

‘SUNSHINE’
VETIVERGRASS
Chrysopogon zizanioides (L.)
Roberty
 Plant Symbol = CHZI

Contributed by: USDA NRCS Pacific Islands Area Plant Materials Program



Michael Robotham, USDA NRCS Pacific Islands Area State Office. ‘Sunshine’ with Bermudagrass used to stabilize waterway.

Alternate Names

Vetiveria zizanioides (L.) Nash; symbol=VEZI80
 English: kus-kus, cuscus, vetiver
 Fijian: mulimuli
 French: chiendent odorant, vetiver
 Hindi: garara, khas khas
 Maori (Cook Islands): ai, mauku ai
 Portuguese (Brazil): patchuli-falso
 Spanish: zacate violeta, pacholi
 Tamil: vetiver
 Tongan: ahisiaina

Vetivergrass is a perennial bunch grass with many uses. The ‘Sunshine’ genotype is described here. Sunshine is the domesticated type from South India and must be propagated asexually because it is non-fertile. It is the only vetivergrass recommended by NRCS and land-grant universities for use in the NRCS Pacific Islands Area (American Samoa, Federated States of Micronesia, Guam, Hawaii, Marshall Islands, Northern Mariana Islands, and the Republic of Palau).

Vegetative planting material of Sunshine was received by the Hoolehua Plant Materials Center from the Agricultural Research Service (ARS) Plant Introduction Station in Griffin, Georgia. Several official germination tests of 400 seeds per sample were conducted by the State of Hawaii Department of Agriculture in 1993 and 1994 on seeds harvested from observational plantings at Hoolehua, Hawaii and Barrigada, Guam. A seed germinated in one of the tests; however, the seedling did not survive after being transplanted from the blotters to soil and taken from the germinator to the greenhouse. In 1993, an unofficial test was also conducted by the Hawaii Department of Agriculture with 100 seeds in a vermiculite substratum and one seed germinated, but it did not survive for more than a week. For approximately the past 15 years, no volunteer seedlings have been observed from conservation plantings of Sunshine in the Pacific Islands Area. Sunshine was evaluated for invasiveness by the Hawaii-Pacific Weed Risk Assessment and Pacific Island Ecosystems at Risk. It received a low risk score (-8) for the potential to become invasive.

Uses

Erosion control: A vegetative barrier is a dense hedge or row of plants growing on or near the contour. Vetivergrass is well adapted to the vegetative barrier practice used to control erosion on farm land because of its strong, compact root system and numerous stiff stems. The stiff stems slow the movement of the silt-laden runoff, spreading it out, trapping sediment, and causing deposition of the silt behind the barrier. Slowing of the runoff allows more water to infiltrate into the soil. Water infiltration is also aided by the deep root system of the grass. Over time, a natural terrace-like bench is formed behind the barrier.

The standard minimum barrier width of a vegetative barrier for the Vegetative Barrier Practice (Conservation Practice Code 601) to reduce sheet and rill erosion and manage water flow is 36 inches. The Pacific Islands Area received a variance from the standard minimum width of 36 inches to 12 inches when using vetivergrass for vegetative barriers. Sunshine vetivergrass, when planted in a single row at the correct within-row spacing and with proper care, will form a functional vegetative barrier, 12 inches wide at a height of 6 inches, within one growing season. A minimum amount of crop land is devoted to these single-row vegetative barriers and

there is minimal competition with the crop plants because the root system grows essentially straight down.

Other conservation uses include road bank stabilization, stream bank stabilization, waterway stabilization, as a supporting ridge for diversions, and rehabilitation of degraded lands.

Phytoremediation and bioremediation: Vetivergrass has been shown to enhance the degradation of heavy metals such as aluminum, cadmium, chromium, copper, lead, and nickel and polycyclic aromatic hydrocarbons in the soil. It is used for wastewater treatment and rehabilitation of old mines.

Perfumery: Vetivergrass roots contain an essential oil that has been known in India since ancient times and considered a high-class perfume. Copper plate inscriptions have been found that list the perfume as one of the articles used by royalty. Vetiver oil is one of the ingredients in Chanel No. 5. The famous French perfume was introduced in 1921 and is still in production. The annual world trade in vetiver oil is estimated to be approximately 250 tons with Brazil, China, Haiti, India, Japan, Java, and Reunion being the main producers. Europe, India, Japan, and the United States are the main consumers. Vetiver oil is contained in 90% of all western perfumes and its greatest use is in modern perfume creations.

Other uses: A traditional medicine; an ingredient in curry; the roots are woven into various articles such as baskets and coarse mats and screens which are fragrant when wet; a biomass fuel for generating electricity; an ornamental; and as a potential trap crop for the stem borer (*Chilo partellus*).

Status

Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description

General: A densely tufted perennial grass. The culms or tillers arise from aromatic rhizomes, are erect, and up to eight feet tall. The rhizomes are short and do not runner out. The tillers are strong and stiff. There is very little lodging. Roots are stout, strong, spongy, and aromatic. The root system is massive, but quite compact and only grows out about 2 feet on each side of the plant. It can reach depths of over 8 feet. The leaves are narrow, erect, keeled, and the margins are rough to the touch. The inflorescence is a panicle (6-16 inches long) comprised of numerous slender

racemes in whorls on a central axis. The spikelets are gray green or purplish, 1/8-1/4 inch long, in pairs. The spikelets are awnless.

Distribution

For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

Adaptation

Vetivergrass is adapted to the tropics and subtropics. It is native to the tropical and subtropical areas of the Indian Subcontinent (India, Pakistan, Sri Lanka) and Indo-China (Indochina, Myanmar, Thailand). In the United States, vetivergrass is adapted to the USDA Plant Hardiness Zones 9 to 11. It is adapted throughout the Pacific Islands and Caribbean Areas. In Hawaii, where farmers grow crops over a wide range of elevations, vetivergrass appears to be adapted from sea level to about 4,000 feet. However, in trials at locations above 2,000 feet it had slower growth and a lower rooting percentage of slips.

Established vetivergrass plants have been known to persist in areas with annual rainfall from approximately 20 to 200 inches. Below 35 inches they may need supplemental moisture, particularly during extended dry seasons. Vetivergrass will grow on a wide variety of soils from sands to sandy loams and clays. It will grow on strongly acid to slightly alkaline soils with a pH range from 4 to 7.5; however, it prefers neutral to slightly alkaline soils. It tolerates saline soils and a range of heavy metals in the soil.

Establishment

Planting may be done either by hand or by a machine similar to the tractor mounted mechanical transplanters used to plant vegetable seedlings. Young plants are not shade tolerant and should be planted in a weed-free seedbed in full sun. The plantlets or slips must develop new roots and, therefore, must be kept moist until they have a good root system and are well established. The time of planting should be scheduled during the rainy season or irrigation provided. Drip irrigation works well with a drip line for each row or barrier. Anchor the drip tubing 12 to 18 inches to the upslope side of the row, so it doesn't become entangled in the grass clumps as this may cause the tubing to constrict and reduce the flow of water. Prior to planting, keep the slips in the shade and do not allow them to become dry.

Fertilize according to soil test results and recommendations. In some locations, a soil test with

fertilizer recommendations may be difficult to obtain. In lieu of a soil test, a general fertilizer recommendation is 6.5 pounds of 15-15-15 or similar fertilizer per 100 feet of row. To prevent fertilizer burn, apply the fertilizer in narrow bands 2 to 3 inches to the side and 1 to 2 inches below the slips. Alternatively, apply the fertilizer before planting the slips. Spread it evenly over the soil in a band 36 inches wide and thoroughly till it into the soil. Fertilizer is very important for normal growth, especially in infertile soils. Calcium in the form of lime and gypsum has also been shown to enhance growth.

Plant the slips 3 to 4 inches apart in the row. In fertile soils, or if well-rooted plants are used, they may be planted up to 6 inches apart. Double rows, with the plants staggered and spaced 3 to 6 inches within the row by 6 inches between rows, may be necessary in highly eroded areas. Constructing a furrow and planting on the berm will give more height to the planting, as well as a place for water to flow or pond until the barrier establishes. Deposition will take place upslope of the barrier, so installers need to be aware of how deposition will affect ponding and flow of water by the barrier. Plants can back up water 12 to 18 inches, so installers need to be aware of overflow and flow to point and provide protection for these areas. When planting vegetative barriers, follow the procedures outlined in the Vegetative Barrier (601) Conservation Practice Standard and Jobsheet.

Management

Irrigate and fertilize as needed and control weeds. It's important to properly care for the plants until they are completely closed-in and well established. The critical period for maintenance is usually during the first year. It's very important to replace dead plants as soon as possible as there should be no gaps in the barrier at the end of the first year. A vegetative barrier is not completely effective unless the plants have grown together and there are no gaps. When planting to fill in gaps, a new line of slips can be planted on the sun side of the original planting. Replacement slips planted in the same spot as the dead plants may be shaded by adjacent plants. If this occurs, the adjacent plants must be trimmed to prevent shading of the new slips. Trimming to a height of 15 to 20 inches when the plants reach a height of 4 feet will promote the development of new tillers.

With proper care, the plants should reach their maximum height after one year's growth. After the first year, annual trimming to a height of 15 to 20 inches is needed. Trimming can be done by hand

with a hedge clippers, a powered hedge trimmer, or a tractor mounted sickle bar or disc mower. The trimmings can be placed along the barrier to control weeds, help trap sediment and slow water, or they can be used to mulch the adjacent crop plants. Trimming will help prevent dead centers from forming in the grass clumps, reduce the severity of leaf diseases, and prevent a stem bending down into moist soil and rooting at a node. This can happen occasionally and the new plant that develops will cause the barrier to widen. When done purposely, this method of propagation is called layering and can be used to advantage when there is a gap between plants that needs to be filled.

Maintenance applications of fertilizer may be needed on infertile and shallow soils. Fertilizer can be applied broadcast, as a side dressing, or in the irrigation water.

The plants produce tillers and the row will gradually widen. Close tilling parallel to the vegetative barrier will keep it compact and should be done, so a minimum amount of land is taken out of crop production. Protect new plantings from grazing as domestic animals and wildlife will browse the grass in its early stages of growth. Vetivergrass is tolerant of fire and controlled burning can be used as a management tool to reduce the incidence of insect and disease pests and accumulation of dead material.

Pests and Potential Problems

Vetivergrass is relatively pest-free and is resistant to root-knot nematodes (*Meloidogyne* spp.). However, it is susceptible to attack by certain insects and diseases.

Insects: Stem borers (*Chilo* spp.) can attack vetivergrass. Stem borers are also a problem on corn, rice, and sugar cane in Asia and throughout east and southern Africa. This may actually be a potential use for vetivergrass. The stem borer moth (*Chilo partellus*) appears to prefer vetivergrass for oviposition but larval survival on vetivergrass is quite low. Thus, vetivergrass has the potential as a trap crop to concentrate oviposition away from the cash crop and reduce subsequent stem borer population development. In certain areas, termites will attack dead or dying parts of vetivergrass. The "hills" created by serious attacks can smother living plants.

Diseases: Vetivergrass is susceptible to the leaf blight caused by *Curvularia trifolii*.

Environmental Concerns

Vetivergrass is listed in the *Global Compendium of Weeds*. Vetivergrass genotypes that produce viable seed exist in certain areas and countries, such as the Caribbean and Australia, and are considered invasive weeds. The genotype “Sierra” was selected by NRCS Caribbean Area, after an evaluation of eight genotypes, as it is also essentially sterile. Those considered invasive should never be used for conservation plantings and are cause for concern. A short row of a fertile strain was observed growing on a ditch bank on the small island of Aunuu in American Samoa. The farmer uses the tops to mulch his taro. Although the plants have been growing for many years and haven’t spread, this strain should not be planted on the other islands in American Samoa.

A concern is that people may order vetivergrass plants over the internet or by mail order without knowing that fertile strains exist, and accidentally import one of these. This is a real concern for most areas. Hawaii is somewhat unique in that plants and other vegetative material of grasses entering the state must be quarantined for one full year in a State of Hawaii Department of Agriculture plant quarantine facility. The plants can not be used or out-planted until after they have been released from quarantine.

There is concern that the widespread use of a single clone, such as the Sunshine genotype, for conservation plantings could be a problem in the event of an attack by a very destructive insect or disease specific to the clone.

Plant Production

For large scale plant production, planting material is obtained mainly by splitting up older plants into plantlets or slips. For ease of digging, splitting, and cleaning, the plants should not be much older than 18 months of age. After two years, although no viable seed is produced, the plants begin to produce a significant amount of seed heads. These “seed head” slips do take although slips from plants that have not gone to seed generally produce new roots faster. Dead material can accumulate in the older plants, so cleaning the slips takes longer. In addition, older plants are harder to dig. New plantings should be scheduled in succession, so the plants being harvested are no older than 18 months. In a production nursery, the plants can be spaced 12 inches apart within the row. The rows can be 36 inches or more apart depending on the type of harvesting and planting equipment that will be used. For large scale production nurseries, the slips can be planted with a tractor mounted mechanical transplanter.

A front end loader, with a fork lift or similar attachment, or backhoe on a farm tractor can be used to lift the clumps out of the ground. A sharp disk plow or moldboard plow can also be used. The plants can also be dug by hand using a sharp shovel to cut through the rhizome tissue directly around the crown and approximately 4 to 6 inches below the surface of the soil. It’s easier to handle the harvested material if the tops are trimmed to between 12 and 20 inches before digging. Separate into individual slips with the rhizome tissue intact. Remove dead matter and trim the existing roots to approximately 1/2 inch. The slips are then cut to a uniform length of about 8 inches, washed, and packed for shipment to the planting site.

The slips should be planted within 48 hours after being dug up and prepared. They must not be allowed to become dry. They are similar to non-rooted cuttings in that they must produce new roots from the tissue at the base of the slip. Immersing the slips in water for a week until new roots start to develop will enhance establishment. The water should be changed daily or it may become rancid. A similar method of developing new roots is planting the slips in a box or bed of moist sand, cinders, or potting mix. The growing media should be 6 to 8 inches deep. After they have developed a sufficient amount of new roots, the slips are easily removed from the media, washed, and ready for field planting. The preferred method to enhance establishment rate is to grow the slips in polyethylene grow bags, dibble tubes, bamboo tubes, plastic pots, or similar containers. A novel type of container is a modified form of poly bag called planting strips. Instead of using individual bags, the slips are planted closely in polyethylene plastic lined furrows or troughs that are transported intact to the planting site. They are used when planting on difficult sites because, since the roots remain together, the survival rate is high. After 3 to 6 weeks in containers, the plants should have developed an adequate root system and be ready for planting in the field.

Other asexual propagation techniques are tissue culture, stem cuttings, and plantlets that develop at the stem nodes. Laying or inserting fresh cut pieces of stems or culms in moist sand under mist will cause roots and shoots to develop at the nodes. Vetivergrass plants that haven’t been trimmed will develop aerial plantlets at some of the stem nodes. When these are clipped off and immersed in water, they will develop new roots similar to slips.

Control

Vetivergrass can be killed by glyphosate herbicide, dense shade, and by digging up the crown. Please

contact your local agricultural extension specialist or county weed specialist to learn what works best in your area and how to use it safely. Always read label and safety instructions for each control method. Trade names and control measures appear in this document only to provide specific information. USDA NRCS does not guarantee or warranty the products and control methods named, and other products may be equally effective.

Cultivars, Improved, and Selected Materials (and area of origin)

It is generally accepted that there are basically two types of vetivergrass: the wild type from North India and the “domesticated” type from South India. The North India type produces fertile seed while the South India type is essentially sterile. Based on DNA fingerprinting data, it appears that almost all the non-fertile cultivars used for erosion control outside South Asia have been derived from the Sunshine genotype. For example, Sunshine and the following cultivars are genetically the same: Boucard, Fort Polk, Haiti, Huffman, Monto, and Vallonia.

Contact your local Natural Resources Conservation Service (formerly Soil Conservation Service) office for more information. Look in the phone book under “United States Government.” The Natural Resources Conservation Service will be listed under the subheading “Department of Agriculture.”

References

Adams, R.P. 2000. DNA Analysis of the Genetic Diversity of Vetiver and Future Selections for Use in Erosion Control. Second International Conference on Vetiver-ICV2, Thailand, January 2000. URL: http://www.vetiver.org/TVN_IVC2/PL-4.PDF

Carey, B. 2006. Monto Vetiver Grass for Soil and Water Conservation. Natural Resource Sciences, Queensland, Australia. Council of Scientific and Industrial Research (CSIR). 1976.

CRC for Australian Weed Management. URL: http://www.weedscrc.org.au/cropweeds/crop_weeds_v.html

Global Compendium of Weeds. URL: http://www.hear.org/gcw/species/vetiveria_zizanioides/

Greenfield, J.C. 1990. Vetiver Grass. The Hedge Against Erosion. 3rd ed. The World Bank, Washington, D.C.

Hawaii-Pacific Weed Risk Assessment. URL: http://www.botany.hawaii.edu/faculty/daehler/WRA/full_table.asp

National Research Council. 1993. Vetiver Grass: A Thin Green Line Against Erosion. National Academy Press, Washington, D.C.

Pacific Island Ecosystems at Risk (PIER). URL: http://www.hear.org/pier/species/chrysopogon_zizanioides.htm

Paquin, D., R. Ogoshi, S. Campbell, and Q.X. Li. 2002. Bench-Scale Phytoremediation of Polycyclic Aromatic Hydrocarbon-Contaminated Marine Sediment with Tropical Plants, International Journal of Phytoremediation, 4:4, 297-313.

USDA, ARS, National Genetic Resources Program. *Germplasm Resources Information Network – (GRIN)* (Online Database). National Germplasm Resources Laboratory, Beltsville, Maryland. URL: <http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?424704> (20 March 2009)

USDA, NRCS. 2009. The PLANTS Database (<http://plants.usda.gov>, 17 March): National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Van den Berg, J., C. Midega, L.J. Wadhams, and Z.R. Kahn. 2003. Can Vetiver Grass be Used to Manage Insect Pests on Crops? Third International Conference on Vetiver-ICV3, Guangzhou, China, October 2003. URL: http://www.vetiver.org/ICV3-Proceedings/SA_stem%20borer.pdf

Vetiveria. The Wealth of India, Vol. X. Publications and Information Directorate, CSIR, New Delhi, PP.451-457.

Vetiver Network International. URL: <http://vetiver.org>

Prepared By: Robert J. Joy, USDA NRCS Plant Materials Center, Hoolehua, Hawaii

Species Coordinator: Robert J. Joy, USDA NRCS Plant Materials Center, Hoolehua, Hawaii

Edited: 090329 isp; 090515 jsp

For more information about this and other plants, please contact your local NRCS field office or Conservation District, and visit the PLANTS Web site <<http://plants.usda.gov>> or the Plant Materials Program Web site <<http://Plant-Materials.nrcs.usda.gov>>

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer."

Read about [Civil Rights at the Natural Resources Conservation Service](#).