Working toward 'smart farm' of future

CSIRO is working toward the 'smart farm' of the future with research focusing on wireless sensor networks (WSNs) and their potential to transform Australian agriculture.

Project leader Tim Wark said the viability and sustainability of many agricultural industries hinged on the ability to use and manage water and labour resources effectively, which were becoming more scarce and costly.

A key factor in this process was the availability of timely, accurate information and know-how that could revolutionise how daily management decisions were made, he said.

WSNs are a rapidly growing area of research and provide access to environmental information in more detail than ever before possible.

A WSN comprises a group of 'nodes' each measuring a variable, for example, soil moisture, which wirelessly interact with their neighbours creating an ad-hoc network that passes information to a central database.

By covering a farm with these nodes the farmer could always have an accurate picture of soil moisture levels to determine the most effective irrigation needs for a paddock, Dr Wark said.

Researchers are investigating the potential of WSNs for monitoring and understanding cattle behaviour.

The nodes are worn by cattle with the information retrieved being used to help develop methods for classifying and modelling herd behaviour under different environmental conditions.

By combining this information with additional information from sensor networks, the effect of environmental and herd factors on animals' development over their lifetime can be better understood.

WSNs provide the opportunity to monitor and manage livestock production systems in real time autonomously.

The research is a partnership involving the CSIRO Information and Communication Technologies Centre and CSIRO Livestock Industries based at Rockhampton, Queensland.

Smart farm: *An animal tracking collar with GPS module forms part of a wireless sensor network.*

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Developing disease outbreak control model

CSIRO researchers aim to develop a complex systems model to improve Australia's management responses to an infectious disease outbreak and its emergency response capability.

The model will be used as a management tool in highly communicable animal disease outbreaks. It might also have potential to help predict and manage human diseases or bioterrorism.

The outbreak of a highly infectious disease such as foot-and-mouth disease (FMD) could cripple a major Australian export industry.

The project will focus on FMD as a test-case disease model for a range of animal and human disease epidemics and include information across the livestock industries, along with infrastructure, transport, community and environmental data. The model will take into account the introduction of an infectious agent via both a breach in the quarantine barrier and by deliberate introduction, which would likely involve more than one outbreak location and type of virus.

In addition to FMD, there are several livestock diseases to which the intended approach could be applied.

The project will be carried out in collaboration with the Department of Agriculture, Fisheries and Forestry.

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Sugars might spice up grain germination

Research focusing on processes affecting germination rates and early seedling growth in wheat and rice could help plant breeders develop crop varieties better suited to specific conditions.

Researchers recently have characterised the movement of sugars to feed germinating embryos of wheat and rice — a key step toward understanding the causes of different germination rates and early seedling growth.

Germination occurs when insoluble starch within the endosperm, the food reserve of the embryo, starts breaking down into sugars. These sugars are transported to the embryo, providing it with an energy source to start growing roots and shoots.

CSIRO Plant Industry researcher Bob Furbank used a fluorescent dye to examine the pathway for movement of the sugars to the embryo and which genes and proteins were important in the process. The dye showed the sugars moved from the endosperm to the embryo via sucrose and glucose transporter proteins in the cell membranes. When in the embryo, the sugars moved freely from one cell to the next via plasmodesmata (pipes that connect adjacent plant cells), Dr Furbank said.

Although earlier work showed what triggered the breakdown of starch to sugar, no work had been carried out on the movement of the sugars to the embryo.

Dr Furbank's team previously identified sucrose and glucose transporter genes that move sugars into maturing seeds. It appears these same genes are involved in transporting the sugars maltose and glucose, made from starch, to the embryo.

Germination rates can influence seedling vigour and the undesirable pre-harvest sprouting.

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Better beef: *New research aims to improve consistency in meat tenderness.*

Beefing up the quality of meat

A new CSIRO project could significantly improve the quality of meat available to consumers.

Inconsistency in meat tenderness is a major issue for the *Bos indicus*-based beef industry in northern Australia. Researchers have recently identified several genetic markers associated with meat tenderness. But the discovery of these markers alone will not be sufficient for novel gene-based technologies to be incorporated into cattle breeding programmes.

More research is needed to validate the size of the markers' effects in improving meat quality and their applicability over a wide range of industry herds.

CSIRO Livestock Industries researchers are using a functional genomics and bioinformatics approach to studying the gene expression profiles of meat quality traits in *Bos indicus* to understand then design meat quality.

Yonghong Wang said the project would examine several production traits, with tenderness the primary focus for the next few years.

Consumers rate tenderness as the key element contributing to the eating quality of beef.

Unfortunately, tenderness is also affected by many factors such as animal genetic background, nutrition and post-slaughter process.

Dr Wang said little was known about how these factors interacted or influenced tenderness.

By better understanding the control mechanism of meat tenderness, researchers hope eventually to manipulate these factors to meet beef industry needs.

The research is funded by CSIRO, Beef Cooperative Research Centre and Meat and Livestock Australia.

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