AUSPLOW
Digging deep for every farmer.
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WA RESEARCH POINTS TO NATURAL DISEASE SUPPRESSION

WA scientists are involved in world-leading research investigating the potential of soil-borne suppression of crown rot in wheat.

And it could lead to identifying other positive attributes of soil biota associated with disease suppression of plants, such as sclerotinia in canola, and root diseases including rhizoctonia, take-all and pythium root rot in cereals.

Involved with a research team, which released a paper earlier this year on the subject, was Ausplow consultant and former CSIRO scientist and microbiologist Dr Margaret Roper.

According to Dr Roper the soil contains a huge variety and number of soil biota, "capable of many positive functions in the soil".

In the paper's conclusion, it said the screening of 53 isolates from a collection of endophytic Actinobacteria revealed several promising isolates.

"Two in particular, strongly suppressed growth of the (crown rot) fungus in plate cultures, and resulted in increases in grain yield compared to diseased controls in glasshouse experiments," Dr Roper said.

She added that further studies were needed to verify the efficacy of the treatments at the field scale and to determine the mode of action and underlying genetics of biocontrol activity.

According to Dr Roper, management strategies to control crown rot are somewhat limited.

"Fungicide seed dressings are available, but they are often inactivated over time by environmental conditions," Dr Roper said.

"Research has shown (anti-fungal) protection is usually best in the early stages of the plant growth cycle.

"Plant breeding has produced some more resistant varieties but none of these show robust and durable disease resistance in the field.

"An additional problem for crown rot control is that the fungal pathogens that cause the disease (F. pseudograminearum and F. culmorum) survive and continue to grow in the stubble left after harvest, increasing the risk of infection in the following crop.

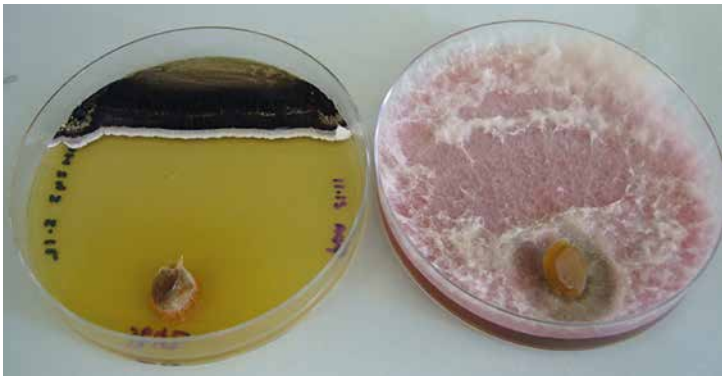
"This can happen regardless of the level of resistance/tolerance of the wheat variety in the living phase of the crop."

Dr Roper said studies from various locations around the world have shown that micro-organisms (bacteria and fungi), that produce secondary metabolites, play a significant role in the formation of disease suppressive soils.

Continued page 2

Ausplow consultant and former CSIRO scientist and microbiologist Dr Margaret Roper is part of a research team involved in world-leading research into the potential of soil-borne suppression of crown rot in wheat.

From page 1



An actinobacteria culture (left tray in black at top) inhibiting growth of a crown rot pathogen in a laboratory plate test compared with the control plate (right tray) showing the uninhibited pathogen spread.

Such work suggests that there remains considerable unexplored potential within soil microbial populations for further novel biocontrol products.

"One group of bacteria (actinobacteria) are very common in soils, survive well in our extreme WA soil environments and produce various bioactive agents including antibiotics, enzymes, and vitamins," Dr Roper said.

"Actinobacteria can reside within a plant where they are protected from adverse environmental conditions and other microbial competitors.

"There are also other soil microbes which can colonize plants as endophytes and these are likely to be the most successful in suppressing plant pathogens."

The research work, which Dr Roper has been involved with for more than 30 years, is an exciting development as Ausplow promotes its hypothesis of the near-row BioFurrow™ system of crop establishment.

Dr Roper said in the past inter-row sowing had been used to decrease disease risk, but trials in South Australia by Dr VVSR Gupta (CSIRO) have shown that the expression of root diseases such as rhizoctonia was less under near-row seeding, as distinct from inter-row sowing.

Dr Roper listed the following benefits of near-row seeding relative to inter-row sowing as:

1. Larger and more diverse microbial communities.
2. More water available to a new crop (in water-repellent soils).
3. Improved crop establishment.
4. Repellency declines during the season.
5. Improved yields in some years.
6. Fewer weeds.
7. Greater disease risk, BUT less disease incidence and severity.

Dr Roper's research has shown that plant roots, preserved by no-till, behave as pathways for water infiltration, particularly in water repellent soils, to create an environment which can include the above benefits.

She said the combination of near-row sowing with the DBS sowing system creates the BioFurrow™ system of crop establishment, and this can provide significant benefits for a developing seedling.

"Firstly, the provision of liquid nutrients directly below the seed provides a source of water vapour for seed germination," Dr Roper said.

"The 'precision seed bed', created by the DBS closing tool to provide a firm and aerated base for the seed, contains fine capillaries through which water vapour (from the liquid nutrients) can rise to the seed and promote germination.

"Scientific research also has presented evidence that water vapour is the primary source of water for seed germination in unsaturated soils."

(This arguably, could be part of an explanation for why DBS owners report quicker germinations in dry sowing compared with other tillage systems.

The main conversation over the past nearly 30 years in regard to dry sowing, is that the DBS penetrates hard pans and promotes water capillarity, from subsoil moisture, to wet up the seed bed).

Ausplow will continue to support and promote Dr Roper's research in field trials at Quairading.

A tell-tale sign of crown rot in a wheat plant compared with healthy green heads in the background.

SCIENCE SPOTLIGHTS SOIL BIOLOGY

IT IS INTERESTING THAT SCIENCE HAS BEEN AWARE, FOR DEC ADES, OF NATURAL PROCESSES FOR PRODUCING HEALTHY PLANTS.

Yet little of the huge amount of scientific research that has been done on the subject, has impacted on agriculture – in terms of establishing healthy crops and pastures.

There has been little commercial enthusiasm for what we might call Mother Nature's inherent mechanisms that can produce healthy crops and pastures, build soil carbon and mitigate fungal diseases and insect damage.

One example of these natural processes was cited in the last edition of Ausfacts for Profit, relating to plant inoculants protecting roots against diseases.

In the right soil environment, beneficial soil micro biota flourish naturally, providing all the benefits that are claimed by popular commercial inoculants.

The right soil environment can be described as soil with organic matter, structure, balanced soil pH, moisture and oxygen.

So, what about the studies that have found that the plant's internal defences (such as insect and disease resistance) are significantly affected by the nutrition of the plant?

That domain has largely been left to commercial interests, plying synthetic fertilisers, pesticides and fungicides, ostensibly to keep plants healthy.

In this edition's lead story, Ausplow and former CSIRO scientist and microbiologist Dr Margaret Roper reveals research from laboratory experiments that have shown how naturally occurring soil microorganisms suppress crown rot in wheat.

While Dr Roper is keen to remind farmers that field trials are now needed to substantiate the research, Ausplow managing director John Ryan believes we are now moving into a science-led era that can also substantiate Ausplow's BioFurrow™ hypothesis.

"If you look at what scientific research has revealed it presents a range of questions to me that has helped me in the design evolution of the DBS, leading to our hypothesis on the BioFurrow™," John said.

The BioFurrow™ crop furrow concept is based on creation by the DBS system of a moist, aerated and nutrient-rich environment where microorganisms flourish and plants thrive.

According to John, the history of agriculture has proven the pitfalls of over-cultivating and low soil pH – loss of topsoil and, particularly in Western Australia's wheatbelt, salinity.

"Farmers throughout the world have led the way in overcoming these challenges, to some extent, through minimum cultivation and soil renovation," he said.

"But what science is now showing us through decades of work by researchers such as Dr Roper, is a bigger picture.

"Science is breaking through myopic views that our 'conventional' methods of crop and pasture establishment will stand the test of time.

"But nowhere have we evidence of such a fact.

"We do have evidence of 'sugar hits' through deep tillage, rotary hoeing, spading and mouldboard ploughing but I've never heard anybody talk about the longer-term residual benefits past five or six years.

"What I do know is that soil microbes have been around since before the start of agriculture.

"These soil microbes (or soil biota) physically contribute to soil structure and help build organic matter (by sequestering carbon), leading to healthy plants.

"Scientists have long despaired that our 'conventional' agricultural methods and inputs are killing these microbes.

Continued page 4

From page 3

"Hence the microbes don't get much chance to show their wares.

"But when they do, they conclusively prove what scientists have been saying for decades and what recently, New South Wales farmer and DBS owner Greg Chappell, has revealed to us in his Ausfacts stories.

"Briefly, since 2008, Greg has been re-building his soil by increasing organic carbon content through things like mulching weeds, manuring and using a liquid potassium mix based on plant analysis.

"Crops and pastures really took off when he started using the DBS in 2017.

"When he started, paddock measurements were below one for organic carbon and now it's around 3.5.

"With soil pH, measurements have gone from between 4.4 and 5.7 to between 5.9 and 7.1.

"He says he's retaining organic carbon and this is increasing the water-holding capacity of the soil; he attributes these benefits to the positive contribution from soil microbes.

"His parting message in his story in the October 2018 edition of Ausfacts was:

'Let's give biology a go.'

"I can only encourage DBS owners to critically evaluate what they want to achieve with crop and pasture establishment and at least trial a bit of biology.

"Even if it's only one run to establish, for example, a BioFurrow™ trial as a control, at least you're on the road to meaningful comparisons.

"The DBS is only one tool, but I believe biology is the toolbox.

"Why not discover what other tools you can find in the toolbox?"

Scientific research is showing soil biology can play a bigger role in producing healthy crops.

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