

Cortaderia spp.

Pampas grass

Poaceae

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OVERVIEW

C. jubata and *C. selloana* (pampas grass) are giant tussock grasses with long saw toothed leaves and white to pink flower plumes. Both species have been widely cultivated around the world as ornamental garden plants and their plumes have been sold for decorative dried flower arrangements. Originally, it was thought that *C. jubata* was the weedier of the two species and that *C. selloana* did not spread. However, with the increasing of use of *C. jubata* and both male and female *C. selloana* plants being spread in horticulture trade around the world, both species are now known to reproduce and have become invasive pests in areas where they are planted, including at least New Zealand, Australia, California, South Africa, and Hawai'i. Invasive characteristics of pampas grass includes rapid growth, large biomass accumulation, production of numerous seeds, and long distance seed dispersal (up to 20 miles). Pampas grass can crowd out native plants, impede access to areas, damage grazing lands, and create fire hazards. In Hawai'i, pampas grass can invade a variety of environments from wet to dry climates and from disturbed to native environments. On Maui, pampas grass is widely planted in residential and urban areas, especially cool upland residential areas such as Olinda and Kula. Infestations have been found from wet dense native rainforest areas to high elevation arid habitat including alpine shrubland and within and around Haleakala Crater. *C. jubata* is listed as a Hawai'i state noxious weed and efforts are being taken to add *C. selloana*. Both species are currently targeted for control on Maui by the Maui Invasive Species Committee (MISC), Moloka'i (*C. jubata*) by the Moloka'i Invasive Species Committee (MOMISC), Hawai'i by the Big Island Invasive Species Committee (BIISC), and Kaua'i by the Kaua'i Invasive Species Committee (KISC).

TAXONOMY

Family: Poaceae (grass family) (Bailey and Bailey 1976).

Latin name: *Cortaderia jubata* (Lem.) Stapf., *C. selloana* (J.A. and J.H. Schultes) Asch. & Graebn. (Bailey and Bailey 1976, PLANTS 2003).

Synonyms: *C. jubata*: *C. atacamensis* (Phil.) Pilger, *Gynerium jubatum* (Lem.) (Weeds Australia 2000, GRIN 2003, PLANTS 2003). *C. selloana*: *Arundo selloana* Schult. and Schult. f., *C. argentea* (Nees) Stapf, , *C. dioica*, *Gynerium argenteum* Nees (Bailey and Bailey 1976, Weeds Australia 2000, PLANTS 2003).

Common names: *C. jubata*: jubata grass, purple pampas grass, pink pampas grass, Andean pampas grass. *C. selloana*: Uruguayan pampas grass, pampas grass, silver pampas grass (Neal 1965, PIER 2002, GRIN 2003, PLANTS 2003).

Taxonomic notes: *Cortaderia* is a genus comprised of about 24 species of evergreen or semi-evergreen, perennial grasses native to New Zealand, New Guinea, and South America (Bailey and Bailey 1976).

Nomenclature: Not known.

Related species in Hawai'i: There are no other *Cortaderia* species known from Hawai'i. A few other species and varieties are cultivated around the world.

DESCRIPTION

Cortaderia jubata: "Robust, tussock grass up to 3 m in diameter, flowering stalks up to 3 m high. Leaves bright green, up to 1500 mm long x 12 mm wide, reflexed, tips not bristle-like, blade flat to only slightly v-shaped in cross-section, margins rough, cutting; leaves mostly basal to half the height of the flowering stalks. Inflorescence yellowish or purple, loosely branching, feathery, 600-800 mm long. Seeds, falling from old inflorescence which remains a dark or yellowish color." (Henderson 1995).

"Distinguished from *C. selloana* by the looser, yellowish or purplish panicle and somewhat smaller spikelets 1/2 - 5/8 in. long, callus to 1/16 in. long, with white hairs to 5/32 in. long, lemma with hairs to 5/16 in. long appearing above level of top of palea." (Bailey and Bailey 1976).

Cortaderia selloana: "Robust, tussock grass up to 3.5 m in diameter, flowering stalks up to 4 m high. Leaves grayish or bluish-green, up to 1800 mm long x 10 mm wide, reflexed, tips narrowly tapering, bristle-like, blade often v-shaped in cross section, margins rough, somewhat cutting; leaves mostly basal to two-thirds of the height of the flowering stalks. Inflorescence silvery-white to pink or mauve, stiffly branching, feathery, 400-700 mm long. Seeds, falling from old inflorescence which then appears white." (Henderson 1995). "Large clumps, to 10 ft. or more; panicle silvery-white to pink, 1-2 ft. long, 4-6 in. wide; spikelets 4-7-fl'd., 5/8 - 3/4 in. long, the female silky with long hairs, the male not hairy, glumes white, papery, elongate, lemma long-awned, palea less than half as long as lemma." (Bailey and Bailey 1976).

BIOLOGY & ECOLOGY

Cultivation: Pampas grass has been a popular ornamental garden plant since the Victorian era (Greenlee 1992). A few species are grown around the world, with *C. selloana* being the most popular and prized for their stunning white silky plumes born on female plants. *Cortaderia* was first cultivated in France and Ireland from seeds collected in Ecuador (Costas-Lippmann 1977). In California, *C. jubata* and *C. selloana* were introduced some time in the late 1800's. In the 1870's, nurseryman Joseph Sexton grew *C. selloana* commercially on a large scale near Santa Barbara and their dried plumes became very popular for ornament (Thompkins 1966). At this time, *C. jubata* was not widely grown and selection for attractive female *C. selloana* plants was high, as male plants had less attractive plumes. With time, both *C. jubata* and *C. selloana* of both sexes were mixed into the trade and naturalized plants soon began to occur. Pampas grass has also been cultivated as cattle forage and for erosion control in California, New Zealand, and South Africa (Lemon and Taylor 1949, James 1966, Pleasants and Whitehead 1977). Today, pampas grass is widely cultivated as an ornamental garden plant. In Hawai'i, Neal (1965) reports, "*C. selloana*, from South America, is seen in gardens here and there.

The male flowers are smooth and form less attractive panicles than the silky-haired, feathery, silver-to-pink female panicles, which are sometimes grown commercially for dry bouquets. The leaves have been manufactured into paper, the roots prepared for medicine." In Hawai'i today, both *C. jubata* and *C. selloana* are popular landscaping plants on Maui, especially at cool mid-elevation urban areas of Kula and Olinda from 2,000 to 4,000 ft. Plantings, as well as naturalized plants, have been removed recently.

Invasiveness: Pampas grass has numerous invasive characteristics. The large tussock forming grass grows rapidly and forms dense thickets. Plants are capable of flowering after 1-2 years and can produce thousands to millions of seeds within its lifespan of about 10-15 years (Cowan 1976). Seeds are light and capable of long distance dispersal of up to 20 miles on the wind (Connor 1973, DiTomaso et al. 1999). *Cortaderia* spp. readily spread from the garden and are considered pests in numerous places including California, Hawai'i, New Zealand, Australia, and South Africa (Loope and Medeiros 1992, Haley 1997, DiTomaso et al. 1999, PIER 2003, Stellenbosch 2003). In Hawai'i, pampas grass has proved to be highly invasive on the island of Maui. Its long distance dispersal capability is quite impressive and naturalized plants have been found far from plantings. Pampas grass invades a wide range of climatic conditions from native mesic and wet forests to dry alpine shrubland. Pampas grass also colonizes open disturbed areas such as roadcuts, pastures, gulches, and yards. With time, infestations form large impenetrable thickets and continue to spread by producing numerous seeds and seedlings both nearby and far away. In California, pampas grass threatens native plants in coastal habitats through intense competition. In New Zealand, this aggressive grass spreads quickly from gardens and invades disturbed areas and open rocky sites. Pampas grass competes with other vegetation and creates a fire hazard with excessive build up of dry material (Haley 1997).

Pollination: *Cortaderia jubata* reproduces through the process of agamosperous apomixis. All plants are female and are able to produce viable, genetically identical seed without pollination (Costas-Lippmann 1979). *Cortaderia selloana* are dioecious outcrossing individuals. In Hawaii, *Cortaderia jubata* flowers from early August to late October, versus mid-September to mid-November for *C. selloana* (Chimera 1997). In Hawaii, *C. jubata* plants have been observed to flower after 2-4 years (Loope and Medeiros 1992).

Propagation: Pampas grass can be propagated from seeds or from root divisions. In *C. jubata*, seeds are readily set. In *C. selloana*, both male and female plants must be present for seeds to occur, and propagation is usually through root divisions.

Dispersal: Pampas grass has been cultivated and dispersed around the world by humans who grow the plant for ornament, cattle forage, erosion control, and other various uses. Seeds of *C. jubata* are primarily wind-dispersed (Connor 1973) and are capable of dispersal distances up to 20 miles (DiTomaso et al. 1999).

Pests and Diseases: Brickell and Zuk (1997) report that *Helminthosporium* leaf spots are common.

DISTRIBUTION

Native range: *C. jubata* is native to the Andes Mountains of northern Argentina, Bolivia, Peru, and Ecuador typically at elevations ranging from 2,800-3,400 m (9,186-11,155 ft) (Costas-Lippmann 1979). Bailey and Bailey (1976) report that *C. jubata* is native from Ecuador and Peru to Argentina. The region is mostly mountainous coastal terrain bordering the Pacific Ocean with some woodland and shrubland, desert and desert shrubland, and highlands (Hammond 1986). Average temperatures in these regions range from 32-68 F (0-20 C) in January to 32-86 (0-30) in July (Hammond 1986). The approximate average annual rainfall in these areas varies from dry alpine areas that receive under 10-40 in (under 25-100 cm) to moister woodland areas that receive 40-over 80 in (100-over 200 cm) (Hammond 1986). In its native range, *C. jubata* forms nearly solid stands up to several hundred hectares. It easily establishes in bare wet sandy soils, yet has broad habitat requirements and can grow in practically any soil type, low or high moisture regimes, and in full sun to dense shade (Cowan 1976). The Missouri Botanical Garden (2003) specimen database lists elevations as low as 3 m (10 ft) and as high as 4,000 m (13,123 ft), with most collections being from Ecuador and average elevation ranging mostly around 2,000-4,000 m (6,562-13,123 ft). The following is a summary of collections: Argentina, 3 m (10 ft); Bolivia, 2,950-4,000 m (9,678-13,123 ft); Ecuador, 970-3,450 m (3,182-11,319 ft); and Peru, 330-3,400 m (1,083-11,155 ft). This region of Southern America occurs from near the equator in Ecuador and stretches south through Peru and Bolivia, and further south to just below the Tropic of Capricorn in Salta, Argentina (GRIN 2003).

C. selloana is native to Argentina, Brazil, Chile, Paraguay, and Uruguay (GRIN 2003). Bailey and Bailey (1976) report that *C. selloana* is native from Brazil, Argentina, and Chile. In its native range, *C. selloana* grows in relatively damp soils and along river margins (DiTomaso et al. 1999). This region of South America is more inland and includes rivers, tropical rainforests, grass and shrubland, light tropical forest, and some highlands (Hammond 1986). Average temperature in these regions varies from 68-86 F (20-30 C) in January to 50-86F (10-30 C) in July (Hammond 1986). Average annual rainfall in these regions is 40-over 80 in (100-over 200 cm) (Hammond 1986). The Missouri Botanical Garden (2003) lists the following collection information: Bolivia, 700-1,325 m (2,297-4,347 ft); Brazil; Chile; and Colombia. There are also collections listed from the following Mesoamerican countries, though it is not certain whether these are within the native range or not, these include: Honduras, 1,000 m (3,281 ft); and Mexico, 2,895 m (9,498 ft).

Global distribution: *C. jubata* and *C. selloana* have been widely cultivated and distributed around the world through the global nursery trade. *C. jubata* and *C. selloana* have become pests in California, along the Pacific coast of the United States, Hawai'i, New Zealand, Australia, and South Africa (Haley 1997, DiTomaso et al. 1999, PIER 2003, Stellenbosch 2003). *C. jubata* is known from Hawai'i and California (PLANTS 2003). *C. selloana* is known from Alabama, California, Georgia, Hawai'i, Iowa, Louisiana, Missouri, New Jersey, North Carolina, Oregon, South Carolina, Tennessee,

Texas, Utah, and Virginia (Neal 1965, PLANTS 2003, Missouri Botanical Garden 2003). Both species are widely cultivated and are likely in other states as well.

In California, large infestations of pampas grass threaten coastal ecosystems by crowding out native species (DiTomaso et al. 1999). Greenlee (1992) warns of *C. jubata*, "Purple pampas grass has some serious faults, not the least of which is its aggressive, weedy reseeding in mild climates. In California, native plant enthusiasts sadly watched it invade the chaparral and coastal forests, choking out the native vegetation and forming dense, impenetrable thickets." According to Peterson (1988), "*Cortaderia* is highly competitive with native plants once seedlings become established and is a substantial threat to the ecological quality of preserves, particularly in coastal and grassland sites. Its rapid growth and accumulation of above ground and below ground biomass allow it to acquire light, moisture, and nutrients that would be used by other plants. It can be damaging even at low densities because of the amount of cover it can occupy. Particularly threatened habitats include coastal sand dunes and inland sand hills that contain a number of rare and endangered plant species."

The spread of *Cortaderia* spp. is explored in Lambrinos (in press) who reports the following information on the history and spread of *Cortaderia* in California. "The earliest herbarium record of *Cortaderia* in California was an ornamental specimen of *C. selloana* collected near the campus of the University of California, Berkeley in 1915. There were no specimens of naturalized *Cortaderia* until a female specimen of *C. selloana* was collected near a pond in Mandeville Canyon, Los Angeles in 1929. The first herbarium record of naturalized *C. jubata* was not encountered until 1946 when an individual growing along San Antonio Creek in Ventura Co. was collected. After the 1940's both species spread rapidly from southern California. *C. selloana* exhibited a dual foci pattern of spread, with populations established in the San Francisco Bay Area as well as southern California by the 1950's. From these initial foci, *C. selloana* spread up the deltas of the Sacramento and San Joaquin rivers, as well as along the coast during the 1960's and 1970's. A multiple foci pattern of spread for *C. jubata* was not readily discernible from herbarium records. However, from its first 1946 collection *C. jubata* rapidly appeared both north and south along the coast, but it did not expand inland as *C. selloana* had...The heaviest infestations of *C. selloana* were found south of Point Conception while the heaviest infestations of *C. jubata* were found north of Point Conception." Lambrinos (in press) further adds, "In subsequent years, herbaria data indicate that *C. selloana* has been the more invasive of the two species in California. *C. selloana* currently occupies more area, invades a greater variety of habitats, and invades non-ruderal habitats more frequently than *C. jubata*."

In New Zealand, both *C. jubata* and *C. selloana* are considered invasive pest plants. *C. jubata* is widespread and abundant from coastal and lowland shrub and forest margins, sand dunes and hinterland, cliffs, bluffs, riverbeds, inshore islands and coastal areas, disturbed forest and shrublands, gumlands and pakihi, consolidated sand dunes, roadsides, railway lines, farm hedges, quarries, wasteland, and exotic plantations (Haley 1997). *C. selloana* is also found in similar habitats but is not as abundant as *C. jubata* (Haley 1997).

In Australia, both *C. jubata* and *C. selloana* are considered invasive pest plants. Pampas grass was previously considered a relatively benign garden plant, but the introduction of new strains in the 1970's has made it more aggressive (Eurobodalla Shire Council 2003). Wild pampas grass is found close to towns in disturbed open and moist areas (Eurobodalla Shire Council 2003).

In the Cook Island, *C. selloana* is cultivated in Rarotonga (PIER 2003).

In South Africa, *C. jubata* and *C. selloana* are considered category 1 restricted plants according to the Conservation of Agricultural Resources Act, 1983 (Stellenbosch 2003). Category 1 plants may not occur on any land or inland water surface other than in biological control reserves. Land users are required to control any of these category 1 plants that occur on any land or inland water surface (Stellenbosch 2003).

State of Hawai'i distribution: Neal (1965) stated that pampas grass, *Cortaderia selloana*, is seen in gardens here and there in Hawai'i. St. John (1973) listed *Cortaderia selloana*, noting that it occurs only in cultivation and was first introduced to Hawai'i in 1925. *Cortaderia jubata* was not included in the 1990 edition of the Manual of the Flowering Plants of the Hawaiian Island, and until 1990, there has been no record of *C. jubata* occurring or being naturalized in the Hawaiian Islands. *C. jubata* is now documented as naturalized on Maui (Loope and Medeiros 1992, Meidell et al. 1997, Wagner et al. 1999). On Moloka'i, *C. jubata* is reported from 3 plantings in Maunaloa, including several naturalized plants, which were removed in 2002 by MOMISC. On Hawai'i, *C. jubata* and *C. selloana* are currently targeted for control by BIISC. On Kaua'i, pampas grass is reported from Princeville and in urban areas and is targeted for control by KISC.

Island of Maui distribution: *C. jubata* and *C. selloana* are cultivated mostly as hedges and garden plants in urban and residential areas of Maui from sea level up to at least 4,000 ft (1,219 m). Plantings are especially common on East Maui from Ha'iku to Kula at elevations ranging from 1,000 ft (305 m) to 4,000 ft (1,219 m). There seems to be little discrimination between the two species in plantings and in some instances both species are observed in the same hedge or planting. Most naturalized plants appear to be *C. jubata*. However, a few suspected *C. selloana* were recently observed naturalizing in Olinda and Kula. Plants quickly reach sexual maturity within a few years and begin to set large amounts of seed. Seedlings readily germinate nearby and eventually form large patches. Infestations are densest close by original seed plants but do have the ability to spread far away. Seeds readily alight on the wind and have been known to germinate far from original plantings in a variety of habitats and climatic regimes from the alpine cinders of Haleakala to the rainforest mud of Iao Valley. Pampas grass invades open disturbed sites such as roadsides, yards, pastures, pipelines, and steep banks, as well as closed undisturbed environments, such as native mesic to wet forests and arid shrubland. Pampas grass has been found invading in areas as dry as 30 in (76 cm) to as wet as 145 in (368 cm) and at elevations from 800 ft (244 m) to 7,828 ft (2,386 m). Mapping flowering plants from a helicopter seems to be the best way to locate plants that are in inaccessible

areas and rough terrain. Plants that exist in backyards and gated areas are hard to locate and there are likely many plants still undetected. Early detection in natural areas will be key in preventing large infestations.

East Maui: Pampas grass is a popular landscape plant on East Maui that is commonly cultivated in Makawao, Olinda, and Kula and less commonly planted in Kihei, Paia, and Keokea. Large infestations have been located in wet native forests of east Maui near Honomanu gulch at an elevation of 3,500-6,000 ft (1,067-1,829 m). It has also been found in relatively arid alpine shrubland on the south rim of Haleakala Crater, elevation 7,828 ft (2,386 m).

West Maui: Pampas grass is not as widely planted on West Maui as it is on East Maui. One of the largest mixed plantings of *C. jubata* and *C. selloana* was located in Waiehu, elevation approximately 500 ft (152 m), where numerous large clumps were planted around the water features at a golf course. This population has since been removed with cooperation between the golf course and MISC. Naturalized plants have been found and removed in several locations at higher elevations, up to 3,200 ft (975 m) in relatively undisturbed mesic to wet forest areas.

Today, there is a lot less pampas grass being cultivated and many naturalized plants and some large infestations have been controlled. However, there are still a few yards with hedges of pampas grass and it continues to be found and controlled in the wild. Numerous single plants crop up on roads, pastures, gulches, and shrubland, wet forests, Haleakala Crater, Polipoli, and other places.

CONTROL METHODS

Physical control: Workers should protect themselves when manually removing *Cortaderia* as it has sharp serrated leaves that can cut unprotected skin. Seedlings and small plants can be hand pulled or dug up especially in loose ashy soils. It is somewhat harder to pull or dig up in lava and compounded soils. Larger plants can be removed by heavy machinery. Care should be taken to contain any seeds or flowering stalks and these should be double bagged and disposed of in the garbage or left on site.

Chemical control: Chemical control is employed for populations of pampas grass that can not be mechanically removed. Foliar applications of Roundup (4% solution) or Roundup Pro (2% solution) are effective in controlling pampas grass (DiTomaso 1999). Plants should be sprayed until wet but not to the point of run off. In wild areas, aerial spray by helicopter is employed. Leaving plants in place after spraying will result in less disturbance and may help reduce subsequent seedling germination in the area.

Biological control: No information was found on biocontrol for *Cortaderia*. Sugar cane and ranching both cultivate grasses and would likely be hesitant to release a biological control for Poaceae in Hawai'i. Unlike New Zealand, Hawai'i has no native *Cortaderia*.

Cultural control: The public could be informed not to plant pampas grass and other harmful pest plants.

Noxious weed acts: In Hawai'i, *C. jubata* is listed as a state noxious weed (HDOA 1992) and there are currently efforts being taken to add *C. selloana*. In Australia, *C. jubata* and *C. selloana* are both declared noxious in category W2 which means they must be continuously suppressed and destroyed in all south coast local government areas (Eurobodalla Shire Council 2003). Australia also lists *C. richardii* (New Zealand pampas grass) and *C. spp.* as noxious in category W2 (Weeds Australia 2000). In New Zealand, *C. jubata* and *C. selloana* are both prohibited from propagation, sale, and distribution (Haley 1997). In South Africa, *C. jubata* and *C. selloana* are considered category 1 restricted plants according to the amended regulations of the Conservation of Agricultural Resources Act 1983 (Stellenbosch 2003). These plants may not occur on any land or inland water surface other than in biological control reserves. Land users are required to control any of these category 1 plants that occur on any land or inland water surface.

MANAGEMENT RECOMMENDATIONS

C. jubata and *C. selloana* have become invasive in many places where they are cultivated including California, Hawai'i, New Zealand, Australia and South Africa. In Hawai'i, both *C. jubata* and *C. selloana* are cultivated as landscape plants. On Maui, *C. jubata* is known to be naturalized and recent evidence has shown that *C. selloana* is sparingly naturalized. *C. jubata* is currently listed as a Hawai'i state noxious weed and efforts are being made to add *C. selloana*. Both species have been targeted for control due to their deleterious effects on native and managed ecosystems in Hawai'i and elsewhere. On Maui, pampas grass readily invades both disturbed and intact areas, produces numerous seeds, and is capable of long distance wind aided dispersal. Pampas grass is capable of forming large infestations that can crowd out native plants and threaten many different ecosystems on Maui. It has been found deep in the rain forest under considerable shade as well as in several areas of the crater district of Haleakala National Park. On Maui, Pampas grass is relatively easy to find especially when flowering and many cultivated plants and infestations have been located and controlled. Continued early detection, mapping, control, and public education will be needed to prevent large infestations of pampas grass on Maui.

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