

Tropical Forages

Setaria sphacelata

Scientific name



Setaria sphacelata (Schumach.) Stapf & C.E. Hubb.

Subordinate taxa:

Setaria sphacelata (Schumach.) Stapf & C.E. Hubb.
var. *anceps* (Stapf) Veldkamp

Setaria sphacelata (Schumach.) Stapf & C.E. Hubb.
var. *aurea* (Hochst. ex A. Braun) Clayton

Setaria sphacelata (Schumach.) Stapf & C.E. Hubb.
var. *sphacelata*

Setaria sphacelata (Schumach.) Stapf & C.E. Hubb.
var. *splendida* (Stapf) Clayton

Setaria sphacelata (Schumach.) Stapf & C.E. Hubb.
var. *torta* (Stapf) Clayton

Synonyms

var. *anceps*: Basionym: *Setaria anceps* var. *sericea* Stapf; *Setaria almaspicata* de Wit; *Setaria anceps* Stapf; *Setaria anceps* var. *anceps* Stapf; *Setaria sphacelata* var. *sericea* (Stapf) Clayton

var. *aurea*: Basionym: *Setaria aurea* Hochst. ex A. Braun; *Chaetochloa aurea* (Hochst. ex A. Braun) Hitchc.; *Setaria trinervia* Stapf

var. *sphacelata*: Basionym: *Panicum sphacelatum* Schumach.; *Setaria flabellata* Stapf; *Setaria neglecta* de Wit; *Setaria perennis* Hack.; *Setaria sphacelata* var. *stolonifera* de Wit

var. *splendida*: Basionym: *Setaria splendida* Stapf

var. *torta*: Basionym: *Setaria torta* Stapf

Family/tribe

Family: *Poaceae* (alt. *Gramineae*) subfamily: *Panicoideae* tribe: *Paniceae* subtribe: *Cenchrinae*.

Morphological description

Perennial tussock; rhizomes short or elongated, culms 20–300 cm tall, erect or decumbent at base, usually branched from the lower and middle nodes; culm-nodes glabrous. Leaf sheaths keeled, glabrous, the margin hyaline. Leaves bluish grey-green; leaf blades 7–0 (–80) cm long; 3–20 mm wide, soft, glabrous to slightly hairy on both surfaces, margin entire, apex acuminate; ligule membranous, fringed with hairs, 1–2 mm long, membrane 0.8–1.5 mm long, cilia 0.2–1.5 mm long. Inflorescence a tightly contracted panicle producing a false spike, 3–30 (–50) cm long and about 8 mm wide (excluding the dense, radiating golden-yellow bristles), panicle axis tomentellous; spikelets subtended by an involucre; fertile spikelets sessile, 1–4 in the cluster;



S. sphacelata var. *anceps* x *splendida* cv. Splenda



Many tillered tussock growth habit



Leaves folded in bud; leaf sheaths keeled, glabrous



Inflorescences; tightly contracted panicle producing a false spike



Long inflorescences on var. *splendida*



Shorter inflorescences on var. *anceps*



Inflorescence with feathery purple stigmas and white stamen filaments (stigmas white in cv. Nandi)



Seed units

involucral bristles persistent, 1.5–12 mm long, 6–15 in principal whorl, flexible; antrorsely scaberulous, glabrous. Spikelets elliptic, moderately dorsally compressed, 1.5–3.5 mm long, comprising 1 basal sterile floret + 1 fertile floret, without rhachilla extension, stigmata purple or white. Spikelets falling entire when mature. Seeds average about 1.5 million per kg.

Setaria sphacelata is a polymorphic species and differences among the recognized varieties are largely relative and often environmentally influenced.

var. anceps: Culms 4–10-noded, 3–6 mm in diameter at base, 100–200 cm tall. Blades 3–10 mm wide. Panicle 7–25 cm long.

var. splendida: Culms 6–16-noded, 6–12 mm in diameter at base, 180–300 cm tall. Blades 10–20 mm wide. Panicle 20–50 cm long.

var. aurea: Culms 2–7-noded, 1.5–6 mm diameter, 30–50 (–150) cm tall. Blades 2–7 mm wide (often hairy). Panicle 5–35 cm long.

var. sphacelata: Culms 2–4-noded, 1–3 mm in diameter at base, 40–100 cm tall. Blades 2–5 mm wide. Panicle 3–15 cm long.

var. torta: Culms 2–4-noded, 1–2 mm diameter, occasionally flat and rooting at nodes, 30–80 (–100) cm tall. Blades 1–4 mm wide. Panicle 1–10 cm long.

Common names

Africa: gewone mannagras, gewone setaria, goue mannagras, kanariegras, katstertmannagras, kruipmannagras, ou land gras (Afrikaans); kleinkuipmannagras, kruipgras (var. *torta*, Afrikaans); orutaratumba (Runyankole/Rukiga, Uganda); amachomesi (Gisu, Uganda); cununo (also *S. incrassata*), quisumbe (Niassa, Mozambique); likonge (Shishambyu, Namibia), makonge (Rumanyo Namibia); umFushlo, ikununu, umpuhlo (Zulu, South Africa); umfuhlo (Swaziland)

Asia: Kezun grass (India); rumput lampung, rumput setaria lampung, rumput setaria, rumput splendida (Indonesia); sekoi (Malaysia, also *S. italica*); bunga-bunga (Philippines ?); ya taiwan (Thailand); ya cõ đuôi chó, đuôi chõn vàng, tở vĩ, cõ sáu róm vàng (Vietnam)

English: African bristle grass, African pigeon grass, broadleaf setaria, canary seed grass, common setaria, dog's tail, golden bristle grass, golden millet, golden setaria, golden Timothy, pigeon grass, Rhodesian grass, setaria, South African pigeon grass; giant setaria, splendid(a) bristlegass (var. *splendida*), small creeping foxtail (var. *torta*)

French: queue de chien, séttaire géante (var. *splendida*), séttaire queue de chien

Latin America: capim do Congo, capim marangá, capim-setária, napierzinho (Portuguese); cola de perro, fleo dorado, mijo silvestre, pasto San Juan, pasto miel,



Line illustration



Seed crop cv. Kazungula, Queensland Australia



Seed crop, north Queensland Australia



Tiller can be used for vegetative propagation



With Greenleaf and Silverleaf desmodium in leniently grazed pasture, SE Queensland Australia



With Greenleaf desmodium in intensively grazed pasture, south-east Queensland Australia



With *Neotonotia wightii* cv. Cooper in leniently grazed pasture, south-east Queensland Australia (cv. Nandi)



With *Neotonotia wightii* cv. Cooper, north Queensland Australia (cv. Kazungula)



With cv. Siratro (cv. Nandi)



var. *splendida* under grazing, West Java, Indonesia

rabo de cachorro, setarea, setária, setaria gigante (var. *splendida*), zacate setaria, San Juan (Spanish)

Distribution

var. *anceps*

Native:

Africa: Angola; Benin; Botswana; Burkina Faso; Cameroon; Democratic Republic of the Congo; Côte d'Ivoire; Ghana; Guinea-Bissau; Kenya; Mali; Mauritania; Namibia; Nigeria; Senegal; Sierra Leone; South Africa; Swaziland; Tanzania; Togo; Uganda

Cultivated/naturalized:

Asia: China; Indonesia; Laos; Malaysia; Taiwan; Vietnam

Australasia: Australia (New South Wales, Northern Territory, Queensland)

Northern America: Mexico

Central America: Costa Rica; El Salvador; Honduras; Nicaragua

South America: Argentina (Chaco, Corrientes, Misiones, Salta); Brazil (Rio Grande do Sul, Santa Catarina); Paraguay (Amambay, Canendiyu, Itapua); Peru; Uruguay (Florida, Soriano)

Pacific: Hawaii

var. *splendida*

Native:

Africa: Kenya; South Africa (Cape Province, KwaZulu-Natal); Sudan; Tanzania; Uganda; possibly native elsewhere in East Africa

Cultivated:

Africa: Africa (e.)

Asia: Indonesia; Malaysia; Nepal

Australasia: Australia (Queensland, New South Wales)

Note: Only var. *anceps* and var. *splendida* have been brought into cultivation to any extent.

Uses/applications

Forage

Permanent pasture for grazing and is popular among farmers for cut-and-carry systems because of comfort of handling by virtue of the soft foliage and absence of foliar bristles. It ensiles well and finer types are suitable for hay.

Environment

Forms stable groundcover for soil conservation, particularly along waterways where soil might be too moist for other grasses.

Other

Seed is considered famine food for humans, but is only used after boiling for 5 minutes before grinding. Seed is sought by birds.

Ecology

Soil requirements

Most commonly found on soils with texture ranging from sand to clay loam and light clay, but will also grow on heavy clay if moisture is adequate. Survives low fertility conditions but responds to improved fertility particularly in relation to nitrogen and phosphorus, and sometimes potassium, in low fertility soils. Not well adapted to alkaline or very acid soils, most wild collections coming from soils of pH 5.5–6.5. Generally low salt tolerance.

Moisture

Found on a wide range of habitats from wet areas (e.g. riparian land, swamp margins) to dry rocky hillsides. Although mostly growing naturally in areas with rainfall down to about 750 mm/yr, it is generally only sown where annual rainfall exceeds 1,000 mm. It is more tolerant of waterlogging and flooding than many other tropical grasses, but generally less drought tolerant than species such



Soft foliage ideal for cut-and-carry, Indonesia



In use as hedgerows

as *Megathyrus maximus* and some *Urochloa* spp. While *S. sphacelata* can survive long dry seasons, it is best with short or no dry season. Leaf reddening often associated with moisture stress. Var. *splendida* is mostly cultivated in areas with rainfall above 1,500 mm/yr, although like var. *anceps*, it can still be productive in lower-lying moist areas where the rainfall is >1,000 mm.

Temperature

Best suited to non-equatorial conditions. Found in its native environment from sea level to 3,300 m, most commonly between 600 and 2,700 m asl. High altitude collections mostly come from near the equator in Kenya and Uganda (average annual temperature c. 20 °C), although one collection from 32.4° S in South Africa was found at 1,150 m asl where average annual temperature is about 15 °C. In general, *S. sphacelata* grows best at about 18–22 °C. Moderate early season growth in the subtropics and upland tropics, with 'Narok' and 'Solander' producing up to four times the cool season yield of the other cultivars. Frost tolerance varies with provenance/cultivar, with 'Narok' and 'Solander' the most frost tolerant, sustaining little leaf damage at grass temperatures down to -3 °C (similar to *Paspalum dilatatum*). 'Kazungula' is more cold tolerant than 'Nandi' in which plants are killed at -4 °C. Var. *splendida* is generally better adapted to the tropics than is var. *anceps*.

Light

Low to moderate shade tolerance, producing to 60–70% of full light yield at 50% light. It is not well-suited to growing under even moderately dense tree canopies.

Reproductive development

Flowering time varies markedly with strain and area of origin. 'Nandi' begins flowering in December (early summer) in the subtropics of Australia, continuing through to April or May, with a peak of flowering in January. 'Kazungula' flowers about a month later. Var. *splendida* is generally later flowering than var. *anceps*.

Defoliation

Persists under frequent cutting or grazing, but requires controlled management to achieve optimum productivity. If continuously grazed heavily, setaria is replaced by stoloniferous/rhizomatous grasses such as *Digitaria didactyla* and *Paspalum notatum*. It declines more rapidly if soil N status is low. For the best combination of regrowth and quality, particularly important in dairying systems, var. *splendida* should be cut at 30–45 cm at least every 30 days; maximum regrowth was measured in the Philippines cutting at 45 cm every 60 days.

Fire

Mostly not burnt, but will survive the occasional fire. Higher basal area and tiller number can be achieved under late burning compared with early or no burning.

Agronomy

Guidelines for establishment and management of sown forages.

Establishment

Fresh seed is dormant and should be stored for at least 2 months before sowing. *S. sphacelata* is normally sown at 2–5 kg/ha. Like many small-seeded tropical grasses, seedlings are slow to develop, although the more robust cultivar, 'Kazungula', establishes more rapidly than other cultivars. Var. *splendida* produces little or no viable seed and is normally planted from rooted tillers; clumps/splits are topped to about 15 cm and separated into pieces each with 2–3 tillers; planting material should be freshly prepared and not allowed to dry out; they are planted with tops exposed on a grid from 70 × 90 cm to 45 × 100 cm. Wider row spacing can be used to conserve planting material; when rows are established and plants are tall enough, they can be rolled flat to facilitate nodal rooting and sward formation. Var. *anceps* is also readily established vegetatively.

Fertilizer

Normally planted with a basal NPK dressing. Setaria competes strongly for nutrient and potassium uptake is very high; regular applications of K fertilizer may be necessary in low K soils to maintain vigour of the setaria and the associated species. Responds well to nitrogen, producing about 30 kg DM and 3 kg CP per kg N applied.

Compatibility (with other species)

S. sphacelata is a very competitive species, suppressing most weeds once established. In the first season, it can be suppressed by short-lived weeds, but assumes dominance in the second or third year. Setaria combines well with legumes if soil fertility, particularly potassium, is maintained, but will suppress legume if not well managed or well fertilized with P and K. N fertilizer increases competitiveness of the grass. Var. *splendida* and 'Kazungula' are more competitive than other cultivars/varieties.

Companion species

Grasses: Normally not sown with other grasses.

Legumes: Less intensive management systems: *Centrosema molle*, *Desmodium intortum*, *D. uncinatum*, *Macroptilium atropurpureum*, *Neonotonia wightii*. More intensive management systems: *Arachis pintoi*, *Lotus uliginosus*, *Trifolium repens*, *Vigna parkeri*.

Pests and diseases

Leaf spot caused by *Pyricularia grisea* affects 'Nandi' and 'Narok' under hot, humid conditions but usually not 'Kazungula'. Fungal diseases caused by *Tilletia echinosperma* (bunt) in Kenya and *Sphacelotheca* sp. and *Fusarium nivale* var. *majus* in DRC can seriously reduce seed crops. The buffel grass seed caterpillar (*Mampava rhodoneura*) can also damage seed crops. Attacked by insects such as army worm (*Pseudaletia convecta* in Australia and *Spodoptera exempta* in Africa) that attack other tropical grasses. Var. *splendida* is not seriously affected by pests or diseases.

Ability to spread

Var. *anceps* spreads effectively by seed, readily colonising disturbed areas such as roadsides. Var. *splendida* mostly sets negligible amounts of seed, spreading only by growing tall, falling over and developing new plants at nodes touching the ground.

Weed potential

Listed as a weed in some regions but rarely invades undisturbed areas. Var. *anceps* can pose significant problems when fields are ploughed as that seedlings volunteer in subsequent crops. Seedlings can achieve a complete cover and dominate other grasses.

Feeding value

Nutritive value

Moisture levels in fresh growth are often higher than in other tropical grasses, reaching levels >85%. CP content of 6–20% depending on age of material and nitrogen fertilization, with CP digestibility ranging from 44 to 77%. DM digestibility values of about 70% have been recorded in young leafy 3-week regrowth, falling to 50–55% at 6–8 weeks.

Palatability/acceptability

Extremely palatable when young but becomes stemmy and unacceptable with maturity. The tendency to stemminess is more pronounced in some cultivars than others.

Toxicity

Oxalate is present in all cultivars, but varies with cultivar: 'Kazungula', 'Splenda' > 'Narok', 'Solander' > 'Nandi'. Levels are higher in fresh growth, and exacerbated by N and K fertilization. Highest levels of oxalate occur at night, and the lowest in mid-afternoon. High oxalate levels cause ill-thrift, lameness and swelling of the head bones or 'big head' disease (*Osteodystrophia fibrosa*) in equines, and horses and donkeys should not be permitted to graze setaria for more than 1 month at a time. High levels can also lead to 'milk fever' (*Hypocalcaemia*) in cattle grazing *Setaria sphacelata*, particularly 'Kazungula'. This can be treated with an injection of calcium borogluconate solution. Cattle that have not grazed well fertilized setaria for some time should be introduced gradually to the setaria, before more regular exposure. This allows them to develop a rumen flora that can detoxify oxalate. 'Grass staggers' (hypomagnesaemia) can also occur, a disease caused by too little magnesium in the blood system, induced through low levels of Mg and high levels of K in the feed. In dairy cows, 'grass staggers' is often a complication of 'milk fever'. It is therefore wise to use a combined treatment of calcium borogluconate and magnesium hypophosphite. Problems relating to high oxalate levels, and cation imbalances in animals grazing *S. sphacelata* are mostly encountered in high-producing cows.

Feedipedia link

<https://www.feedipedia.org/node/381> (var. *anceps*)

<https://www.feedipedia.org/node/380> (var. *splendida*)

Production potential

Dry matter

Annual yields of 4 to about 26 t/ha DM, depending on fertility and moisture. Yields of as high as 31 t/ha have been recorded for var. *splendida* in the wet tropics. While high yields have been recorded from well-fertilized, irrigated stands, yields of the order of 10–15 t/ha DM are more common.

Animal production

In the subtropics, steers continuously grazing setaria fertilized with 330 kg/ha/yr N, and stocked at about 3 steers per hectare, can produce liveweight gains of 500–800 kg/ha per year.

Genetics/breeding

S. sphacelata is a cross-pollinating species. Most accessions studied have been diploids ($2n = 18$) and tetraploids ($2n = 36$), although pentaploids ($2n = 45$), hexaploids ($2n = 54$), octoploids ($2n = 72$) and rarely septaploids ($2n = 63$) and decaploids ($2n = 90$) have been identified. Crosses have been obtained between proximate ploidy levels, tetraploid and hexaploid, as well as hexaploid and octaploid, but not between diploid and tetraploid, nor between high and low ploidy levels.

Seed production

Flowering occurs over a long period and seed on individual panicles ripens sequentially resulting in asynchronous maturation of seed.

Also, numbers and proportion of fertile culms varies with genotype and environmental conditions. Consequently, presentation seed yields ranging from 40 to 560 kg/ha are quoted in the literature. However, good commercial yields are usually of the order of 100 kg/ha. Crops are fertilized with 100–150 kg/ha N are usually direct headed when 10–15 percent of the seed has shattered.

Herbicide effects

Established setaria is tolerant of 2,4-D, dicamba and MCPA. It can be controlled with glyphosate.

Strengths

- Palatable.
- Establishes easily from seed.
- Persists under moderate grazing
- Adapted to a wide range of soils.
- Tolerant of flooding and waterlogging.
- Some lines frost tolerant.

Limitations

- Heavy spring/summer seeding reduces feed quality.
- High oxalate levels can cause animal disease .
- Not very drought tolerant.

Selected references

Bogdan, A.V. (1977) Tropical Pasture and Fodder Plants. Longman Inc., New York, USA. p. 249–260.

Gibbs Russell, G.E., Watson, L., Koekemoer, M., Smook, L., Barker, N.P., Anderson, H.M. and Dallwitz, M.J. (1990) Grasses of Southern Africa: An identification manual. Memoirs of the Botanical Survey of South Africa No. 58. Botanical Research Institute, Pretoria, South Africa.

Hacker, J.B. (1992) *Setaria sphacelata* (Schumach.) Stapf & Hubbard ex M.B. Moss. In Manetteje, L.'t and Jones, R.M. (eds) Plant Resources of South-East Asia No. 4. Forages. Pudoc Scientific Publishers, Wageningen, the Netherlands. p. 201–203.
edepot.wur.nl/327785

Hacker, J.B. and Jones, R.J. (1969) The *Setaria sphacelata* complex - a review. Tropical Grasslands 3:13–34. bit.ly/39yQrjx

Hacker, J.B. and Minson, D.J. (1972) Varietal differences in *in vitro* dry matter digestibility in *Setaria*, and the effects of site, age, and season. Australian Journal of Agricultural Research 23:959–967. doi.org/10.1071/AR9720959

Jank, L., Quesenberry, K.H., Blount, A.R.S. and Misleve, P. (2002) Selection in *Setaria sphacelata* for winter survival. New Zealand Journal of Agricultural Research 45:273–281. doi.org/10.1080/00288233.2002.9513517

Jones, R.J. and Jones, R.M. (1989) Liveweight gain from rotationally and continuously grazed pastures of Narok setaria and Samford rhodesgrass fertilized with nitrogen in southeast Queensland. Tropical Grasslands 23:135–142. bit.ly/2JrFzJl

Jones, R.M. and Jones, R.J. (2003) Effect of stocking rates on animal gain, pasture yield and composition, and soil properties from setaria-nitrogen and setaria-legume pastures in coastal south-east Queensland. Tropical Grasslands 37:65–83. <https://bit.ly/2vZzUXX>

Oram, R.N. (1986) *Setaria sphacelata* (Schumach.) Moss var. *sericea* (Stapf) Clayton (setaria) cv. Solander (Reg. No. A-8a-5). Journal of the Australian Institute of Agricultural Science 52:180–181.

Cultivars

'**Bua River**' Released in South Africa. Origin Malawi, used for silage, hay or green chop. Oxalate levels similar to those of 'Kazungula'.

'**Du Toits Kraal**' Released in South Africa. Origin Zimbabwe, recommended for areas with 500–700 mm rainfall. Drought resistant and retains some greenness and palatability into winter.

'**Kazungula**' Released in South Africa (1940s) and Australia (1962). Origin Zambia. Tetraploid. Culms to 2 m tall. Stigmas purple. Developed for grazing and hay. Coarser and more robust than 'Nandi'. Flowers a month later and seed is slightly smaller than that of 'Nandi'. Hardier and more adaptable, being particularly tolerant of waterlogging, yet growing on as little as 575 mm annual rainfall. Used in more tropical environments in Australia. Has a high sodium and potassium content, and higher oxalate content than other cultivars. Under grazing, tends to be much stemmier than 'Nandi' unless grazing management is very good during flowering and seeding.

'**Lampung**' (CPI 15899) Released in Indonesia. Var. *splendida*. Introduced to Australia from Mpwapwa, Tanzania. Variety most commonly used in southeast Asia.

'**Nandi**' (CPI 28709) Released in Kenya (1953) and Australia (1963). Origin Nandi district in Kenya highlands. Selection from the fairly

variable initial collection at Kitale, Kenya, of an improved leafy, vigorous, and late-flowering form. Diploid. Culms to 1.5 m tall. Stigmas white. More sensitive to frost and flowers earlier than 'Kazungula'. Lowest oxalate content of Australian cultivars. Establishes less readily than 'Narok' and 'Kazungula'.

'**Nanoy**' (PI 451734) Mexico?

'**Narok**' (CPI 33452, Fenwick's setaria) Released in Australia (1969). Tetraploid from the Aberdares region of Kenya (altitude 2,190 m). Culms to >1.8 m tall; more robust than 'Nandi' but not as coarse as 'Kazungula'. Stigmas usually purple, sometimes white. Selected for improved winter production and frost tolerance.

'**Nasiwa**' Released in Kenya. Earlier flowering selection from 'Nandi'.

'**San Juan morado**', '**San Juan blanco**' Costa Rica.

'**Solander**' Released in Australia (1985). Tetraploid hybrid using frost tolerant accessions CPI 32930 (16%) and CPI 33452 (34%), and more robust frost susceptible accessions CPI 19915 (18%), CPI 16413 (24%) and var. *splendida* CPI 15899 (8%). Culms to >1.8 m tall. Stigmas purple, sometimes white. Selected for winter yield, winter greenness and seed production (superior to that of 'Narok').

'**Splenda**' Released in Australia (1981). Hybrid from crosses between the tetraploid var. *splendida*, CPI 15899, and two tetraploid accessions of var. *sericea*, CPI 19915 and CPI 16067. Selected for seed production (up to 80 kg/ha cleaned seed) and conformity to var. *splendida* phenotype (late flowering and leafiness). Later flowering than 'Kazungula', 'Nandi' and 'Narok'. Well adapted to wet tropical situations but also of value in other tropical and subtropical regions with a rainfall exceeding 1,000 mm where dry periods do not exceed 3 months. Not suitable for horses because of high oxalate concentration in the dry matter of young leaf about 4.7% (91% soluble). Na and K concentrations were 0.74 (a Na accumulator) and 4.47% respectively.

Promising accessions

CPI 32847, **CPI 32714** Selected in Australia (Queensland). Origins Ndargawa, Kenya (0°04' S, 2,300 m asl) and Arusha, Tanzania (3°22' S, 1,145 m asl), respectively. Both hexaploids with some salt tolerance and cold tolerance.

CPI 32930 Selected in Australia (Queensland). Origin Kenya. More frost tolerant than 'Narok'; also better cool season growth, but lower annual yield.

© Copyright 2020. All rights reserved.

