Pennisetum clandestinum Hochst. ex Chiov.

Home

Graminae

Common names

Photo

Kikuyu grass (after the Kikuyu people of Kenya, east of the Aberdare Mountains, where the grass thrives).

Description

A prostrate perennial which may form a loose sward up to 46 cm high when ungrazed, but under grazing or mowing assumes a dense turf. The grass spreads vigorously from rhizomes and stolons which root readily at the nodes, and are profusely branched. Short, leafy branches are produced from stolons, with leaf- blades strongly folded in the bud, later expanding to 44.5114.3 mm long and 6 mm wide, tapering to sub-obtuse tips; leaf surface is sparsely and softly hairy. The ligule can be recognized by a ring of hairs, and the collar by its prominent pale yellow colour. The flower is small, consisting of a spike of two to four subsessile spikelets which are partly enclosed within the uppermost leaf-sheath. The spikelets are bisexual, or functionally unisexual. The florets are protogynous and the stamens are rapidly exserted on long filaments, usually in the early morning. The stigma is branched and feathery. The large seed (2 mm long) is dark brown, flat or ellipsoidal with a prominent style (Mears, 1970).

Distribution

From Zaire and Kenya the grass has been introduced widely in tropical areas, especially Costa Rica, Colombia, Hawaii, Australia and southern Africa.

Season of growth

Spring, summer and autumn.

Altitude range

Sea-level to 3 500 m.

Rainfall requirements

In its natural habitat, 1 000-1 600 mm/year either falling in one season or as a bi-modal rainfall (Mears, 1970). Mean 1 269 + 632 mm (Russell & Webb, 1976).

Drought tolerance

Reasonably good because of its deep root system. It extends to 5.5 m, but only sparsely below 60 cm, with 90 percent of the total root weight found in the 0-60 cm layer. Added nitrogen improves the efficiency of water use.

Soil requirements

Its natural occurrence is mainly on deep latosolic soils of good fertility, and it has quickly adapted to similar soils elsewhere. It also thrives on alluvial soils and on moist, sandy soils where the fertility has been raised by animal excrete or mineral fertilizer. It is an excellent colonizer and soil stabilizer in small paddocks around dairy bails, piggeries and feed-lots, and where non-toxic effluent is discharged from factories. It does require soils with good drainage.

Ability to spread naturally

Under favourable conditions of moisture and fertility, Kikuyu will spread rapidly from rhizomes and stolons, and from seeds germinating in dung pats (Wilson & Hennessy, 1977).

Land preparation for establishment

A properly prepared seed-bed is necessary for good establishment from seed. For stem and root cuttings a rougher seed-bed may suffice, as long as the vegetative material is adequately planted. Sowing methods. Hand planting of vegetative stem and root cuttings has been traditional. Sprigs containing two or three nodes, planted on a 1-m grid is a usual plant spacing, but availability of sprigs and desired rapidity of establishment will decide procedure. For large areas, broadcasting sprigs (produced by putting plants through a chaff cutter) and then disc-harrowing them in will give adequate establishment if accompanied by a fertilizer mixture of nitrogen and phosphorus (Mears, 1970). Now that seed is available, well prepared seed-beds are essential as seed is costly. Pellet seed with activated charcoal at 1.3 kg a.c./ha and use atrazine at up to 4.5 a.c./ha. This reduces weed competition, especially from Eleusine indica and gives satisfactory stands (Cook & O'Grady, 1978). A drill with attached fluted furrow press wheels gives excellent results (Wilson, 1978).

Sowing depth and cover

Sow seed at approximately 5 mm depth, and roll to cover. Cultivar Whittet can germinate from a depth of 5.6 cm (Blair et al., 1974).

Sowing time and rate

Plant in the spring, to compete against weeds at the rate of 2-4 kg/ha. The optimum temperature for germination is within the range of 19- 29°C with the fastest rate at 29°C (Blair et al., 1974). Sow after the topsoil reaches a temperature of 20°C.

Number of seeds per kg.

About 40 000.

Tolerance to herbicides

Kikuyu itself may become a weed in cultivation. It can be killed by several herbicides including dalapon, but each successive seedling emergence must be treated. 2.2-DPA at 8 kg/ha will suppress it enough for sod- seeding another species into it. Atrazine at 1.0-1.5 kg/ha will eliminate weeds from a pure Kikuyu pasture.

Seedling vigour

The seedlings should be protected by slashing to reduce weed competition; vigour is enhanced by high nitrogen and phosphorus in the soil.

Vigour of growth and growth rhythm

On the Atherton Tableland, Queensland, it grows vigorously from December to April (lat. 17°13'S) but may be cut by frost from the first week in April to mid-July and be halted by dry weather from mid-July to late November (Quinlan & Edgley, 1975). Graphs of growth rhythm in south-eastern Queensland and northern New South Wales are given in Figure 15.127.L

Response to defoliation

Information has been obtained from cutting experiments. Colman (1966) at Wollongbar, northern New South Wales, found frequent cutting (every two weeks) reduced dry-matter yield by 54 to 25 percent, compared with a maximum yield at the 12-week cutting interval; this depression was greater in the presence of nitrogen fertilizer. Mean yield of nitrogen in the herbage fertilized with 224 kg N/ha and cut every two weeks was 176 kg/ ha, compared with 131 kg/ha when cut at 12-week intervals. In Colombia, maximum production of green herbage and protein was obtained from a Kikuyu/clover sward cut to 5 cm every nine weeks. In north Queensland, a cycle of three to four weeks' grazing to 13 cm is preferred.

Grazing management

Close grazing or cutting designed to avoid the build-up of a dense mat of stolons is necessary to maintain temperate legumes with Kikuyu. Renovation

of worn-out or degenerate pastures by mechanical ripping has no long- term effect unless accompanied by fertilization with inorganic nitrogen or the inclusion of a legume. Where Neonotonia wightii cv. Clarence was the associated legume, grazing every four weeks reduced the legume percentage, compared with the eighth- or 12-week grazing interval. The sward should be maintained with a dressing of at least 150 kg N/ha applied in split dressings in spring and autumn. If weeds are troublesome the pasture can be slashed. With a Kikuyu/tropical legume mixture, grazing to a height of 10-15 cm should take place every six to eight weeks. With strip grazing, 50 beasts per hectare per day can be grazed on a grass/legume mixture.

Response to fire

Where Kikuyu thrives there should be little fire risk, but in dry times the green top growth may hide a dry basal layer of dead leaves which can support a creeping fire. The plants soon recover.

Dry-matter and green-matter yields

In northern New South Wales, a ceiling yield of 30 000 kg/ha of dry matter was obtained by applying 1 120 kg/ha of fertilizer nitrogen. On the Atherton Tableland, Queensland, a Kikuyu-dominant pasture produced 12 170 kg DM/ha per year.

Suitability for hay and silage

Although Kikuyu grass silage is palatable to dairy cattle, a considerable loss of dry matter occurs and digestibility of the silage is about 19.5 units lower than freshly-cut grass. Milling and pelleting the leaf for sheep resulted in a live-weight increase three times that of sheep fed the unmilled leaf ration (Hennessy & Williamson, 1976).

Toxicity

It is rarely toxic. Lush grass growing on a heavily-manured, disused cow yard has caused nitrite poisoning (Everist, 1974; Quinlan & Edgley, 1975), and bloat (Said, 1971). In New Zealand, serious toxicity occurs spasmodically on Kikuyu pastures after rainfall in excess of 20 mm, grass temperatures above 14°C and invasion of pasture by army-worms. The toxin is unknown (Martinovich & Smith, 1973).

Seed yield

25 kg/ha from new stands, up to 500 kg/ha from established swards. Increasing the rate of nitrogen fertilizer from nil to 224 kg N/ha increased leaf production but decreased seed yield (Wilson & Rumble, 1975).

Cultivars

Edwards (1937) recognized three ecotypes in Kenya.

- ***'Rongai'***

  coarse, with broad leaves and thick stolons which develop rapidly after cutting; male sterile, anthers never exserted.

- ***'Molo'***

  a finer plant with narrow leaves and more slender stolons which tend to throw up shoots from the centre crown after cutting; the stamens are never exserted (Parker, 1941), and the pollen is sterile.

- ***'Kabete'***

  an intermediate form. The stamens are exserted, and functional pollen is produced. Barnard (1972) registered two Australian cultivars.

- ***'Whittet'***

  obtained from the Grassland Research Station, Kitale, Kenya, and developed at the Grafton Experiment Station, New South Wales. A taller, coarser, more broad-leaved and vigorous plant than the 'Kabete' ecotype above. It survives better than common Kikuyu under less fertile conditions. Seed is available

from Grafton Experiment Station.

- ***'Breakwell'***

  also developed at Grafton. It is more densely tillered than 'Whittet', more prostrate with narrower leaves, thinner stems and shorter internodes. The plants are female-fertile, but 15-20 percent are male-sterile. Seed is available at Grafton.

Diseases

Kikuyu yellows is common in northern New South Wales, especially in grass fertilized with nitrogen. To control it, return the area to cultivation of cash crops for a few years. A leaf-spot caused by Pyricularia pennista produces a spot surrounded by a yellow halo, and results in some leaf death, but is not of economic importance in a well-managed and fertilized pasture (Brands & Cook, 1976). A fungus disease caused by Pyricularia grisea causes high seedling mortality on the Atherton Tableland, Queensland, in wet seasons.

Main attributes

Kikuyu is a highly digestible, high protein, low fibre, palatable grass which responds readily to nitrogen, stands heavy grazing, holds soil against erosion and is an excellent lawn grass.

Main deficiencies

It does not easily lend itself to mixed grass/legume pastures, and may become a weed of cultivation.

Optimum temperature for growth

16-21°C. It has a poor adaptation to high temperatures. Mean 18.8° + 2.8° (Russell & Webb, 1976).

Minimum temperature for growth

2-8°C in Kenya (Mears, 1970). Mean 7.7° + 4° (Russell & Webb, 1976).

Frost tolerance

It tolerates an occasional frost but not sustained frosting.

Latitudinal limits

Mean 27°N and S (Russell & Webb, 1976).

Response to light

Kikuyu does not grow well in shade.

Ability to compete with weeds

With adequate moisture and fertility, Kikuyu will suppress weeds.

Maximum germination and quality required for sale

In Queensland, 60 percent germinable seed of 93 percent purity.

Pests

Larvae of the pasture scarab beetle (Rhopea magnicornis), Tarsonemus mites and soldier fly (Atlermetapomia rubiceps) have caused temporary damage to Kikuyu in Australia, but the effects are short-lived (Mears, 1970). In Hawaii, the hunting bull bug (Sphenophorus vestitis) and grass webworm (Herpetogramma licarsicalis) cause damage (Plucknett, 1970).

Palatability

Very high.

Response to photoperiod

Flowering is not sensitive to changes in day length.

Chemical analysis and digestibility

Quality depends on frequency of defoliation and fertilizer applied. The high protein content of the leaves (rarely less than 12 percent) gives a high quality margin over the 8 percent crude protein required to obtain positive nitrogen balance, even with grass regrowth up to 100 days old. Digestibility of the dry matter is in the range of 60-70 percent. Kikuyu grass maintains high levels of digestible crude protein (Milford & Haydock, 1965) and of digestible organic matter (Holder, 1967). General phosphorus, potassium, calcium and magnesium levels in the herbage are adequate compared with other species, but in Hawaii some calcium deficiency in beef cattle has been recorded (Younge & Otagaki, 1958); in New South Wales, Australia, a mineral supplement of sodium, calcium and phosphorus increased calf live-weight gain by 27 percent (Kaiser, 1975).g

Natural habitat

Highland grassland on deep red, well-drained latosolic soils at the forest margins, and in grassy glades at an elevation of between 1 950 and 2 700 m in East and Central Africa (Ethiopia, Kenya, Tanzania, Uganda and Zaire).

Tolerance to flooding

It tolerates flooding well. It survived ten days flooding at Quirindi, New South Wales (Dale & Read, 1975).

Fertilizer requirements

Beyond basic nutrient requirements according to soil fertility, Kikuyu responds readily to nitrogen fertilizer which gives it a competitive advantage against Axonopus spp. and Paspalum dilatatum in Australia. Colman (quoted by Mears, 1970) in northern New South Wales obtained an efficiency response of 17-24 kg DM/ha/kg N applied. Responses in Colombia were recorded up to 150 kg N/ha. An effective association with the legume Trifolium repens (white clover), where the clover provides 25-60 percent of the pasture, reduced the need for nitrogen (Mears, 1970). Kikuyu does not give a good response to phosphorus except on markedly deficient soils, though phosphorus application increases the legume component. The critical level for phosphorus as a percentage of the dry matter at the immediate pre- flowering stage is 0.22. Potassium response is not likely unless intensive removal of the vegetative growth occurs. Symptoms of potassium deficiency appear as tip- burning and senescence of the lower leaves, and a reduced potassium content of the herbage (0.64-1 percent). Sulphur may also become deficient under heavy grazing or cutting. It is usually corrected in one normal superphosphate application (Mears, 1970).

Compatibility with other grasses and legumes

Under suitable conditions of soil and moisture, Kikuyu will dominate a pasture; most existing Kikuyu pastures are monospecific. With renovation and application of phosphorus-containing fertilizers, it can be combined with white and red clovers or Desmodium uncinatum and D. intortum, but management and fertilizer treatment must be good to maintain the mixture. Trifolium burchellianum and T. semipilosum occur naturally with Kikuyu on the East African highlands, and some success has been achieved with the latter on the Atherton Tableland. Pure Kikuyu pastures, top-dressed with nitrogen, are usually more productive than grass/legume mixtures.

Genetics and reproduction

The somatic chromosome number of Kikuyu is 2n=36. Bisexual and male-sterile races exist. The Rongai strain is female-fertile. It has been suggested that apomictic reproduction occurs (Mears, 1970).

Seed production and harvesting

Seed production for commercial sale is relatively new. Repeated defoliation of the main shoots is essential to induce flowering from lateral shoots of Kikuyu (Evans, Wardlaw & Williams, 1964). Seed produced by fertile types is set so close to the ground it is difficult to harvest; hence, for seed-harvesting the Kikuyu pasture must be flat and even. Once established, the grass is mown to

a height of about 25 mm and the cuttings removed. This stimulates flowering and seed production. The mower is then raised slightly so that at the next mowing, leaf growth is removed but the first crop of flowers is untouched. This promotes a second flush of flowers. Successive seed sets accumulate and the crop is mown at the end of the season, wind-rowed and threshed with a self-propelled combine (Quinlan, Shaw & Edgley, 1975).

Economics

Kikuyu grass is essentially a high-quality grass for dairying and cattle finishing in high-altitude areas of the tropical and subtropical world; a useful lawn grass and soil stabilizer against erosion.

Animal production

Taylor (1941) recorded that from an area of 0.4 ha of fertilized Kikuyu grass in Natal, three Jersey cows grazed on a put-and-take system from October to May and fed a supplement of 0.45 kg maize meal at each milking time, produced a range of 8 260- 15 550 kg milk per hectare (442-764 kg butterfat/ha) over a seven-year period. At Wollongbar in northern New South Wales, from a Kikuyu-based pasture fertilized with 336 kg N/ha, stocked at 4.94 cows/ha, 447 kg and 361 kg butterfat/ha were produced over two successive lactations (Kaiser & Colman, 1969). In Hawaii, beef production from fertilized Desmodium canum/grass mixtures was 587, 644, 706 and 806 kg/ha per year from native grass, Kikuyu, Paspalum dilatatum and pangola grass respectively (Younge, Plucknett & Rotar, 1964).

Dormancy

There is some initial hard-seededness, but it is modified by scarification during harvest or by passage through an animal (Mears, 1970).

Value for erosion control

Kikuyu is excellent for erosion control, being used in a rainfall regime as low as 680 mm on black clays on the eastern Darling Downs, Queensland, although it prefers latosols in a higher-rainfall area. Its main function in the irrigation areas of New South Wales is to control erosion of irrigation channel banks, especially near regulators and water wheels (Read, 1975).

Tolerance to salinity

Kikuyu lawns in western Queensland will tolerate saline soils if adequately watered to keep soil salts at depth (Everist, 1974). Russell (1976) also found that it had good salt tolerance.

Links:

- Common names, economic importance and distributional range; references
- Ruminant nutrition: Effect of supplementation with a tree legume forage on rumen function
- Nutrients in P. clandestinum pastures: Australian Journal of Experimental Agriculture, 1998, 38, 227-40 (pdf-file)
- Invasive plant species in the Pacific Island Ecosystems: Description, distribution, ecology and control; references

Links for the genus:

- Grass genera of the world: Rich information about the genus, photographs, drawings and links to other grasses
- The Pennisetum genus: Description and links to other Poaceae
- Species, cultivars, culture and propagation

Further reading

Mears, 1970; Quinlan, Shaw & Edgley, 1975.