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## BRIEF COMMUNICATION

### A conceptual framework for an expert system to improve drying off decisions on seasonal supply dairy farms

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#### INTRODUCTION

Stocking rate, calving date, calving spread and drying off date are major determinants of productivity on New Zealand's seasonal supply dairy farms (Bryant, 1981; Holmes and Macmillan, 1982; Bryant and Holmes, 1985). Of these factors, the drying off decision has received the least attention in the literature. The decision to dry off the herd is based on a series of decisions through time rather than a single event (Campbell *et al*, 1977). As such, the drying off decision can be defined as; those management decisions made in the latter half of a herd's lactation affecting the suspension of milking in preparation for next season's lactation.

The application of expert systems technology to the drying off decision is being investigated at Massey University. An expert system incorporates the knowledge of "experts" into a simple interactive model programmed to simulate the process of solving a well-specified problem (Rajotte & Bowser, 1990). The result is a management recommendation that the farmer can then implement. It is often accompanied by a comparative financial analysis of alternative decisions about the same problem. In this manner an expert system can make the knowledge of scientists, consultants and other farmers available to a farmer irrespective of their location and individual farm circumstances. In the case of the drying off decision a farmer would use the expert system from January until the herd is dried off to improve decisions regarding the allocation of resources (e.g., when to sell cull cows, feed silage or use a summer forage crop) so that management goals are achieved.

Formulation of a conceptual framework, or a model of the decision making process, that experts use to solve a problem, is an important step in the development of an expert system (Hickman and Taylor, 1989). Four farmers from the Manawatu region were selected to assist in the development of the conceptual framework using the KADS methodology described by Hickman and Taylor (1989).

The conceptual framework used by these farmers was derived using a series of interviews at half monthly intervals from January until the herd was dried off. All interviews were tape recorded and transcribed to text, as described by Galloway (1990). The interview text was analysed to define the knowledge, decision rules and problem solving processes used by each farmer when making the drying off decision. Common elements of the farmers' decision making processes and decision rules were used to develop a conceptual framework.

The decision making process used by the "expert" farmers from January until drying off was goal driven and was to optimise

milk solids production in the current lactation, without jeopardising milk solids production in the first 8-12 weeks of the subsequent lactation. To achieve this, each of the "expert" farmers had a priority decision rule that the herd must be dried off on a date that would allow the herd to be calved at an average condition score of 4.5-5.0 and the farm to have an average pasture cover equal to or greater than 2000-2200 kg DM/ha. (Table 1).

**TABLE 1** The pasture cover and cow condition score targets used by four "expert" farmers in relation to the drying off decision.

Objective Decision Rules	Farmer 1	Farmer 2	Farmer 3	Farmer 4
Minimum average pasture cover (kg DM/ha)				
- at drying off	1700	2000	1400	1800
- at calving	2000	2000	2200	2200
- early lactation	1600	- <sup>a</sup>	1700	1700
Minimum condition score (Scale 1-10) <sup>b</sup>				
- R3yr heifers at drying off	3.5	3.5	3.5	3.5
- at drying off	4.0-4.5	4.0-4.5	4.5	4.0-4.5
- at calving	5.0	4.5	4.5	4.5-5.0

<sup>a</sup> Pasture cover target at calving and not pasture cover target in early lactation was used.

<sup>b</sup> On a scale of 1-10 as described by Scott and Smeaton (1980).

Alternative tactical options, outlined in Table 2 such as culling cows and using supplementary feeds, were adopted during the latter half of the lactation to mitigate the effects of inadequate pasture growth or declining cow condition score. By using these options the "expert" farmers were able to delay drying off until it was no longer possible to continue milking without compromising their goal of maximising milk production in the first 2-3 months of the subsequent lactation. The ability to delay drying off through the use of tactical options, selected by careful planning and monitoring, is likely to be a key factor that distinguishes between the levels of milk production achieved by "expert" and "non-expert" farmers.

To achieve their milk production goal the "expert" farmers followed the four classical functions of management: planning, implementation, monitoring and evaluation. The sequence of these functions enabled the farmers to proceed towards their goal despite imperfect knowledge of future events, particularly those related to the effect of climate on feed supply. The use of monitoring and replanning was instrumental in allowing the decision to dry off the whole herd to be delayed until the 'optimum' time was reached. The main purpose of the manage-

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**TABLE 2** Tactical options ranked in order of preferred use by the "expert" farmers in mid- and late-lactation to ensure that condition score and pasture cover targets were achieved.

January - March	April - May
Sell low producing cull cows.	Sell remaining cull cows, e.g. empties.
Reduce pasture cover.	Dry off rising 3 year heifers at condition score 3.5.
Use supplements surplus to winter/ spring requirements	Dry off older cows at condition score 3.5.
Sell other cull cows, e.g. animals with health problems.	Reduce balance of herd condition score to 4.0-4.5.
Feed off crop if available <sup>1</sup> .	Reduce pasture cover to a pre-determined minimum.
Use cow condition by reducing cow intake.	Dry off balance of herd.
Dry off part of the herd.	

<sup>1</sup> Ranking varied depending on the growth and development of the crop.

ment process was to determine when a response to a change in the farm's condition was required and to identify what form this response should take.

Table 3 outlines examples of the decision rules used to decide which tactical option to choose.

The next step in the development of the expert system will be to test whether the decision rules, knowledge and problem solving processes used by the "expert" farmers during the real-time study would vary if seasonal conditions were changed. A series of workshops with these farmers will be used for this purpose and the refined conceptual framework will then be described mathematically for inclusion in an expert system model.

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## REFERENCES

- Bryant, A.M. 1981. Maximizing milk production from pasture. *Proceedings of the New Zealand Grasslands Association* 42: 82-91.
- Bryant, A.M.; Holmes, C.W. 1985. Utilisation of pasture on dairy farms. Pp. 48-63, In The Challenge : Efficient Dairy Production. Ed. T.I. Phillips, Australian Society of Animal Production, Dairy Production Conference.
- Campbell, A.G.; Clayton, D.G.; Bell, B.A. 1977. Milkfat production from No. 2 Dairy, Ruakura. How is it attained: what is it worth? *New Zealand Agricultural Science* 11: 73-86.
- Galloway, J. 1990. A real time study of a dairy farmer's decision making. DipAgrSc dissertation, Department of Agricultural and Horticultural Systems Management, Massey University, Palmerston North.
- Hickman, F.R.; Taylor, R.M. 1989. Analysis for Knowledge-based Systems : A Practical Guide to KADS Methodology. Ellis Horwood Limited, Chichester, West Sussex, England.
- Holmes, C.W.; Macmillan, K.L. 1982. Nutritional management of the dairy herd grazing on pasture. Pp. 244-274, In Dairy Production From Pasture. Eds K.L. Macmillan and V.K. Taufa, New Zealand and Australian Societies of Animal Production.
- Rajotte, E.G.; and Bowser, T. 1990. Expert Systems: An aid to the adoption of sustainable agricultural systems. Sustainable Agricultural Research : Proceedings of a workshop, National Academy Press.

**TABLE 3** An example of the decision rules used by an "expert" farmer to decide when to use different tactical options through the autumn.

January - Mid March	Mid March - Drying off
1. If a cow is producing less than 0.1 kg MF/cow/day 0.1kg MF/cow/day Then cull the cow	1. If the feed budget predicts that average pasture cover will fall below 1700 kg DM/ha in early lactation. Then plan to allocate silage surplus to winter/spring requirements.
2. If milk fat production falls to 0.63 kg MF/cow/day And the summer forage crop is actively growing. And the summer forage crop is not declining markedly in quality And there is silage available surplus to winter/spring requirements. Then feed out sufficient silage to maintain milkfat production at or above 0.60 kg MF/cow/day.	2. If the feed budget predicts that average pasture cover will fall below 1700 kg DM/ha in early lactation. And silage surplus to winter/spring requirements has been allocated in the feed budget. And the herd has not been pregnancy tested. Then identify and plan to sell a maximum of 5% of the herd culls.
3. If Milkfat production falls to 0.63 kg MF/cow/day And the summer forage crop is in a state (yield/quality) suitable for grazing. Or silage surplus to winter/spring requirements is unavailable Then feed out sufficient summer forage crop to maintain milkfat production at or above 0.60 kg MF/cow/day	3. If the feed budget predicts that average pasture cover will fall below 1700 kg DM/ha in early lactation. And silage surplus to winter/spring requirement has been allocated in the feed budget And the herd has been pregnancy tested And the culls have been identified. Then plan to sell the cull cows.
	4. If the feed budget predicts that average pasture will fall below 1700 kg DM/ha in early lactation And the cull cows have been sold And it is early April Then dry off any cow that are at or below a condition of score of 3.5.