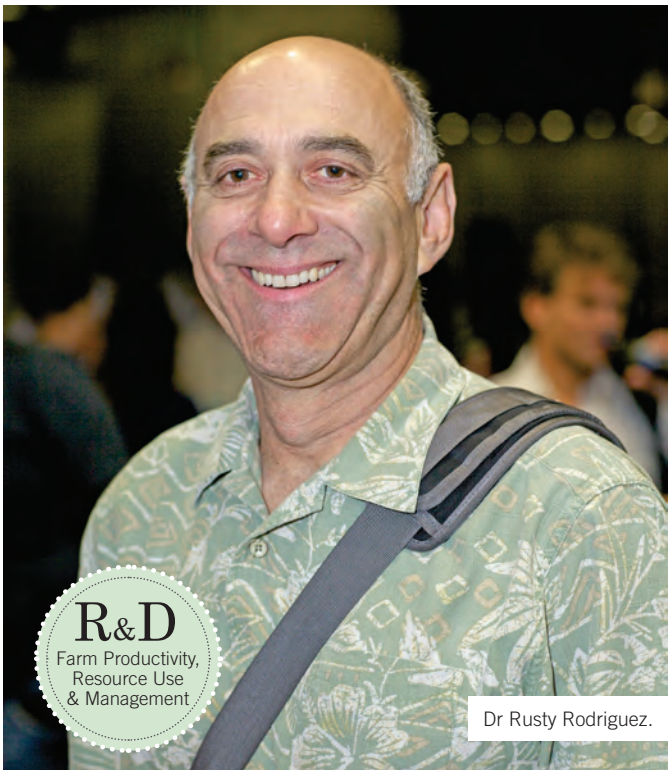
Functional fungus: Conferring stress tolerance to vegetable crops



Dr Rusty Rodriguez.

AT THE 2013 AUSVEG EMERGING TECHNOLOGIES IN HORTICULTURE SEMINAR, HELD AT JUPITERS GOLD COAST ON 31 MAY, US SCIENTIST DR RUSTY RODRIGUEZ SPOKE TO *VEGETABLES AUSTRALIA* ABOUT ENDOPHYTIC FUNGI, STRESS TOLERANCE IN PLANTS, AND THE IMPORTANCE OF A THOROUGH REGULATORY PROCESS FOR NEW TECHNOLOGIES IN THE FIELD OF HORTICULTURE.

Dr Rusty Rodriguez is the CEO of Seattle-based scientific research company, Adaptive Symbiotic Technologies, and was a speaker at this year's Emerging Technologies in Horticulture Seminar.

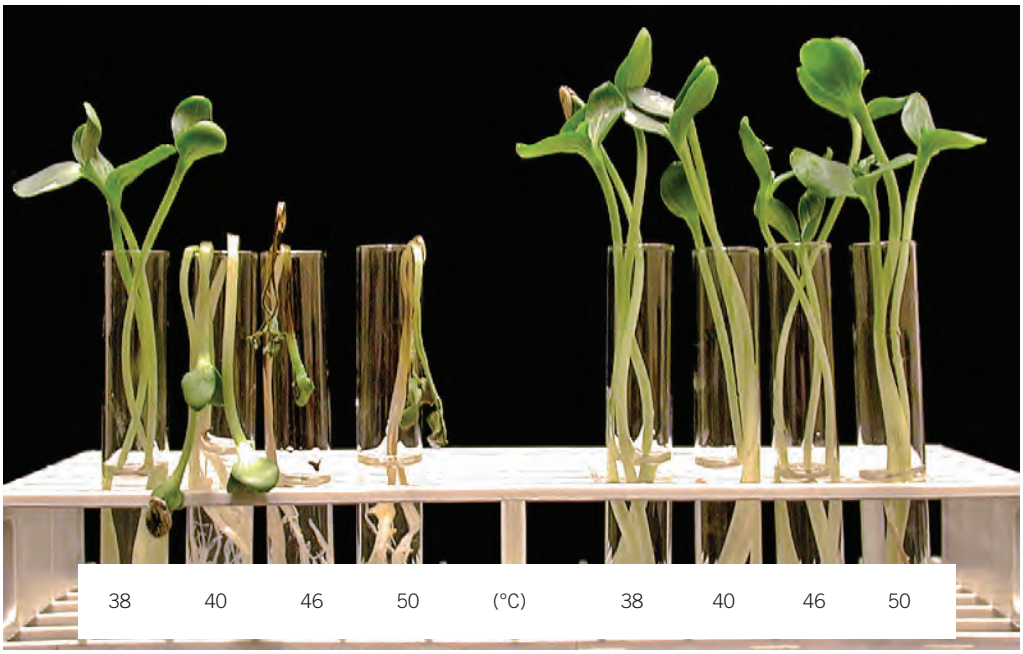
Dr Rodriguez spoke to attendees about the research field of plant-fungal symbiosis, with symbiosis referring to the prolonged and mutually beneficial relationship between two or more different species. Dr Rodriguez discussed "extremophile" plants: plants which thrive in habitats exposed to great amounts of environmental stress, such as drought, salt, or temperature stress. These "extremophile" plants - specifically, species found in geothermal sites based in the US - had managed to survive in high temperatures and highly toxic soils because of the existence of a special endophytic fungi which lived in symbiosis with the plant. Tests carried out by Dr Rodriguez found that combining the endophytic fungi with plant types that had no prior relationship with the fungi led to the transfer of beneficial stress tolerance properties, indicating the potential for vegetable crop production in arid and saline environments across the world.

Bio Insure

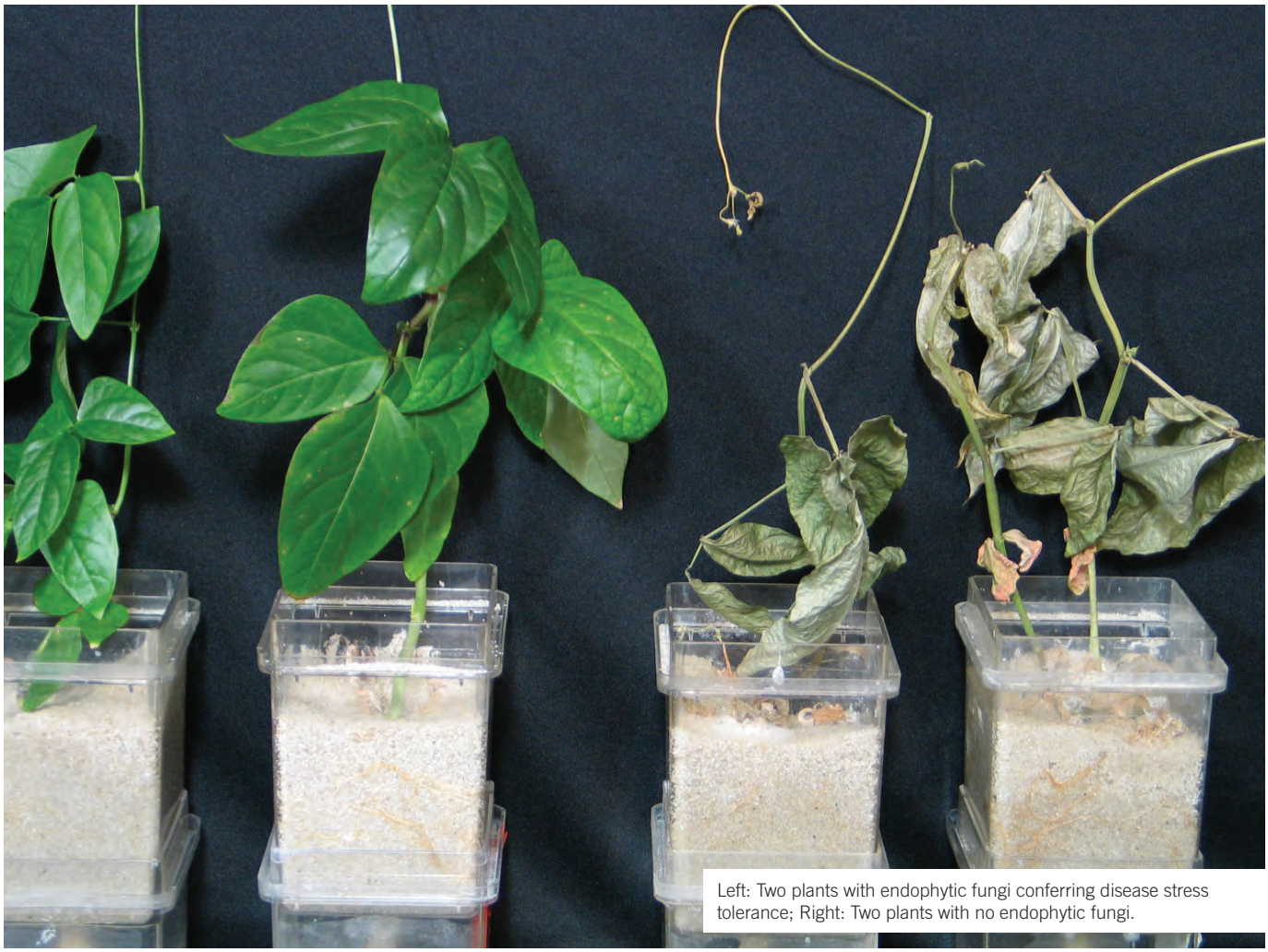
In light of this discovery, Dr Rodriguez and his colleagues at Adaptive Symbiotic Technologies are currently developing a technology called Bio Insure. "It is comprised of microorganisms that are from native plants. These are not genetically modified organisms. We use these to confer stress tolerance - drought stress, salt stress, or temperature stress - to crop plants. We can confer that protective capability to virtually any crops," he said, highlighting the adaptability of the technology.

The idea to confer favourable stress-tolerant microorganisms from stress-tolerant plants to vegetable crops originated from Dr Rodriguez studying how plants adapt to high-stress habitats.

"There are high-stress habitats all around the world - some of them are drought stress, some of them are salt stress,



Left: Four watermelon plants with no endophytic fungi; Right: Four watermelon plants with endophytic fungi conferring heat stress tolerance.



Left: Two plants with endophytic fungi conferring disease stress tolerance; Right: Two plants with no endophytic fungi.

temperature, both cold and hot - and we wanted to know how [the plants] did it and if microbes played a role," he said. "It turns out the first ones we looked at were in these geothermal soils, and the microbes played a tremendous role. In fact, the microbes were completely responsible for that heat tolerance."

Impact on the horticulture industry

Dr Rodriguez believes that the impact that this technology will have, when applied to the horticulture industry, is multi-faceted.

"We look at it as four different levels of plant production. These include seed germination, seedling growth and development, heat tolerance, and…yield increases," he said. "We parcel that as four different things. We see significant improvements in seed germination rates, and seedling growth and development establishment."

Limitations to the development of Bio Insure have thankfully been few and far between for Dr Rodriguez and his team.

"I would say the biggest limitation we have right now is being able to define the mechanism behind what we're observing, both on the plant side and the microbe side. We've been spending a fair amount of time and effort trying to do that. Other than that, we've pretty much worked through all other areas or aspects that we might consider limitations. We've overcome all the problems with scale-up cultivation of the organisms, and formulations for seed treating," he said.

Looking to the future

Currently in their second year of field testing, Dr Rodriguez said testing will continue to be accompanied by greenhouse studies. Several growers who attended the seminar expressed interest in hosting trials on their own farms. It is anticipated that the technology will become available in Australia, Europe, the US and South America in late 2013.

Dr Rodriguez is currently seeking regulatory approval for pilot trials in Australia, and approval is the last obstacle to be overcome. However, Dr Rodrigues does not see this as an impediment to the development of his technology.

"I actually think that the regulatory process is not a bad one. I think that it's critical we have one. I think that it needs to be updated, and made more realistic with... our new understanding of biology, ecology and whatnot. I don't ever see it being insurmountable," he said. "It is important though. For me, one of the most important aspects of the regulatory process is that we pretty much know now that once something is released, you can't take it back. So once it's out of the bottle, the genie doesn't go back in. We've already seen plenty of problems with that, so that's why I say I think we definitely need a regulatory process."

In reflecting on developing his technology, Dr Rodriguez said there were many reasons why this field of research kept him happy.

"It's been a fantastic adventure because it's all new discoveries. It kind of flies a bit in the face of what's contemporarily viewed as plant adaptation and ecology, so it's been fantastic from a scientific perspective," he said.

"It's been a fantasy, I think, of most scientists to be able to do basic research, to be able to make new discoveries, develop something and actually bring it to fruition where you're seeing it applied and making a difference," he said. "So for me…changing the way we do agriculture is going to be one of the best benefits of it. To be able to reduce inputs going into agriculture, dealing with water quality and availability, bringing this to developing nations to be able to assist sustainability on small farms, will all be fantastic."

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