Chloris gayana

Scientific name
Chloris gayana Kunth

Synonyms
Chloris abyssinica Hochst. ex A. Rich.

Family/tribe

Common names
Rhodes grass (Australia, United States, Africa); chloris, herbe de rhodes (French); rhodasgras (German); capim-de-rhodes (Portuguese); grama de rodas, pasto de rodas (Spanish); pasto rhodes (Peru); koro-korosan, banuko (Philippines); ya rot (Thailand); tucgiéân (Vietnam); zacate gordura; banuko; abu raseya; erigaru; of'piripiri-andoi.

Morphological description
Tufted perennial, usually stoloniferous (varies with genotype), with foliage from 0.5-1.2 m, and fertile tillers from 0.9-2 m tall. Can act as an annual in regions with extremely cold winters or long dry seasons. Stolon stems 4-5 mm diameter, fertile stems 2-4 mm diameter. Leaves glabrous, with 2-3 mm long hairs near the collar; blades (12.5-) 25-50 cm long, and (1.5-) 3 to >9 mm wide, tapering to a fine, pointed apex. Inflorescence a digitate (single whorl) or subdigitate (double whorl), comprising (3-) 6-15 (-20) ascending or spreading, spike-like racemes 4-15 cm long, usually light, greenish brown (rarely yellow) in colour, ripening to darker brown. Spikelets about 3.5 mm long, comprising 3-4 florets, usually one perfect with 1-10 mm long awn, and another, male, with 1.5-5.5 mm long awn (awn length can be useful in cultivar differentiation), sometimes all florets hermaphrodite and fertile. 4 million seeds (spikelets)/kg for 'Katambora', and 7-10 million for most other varieties. Caryopsis brown, c. 2 mm long, 0.5 mm wide, separating readily from the spikelet in some varieties, about 2 million/kg. Roots to 4.7 m deep, but sparse beyond 2.4 m.

Distribution
Native to:
Other:
Widely naturalised in Africa (exact native range obscure) and elsewhere in the tropics and subtropics.
Found in open woodland and grassland, riverine and lake margins, and seasonally waterlogged plains, on a wide range of soils.

Uses/applications
Used in permanent pasture or as a short- to medium-term pasture ley to restore soil structure, improve organic matter levels, and reduce nematode numbers. Can also be under sown into maize. Makes good hay if cut at or just before very early flowering. Generally not suitable for silage. Provides fair standover roughage when mature, better than Cenchrus ciliaris and Panicum maximum due to its greater cold resistance and lower loss of dry leaves. Develops good ground cover and effectively controls erosion once established (needs regular defoliation to maintain cover). Also effectively suppresses woody regrowth provided trees and shrubs are not well established prior to planting the grass.

Ecology
Soil requirements
While preferring well-structured loams and clays of volcanic origin, it grows on most well drained soils, except very heavy clays, provided fertility is adequate. Very tolerant of high soil Na levels (conductivity >10 dS/m), particularly as HCO$_3^-$ and SO$_4^{2-}$, but less so as Cl$^-$ or NO$_3^-$. Also tolerant of high Li$^+$ but not Mg$^{2+}$. More tolerant of high than low pH, growing best in soils with pH between about 5.5 and 7.5, but will grow down to pH 4.5 and up to 10. Intolerant of high soil manganese.

Moisture
Rainfall in its natural range varies from about 500-1,500 mm/yr. In cultivation, it is usually planted in areas with rainfall from 700-1,200 mm, but has been successful at lower annual averages. It does not thrive in areas with more than 1,800 mm rainfall. It is popular in irrigated pastures, particularly where irrigation water may be too saline for other species. Drought tolerance is less than that of Cenchrus ciliaris and Panicum maximum, but can still survive in areas with a 6-month dry season, by virtue of a root system that can extract water to a depth of >4 m. Tolerates seasonal waterlogging, and up to 15 days' flooding.

Temperature
Occurs from near sea level to 2,000 m in the tropics, and sea level to >1,000 m asl in the subtropics, and from near the equator to 34.5ºS. This equates to a range in average annual temperatures from about 16.5°C to >26°C. This wide geographical and thermal distribution is probably reflected in the variable reports in the literature for optimum growing temperatures, ranging from 20-37°C, with
extremes of 5º and 50ºC. Sufficient to say that within the germplasm available, there are types that can produce significant growth at relatively low temperatures, even showing significant frost tolerance, and types that can grow at high temperatures. Low night temperatures in controlled environments reduced seed set in 'Callide' and 'Pioneer'.

**Light**

Generally poor shade tolerance.

**Reproductive development**

Flowering behaviour varies with ploidy level. The diploids (2n = 20) are generally insensitive to daylength and flower throughout the growing season. The tetraploids largely respond to shortening daylength, and although a few inflorescences are produced throughout the growing season, there is a flush of flowering when daylength falls below 12 hours. In the southern hemisphere subtropics, this equates to an intense flowering in mid-April, and another post-winter in October/November.

**Defoliation**

Stands develop quickly and can be grazed 4-6 months after planting, although highest production is reached in the second year. Growth commences early in spring. Since feeding value declines rapidly with onset of flowering, it is important to maintain the stand in a leafy condition by fairly regular defoliation. The late flowering tetraploid varieties give more flexibility in this regard. *Chloris gayana* is tolerant of heavy grazing, but production is reduced by very frequent defoliation (e.g. 14 day v. 28 day). Makes good hay if cut at or just before very early flowering, giving up to 6, 25- to 50-day harvests.

**Fire**

Recovers well after fire.

**Agronomy**

Guidelines for the establishment and management of sown pastures.

**Establishment**

Can be propagated vegetatively or from seed. Planting material can be obtained by breaking up larger clumps into pieces, or using the small tussocks along the stolons that establish readily. Either is planted on about a 1 m grid. A more rapid cover can generally be obtained by planting from seed, usually at sowing rates of 0.5-1 kg/ha. Seed of the diploids has little or no post-harvest dormancy, while seed of the tetraploids may not reach maximum germination for 3-6 months (sometimes up to 18 months) after harvest. Seed is best obtained by planting from seed, usually at sowing rates of 0.5-1 kg/ha. Seed of the diploids has little or no post-harvest dormancy, while seed of the tetraploids may not reach maximum germination for 3-6 months (sometimes up to 18 months) after harvest. Seed is best obtained by planting from seed, usually at sowing rates of 0.5-1 kg/ha. Seed of the diploids has little or no post-harvest dormancy, while seed of the tetraploids may not reach maximum germination for 3-6 months (sometimes up to 18 months) after harvest. Seed is best obtained by planting from seed, usually at sowing rates of 0.5-1 kg/ha. Seed of the diploids has little or no post-harvest dormancy, while seed of the tetraploids may not reach maximum germination for 3-6 months (sometimes up to 18 months) after harvest. Seed is best obtained by planting from seed, usually at sowing rates of 0.5-1 kg/ha.

**Fertiliser**

Although *Chloris gayana* can survive on infertile soil, it is very unproductive, and may eventually die out, particularly if grazed regularly. Responds to phosphorus in poorer soils, and gives a linear yield and crude protein response of up to 300 kg/ha of nitrogen if other nutrients are adequately supplied. Split applications, each of 50-100 kg/ha N, are normally used when economically feasible.

**Compatibility (with other species)**

Grows well with temperate and tropical legumes, by virtue of its open stoloniferous ground cover.

**Companion species**

Grasses: *Cenchrus ciliaris*, lower growing *Panicum maximum* cultivars (e.g. Petrie, Gatton), *Setaria sphacelata*. Legumes: *Centrosema pubescens*, *Clitoria ternatea*, *Desmodium uncinatum* *Neonotonia wightii*, *Lotononis bainesii*, *Macroptilium atropurpureum*, *Medicago sativa*, *Stylosanthes guianensis*, *Trifolium repens*.

**Pests and diseases**

While the following fungi and nematodes have been isolated from the grass, they rarely have any economic impact.

**Fungi**

*Aspergillus flavus*, *Cerebella andropogonis*, *Cladosporium* sp., *Claviceps* sp., *Cochliobolus heterostrophus*, *Cochliobolus chloridis* (leaf blight) *Drechslera australiensis* (drechslera leaf spot), *Fusarium equiseti*, *F. gramineum* (smut), *F. oxysporum*, *Helminthosporium carbonum*, *Himaydis* sp., *Nigrospora sphaerica*, *Puccinia chlorides*, *Pythium aphanidermatum*, *Rhizoctonia solani* ('summer blight'), *Tolyposporium chlorides*, *Trichoderma* sp., and *Uromyces kenensis*.

**Nematodes:** *Helicotylenchus dihystera*, *H. nannus*, *H. pseudorobustus*, *H. cavenessi*, *Hemicyclichora truncata*, *Hoplolaimus pararobustus*, *Meloidogyne acronea*, *M. incognita acrita*, *M. javanica*, *Pratylenchus brachyurus*, *Rotylenchulus reniformis* (reniform nematode), *Scutellonema clathricaudatum*, *Trichodorus minor*, *Tylenchus spiralis*, *Xiphinema elongatum*, *X. italicum*. 'Katamba' and 'Nemkat' are resistant to *Rotylenchulus reniformis*, and are used in pasture leys to reduce nematode populations in preparation for succeeding crops.

*Chloris striate mosaic virus*, which may also attack *leuocosperum unisetus*, *Dactylis glomerata*, *Triticum* ssp., *Avena sativa*, *Hordeum vulgare*, and *Zea mays* is transmitted by *Nesoculthua (obscura) pallida* (Cicadellidae), and may be carried in the seed. Insect pests include fall armyworm (*Spodoptera frugiperda*), larvae of *Mocis latipes*, (both *Lepidoptera: Noctuidae*), the lesser corn-stalk...
borer (Elasmopalpus lignosellus), rhodes grass scale or rhodes grass mealybug (Antonina graminis), chinch bugs (Hemiptera: Lygaeidae: Blissus spp.) and the two-lined spittle bug (Homoptera: Cercopidae:Prosapia bicincta). Some of these can severely damage stands if conditions are suitable. The angiosperms, Striga lutea and S. asiatica, parasitise Chloris gayana.

Ability to spread

Spreads vegetatively by "looping" stolons and by seed that is readily carried by wind or by adhering to animal fur. Some varieties are more strongly stoloniferous than others. It is widely naturalised, found on roadsides and other areas of disturbance throughout the tropics and subtropics.

Weed potential

Chloris gayana invades disturbed ground and can be a weed of cultivation. However, it usually dies out after 4-5 years if not further disturbed or fertilised, and rarely invades natural areas.

Feeding value

Nutritive value

Crude protein levels vary with age of material and level of available nitrogen, and may range from 17% on a (DM basis) in very young leaf, to 3% in old leaves e.g. 'Callide' yielded 6 t/ha (52% leaf, 9% CP) cut at 7 weeks, 11 t (28% leaf, 5% CP) at 13 weeks, 12 t (30% leaf, 3% CP) at 22 weeks and 14 t (20% leaf, 3% CP) at 27 weeks. Phosphorus levels in the DM also vary with age of material and available soil phosphorus, and may range from 0.4% in young growth to 0.1% in older material. Similarly, IVDMD varies from 40-80%. Sodium levels vary from 300-3,100 ppm , depending on variety.

Palatability/acceptability

Young growth is very palatable, but after the plants have seeded they are less attractive. Tetraploids are generally more readily eaten than diploid varieties, particularly when mature.

Toxicity

No record of toxicity. Levels of oxalate in the DM are low, making this an ideal species for horse pastures, although there are some suspicions that it may cause skin troubles. If indeed it does, this is not a common problem.

Production potential

Dry matter

DM yields generally range from about (2-) 10-25 t/ha, depending on variety, soil fertility, environmental conditions, and cutting frequency. Yields in the second year may be double those of the establishment year, but this also depends on management and environmental conditions. While yields of 35-60 t/ha DM are reported, these are not the norm.

Animal production

Can carry about 1-4 beasts/ha depending on pasture productivity. Annual liveweight gains of up to 160 kg/head and 850 kg/ha are achievable. Production declines without a vigorous legume or the use of fertiliser nitrogen.

Genetics/breeding

2n = 20, 30, 40. Primarily cross-pollinating, with only 1-4% self-compatibility. This can lead to "genetic drift" in seed crops.

Seed production

With the diploids that are largely daylength insensitive, up to 3 crops per year are possible, depending on growing conditions. With the tetraploids, 2 crops per year are possible, but the early season crop is generally fairly light and may not be economically feasible. All standing material is cleaned off to (10 cm stubble about 2 months prior to flowering, and the area fertilised with 50 kg/ha N on fertile soils, or 100-150 kg/ha N on infertile soils. Seed matures 23-25 days after flowering. Mechanically harvested seed can contain a fair proportion of straw. Hand picking is satisfactory for small areas, and this seed needs minimal cleaning. The diploid cultivars, 'Pioneer' and 'Katambora', produce more florets/year and higher seed set than the tetraploids, 'Callide' and 'Samford'. Potential seed yield for 'Callide' is about 850 kg/ha. Mechanically harvested yields of 100-200 (-300) kg/ha can be achieved from properly managed crops. Mature seed may have some post-harvest dormancy (see "Establishment"), and should remain viable for up to 4 years depending on environmental conditions (best at low humidity, low temperature ).

Herbicide effects

Susceptible to pre-emergence atrazine. Even when mature, it is readily controlled with the selective grass herbicide, haloxyfop. Weakened, but not killed by glyphosate at normal rates.

Strengths

- Widely adapted.
- Easily established.
- Early nutritive value.
- High salt tolerance.
- Tolerant of heavy grazing.
- Few pests or diseases of economic importance.
- Some varieties can suppress nematodes (e.g., cv. Katambora).
- Good seed production.

**Limitations**
- Short season of nutritive peak in many cultivars.
- Fluffy seed difficult to sow.
- Not adapted to acid, infertile soils.
- Plants require high fertility to persist.
- Low shade tolerance.

**Other comments**

**Selected references**


**Internet links**

- [http://www.hort.purdue.edu/newcrop/duke_energy/Chloris_gayana.html](http://www.hort.purdue.edu/newcrop/duke_energy/Chloris_gayana.html)

<table>
<thead>
<tr>
<th>Cultivars</th>
<th>Country/date released</th>
<th>Details</th>
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<tbody>
<tr>
<td>'Asatsuyu'</td>
<td>Japan (1995)</td>
<td>Developed by Kagoshima Prefectural Agricultural Experiment Station. A synthetic cultivar comprising 7 clones selected from 'Fords Katambora 8189' and 'Gunsons'. An early-flowering diploid of medium growth form; more upright, with fewer stolons and wider leaves than 'Katambora'. Similar flowering time to 'Hatsunatsu', which is approximately two weeks earlier than 'Katambora' at 31.9ºN. More tolerant of cool temperatures than 'Katambora' and 'Hatsunatsu', with vigorous growth in both cool and warm seasons, producing higher yields than 'Katambora'. Selected for use in southern part of Japan, including Kyushu and the subtropical islands.</td>
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<tr>
<td>'Belf'</td>
<td>USA (1966)</td>
<td>Developed from naturalised and introduced varieties in southern Texas. Selected for resistance to rhodes grass scale. Has also proven nematode resistant.</td>
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<tr>
<td>'Boma'</td>
<td>Kenya (1975)</td>
<td>Tetraploid, early-flowering selection from 'Masaba'.</td>
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<tr>
<td>'Callide'</td>
<td>Australia (1963)</td>
<td>A tetraploid. Tall, leafy, late maturing type. Coarser in appearance than the fine-leaved 'Katambora', 'Pioneer', and 'Samford'. Readily distinguished from other varieties by virtue of long awns (6-9 mm) and a long tuft of hairs at the awn base. Very palatable to cattle even when mature. Responds well to nitrogen. More frost tender than 'Katambora'. Flowers primarily when daylength falls below 12 hours, and is slightly earlier than 'Samford'. Same as 'Giant', 'Mwpawpa', and 'Kongwa'.</td>
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<tr>
<td>'Elmba'</td>
<td>Kenya (1975)</td>
<td>Selected from 'Mbarara' for early maturity (increased seed yields), increased biomass and pure germinating seed content.</td>
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<tr>
<td>'Finecut'</td>
<td>Queensland, Australia (1993)</td>
<td>Synthetic variety derived from two distinctly different naturalised populations of 'Katambora'. Selected for dry matter production, early uniform flowering, and dense upright growth for hay production. Makes good, palatable hay, but is not grazed as well as 'Callide' in the field.</td>
</tr>
<tr>
<td>'Giant'</td>
<td>Zimbabwe (1942)</td>
<td>See 'Callide'.</td>
</tr>
<tr>
<td>'Hatsunatsu'</td>
<td>Japan (1988)</td>
<td>Derived from 42 accessions: produced by inter-crossing of 16 selected clones, after 3 maternal line selections. An early flowering, high yielding diploid, with wide, upright leaves, and large stolons, flowering 2 weeks earlier than 'Katambora' in Japan. No longer commercially available, it has been replaced by 'Asatsuyu' for for grazing and haymaking in southern part of Japan, including Kyushu and the subtropical islands.</td>
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<tr>
<td>'Karpedo'</td>
<td>Kenya</td>
<td>Selected for drought tolerance.</td>
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<tr>
<td>'Katambora'</td>
<td>Zimbabwe (1951)</td>
<td>A diploid. Probably originally from Katombora, Zambia, (17.8ºS, 700 m asl, rainfall 740 mm). Leafy, densely growing, with long, relatively thin stolons. Later maturing and a more vigorous stoloniferous habit than in 'Pioneer': leaves and culms finer, and less tendency to become tussocky. Selected for drought tolerance and very rapid growth rates. Higher spring and summer yields than those of 'Pioneer'; more persistent under grazing. High seed production. Establishes and covers rapidly and persists well, even at low fertility. Nematode resistant types (see 'Nemkai').</td>
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<tr>
<td>'Kongwa'</td>
<td>Tanzania (1950s)</td>
<td>Similar or identical to 'Callide'.</td>
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<tr>
<td>Promising accessions</td>
<td>Country</td>
<td>Details</td>
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<td>ILCA 6627</td>
<td>Shika, Nigeria</td>
<td>Highest mean yields over 3 years.</td>
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<tr>
<td>PI 283217, CPI 16663</td>
<td>Gainesville, Florida</td>
<td>Highest yielding of 350 lines tested.</td>
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<tr>
<td>ATF 3964</td>
<td>Australia</td>
<td>From Tsawing, Soutpan, 40km NNW of Pretoria, South Africa; 1,400 m asl; 600mm rainfall. Fine leaved type to 100 cm tall; dense stand surrounding sodic lake, in silty loam, pH 10.0. May have superior alkali or salt tolerance to other varieties. Probably the same as the type mentioned in FAO Grassland Index (link above) as originating from Hammarskraal.</td>
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</table>
Regrowth of cv. Callide in fertile situation.

Seedcrop of cv. Callide in northern Australia.

Harvesting seed of cv. Finecut in northern Australia.

Cattle grazing a Chloris gayana and Trifolium repens cv. Haifa pasture.

Haymaking following a seed harvest in northern Australia.

cv. Callide and Neonotonia wightii cv. Tinaroo in northern Australia.