Adaptation, management and use of warm-season turfgrasses

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Despite the efforts of modern advertising...
- There is no such thing as a perfect turfgrass
  - And there never will be
- There is no one grass that is best for all uses in all situations and at all locations

Choosing a turfgrass
- Forget what is trendy
  - Put promotional “information” into perspective
- Look at the use required
- Choose the best adapted grass for that use under the climatic and soil conditions on your site

Management
- Choose a well adapted grass
  - Easier to manage
  - Cheaper to manage
  - Better turf quality (e.g. less weed invasion)
- Understand your plant and work with it
  - Science-based information (e.g. physiology, ecology, nutrition)
- Concentrate on overcoming weaknesses
  - Strengths take care of themselves

Marketing ‘information’
- “...sales information is what gets repeated over and over until it is accepted as fact - not always accurate”

The tropical challenge
- Most warm-season grass varieties from North America, etc., have not been developed for tropical conditions
  - Periods of heat, humidity, rain (irregular mowing), heavy cloud cover, low light, high pest & disease pressure
  - Monsoonal climates with 4-8 month dry season (need good drought tolerance or unlimited irrigation)
- Develop better adapted “local” varieties
  - E.g. most green-quality bermudagrasses from about 30° latitude
  - Novotek® developed in north Queensland tropics (17° latitude)
- Make greater use of Asian species and germplasm
Outline of presentation

- Summarise strengths & weaknesses of the major species
- Explore underlying factors leading to adaptation
  - Climate (temperature, drought, shade)
  - Soils (salinity)
  - Wear
- Introduce some minor species and their attributes
- Turf quality vs. sod price
- Quality assurance
  - An unnecessary expense or value for money?

Cynodon dactylon (bermudagrass)

- Most widely used warm-season turfgrass
- Strengths
  - Spreads rapidly by stolons and rhizomes
  - Good drought tolerance
  - Fair to good wear tolerance
  - Organocrescent herbicides used to control most other grasses
- Weaknesses
  - Few varieties adapted to tropical conditions
  - Poor shade tolerance
  - High N requirements
  - Varietal contamination (seed, vegetative survivors)
  - Organocrescent herbicides to be phased out in 2014

Cynodon dactylon X transvaalensis (hybrid bermudagrass)

- Medium- & fine-textured genotypes for fairways & greens
- Strengths
  - Sterile hybrids (do not set fertile seeds)
  - Greater shoot densities than C. dactylon
  - Can be mown shorter than C. dactylon
  - Finer textured turf than C. dactylon
- Weaknesses
  - Best adapted to warm temperate & subtropical conditions
  - Need intensive management
  - Genetically unstable (mixture of two different genomes)
  - Mutate vegetatively particularly when under stress
  - Finer stems do not mow as well as C. dactylon at higher levels

Paspalum vaginatum (seashore paspalum)

- Former “niche” species well promoted over past decade
- Strengths
  - Vibrant green colour (the “wow” factor)
  - High salinity & waterlogging tolerance
  - Possible to plant a single variety wall-to-wall
- Weaknesses
  - Expensive to manage in non-saline situations (competition)
  - Limited range of herbicides (none for grass control)
  - Poor shade & drought tolerance
  - Slow to recover from damage (scalping, drought thinning)
  - Higher N requirements than promoted
  - Risk of varietal contamination from seed
  - Disease susceptibility (e.g., dollar spot under low fertility)

Drought, Weed invasion after drought, Scalping, Building
**Digitaria didactyla (serangoon grass)**
- **Strengths**
  - Medium-textured stoloniferous grass for low fertility sites
  - Similar to Queensland blue couch & Swazi grass (Australia)
- **Weaknesses**
  - Clippings stick together when mowing moist grass
  - Susceptible to Fe deficiency after heavy rainfall
  - Fair wear tolerance

**Axonopus compressus (broadleaf carpetgrass)**
- **Strengths**
  - Coarse-textured grass for shaded roughs, parks, etc
  - Tolerant of acid infertile soils
  - Blue-green colour
  - Originates from subtropical & temperate areas
- **Weaknesses**
  - Poor drought & wear tolerance
  - Lower thatch development than other turf grasses

**Zoysia spp. (zoysiagrass)**
- **Strengths**
  - Low maintenance grasses for fairways, tees & greens
  - Medium-textured, genotypes for fairways & roughs
  - Originates from subtropical & temperate areas
- **Weaknesses**
  - Slow growth (longer sod production cycle than for other species)
  - Resistant to wear

**Zoysia japonica (Japanese lawngrass)**
- **Strengths**
  - Low nutritional requirements
  - Less mowing than other grasses (slow growth)
  - Good drought tolerance
  - Few pests and diseases
  - Tolerant of a wide range of herbicides (several for grass control)
  - Good ball lie (shiny)
  - Highly resistant to wear
- **Weaknesses**
  - Slow growth (longer production cycle than for other species)
  - Resistant to wear

**Weaknesses**
- Susceptible to zoysia rust (Puccinia zoysiicola)
- Tolerant temporary but not permanent, waterlogging
**Zoysia matrella (Manilagrass)**

- Medium- & fine-textured genotypes for fairways & greens
  - More tropical in origin than *Z. japonica*

**Strengths**
- Bright green colour (varies with variety)
- High shade tolerance
- High salinity tolerance
- Tolerant of high strength soils
- Not affected by zoysia rust (Puccinia zoysiae)

**Weaknesses**
- Thatch development
- Slower green speeds than bermudagrass
- Tolerates temporary, but not permanent, waterlogging

**Temperature adaptation – *Cynodon* varieties**

- Optimum temperature related to area of origin
- Stronger winter dormancy in genotypes from cooler areas
- Warm temperate (Melbourne – 13.4°C annual average)
  - Victorian > NSW & Queensland varieties (Redlands research)
- Subtropical (Brisbane – 20.5°C annual average)
  - Queensland & NSW > Victorian varieties (Redlands research plots)
  - Close to the warmer limit for *Cynodon* hybrid
- Tropical (Cairns – 24.8°C, Darwin – 28.1°C annual averages)
  - Also need tolerance of long periods of heavy cloud & low light
  - Very few well adapted *Cynodon* varieties
  - Local versions best (e.g. from ‘Greenlees Park’)

**Disease susceptibility**

- Disease tolerance related to area (climate) of origin
  - e.g. Bermudagrass accessions from dry (less humid) areas more susceptible to leaf diseases
  - e.g. *UQ Australia* (germplasm collection)
- Disease control
  - Adds to management costs
  - Compromises turf quality
- Greater emphasis on selecting new varieties for disease tolerance if available
Water use efficiency OR drought tolerance?

- **Water use efficiency**
  - Amount of water required to produce 1 unit of dry matter

- **Drought tolerance**
  - What happens in absence of rain & irrigation (survival and how well it survives)

- **Total irrigation** (e.g. desert conditions)
  - Water use efficiency
  - Small savings in water use are possible

- **Strategic irrigation** (e.g. irregular or seasonal rainfall)
  - Drought tolerance
  - Large savings in water use are possible by reducing frequency

**Paspalum vaginatum**

**Cynodon dactylon**

**Depth of rooting**

**Physiological drought tolerance – Yi Zhou (UQ)**

- Shade stress affects approx. 25% of turfgrass plantings
  - Trees & Buildings in the landscape
  - Sports stadiums
  - Cloudy or hazy conditions
Some “shady” facts

- Measure Photosynthetically Active Radiation (PAR)
  - 400-700 nm wavelength band
- 70% of daily radiation
  - 9:00am to 3:00pm (summer)
  - 10:00am to 2:00pm (winter)
  - Meeting light requirements for a turfgrass depends on when light is received, not just the fixed number of hours.
- Heavy dappled tree shade
  - c. 20-40% of full sunlight
- Building shade (e.g. elite sports stadiums)
  - c. 10% of full sunlight

Salinity growth response over time

- Two-stage process (Rana Munns, 1993)
  - physiological drought (osmotic effect) for first 4 wk
  - transition from physiological drought to toxic ion effects (4-6 wk after treatment)
  - toxic ion effects reduce DM production (6+ wk)
- Germination affected by physiological drought
- Perennial plant growth affected by both physiological drought and toxic ion effects over time

Screening perennial turfgrasses for salinity tolerance

- Three stages:
  1. establishment of vegetative material in pots (salt-free conditions)
  2. transition to salinity treatments (progressively add salt over 1-3 wk period)
  3. experimental measurements over a 12-wk period after reaching targeted salinity treatment levels
- Determination of salinity tolerance focused on 8-12 wk data
  - relative DM yield (linear regression to determine EC at 50% control DM yield)
  - % leaf firing
  - root biomass (12-wk)
Wear tolerance

- Two components of wear tolerance
  - Resistance to wear
  - Recovery from wear

- Fortnightly wear (home-and-away) less damaging than weekly wear in 3-yr simulated wear trial
  - e.g. apply 30 passes per week
  - or 60 passes per fortnight

Traffic simulator
- based on a standard US design
- two rubber-covered rollers rotating at different speeds
- causes scuffing of turf, minimal soil compaction

Factors & attributes contributing to wear tolerance

- Higher Total Cell Wall constituents
  - TCW = lignin + Acid Detergent Fibre (ADF)

- Higher turf density

- Tighter matting growth habit

- Age of turf
  - 2nd year “decliners” need regular aggressive rejuvenation
  - (e.g. elite stadiums)
  - 2nd year “improvers” should be left to mature
  - (e.g. community sports fields)

8 Cynodon cultivars showing wear effects

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**Primo® (trinexapac-ethyl)**

- Used to condition turf
  - Improve turf quality by tightening up sward
  - Reduce mowing requirements
- Some varieties affected more than others

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**Legend®**

- no Primo + Primo

**Conquest®**

- no Primo + Primo

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**Primo® (trinexapac-ethyl)**

- Used to condition turf
  - Improve turf quality by tightening up sward
  - Reduce mowing requirements
- Some varieties affected more than others
- Two-stage effect on growth
  - Initial reduction in growth rate
  - Followed by a surge of pent-up growth unless re-applied
- Wear damage may increase during growth reduction stage
  - Recovery from wear is restricted
- Restrict prolonged or continuous Primo use to low wear situations
**Axonopus fissifolius, syn. A. affinis (narrowleaf carpetgrass)**

- Coarse-textured stoloniferous grass for low quality fairways, sports fields, parks & lawns
- Not as coarse-textured as *Axonopus compressus*

**Weaknesses**
- Poor wear tolerance
- Moderate to poor shade tolerance
- Less tolerant of waterlogging than *Axonopus compressus*

**Pennisetum clandestinum (kikuyugrass)**

- Coarse-textured stoloniferous & rhizomatous grass for fairways, race tracks, sports fields, lawns in cool highland tropical areas
- Also warm temperate & cool subtropical (Australia, South Africa, etc)

**Weaknesses**
- Poor resistance to wear
- Poor shade tolerance
- High fertility requirement (N)
- Disease susceptible under hot, humid conditions

**Paspalum notatum (bahiagrass)**

- Tough coarse-textured grass with shortly creeping shallow rhizomes for roadsides, sports fields, etc in subtropics & tropics

**Weaknesses**
- Shallow surface rhizomes easily damaged by horses
- Existing development slow
- Susceptible to waterlogging
- Profuse production of 40-60 cm tall seed heads (requires frequent mowing)
**Paspalum notatum**

- Short bahiagrass for roadside & sports field use
- 20-30 cm high seed heads (cf. 40-60 cm for ‘Pensacola’, etc)

**Paspalum nicorae**

- Coarse-textured blue-green grass with deep shortly creeping rhizomes for roughs, roadsides, horse venues, etc

**Strengths**
- Deep rhizomes not damaged by horses (recovered quickly after use)
- Good drought tolerance
- Sown by seed
- Low to moderate fertility requirement (N)

**Weaknesses**
- Blue-green leaf colour (if dark green is desired)
- Seedling development slow
- Summer flowering long-day plant
- Production of 40-60 cm tall seed heads (reduced under lower fertility)

**Turf quality vs. Sod price**

- Price depends on
  - How fast production fields grow in
    - How often the fields can be harvested
  - Ease of management
    - Maintenance, etc.

- Quality depends on
  - Creating a tight mown surface

**Stolon internode length**

- Long for rapid growth
- Short for quality turf

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**Linear regression – Internode length vs. Lateral spread**

\[
\begin{align*}
\text{Lateral spread (cm)} &= 2.35x + 0.737 \\
\text{(R}^2 &= 0.85) \\
\end{align*}
\]

**Scatter diagram – Internode length vs. Branching**

- Various genotypes
- Linear relationships
- Graphical representation
New cultivar ... like a 3-legged barstool?

- **Leg 1:** Breed the cultivar
  - The easy bit

- **Leg 2:** Keep the integrity of the cultivar over the long term
  - Don’t lose the gains made through breeding
  - Avoid contamination by other varieties

- **Leg 3:** Promote the cultivar effectively
  - Hollow advertising alone won’t work in the long term
  - Support with sound science-based technical information

Without all three “legs”?
- Instability and failure

Maintaining varietal integrity

- **Care and vigilance**
- Don’t multiply your mistakes
  - Maintain a pure Foundation block as a source of planting material for larger production fields
  - Don’t take planting material from larger production fields where the risk of contamination is greater

- Mow off seed heads within a week or so of emergence
  - Even 1% self-compatibility (e.g., Cynodon dactylon, Paspalum vaginatum) could lead to significant numbers of new genotypes establishing

- Spot-spray any contaminant plants found
  - Walk production fields regularly

Take home messages

- Consider the use required in relation to site characteristics
  - Climate, soils

- Choose the best adapted species and variety
  - Critically assess all information, including the accuracy of promotional material as it relates to your conditions
  - Ask searching questions

- Buy from a reputable source of clean planting material, not just seek the cheapest supplier

- Management of a well adapted grass will be easier & cheaper, and should result in better turf quality