



ECHO Asia Notes

A Regional Supplement to ECHO Development Notes

ECHO Asia Notes

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Vegetable Production Throughout the Rainy Season

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The cool, dry season offers the best window for vegetable production in the tropics, assuming an adequate water supply. Pest and disease pressures are relatively low and temperatures are moderate. By contrast, the rainy season brings a combination of high temperatures and humidity that encourages the return of voracious snails and other pests. This means that many desirable vegetables, such as lettuce and tomatoes, are difficult to produce under rainy season conditions without significant inputs such as plastic row covers and pesticides.

In anticipation of the rainy season, ECHO Asia's Seed Bank staff have compiled a list of 32 vegetable crops that are productive throughout the rainiest months. These crops, both annual and perennial vegetables, can withstand pest and disease attack (e.g. snails and fungi) and provide a nutritious base to the daily diet. The practice of cultivating both annuals and perennials simultaneously lends itself to better production and nutrition and ensures a fallback when a particular species or variety fails. In this list we emphasize mainly plants producing edible foliage and leaf shoots.

In Southeast Asia, leaves and shoots are traditionally harvested in small amounts, moving between species and varieties on a regular basis in what can be likened to browsing or foraging. Many crops harvested in this way can continue to provide food for long or extended periods of time. Additionally, various shoots and flowers are customarily prepared as sides or "dipping" vegetables (*i.e.* used to dip sauces and curries) rather than as main dishes. Therefore, these types are not required in large amounts.



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**ECHO Agricultural
Conference**

The following list of recommended vegetables for the rainy season is arranged in alphabetical order by common name. It includes plants that can generally be found in the household gardens and on the tables of our seed bank staff at any given time. For seed or cuttings of recommended varieties, please check our [ECHO Asia Seed Bank Catalog](#). However, not all varieties may be available through the ECHO Asia Seed Bank. If we are unable to provide seed, readers may wish to check with the [ECHO International Seed Bank](#) where noted. Several references are made to wild or forest species, and to those that can be found easily in your local market. As usual, the ECHO Asia Seed Bank highly recommends investigating all species and varieties that are available to you locally.

Vegetables for the Rainy Season:



Bamboo shoots - *Dendrocalamus*, *Gigantochloa* and *Thyrsostachys* species and others

Characteristics: Bamboo species native to much of Southeast Asia; produce multiple stems ("culms") in clumps.

Edible Parts: Bamboo shoots are high in nutritional value. In comparison to many commonly consumed vegetables, bamboo shoots have higher free amino acids, protein, and dietary fiber content. Except for *Brassica* vegetables, they also have a higher amount of vitamin C. Edible new stem shoots are produced particularly during the last half of the rainy season. Shoots are eaten boiled, fried, curried and pickled.

Planting Recommendations: Cultivated bamboo is usually propagated vegetatively, for example through clump division and culm (stem)/branch cuttings; techniques depend upon the species. As opportunity presents, wildlings that have germinated from seed can be used. Bamboo plantings must be spaced widely, no less than 3-5 meters (10-16 ft.) apart.

Possible Pests/Disease: Stem borers, mealy bugs, scale and mites; usually not severe.



Chaya - *Cnidocolus chayamansa*

Characteristics: A fairly recent arrival to Asia, chaya is a perennial with thick, succulent, upright shoots bearing large lobed leaves. The ECHO Asia Seed Bank and ECHO International Seed Bank offer cuttings of 'ECHO' variety.

Edible Parts: Young chaya leaves and shoots are a good source of protein, calcium, phosphorus, iron, niacin, riboflavin, thiamine and vitamins A and C.

Important Note: Raw chaya shoots and leaves contain cyanide and are poisonous. Boil or steam in an open/uncovered pot for 10 minutes and remove water before consuming.

Planting Recommendations: Plant as cuttings, spaced 50 cm (1.6 ft.) apart on

December 4-6, 2012

Fort Myers, Florida

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Planting Recommendations: Plant as cuttings, spaced 50 cm (1.6 ft.) apart or slightly closer for an edible fence. Chaya grows in sun or partial shade; early growth is improved with regular watering but the plant does not tolerate

standing water.

Possible Pests/Diseases: No major pests.



Chayote - *Sechium edule*

Characteristics: A viny, perennial, herbaceous plant.

Edible parts: Fruit, root, stems, seeds and leaves are edible. Fruit can be eaten raw or cooked. The leaf shoots, available through the rainy season, are harvested and prepared in a manner similar to pumpkin and bottle gourd-the tougher, slightly pubescent outer layer of the shoots is removed to access the tender, edible portion.

Planting recommendations: Plant by placing the whole fruit on its side in a hollow in the soil. Trellising is recommended for chayote; space plants 2-3 meters (approximately 7-10 ft.) apart. In the tropics, chayote grows best at higher elevations (800 m and higher) and requires consistent soil moisture for adequate production.

Possible Pests/Diseases: Aphids, fruit flies and some crickets.



Climbing wattle - *Acacia pennata*

Characteristics: With edible bipinnate leaves, climbing wattle is grown as a bushy, perennial vegetable in Myanmar, Thailand, Laos and Cambodia.

Edible Parts: Climbing wattle produces edible leaf shoots year round, especially during the rainy season. The shoots have a strong aroma and flavor, and are often deep-fried, added to omelets or blanched for use as a dipping vegetable.

Planting Recommendations: Plants can be established from stem cuttings or

from seed. Seedlings should be spaced at least 1 meter (3.3 ft.) apart.

Possible Pests: No major pests.



Cowpea - *Vigna unguiculata*

Characteristics: Annual bush or creeping vine. ECHO Asia Seed Bank offers 'Samoeng' variety (a low, creeping cowpea with white flowers) and 'Lahu/Mae Ai' (a bush cowpea variety).

Edible Parts: Young shoots and pods; mature seeds.

Planting Recommendations: Direct seed; space 30 cm (11.8 in) apart; plant in full sun.

Possible Pests/Diseases: Aphids (spray plant with wood vinegar or mild detergent solution).



Cucumber - *Cucumis sativus*

Characteristics: Climbing vine with hairy leaves; an annual. ECHO Asia Seed Bank offers 'Khmer' variety with large fruit.

Edible Parts: Young or mature fruit.

Planting Recommendations: Plant seeds 30 cm (11.8 in.) apart and support with a trellis.

Possible Pests/Diseases: Cucumber moth (control with preventive cultural practices such as sanitation and row covers) and fungal diseases.



Eggplant - *Solanum melongena*

Characteristics: Broad, hairy leaves; oblong or oval fruits; local varieties-often with plum-sized fruit or large-are available. Though this plant often performs best in the cool season, some naturalized *Solanum* species (e.g. *S. torvum*) are also productive during the rainy season. ECHO Asia Seed Bank offers 'Yellow' variety (*S. melongena*), a long-lived annual with large, gourd-like fruits.

Edible Parts: Fruit. ECHO Asia's 'Yellow' variety can be eaten young when the fruit is green and firm, or mature and yellow when the fruit is soft but somewhat bitter.

Planting Recommendations: Plant seeds 30 cm (11.8 in.) apart in well-drained soil in an area with full sun or light shade.

Possible Pests/Diseases: Root/stem fungal diseases (remove infected plants immediately and rotate production areas; soil solarization with clear plastic mulch during the hottest months is also recommended).



Vegetable fern - *Diplazium esculentum*

Characteristics: Herbaceous perennial found wild along forest streams or wetlands. Plants produce edible pinnate shoots (fronds). Vegetable fern is usually collected from the wild and sometimes available in local markets; cultivation is limited.

Edible Parts: New curled fronds and young, tender leaf shoots.

Planting Recommendations: Cultivate by establishing divided plantlets; performs best in shade and moist conditions.

Possible Pests/Diseases: Occasional snails.



Fishtail Palm - *Caryota mitis*

Characteristics: Palm that produces multiple stems with edible inner core, which can be harvested when approximately 2-3 meters (7-10 ft.) tall; has distinct "fishtail" shaped leaves. Found in the wild but often cultivated as an ornamental.

Edible Parts: Inner shoot (heart) accessed by removing woody outer layer of stem; has a slightly bitter/sweet flavor.

Planting Recommendations: Fishtail palm is a clustering species that grows in full sun and partial shade. Establish seedlings at least 3 meters (approximately 10 ft.) apart; they will take at least three years to begin producing edible shoots.

Possible Pests/Diseases: No major pests.



Jack Bean - *Canavalia ensiformis*

Characteristics: Annual bush or creeping vine with purple flowers and large pods. ECHO Asia Seed Bank offers 'Thai' variety, which is a bush type.

Edible Parts: Very young pods and shoots; flowers. Important Note: Mature jack bean seeds are mildly toxic and should not be consumed in large amounts without special preparation.

Planting Recommendations: Direct seed; space 30 cm (11.8 in.) apart in full sun or partial shade.

Possible Pests/Diseases: Pod borers in maturing pods, especially during late rainy season.



Katuk/Sweet Leaf - *Sauropus androgynus*

Characteristics: Perennial with upright stems that produce green shoots with small oblong leaves. ECHO Asia Seed Bank offers cuttings of 'Thai local' variety as available.

Edible Parts: Tender, young shoots and leaves.

Planting Recommendations: Plant rooted cuttings 30 cm (11.8 in.) apart, or closer for an edible fence; grows in sun but prefers partial shade.

Possible Pests/Diseases: Scale and sucking insects (apply wood vinegar solution or "Cornell" spray made with 5 T (tablespoons) vegetable oil, 1 T baking soda, and 4 T Safer's soap or 2 teaspoons of mild liquid dish soap in one gallon of water).



Kwangtung Gymnema - *Gymnema inodorum*

Characteristics: A viny, woody perennial that is widely distributed across South Asia, mainland Southeast Asia, southern China, Borneo, Indonesia and the Philippines. Found in gardens and local markets. Vines can reach lengths of several meters or more.

Edible parts: Tender leaves and leaf shoots are produced year round; most flavorful during the dry season (bitter but edible during the rains); consumed in various ways including omelets, stir fries and curries. Medical studies show that compounds in *G. inodorum* have medicinal properties including the regulation of blood sugar and supplying antioxidants.

Planting recommendations: Propagate from stem cuttings. Allow to grow along fences and trellises.

Possible Disease: No major pests.



Leaf Pepper - *Piper sarmentosum*

Characteristics: Creeping perennial vine with broad ovate leaves. Grows wild or found in gardens and markets.

Edible Parts: Tender, young shoots and leaves; eaten raw in salads, wrapped around various ingredients and in curries; contains the antioxidant naringenin.

Planting Recommendations: Plant rooted stem cuttings as ground cover; prefers shade.

Possible Pests/Diseases: No major pests.



Long Bean/Yard-long Bean - *Vigna unguiculata ssp. sesquipedalis*

Characteristics: An extremely viny cowpea (annual) that produces long pods approximately 50 cm (20 in.) in length. Widely grown and available in markets.

Edible Parts: Pods; may become stringy in texture if left on the vine too long.

Planting Recommendations: Direct seed along a trellis; space 50 cm - 1 m (approximately 20 in. - 3 ft.) apart. Grows in full sun or light shade.

Possible Pests/Diseases: Aphids (spray plant with wood vinegar or mild detergent solution).



Malabar Spinach - *Basella alba*

Characteristics: Succulent climbing perennial vine with oblate leaves. ECHO Asia Seed Bank offers 'Bangladesh,' a thick-stemmed variety with large leaves. Other varieties are generally smaller.



Edible Parts: Young leaves (somewhat mucilaginous when cooked) and pink flower buds; often cooked with seafood and in soups and curries.

Planting Recommendations: Propagate by seed or cuttings; space 30-50 cm (approximately 12-20 in.) apart; handles full sun or partial shade. Malabar spinach generally performs better when trellised.

Possible Pests/Diseases: Root-knot nematodes (to control them, apply large amounts of composted manure, rotate with crops less susceptible to nematodes, and solarize soil with clear plastic mulch during the hottest months).



Moringa - *Moringa oleifera*

Characteristics: Tree with small rounded, pinnately compound leaves. ECHO Asia Seed Bank currently offers local mixed varieties.

Edible Parts: Leaves are especially high in protein, calcium, and vitamins A, B, and C; can be eaten raw, cooked, or dried and ground. Young pods are included in curries (inner portion is edible). Roots can be used as a spicy condiment similar in taste to horseradish. ECHO Asia offers a 'Regional Mix'

selection.

Planting Recommendations: Can be direct seeded into fields and gardens, but better to establish plants in seedling bags and then transplant. Stem and branch cuttings may also be rooted. Plant as a single specimen or in stands for leaf and seed production (at least a few meters apart). Moringa may also be spaced 50 cm (20 in.) apart or closer for an edible fence. Grows well in poor soils and full sun, but must be established in well-drained sites; yellow leaves and dieback may indicate too much water. Keep coppiced to produce flushes of new leaves and for easy harvest.

Possible Pests/Diseases: No major pests.



Morning Glory - Water Spinach/Kang Kong - *Ipomoea aquatica*/*Ipomoea reptans*

Characteristics: Perennial creeping vine with both aquatic/lowland (*I. aquatica*) and upland species (*I. reptans*). Upland varieties are grown almost exclusively in plant beds whereas aquatic/lowland types are grown in bodies of water (e.g. ditches and ponds), wetlands and plots prone to flooding. Both types are often found in Southeast Asian markets.

Edible Parts: Young shoots and leaves are eaten in soups, stir-fried as an individual dish, and steamed as a side or to be eaten as a "dipping" vegetable.

Planting Recommendations: Plant seed of upland varieties into beds in hills 10-15 cm (approximately 4-6 in.) apart. Establish aquatic types with stem cuttings. Tolerates some shade. Beware of invasive

tendency.

Possible Pests/Diseases: Caterpillars.



Mustard greens - *Brassica juncea*

Characteristics: Mustard greens are annual, leafy greens with a slightly strong horseradish flavor. Mustards perform better under rainy season conditions (e.g. they are more resistant to various rainy season pests) than many other *Brassic*s; widely planted in gardens and fields. The ECHO Asia Seed Bank offers 'Khasi.'

Edible parts: Tender leaves.

Planting recommendations: Sow into plant beds and thin to 10-15 cm (approximately 4-6 in.) apart.

Possible pests: Snails and slugs and other leaf feeders.



Okra - *Abelmoschus esculentum*

Characteristics: Upright annual plant with plump, hairy pods. ECHO Asia Seed Bank offers the 'Clemson Spineless' variety, which produces pods with fewer spines.

Edible Parts: Mainly tender pods (leaves are reportedly edible too). Pods are mucilaginous (i.e. contain a slimy substance). Fry with chilies or boil and add cumin, salt, and/or lime to cut mucilage.

Planting Recommendations: Direct seed in rows at least 60 cm (24 in.) apart with hills approximately 30 cm (12 in.) apart in full sun.

Possible Pests/Diseases: Aphids (spray plant with wood vinegar solution or mild detergent solution).



Pumpkin/Squash - *Cucurbita moschata*

Characteristics: Creeping annual vine with hairy leaves and shoots.

Edible Parts: Young leaf shoots, flowers and fruit. Peel off pubescent/veiny outer layer of leaf shoots for more palatable consumption. When planted at the start of the rainy season, fruits will not mature until the cool dry season.

Planting Recommendations: Direct seed no less than 50 cm (1.6 ft.) apart in full sun or partial shade; trellis if desired.

Possible Pests/Diseases: No major pests.



Rattan - *Calamus viminalis* and other species



Characteristics: Rattans are multi-stemmed palms. Young stems, which vine over time, grow upright. Many rattans are extremely thorny. Can be harvested in the wild (unfortunately becoming rare in many locations) but also grown for local markets in parts of Southeast Asia. Mature vines (canes) are harvested to produce wicker products.

Edible Parts: Inner core of shoots and stems (i.e. hearts) are consumed. The woody, thorny outer layer of the stem must be carefully removed to access the edible core.

Planting Recommendations: Establish as seedlings spaced at least 1.5 meters (approximately 5 ft.) apart in sun or partial shade. Seedlings must grow approximately three years before the stems are edible. Afterward, harvest

stems continually to manage growth and maintain long term shoot production. Seed for *C. viminalis* is available on a seasonal basis (April-June) through the ECHO Asia Seed Bank in partnership with the Upland Holistic Development Project (UHDP), Mae Ai/Fang, Thailand. Rattan seed viability diminishes soon after harvest. Seedlings may also be bought at UHDP.

Possible Pests/Diseases: No major pests.



Red Shoot Fig - *Ficus virens*

Characteristics: A type of strangler fig that can be planted as a self-supporting tree.

Edible Parts: Edible, young leaf shoots emerge after a brief leaf fall during the mid-late dry season. Trees continue to produce the leaf shoots through the remainder of the dry season and on through the rainy season. The leaf shoots are prepared in a variety of ways including stir-fries and curries.

Planting Recommendations: Plant seedlings in full sun to partial shade. The tree can grow very large, so best keep it coppiced to 1-2 meters (approximately 3-7 ft.) to control the size and for easier harvest. Propagated from stem cuttings.

Possible Pests/Diseases: No major pests.



Roselle - *Hibiscus sabdariffa*

Characteristics: An annual bush with distinctive cranberry-colored shoots, stems and flower calyxes.

Edible Parts: Tender leaves and leaf shoots (slightly mucilaginous and sour) and flower calyxes (also sour; used to make teas and jams). Planted at the beginning of the rains, tender leaves and shoots are produced throughout much



of the rainy season. The calyxes are ready for harvest by the cool dry season.
Planting Recommendations: Direct seed 50 cm (1.6 ft.) apart or wider; prefers full sun. The ECHO Asia Seed Bank offers seeds of the 'Burmese' variety that produces good shoots.

Possible Pests/Diseases: Snail damage possible.



Scarlet/Ivy Gourd - *Coccinia grandis*

Characteristics: Climbing vine with ivy-shaped leaves, white flowers and small scarlet fruit.

Edible Parts: Young vine and leaf shoots. The mature fruit is also edible.

Planting Recommendations: Ivy gourd is often found growing wild; shoots are harvested by foragers. However, seeds or wildings can be used to establish plants in gardens. Best to plant along a trellis or fence; can be grown in full sun

or partial shade. Ivy gourd is invasive and prohibited in some locations outside of its native range that extends from Africa to Asia. The ECHO Asia Seed Bank offers seed but recommends planting only within the native range.

Possible Pests/Diseases: Powdery mildew.



Sesbania - *Sesbania grandiflora*

Characteristics: Tree grows to 5 meters tall with pinnately compound leaves and large white, pink, red, or yellow flowers.

Edible Parts: Flowers (most commonly), young leaves and pods (occasionally). Flowers are eaten raw, in curries, or steamed as a side. Young leaves and pods are sometimes included in a white coconut curry.

Planting Recommendations: Best to plant seedlings in moist but well-drained soil. Grows well in full sun and light shade. Establish trees at least a few meters (6-9 ft.) apart.

Possible Pests/Diseases: Leaf webbers and feeders; stem borers; root knot nematodes; some gray leaf spot; some mosaic virus.



Siamese Senna/Kassod Tree - *Senna siamea*

Characteristics: A leguminous tree with pinnately compound leaves that grows to between 15 and 20 meters in height. Commonly planted and found in the wild. ECHO Asia Seed Bank offers seed of a local variety.

Edible Parts: Young leaves and flowers. The taste is bitter, but the plant parts are consumed in soups and curries or with chili pastes. Traditional senna leaf curries were reportedly used as a mild laxative drug; the leaves contain

glycosides, much of which can be reduced by cooking.

Planting Recommendations: Can be direct seeded or established as seedlings. If you are planning to coppice, trees can be spaced 1-2 meters (approximately 3-7 ft.) apart. Use a planting distance of 3 meters (9.8 ft.) or more for larger trees. Prefers sun or light shade; does not grow well above 1300 meters elevation.

Possible Pests/Diseases: No major pests.



Sunnhemp - *Crotalaria juncea*

Characteristics: Sunnhemp is an annual with stems that grow to a height of a meter or more and produce bright yellow flowers and plump, velvety pods. Sunnhemp performs well any time of year if moisture is adequate, and is mainly used as a green manure/cover crop. ECHO Asia Seed Bank offers 'Chiang Mai' variety.

Edible Parts: Flowers are eaten in soups or omelets.

Planting Recommendations: Broadcast seed. Thin seedlings to 30 cm (11.8 in.) spacing. Prefers full sun and performs well in almost any soil that is not water-logged.

Possible Pests/Diseases: Sunnhemp moth and stem borers.



Sweet Potato - *Ipomoea batatas*

Characteristics: Creeping, herbaceous, perennial vine with large cordate (heart-shaped) leaves and tubers. Various varieties (e.g. white, purple and orange tubers) are available in local markets and widely planted.

Edible Parts: Young shoots and leaves, as well as tubers. Tender leaves and shoots are prepared in various ways, including blanching, stir fries and curries.

Planting Recommendations: Plant tubers or establish cuttings from the main runner of a plant; space at 50 cm (1.6 ft.); fills in quickly.

Possible Pests/Diseases: Snails (especially on young seedlings).



Tropical/Indian Lettuce - *Lactuca indica*

Characteristics: A fast-growing, self-seeding semi-perennial with long,



lanceolate leaves. ECHO Asia Seed Bank offers 'ECHO Tropical' variety.
Edible Parts: Leaves are a fair source of vitamins A and C. Young leaves can be eaten raw; older leaves can be served raw with vinegar, steamed, or boiled.
Planting Recommendations: Plant seeds 50-60 cm (approximately 1.6-2 ft.) apart to accommodate the plant's bushy nature. Performs well in warm, moist conditions. If planted in well-drained soil, it can tolerate rainfall in excess of 3500 mm/year.
Possible Pests/Diseases: Aphids (spray with wood vinegar solution or mild detergent solution).



Vegetable Taro - *Colocasia esculenta*

Characteristics: An herbaceous perennial that produces a thick fleshy stem with large triangular-ovate leaves and oval tubers. Tubers and plantlets of local varieties planted widely throughout the Asia/Pacific region and available in markets.

Edible Parts: Depending on the variety, young leaves, stems and/or tubers are edible. Among vegetable types, varieties with edible stems appear most widely available in much of Southeast Asia. Important note: In general, taro species contain toxic oxalate crystals which necessitate boiling and/or other forms of preparing to make plant parts safe for handling and consumption. Some varieties are more potent than others, thereby affecting edibility. Consult local methods for handling and consuming local varieties.

Planting Recommendations: Plant tubers in sun or partial shade; space about 1 meter (3.3 ft.) apart to accommodate wide-spreading leaves.

Possible Pests/Diseases: No major pests.



Wax gourd/Wintermelon - *Benincasa hispida*

Characteristics: Creeping annual vine yielding large, waxy-looking gourds 45 to 60 cm in length. ECHO Asia Seed Bank offers a local variety.

Edible Parts: Leaf shoots are consumed during the rainy season when vines are actively growing. Fruit and seeds are generally available during the dry season.

Planting Recommendations: Plant seeds 50 cm - 1 m (approximately 1.6-3.3 ft.) apart, in full sun or partial shade.

Possible Pests/Diseases: Squash beetle and a yellow leaf-eating beetle.



Winged Bean - *Psophocarpus tetragonolobus*



Characteristics: Perennial, climbing vine with long, fringed (winged) pods. The ECHO Asia Seed Bank offers a 'Day Neutral' variety that produces pods year round (common day-length sensitive varieties only produce pods during the cold season).

Edible Parts: Young leaves and pods.

Planting Recommendations: Plant seed at least 30 cm (11.8 in.) apart along a trellis, in sun or partial shade.

Possible Pests/Diseases: Aphids (spray with wood vinegar or mild detergent solution).

Honorable mentions: We include the following vegetables separately, as they may begin well during the rainy season but then prove susceptible to pest pressures later on. **In general, all three varieties will perform best if planted at the end of the rainy season or during the dry season.**



Bitter Gourd/Melon - *Momordica charantia*

Characteristics: Perennial, climbing vine with hairy lobed leaves and pimply or bumpy fruit, which turns a distinct yellow-orange color when mature. Widely planted and available in local markets.

Edible Parts: Leaf tips and young fruit. Mature fruit is tough and extremely bitter. Cook young fruit in soups or use raw in a cold blended drink. Eat leaves steamed or in stir-fries.

Planting Recommendations: Plant seeds 30 cm (11.8 in.) apart with trellis; prefers sun.

Possible Pests/Diseases: Sucking insects (apply wood vinegar or mild detergent solution).



Calabash Gourd - *Lagenaria siceraria*

Characteristics: Annual, climbing vine yielding various sized and shaped gourds (depending on the variety). ECHO Asia Seed Bank offers 'Burmese,' 'Om Koi Long' and 'ECHO Bottle' varieties.

Edible Parts: Young leaves, shoots, and green fruit.



Planting Recommendations: Plant seeds along a strong trellis, 50 cm - 1 m (approximately 1.6-3.3 ft.) apart, in sun or partial shade.

Possible Pests/Diseases: Squash beetle and a yellow leaf-eating beetle.



Luffa - *Luffa cylindrica*

Characteristics: Annual, climbing vine with yellow flowers and long fruits. ECHO Asia Seed Bank offers 'ECHO' and 'Thai Long' varieties.

Edible Parts: Young leaves and young fruits.

Planting Recommendations: Plant seeds 1 meter apart (3.3 ft.) with trellis, preferably in the sun.

Possible Pests/Diseases: Snails and sucking insects. Plants usually begin well in the early rainy season, but often fail in the long-term due to snail and disease pressure.

We are interested in hearing from readers regarding your experience with these vegetables and/or any other rainy season varieties you have grown. To participate in an online forum, click here: [Community Forum](#)

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Three Cheers for Job's Tears: Asia's Other Indigenous Grain

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Introduction

In many parts of tropical Asia, especially on rainfed farms, there has been an explosion of acreage planted in maize. The increase in commercial maize production is driven by growing livestock feed demand, and is displacing many traditional crops, including the staple upland rice.



Prior to the current Asian maize boom, and even thousands of years before European traders brought the crop to the Far East,



a plant called Job's tears (*Coix lacryma-jobi*) was grown across Southern, Southeast and Eastern Asia. The crop continues to be planted, as a cereal for human consumption, and also as animal feed (both grain and fodder).

Botanically, Job's tears is described as an annual, erect grass, 1-2 m tall, with maize-like brace roots that grow from the lower nodes. The grass is monoecious, having separate male and female flowers on different parts of the plant. The female flowers produce yellow, purple or brown seeds; often tear-shaped (hence the name). Soft-shelled varieties are eaten (*Coix lacryma-jobi* var. *ma-yuen*) and hard-shelled varieties (*Coix lacryma-jobi* var. *stenocarpa* and var. *monilifer*) are often used as ornamental beads (FAO).

Job's tears is not considered a major grain crop, and is often relegated to millet status, i.e. one of the small-seeded cereal crops grown for food and fodder. The plant is even minimized among millets; the only mention of the grain in the FAO publication *Sorghum and millets in human nutrition* is that Job's tears is "of minor importance."

Perhaps Job's tears deserves a bit more attention.

Traditional Uses of Job's tears

Job's tears is consumed as a grain by both humans and livestock. According to PROSEA's *Coix lacryma-jobi* website, a 100 g edible portion of the husked grain of Job's tears contains: water 10.1-15.0 g, protein 9.1-23.0 g, fat 0.5-6.1 g, carbohydrates 58.3-77.2 g, fiber 0.3-8.4 g and ash 0.7-2.6 g. The energy value is about 1500 kJ/100 g. Despite its minor crop status, Job's tears is a nutritious grain, containing more fat and protein than rice and wheat.

Both sticky and non-glutinous varieties are grown throughout much



Steamed Job's tears

Both sticky and non-glutinous varieties are grown throughout much of South and Southeast Asia, as well as parts of China. Job's tears is consumed in various ways; for example, it is steamed like rice and included in soups, beverages and desserts. Although dough made exclusively from Job's tears flour will not rise because of the absence of gluten, a recommended mixture for bakery purposes is 70 percent wheat flour and 30 percent Job's tears flour (PROSEA).

Job's tears is also fermented into beer. Anthropologist Dr. Malcolm Cairns reports that although the crop is rapidly disappearing from the upland fields of the Angami Nagas in northeast India, Job's tears was traditionally grown by the Naga farmers to be fermented, and also for use in snacks and tea.

The Naga farmers also used Job's tears as pig and chicken feed. As a locally-sourced animal feed, Job's tears can be fed to animals when ground, broken, or as a whole grain. PROTEA reports that Job's tears flour can replace maize flour in poultry feed.

For forage purposes, the FAO's *Coix lacryma-jobi L. Grassland Species Profiles* web page states that Job's tears green material is very palatable. The site also offers forage nutritional information for fresh, early vegetative Job's tears growth in India: 29.9 percent dry matter, 8.5 percent crude protein, 27.9 percent crude fiber, 8.96 percent ash, 2.7 percent ether extract and 51.9 percent nitrogen-free extract.

The FAO reports that in India, Job's tears forage yields about 13.9 tons of green material per hectare (6.1 non-metric tons/acre). The Indian Grassland and Fodder Research Institute offers a few forage varieties of Job's tears, including *Bidhan Coix 1*. This variety is reportedly suitable for cultivation in West Bengal, Orissa, Assam and north Bihar with an average green fodder yield of 34.6 t/ha (15.22 non-metric tons/acre) and a dry matter yield of 6.9 t/ha (3.04 non-metric tons/acre). Several cuts of Job's tears fodder per year are possible.

In addition to agricultural and nutritional applications, Job's tears has also been used in traditional Chinese and Indian medicine. The grain contains kanglaite, a neutral lipid extract from the endosperm, which has been endorsed as a treatment for lung, liver, stomach and breast cancers by the Chinese government. Medicinally beneficial compounds in Job's tears seeds which have antitumor properties include coixenolide, palmitic acid, stearic acid, oleic acid and linoleic acid (Waraluck, et al.).

Finally, the hard, inedible seeds of the non-grain varieties (*Coix lacryma-jobi* var. *stenocarpa* and var. *monilifer*) are often employed as beads that are sewn onto garments and used for rosaries.



Ornamental Job's tears seeds

Jamlong Pawkham with the Upland Holistic Development Project based in Chiang Mai describes the hard, ornamental Job's tears seed as having both long grain and oval shapes. The seeds are naturally hollow and can be threaded as beads. Pawkham shared that an informal market for the ornamental seeds exists in northern Thailand among business people making hilltribe handicrafts and/or those buying seeds to sell to other handicraft makers. In 2010 the reported value of 20 liters of Job's tears seed was 400 baht (\$13.00 US).

Commercial Opportunities for Job's tears - Reliable Markets?

Commercial markets for Job's tears exist, especially in China and Taiwan; for these markets, the crop is processed into various food and beverage products that are often marketed under the name "Chinese Pearl Barley," even though the crop is not true barley (*Hordeum vulgare*). Compared to maize and other major field crops, the regional Job's tears market is much less developed.

Beginning in the 1990s, commercial Job's tears production has been occasionally promoted in Laos as a means of alleviating rural poverty. However, a 2006 UNESCAP-CAPSA paper reported that the farm gate price of agricultural products, including Job's tears and other crops, has remained rather low because outside middlemen hold the power in negotiating prices. From the farm, domestic Job's tears is exported abroad as a raw material for processing, with the finished products finally imported back into Laos, ready-to-eat but with a higher price. The writers recommended that processing product investment should be made domestically to increase the value of Job's tears products in order to help Lao farmers generate higher incomes (Douangsavanh and Bouahom).

Fortunately, domestic Job's tears processing in Laos is becoming a reality. ECHO network member Kirby Rogers reports that XP Trading Co. (<http://xptradingcompany.com/>), located in Vientiane, can now de-hull the Job's tear berry (*i.e.* seed) into a whole berry, cracked berry or flour.

Elsewhere in Southeast Asia, food scientists are also looking at new ways to process the grain into local food products. For example, food scientists at Mae Jo University are studying the potential of manufacturing ice cream from Job's tears (Waraluck et al.).

Job's tears Ecology

PROSEA describes Job's tears as a quantitative short-day plant (i.e. it undergoes accelerated flowering under short-day conditions, but will flower under either long- or short-day conditions) that requires high temperatures, abundant rainfall and reasonably fertile soils. In the tropics the plant can occur up to 2000 m (6561 ft.) altitude.



Wild Job's tears

While intolerant of drought, Job's tears will grow in flooded conditions. Wild stands are often found in wet areas along streams and ditches. Dr. Lory Lirio, a Philippine Job's tears researcher, states that in exposed, swampy areas, wild stands regenerate themselves through tillers and seeds.

Job's tears can spread naturally, but slowly, in favorable locations (FAO). However, according to Dr. Lirio, in many places wild Job's tears is under threat due to heavy seed harvests that may prevent stands from reseeding themselves.

Job's tears Cultivation

Job's tears is often found planted in stands or dispersed in and around upland fields. According to PROSEAS's *Coix lacryma-jobi* website, seeds should be pretreated before planting with a fungicide, or by submerging seeds in hot water (60-70°C/140-158°F) for about 10 minutes to control smut fungus (*Ustilago coicis*). Then the crop can be established by dibbling seeds about 5 cm (2 in.) deep into prepared fields at the beginning of the rainy season. Hills should be spaced approximately 30 cm (12 in.) apart in rows 40-80 cm (16-32 in.) apart with a seed rate of 7-15 kg/ha (6.2-13.4 lb./acre). Propagation by cuttings is reportedly possible, especially for fodder production, however no details were provided.

Seeds germinate in one to two weeks. The plant grows vegetatively for at least four months before flowering and pollination occur. Grain filling takes another two months. The stalk begins to dry when most of the seeds are mature. After threshing and husking the grain (either manually or with the same tools used for rice), it is dried for storage. Under humid conditions, the grain does not store well—though the whole grain reportedly stores better than husked grain (PROSEA).

Both the FAO and PROSEA report Job's tears yields of 2-4 tons of husked grain per hectare (0.9-1.8 non-metric tons/acre), with a hulling percentage (amount of grain remaining after husking) of 30-50 percent.

Why Promote Job's tears?

A Palaung hilltribe farmer, Nam Saeng Loongmuang, explains that in addition to the main upland rice crop, hill field cultivators along the Thai-Myanmar border would traditionally integrate local varieties of maize, sorghum (*Sorghum bicolor*) and Job's tears as possible famine food (should the main rice crop fail) and as supplemental grain for both human and livestock consumption. Grain crop diversity, particularly for small holder subsistence farmers, is a very good reason to incorporate Job's tears production.

Another advantage of Job's tears is the crop's resilience, as it is affected by very few diseases and pests and requires little care. The crop is also productive in waterlogged, acidic and lateritic soils, and on degraded, sloping land (Pandey and Roy).

As a flavorful grain with more nutrition than rice and wheat, Job's tears is a potentially important cereal for a growing world population. Besides, both the grain and the forage are viable livestock and poultry feed options.

The ECHO Asia Seed Bank offers a selection of Job's tears seed called 'Mekong Mix'. Click on this link to access the seed bank catalog and to place seed orders [ECHO Asia Seed Bank Catalog](#).

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Electronic Resource Library

Compiled by Ruth Tshin, ECHO Asia Volunteer Consultant

At the ECHO Asia Seed Bank, we are in the process of creating plant information sheets for many of the under-used and tropical Asian food plants specific to our collection. We have found the following links to be helpful (most of the links are taken from public research organizations or academic sources). In this article, the links are divided into sites that allow searches for plant names and sites that contain articles and information about specific plants. This list is a work-in-progress, so let us know of any important plant-related websites that we may have missed.

We plan to upload our seed bank plant information sheets once they are completed and will announce that in a future EAN.

Plant Names Searches

- [Australian New Crops](#) - Site is supported by the Rural Industries Research and Development Corporation in Australia. Listings under Latin or English common names.
- [Cambodian Plant Photos](#) - A Flickr account with photos of native Cambodian plants, ordered somewhat by scientific name but with Khmer name and script available.
- [ECHO Seed List](#) - Site lists seeds offered by ECHO USA by [Latin](#) or [English common name](#) indices; each listing has a short but informative description of an under-used tropical plant.
- [FAO Grasslands Database](#) - Detailed descriptions of more than 600 grasslands species, with a picture gallery; searchable using Latin and English common names.
- [Glossary of Asian Vegetables - Department of Primary Industries](#) - An Australian government database containing pictures and alphabetic glossary of Asian vegetables sold in the country. Non-searchable listing is ordered by English common name.
- [ICRAF/World Agroforestry Centre Tree Database](#) - A searchable database of agroforestry tree species by Latin or English common name.
- [Multilingual Plant Name Database](#) - University of Melbourne's portal for plant names in many languages. Ordered by genus name.
- [The Plant List](#) - This collaboration between the Royal Botanic Gardens, Kew and Missouri Botanical Gardens is a working list of all known plant species. Searchable by Latin names.
- [Purdue Crop Index](#) - Purdue University's list of horticulturally important crops (not US-specific; has good list of tropical plants). Site is searchable as well as ordered by Latin names and English common names.
- [Purdue Famine Foods Index](#) - A listing of "unconventional food sources", the site is searchable by Latin family and genus names.

Plant Articles and Information Searches

- [AVRDC Extension Publications](#) - The World Vegetable Center's main repository of publications such as technical bulletins, production guides, fact sheets and training guides. This page is sorted by publication title with links leading to related PDFs. A search engine is also available.
- [AVRDC Nutrient Database](#) - Nutrient data compiled for more than 140 indigenous plant species from Asian and African countries.
- [AVRDC Report: The Vegetable Industry in Tropical Asia](#) - PDF report that reviews production and trade of the vegetable industry in tropical Asia, including Thailand, Indonesia, the Philippines, Vietnam and India.
- [CIAT in Asia: Library and Publications](#) - International Centre for Tropical Agriculture's listing of [databases](#) and [recent publications](#) related to economically-important Asian crops. Searchable website.

- [**Crops for the Future**](#) - A collaboration of public research institutions that focuses on providing technical reports and publications related to "neglected and under-utilised species".
- [**ECHO Asia - Useful Links**](#) - ECHO Asia Regional Impact Center's listing of useful links related to sustainable agriculture and appropriate technology.
- [**ECHO - Agricultural Information**](#) - ECHO USA's listing of publications and web links.
- [**FAO Non-wood Newsletter**](#) - Informative publications related to Non-Wood Forest Products (NWFP) such as food, medicines and resins.
- [**FAO Information Resources**](#) - FAO's portal to online information resources with links to many databases and indices.
- [**FAO EcoCrop Datasheets**](#) - Database of crops searchable by the following criteria: specific environmental conditions, growth habit, or defined use.
- [**FAO: Publications**](#) - FAO's collection of influential publications presenting comprehensive information and analysis of the current global state of food, agriculture and hunger. These are typically used for policy-making.
- [**FAOSTAT**](#) - This database contains data related to food and agriculture for 200 countries.
- [**FOSRIN: Ricebean research for food security in India and Nepal**](#) - The Ricebean Network's website with links related to nutrition and production of the ricebean.
- [**Globinmed Databases**](#) - An initiative from the Malaysia Ministry of Health, this website is a portal to medicinal plant and herb databases, serving those working in the area of traditional and complementary medicine.
- [**Hawai'i Forestry Extension: Forestry Links**](#) - University of Hawai'i's forestry links, including links to external websites and databases.
- [**ICARDA/CGIAR Library**](#) - Searchable database of publications from the International Center for Agricultural Research in Dry Areas (ICARDA).
- [**ICRISAT Library**](#) - International Crops Research Institute for Semi-Arid Tropics' portal for online databases and full-text publications.
- [**IDRC: International Development Research Centre**](#) - Canadian-government funded IDRC's portal to its databases and publications.
- [**NAFRI Lao**](#) - National Agriculture and Forestry Research Initiative's portal for web-based databases and publications focused on Laos.
- [**Open Access Journals**](#) - Free, full-text scientific and scholarly articles.
- [**OISAT - Online Information Service for Non-Chemical Pest management in the Tropics**](#) - A website listing non-chemical pest management strategies for various economic food crops. Listing is ordered by English common names.
- [**The Overstory--Free Email Agroforestry Journal**](#) - Free, full-text, online agroforestry journal focusing on trees and their roles in agriculture, ecosystems and human culture.
- [**Plants for A Future**](#) - The databases offered by this organization provide medicinal and food uses of plants in temperate climates. Searchable by Latin and English common names.

- [PROTA Database search](#) - This database provides extensive historical, ecological and production information related to sub-tropical and tropical plants found in Africa, some of which overlap with Asian plants. Searchable by Latin and English common names.
- [Seed Savers Exchange](#) - This non-profit organization is dedicated to saving and sharing heirloom seeds. This page is a listing of vegetable planting and seed saving techniques, ordered by English common names.
- [Winrock Agroforestry Factsheets](#) - Winrock is a US-based development NGO. This page is a listing of their agroforestry tree factsheets, ordered by Latin names.

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