



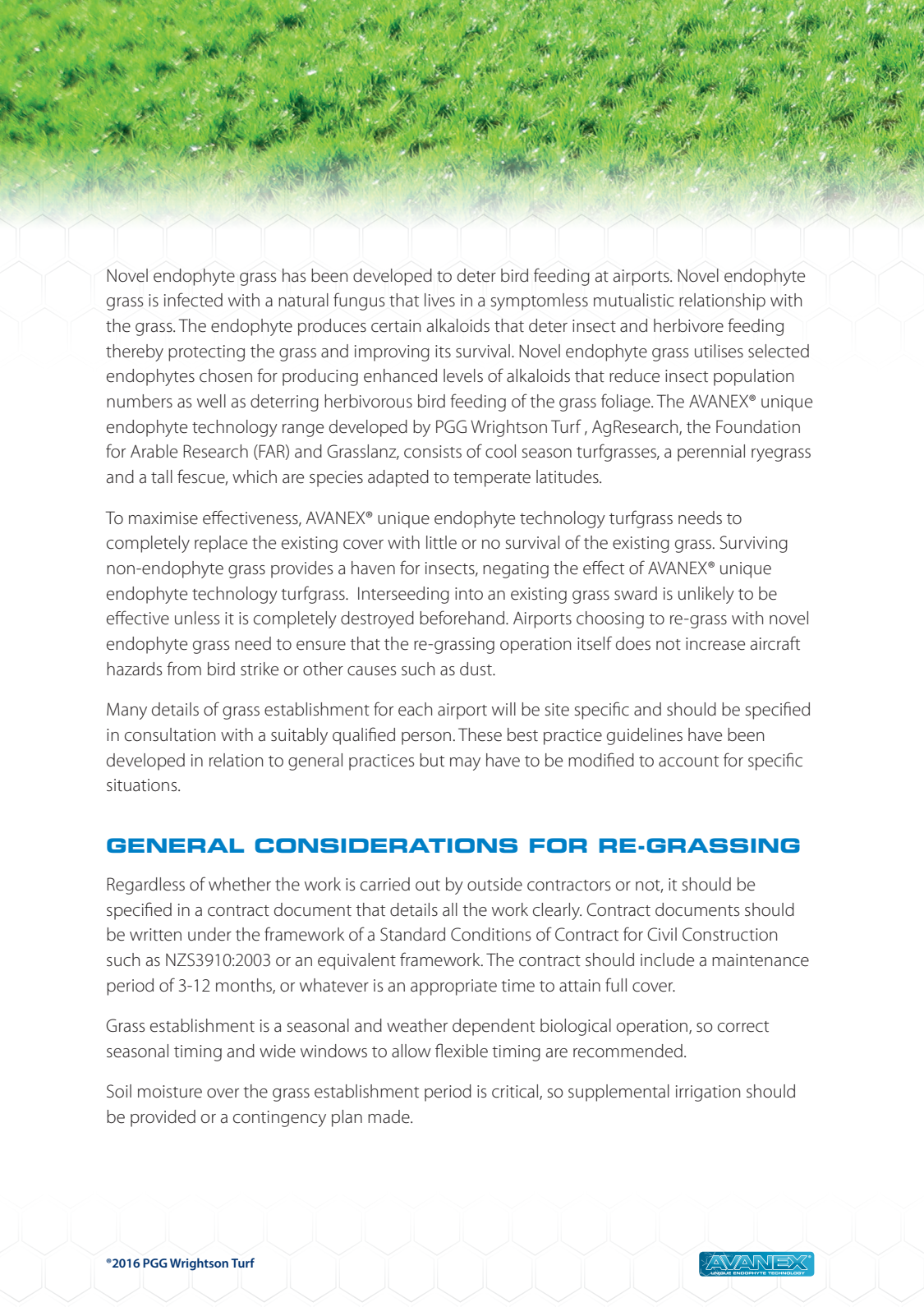
BEST PRACTICE GUIDE



FOR AIRPORTS




PGG Wrightson *Turf*



Novel endophyte grass has been developed to deter bird feeding at airports. Novel endophyte grass is infected with a natural fungus that lives in a symptomless mutualistic relationship with the grass. The endophyte produces certain alkaloids that deter insect and herbivore feeding thereby protecting the grass and improving its survival. Novel endophyte grass utilises selected endophytes chosen for producing enhanced levels of alkaloids that reduce insect population numbers as well as deterring herbivorous bird feeding of the grass foliage. The AVANEX® unique endophyte technology range developed by PGG Wrightson Turf, AgResearch, the Foundation for Arable Research (FAR) and Grasslanz, consists of cool season turfgrasses, a perennial ryegrass and a tall fescue, which are species adapted to temperate latitudes.

To maximise effectiveness, AVANEX® unique endophyte technology turfgrass needs to completely replace the existing cover with little or no survival of the existing grass. Surviving non-endophyte grass provides a haven for insects, negating the effect of AVANEX® unique endophyte technology turfgrass. Interseeding into an existing grass sward is unlikely to be effective unless it is completely destroyed beforehand. Airports choosing to re-grass with novel endophyte grass need to ensure that the re-grassing operation itself does not increase aircraft hazards from bird strike or other causes such as dust.

Many details of grass establishment for each airport will be site specific and should be specified in consultation with a suitably qualified person. These best practice guidelines have been developed in relation to general practices but may have to be modified to account for specific situations.

GENERAL CONSIDERATIONS FOR RE-GRASSING

Regardless of whether the work is carried out by outside contractors or not, it should be specified in a contract document that details all the work clearly. Contract documents should be written under the framework of a Standard Conditions of Contract for Civil Construction such as NZS3910:2003 or an equivalent framework. The contract should include a maintenance period of 3-12 months, or whatever is an appropriate time to attain full cover.

Grass establishment is a seasonal and weather dependent biological operation, so correct seasonal timing and wide windows to allow flexible timing are recommended.

Soil moisture over the grass establishment period is critical, so supplemental irrigation should be provided or a contingency plan made.



SPECIES AND CULTIVAR SELECTION

It is important to carefully choose a grass species and cultivar that is adapted to the climate and will persist as a permanent perennial species with minimal maintenance. The AVANEX® unique endophyte technology range includes Colosseum perennial ryegrass and Jackal tall fescue. Both are suitable for a mowing height range of 75 - 100 mm with Jackal better suited to the higher mowing heights.

The endophytes in the AVANEX® Jackal and Colosseum cultivars are different to “standard” or “wild type” endophyte present in many turfgrasses. AVANEX® unique endophyte technology turfgrass should be sown alone as a monostand and not sown in a mixture with other grass.

GROUND PREPARATION AND DIRECT DRILLING

Re-grassing by direct drilling involves thoroughly destroying the existing vegetation, removing any surplus dead vegetation, then direct drilling into the intact soil surface. It is critical to thoroughly destroy the existing vegetation so it doesn't recover and compete during the establishment of the new sowing. The existing grass cover should be destroyed using a non-selective non-residual herbicide such as glyphosate or a short residual herbicide and allowing enough time for soil residues to decline sufficiently between application and sowing. Treatment should begin some months before sowing to allow for repeat applications provided the temperature and soil moisture is suitable for active growth needed for herbicides to work.

Once the grass has browned, excessive vegetation can be removed. In general where the grass length or mowing height is over 75 - 100 mm there is likely to be excessive dead vegetation that needs to be removed using a forage harvester or bagging mower.

The area can now be direct drilled. Selection of the seed drill type and method of operation is critical to the success of direct drilling. It is imperative that the seed drill places the seed in the blade slit below the surface otherwise seed on the surface becomes an attraction for birds. Grooving type seeders and single disc or chisel type drills are not suitable.

The preferred seed drill is a turf type disc slitting drill with 75 mm coulter spacing. Alternatively a triple disc type or “inverted T” type with 150 mm coulter spacing could be used if a turf drill was unavailable but these are inferior options.

Direct drilling is carried out in three passes with each pass at a shallow angle to the previous pass. This gives good coverage with limited tearing of the surface. If using a drill with 150 mm coulter spacing, four passes should be made if possible. Before starting, a test should be made to check there is not too much tearing or cultivating with the number of passes chosen.



The depth of sowing is chosen for the species concerned and the soil conditions. A depth of 5mm is suitable for both perennial ryegrass and tall fescue.

A seeding rate needs to be chosen that is sufficiently high to provide full cover rapidly enough to suppress weeds. An appropriate seeding rate will be affected by the type of seed drill used and the number of passes possible.

Lack of water is likely to be the main factor leading to grass establishment failure, so limiting establishment to an area that can be irrigated with water trucks is recommended in challenging conditions. Direct drilling at the optimum time for grass establishment is the best approach.

SITE SPECIFIC FACTORS

- ***Pest control***

The newly sown grass seed may require protection from weeds, insects and molluscs. Emerging seedlings will not produce enough protective alkaloids until the plant is well established. Grass weeds such as *Poa annua* or summer annual grass weeds can be controlled using a pre-emergence herbicide such as ethofumesate and applied immediately after seeding or no more than four days later. Surface feeding insects may need treatment using a liquid insecticide applied with the pre-emergence herbicide. Soil living insects can be controlled using a granular insecticide drilled into the soil with the seed.

To minimise attractiveness of the seed to birds, a stenching agent or other bird deterrent product should be applied immediately after seeding. The most commonly used product is a granule spread by centrifugal spreader.

- ***Fertility***

The fertility of the re-grassing site should be assessed with a soil analysis taken well beforehand and interpreted by a suitably qualified person. A stand and soil sampling depth is 75 mm. The recommended pre-sowing fertiliser and lime should be applied before direct drilling.

- ***Dust and straw***

Care must be taken to avoid dust and straw nuisance as this could cause problems for aircraft. While it would be desirable to begin destroying the existing vegetation cover several months before direct drilling to control any surviving re-growth with repeat herbicide applications, the nuisance caused by dust from bare ground needs to be taken into account, and a shorter period may be appropriate.



In general, direct drilling using an approved seed drill should make slits in the surface without cultivating and leaving loose soil at the surface, where up to three passes are made. There is an increased risk of surface tearing or cultivating with more passes. This increases the risk of dust in dry windy conditions requiring irrigation to subdue the dust.

- ***Irrigation***

Direct drilled grass seed is placed into the soil where it is less vulnerable to drying out at establishment compared to surface sown seed. Irrigation or rainfall is still needed at regular intervals, ideally every few days, for grass to establish. Even in climates where irrigation is not normally required, it would be prudent to have a contingency for irrigation should dry weather or the likelihood of dust occur.

Airports generally don't have inbuilt irrigation systems so a water truck delivery and application system needs to be used. Water spray trucks used in road making can be used to deliver and apply irrigation to newly seeded areas. The number of water spray trucks available, and the turnaround time to discharge and refill, and the time available for irrigation during airport operation may all limit the area that can be established using a single truck.

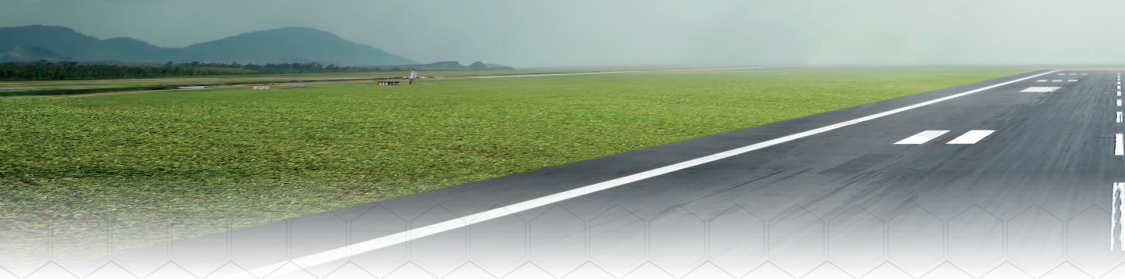
Irrigation needs are extremely site specific depending on climate and soil moisture retention.

- ***Tall grass***

Long vegetation that is suddenly mowed close may expose molluscs and insects that are attractive to bird feeding. It may be desirable to lower the mowing height in stages over several months before destroying the grass cover or destroying the grass and mowing off the vegetation at a favourable time of year when bird activity is minimal.

FOLLOW-UP MAINTENANCE

Follow-up maintenance involves initial mowing at 75 - 100 mm as soon as there is grass to cut, taking care to remove no more than one third of the leaf blade length at each mowing. Turf type rotary mowing equipment is most efficient and gives a good finish at this height, but flail or possibly reel mowers could also be used. Mowing appears to stimulate alkaloid production, but optimum mowing heights and frequencies are yet to be determined.



There may be a need for nitrogen (N) fertiliser applications once mowing begins. Airport grass areas are typically maintained under low maintenance regimes, meaning that little or no nitrogen fertiliser is applied for routine maintenance. Nitrogen fertiliser is desirable during establishment to speed up attaining full coverage. Several applications of 25 kg N/ha may be made at 6 weekly intervals using soluble nitrogen fertiliser or controlled release nitrogen. The need for nitrogen during the first year of establishment will be site specific.

A selective herbicide application may be necessary if broadleaf weed invasion warrants treatment. Broadleaf weeds often produce seeds that birds feed on, so keeping weeds to a low level in the new sowing is desirable. The herbicide needs to be carefully chosen to be selective to the desirable grass species, effective on the weeds present, and safe on young turf.

THE FEASIBILITY STUDY

For airports in the zone of adaptation for perennial ryegrass and tall fescue, re-grassing with AVANEX® unique endophyte technology turfgrass should help to deter bird feeding and bird numbers. Airports must avoid activities that create short term hazards to aircraft. A suitably qualified consultant should be engaged to carry out a feasibility study to determine the costs of safe and successful re-grassing and to prepare contract documentation if the feasibility study is accepted.



A NEW ZEALAND CASE STUDY

An area adjoining a major airport in New Zealand was chosen as a commercial testing site for re-grassing with AVANEX® Jackal tall fescue. The resident grass was destroyed with glyphosate and the brown vegetation was removed with a forage harvester some 2 - 3 weeks later. A soil analysis was taken and a pre-sowing fertiliser application was made. A second herbicide application (which included a broadleaf herbicide as well as glyphosate) was applied two weeks before direct drilling.

Rainfall before spraying and before sowing produced favorable soil moisture conditions. The area was direct drilled with AVANEX® Jackal tall fescue at 200 kg/ha using a Redexem overseeder 2075 turf drill with 75 mm triple disc coulter spacing in three passes at one third rate each time. A controlled release granular chlorpyrifos insecticide was mixed with the seed and applied through the drill to control sub-surface insects. No surface insecticide, molluscicide or stenching agent was applied and no noticeable bird feeding on the sown seed was observed. No irrigation was applied as rainfall after sowing was sufficient to achieve uniform coverage. No subsequent nitrogen fertiliser application was applied as the nitrogen in the seedbed was sufficient until growth slowed with cool winter conditions.

Ground cover was about 80% going into winter. Mowing was not required before winter. AVANEX® Jackal tall fescue has a little more winter growth than many tall fescue cultivars and slow growth over the late autumn period increased the ground cover to about 90% by mid winter. Some weak patches were visible where cut grass had been dropped during forage harvesting before sowing. There has been no noticeable re-growth of the previous grass in the first 18 months.





INTELLECTUAL PROPERTY PROTECTION

AR601 endophyte is protected by United States Patent Application No. 8101400. Harvesting / propagating, resowing, and/or onselling of AR601 may infringe this patent and may result in prosecution. Grasslanz is a registered trademark of Grasslanz Technology Limited in New Zealand and Australia. AVANEX is a registered trademark of PGG Wrightson Seeds Limited in New Zealand, Australia and the European Community.

The AR601 endophyte has patent pending in: New Zealand No. 579801, Australia No. 2008 244736, United States DIV No. 13/308939, Europe No. 08753855, Argentina No. 8010793 and Uruguay No. 31.054. The AR601 endophyte is protected under the New Zealand Plant Variety Rights Act 1987. Grant number 2874. The AR95 endophyte has PVR pending. New Zealand Application No. FEN016.

WARNING: THIS GRASS VARIETY CONTAINS A NOVEL ENDOPHYTE. INGESTION OF THE SEED OR THE GRASS CAN CAUSE SEVERE ADVERSE ANIMAL HEALTH ISSUES AND IS NOT TO BE USED AS FEED FOR ANIMALS AND BIRDS. IN SEVERE SITUATIONS IT MAY CAUSE DEATH TO GRAZING ANIMALS.

DISCLAIMER

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