ADVANCEMENT OF PLANT RESEARCH USING MICROARRAYS

Affymetrix GeneChips® and Agilent Arrays have enabled researchers to easily identify genes that play a role in stress tolerance, disease resistance, and reproductive development[1-7]. For plant-specific oligonucleotide array products, Affymetrix GeneChips® are available for many agriculturally important plant species and Agilent offers Arabidopsis and Rice arrays, as well as customised arraying services. The University Health Network Microarray Centre (UHNMAC) offers genomic services for both platforms and custom printing services.

Stress Tolerance

Gene expression studies can be performed to identify genes involved in stress tolerance. Rice GeneChips® have been used to investigate transcriptional changes in response to drought. Hazen *et al.* studied the effects osmotic adjustment, a trait associated with drought tolerance, on the expression of rice genes[1]. In this study, Hazen *et al.* were able to associate stress-regulated gene expression changes with quantitative trait loci (QTL) for osmotic adjustment and identify promising candidates for several QTL[1]. Ito *et al.* have used Agilent Rice arrays to study the dehydration-responsive element binding protein 1 (DREB1), a transcription factor that controls the expression of many stress-inducible genes[2]. This study found that transgenic rice plants overexpressing DREB1 orthologs had improved tolerance to drought, high salt, and low temperature stressors, and concluded that DREB1-type genes are useful for the improvement of stress tolerance to environmental stressors[2]. Agilent Rice arrays have also been used to study DNA repair pathways for UV-induced damage in the proliferating and non-proliferating cells of rice[3].

Jasmonic acid (JA) regulates diverse physiological processes in plants including response to wounding. Taki *et al*. have published a gene expression study that used the Agilent Arabidopsis array to compare the wound response when treated with JA and 12-oxo-phytodienoic acid (OPDA), a precursor of JA[4]. A set of genes were identified that responded only to OPDA and these genes primarily encoded signalling components, transcription factors, and stress response-related genes[4]. This study indicates that an OPDA signalling pathway, which functions independently of JA signalling, is essential for the wounding response in *Arabidopsis*[4].

Disease Resistance

Affymetrix GeneChips® have been used to investigate genes associated with disease resistance, including fungal and viral infections. *Rpg1* is a stem rust resistance gene that protects barley by conferring resistance to many pathotypes of the stem rust fungus *Puccinia graminis* f. sp. *tritici*[5]. A study by Zhang *et al.* takes a closer look at a deletion mutant in barley (cv. Morex), which carries *Rpg1* yet is susceptible to stem rust pathotype Pgt-MCC, and suggests that other genes may be responsible for this phenotype[5].

Reproductive Development

Gene chips have also been used to investigate the reproductive development of plants. Stupar *et al.* used the Maize GeneChip® to analyse gene expression patterns in immature ear, seedling, and embryo tissues from the maize inbred lines B73 and Mo17[6]. Upon analysis of allele-specific expression patterns in the hybrid, the data suggested that intraspecific variation in gene expression levels is largely attributable to *cis*-regulatory variation in maize[6].

UHN Microarray Centre
www.microarrays.ca

For researchers studying a plant species for which a species-specific array does not exist, customised arrays can be manufactured or arrays from a closely related species may be used in some cases. Using the custom printing services offered at the UHNMAC, Golkari *et al*. made a custom wheat cDNA microarray to investigate the transcriptome patterns of 6 major organs of wheat spikes infected with the fungus *Fusarium graminearum*[7]. Agilent offers a customised array service that enables researchers to design the oligonucleotide probes on the array. There are also several examples of Affymetrix GeneChips® specific for one crop species used to monitor the gene expression of another closely related species[8-9]. For example, Buescher *et al.* have reported that the Wheat GeneChip® may be a useful tool for examining the oat (*Avena sativa*) transcriptome[8].

References

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