balm, Common Balm, Lemon Fragrance

INTRODUCTION

Lemon Balm, a native of Southern Europe, is a lemon scented member of the mint family Lamiaceae. It is now naturalized in almost all parts of the world. This erect perennial plant grows to a height of about 2 feet, develops many branches and is bushy. The heart shaped leaves with toothed edges resembling mint leaves are found in pairs. The leaves are about 2 to 3 inches long. The leaves when bruised emit lemon smell. The flowers are hermaphrodite, small, about ½ inch long, 2-lipped, found in clusters and are white, light yellow or light blue-purple in color.

USES

Raw lemon balm leaves are added to both vegetable and fruit salads since it imparts a lemon flavor to the salads. It also enhances the flavor when cooked with vegetables, meat, seafood and deserts. The dried leaves are also used to make tea. It is also used to flavor vinegar, sauces, jams, jellies, alcoholic and non-alcoholic beverages.

Lemon balm has several medicinal properties. It is used as a relaxant, an anti-depressant, sedative, carminative, and antispasmodic. It is also used to treat high blood pressure, fever, sore throat, cold sores and menstrual irregularities.

The herb is used for cosmetic purposes as a toner, and an astringent. Crushed lemon balm leaves are used to treat bee stings and also acts as an insect repellant. Lemon balm is also known as Bee balm as it was traditionally used to attract honey bees. Crushed leaves and the oil extract from the leaves are used to polish wooden furniture. Dried leaves are used in potpourri.

PICTURES

Pictures source from left to right. http://www.theherbcottage.com/6-11_lemon_balm.html, http://www.aphotoflora.com/d_melissa_officinalis_lemon_balm.html, http://www.uni-graz.at/~katzer/engl/spice_photo.html#meli_off, http://aidanbrooksspices.blogspot.in/2007/10/lemon-balm.html

VARIETIES

There are several cultivars for Lemon Balm. Prominent among them are Compacta, Lime, All Gold, Quedlinburger, Citronella and Aurea.

"Compacta" is the dwarf variety that grows only up to a height of 6 inches. It can be planted very close to each other compared to other varieties. It has dark green leaves, does not produce flowers or seeds. The leaves have a moderate lemon flavor.

"Lime" variety grows to a height of about 3 feet. The plants need to be more spaced out. It has green leaves and bears small white flowers. The flavor of this cultivar is more lime-like.

"All Gold" variety grows up to 18 inches tall and wide, and hence needs to be spaced out accordingly while propagation. The leaves are golden yellow and hence can be used as an ornamental plant. The flowers are light-lilac in color. This variety must be planted in areas which receive partial shade. Exposure to full sun throughout the day may result in the leaves being scorched and developing pale spots.

"Quedlinburger" grows to a height of about 2 feet. Plants need to be spaced out wider when compared to other varieties of lemon balm. The leaves have a very strong flavor and the content of essential oil is high. Due to its strong flavor, this variety is used more often than others in salads and beverages.

"Citronella" variety grows up to 16 inches tall. The leaves are green, have a strong citronella scent, high in essential oil content and are mildew resistant. The plant produces white flowers.

"Aurea" or "Variegata" variety grows up to 24 inches tall. The leaves are a combination of green and golden yellow. It bears white flowers. It has a moderate flavor and is well suited to be grown as an ornamental plant. The colors are more vibrant in spring and tend to fade away in summer.

CLIMATE

Lemon balm can be grown in USDA Hardiness Zones 3 to 7. In cold regions, they will die down in winter but will re-grow the following spring. In temperate and sub-tropic regions, they can be grown outdoors all year round. Lemon balm can be grown in full sun or partial shade. The "Variegata" and "All Gold" varieties will be scorched when grown in full sun and hence these varieties should be grown only in partial shade.

SOIL

Lemon balm grows in almost all types of soil but grows best in well-drained clayey or sandy loam soil. It can also be grown in acidic and very alkaline soil but prefers a soil pH level of 5-8.

FIELD PREPARATION

About 2 weeks before planting add 2 to 4 inches of compost or manure and work them about 8 inches into the soil. Additional fertilizers can be incorporated based on the results of the soil test. Create rows 2 - 5 feet apart, depending on the variety of lemon balm to be grown.

SOWING

Propagation may be made by direct seeding, transplanting, stem cutting, root cutting or layering. Irrespective of the method of propagation steps must be taken to ensure that the space between plants is about 12 to 24 inches and the space between rows is 24 to 36 inches. The seeding rate is about 9 kg/hectare and the planting density should be about 50000 plants /hectare.

For propagation by ***direct seeding***, sow the seeds in well-drained soil after the danger of the last frost has passed and the soil can be worked on. Leave them uncovered or cover with a thin layer of soil or vermiculite. The seeds with germinate in one to two weeks. Once the seedlings develop 4 true leaves, thin them to ensure a space of 12-18 inches between plants, dependent on the variety of lemon balm to be grown.

For propagation by ***transplanting***, broadcast the seeds in trays on raised beds in green house soil. The seedlings will germinate in 7-14 days. Once the seedlings develop 4 true leaves, transplant each seedling into individual pots to harden the seedlings before transplanting them out in the fields. The seedlings can be transplanted from the individual pots on to the field when they are at least 15 cm tall.

If propagating lemon balm from ***stem cuttings***, take about 3-4 inch softwood tip cutting, remove about 2/3 of leaves from the bottom of the cutting, dip the cutting in rooting hormone powder and place them in a sterile potting soil, provide support, keep them moist and away from direct sun. The cuttings will root in about two to three weeks. If the cuttings are propagated in fall, the cuttings should be made from the stems which do not have flowers. However, if the cuttings are propagated in spring, they can be made from flowering stems. Once the roots are well established, the cuttings can be transplanted onto the field.

Propagation may also be made by ***root cuttings***. Divide large clumps of roots into smaller clumps ensuring that each clump has at least three or four buds and plenty of roots. Root cuttings may be planted directly in the field in fall or they may be raised indoors and transplanted in spring.

To propagate by ***layering***, bend a branch and place a heavy object like stone or bury a part of the branch in soil. The roots will begin to develop in a few days where the branch touches the soil. Once the roots are well established, severe the branch from the main plant just below where the roots are established and then transplant the severed branch to a new location.

IRRIGATION

Moist, well-drained soil is important for a good yield of lemon balm. Regular watering through drip or overhead irrigation is required when the plants are grown in full sun. Steps must be taken to ensure that the plants are not subject to water stress.

FERTILIZATION

Incorporating 2 - 4 inches of top soil along with compost, lime and nitrogen based on the results of the soil analysis is sufficient for growing lemon balm. For plants older than one year side-dressing with nitrogen several times during the growing season will result in better yield and oil content in the leaves.

PLANT PROTECTION AND WEED CONTROL

Watering the plants early in the morning ensures that the leaves are dry and are not susceptible to diseases like powdery mildew and Septoria leaf spot. Adequate spacing between plants improves air circulation and is important to prevent lemon balm plants from being affected by powdery mildew and Septoria leaf spot. The onslaught of whitefly, aphids, and spider mites may be controlled by planting in well-drained soil in high sunny areas. Placing a board with sticky yellow colored substance near the plants will also help in attracting the pests towards the board and away from the plants. Practice of crop rotation along with measures to prevent water logging helps in the prevention of soil-borne diseases.

Weed control is very important while growing lemon balm. Presence of weed in the dried product results in an inferior product which in turn triggers lower price for the product. Use of mulch together with shallow cultivation, and hand weeding is recommended for controlling weeds. Since lemon balm is primarily used for medicinal purposes use of herbicide should be avoided to control weeds.

HARVEST AND YIELD

The first harvest of lemon balm can be made at about 10 weeks from the date of transplanting. Subsequent harvests may be made at monthly intervals. To ensure a constant supply of lemon balm, harvest about one-third of the field every week. Adequate care should be taken to ensure that the leaves are not bruised during the harvest, as the leaves easily turn black when bruised. Leaves can be used fresh or may be dried. Harvested stems may be tied together in bunches and hung in a dark ventilated room to dry. It can also be dried outside in partial shade. Ensure that the leaves are not exposed to night time moisture. They dry in about 2 days. The dried leaves may be stored for up to a year in a cool, dark place for up to a year. On an average the yield is about 2500 lbs per acre.

NUTRITION

Currently, no breakdown of the nutrients in lemon balm leaves is available from an authenticated source. Lemon balm leaves are said to contain Vitamin C and Thiamin.

LEMON VERBENA

(*Refer to Lemon Verbena under Mexican Herbs and Greens*)

MARJORAM

(*Origanum majorana*)
Family: Lamiaceae/Labiatae (mint Family)
Common Names: Sweet Marjoram, Knotted Marjoram

INTRODUCTION

Origanum majorana generally known as Sweet Marjoram is part of the Oregano family. A native of the Mediterranean and the Middle East, it is now widely cultivated in almost all parts of the world. This perennial herb grows to a height of up to 2 feet. This multi-branched plant has fuzzy grey-green leaves that are oval in shape, about an inch in length and are formed opposite to each other on the stem. The leaves are covered with minute gray colored hair giving it the fuzzy feel. The stems are reddish in color. The flowers are tiny, white, pink or purple in color, are hermaphrodite and are found in clusters. The flowers are said to attract bees. Since the unopened flower buds resemble finely tied knots, it is also known as Knotted Marjoram. The seeds are very tiny, oval in shape and dark brown in color. The marjoram plants have a life of up to seven years if grown in temperate regions.

USES

Sweet Marjoram is widely used as a flavoring agent in vegetable and fruit salads, soups, and vegetable and meat dishes. The leaves, both fresh and dried, are used to flavor sauces, omelet, poultry stuffing, pizzas, and desserts. Herbal tea made using marjoram leaves is said to provide relief for headache. Sweet Marjoram is also widely used for its medicinal properties. It is used to treat indigestion, hay fever, stomach pain, and nervous disorders. The oil extracted from this herb is used as a muscle relaxant and also for its carminative, antifungal and antioxidant properties. The oil extract is also used in the manufacture of commercial perfumes, body soaps and hair care products. The dried leaves and flowers are also used to make flower arrangements and in potpourris.

PICTURES

Picture source: Internet from Left to Right
http://www.floralencounters.com/Seeds/seed_detail.jsp?productid=92655
http://bargains-o-plenty.com/Herbs/SweetMarjoram.html,
http://www.nzessentialoil.co.nz/Essential-Oils.php
http://www.flickr.com/photos/ingridsgardenseedlings/4421212708/

VARIETIES

Origanum majorana "Russell's" also known as Golden Greek Marjoram or Golden Sweet Marjoram, Origanum majorana "Max", and Origanum majorana "aurea" are some of the well known cultivars.

CLIMATE

Sweet Marjoram prefers warm temperatures, and moderate sun. It is frost tender and should be planted after the danger of the last frost has passed and when soil temperatures are between 50°F and 77°F. It grows best when the day time temperatures are about 75°F and the night time temperatures are not below 60°F. It is drought tolerant and can survive harsh summers if provided with some shade during the hottest part of summer. It can be grown in USDA Zones 7 and above.

SOIL

Marjoram grows in a variety of soils. However, it prefers dry, well-drained, fertile sandy, clayey or loamy soil that has pH levels between 6 and 8.

FIELD PREPARATION

Thoroughly till the field 6-8 inches deep to loosen the soil. Spread 2 - 3 inches of organic matter and incorporate them into the soil 6-8 inches deep. Depending on the results of the soil analysis additional fertilizers may be incorporated into the soil prior to planting. Create rows that are about 2 feet apart.

SOWING

Propagation may be made by direct seeding or by transplanting.

***Direct Seeding*:** Sow the seeds thinly at a depth of about 5 mm into warm moist soil and cover them with a thin layer of mulch or sand to prevent the seeds from being washed away by rain or blown away by wind. The soil temperature at the time of sowing should be between 60-70°F. Irrigate frequently with just enough water to keep the soil moist. The seeds will germinate in about 1-2 weeks. Thin the seedlings to leave a space of 2 feet between plants.

Transplanting: Marjoram may also be propagated by transplants. Transplants may be raised from seeds sown indoors in individual containers. They may also be raised from stem cuttings. Cut about 8 inches of the stem that has at least 3-4 nodes and plant them in rooting medium or potted containers. Once the cuttings develop roots, new branches will begin to emerge from the nodes. Transplants may also be raised from layering since the marjoram plants develop roots at the point where the stem touches the soil. Once the roots are well established, the stem can be cut off just above the where the roots are developed and transplanted on to the field. Transplants raised indoors should be

hardened off by leaving the containers out in the open for about a week before they can be transplanted on to the field. Seedlings must be transplanted after the danger of the last frost has passed.

IRRIGATION

Marjoram plants thrive on well-drained soil with frequent watering. Established plants are drought tolerant. Frequent watering with less amount of water each time is recommended compared to less frequent watering with more amount of water each time. If propagation is by direct seeding, during the first week irrigate 2-3 times a day just enough to keep the soil moist for germination. For the next 2 weeks after germination water once daily to keep the soil moist. Subsequently for the next 3 weeks water twice a week to maintain the moistness in the soil. Irrigate sparingly as needed after about six weeks. Ensure that the soil is well drained to prevent the plants from the attack of fungal diseases. Irrigate after each harvest.

FERTILIZATION

Apply 2- 3 inches of organic matter, and if required, along with 100 kg/ha of Super Phosphate and incorporate it 6-8 inches into the soil. Application of 100 kg/ha of Urea, 30 days after planting along with 100 kg/ha of Potassium Nitrate 70 days after planting and again about 2 weeks prior to flowering would result in good quality yield. Too much Nitrogen may result in the yield of less flavorful herb.

PLANT PROTECTION AND WEED CONTROL

Marjoram plants are less susceptible to many pest and disease problems if grown from cuttings when compared to the marjoram plants grown from seeds. Good water drainage along with pruning the plants from time to time results in better air circulation between plants which reduces the attack of fungal attacks, stem and root diseases. Treat marjoram plants that are susceptible to aphids, spider mites and white flies with natural and chemical treatments suggested by county agents. Hosing the plants with water also helps to get rid of aphids, white flies and spider mites. Undertaking hand weeding along with hoeing on a regular basis helps to control weeds. Use of weed control chemicals is generally not recommended for herbs.

HARVEST AND YIELD

Marjoram can be harvested throughout the growing season but the flavor is at its best just before the plants start to produce flowers. The best time for the first harvest is when the plants are at a 30% flowering stage. The second harvest should be made when the flowering stage is at its peak during late summer or early fall. Pruning the plants between the harvests would stimulate growth of leaves and results in higher yields during the second harvest. Harvesting can be done mechanically or by hand. Steps should be taken to ensure that there is minimum damage to the stems and leaves.

Marjoram should be harvested when the temperatures are cooler early in the morning or late in the evening. The harvested herb may be tied in small bundles and shipped for sale. Fresh cut

marjoram has a very short shelf life of about 2 – 3 days. The shelf life of the harvested herb can be extended up to a period of 2-3 weeks by storing them at a temperature of 32°F and at a relative humidity of about 95%. Cut marjoram can also be dried and stored. The stems may be tied in bundles and hung upside down in a cool place to dry. The harvest may also be dried by spreading out the herb on racks and turned frequently for an even drying. Dehydrators may also be used to dry the herbs.

An average of 40 – 50 tons per hectare of marjoram may be harvested every year.

NUTRITION

Serving Size: 100 g Dried Marjoram, Spices

Nutrient	Unit	Value per 100 g
Water	g	7.64
Energy	kcal	271
Protein	g	12.66
Total lipid (fat)	g	7.04
Carbohydrate, by difference	g	60.56
Fiber, total dietary	g	40.3
Sugars, total	g	4.09
Calcium, Ca	mg	1990
Iron, Fe	mg	82.71
Magnesium, Mg	mg	346
Phosphorus, P	mg	306
Potassium, K	mg	1522
Sodium, Na	mg	77
Zinc, Zn	mg	3.60
Vitamin C, total ascorbic acid	mg	51.4
Thiamin	mg	0.289
Riboflavin	mg	0.316
Niacin	mg	4.120
Vitamin B-6	mg	1.190

Nutrient	Unit	Value per 100 g
Folate, DFE	mcg_DFE	274
Vitamin B-12	µg	0.00
Vitamin A, RAE	mcg_RAE	403
Vitamin A, IU	IU	8068
Vitamin E (alpha-tocopherol)	mg	1.69
Vitamin D (D2 + D3)	µg	0.0
Vitamin D	IU	0
Vitamin K (phylloquinone)	µg	621.7
Fatty acids, total saturated	g	0.529
Fatty acids, total monounsaturated	g	0.940
Fatty acids, total polyunsaturated	g	4.405
Cholesterol	mg	0
Caffeine	mg	0

Source: **USDA National Nutrient Database for Standard Reference, Release 24 (2012)**

SORREL

(*Refer to Indian Sorrel Spinach under Asian Indian Herbs and Greens*)

PURSLANE

(*Refer to Purslane under Asian Indian Herbs and Greens*)

GARLIC CHIVES

(***Allium tuberosum***)
Family: *Alliaceae (or Lilliaceae)*
Common Names: Chinese Chives, Chinese Garlic, Chinese Leeks, Flowering Chives, Oriental garlic, Yellow Chives, Nira (Japanese), Jiu Cai, Gow Choy

INTRODUCTION

Garlic Chives also known as Chinese chives or Chinese leeks belong to family of onions and garlic and are the smallest member of the onion family. The origin of Garlic chives can be traced back to Southeast Asia. This herb deriving its name for its garlic flavor is native to China and Japan. It has been used for centuries in those countries for culinary and medicinal purposes. Garlic Chives are slowly gaining popularity and are now being grown and consumed almost all over the world. This hardy perennial herb has flat grass like leaves unlike the onion chives which has hollow tubular leaves. This cool season, cold tolerant perennial grows to a height of about 12 – 15 inches. This easy to grow grass like herb bears fragrant tiny clusters of star shaped white flowers. The leaves are shorter than the flowering stalk. A green colored seed capsule replaces each flower. Several small, shiny, black colored seeds can be found within each capsule. The plant grows as a clump and has an elongated bulb with several fibrous roots at the bottom of the bulb.

USES

Garlic Chives can be used as an herb in several dishes primarily for its mild garlic flavor. The snipped leaves are used raw in salads and to flavor butter, cheese and spreads. It can also be used to flavor stir fries, cooked meat and vegetable dishes. If added to cooked food, it should be added during the last few minutes of cooking to ensure that it is not over cooked and to impart its flavor. The flowers are also edible and taste the best when they are in the bud stage. They can be used in salads and in stir-fry dishes. The cut flowers can also be used either fresh or dried in flower arrangements.

Garlic Chives are also used for medicinal purposes. The leaves are used to reduce fatigue, improve digestion, stimulate appetite, and promote blood circulation. The leaves and bulb are used to treat bug bites, cuts and wounds while the seeds are used to treat liver and kidney problems.

PICTURES

Pictures Source (From Left to Right): http://www.flickr.com/photos/ingridsgardenseedlings/4399247482/, http://www.our-spice-garden.com/garlic-chives.htm, http://farmproject.org/produce/garlic-chives, http://www.plant-biology.com/Allium-Wild-Onion.php, http://fritzmonroe.com/fritz/wp-content/uploads/2011/10/garlic_chive_seed_pods.jpg

VARIETIES

Garlic Chives are generally categorized into Winter Dormant and Winter Non-Dormant varieties. Winter Dormant varieties are cold tolerant. They require at least 2 months of cold weather for their dormancy for good quality yield and therefore are most suitable for open field cultivation in the colder regions. The Winter Non-Dormant varieties do not require the dormancy period and can grow continuously. They are most suitable for cultivation in green house and in tropical regions. Dah Ye, Dugeirhong, Hiro Haba, New Belt, Ping Giant, Tai Jui, Green Belt, Super Green Belt, Wonder Green Belt and Shikibana are some of the varieties of garlic chives.

CLIMATE

Garlic Chives plants are adaptable to varied weather conditions. They can tolerate extreme hot and cold temperatures. They die down during cold winters and will re-grow when temperatures warm up in spring. They turn woody and fibrous under extreme hot temperatures resulting in low quality yield. Temperature ranging between 64°F and 75°F is ideal for cultivating garlic chives that would result in high yield and good quality herb. They can tolerate shade but prefer about 8 hours of direct sun light.

SOIL

Garlic Chives can grow in any type of soil that has a pH level ranging between 5.5 and 7.5. The roots of well established plants can grow up to 50 cm deep, so they prefer soils that are not shallow but are moist, fertile, well-drained and rich in organic matter.

FIELD PREPARATION

Prior to planting, till the field and incorporate well-composted organic manure and nitrogen about 6-8 inches into the soil. Create rows that are about 45 cm apart and mark spots about 10 cm apart for direct seeding or transplanting.

SOWING

Propagation may be made by direct seeding, transplanting or division of clumps.

> ***Direct Seeding***: Soak seeds in warm water for 24 hours. Plant seeds about ½ inch deep and about 8 inches apart. Cover the seeds with soil and pat them down gently to establish contact between seed and soil. Keep the soil moist. The seeds will germinate in about 2 weeks.
>
> ***Transplanting***: Soak seeds in warm water for 24 hours. Plant the soaked seeds in flat trays or seed cells. Keep the soil moist and maintain the temperature between 65°F and 75°F in the area where the seedlings are raised. The seeds will germinate in about 2 weeks. Transplant the seedlings on to the field when they develop about 5 to 6 leaves and the danger of the last frost has passed.

Division of clumps: The clumps of garlic chives plant multiply fast. The bigger clumps along with the roots can be divided into smaller clumps of about 5 bulbs each and planted directly on to the field.

Propagation by division of clumps or by transplants is the most efficient way to grow garlic chives, since it results in good yield and better quality in a relatively shorter period of time when compared to propagation by direct seeding.

IRRIGATION

Garlic chives require normal amount of water but on a frequent basis. It is important to keep the soil moist and ensure that the root zone does not dry out. They can tolerate drought and water stress but at the cost of low growth, productivity, quality and yield.

FERTILIZATION

Fertilization requirements are dependent on the results of the soil analysis conducted at the field. In general about 75 kg each per ha of NPK is recommended at planting with an additional 10-15 kg/ha of nitrogen as side dressing twice during the growing season.

PLANT PROTECTION AND WEED CONTROL

Thrips and Root Maggots can pose significant risks to garlic chives cultivation. A well-drained soil together with proper sanitation at the field and the use of registered pesticides can help contain the damage caused by Thrips and Root maggots. Garlic chives are susceptible to Downy Mildew. Proper spacing between plants, facilitating good air movement between plants and ensuring that the leaves are dry by irrigating during the early morning hours, along with the registered chemicals can help reduce the impact of the disease on the growth and yield of this herb. Weed control during the initial stages of plant growth is very critical to ensure that the garlic chives plants are not deprived of adequate nutrition and water. Weeds can be controlled by hand weeding, practicing crop rotation, use of mulches, and use of registered chemicals. Dead heading of seeds at the appropriate time also ensures that the plants do not reseed themselves.

HARVEST AND YIELD

The first harvest of garlic chives can be undertaken in about a month from planting if propagation is by transplants or in about 2 months from planting if propagation is by direct seeding. Subsequent harvests can be undertaken when the leaves are about 15 inches tall or just before the flowers begin to seed. The plants can be harvested about 3-4 times in a growing season during the first year. If the plants are maintained for more than a year, the plants can be harvested once a month during the growing season in the subsequent years. These plants have a life of about 10 years if provided with adequate care. However, it is important to divide the clumps once in every 2-3 years. In addition to the leaves, the flowers can also be harvested along with the stalk before they seed and be sold for culinary purposes or for floral arrangements.

Garlic chives have a very short shelf life and taste the best when used fresh. The shelf life can be extended to about one to two weeks by storing the harvested garlic chives at 34°F and at a relative humidity of 95-100%. Garlic chives can also be dried or frozen for later use. It is not necessary to thaw the frozen garlic chives when used for culinary purposes.

Garlic chives can also be blanched (excluding light from the plants during growth) during the growing season. This process makes the leaves turn yellow in color and enhances the texture of the leaves. Blanched garlic chives are considered to be a delicacy and are a high value product compared to the regular garlic chives.

The approximate yield of fresh cut garlic chives for commercial cultivation is about 25000 kg/ha.

NUTRITION

Nutrition Facts

Serving Size ¼ cup chopped, raw

Amount per Serving	
Calories 10	Calories from Fat 0
	% Daily Value *
Cholesterol 0mg	0%
Fiber 1mg	0%
Protein 1mg	0%
Total Fat 0g	0%
Saturated Fat 0g	0%
Sodium 0mg	0%
Sugars 0mg	0%
Total Carbohydrate 1g	0%
Calcium	2%
Iron	2%
Vitamin A	25%
Vitamin C	30%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

Nutrition Source: http://www.melissas.com/Products/Products/Nira-Grass-Garlic-Chive.aspx

LETTUCE

(***Lactuca sativa***)
Family: *Asteraceae*
Common Names: Lechuga (Spanish)

INTRODUCTION

Lettuce is an easy to grow cool season annual leafy green vegetable. It belongs to the Asteraceae family and is said to be a native of the Mediterranean and its initial cultivation dates back to 4500 BC. It is now commonly cultivated and used worldwide. It is said to have been brought into the USA from Europe in the late 15th century by Christopher Columbus. Lettuces can be found in a variety of sizes and leaf structures and are generally classified into five main classes. Butterhead or Bibb, Crisphead or Cabbage Lettuces, Cos or Romaine, Curled or Loose Leaf and Celtuce or Stem Lettuce. Curled or Loose Leaf variety of lettuce is widely used and is commonly referred to as Lechuga in Puerto Rico. Loose leaf lettuce is also known as cutting or bunching lettuce.

Leaf lettuce form tight rosettes of individual leaves and do not form heads or hearts. There are many variations in the size, texture, margins and color of the leaves of Lechuga. The texture of the leaves may be smooth, crinkled, ruffled or curled; the colors may vary from green, red, purple, yellow or a combination of these colors and the size and shape of the leaves may be wavy, small, large, or in the shape of an oak leaf. The leaves of Lechuga are slightly curly with firm central ribs and are arranged around a central stalk. Lettuce plants generally have a width and height of about 6 to 12 inches. With the exception of the Celtuce cultivar, lettuce plants do not have stems but have rosette of leaves or heads. Their root system consists of one main tap root and several secondary roots. Lettuce plants cannot tolerate high temperatures and tend to bolt and develop flower stalks that may be about 3 feet tall. The flower stalk bears several tiny yellow flowers resembling tiny dandelions. The flowers stay open during the day and close at night. Each flower yields one tiny tear drop shaped fruit that contain one tiny seed per fruit. The seed color may be white, yellow, brown or gray depending on the variety of the lettuce.

USES

This high water content green leafy vegetable is very low on calories and rich in fiber. It is most commonly consumed raw and sometimes braised or creamed. The flavor of leaf lettuce is generally mild with the green leaf varieties tending to be a bit sweet and the red leaf varieties tending to be a bit spicy. It is mostly used in salads, sandwiches and wraps. It is said to aid digestion, improve liver health, relieve insomnia and reduce the risk of stroke and heart attack. Lettuce extracts are also used in creams and lotions that are used to treat sun burn and rough skin problems.

PICTURES





Pictures Source from L to R: http://salud-gratis.info/blog/2009/03/lechuga.html, http://www.geekcasual.com/food/salad-days/attachment/red-leaf-lettuce/, http://luirig.altervista.org/naturaitaliana/viewpics2.php?rcn=32498, http://charisawernick.blogspot.in/2011_04_01_archive.html, http://frogstarfarm.com/blog1/tag/seeds/

VARIETIES

Leaf Lettuce is generally classified as Green Leaf and Red Leaf depending on the predominant color of the leaf.

The most common commercially cultivated Green Leaf varieties are Green Salad Bowl, Tropicana, Green Star, Two Star, Black-seeded Simpson, Grand Rapids, Green Oak Leaf, Slobolt, Waldmann's Green, Royal Green, Tiara, Big Star, Burgam's Green, North Star and Tehema.

The most common commercially cultivated Red Leaf varieties are Galactic, Red Salad Bowl, New Red Fire, Vulcan, Ibis, Red Oak Leaf, Red Sails, Ruby, Garnet, Prize Head, Aragon Red, Deep Red, Redina, Royal Red, Read Leaf 20, Red Fox and Red Tide.

CLIMATE

Lettuce is a cool season crop. The ideal temperature for growing lettuce is 60°F - 65°F. It can tolerate temperatures as low as 45°F and high of up to only 75°F. The plants tend to bolt, experience tip burn problems and taste bitter at higher temperatures. Good germination rate can be achieved even at 40°F but might result in poor or no germination at temperatures above 85°F. Minimum soil temperature required for seed germination is 32°F while the maximum soil temperature for seed germination is 75°F.

SOIL

Nitrogen rich mucky, sandy peat, sandy loam and loamy soils with a pH balance between 6.0 and 6.8 are ideal for growing lettuce. Well drained soil with good moisture holding capacity is best suited for growing lettuce.

FIELD PREPARATION

Incorporate any fertilizer, if necessary, and disk the field prior to planting. If cultivating on raised beds, create the raised beds with rows. Ensure a spacing of at least 15 inches between rows to provide adequate spacing for air movement, growth and uniform maturity.

SOWING

Propagation may be made by direct seeding or by transplanting.

> ***Direct Seeding*:** Plant pelletized seeds 3 inches apart and at a depth of ¼ inch with a precision planter. Thin plants to about 12 inches apart when three or four true leaves appear. Irrigate with sprinkler immediately after planting and until the seeds germinate. Once seeds germinate and are thinned, the plants can be irrigated by furrow irrigation. Planting lettuce seeds on raised beds with a row spacing of about 30 cm ensures consistent growth. The seeding rate for direct seeding is dependent on row spacing and varies from 1 to 2 kg per hectare.
>
> ***Transplanting*:** Soak seeds in starter solutions and plant them in cells or module flats with about 5 cm spacing between plants. Good planting mix, proper maintenance of temperature, adequate moisture and light ensures consistent growth and results in good quality seedlings. The seedlings should be raised in greenhouses for about 3- 4 weeks and hardened before they are transplanted in the field. Reducing water, nutrients and exposure to temperature for about 3-5 days hardens the transplants prior to field setting. Set plants deep enough to cover the roots and firm the soil around the plant. Irrigate immediately after transplants are set in the field. The seeding rate is about 275 g of seed per hectare when the transplants are raised in greenhouses.

Transplanting is preferred to direct seeding since lettuce is a short-season crop. Transplanting ensures better seeding rate and consistent growth.

IRRIGATION

Pre-irrigate the field prior to seedbed formation. This helps the soil to soften and makes it moist. In case of direct seeding, irrigate with sprinkler frequently for about 7 days until the seeds emerge. Transplants are also irrigated with sprinkler initially until are transplants are established. Furrow irrigation can be adopted once the plants are established. Since lettuce is mostly made up of water, the plants require frequent irrigation. Planting date, type of lettuce and season variations determines the water requirement for irrigation. As many as 10 irrigations with about 12 inches of water per acre many be required for growing lettuce. Since the lettuce plant has one main tap root and several shallow secondary roots, frequent but light watering is preferred to over watering which might result in root rot, soft growth and other diseases.

FERTILIZATION

Fertilization requirements should be determined based on soil analysis result. Broadcast about 120- 150 lbs of NPK and disk in the fertilizer prior to planting. Incorporating about 15 tons of farm yard manure also enriches the soil for lettuce production. Sidedress with nitrogen immediately after thinning and during later stages of growth.

PLANT PROTECTION AND WEED CONTROL

Downy mildew, lettuce drop, gray mold, and dampening off, are some of the diseases that affect lettuce. Good quality primed seeds, raised beds, well drained soil, practicing crop rotation, ensuring adequate in-row and between-row spacing, proper use of fungicide and herbicide at the appropriate time, plowing down crop residue immediately after harvest, and adequate weed control are some of the measures that would help protect lettuce plants from the diseases. Aphids, thrips, leafminers, cutworms, cabbage loopers, and silverleaf whitefly are some of the pests that affect the growth and quality of lettuce. Use pesticides as recommended by extension personnel to protect plants from insects. Good weed control is very important while growing lettuce. Hoeing and weeding on a regular basis helps control weeds. Use of herbicides on a timely basis as recommended by agricultural agents also helps control weeds. Prior to planting, it is important to ensure that the field is free of perennial weeds.

HARVEST AND YIELD

Leaf lettuce will be ready for harvest in approximately 60 days from planting. Traditionally lettuce is hand cut and trimmed. Mechanically harvesters can also be used for harvesting when adequate between-row spacing has been provided. Harvested lettuces should immediately be packed in perforated film wraps, vacuum cooled to 32°F, packed in cartons; and stored. The shelf life of harvested lettuce can be extended for several days by storing properly packed cartons at a temperature of 32°F and at a relative humidity of 98%. Ensure that the harvested lettuce is free from dirt, mud and water before it is vacuum-cooled and packed. Lettuce should not be stored with apples, pears, cantaloupes and other ethylene producing fruits and vegetables as it may result in russet spotting. Lettuce is normally packaged in cartons that contains about 24 counts or weighs about 25 lbs. The average yield is about 12 tons/acre.

NUTRITION

Serving size: Green Leaf, Raw, 100 g

Nutrient	Unit	Value per 100.0g
Water	g	94.98
Energy	kcal	15
Protein	g	1.36
Total lipid (fat)	g	0.15
Carbohydrate, by difference	g	2.87
Fiber, total dietary	g	1.3
Sugars, total	g	0.78
Calcium, Ca	mg	36
Iron, Fe	mg	0.86

Nutrient	Unit	Value per 100.0g
Magnesium, Mg	mg	13
Phosphorus, P	mg	29
Potassium, K	mg	194
Sodium, Na	mg	28
Zinc, Zn	mg	0.18
Vitamin C, total ascorbic acid	mg	9.2
Thiamin	mg	0.070
Riboflavin	mg	0.080
Niacin	mg	0.375
Vitamin B-6	mg	0.090
Folate, DFE	mcg_DFE	38
Vitamin B-12	µg	0.00
Vitamin A, RAE	mcg_RAE	370
Vitamin A, IU	IU	7405
Vitamin E (alpha-tocopherol)	mg	0.22
Vitamin D (D2 + D3)	µg	0.0
Vitamin D	IU	0
Vitamin K (phylloquinone)	µg	126.3
Fatty acids, total saturated	g	0.020
Fatty acids, total monounsaturated	g	0.006
Fatty acids, total polyunsaturated	g	0.082
Cholesterol	mg	0
Caffeine	mg	0

Source: USDA National Nutrient Database for Standard Reference, Release 24 (2011)

SPANISH OREGANO

(***Plectranthus amboinicus***)
Family: *Lamiaceae*
Common Names: Cuban Oregano, Spanish Thyme, Indian Borage,
Broad Leafed Thyme, Mexican Mint, Mother of Herbs**,** Orégano Brujo (Puerto Rico)
Queen of Herbs, Five in One Herb, Chinese Three in One, Spanish Sage, Puerto Rican Oregano

INTRODUCTION

Plectranthus amboinicus, native to India and Malaysia is commonly known as Indian Borage, Spanish Oregano or Cuban Oregano. It is now grown almost all over the world as a potted herb or cultivated for its medicinal properties. Spanish Oregano is a succulent perennial that can grow up to a height of 2 feet. The fleshy ovate shaped leaves with scalloped margins are fuzzy, 4-10 cm long and are found in pairs opposite to each other. The leaves emit a very strong smell when pressed. The stems are brittle and the plant itself is extremely tender. The plant occasionally produces a single stalk flower spike of tiny white, pink or pale violet colored flowers.

USES

Spanish Oregano is commonly used as an herb for culinary and medicinal purposes. Spanish Oregano leaves are primarily used for medicinal purposes. Raw leaves when chewed are said to act like an expectorant and is used to treat cold, cough and sore throat. Tea made by boiling the leaves is said to act as a cure for asthma, bronchitis, stomach cramps, convulsions and sleeplessness. It is also used to clear blocked nasal passages by inhaling the vapor that is emitted when the leaves are crushed. Pulp of the leaves when applied on the forehead is said to relieve headache. The pulp when applied on burns, insect bites, bee stings, and on skin infections is said to provide relief from the said conditions. The leaves are also chewed to cure discomfort related to indigestion and flatulence.

The leaves have a very strong flavor and should be used in moderation for culinary purposes. The leaves are chopped and used to flavor vegetable and meat dishes and also as a stuffing for poultry. Spanish Oregano leaves can be combined with coconut, green or red chilies and other ingredients to make a sauce. In some parts of the world it is believed that the consumption of leaves of Spanish Oregano by lactating mothers would result in increased lactation.

PICTURES

Pictures Source (from Left to right) - http://www.naturesherbfarm.com/nhf1_009.htm, http://www.naturesherbfarm.com/nhf1_009.htm, http://davesgarden.com/community/forums/fp.php?pid=551095, http://dtlherbsltd.blogspot.in/2011/02/herb-of-week-cuban-oregano.html

VARIETIES

Spanish Oregano can be found in the variegated form and the plain green form. The plain green cultivar has green leaves and grows best in shade. The variegated cultivar looks similar to the plain green cultivar but has white variegation on its leaves and prefers full sun to partial shade.

CLIMATE

The ideal temperature for growing Spanish Oregano is between 65°F - 75°F. Temperatures below 60°F would slow growth and temperatures above 80°F would result in the leaves curling and turning yellow. It is hardy to zones 9 – 11. The plain green cultivar prefers partial shade while the variegated cultivar colors better when grown in full sun to partial shade.

SOIL

Spanish Oregano can be grown in any kind of well-drained soil. However, it grows best in soil with the pH level 6-8.

FIELD PREPARATION

After the danger of the last frost has passed and the soil temperature is at least 60°F loosen the soil at least 2 weeks prior to planting by thoroughly tilling the field. If necessary till the field again and incorporate about 60 tons of compost into the soil. Create rows that are at least 40 cm apart.

SOWING

Propagation is made from stem cuttings. Ensure that the stem cuttings have at least two nodes, and are about 8- 10 inches long. Remove the leaves from the lower portion of the cutting, wash the cuttings and place them in a well drained rooting medium or soil in partial shade. The soil should be kept moist and well drained. The stem cuttings will root in about 2 weeks. Once the roots are established, transplant the plants on to the field in holes that are 40 cm apart. Place lower one-third of the rooted cuttings into the hole and gently compact the soil around the plants. Cuttings can also be directly planted in the field, but transplanting the cuttings after the roots are established in the preferred method as it ensures even growth of plants. Keep the soil moist. Approximately 60,000 plants can be raised per hectare.

IRRIGATION

Water requirements for Spanish Oregano plants are moderate. Irrigate frequently but moderately each time. Do not over water and ensure that the soil is not water logged and is well drained.

FERTILIZATION

Spanish Oregano plants require minimum fertilization. A basal application of organic manure or compost can be undertaken at the time of preparation of the field prior to planting. Subsequently, if required, organic manure or compost can be applied at the rate of about 2 kg per plant on a monthly basis. However, fertilization of plants after each harvest is important as it ensures good subsequent growth.

PLANT PROTECTION AND WEED CONTROL

Spanish Oregano plants are not susceptible to major damage from pests and diseases. Aphids may sometimes be found on the underside of the leaves. If found they may be hosed down with water. Depending on the severity, sometimes the infested leaves may also be removed. Weed control by hand weeding, improved irrigation with well drained soil, crop rotation and proper maintenance of field helps prevent diseases and/or restrict infestation.

HARVEST AND YIELD

The first harvest should be undertaken in approximately a month from the date of planting, before the flowers begin to emerge. The average height of the plant at this time would be about 50 cm. Subsequent harvests may be undertaken at an interval of 2-3 weeks. Ensure that no more than two-thirds of each plant is harvested at any given time.

Spanish Oregano leaves have a very short shelf life and are usually consumed fresh within a day or two of harvest. However, the dried leaves have a longer shelf life. Once the stems and leaves are harvested, the best quality leaves are picked and washed thoroughly in water to get rid of dirt and other impurities. The washed leaves are drained, spread out as a single layer on a clean mat and allowed to sun dry. The leaves are turned over once in every four hours to ensure even drying. The leaves may also be dried in an oven set at 140°F. Alternatively, the leaves may also be spread out on a dehydrator tray and dried for approximately 3 hours in a dehydrator set at 125°F. The leaves are dried until they become brittle. Once dried, the leaves may be crumbled and stored in an air tight container.

The average yield of fresh leaves is about 9 tons/ha and that of dried leaves is about 2 tons/ha.

NUTRITION

Spanish Oregano contains Vitamins A, C and E and other minerals and phosphates.

WILD GARLIC

(***Allium vineale***)
Family: *Liliaceae*
Common Names: Field garlic, Crow Garlic, Bear's Garlic, Wood Garlic, False garlic, Meadow Garlic

INTRODUCTION

Wild garlic a bulbous perennial herb, native to Europe, Western Asia and North Africa is now commonly found in North America and Australia. This grass like plant has thin, hollow, cylindrical bluish-green color leaves that are hairless, waxy and grow to a height of about 12 – 15 inches. A small globe like cluster of purple or white flowers is formed above the aerial bulbils at the tip of the unbranched main stem that grows to a height of about 4 feet. The flowers are hermaphrodite. During the initial stage the inflorescence is entirely covered by a thin membrane. This membrane breaks open later to release the flowers and bulbils. The bulbils are oval in shape and may sprout while it is still attached to the plant. These bulbils when dislodged from the plant aids in automatic reseeding. The seeds formed from the flowers are tiny, black and flat on one side. The plant has several small underground bulbs that consist of short fibrous roots. The bulbs are covered by a thin, papery membrane. The entire plant is edible and has a strong garlic flavor. Wild garlic reproduces and spreads by seeds, bulbils and underground bulbs.

Considered an invasive weed by most farmers, it possesses almost the same nutrients of field grown garlic. It is mostly found in the wild and harvested by foragers for culinary and medicinal purposes. It is seldom grown on a commercial basis as it takes a long time to render the land cultivable for other crops where wild garlic was grown. If grown near wheat fields, the aerial bulbils can contaminate wheat by altering the taste with the garlic flavor. If cattle and poultry feed on wild garlic, the resulting meat and dairy are rendered unmarketable resulting in financial losses.

USES

Wild garlic has been used for culinary purposes for several hundred years. The leaves when crushed emit garlic flavor. Almost all parts of the plant are used for culinary purposes. The leaves can be chopped and used raw in salads, used in soups and stews for its garlic flavor. It can also be used as a substitute for garlic in almost all dishes that includes garlic as one of the ingredients. It can be chopped and mixed with butter to impart the garlic flavor. It is believed that in ancient times, water boiled with wild garlic in it and mixed with honey would provide relief from cough, asthma and other breathing problems. It is used as a carminative and is said to reduce blood pressure and is also said to possess antifungal, anti viral and antibiotic properties. It is also used as a dye to prevent worms and colic in children. The juice of the plant is also used as an insect repellant.

PICTURES

Pictures - Source from Left to Right: (First picture) http://www.cas.vanderbilt.edu/bioimages/species/alvi.htm, (Rest of the pictures) http://keyserver.lucidcentral.org/weeds/data/03030800-0b07-490a-8d04-0605030c0f01/media/Html/Allium_vineale.htm

VARIETIES

There are no known commercial varieties available for wild garlic.

CLIMATE

It is hardy to Zone 5 and does not prefer full sun. Since wild garlic plants are perennial they remain dormant during winter and new growth occurs in spring. They do not prefer hot temperature. The leaves die down due to excessive heat.

SOIL

Wild garlic is very adaptable and grows in a variety of soil types including dry, sandy and gravelly soils. However the intensity of the flavor is milder and the texture is good when it grows in moist and rich well-drained sandy and loamy soils with the pH level between 6 and 7.

FIELD PREPARATION

Thoroughly till the field. Spread about 2 inches of compost and incorporate it into the soil about 5-6 inches deep. Dig holes about 3 ½ to 6 inches deep and 4 inches apart. Create rows about 45 cm apart.

SOWING

Propagation may be made using seeds, aerial bulbils and bulbs.

Wild Garlic may be sown directly in the prepared field in early summer. Sow seeds in holes that are about an inch deep, cover it with soil and pat gently. Keep the soil moist. Germination should occur shortly and the plants must be ready for harvest in the third year. Bulbs may also be used to raise wild garlic plants. Plant the bulbs in holes that are about 3 ½ -6 inches deep and that are 4 inches apart. Cover the holes loosely with soil, pat them gently and immediately water them to keep the soil moist. Similar to planting bulbs, sprouted aerial bulbils may also be planted into the soil. Wild garlic plants grown from bulbs or aerial bulbils will be ready for harvest from the second year of planting.

IRRIGATION

Wild garlic thrives well on moist soil. Water the plants minimally but regularly to keep the soil moist up to 6 inches deep. Plants subject to water stress may result in yellow - brown leaves or have a woody texture. Ensure that the plants do not receive excessive water closer to the harvesting date, as they would hamper storage quality of the harvested leaves.

FERTILIZATION

Fertilization requirements should be based on the results of the soil test. Soil rich in nutrients, especially nitrogen is best suited for growing good quality wild garlic leaves.

PLANT PROTECTION AND WEED CONTROL

Wild garlic plants are susceptible to White rot, White Mold, Aphids and Fusarium Basal rot. They are also affected by nematodes, thrips, maggots, and wireworms. Use registered fungicides to treat these problems. Since the leaves of wild garlic are vertical and tubular, the use of fungicides may not be very effective. Proper practice of crop rotation, ensuring that the soil is well drained and maintaining proper hygiene in the field ensures protection from diseases. Hand weeding and hoeing is recommended as and when necessary.

HARVEST AND YIELD

Wild garlic leaves can be harvested when the leaves are about 18 inches tall. Hold the leaves together and cut them about 2 cm above the ground. This will enable the plants to re grow for subsequent harvests. Wild garlic plants survive for several years allowing for multiple harvests over a period of several years. Wild garlic leaves have a very short shelf life and taste the best when they are fresh. The shelf life of this herb can be extended for up to 2 weeks when they are stored a temperature of 32°F and at a relative humidity of 95-100%. Yield data for this herb is unavailable at this time.

NUTRITION

Wild garlic is said to have almost all the nutrition available in the cultivated garlic bulb. In addition to that, wild garlic leaves are said to be rich in sulphur and adenosine. No detailed nutrition information is available specifically related to wild garlic leaves.

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