

Pasturepak: an electronic pasture adviser built on previous results and experience

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Summary. The corporate knowledge of the Department of Primary Industry (DPI) Tasmania on pasture and fodder plants is formalised in PASTUREPAK. It is a computerised advisory system developed to advise farmers in Tasmania as to the best pasture and fodder crops to suit their requirements.

The DPI Tasmania intends to sell this software to seed retail outlets to provide counter staff with the best pasture and fodder crop advice. Regular updates will provide a medium for communication with seed merchants. The system will replace printed "Farm Notes" that are rapidly outdated, and costly to revise.

PASTUREPAK calculates a score that reflects the adaptation of the available pasture plants and fodder crops to the environment and the forage needs of livestock. Well adapted species have a high score, and minor species in the mixture a low score. The software offers the client a choice of cultivars from each species.

Introduction

The evaluation of cultivars of pasture plants for Tasmania is an important part of the work of the Pastures and Field Crops Branch. Advice on the use of these cultivars flows to farmers through publicity, field days and a series of "Farm Notes".

The recent promulgation of Plant Variety Rights legislation has lead to an increased number of cultivars that are promoted by the seed merchants. At the same time the DPI Tasmania has increasing difficulty in adequately servicing individual farmers because of reduced staff numbers.

Counter staff at seed retail outlets are asked questions about new cultivars and pasture mixtures by farmers who wish to buy seed. These staff are also bombarded with advertising from wholesale seed companies wishing to promote their own lines of seed. They are often juniors without the training to adequately assimilate the complex information and advise farmers.

Computer-based advisory systems provide a useful way to service farmers with current advice. The DPI Tasmania took a new initiative to develop a system to advise on pasture mixtures in the 1990 financial year. The package has been named PASTUREPAK and will be commercially available in 1992. We are encouraging rural retailers to install the system in time for sowing in autumn 1992.

Conceptual framework

When officers from the DPI Tasmania give advice on pastures, they first seek information on the location of the property, to identify the environment. They do this from an intimate knowledge of the climate and soils in the State.

We copied this process in our initial design, asking for a location, and then using a decision tree to describe the environment. But the permutations of climate and soil compounded to an unmanageable size. The alternative was to focus directly on environmental descriptors and match these with the adaptation of the species available. Indeed, the most experienced experts do this subconsciously. They will also match the quality of the pasture plants to the need of the livestock. They will evaluate the need for improved animal production against the value of pasture longevity. For example, some dairy farmers will sow a short rotation ryegrass to gain production, but extensive pastoral graziers value persistence more highly. Pasture grubs are a problem in Tasmania. In the high rainfall north-west region, highly

productive pastures that are susceptible to attack from these insects are preferred to resistant species that are less productive.

A summary of the input information and species the PASTUREPAK advises is shown in Tables 1 and 2.

Table 1. Input information that the client needs to supply. PASTUREPAK tests this information against its knowledge base to derive an adaptation score.

Pastures	Fodder crops
Rainfall zone	Time of sowing
Irrigation	Time of year when feed needed
Soil drainage	Soil Drainage
Soil salinity	Soil Fertility
Soil texture	Type of Livestock
Severity of pasture grubs	"Late Country" (i.e., inland high and altitude)
Type of livestock	
Length of rotation	

Table 2. The arrays of pasture grasses, pasture clovers and fodder crops contained in the PASTUREPAK knowledge base. A second dimension of these arrays contains lists of cultivars, both those recommended and some that have not yet been proven in Tasmania.

Pasture grasses	Fodder crops	Pasture clovers
Italian ryegrass	Turnips	Red clover
Hybrid ryegrass	Swedes	White clover
Perennial ryegrass (standard)	Rape	Sub-clover (subterranean)
Perennial ryegrass (irrigation)	Hybrid Brassica	Sub-clover (yaninnicum)
Perennial ryegrass (summer dormant)	Kale	Strawberry clover
Cocksfoot	Chicory	Persian clover
Phalaris	Oats	Balansa clover
Tall Fescue	Westerwolds ryegrass	
	Persian clover	
	Lucerne	

Implementation

We wanted to develop a package that would be simple for counter staff and people with only basic computer skills to operate. We chose Crystal 4 to develop PASTUREPAK (available from Oxford Systematics). Crystal 4 is a rule based expert system shell that runs on a DOS PC. It has very good screen building capabilities, and graphics functions.

Pasture mixtures

The client has to respond to a series of menu questions to identify the environment. The answers are used to build a template of variables with scores of either 1 or 0, and this is used in formulae to calculate an "adaptation score" for each species. Each species gains or loses points, depending on its adaptation to the particular environmental parameter. The best adapted species are those with the highest scores.

This technique allows us to adjust the adaptation value for each species. It is especially useful where it is necessary to show a marginal adaptation to a particular environmental factor. We have run hundreds of enquiries to ensure that the weight that we have allotted to the adaptation for each species reflects the results of field experiments.

The advisory screen of PASTUREPAK shows the grasses and clovers that are best adapted. PASTUREPAK offers the client a small amount of choice in making up a pasture mixture. The plants with scores above 10, and preferably higher, are needed for the mixture, but for some situations a second or third species has a score that is less than 10. In these cases, the client has the discretion as to whether the species is included.

All advisers have had experience of enquiries where no pasture plants will suit. Examples of these unreasonable enquiries are requests for pasture plants adapted to saline soils in low rainfall areas in Tasmania, or dryland dairy pastures in areas with less than 500 mm annual rainfall. For these enquiries, PASTUREPAK shows a message to the effect that no commercial grasses or clovers species are available for the particular situation.

The advice offered by PASTUREPAK on sowing rate is designed to encourage use of appropriate rates, rather than the luxury rates in common use. Experiments have shown that pastures sown with too much seed suffer from intraspecific competition and lack persistence. To offer advice on sowing rates, we have assigned a primary, secondary and tertiary sowing rate to each species. The primary sowing rate is intended as the rate to be used where the species was the only grass (or clover) in the mixture. The secondary and tertiary rates are smaller amounts and are used where the species becomes a minor part of the mixture.

The sowing rate of minor components are additional to the mixture, and are not intended to replace apart of the major component. The primary rate is shown only when a species is selected as the best adapted grass or clover. Secondary and tertiary rates are shown where a second and third species is also adapted for the situation.

PASTUREPAK allows the client to revise the input information after a result has been calculated. A client may want to do this because advice may be unexpected, or perhaps to check the importance of a specific input, for example, if the pasture was to be grazed by beef cattle instead of dairy cows.

A second dimension of the species array contains information on cultivars. This is shown to clients after they are satisfied with the species advice. In Tasmania perennial ryegrass is an important species and many cultivars are available. We have grouped cultivars of this species into three separate versions. The reason for this is to give special cultivar advice where the client intends to irrigate (demanding rust-resistant and summer-active cultivars); or for the low rainfall zone (summer-dormant cultivars).

Fodder crops

The architecture used to design the advice on fodder crops is the same as for the pasture mixtures. The difference is that fodder crops are usually sown as monocultures rather than in mixtures. The adaptation scores for each species reflect the usefulness of that species for the purpose that the client requests.

We have found that farmers are not always clear about when they need the forage from a fodder crop. PASTUREPAK requests this advice on the first menu to emphasise its importance. Another problem is that some farmers are late in sowing their fodder crops. PASTUREPAK copes with this situation by changing the selection of species. The adaptation score decreases as the chance of getting satisfactory production diminishes.

Discussion

The development of PASTUREPAK has formalised the corporate knowledge on pasture mixtures and fodder crops in the DPI Tasmania. PASTUREPAK will eventually replace the series of "Farm Notes" prepared for advice on pastures and forage crops. It will need annual revisions because new cultivars and species are continually being released. The design of PASTUREPAK has been chosen to allow for easy revisions and maintenance.

In Tasmania an Advisory Committee on pasture and forage plants is soon to be established. This body will have representatives from all parties interested in pastures, including rural merchants, farmers' representatives and the DPI Tasmania. New cultivars will be recommended by the committee on evidence from a merit testing programme, a co-operative venture with the Victorian Department of Agriculture and the DPI Tasmania. PASTUREPAK will formalise the recommendations in such a way that it will be quickly available at the point of sale.

We have made an on line search for references of similar work using the descriptors "Expert System", "Pastures", "Fodder", "Forage", "Grass" and "Legume". The data bases searched were AGRICOLA and the CAB, both for the last five years. The search revealed references to models that calculate feed budgets and pasture management. There was no work similar to that reported here, except for an expert system for selection and management of turf grasses (1).

We believe that PASTUREPAK will have an important part to play in the advice on pasture mixtures and fodder crops in Tasmania. The DPI Tasmania has experienced a growing computer awareness amongst the farming community. Farmers who have consulted PASTUREPAK are enthusiastic, and the retailers and seed merchants have been supportive of the prototypes that they have seen.

Reference

1. Liu, H., Fermaian, T.W. and Cramer, S.G. 1991. Agron. J. 83, 140-143.