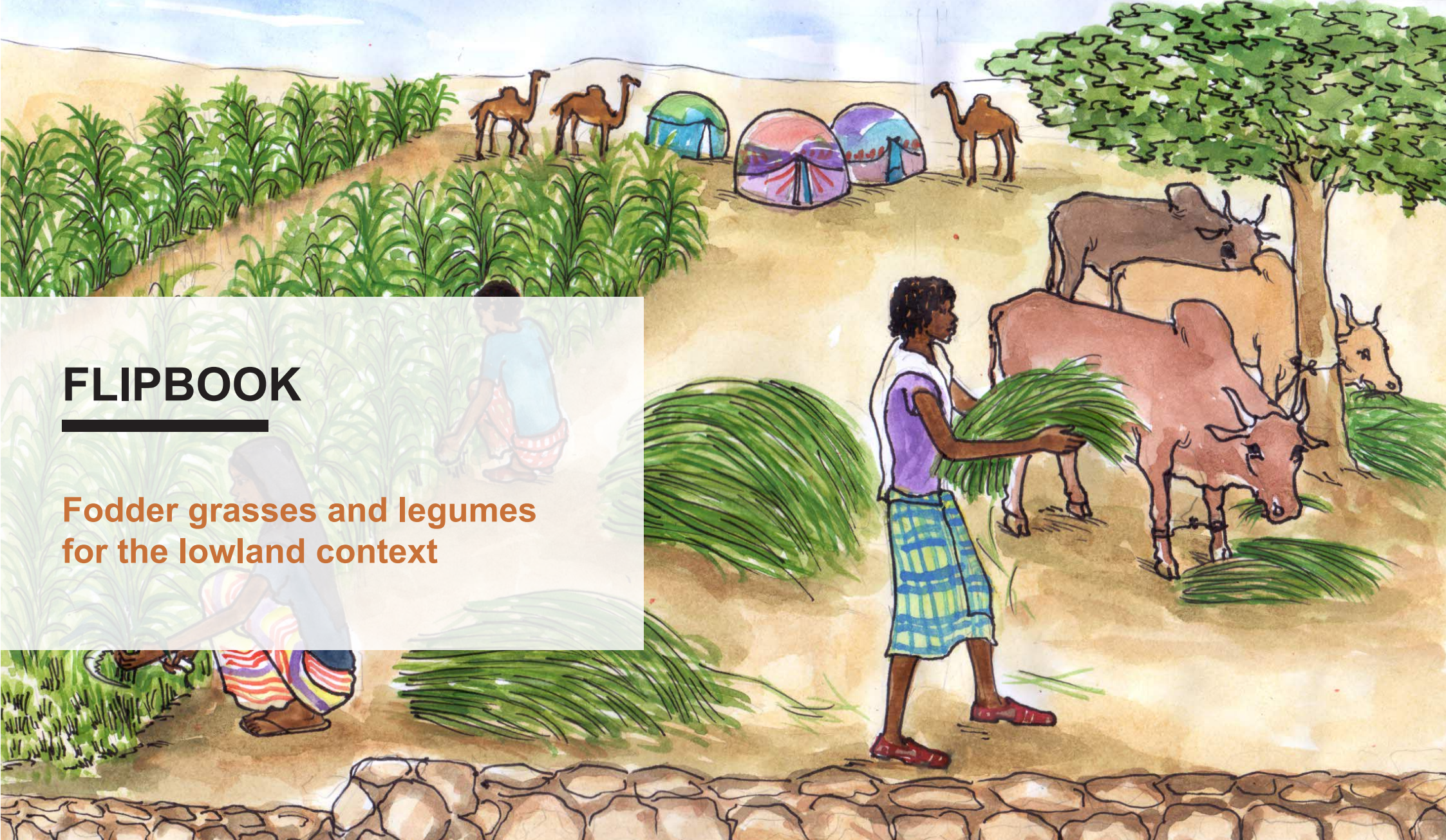


FLIPBOOK

Fodder grasses and legumes for the lowland context



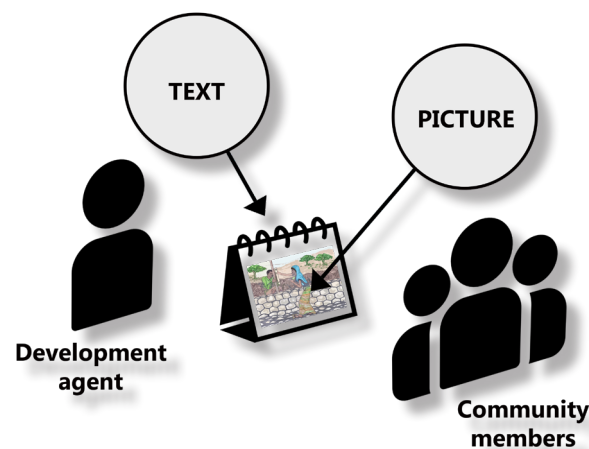


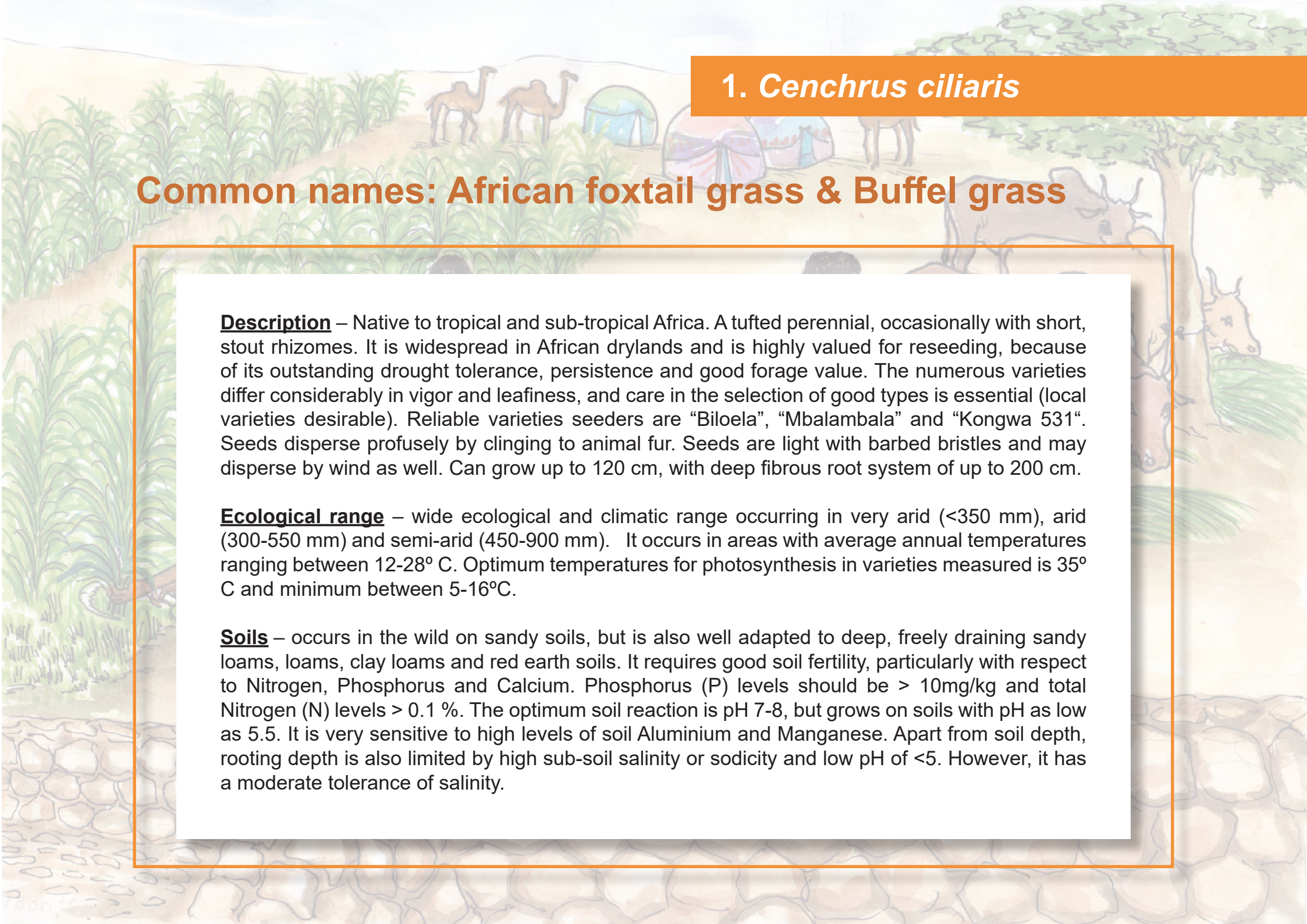
Introduction /how it works

This flipbook is developed as a tool for DAs to introduce the fodder grasses and legumes suitable for the lowland context to communities. The flipbook shows and describes 10 types of grasses and 2 types of legume crops and provides information on:

- Description
- Ecological Range
- Soils
- Forage value and seed production
- Geographical distribution

The facilitator shows the illustration to the community members and can use the description on the other side to facilitate the discussion and give insights on the varieties.





1. *Cenchrus ciliaris*

Common names: African foxtail grass & Buffel grass

Description – Native to tropical and sub-tropical Africa. A tufted perennial, occasionally with short, stout rhizomes. It is widespread in African drylands and is highly valued for reseeding, because of its outstanding drought tolerance, persistence and good forage value. The numerous varieties differ considerably in vigor and leafiness, and care in the selection of good types is essential (local varieties desirable). Reliable varieties seeders are “Biloela”, “Mbalambala” and “Kongwa 531”. Seeds disperse profusely by clinging to animal fur. Seeds are light with barbed bristles and may disperse by wind as well. Can grow up to 120 cm, with deep fibrous root system of up to 200 cm.

Ecological range – wide ecological and climatic range occurring in very arid (<350 mm), arid (300-550 mm) and semi-arid (450-900 mm). It occurs in areas with average annual temperatures ranging between 12-28° C. Optimum temperatures for photosynthesis in varieties measured is 35° C and minimum between 5-16°C.

Soils – occurs in the wild on sandy soils, but is also well adapted to deep, freely draining sandy loams, loams, clay loams and red earth soils. It requires good soil fertility, particularly with respect to Nitrogen, Phosphorus and Calcium. Phosphorus (P) levels should be > 10mg/kg and total Nitrogen (N) levels > 0.1 %. The optimum soil reaction is pH 7-8, but grows on soils with pH as low as 5.5. It is very sensitive to high levels of soil Aluminium and Manganese. Apart from soil depth, rooting depth is also limited by high sub-soil salinity or sodicity and low pH of <5. However, it has a moderate tolerance of salinity.

1. *Cenchrus ciliaris*

Common names: African foxtail grass & Buffel grass

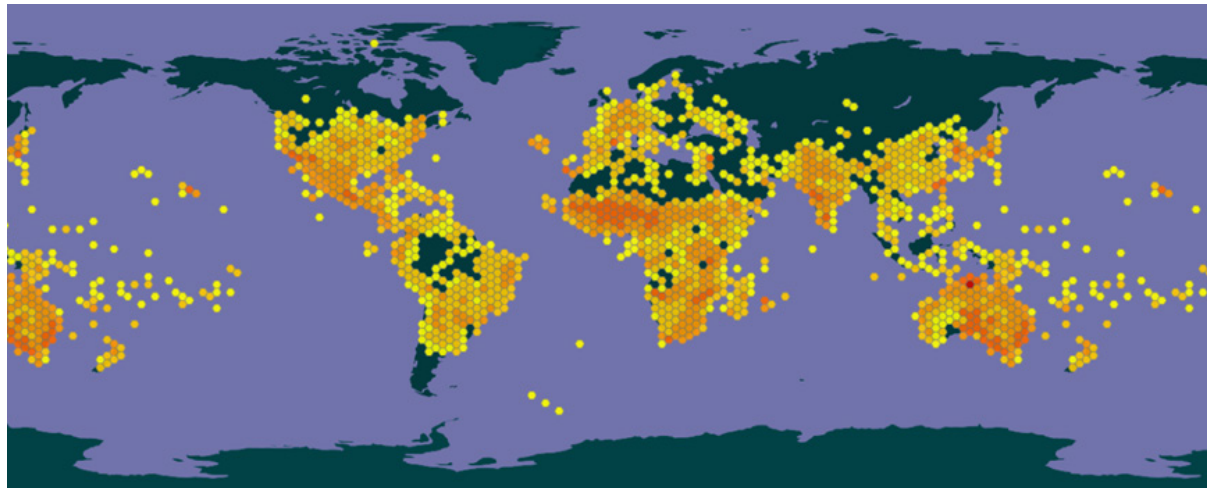


1. *Cenchrus ciliaris*

Common names: African foxtail grass & Buffel grass

Forage value and seed production - It produces reasonable quality hay when cut in the early flowering stage, yielding up to 2 500 kg/ha per cut with a protein content of 6-10% of dry matter. Dry matter yields depend greatly on soil fertility and growing conditions but is mostly in the range of 2-9 tonnes/ha and under ideal conditions up to 24 tonnes/ha. Seed yield ranges between 10-60 kg/ha of clean seed per harvest. Easily established from seeds that can be picked in arid and semi-arid African rangelands.

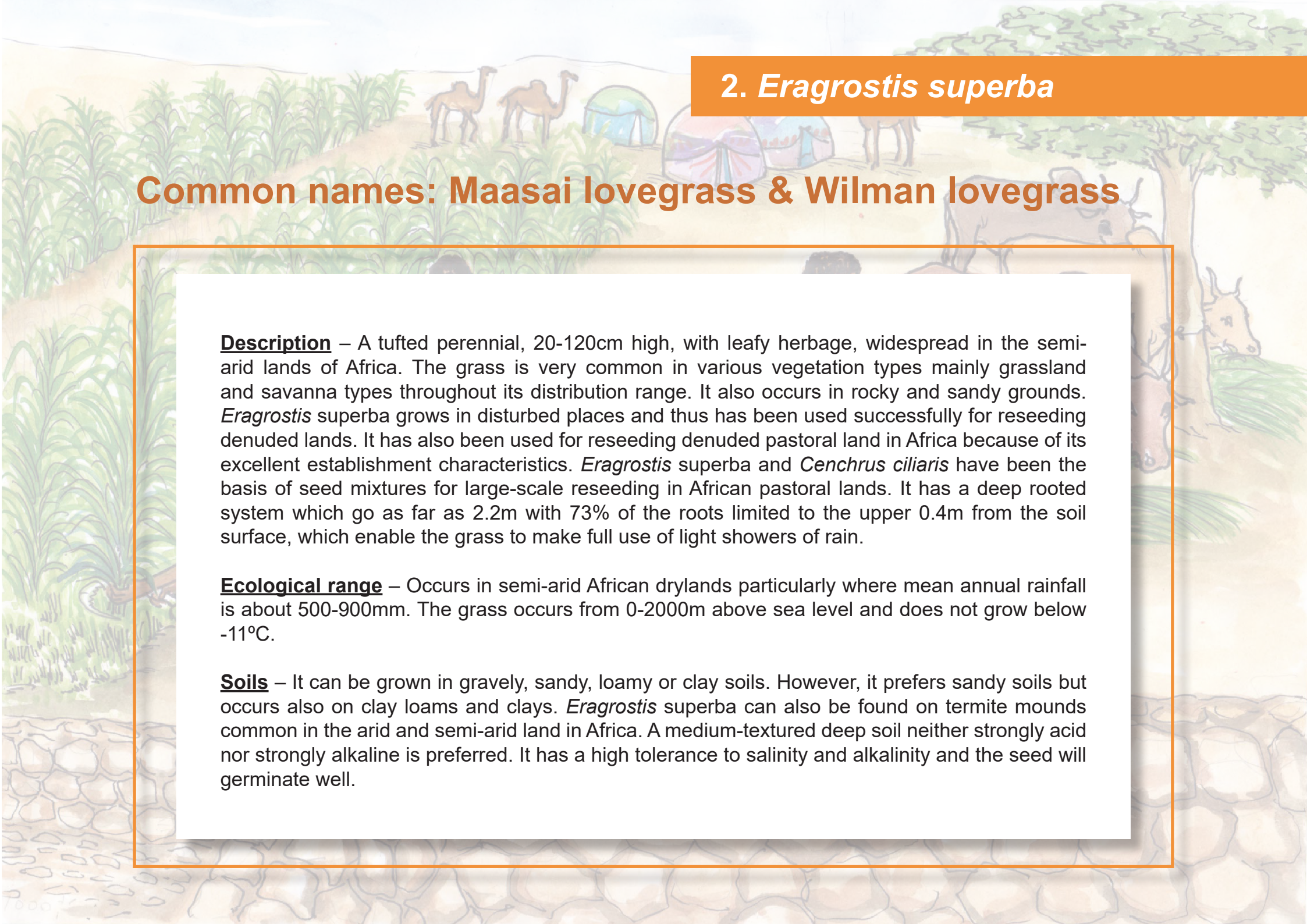
Geographical distribution



1. *Cenchrus ciliaris*

Common names: African foxtail grass & Buffel grass





2. *Eragrostis superba*

Common names: Maasai lovegrass & Wilman lovegrass

Description – A tufted perennial, 20-120cm high, with leafy herbage, widespread in the semi-arid lands of Africa. The grass is very common in various vegetation types mainly grassland and savanna types throughout its distribution range. It also occurs in rocky and sandy grounds. *Eragrostis superba* grows in disturbed places and thus has been used successfully for reseeding denuded lands. It has also been used for reseeding denuded pastoral land in Africa because of its excellent establishment characteristics. *Eragrostis superba* and *Cenchrus ciliaris* have been the basis of seed mixtures for large-scale reseeding in African pastoral lands. It has a deep rooted system which go as far as 2.2m with 73% of the roots limited to the upper 0.4m from the soil surface, which enable the grass to make full use of light showers of rain.

Ecological range – Occurs in semi-arid African drylands particularly where mean annual rainfall is about 500-900mm. The grass occurs from 0-2000m above sea level and does not grow below -11°C.

Soils – It can be grown in gravely, sandy, loamy or clay soils. However, it prefers sandy soils but occurs also on clay loams and clays. *Eragrostis superba* can also be found on termite mounds common in the arid and semi-arid land in Africa. A medium-textured deep soil neither strongly acid nor strongly alkaline is preferred. It has a high tolerance to salinity and alkalinity and the seed will germinate well.

2. *Eragrostis superba*

Common names: Maasai lovegrass & Wilman lovegrass

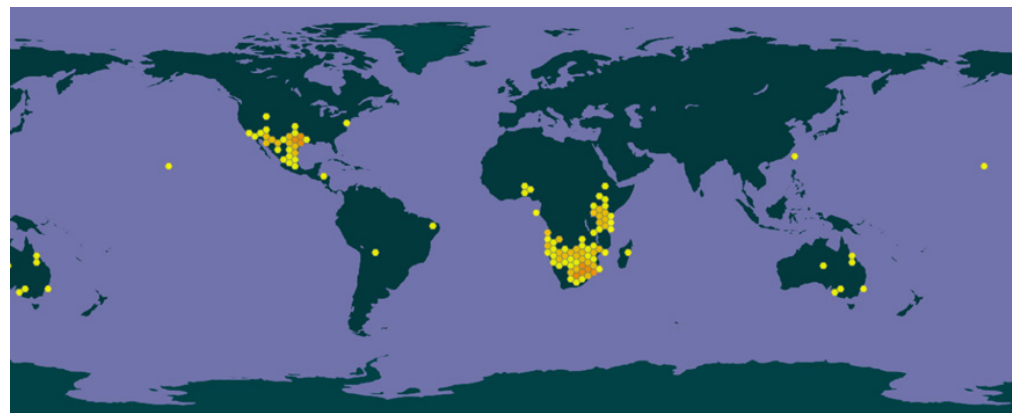


2. *Eragrostis superba*

Common names: Maasai lovegrass & Wilman lovegrass

Forage value and seed production - Chemical and digestibility analyses indicate that the grass has 12% crude protein (% CP) in the dry matter at an early-flowering stage with 30-35% crude fibre (%CF). Pastoralists in Africa have identified *Eragrostis superba* as one of the grass species suitable for fattening and improving the condition of their livestock herd and increasing milk production. Seed can be collected easily from open grassland or at roadsides by stripping the ripe panicles. Mature spikelets are easily detached. The grass grows very easily from seed. Depending on the management, it can give high yields of more than 24000 kg ha⁻¹ per annually at 8-week cutting interval.

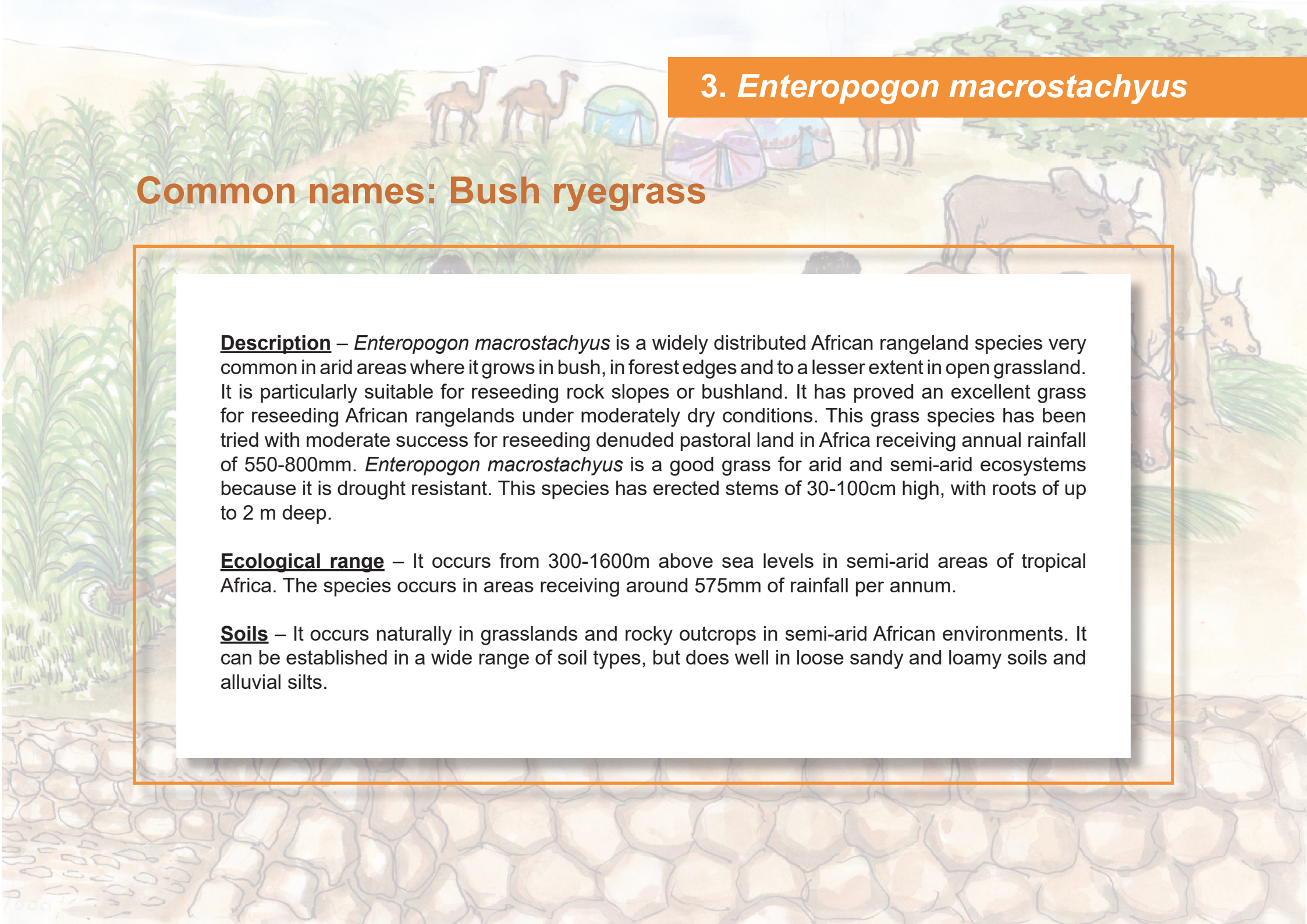
Geographical distribution



2. *Eragrostis superba*

Common names: Maasai lovegrass & Wilman lovegrass





3. *Enteropogon macrostachyus*

Common names: Bush ryegrass

Description – *Enteropogon macrostachyus* is a widely distributed African rangeland species very common in arid areas where it grows in bush, in forest edges and to a lesser extent in open grassland. It is particularly suitable for reseeding rock slopes or bushland. It has proved an excellent grass for reseeding African rangelands under moderately dry conditions. This grass species has been tried with moderate success for reseeding denuded pastoral land in Africa receiving annual rainfall of 550-800mm. *Enteropogon macrostachyus* is a good grass for arid and semi-arid ecosystems because it is drought resistant. This species has erected stems of 30-100cm high, with roots of up to 2 m deep.

Ecological range – It occurs from 300-1600m above sea levels in semi-arid areas of tropical Africa. The species occurs in areas receiving around 575mm of rainfall per annum.

Soils – It occurs naturally in grasslands and rocky outcrops in semi-arid African environments. It can be established in a wide range of soil types, but does well in loose sandy and loamy soils and alluvial silts.

3. *Enteropogon macrostachyus*

Common names: Bush ryegrass



3. *Enteropogon macrostachyus*

Common names: Bush ryegrass

Forage value and seed production - Although stemmy, it is drought resistant and provides useful grazing for herbivores. It is palatable. Thus, its re-introduction in degenerated African pastoral lands is of obvious value to livestock: Crude protein 7-14%, up to 16% at early flowering stage. It is highly palatable especially when young. Biomass yields of 10 t ha⁻¹ annually and up to 600 bales of hay weighing 15 kg annually. It is well grazed by livestock and is a valuable grass in semi-arid rangelands. Good seeding stands occur in Acacia/Commiphora bushlands. Seed production of up to 108 kg ha⁻¹. It is a very good seeder and seed can be collected rapidly by cutting the seed heads or stripping the heads by hand. The seeds germinate readily and grow vigorously. For seed quality and rapidity of germination, *Enteropogon macrostachyus* has no equal amongst the dryland grasses. It is an excellent grass for reseeding under moderately dry conditions.

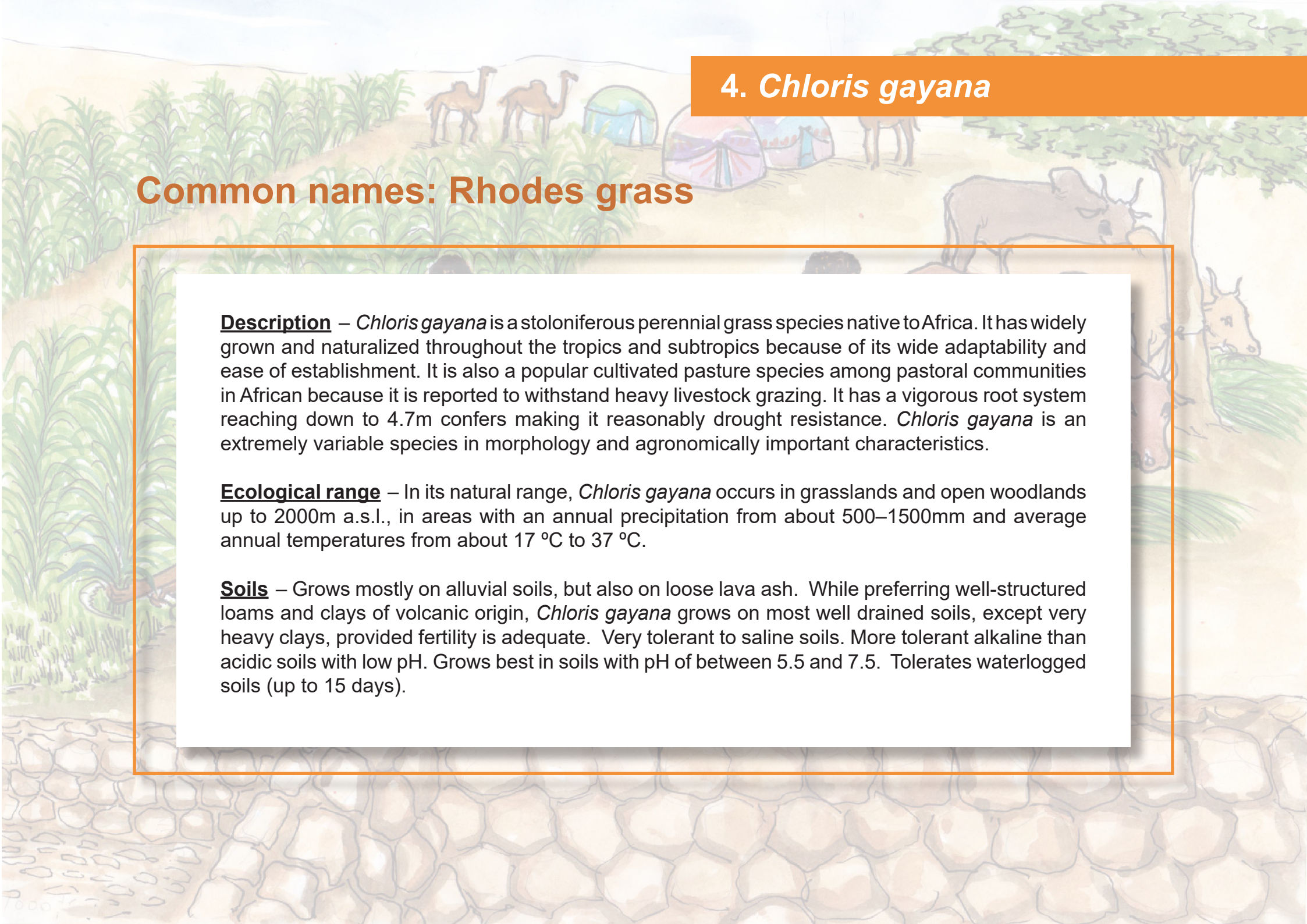
Geographical distribution



3. *Enteropogon macrostachyus*

Common names: Bush ryegrass





4. *Chloris gayana*

Common names: Rhodes grass

Description – *Chloris gayana* is a stoloniferous perennial grass species native to Africa. It has widely grown and naturalized throughout the tropics and subtropics because of its wide adaptability and ease of establishment. It is also a popular cultivated pasture species among pastoral communities in African because it is reported to withstand heavy livestock grazing. It has a vigorous root system reaching down to 4.7m confers making it reasonably drought resistance. *Chloris gayana* is an extremely variable species in morphology and agronomically important characteristics.

Ecological range – In its natural range, *Chloris gayana* occurs in grasslands and open woodlands up to 2000m a.s.l., in areas with an annual precipitation from about 500–1500mm and average annual temperatures from about 17 °C to 37 °C.

Soils – Grows mostly on alluvial soils, but also on loose lava ash. While preferring well-structured loams and clays of volcanic origin, *Chloris gayana* grows on most well drained soils, except very heavy clays, provided fertility is adequate. Very tolerant to saline soils. More tolerant alkaline than acidic soils with low pH. Grows best in soils with pH of between 5.5 and 7.5. Tolerates waterlogged soils (up to 15 days).

4. *Chloris gayana*

Common names: Rhodes grass

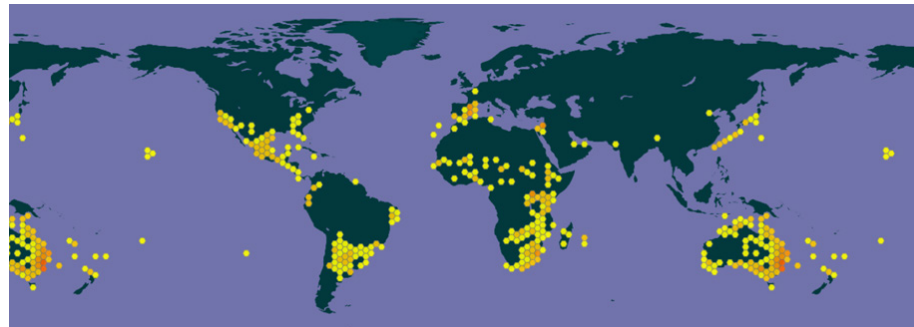


4. *Chloris gayana*

Common names: Rhodes grass

Forage value and seed production - *Chloris gayana* is a prolific seeder and the seeds are easy to handle. Seeds can be obtained in formal seed suppliers in Africa. Thus, there is a tendency to use Rhodes grass indiscriminately because of its ease of establishment. However, its use should properly be restricted to areas where it is known to persist, which will normally receive higher mean annual rainfall (>800 mm). For reseeded denuded pastoral land, the “Rongai” and “Boma” varieties are normally preferred because of biomass yields and are more drought and salinity tolerant than most other cultivated varieties. Biomass yields of between 10-16 tonnes DM ha⁻¹ and seed production of up to 173 kg ha⁻¹. Nutritive value of crude protein 8-10% DM and crude fibre 35-40%. *Chloris gayana* is often used to reseed pastoral grazing lands in Africa because of its ability to spread fast to cover the ground, tolerance to drought, light frost and its suitability for growing in association with many tropical legumes. *Chloris gayana* can be established vegetatively or by seed.

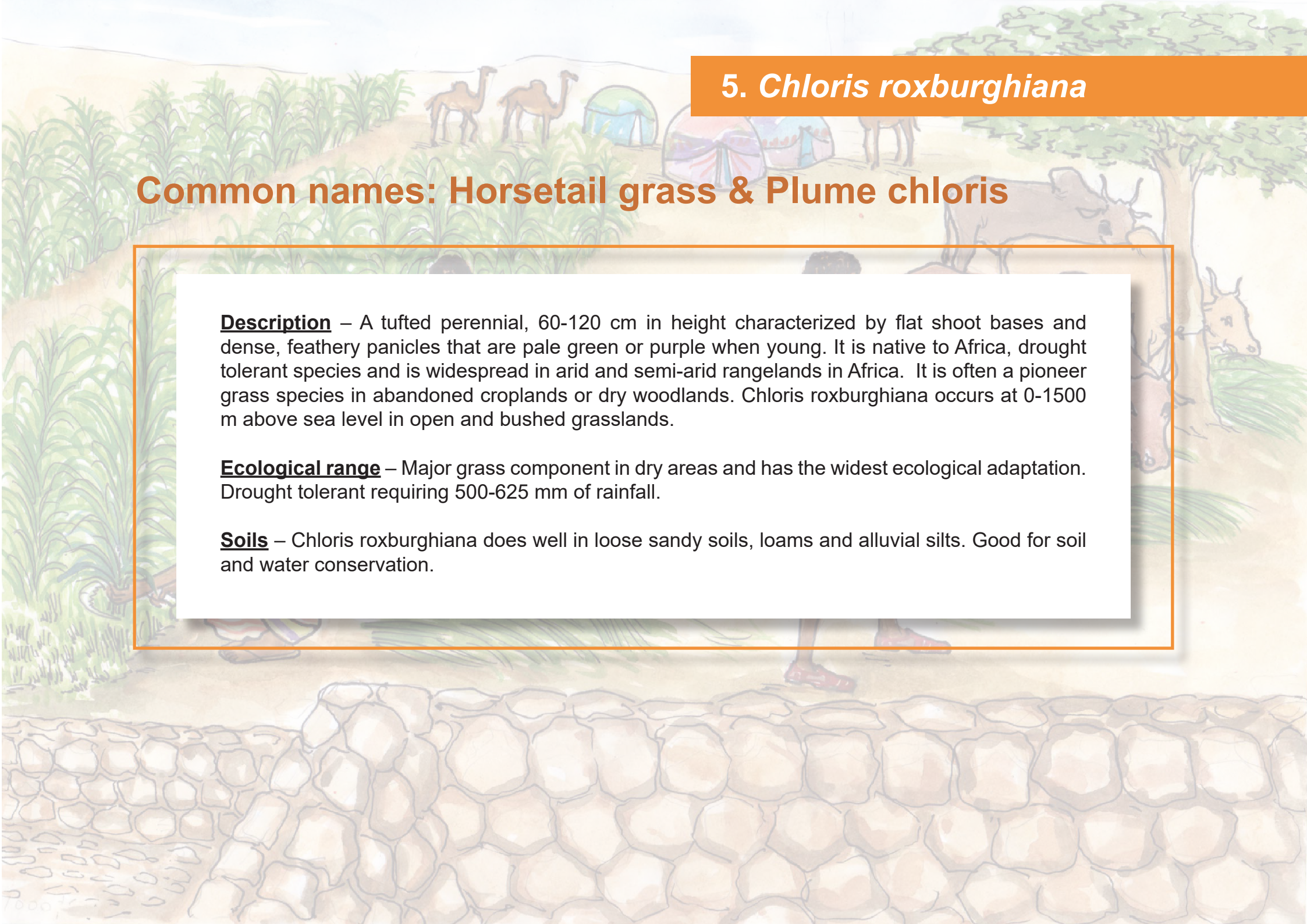
Geographical distribution



4. *Chloris gayana*

Common names: Rhodes grass





5. *Chloris roxburghiana*

Common names: Horsetail grass & Plume chloris

Description – A tufted perennial, 60-120 cm in height characterized by flat shoot bases and dense, feathery panicles that are pale green or purple when young. It is native to Africa, drought tolerant species and is widespread in arid and semi-arid rangelands in Africa. It is often a pioneer grass species in abandoned croplands or dry woodlands. *Chloris roxburghiana* occurs at 0-1500 m above sea level in open and bushed grasslands.

Ecological range – Major grass component in dry areas and has the widest ecological adaptation. Drought tolerant requiring 500-625 mm of rainfall.

Soils – *Chloris roxburghiana* does well in loose sandy soils, loams and alluvial silts. Good for soil and water conservation.

5. *Chloris roxburghiana*

Common names: Horsetail grass & Plume chloris



5. *Chloris roxburghiana*

Common names: Horsetail grass & Plume chloris

Forage value and seed production - *Chloris roxburghiana* has good nutritive value with up to 16% crude protein in the dry matter (DM) at the early-flowering stage. The crude fibre content at this phenological stage is about 30% of the DM. It is a prolific seeder. This species often forms pure stands from which seed can be collected in large quantities. The spikelets are not easily detached from the panicles (due to the matting of the long fine awns) and it is therefore convenient to cut the panicles and thresh the seed later. The seed is extremely difficult to handle. Each panicle contains about 1000 seeds. The caryopses are small with a density of 6.5 to 13 million seeds per kg. *Chloris roxburghiana* has been successfully used for reseeding African drylands. However, it may not be suitable for reseeding at altitudes > 1200 m, because it is a grass of warmer climates. It is a highly palatable especially when young. The grass has also been observed to be highly palatable to cattle, shoats (sheep and goat) and wild herbivores. Biomass yields of 9.9 tonnes ha⁻¹ annually, and up to 657 bales of hay weighing 15kg. Highly rated as a valuable forage species in African rangelands. *Chloris roxburghiana* can also be used as a garden ornamental.

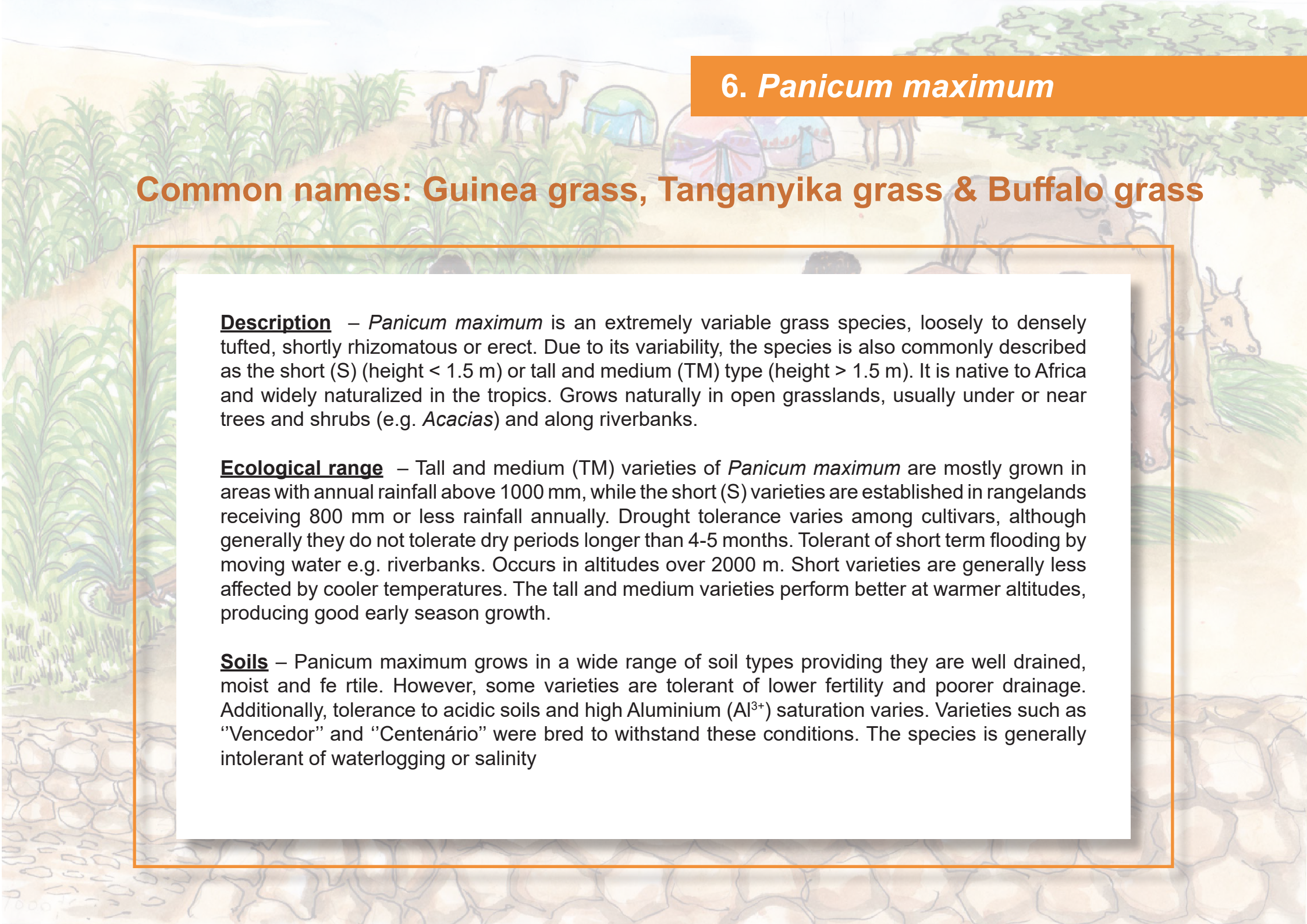
Geographical distribution



5. *Chloris roxburghiana*

Common names: Horsetail grass & Plume chloris





6. *Panicum maximum*

Common names: Guinea grass, Tanganyika grass & Buffalo grass

Description – *Panicum maximum* is an extremely variable grass species, loosely to densely tufted, shortly rhizomatous or erect. Due to its variability, the species is also commonly described as the short (S) (height < 1.5 m) or tall and medium (TM) type (height > 1.5 m). It is native to Africa and widely naturalized in the tropics. Grows naturally in open grasslands, usually under or near trees and shrubs (e.g. *Acacias*) and along riverbanks.

Ecological range – Tall and medium (TM) varieties of *Panicum maximum* are mostly grown in areas with annual rainfall above 1000 mm, while the short (S) varieties are established in rangelands receiving 800 mm or less rainfall annually. Drought tolerance varies among cultivars, although generally they do not tolerate dry periods longer than 4-5 months. Tolerant of short term flooding by moving water e.g. riverbanks. Occurs in altitudes over 2000 m. Short varieties are generally less affected by cooler temperatures. The tall and medium varieties perform better at warmer altitudes, producing good early season growth.

Soils – *Panicum maximum* grows in a wide range of soil types providing they are well drained, moist and fertile. However, some varieties are tolerant of lower fertility and poorer drainage. Additionally, tolerance to acidic soils and high Aluminium (Al^{3+}) saturation varies. Varieties such as “Vencedor” and “Centenário” were bred to withstand these conditions. The species is generally intolerant of waterlogging or salinity

6. *Panicum maximum*

Common names: Guinea grass, Tanganyika grass & Buffalo grass

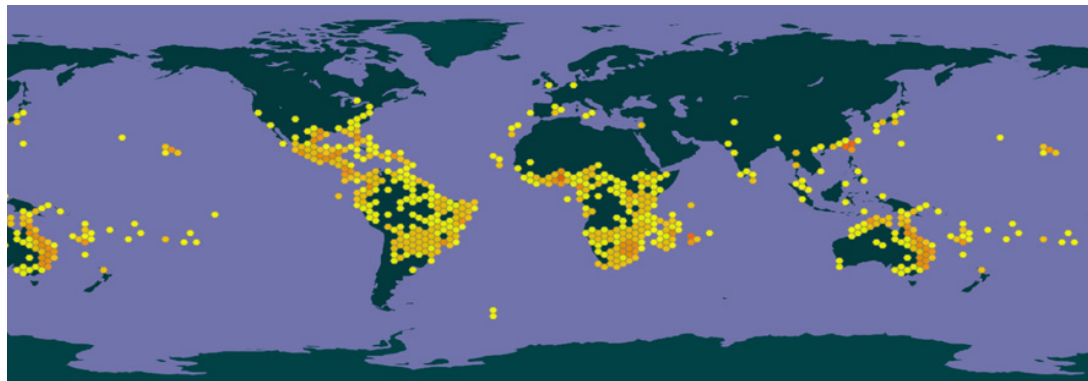


6. *Panicum maximum*

Common names: Guinea grass, Tanganyika grass & Buffalo grass

Forage value and seed production – *Panicum maximum* is of excellent grazing value. It is highly palatable and grazed by all classes of livestock, with particularly high intakes of young leafy biomass. Biomass yields commonly at 20-30 tonnes ha⁻¹ DM and up to 60 tonnes ha⁻¹ DM, depending on variety and growing conditions. Crude protein from 6-25% depending on phenological stage of the grass. Seasonally, in 12 week old regrowth, crude protein commonly range from 5-10%, P levels from 0.15-0.18%, Ca from 0.6-0.8% and Na from 0.07-0.12%. It is very effective in colonizing in ungrazed rangelands, especially where minimal soil disturbance has occurred. Seed yields of 50-100 kg ha⁻¹ pure seed yield are common under machine harvesting and around 200 kg ha⁻¹ from ground sweeping.

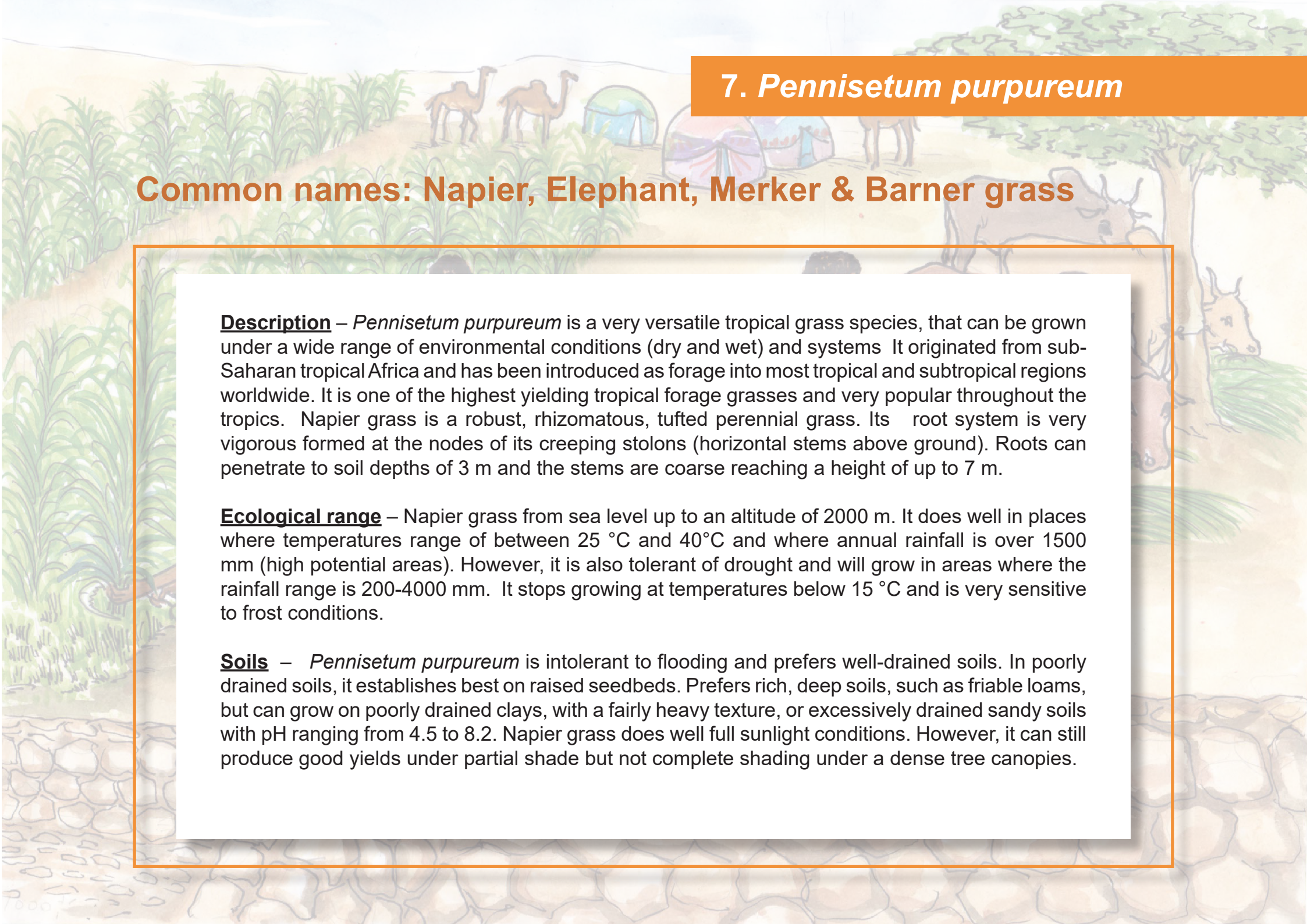
Geographical distribution



6. *Panicum maximum*

Common names: Guinea grass, Tanganyika grass & Buffalo grass





7. *Pennisetum purpureum*

Common names: Napier, Elephant, Merker & Barner grass

Description – *Pennisetum purpureum* is a very versatile tropical grass species, that can be grown under a wide range of environmental conditions (dry and wet) and systems. It originated from sub-Saharan tropical Africa and has been introduced as forage into most tropical and subtropical regions worldwide. It is one of the highest yielding tropical forage grasses and very popular throughout the tropics. Napier grass is a robust, rhizomatous, tufted perennial grass. Its root system is very vigorous formed at the nodes of its creeping stolons (horizontal stems above ground). Roots can penetrate to soil depths of 3 m and the stems are coarse reaching a height of up to 7 m.

Ecological range – Napier grass from sea level up to an altitude of 2000 m. It does well in places where temperatures range of between 25 °C and 40°C and where annual rainfall is over 1500 mm (high potential areas). However, it is also tolerant of drought and will grow in areas where the rainfall range is 200-4000 mm. It stops growing at temperatures below 15 °C and is very sensitive to frost conditions.

Soils – *Pennisetum purpureum* is intolerant to flooding and prefers well-drained soils. In poorly drained soils, it establishes best on raised seedbeds. Prefers rich, deep soils, such as friable loams, but can grow on poorly drained clays, with a fairly heavy texture, or excessively drained sandy soils with pH ranging from 4.5 to 8.2. Napier grass does well full sunlight conditions. However, it can still produce good yields under partial shade but not complete shading under a dense tree canopies.

7. *Pennisetum purpureum*

Common names: Napier, Elephant, Merker & Barner grass

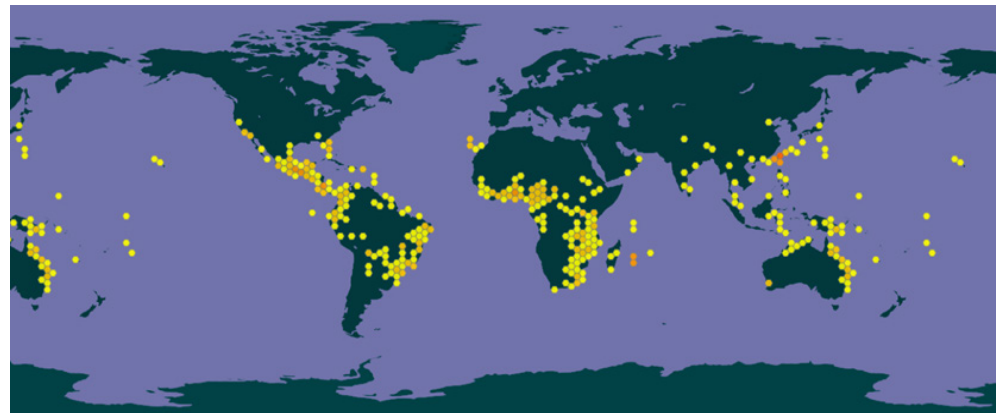


7. *Pennisetum purpureum*

Common names: Napier, Elephant, Merker & Barner grass

Forage value and seed production – *Pennisetum purpureum* produces very few seeds. Thus, it is mainly propagated vegetatively through stem cuttings. Biomass yields are highly dependent on prevailing climatic conditions, especially temperature and rainfall. Under high input fertilization, annual yields range is 20-80 tonnes DM ha⁻¹ and 2-10 tonnes DM ha⁻¹ under rainfed conditions. On average, it has crude protein of 11% dry matter (DM) and crude fibre of 36% DM. Mineral composition of calcium 3 g kg⁻¹ DM, phosphorus 2.5 g kg⁻¹ DM, potassium 27 g kg⁻¹ DM and magnesium 2 g kg⁻¹ DM. Its high moisture content in stems makes it prone to termite attacks during dry season, especially in dryland environments.

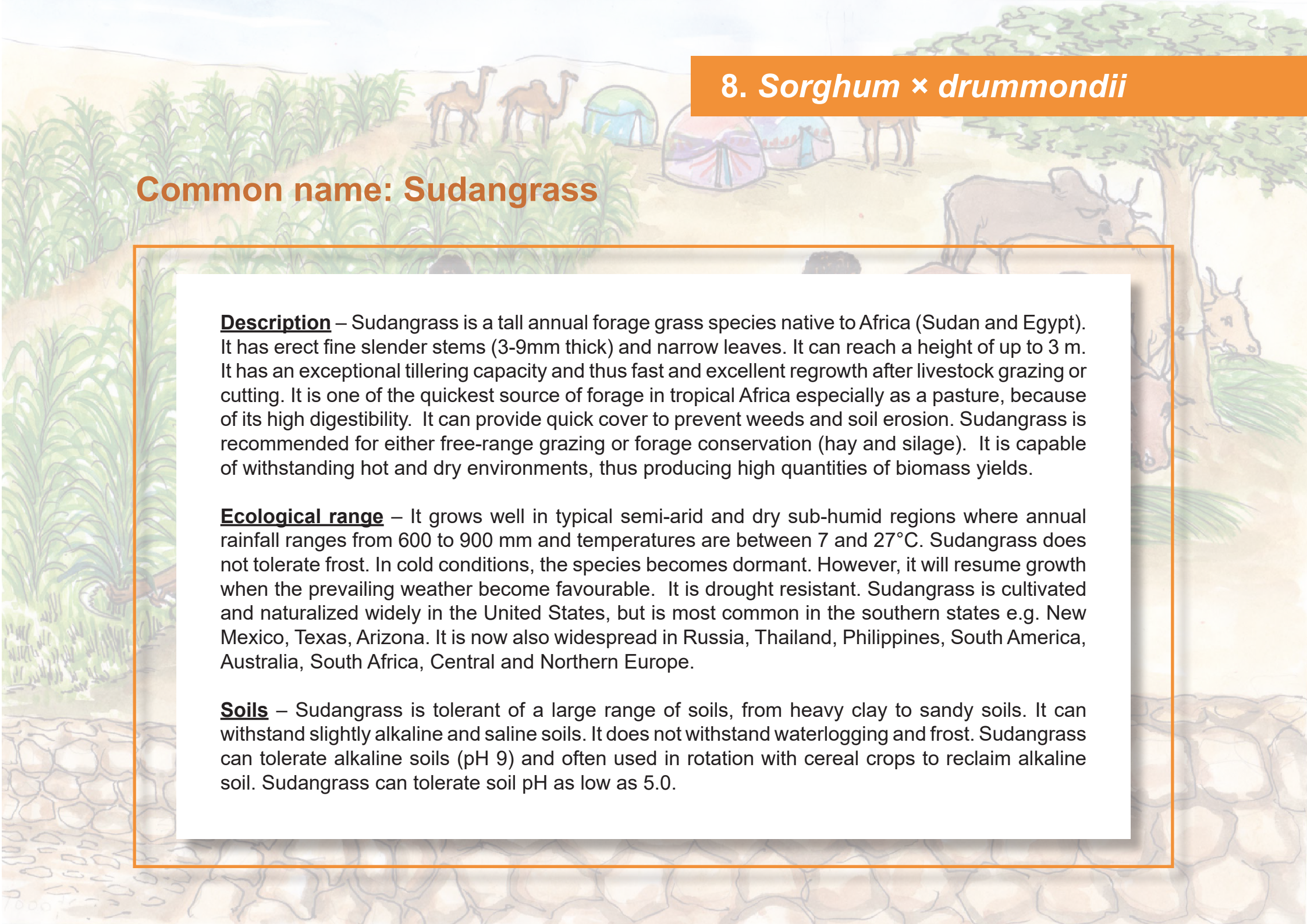
Geographical distribution



7. *Pennisetum purpureum*

Common names: Napier, Elephant, Merker & Barner grass





8. *Sorghum × drummondii*

Common name: Sudangrass

Description – Sudangrass is a tall annual forage grass species native to Africa (Sudan and Egypt). It has erect fine slender stems (3-9mm thick) and narrow leaves. It can reach a height of up to 3 m. It has an exceptional tillering capacity and thus fast and excellent regrowth after livestock grazing or cutting. It is one of the quickest source of forage in tropical Africa especially as a pasture, because of its high digestibility. It can provide quick cover to prevent weeds and soil erosion. Sudangrass is recommended for either free-range grazing or forage conservation (hay and silage). It is capable of withstanding hot and dry environments, thus producing high quantities of biomass yields.

Ecological range – It grows well in typical semi-arid and dry sub-humid regions where annual rainfall ranges from 600 to 900 mm and temperatures are between 7 and 27°C. Sudangrass does not tolerate frost. In cold conditions, the species becomes dormant. However, it will resume growth when the prevailing weather become favourable. It is drought resistant. Sudangrass is cultivated and naturalized widely in the United States, but is most common in the southern states e.g. New Mexico, Texas, Arizona. It is now also widespread in Russia, Thailand, Philippines, South America, Australia, South Africa, Central and Northern Europe.

Soils – Sudangrass is tolerant of a large range of soils, from heavy clay to sandy soils. It can withstand slightly alkaline and saline soils. It does not withstand waterlogging and frost. Sudangrass can tolerate alkaline soils (pH 9) and often used in rotation with cereal crops to reclaim alkaline soil. Sudangrass can tolerate soil pH as low as 5.0.

8. *Sorghum × drummondii*

Common name: Sudangrass

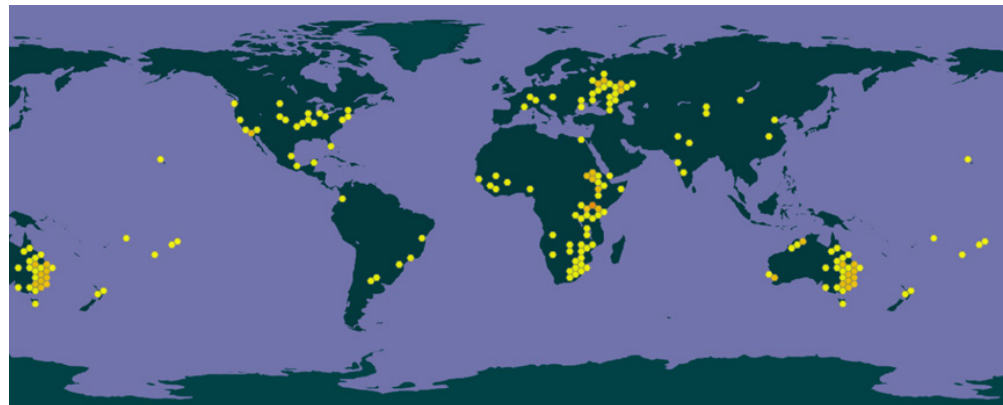


8. *Sorghum × drummondii*

Common name: Sudangrass

Forage value and seed production – Average yields are 80 tonnes ha⁻¹ (fresh weight), 12-15 tonnes ha⁻¹ (dry weight) and 40-45 tonnes ha⁻¹ (e.g. silage). Its exceptional tillering capacity and fast regrowth makes it possible to have 4 harvests during the growing season. Sorghum hybrid varieties are known to produce prussic acid poisoning in livestock. Grazing poses the most risk to livestock when the plants are young (up to 50 cm tall) and drought stressed. Thus recommended to graze or 'cut-and-carry' only when forage is greater than 50 cm tall. Crude protein content ranges between 8-17%. Highly palatable species (juiciness and sweetness) and nutritious forage. Seed production of up to 1500 kg ha⁻¹ under rainfed conditions.

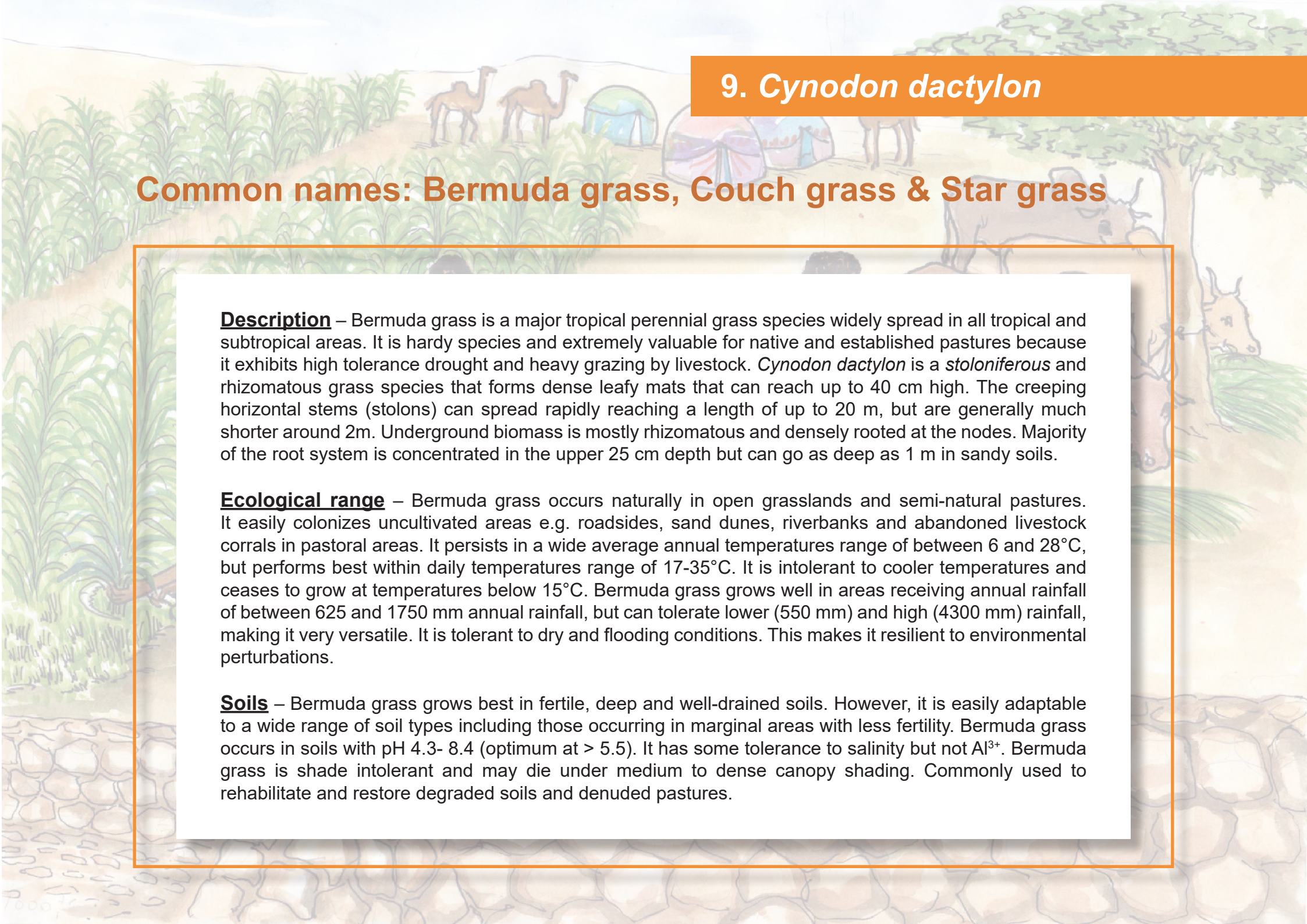
Geographical distribution



8. *Sorghum × drummondii*

Common name: Sudangrass





9. *Cynodon dactylon*

Common names: Bermuda grass, Couch grass & Star grass

Description – Bermuda grass is a major tropical perennial grass species widely spread in all tropical and subtropical areas. It is hardy species and extremely valuable for native and established pastures because it exhibits high tolerance drought and heavy grazing by livestock. *Cynodon dactylon* is a *stoloniferous* and *rhizomatous* grass species that forms dense leafy mats that can reach up to 40 cm high. The creeping horizontal stems (stolons) can spread rapidly reaching a length of up to 20 m, but are generally much shorter around 2m. Underground biomass is mostly rhizomatous and densely rooted at the nodes. Majority of the root system is concentrated in the upper 25 cm depth but can go as deep as 1 m in sandy soils.

Ecological range – Bermuda grass occurs naturally in open grasslands and semi-natural pastures. It easily colonizes uncultivated areas e.g. roadsides, sand dunes, riverbanks and abandoned livestock corrals in pastoral areas. It persists in a wide average annual temperatures range of between 6 and 28°C, but performs best within daily temperatures range of 17-35°C. It is intolerant to cooler temperatures and ceases to grow at temperatures below 15°C. Bermuda grass grows well in areas receiving annual rainfall of between 625 and 1750 mm annual rainfall, but can tolerate lower (550 mm) and high (4300 mm) rainfall, making it very versatile. It is tolerant to dry and flooding conditions. This makes it resilient to environmental perturbations.

Soils – Bermuda grass grows best in fertile, deep and well-drained soils. However, it is easily adaptable to a wide range of soil types including those occurring in marginal areas with less fertility. Bermuda grass occurs in soils with pH 4.3- 8.4 (optimum at > 5.5). It has some tolerance to salinity but not Al^{3+} . Bermuda grass is shade intolerant and may die under medium to dense canopy shading. Commonly used to rehabilitate and restore degraded soils and denuded pastures.

9. *Cynodon dactylon*

Common names: Bermuda grass, Couch grass & Star grass

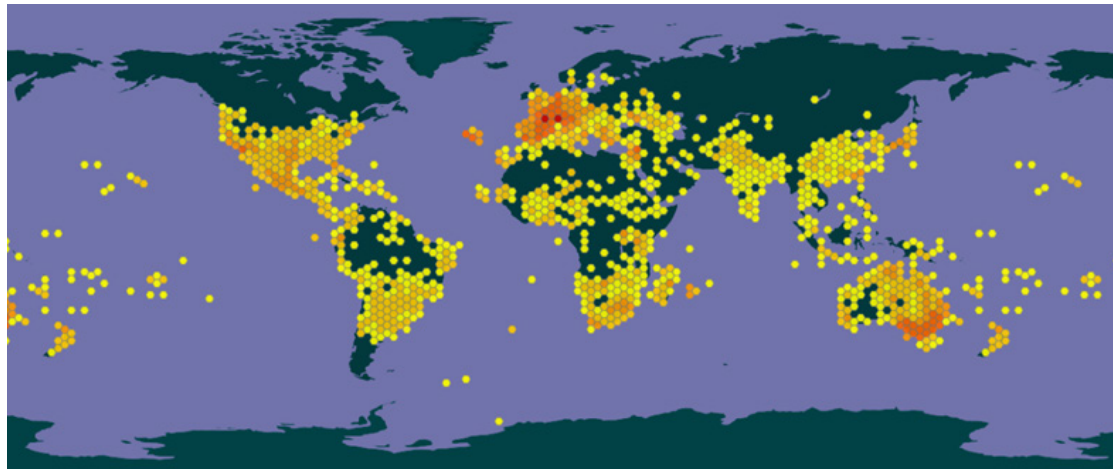


9. *Cynodon dactylon*

Common names: Bermuda grass, Couch grass & Star grass

Forage value and seed production – Bermuda grass is of moderate nutritive value. However, it is a valuable forage species because it is one of the most grazing-resistant tropical grasses and can withstand heavy livestock grazing once established. Dry matter yields of the grass are about 5-15 tonnes ha⁻¹. Bermuda grass has fine stems and leafy biomass making it a suitable species for making good quality hay, with crude protein of up to 16%.

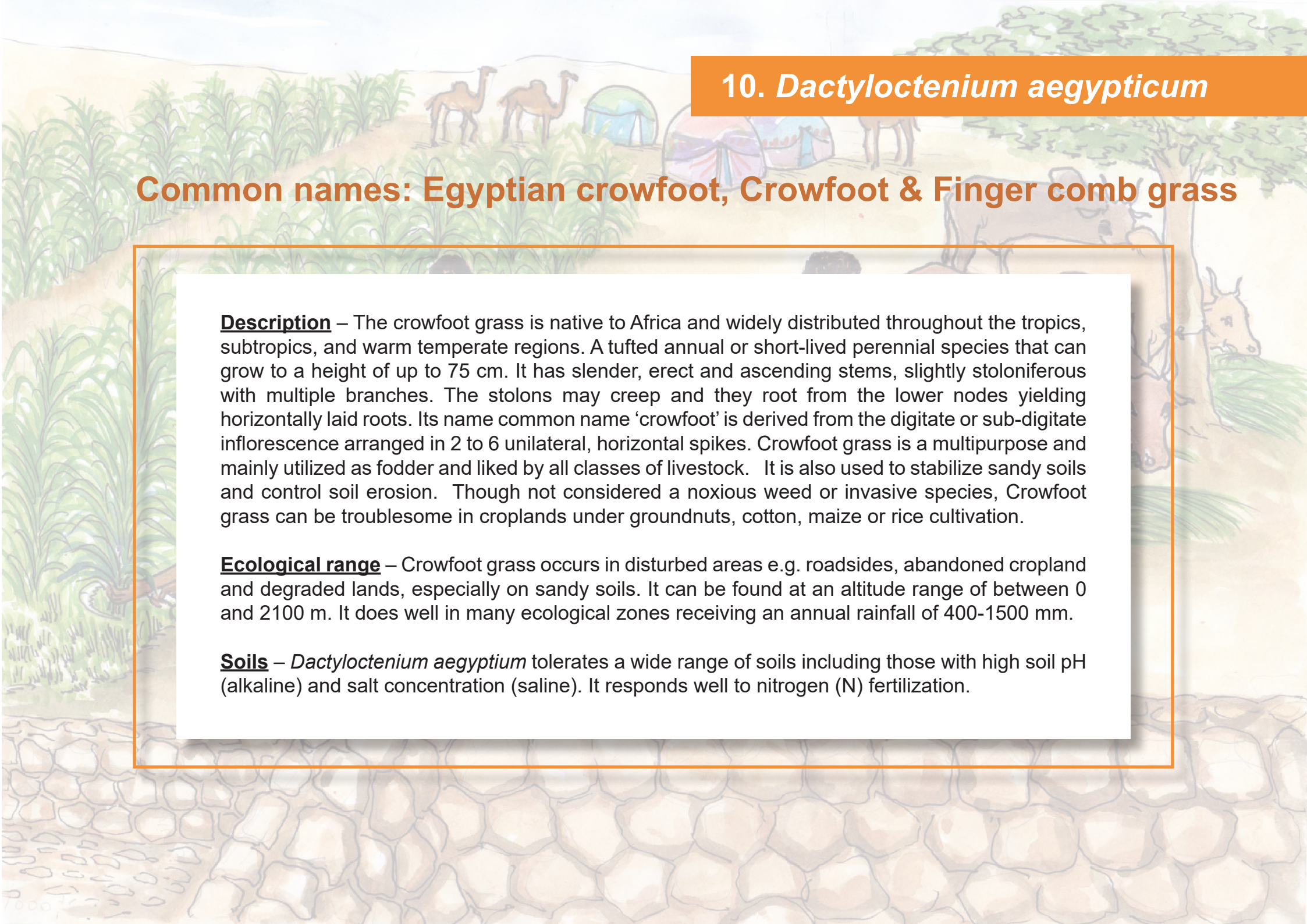
Geographical distribution



9. *Cynodon dactylon*

Common names: Bermuda grass, Couch grass & Star grass



The background of the slide is a stylized illustration of a desert environment. In the upper left, there are green, tufted plants. In the center, two camels are standing on a sandy path. To their right are several colorful tents. In the foreground on the right, a brown cow is visible. The bottom of the slide features a pattern of light brown, irregular shapes resembling stones or sand dunes.

10. *Dactyloctenium aegypticum*

Common names: Egyptian crowfoot, Crowfoot & Finger comb grass

Description – The crowfoot grass is native to Africa and widely distributed throughout the tropics, subtropics, and warm temperate regions. A tufted annual or short-lived perennial species that can grow to a height of up to 75 cm. It has slender, erect and ascending stems, slightly stoloniferous with multiple branches. The stolons may creep and they root from the lower nodes yielding horizontally laid roots. Its name common name ‘crowfoot’ is derived from the digitate or sub-digitate inflorescence arranged in 2 to 6 unilateral, horizontal spikes. Crowfoot grass is a multipurpose and mainly utilized as fodder and liked by all classes of livestock. It is also used to stabilize sandy soils and control soil erosion. Though not considered a noxious weed or invasive species, Crowfoot grass can be troublesome in croplands under groundnuts, cotton, maize or rice cultivation.

Ecological range – Crowfoot grass occurs in disturbed areas e.g. roadsides, abandoned cropland and degraded lands, especially on sandy soils. It can be found at an altitude range of between 0 and 2100 m. It does well in many ecological zones receiving an annual rainfall of 400-1500 mm.

Soils – *Dactyloctenium aegyptium* tolerates a wide range of soils including those with high soil pH (alkaline) and salt concentration (saline). It responds well to nitrogen (N) fertilization.

10. *Dactyloctenium aegyptium*

Common names: Egyptian crowfoot, Crowfoot & Finger comb grass

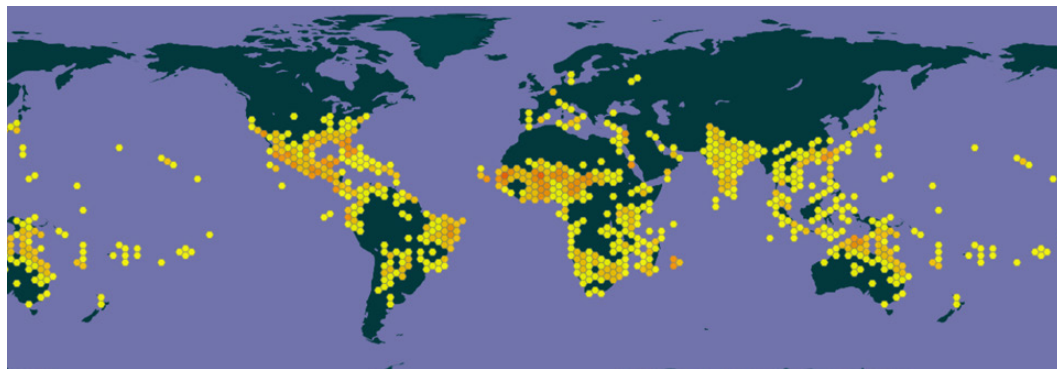


10. *Dactyloctenium aegyptium*

Common names: Egyptian crowfoot, Crowfoot & Finger comb grass

Forage value and seed production – In semi-arid pastoral lands, it makes valuable annual pastures. In its native range (East and South Africa), it has been used to improve the productivity of pastures. Crowfoot grass is also an excellent species for hay and silage making. This is because, once established, it grows fast. Moreover, it is drought-resistant grasses as it can quickly grow and produce seed during the rainy season, quickly replenishing the seed bank. *Dactyloctenium aegyptium* can be established from seed sown at a shallow depth (1 cm deep), prior to the onset of the rainy season in semi-arid lands. It is suitable forage species for free-range grazing and performs relatively well in overgrazed rangelands. Biomass yields range is from 3 to 6 tonnes DM ha⁻¹.

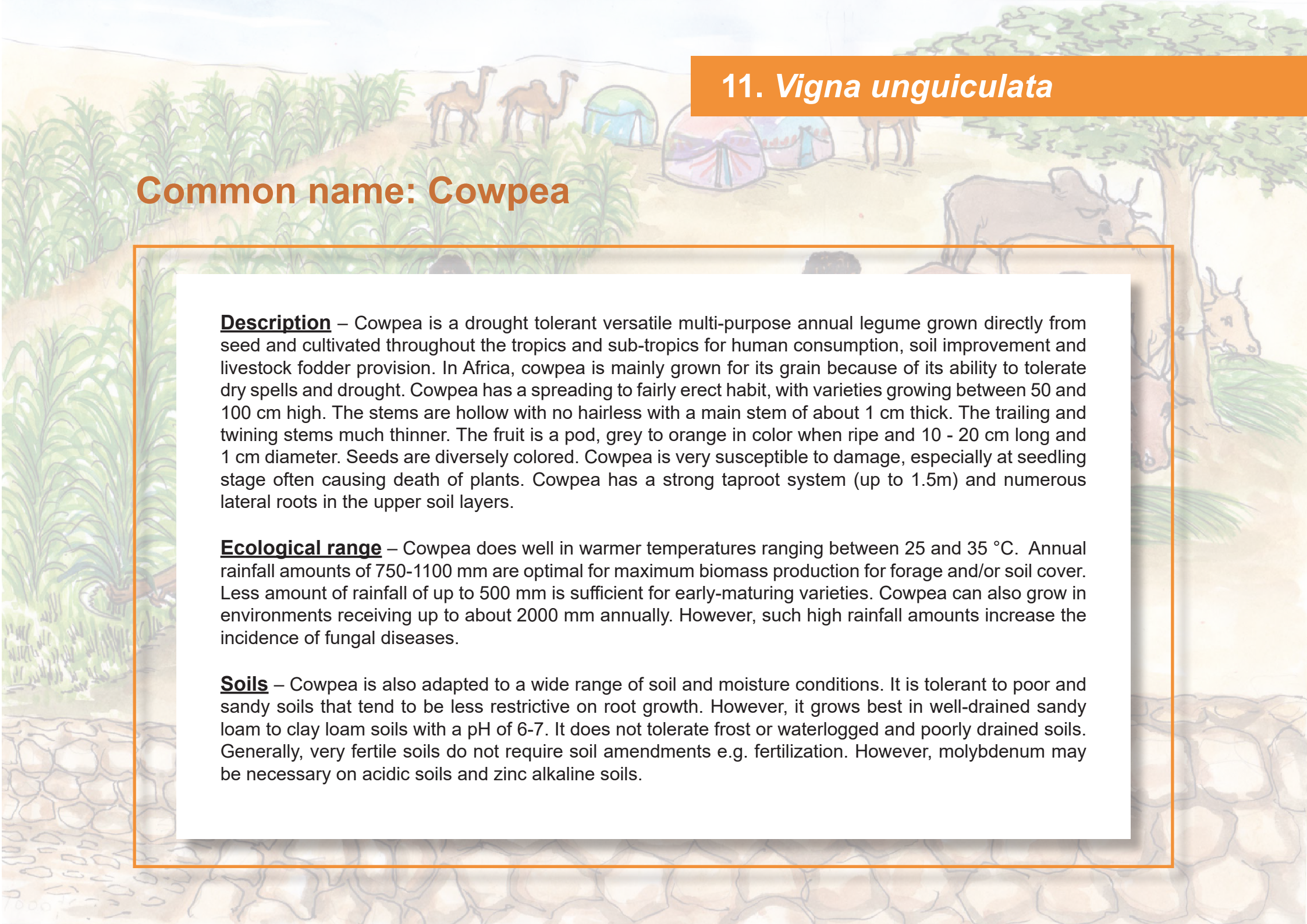
Geographical distribution



10. *Dactyloctenium aegyptium*

Common names: Egyptian crowfoot, Crowfoot & Finger comb grass





11. *Vigna unguiculata*

Common name: Cowpea

Description – Cowpea is a drought tolerant versatile multi-purpose annual legume grown directly from seed and cultivated throughout the tropics and sub-tropics for human consumption, soil improvement and livestock fodder provision. In Africa, cowpea is mainly grown for its grain because of its ability to tolerate dry spells and drought. Cowpea has a spreading to fairly erect habit, with varieties growing between 50 and 100 cm high. The stems are hollow with no hairless with a main stem of about 1 cm thick. The trailing and twining stems much thinner. The fruit is a pod, grey to orange in color when ripe and 10 - 20 cm long and 1 cm diameter. Seeds are diversely colored. Cowpea is very susceptible to damage, especially at seedling stage often causing death of plants. Cowpea has a strong taproot system (up to 1.5m) and numerous lateral roots in the upper soil layers.

Ecological range – Cowpea does well in warmer temperatures ranging between 25 and 35 °C. Annual rainfall amounts of 750-1100 mm are optimal for maximum biomass production for forage and/or soil cover. Less amount of rainfall of up to 500 mm is sufficient for early-maturing varieties. Cowpea can also grow in environments receiving up to about 2000 mm annually. However, such high rainfall amounts increase the incidence of fungal diseases.

Soils – Cowpea is also adapted to a wide range of soil and moisture conditions. It is tolerant to poor and sandy soils that tend to be less restrictive on root growth. However, it grows best in well-drained sandy loam to clay loam soils with a pH of 6-7. It does not tolerate frost or waterlogged and poorly drained soils. Generally, very fertile soils do not require soil amendments e.g. fertilization. However, molybdenum may be necessary on acidic soils and zinc alkaline soils.

11. *Vigna unguiculata*

Common name: Cowpea

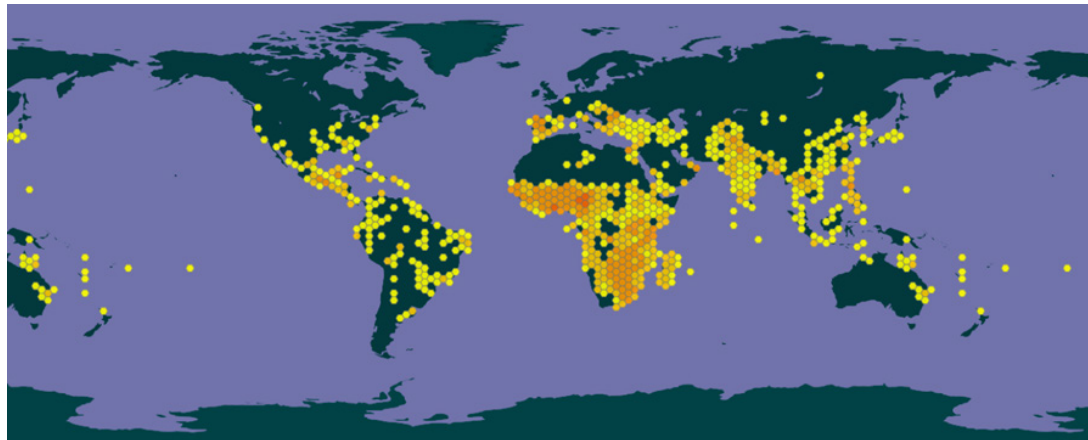


11. *Vigna unguiculata*

Common name: Cowpea

Forage value and seed production - Cowpea is highly palatable and of high nutritive value to livestock (crude protein in green foliage 14-21%, crop residues 6-8% and grain 18 - 26%). Cowpea can produce leafy biomass of up to 5 tonnes of hay per hectare ha in 3 months and seed grain of up to 1000 kg ha⁻¹. Seeds weigh 5 to 30 g per 100 seeds. Best time to harvest cowpea for hay is at peak flowering (2-3 months) after sowing. In good seasons, cowpea forage will regrow after grazing. Light grazing is recommended to maintain the plant structure frame and minimize damage to the crop.

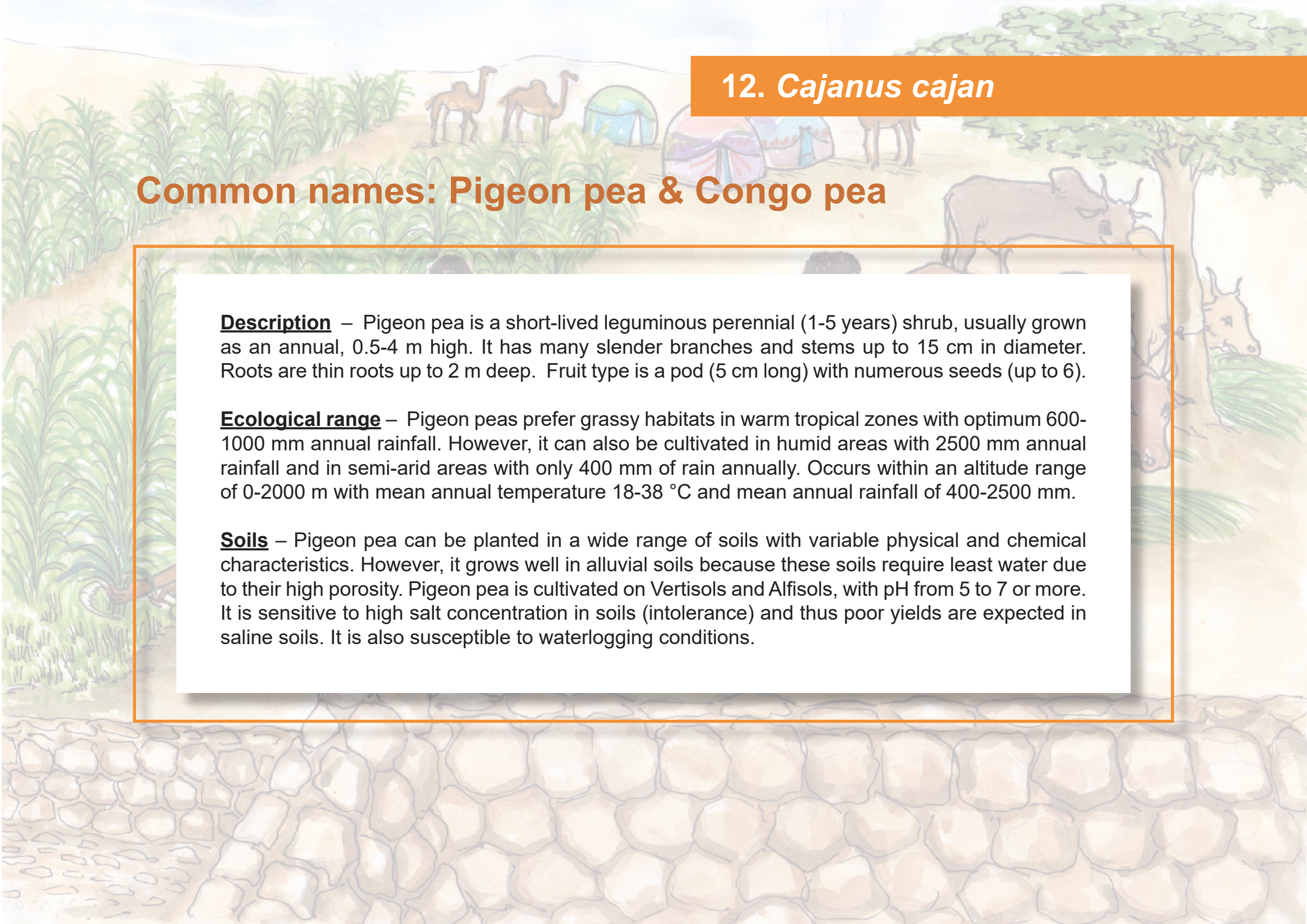
Geographical distribution



11. *Vigna unguiculata*

Common name: Cowpea





12. *Cajanus cajan*

Common names: Pigeon pea & Congo pea

Description – Pigeon pea is a short-lived leguminous perennial (1-5 years) shrub, usually grown as an annual, 0.5-4 m high. It has many slender branches and stems up to 15 cm in diameter. Roots are thin roots up to 2 m deep. Fruit type is a pod (5 cm long) with numerous seeds (up to 6).

Ecological range – Pigeon peas prefer grassy habitats in warm tropical zones with optimum 600-1000 mm annual rainfall. However, it can also be cultivated in humid areas with 2500 mm annual rainfall and in semi-arid areas with only 400 mm of rain annually. Occurs within an altitude range of 0-2000 m with mean annual temperature 18-38 °C and mean annual rainfall of 400-2500 mm.

Soils – Pigeon pea can be planted in a wide range of soils with variable physical and chemical characteristics. However, it grows well in alluvial soils because these soils require least water due to their high porosity. Pigeon pea is cultivated on Vertisols and Alfisols, with pH from 5 to 7 or more. It is sensitive to high salt concentration in soils (intolerance) and thus poor yields are expected in saline soils. It is also susceptible to waterlogging conditions.

12. *Cajanus cajan*

Common name: Pigeon pea & Congo pea

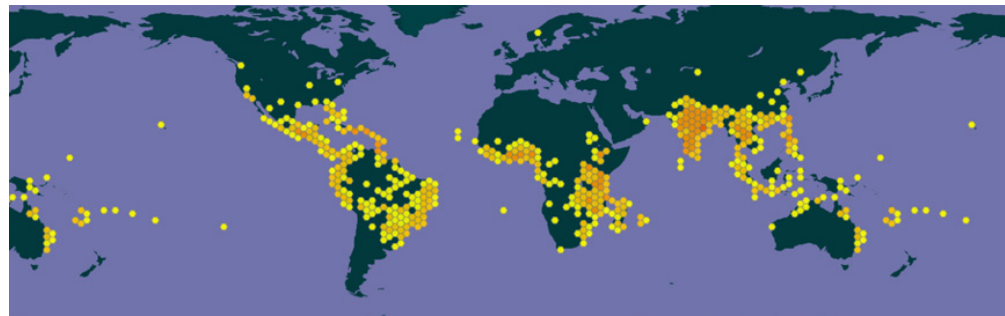


12. *Cajanus cajan*

Common name: Pigeon pea & Congo pea

Multipurpose benefits – Fresh seeds contain vitamins, especially vitamin A and vitamin B complex. Dry seeds contain up to 10 g water, 30 g protein, 9 g fat, 65 g carbohydrates, 10 g fibre and 4 g ash per 100 g edible portion. The energy content averages 1450 kJ per 100 g seeds. Pigeon peas leaves can be used for livestock feed formulations, instead of alfalfa. Pods can be used as livestock feed but are low in protein and high in fibre content. Flowers are a rich source of bee forage. Multiple branches as good source of fuel and timber used for light construction Extensive coverage of croplands with *Cajanus cajan* prevents soil erosion by wind and water. Long-term *Cajanus cajan* crop stands can fix up to 200 kg N ha⁻¹ over a 10-month period, through biological nitrogen fixation (BNF). Its vigorous root system (2 m) can break soil hardpans, thus improving soil structure, enhancing infiltration. Green manure through leaf fall builds soil organic matter and provides additional nitrogen. *Cajanus cajan* is a non-competitive with cereals e.g. maize and wheat, and thus ideal for intercropping.

Geographical distribution



12. *Cajanus cajan*

Common name: Pigeon pea & Congo pea



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