

# LAGOS SPINACH

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*Green- and red-leaved varieties of Lagos Spinach*  
Photos by Tim Motis

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## INTRODUCTION

In a world where hunger and poverty are issues with a large percentage of the population, technology and education are wanting, and agricultural resources are often scarce, a farmer is thankful for low-maintenance crops that will grow with a minimal input of effort and resources. Lagos spinach (*Celosia argentea*) is such a crop. A little-known, underexploited leafy vegetable, *C. argentea* is a crop that is easy to plant, grows in most climates and soils, withstands drought and heat, has few problems with pests and disease, is easy to prepare, highly nutritious and tastes good, and produces large quantities of seed. One might wonder why such a plant is so little known!

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## DESCRIPTION

***Celosia argentea* var. *argentea*** or **Lagos spinach** (a.k.a. quail grass, soko, celosia, feather cockscomb) is a vigorous, broadleaf annual belonging to the Amaranth family (Amaranthaceae). *C. argentea* is grown successfully in temperate as well as tropical regions. It grows widespread across northern South America, tropical Africa, the West Indies and tropical Asia where it grows as a native or naturalized wildflower, and is cultivated as a nutritious leafy green vegetable. It is traditional fare in countries of Central and West Africa, and is one of the leading leafy green vegetables in Nigeria, where it is known as ‘soko yokoto’, meaning ‘make husbands fat and happy.’ *C. argentea* grows rapidly from seed and, depending upon the variety and soil fertility, it can reach a height of 200 cm (6.5 ft.).



Figure 1. Flowering spikes of *C. argentea*.  
Photo by Tim Motis



Figure 2. Cockscomb-type flower of some members of *Celosia* genus.  
Photo by Tim Motis

According to Dr. T. Badra (1991), *C. argentea* originated somewhere between Senegal and Cameroon in West Africa, although Martin, et al (1998) suggest an Asiatic origin. It shares features with members of the genus *Amaranthus* such as broad edible leaves with high protein content (1.2-5.9 %), and flowers and seeds produced in dense spikes (Fig. 1).

Some members of the genus *Celosia* are colorful ornamentals called "cockscombs" (Fig. 2).

Like its ornamental relatives, it is attractive in its own right. When days become shorter, it is covered with silvery-pink to purple blossoms. Each inflorescence is an indeterminate (continuously flowering) feathery spike. As it elongates, the basal end of the inflorescence dies (see spike in middle of Fig. 1), producing large numbers of small, black, edible seeds, while the tip continues to bloom, attracting bees and other insects. At ECHO we have noticed a number of predatory insects frequenting the flowers, particularly wasps and hornets.

*C. argentea* is a good warm-weather leafy vegetable. Even in temperate regions spinach (*Spinacia oleracea* var. *inermis*) does well only in the cooler months of the growing season, and will not produce in the heat. *C. argentea*, on the other hand, will grow robustly in tropical climates, and has leaves that taste very much like spinach when cooked. Roy Danforth, a long-time member of ECHO's network, planted it in the Congo. He wrote that he was pleased that it tasted very much like spinach. More importantly, local farmers were also interested.

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## USES

*C. argentea* is used primarily as a leafy vegetable. The leaves, shoots and tender stems are eaten as a potherb in sauces or soups, cooked with other vegetables, with a main dish or by itself. The leaves break down easily even when cooked only briefly. The seeds are also edible and have medicinal value. Chopped plants have been used as forage for poultry and other livestock. And, the flowers make nice ornamentals, fresh or dried.

Medicinal uses of *C. argentea* have been reported where its use as a leafy vegetable has been adapted into the culture. Ailments treated with *C. argentea* include: abscesses, colic, cough, diabetes mellitus, diarrhea, dysentery, eczema, eye problems, gonorrhea, infected sores, liver ailments, menstruation problems, muscle troubles, skin eruptions, snakebites, and wounds (Schippers 2000). The roots have diuretic properties, and in Kenya, the Masai people make a body wash from the leaves and flowers for convalescents.

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### COOKING & NUTRITIONAL CONTENT

Like its cousins the amaranths, the leaves of *C. argentea* are high in protein, vitamins A and C, and are good sources of calcium and iron. The flavor is pleasant, spinach-like and mild, with no trace of the bitterness sometimes found in amaranth. Young shoots and older leaves are cooked by boiling for about *five minutes* to soften the tissue and remove oxalic acid and nitrates, potentially toxic anti-nutrients. The water may also be discolored by red and yellow plant pigments (anthocyanins, betalains, betacyanins and betaxanthins). These are harmless, but should be discarded because of the dissolved oxalates and nitrates. The leaves themselves will not discolor during the cooking process. In fact, they become an attractive green color looking much like cooked spinach. Lengthy cooking will reduce the vitamin content.

Some people cook greens in a steamer. When staff at ECHO prepared the greens this way, the leaves became black and had an unpleasant taste, actually irritating the tongue. This does not happen when the leaves are boiled and the water discarded. Apparently the pigments and oxalates normally removed via the cooking water were left in the steamed leaves.

The nutrient content in *C. argentea* varies between cultivated varieties, and apparently with time of harvest. It has also been noted that green-leaved varieties generally are more palatable and have higher protein and ascorbic acid (vitamin C) content than red varieties. (Omueti 1980)

*C. argentea* is best eaten as a vegetable before it begins flowering. Most sources recommend harvesting 5-7 weeks after sowing for optimal nutritional value. The highest total marketable and edible yields and total crude protein yield, however, occurs at 15 weeks after sowing. After flowering, the new leaves are too small and unappealing to be worth eating. (Schipper 2000)

A study in Karnataka, India (Sheela 2004) compared the nutrient qualities of 38 underutilized green leafy vegetables. Partial results of this study are in the table below. *C. argentea* is an outstanding source for iron and a very good source for protein and vitamin C (ascorbic acid). (The USDA recommends 60 mg vitamin C, 1000 mg calcium and 18 mg iron per adult per day.) The data in the chart below are determined on a dry weight basis from samples of edible portions weighing 100 g fresh weight.

Crop Name	Moisture (g)	Dry Matter (g)	Protein (g fresh wt)	Protein (% dry wt)	Energy (Kcal)	Ascorbic Acid (mg)	Iron (mg)
<i>C. argentea</i>	85	15	1.2	8.0	23	59	28.3
<i>Amaranthus viridis</i>	91	9	2.0	22.2	25	17	18.2
<i>A. spinosus</i>	84	16	3.6	22.5	62	33	13.1
<i>Alternanthera sessilis</i>	84	16	3.6	22.5	35	14	14.1
<i>Basella alba</i>	93	7	3.3	47.1	31	15	5.5
<i>Sauropus androgynus</i>	88	12	3.4	28.3	28	22	10.1

From the FAO publication, Food Composition Table for use in Africa. 1968.

<i>C. argentea</i>	83.8	16.2	4.7	29.0	44	n/a	7.8
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A study conducted in Lucknow, India (Prakash, et. al.) 1995.

<i>C. argentea</i>	81-89	11-19	4.3-5.9	22.6-39.0	n/a	18.8-53.6	n/a
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The last study also measured carotenoids (vitamin A) at 11.8-15.1 mg. The evaluation of the above compounds was found to vary with the position of the leaves and their age.

As they are in the same family (Amaranthaceae), *C. argentea* is similar nutritionally to amaranth. However, it is lower in protein content, particularly when contrasted with the wild types, *Amaranthus spinosus* and *Alternanthera sessilis*. Overall, research shows that the leaves are high in vitamins A and C, iron and calcium, although until cooked calcium is not generally available due to the presence of oxalic acid. The oxalic acid and accumulated nitrates should pose no danger unless leaves are eaten in unusually large quantities.

And, for consumers on the lookout for healthful produce in the fight against disease, AVRDC (Asian Vegetable Research & Development Center) conducted a study in which *C. argentea* received high marks for its antioxidant content. Antioxidants bind free radicals (cellular by-products known to cause cancer, heart disease and a weak immune system, among others) in the bloodstream and render them harmless. Principle antioxidants include vitamins C, E and carotenoids (beta-carotene). Out of 20 indigenous leafy vegetable species tested for antioxidant content, *C. argentea* placed second only to *Moringa oleifera* (horseradish tree) and *Toona sinensis* (Chinese mahogany). (Sato 2002) In a second study on anti-oxidant levels conducted by AVRDC in collaboration with the Japanese International Research Center for Agricultural Sciences (JIRCAS), out of 52 species tested, *C. argentea* placed 5<sup>th</sup> behind *M. oleifera*, *Rosmarinus officinalis* (rosemary), *Salvia officinalis* (sage) and *T. sinensis*. (Sato 2003)

Peace Corps volunteer Jessica Jacklet tested *C. argentea* at her site in Panama. Few vegetables were grown in that area, as most vegetables performed very poorly. The foliage of *C. argentea* was rich and dark with lovely purple flowers. Those who started growing *C. argentea* were very proud of its exceptional growth. She introduced the plant as "purple spinach" to the villagers, who are learning ways to incorporate the leaves into their recipes. So far, people have added the leaves to a rice and lentil dish, and one containing eggs and tomatoes. This very productive plant is hardy and attractive, and it merits trial in more areas. [top](#)

## CULTIVATION

**SEEDING.** *C. argentea* is grown on raised beds, ridges or flat beds. It may be seeded directly into the soil at a depth of 0.75 cm (0.25 in) or started in a seedbed. Seedbeds should be well-manured and kept moist. Germination can be expected at 5-7 days. Thin seedlings to 15-30 cm (6-12 in) apart, or transplant them into the field when 10-15 cm (4-6 in) tall, at 2-3 weeks, using the same spacing. For a once-over harvest (uprooting the whole plant), seed may be mixed with sand or loose soil at a ratio of 1:20 and broadcast onto the prepared soil. Mixing with sand helps to obtain a more even distribution. The seeding rate is 6-9 g per 10 m<sup>2</sup> whether broadcast or seeded directly into rows. With a fertile soil and sustained harvest, wider plant spacing is recommended. *C. argentea* germinates very readily; so readily in fact, that when a mature seed-bearing plant is harvested and hauled to the compost pile, seedlings often emerge along the path taken.

**TRANSPLANTING.** For a sustained harvest and higher yields via ratooning or successive prunings, it is better to transplant than direct seed. Transplanting also requires less seed, gives more uniformity of stand and better vigor. Because *C. argentea* prefers rich, moist soil, flat beds are often preferred over

raised beds and ridges. The best production has been obtained from flat beds that have been manured and well-worked prior to transplanting.

**IRRIGATION.** Irrigation is optional during the rainy season. During the dry season, depending on the severity of heat and evapotranspiration, two irrigations per week are recommended, totaling about 5.0 cm (2.0 in). *C. argentea* tolerates dry soil, but doesn't like to get its feet wet.

**FERTILIZATION.** *C. argentea* responds well to fertilizer application. As a rule of thumb, for a once-over harvest, a complete NPK fertilizer (such as 10-10-10 or 15-15-15) at 400kg/ha (40kg/1000 m<sup>2</sup>) in a single application (normally at soil preparation) is recommended. If the harvest will be by successive cuttings, two applications of 300kg/ha each are recommended - one as "plow-down"; the other as a side dressing. Organic manures may substitute for, or augment inorganic fertilizers at a rate of 24-40 T/ha. Such manures, (including compost and green manure crops) will not only increase growth, but will also help keep nematodes in check. For a sustained harvest, after ratooning the crop, an additional NPK fertilizer should again be applied at rates of 400 to 600 kg/ha around the plants or between rows.

**ENVIRONMENTAL & CULTURAL CONDITIONS.** Getting a good, properly spaced stand can be difficult, and weed competition may be serious for a while because the *C. argentea* seeds and resulting seedlings are so small. A rich organic soil is the best for growing *C. argentea*, although as a roadside weed it grows in poor acidic laterite soils without organic matter. It tolerates full sun, but will produce best under partial shade. This makes *C. argentea* ideal for kitchen gardens partially shaded by trees or buildings. *C. argentea* is killed by standing water or freezing temperatures, and although temperatures below 20°C (68° F) will severely restrict growth, it withstands high temperatures well. Optimal daytime temperatures range between 30 and 35°C (86-95° F) with optimal nighttime temperatures between 23 and 28°C (73-82° F). *C. argentea* has also produced well at altitudes as high as 1700 m (5400 ft).

*C. argentea* and other members of the amaranth family tend to reseed themselves abundantly, leading to potential weed problems. In places where few plants will grow without special care, that might be an advantage. However, caution should be taken that it does not become weedy.

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### HARVESTING AND SEED PRODUCTION



Figure 3. Small, narrow leaves at flowering stage of *C. argentea*.  
Photo by Tim Motis

**ONCE-OVER HARVEST.** There are basically two methods of harvesting *C. argentea* – 1) once-over (uprooting the whole plant) and 2) sustained (periodic cutting and regrowth). Once-over harvest may begin 4-5 weeks after sowing by selecting and pulling the tallest plants (20-30 cm or 8-12 in). Keep in mind that growth rate may vary, giving taller and shorter plants which may be harvested at different times. The whole uprooted plant can then be eaten, or the roots may be cut off, bundles made and prepared for market. Harvest continues in this manner (depending on uniformity of growth and market demand) until any remaining plants are no longer of marketable quality, usually 40-50 cm (16-20 in) tall. This is also the point at which you may see the onset of flowers and/or lateral branches. Regardless, at this stage new leaves will emerge small (Fig. 3) and unfit for harvest.

**SUSTAINED HARVEST.** As with a once-over, the first harvest is made after about four to five weeks. Tops at this point are cut leaving a stem 15-20 cm (6-8 in) from the ground, allowing side shoots to grow. A second harvest is taken by pruning the side shoots 15-20 cm from the stem, again leaving sufficient number of buds for regrowth. Cuttings may be made in this

manner at 2-3 week intervals. This method allows for 4-5 harvests to be made before the onset of flowering at which time leaf size and quality begin to decline.

NOTE: These are harvesting methods commonly used commercially in West Africa. For the kitchen gardener, the individual leaves and tender shoots may be harvested as desired for the particular meal prepared, rather than cutting the stem or uprooting the entire plant. Although the plant may grow to several feet, the top 20-30 cm (8-12 in) of the shoots are considered the best eating due to the slightly mucilaginous texture when cooked. This is another reason why *C. argentea* is harvested before the plant grows very tall.

Most farmers prefer the once-over harvest method to the sustained method. Research in Nigeria showed that a carefully managed crop harvested by uprooting yielded 47 t/ha, while a carefully managed crop using the sustained method of harvest yielded 57 t/ha. Some farmers will combine the two techniques, first harvesting the entire plant as a thinning operation, then ratooning the remaining crop. Repeated cuttings also yield better quality, less inedible waste and give higher economic returns. (Denton 2004, Schippers 2000).

SEED PRODUCTION. For seed production, select several healthy, vigorous plants and mark them. After the first harvest, cut these plants 15-20 cm from the ground, and allow for regrowth. Pruning will stimulate multiple lateral branch production, and therefore multiple flower heads. If planting specifically for seed production, transplant seedlings into rows 70 cm apart with 40-45 cm between each plant in the row.

Seed harvests in tropical environments may begin 10 weeks after sowing and to continue up to another 10 weeks, 2.5 to 5 months. Seed is ready to be harvested when flowers begin to turn silvery in color and the leaves turn yellow. To harvest the seed, cut the whole flower spike and place in a bag that allows air to circulate. Store in the shade until dry, and then thresh. Alternatively, collect seed weekly by holding a container under the seed head and rubbing or tapping it gently. Seed yield is 200-700 kg/ha. One thousand (1000) seeds weigh 1.0-1.5 g. [top](#)

### PESTS & DISEASES

Although relatively pest-free in temperate regions, and at ECHO's subtropical location in Florida, *C. argentea* sustains damage from a number of diseases and pests in the tropics. Spider mites and nematodes tend to be the biggest pest problems. Also reported in Nigeria are the variegated locust and a beetle, *Baris planetes*, which attack and feed on immature seed capsules causing seed loss. Larvae (caterpillars) of *Hymenia recurvalis* and *Psara bipunctalis* feed on the foliage, and grasshoppers and aphids can cause minor damage. Nut grass (*Cyperus rotundus*) is a serious weed problem.

*C. argentea* is quite susceptible to root-knot nematode (*Meloidogyne* spp.) infection causing the formation of galls on the roots, stunted growth, small brown-colored leaves and reductions in yield of up to 40%. If nematodes are a problem, plant in soil amended with lots of organic matter, topped off as well with organic mulch. In some studies, the green varieties have been observed to be more susceptible to nematode damage than the red varieties (Schippers 2000). This report surprises us at ECHO, where we have severe root knot nematode problems in general, but have no difficulty whatever growing *C. argentea*.

White rust and crown blight are considered the most serious fungal diseases affecting *C. argentea*. During the rainy season and when there is high humidity these and several other fungal diseases can cause problems in *C. argentea*, which in turn cause poor leaf quality. Appropriately spaced plant stands, clean fields (free of diseased and dead plants) and resistant varieties can help to significantly reduce fungal disease damage to your crop.

White rust (*Albugo blitii*) causes white pustules on the undersides of the leaves with chlorotic lesions on top, and seriously damages Nigerian-grown plants. It is recommended to rogue out and destroy infected plants to reduce the incidence of infection in subsequent crops.

Crown blight (*Choanephora cucurbitarum*) is a wet rot fungus that can become a problem in dense plots with insufficient aeration. This is the main disease of amaranth during rainy season, and can sometimes affect *C. argentea* in the same way.

A virus causing mosaic and leaf-curl has been isolated from vegetable farms producing *C. argentea* near Lagos and Tejuoso, Nigeria. It is transmitted in a non-persistent manner by two aphid species (*Aphis spiraecola* and *Toxoptera citricida*). On the basis of the available information, this virus is different from other viruses infecting vegetables in Nigeria. The name celosia mosaic virus (CIMV) has been suggested for this virus. (Owolabi 1998)

Other diseases include *Rhizoctonia solani*, *Pithium aphanidermatum* and *Thatatephorus cucumeris*, which cause damping-off of seedlings, and collar rot (*Phytophthora cryptoge*) which causes similar symptoms on older plants as well. Cercospora leaf spot (*Cercospora celosiae*) causes red-rimmed grey spots on the leaves. Alternaria leaf spot (*Alternaria* spp.) and charcoal rot (*Macrophomina phaseolina* and *Curvularia* spp.) cause dark spots on the leaves.

Use appropriate measures to control diseases and pests without endangering your household or the environment. If you must utilize commercial chemicals, read the label and understand how to safely apply the chemical, how to clean yourself and your equipment afterwards and how to safely dispose of the empty container. If the chemical is not labeled specifically for *C. argentea*, it is best not to use that chemical. However, if you have a severe pest or disease problem, check with your local agricultural specialist. Under his guidance you may be able to apply such a chemical, especially if it is labeled for a similar crop species, such as amaranth or quinoa. [top](#)

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