Botany company's study of the secret life of plants reveals natural defences

Hexima hopes its genetic research will slash insecticide use, writes **Garry Barker**.

Girl power: The female parts of plants protect the seeds, says Hexima founder Professor Adrienne Clarke. PICTURE: SIMON SCHLUTER

FOR a botanist the question was intriguing: why are flowers not incestuous? They all carry, close together, both male and female parts yet they do not have an incestuous mating within the same flower.

The answer, discovered by an all-women group of plant scientists, led by Adrienne Clarke, laureate professor of botany at the University of Melbourne, has led to the formation of Hexima, a research company listed on the ASX that now has confidential agreements with four of the six global agribusiness groups in the world.

Out of that is coming genetically modified strains of cotton and corn that the research team hopes will greatly reduce, if not remove, the need to spray with dangerous and expensive poisonous chemicals to beat back insect attack.

Hexima was formed at the University of Melbourne in 1998 by Professor Clarke, Professor Marilyn Anderson (now at the school of biochemistry at La Trobe University), Dr Robyn Heath and Dr Angela Atkinson. "This was a girlie thing," says Professor Clarke with evident pride and satisfaction.

Research is continuing under contracts with the University of Melbourne, from which the original intellectual property portfolio was acquired, and La Trobe University, financed by a small group of Melbourne investors and grants from the Commonwealth and Queensland governments.

Cotton is big, but corn is bigger, especially now that so much of the world crop is going into production of ethanol engine fuels. Hexima's team of about 30 is working on its science with partner companies overseas.

"We need to partner," said Professor Clarke, "because obviously we are not going to be selling to the farmer. But we want to take the risk as far down the track as we can, so we get a better share of the benefits for our shareholders in getting the technology through to commercialisation. We have got the genes, but we also need enabling technologies and other bits of the equation."

The company listed last year and in the decade to then had spent about $10 million of investors' money. Other substantial funding has come from the Commonwealth and Queensland governments — "incredibly important", said Professor Clarke.

The key to the science is the now patented discovery of several molecules in flowers that protect the female stigma from insect predation and fungal infection.

"In flowers the male and female parts are so close together that normally there might be an incestuous mating within the same flower, but that does not happen," said Professor Clarke. "This is really important for understanding evolution and the success of life on earth. If plants . . . were allowed to breed with themselves there would have been inbreeding depression and none would have survived."

The question of how self-incompatibility is achieved by plants has puzzled botanists since Charles Darwin's day, but came to prominence when the first plant genes were being cloned. "That was a terribly exciting time," Professor Clarke said.

"Cloning a gene means you take the piece of DNA that specifies to a cell to (make, say, insulin or perhaps hair). So cloning a gene in that sense meant identifying that bit of gene and moving it into a bacterium, or something, so you could make plenty of it," she said.

"So we said we would clone a gene that specified self-incompatibility. We got a big grant (from the government) which was vitally important for us, and we met an American company called Agrigenetics that had raised $50 million from Hollywood stars in a limited partnership deal. It was a huge amount of money in those days — equal to the whole research budget for Australia.

Chemical weapon: Plants' proteinase inhibitors block enzymes that insects use for digestion. PICTURE: LOUIE DOUVIS

"With that backing they went around the world picking up the best plant scientists because a revolution was occurring in agriculture by applying medical cloning technologies to plants," Professor Clarke said. "We were identified as one of the recipients."

Initially the university was cautious about assigning intellectual property rights, which the deal with Agrigenetics required. "There was a big argument about whether we should be involved, but we said what else were they going to do with (the discovery), so eventually, after some debate, we signed up and off we went with a really good budget. And we got there. It was very exciting," she said.

That led to worldwide scientific interest and a cover story in *Nature*, the most prestigious of science magazines. "Not only did we work out the gene but what you could do with the plant and how the female recognised the male, which produced a series of scientific papers."

Professor Clarke is proud of her achievements and especially of the team of researchers with whom she works but says: "Things are often discovered by accident. It really depends on how receptive your mind is to seeing and understanding what you have discovered."

She adds: "For instance, we found a number of other genes, one of which was really highly expressed right on the surface of the female; 20% of all the plant's energy was going into the production of this stuff."

It turned out to be a series of proteinase inhibitors, which help crops resist insect attack by blocking the enzymes the insects use to digest the plant proteins.

"Why was the plant doing that?" said Professor Clarke. "Because it has to protect its eggs; that's the girl's job in life. So we made some of this stuff and tested it on some crickets. We found they became very lethargic. Normally they jump around inside the laboratory jar, but with this stuff they just lay on the bottom."

Out of that came a method of combating the boll worm, a pest in Australian cotton. "We set up a facility for putting genes into cotton; we are one of the few labs in the world doing it and we are very skilled at it," she said.

Research is now continuing into another set of female protective molecules called defensins that combat fungal attack in plants. "Nobody has done much about them until recently," she said.

Field trials are now under way into defences against fusarian wilt and blackleg, two serious diseases of cotton.