Zoysia grasses are semitropical grasses naturally distributed and grown extensively as turf in temperate east Asia and Malaysia. While zoysia grass has been grown as a lawn grass in the US since 1895, it is relatively uncommon in Australia, although Zoysia macrantha (prickly couch) is a widespread grass indigenous to Australia, a component of coastal heath grasslands from the Grampians in Victoria to the Sunshine Coast in Queensland.

Zoysia comprises 10 species named after Karl von Zois, 1756–1800, country gentleman and plant-collector of Carniola, Austria. Three species are commonly utilised for turfgrass purposes: Z. japonica, Z. matrella, and Z. tenufolia. They form a dense, low growing turf with a low water requirement and relatively good shade tolerance, although they are quite slow to establish full cover. Zoysia japonica is sometimes called Japanese or Korean lawngrass or common zoysia.

Zoysia was probably involved in the first recorded reference to turf, in the "Man-yo-shu", a collection of poems from 759 AD. Subsequent references to sodding occurred in the "Saku-tei-ki", a gardening book published in Japan in 1156. According to Maki (1976) the lawn garden was connected with the tea ceremony, and commercial sod farming began in 1701. Zoysia japonica and other species grow wild in native grasslands in Japan. A finer leaved species, Z. matrella was introduced to Japan from China in 1713. In the late 1920's Koraishiba was used on the course at the Kobe Golf Club in Japan.

In 1906 Dr. Frank N. Meyer, a noted plant explorer, collected seed in Korea and introduced Zoysia matrella into the United States (Meyer also collected the first Centipede grass seed in China ten years later). In 1951 Meyer zoysiagrass, a selection made by Dr. Ian Forbes at the USDA Research Station at Beltsville, Maryland, was released. Soon after Dr. Forbes released Emerald Zoysia, a fine textured hybrid similar to the better strains of Z matrella. Meyer and Emerald have been popular for 50 years and many people consider them the ultimate in lawn grasses. Emerald produces few viable seed and Meyer seed do not reproduce true to type. Therefore each must be established with sprigs or plugs, which can require one to three years, or solid sodding, which is expensive.

Limited new cultivar development has occurred in the past few years, but room definitely exists for improvement to realise the potential for this grass. Several US programs are currently in progress to develop effective seed treatment techniques to enable growing from seed.

In Australia very little is known about warm season and tropical turfgrasses. We import most of our grass cultivars, and the information on the management of these grasses from the United States. Aside from performance evaluations of many cool season grasses, mainly for golf and bowling green applications, little research has been performed on turfgrass in Australia. The Queensland Department of Primary Industries has initiated a turf unit to investigate management of turf under various environmental stresses including shade, salinity, drought and temperature on thirteen warm-season turfgrasses. The University of Western Australia looked at water requirements of eleven warm season grasses in 1998 and were able to show that the minimum daily irrigation required to maintain acceptable growth ranged from 50-60% of net daily evaporation in summer conditions. An important result because it showed that many grasses could perform well with appreciably less water and provided a yardstick, using evaporation, to determine the amount of water needed.

Description: The creeping stolons closely resemble couch grass in appearance although the leaf blades are much stiffer than many other lawn grasses. Zoysia is a mat forming perennial with creeping rhizomes and stolons. If newly planted zoysia is left for too long before mowing, it tends to form stout clumps instead of spreading laterally. Leaf blades are narrow and usually flat. Auricles not present, the ligule a fringed membrane to a fringe of hairs, similar to Cynodon.

While not suited for all areas, Zoysia performs best when night temperatures are warm, preferably above 20°C, which makes it an ideal grass for northern Australia. Because many subtropical gardens are shady groves of trees, grasses fight
Zoysiagrass is generally propagated by plugs or shredded sod and is very slow to establish, usually requiring two to three years to achieve uniform cover. Breeding efforts have developed seeded varieties that reduce the slow establishment time that traditionally has been a major drawback with zoysiagrass. Establishment from seed results in more even cover, without the clumpiness observed from vegetatively propagated turf. Until full cover is obtained, weed control is important to minimise competing weed species in newly established turf.

Major varieties of zoysia for turf use are Meyer, Emerald and Zenith

**Meyer (Z-52) Zoysia japonica**
Meyer, an improved variety of *Zoysia japonica* with good texture, colour and vigour, was released by the US Dept of Agriculture and the US Golf Association in 1951 and has remained the most well known and used variety of zoysiagrass. It was bred from Japanese lawngrass seed introduced in 1930 from northern Korea.
Develops tough, wear-resistant turf. Leaf width intermediate between that of *Z. matrella* and common *Z. japonica*. Drought resistant, but will turn brown during long, dry periods. Grows and persists on relatively poor soils. Rate of spread and colour improved by applications of fertiliser and irrigation. Competes very satisfactorily with weeds and other grasses in areas where adapted. Competition from other species increases time required to attain complete coverage.
Winter-hardy, but in general only recommended in areas with long, warm growing season.
This is the zoysia "Amazoy" often advertised as the "super" grass in newspapers and magazines.

**Belair Zoysia japonica**
A single-plant selection from F1 progeny of a promising vegetative selection most likely introduced from North Korea, from an old turfgrass nursery at the Beltsville Agricultural Research Centre. Intended use on lawns, parks, athletic fields, and golf courses. Exhibits a green- or white-coloured rhizome as opposed to red- or purple-coloured rhizomes on other cultivars.
Belair, released in 1987, is noted for its excellent cold tolerance and medium green colour. It has a coarser leaf texture and faster rate of establishment than Meyer. It is susceptible to brown patch disease.

**El Toro Zoysia japonica**
El Toro is a relatively new zoysia that was developed by Dr. Victor Younger at the University of California, Riverside and looks like Meyer. It is the fastest growing zoysia, tolerates mowing with a rotary mower and produces less thatch than Meyer. The winter hardness of this grass is not well established.

**Zenith Zoysia japonica** seeded variety
Dr. Jack Murray, who headed the Zoysia research program at Beltsville, retired in 1988 because of health problems, and was permitted to take a collection of some of the most promising materials with him to his new home in Florida. Murray reasoned that if two or more of his best Zoysia selections were systematically planted in a manner that invited one parent to fertilise the other and cross-pollinate, the resulting variety would produce plants endowed with the hybrid vigour as well as the meritorious characteristics of the parent plants. Murray provided Patten Seed Company, with five of the better USDA selections and under his...
guidance seed production fields and observation plots were established. One resultant variety which had two parents that produced reddish-purple anthers (flowers) failed to live up to its seed production promise and production was suspended. Zenith, the other variety, surpassed expectations insofar as turf quality is concerned, although seed yields per acre are low and therefore the seed will never be low priced. Zenith is the progeny of three parent plants which have yellow-white flowers. Each parent was selected for superior attributes such as leaf texture, colour, disease resistance, drought tolerance, fall colour retention, uniform colour when dormant, and early spring greenup.

**Crowne Z japonica**
A coarse-textured vegetatively propagated clone of *Z. japonica* from Texas A&M. Crowne is noted for its tolerance to low water use requirements, excellent cold hardiness and rapid recuperative ability.

**DeAnza Z japonica**
DeAnza is an offspring of El Toro Zoysia, but has a finer leaf blade than its parent.

**Emerald Z japonica X Z. tenuifolia**
Hybrids made in all possible combinations between *Z. japonica* and *Z. matrella* var. tenuifolia. Selection was based on turf quality (leaf width, density, colour, and growth habit) and winter-hardiness. Exhibited hybrid vigour in rate of spread, Browning, and density ratings. Considerably more shade and frost tolerant than couchgrass.

Emerald released in 1955 is a medium textured grass used for lawns and golf courses. Emerald will develop excess thatch rather quickly if overfertilised and is prone to winter injury. Emerald zoysia is a fine-textured hybrid that is possibly the most attractive zoysia. It is well suited for top-quality lawns where a good maintenance program is provided. Emerald zoysia has less winter hardiness but more shade tolerance than Meyer. It has a dark green colour, a very fine leaf textue, high shoot density and a low growth habit.

**Empire, Empress, Cathay, Companion, JaMur, Sunrise, and Traveller** are recent commercial selections of *Z. japonica*.

**Manilla grass Z. matrella**
Warm-season, sod forming grass from Asia. Finer, denser sod, but less winter-hardy than *Z. japonica*. Fine, dark green leaf blades usually 75-125 mm long when not mowed. Grows very dense. Produces creeping stolons that root profusely; ends of stolons cling to ground and thus grow under competing plants. Tolerates considerable shade. Produces seedheads and some seed in spring. Rather free from diseases and insects. Susceptible to drought, but recovers rapidly when moisture becomes available.

**Koraishiba Z. matrella**
*Z. matrella* was originally introduced to Japan from China in 1713. In the late 1920's "Koraishiba" was used on the course at the Kobe Golf Club in Japan (Kakuda, 1987). It is now used extensively in parks and gardens in Japan.

**Birodoshiba Z. matrella (Z. pungens Willd)**
Observed growing as a velvet-like turf in gardens around Tokyo in 1902.

**Cavalier Z. matrella**
Developed by Texas A&M University, Cavalier ranked number one in NTEP zoysia trials over a three year period. It’s rated as having good shade tolerance, good salt tolerance, and excellent autumn colour retention.

**Other Zoysia species**

**Prickly couch Z. macrantha**
Naturalised in coastal dunes in NSW and Queensland.

**Seashore zoysiagrass Z. sinica**
Useful in acid soils where salty or effluent water is required for irrigation.

**Z. tenuifolia**
An ornamental grass ground cover with a unique clumping or mounding appearance. It is usually left unmowed for a freeform natural look. Extremely slow growing, very fine textured, and dark green in colour. It has good shade tolerance. Spreading is by rhizomes (underground runners). *Z. tenuifolia* is not as cold tolerant as the other varieties of zoysia.

**Establishment:** Zoysiagrass is slow to establish compared to other turfgrass species. Due to its slow growth, it should be propagated vegetatively with plugs, sprigs or sod. Recent breeding efforts aimed at creating seeded types have been successful, overcoming the major drawback of slow establishment by sprigging or sod. Winterkill, especially during the first winter following seeding, can be severe.

The growth rate is slow, and is quite stiff and tough compared to other grasses. The invasion by cool-season grasses and broadleaf weeds during winter should be controlled with herbicides in order to maintain a uniform turf.

**Mowing:** When rotary mowers are used, the height of cut for zoysiagrass usually performs well at the 25 to 50mm range. But don’t be conned by the grass salesman’s spiel that zoysia hardly ever needs mowing because of its slow
growth. If it is not mowed regularly, zoysia becomes clumpy and uneven.

Correct mowing is the most important part of lawn management, and regular mowing is essential for a quality zoysia lawn. Frequency of cutting is the most important aspect of mowing: no more than one-third of the grass should be removed at one time. Otherwise, the grass becomes stemmy, thatchy, and weedy.

Watering and fertilising will increase mowing frequency. A satisfactory balance must be achieved between the three cultural practices.

Zoysia is a tough, thick, fibrous grass requiring a sharp blade and a heavy-duty lawnmower. A reel mower is preferred for zoysia, especially for close-cut turf, but the grass must not be allowed to grow tall between mowings. Vary the direction of mowing each time the grass is mowed.

Clippings may be caught for a neat appearance, but catching clippings does not prevent thatch. Mowing height and frequency are more important for thatch prevention than clipping removal.

**Thatch**

Thatch management is vital for a zoysia lawn, as zoysia is more thatch-prone than other lawn grasses. Thatch is a hidden layer of dead surface roots, runners and stems between the soil surface and the grass leaves in established lawns. Thatch accumulates gradually over the years and usually is undetected until it becomes a serious problem. More than 1 cm of thatch is excessive and can be detrimental. It restricts water, fertiliser, and air movement into the soil and favours disease development and insect activity. The roots retract from the soil into the thatch layer as it builds up over the years. Zoysia then loses much of its heat- and drought-resistance. To determine how much thatch a lawn has, cut out a small plug of turf, including some soil, with a knife or plugger. Look for a brown, compressed layer of organic matter. A common misconception is that thatch is caused by clippings. Thatch builds up at the ground level mostly from surface roots, stems and runners that are not cut off by the lawnmower. Clippings decompose more readily than roots, stems and runners because they are 90 percent water.

Infrequent mowing, mowing too high, frequent watering, and over-fertilising with nitrogen accelerate thatch accumulation. Good management will help, but will not completely prevent thatch.

A thick layer of thatch in an older lawn cannot be removed all at once because most of the live roots will be in the thatch layer. Complete thatch removal will result in severe thinning of the turf. The thatch must be gradually reduced over a period of several years by a series of renovations.

**Scarringfying** using a vertical mower, is the recommended method of mechanically removing thatch from couch, buffalo, zoysia, and Centipede lawns. Blade spacing should be 75mm for Buffalo, 50-75mm for Centipede grass, and 25-50mm for couch and Zoysiagrass on home lawns.

Dethatching at the wrong time can result in a serious setback of the zoysia. Dethatching in early summer results in the least shock and the grass recovers most rapidly at that time because rhizome and stolon growth is rapid. Zoysiagrass if scarified in two directions will require approximately 30 days for full recovery during the growing season. Fertilising speeds recovery.

Core aerators may also be used for thatchy lawns. Coring machines remove a core or plug of thatch and soil and leave it on the surface. The small holes they leave in the thatch and soil aid in root, water, and air penetration into the soil. Cores can be left to be broken up by mowing and watering; the soil added to the surface aids in thatch decomposition. Some people set their lawnmowers very low and scalp off all vegetation in early spring before growth begins. This seems to work if it is done every year from the time the zoysia is established. Do not attempt it on lawns when most of the roots are in an old thatch layer. Scalping is a dusty job that is hard on a mower and produces a lot of debris to be removed.

**Fertilising**

Because zoysia is a warm season grass, it is fertilised during the warm months, from late spring to early autumn. It should not be fertilised in early spring. Fertilising in early spring benefits weeds and promotes premature top growth before the roots begin to grow. Late fertilisation may delay the natural dormancy before winter.

Fertiliser helps produce a thick, green lawn, but too much fertiliser, the wrong kind, or fertilising at the wrong time may do more harm than good. Zoysia should not be fertilised as much as other lawn grasses or it will produce excessive thatch.

Nitrogen is the most important fertiliser element for turfgrass, but is not available in sufficient amounts by the soil. Nitrogen increases a lawn’s green colour, density, and growth. Zoysia lawns should receive no more than 10 to 15 grams of actual nitrogen per 100 square metres per growing season. It is best to space several applications four to six weeks apart. Even less may be applied for low-maintenance lawns. Since little phosphorus is used by grass, it often accumulates to excessive levels in established lawns that have been routinely fertilised with this element. Potassium is used in larger amounts than phosphorus.

Lime or sulfur should never be added to the soil unless their need is determined by a soil test. Lime makes the soil more alkaline; sulfur makes it more acidic. Using either element without a soil test increases the risk of making a minor problem more serious. The ideal soil pH of zoysia is 6 to 6.5, which is slightly acidic.

In areas where zoysiagrass remains green year around, frequent applications of soluble nitrogen fertilisers will help maintain a green colour during the cool season (usually 5 grams of soluble nitrogen per 100 sq metres per month will suffice). Where zoysiagrass goes dormant during the winter, discontinue fertilisation until late spring.

**Weed Control**

A thick, well-managed zoysia lawn has good weed resistance during the growing season, but cool season weeds can be
a problem in winter when the grass is dormant. Weeds usually invade turf after it has been damaged or weakened by insects or disease. Improper mowing, watering or fertilising can also lead to weed problems.

Cool season broadleaf weeds such as dandelion, chickweed, and wintergrass should be controlled in autumn rather than in the spring when they bloom. Crabgrass and other warm season grassy weeds are not usually a problem in dense, well-established zoysia lawns. Crabgrass preventers applied in early spring prevent annual grassy weeds while new lawns are becoming established. After establishment they should not be needed on a routine basis.

Cool season perennial grassy weeds such as tall fescue can be unsightly while zoysia is dormant. A few clumps can be dug out; more severe infestations can be controlled with a non-selective herbicide such as Roundup if zoysia is completely dormant.

Compatible preemergent herbicides: benefin, benefin/oryzalin, benefin/trifluralin, bensulide, DCPA, dithiopyr, isoxaben, napropamide, oryzalin, pendimethalin, simazine

Compatible postemergent herbicides: bentazon, chlorosulfuron, CMA, 2,4-D (and mixtures), dicamba, DSMA, fenoxaprop-ethyl, halosulfuron methyl, imazaquin, MCPP, MSMA, metsulfuron-methyl

In zoysiagrass or tall fescue, repeat applications of fenoxaprop at 28 to 35 day intervals during the summer months provides couchgrass suppression.

Zoysia is susceptible to herbicides containing ethofumesate, glyphosate, metalochlor, metribuzin, sethoxydim

**Pests:** scarab grubs, lawn armyworm (Spodoptera mauritia), and billbug can devastate zoysia if they are not controlled. Early detection and control are essential in preventing serious damage. Proper timing is as important as selecting the right control. Most insects are not a problem every year. Apply insecticides only when you are sure that there are enough insects to cause damage.

Insects cause more damage to turf under stress. Thatch also can contribute to certain insect problems, and it impedes penetration of insecticides to soil-active insects.

**Disease**

Zoysia is not especially susceptible to disease. Diseases are strongly influenced by both environmental factors and cultural practices, especially over-watering and overfertilizing. Thatch also may contribute to certain disease problems. A routine spray schedule for disease is not recommended for home lawns, but early detection and prevention are advised when disease problems occur. By the time extensive damage is noticed, it is often too late for control.

The best defence against disease is proper cultural practices, especially mowing, watering, fertilising, and thatch control.

Brown Patch (**Rhizoctonia solani**): The name, brown patch, is not very descriptive of the varied symptom expression caused by Rhizoctonia spp. on turfgrass. Symptoms differ on cool- and warm-season grasses and vary depending on environmental conditions and cultural practices. Outbreaks of brown patch on zoysiagrass lawns are often triggered by one to several days of overcast, wet weather. Stationary fronts with associated evening fogs and rain showers provide conditions conducive to the development of both these and many other turfgrass diseases. Temperature patterns favouring pathogen activity over turf growth will also accelerate the development and increase the severity of damaging turfgrass diseases.

Symptoms on warm-season grasses include circular to irregular patches of blighted turf. Patches up to several yards in diameter commonly develop in autumn, winter and spring when these grasses are approaching or emerging from dormancy, evening temperatures are below 20°C, and rainfall usually increases. Active infections are noticeable by yellow leaves at the edges of patches. Leaf sheaths become rotted, and a gentle tug on the leaf blade easily separates the leaf from the runner. Brown patch usually does not discolor roots. Disease develops most rapidly when air temperatures are between 24 and 30°C and wet conditions are present and generally subsides when air temperatures rise above 32°C.

Management: Water only as needed and early in the day to remove dew and allow the grass to dry quickly. Avoid over fertilisation in spring and fall. Improve the turfgrass root system with good drainage and aeration to reduce damage caused by brown patch. Fungicides are most effective when used on a preventative basis.

Bipolaris, Drechslera and Exserohilum Leaf Spot, Crown and Root Rot (formerly Helminthosporium). Helminthosporium type diseases develop during warm weather when cyclical patterns of wetting and drying occur in the thatch layer. Symptoms often appear on leaf blades (leaf spots) in cool weather and as crown and root rots (melting-out) in hot humid weather. In early stages, severely affected turf has a purple cast and the turfgrass thins. Often the condition becomes advanced before a disease is suspected and verified by the presence of leaf spots. Fading-out is most prevalent on turfgrass weakened by other disease-causing organisms, insect pests, nematodes or improper cultural practices.

Small, brown-to-purple lesions with tan centres occur on leaf blades. Leaf spots are commonly found near the collar area of the leaf blade. Severely affected leaves turn reddish-brown, then wither and die. When temperatures exceed 30°C or under severe disease conditions, a sheath and crown rot may occur with turfgrass killed in patches.

Management: cultural practices contribute to healthy grass that resists development of weak pathogens: Maintain adequate fertility, giving special attention to levels of nitrogen and potassium. Aerate to eliminate soil compaction. Provide good drainage. Avoid herbicide applications during periods of disease activity. Water adequately, but not excessively or too frequently. Mow at the proper height. Avoid thatch build-up.

Fungicide applications hasten recovery of affected turf. However, they should be used in combination with good
cultural practices. Preventive fungicide applications are more effective than treating a severe outbreak.

**Fairy Rings** (fungi - *Agaricus* spp., *Marasmius oreades*): Fairy rings grow in circles or crescent-shaped areas, ranging from a few centimetres to 10 metres in diameter, feed on organic matter in the soil and thatch layer. Areas previously covered with trees or fill which contained stumps or logs are prime candidates for development of fairy rings. Fairy rings are a common problem on newly established golf greens that contain a high level of organic matter. Fairy rings are either dark green or brown. Brown rings develop when fungal mycelium forms a hydrophobic layer. This layer prevents water from reaching turfgrass roots, resulting in drought stress. Turfgrass next to the ring may be dark green because of nitrogen released from organic matter on which the fungus is feeding. Mushrooms may or may not develop after a period of heavy rainfall or irrigation.

Management: Vertical mowing and topdressing to reduce thatch and removal of tree stumps and roots reduce the organic matter on which the fungus feeds. Fertilisation may mask dark green fairy rings by stimulating growth in the rest of the turf. Aeration and drenching the soil with a wetting agent will minimise development of the zone of brown or dead grass in the area of dense mycelial growth. Fairy rings are difficult to control with fungicides since soil in the infected area is almost impervious to water. Sporadic success has achieved by aerating and drenching with fungicide.

**Shade:** Zoysiagrasses vary widely in their shade tolerance, but all grow slower in less than full sun. Zoysia cultivars that have good tolerance to shade include El Toro, Diamond, Belair and Cavalier. Meyer and Emerald have fair tolerance. Couch exhibits extremely poor tolerance to any amount of shade.

(Best) tall fescue > ryegrass > Stenotaphrum > Paspalum notatum > zoysia > Buchloe > Cynodon > centipede (least)

**Salt tolerance:** (best) Paspalum vaginatum > saltgrass (*Distichlis stricta*) > Kikuyu > Buchloe > Stenotaphrum > Cynodon > zoysia > Carpetgrass (*Axonopus*) > Centipede (*Eremochloa*) (least)

**Temperature:** Zoysia continues to grow to temperatures of 37°C and, like other warm-season species, become dormant at temperatures less than 12°C. Of all the warm-season grasses, zoysiagrasses and buffalograss have the greatest cold hardiness, though considerable variation exists among varieties.

It is prone to direct low-temperature injury compared to cool-season turfgrasses and tends to weaken under shaded conditions. These characteristics limit its potential for use.

**Recoverative potential:** Couch > Kikuyu > Stenotaphrum > Zoysia > carpet > centipede

Zoysiagrasses are among the most wear tolerant turfgrasses. Their slow rate of growth gives them very poor recuperative potential. Therefore, they perform satisfactorily on lawns, fairways and sports fields. But, they are not recommended for football or soccer fields where traffic is concentrated in certain areas of the field. If the grass is completely worn in those areas, zoysiagrass is very slow to fill in the damaged areas.

**Irrigation requirement:**

Zoysia is relatively drought tolerant and does not need frequent watering. Established lawns that need frequent watering probably have excessive thatch. Watering too often causes shallow roots, thatch, and disease. It is much better to water thoroughly every week or two than to water several times per week. Regular watering will be needed only during hot, dry weather. Tropical turfgrasses could probably be irrigated over a much longer cycle than currently employed without any impact on quality. Daily irrigation may be less efficient than weekly irrigation designed to wet the bottom of the soil profile. Variable weather and soil conditions are important factors affecting watering. Good judgment is better than watering on a fixed schedule.

Zoysia does not grow well in wet or poorly drained soils. Clay soils present a special problem because they do not drain well. Zoysia roots may rot away in waterlogged soils and then only surface roots remain.

**REFERENCE**


