Pennisetum clandestinum

Scientific name

Pennisetum clandestinum Hochst. ex Chiov.

Synonyms

Pennisetum inclusum Pilg.
Pennisetum longistylum Hochst.
Pennisetum longistylum var. *clandestinum* (Hochst. ex Chiov.) Chiov.
Pennisetum longistylum var. *clandestinum* (Hochst. ex Chiov.) Leeke

Family/tribe

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

Common names

kikuyu grass , west african pennisetum (English); kikuyugras (German); capim-quicuio (Portuguese); kikuyo, pasto africano (Spanish); xi fei lang wei cao (Chinese); ya-khikhuyu (Thai).

Morphological description

A stoloniferous and rhizomatous perennial, mostly to 30 or 40 (rarely to >70) cm tall, the stolons much-branched and closely appressed to the ground, forming a turf under regular defoliation. Sterile shoots have short stems and long leaves; fertile shoots are lower-growing than sterile shoots and with shorter leaves. Leaf sheath pale yellow-green, usually with fairly dense, fine tubercular-based hairs, sometimes glabrous; ligule a dense rim of hairs. Leaf blade linear, to 30 cm long and 7 mm wide, tightly folded when young, but opening flat when mature, glabrous or with sparse to dense tubercular-based hairs, finely serrated margins. Inflorescence reduced to a cluster of 2–4 very shortly stalked spikelets, almost enclosed in the uppermost leaf sheath. Spikelets 10–20 mm long, narrow, comprising 2 florets, the lower one sterile, the upper one bisexual or functionally male or female; 3 stamens, on slender filaments to 50 mm long, with anthers 5–7 mm long; single stigma to 30 mm long, occasionally bifid. Caryopses ovoid, dark brown, about 2.5 mm long and 1.5 mm broad, pointed with persistent short style . Approx. 400,000 seeds/kg.



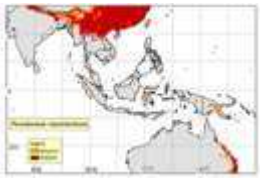




Distribution

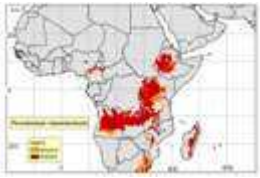
Native to:
Africa: Burundi, Democratic Republic of Congo (Zaire), Ethiopia, Kenya, Rwanda, Tanzania, Uganda.

Naturalised in:
Northern and southern Africa, tropical Asia, Australia, New Zealand, south-west mainland United States (incl. Hawaii), Mexico, Central America, South America, Melanesia and Polynesia.

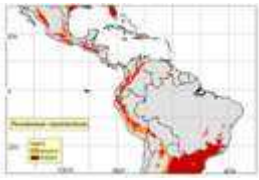


Uses/applications

Permanent pasture, ground cover, amenity turf, irrigated pasture, also hay or silage .



Ecology



Soil requirements

Grows best on high fertility soils of loam or clay, especially well-structured, red basalt soils, but also on alluvial and fertilised moist sandy soils. Tolerates low pH (to pH 4.5) and high Al and Mn, as well as moderate salinity. Prefers at least moderately drained soils.

Top

Moisture

Kikuyu originates from areas with an annual rainfall of 1,000–1,600 mm. Although this native environment mostly does not have a pronounced dry season, the grass has become naturalised in areas of summer or winter rainfall with a distinct 5 month dry season. Where soils are suitable, it has become naturalised in areas with rainfall up to 3,000 mm and down to 800 mm/yr, and performing well under irrigation in lower rainfall areas. It is moderately drought tolerant, because of deep root system (to >3 m). Often found along water courses, it can tolerate some waterlogging and up to 10 days inundation . Most active growth occurs during periods of high humidity.

Temperature

In its native environment it occurs between about 8°N and S of the equator, and at altitudes from about 1,500–3,000 m asl. It has now become naturalised in the warm temperate and mediterranean lowland subtropics (25–38°) and to 3,800 m asl at 16°S in Bolivia, as well as in other tropical highland areas. In Hawaii (19–22°N) , it extends from sea level to >2,000 m asl. Average annual temperatures over this distribution range from about (9–) 18–21 (–25) °C. The optimum temperature for growth is between 16 and 21°C, with growth declining markedly at high temperatures and below 7°C. In the lowland subtropics, this translates to best growth occurring in spring and autumn, moisture permitting, with depressed growth in the heat of summer and during winter. It is more frost tolerant than many warm season grasses, with only exposed foliage being damaged at about -2°C. Although tops are killed, stands survive temperatures as low as -9°C.

Light

Moderate shade tolerance but does not grow well in heavy shade.

Reproductive development

Can flower in any month in the absence of frost, with a peak in autumn and spring. Flowering is stimulated by regular mowing or heavy grazing. In bisexual spikelets, the stigma emerges 1–3 days before the stamens of the same flower, encouraging outcrossing.

Defoliation

Regular defoliation is necessary to maintain forage quality and palatability of the stand. Management should aim to maximise the amount of leaf, and minimise the amount of stem. Accordingly, stands should be grazed to about 5 cm in height and allowed to regrow to about 15 cm. If pasture height exceeds 15 cm, it is best to mow the sward back to 5 cm to remove stems and mature growth. If well fertilised, kikuyu is very tolerant of constant heavy grazing, although productivity is reduced under such management.

Fire

Top

Rarely burnt but recovers from even severe fire by virtue of rhizomes.

Agronomy

Guidelines for the establishment and management of sown pastures.

Establishment

Kikuyu is readily established vegetatively or from seed. Harvested pieces of stolon or rhizome can be planted on a regular grid, or broadcast and cultivated into the soil surface. Subsequent rolling ensures better establishment. Seed is sown at 1–2 kg/ha when soil temperature reaches 20℃. Good moisture conditions for severa l days after sowing are essential for effective establishment.

Fertiliser

Kikuyu is particularly demanding for N and P. While other nutrients are also essential, historically it has been decline in soil N and P levels that has led to decline in formerly productive stands. Renovation of “run-down” kikuyu grass should include incorporation of a legume or the use N and P fertiliser. Good production requires at least 150 kg/ha N applied in split dressings in spring and autumn, although linear responses to levels well above this have been obtained. Available soil P levels should be maintained at or above 15 ppm .

Compatibility (with other species)

Kikuyu is very competitive and generally incompatible with other grasses. Ryegrasses (*Lolium* spp.) can be oversown in autumn if the kikuyu is weakened by ploughing or with chemical prior to sowing. With

the exception of *Vigna parkeri* , legume persistence is largely dependent on appropriate grazing management. Persistence of annual and more prostrate species depends on the sward being grazed heavily at some stage to facilitate redevelopment of the legume stand. Weeds tend to be a problem only in degrading pastures.

Companion species

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Grasses: Not planted with other grasses.
Legumes: *Arachis pintoi* , *Trifolium repens*, *T. burchellianum* , *T. semipilosum* , *Vigna parkeri* .

Pests and diseases

In Australia, kikuyu is attacked in summer by a soil-borne oomycete, *Verrucalvus flavofaciens*, causing 'kikuyu yellows' disease. This disease affects the roots and can devastate complete stands. A leaf-spot caused by *Pyricularia penniseti* causes a leafspot, death of leaf tips, and in severe cases death of seedlings – usually only in nutrient deficiency-weakened plants. Black spot (*Bipolaris setariae*) produces a characteristic black spot on the leaf and yellowing of the leaf tip, making the pasture less palatable to stock. Rust caused by (*Phakopsora apoda*) decreases photosynthetic capacity of infected leaves, but does not kill plants.
Various arthropods and their larvae cause temporary damage to stands. These include army worms (*Spodoptera mauritia* Lepidoptera: Noctuidae), tropical sod web worms(*Herpetogramma licarsisalis*, *H .phaeopteralis* Lepidoptera: Pyralidae), african black beetle (*Heteronychus arator* Coleoptera: Scarabaeidae), the pasture scarab beetle (*Rhopea magnicornis*), soldier fly (*Inopus rubriceps* Diptera: Stratiomyidae), the hunting billbug (*Sphenophorus venatus vestitus* Coleoptera: Curculionidae), kikuyu grass bug (*Halticus chrysolepis* Hemiptera: Miridae), the yellow sugarcane aphid (*Sipha flava* Homoptera: Aphididae), and mites (*Tarsonemus* sp.).

Ability to spread

On suitable soils, it can spread quickly from rhizomes and stolons, and from seed spread by cattle or water flow.

Weed potential

It only presents a potential problem in soils of high fertility, and can be a problem in cooler areas where it can suppress growth of the more cool-season-productive C_3 grasses. As a vigorous creeping grass , it can spread into cultivation areas or water channels. Declared noxious in USA.

Feeding value

Nutritive value

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Well-fertilised kikuyu produces very high quality feed with over 25% CP and over 70% IVDMD in young leaf. CP levels tend to stay high for 1 or 2 weeks and then decline rapidly, to below 10% within 12 weeks. Digestibility also falls to <50% in the same period. Sodium levels (at 0.02–0.05% Na) can be deficient for lactating cattle, and calcium levels, although optimal for lactating cows, may be inadequate due to "tie-up" with oxalate. P levels change with season, falling as the species became dormant. A fall in P and a rise in Ca content results in a high Ca:P ratio (2.5:1) in spring. Optimum quality coincides with the 4½ leaf stage of regrowth.
For good silage fermentation, kikuyu needs to be wilted first or have extra sugar added because of its low DM and low water soluble carbohydrate content.

Palatability/acceptability

Young growth is very soft and palatable, but older growth is not relished by most animals. The presence of a legume in the sward increases utilisation of the kikuyu.

Toxicity

Four nutritional problems are recognised in kikuyu – nitrate poisoning, bloat, oxalate poisoning, and kikuyu poisoning. Lush growth associated with excessive application of nitrogen can result in nitrate poisoning and even bloat, although the latter is rare. Hyperparathyroidism ('big head') in horses, and occasionally nephrosis or hypocalcaemia in ruminants, has been recorded due to high levels of oxalate (up to 1.1% DM). Kikuyu poisoning occurs sporadically in cattle, especially where rapid growth follows a protracted dry period. It occurs only in cattle, affecting all classes and ages. Serious toxicity occurs spasmodically after rainfall in excess of 20 mm, grass temperatures above 14℃ and invasion of pasture by army-worms.

Production potential

Dry matter

DM yields are only limited by soil fertility and moisture availability. Under optimum conditions, it is capable of producing 30 t/ha/yr, but is unproductive if not fertilised. Responses of the order of 15–30 kg DM per kg N applied are reported.

Animal production

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Well fertilised pastures are capable of carrying 1.5–3.0 adult cattle/ha. Dairy cows can produce over 15 L milk/hd/day, and beef animals over 400 kg/ha/yr LWG from vigorous kikuyu pastures.

Genetics/breeding

Tetraploid $2n = 4x = 36$. New cultivars have been selected from natural variation, as normal breeding techniques are not appropriate.

Seed production

The sward must be kept short to encourage flowering, seen as a 'web' of white stamens covering the sward . In the southern hemisphere, the seed crop is initially mowed off in October. Once flowering commences, it is mowed every 3 days, raising the cutting height by about 2 cm each time. After 2 months, the mowing interval is increased to 5 days. Once the crop has been frosted, the whole bulk is mowed to ground level and dried before threshing. Yields of 200–400 kg/ha are normal, and up to 700 kg/ha achievable.

Herbicide effects

Kikuyu is very susceptible to glyphosate, and can be severely set back by only 1 L/ha, and killed at 3 L/ha. It is also susceptible to haloxyfop ethoxyethyl and imazapyr.

Strengths

- Productive under heavy grazing.
- Good ground cover.
- Responsive to good fertility.
- Suited to subtropics and high altitude tropics.

Limitations

Top

- Requires fertile soils for persistence and production.
- Competitive against many legumes.
- Rhizomes can create weed problem.
- Susceptible to 'kikuyu yellows' disease.

Other comments

To maintain animal production in winter, kikuyu pastures can be oversown with temperate species (e.g. rye grass , white clover) following spraying with low concentrations of glyphosate (1–2 L/ha in 100 L/ha of water).

Selected references

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Internet links

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http://www.meu.unimelb.edu.au/grasslands/
http://www.colforest.com.co/serie_especies_forrajeras/pennisetum-clandestinum.pdf

Cultivars

Cultivars	Country/date released	Details
'AZ-1'	Arizona, USA	A seed-producing sport from 'Whittet', developed in Arizona and selected for greater density and softer texture than common kikuyu or 'Whittet'. It is mainly used as a turf, favoured for its winter colour retention, and lower vigour and lower invasiveness than common kikuyu or 'Whittet'.
'Breakwell'	Australia (1971)	Selected from a naturalised male fertile population at Grafton, NSW, possibly originating from Democratic Republic of the Congo (Zaire). More densely tillered than 'Whittet', with more prostrate growth habit, narrower leaves, thinner stems and shorter internodes. Forms denser sward than that of 'Whittet'. Between 15 and 20% of plants grown from seed are male sterile, but all are female fertile, producing good seed yields. Susceptible to 'kikuku yellows' disease.
'Crofts'	Australia (1983)	Clonal selection from 34°S in NSW. Taller with more upright, narrower leaves and thinner, leafy shoots than 'Whittet' or naturalised kikuyu. Higher yields than 'Whittet' or naturalised kikuyu between 32 and 36°S, especially in cooler weather. Produces viable seed. Susceptible to 'kikuku yellows' disease.

'Hosaka'	Hawaii, USA (1982/3)	Bred and released by Dr. Ukio Urata, University of Hawaii. Selected for higher yield, more open habit, improved drought tolerance and lower flowering intensity.
'Kabete'	Kenya (1938)	Ecotype from Kabete, Kenya (1° 16'S, 1,830 m asl, rainfall 1,000 mm). Intermediate morphology between 'Molo' and 'Rongai', with leaves of similar colour to those of 'Molo'. The stamens are exserted, and functional pollen is produced.
'Molo'	Kenya	Ecotype from Molo, Kenya (0°15'S, 2,500 m asl). Finer stolons than 'Rongai' strain, with narrower, lighter green leaves. Less floriferous than 'Kabete' and 'Rongai'. More productive than 'Kabete', but less tolerant of frequent defoliation under dry conditions than 'Kabete' and 'Rongai'.
'Noonan'	Australia (1983)	Single plant, 'W2', selected from seven single plants, at Grafton, New South Wales. These were chosen for further study from 200 plants grown from seed of open pollinated 'Whittet' and 'Breakwell' populations. Selected for ability to flower and set seed without stimulative clipping, a growth habit intermediate to 'Whittet' and 'Breakwell', higher dry matter yield during the cooler months, a good seed yield, and field tolerance to 'kikuyu yellows'.
'Rongai'	Kenya	Ecotype from Rongai, Kenya (0°10'S, 1,910 m asl). Coarse with broad, dark green leaves and thick stolons; male sterile as anthers never exserted. More productive than 'Kabete'.
'Whittet' (K53955, P 713)	Australia (1970)	Institutional collection from Kitale, Kenya, collected at 1,890 m asl. Taller growth, slightly broader leaves, thicker stems and longer internodes than naturalised type in Australia. Uniformly male fertile, producing good seed yields. Slower to form a dense sward than naturalised type. Susceptible to 'kikuku yellows' disease.

Promising accessions

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Promising accessions	Country	Details
None reported.		