Australasian Soil and Plant ANALYSIS Council Inc.

ASPAC Digest – July 2017

9th Edition, July 2017

Contents

Australasian Soil and Plant Analysis Council Inc.
ABN 82 792 475 282 Reg. #: A0024099D ISSN: 1445-524 www.aspac-australasia.com

ASPAC
Australasian Soil and Plant
ANALYSIS
Council Inc.

Greetings from the Chair

Dave Lyons – Chairman ASPAC, Queensland Representative

Welcome to readers of this ASPAC Newsletter for July 2017. Before I forget, I must thank our Newsletter Editor Rob De Hayr who, as well as managing what is probably now the biggest Government soil and plant testing facility in Australia, puts on another hat every couple of months to publish newsletters for us. In each Newsletter, we try to keep Members informed on what the Executive Committee and the various Sub-Committees are up to, along with other topics of general interest. But we also want to include articles from members, or those they collaborate with, who have involvement in novel research or nutrient monitoring of relevance to soil or plant analysis. Such items would be juicy for readers and could lead to support from ASPAC e.g. Travel Awards.

Executive Committee members Janice Trafford (ACT) Rebecca Withnall (New Zealand) and Paul Kennelly (Victoria) have come up with an exciting program for attendees of ASPAC's 5thSoil Technicians Workshop. The Workshop will be held in Napier, New Zealand and will be hosted by the Ravensdown Analytical Research Laboratories. It will run over two days from Tuesday 31st October to Wednesday 1st November. At the same venue, the day before the workshop, the Executive Committee will have its only face to face meeting of the year, leading to ASPAC's first AGM on New Zealand soil. The AGM will kick start the Workshop and should give participants a chance to meet Council members and contribute if they wish. There will be several local presenters including Brian Daly and Roger Hill along with a few members of the Executive from Australia who are returning home on later flights. Thanks to Janice, Rebecca and Warren Webber (ASPAC Executive Officer) for organising this important event.

ISSPA 2017 – 15th International Symposium on Soil and Plant Analysis, May 14-18, Nanjing, China.

The photo shows some happy participants who now know all about nutrient uptake patterns in sugar cane after viewing and listening to a poster presentation by Zofia Ostatek-Boczynski from Sugar Research Australia. Left to right we have Dailena Pienar, Agri-Laboratory Association of Southern Africa (AgriLASA); Warren Webber,; Roger Hill, Hill Laboratories New Zealand; Zofia, Dave Lyons, and Vossie Wilsnach (AgriLASA)

Eight of our members attended, enjoyed and contributed to this very successful Conference, which was organised by the Institute of Soil Science, Chinese Academy of Sciences, with support from the North American SPAC, and a Scientific and Technical Committee of 15 scientists from all round the world, including two from Australia. In addition to the four ASPAC members in the photo, we were also represented by George Rayment who has now retired from ASPAC Committee involvement after some 26 years, an enormous effort; Rob De Hayr DSITI Laboratory Brisbane; Chris Gendle from CSBP Perth and Rob Cirroco from Phosyn Laboratory Gold Coast. ASPAC members presented all up six oral papers and one poster, a very good effort. All were well received by participants. The six oral papers, presented by the first/sole author were:

- Soil testing and fertilizer recommendations – Australasia and South Africa. George Rayment
- Multiple assessments of trends in soil measurement performance by laboratories across methods and time – Australasia. George Rayment, David Lyons
- International governance for future international soil and plant analysis symposia. Warren Webber

Australasian Soil and Plant Analysis Council Inc.
ABN 82 792 475 282 Reg. #: A0024099D ISSN: 1445-524 www.aspac-australasia.com

- Quality control in a commercial, accredited laboratory in New Zealand. Roger Hill
- Using soil test methodology to assess the bioavailability of particulate nutrients in sediments exported to the Great Barrier Reef, Australia. Robert De Hayr, Alexandra Garzon-Garcia, Joanne Burton, Philip Moody, Michele Burford, Hanna Franklin.
- Training workshops and proficiency testing contribute to much-needed improvement in the quality of acid sulfate soil testing in Australia. David Lyons, George Rayment, Angus McElnea.

Members are encouraged to go to the 15th International Symposium website which now shows as new items, photos of events and presenters, as well as PowerPoint files of all oral presentations.

Warren Webber led a two hour out of session discussion on the formation of an ISSPA International Governance Committee, which would oversee future Symposia. The aim being to ensure continuity of these events every two years, but in a more inclusive, professional way, bearing in mind the great legacy that has been in place over the last thirty years, thanks to the North American SPAC. If successful, other Councils like ASPAC will have more say in the planning of future Symposia and systems will be in place to better support local organising committees.

As indicated in the photograph, there was good chemistry between the Australasian and South African Councils leading to some preliminary collaboration which might lead to commonality in the way both organisations run their proficiency programs e.g. sharing proficiency provider, samples, etc. More to come on this; it is very early days and feel free to provide input please.

ASPAC Website

Progress on updating our Website has been steady. Good feedback has been received on improvements we have made in the proficiency module of the Website. An Extension Officer from Victoria was very impressed how easily he was able to search for tests and laboratories. We can thank George Taylor, a website designer in New Zealand, for his initial work in this upgrade, along with recent and on-going fine tuning initiated by Warren Webber, working with Lana Pears (Global Proficiency) and Chris Williams (Web Developer Arris Pty. Ltd. South Australia).

The Laboratory Proficiency Committee

Our Inter-laboratory Proficiency Programs (ILPP) have increased in terms of the number of tests on offer, and we are seeing an increase in the number of international laboratories taking part. Recently we had a laboratory in Dubai wanting to participate in our soil program.

In 2016, ASPAC delivered, through its' Proficiency Provider (Global Proficiency, based in Hamilton, New Zealand), three inter-laboratory proficiency programs - SoilCheck, PlantCheck and an Acid Sulfate Soils program. The following table summarises the scope of these programs.

SoilChek

- 50 certifiable tests
- Between 10 and 52 laboratories provided results depending on the test
- Total of 52 laboratories participated

(Aust. 41; NZ 7; PNG 2; Fiji 2; Thailand 2; Vietnam 2; Indonesia 1; Laos 1 ; Philippines 1)

Australasian Soil and Plant Analysis Council Inc.
ABN 82 792 475 282 Reg. #: A0024099D ISSN: 1445-524 www.aspac-australasia.com

PlantChek

- 21 certifiable tests
- Between 7 and 35 laboratories provided results depending on the test
- Total of 39 laboratories participated
(Aust. 27; NZ 7; PNG 2; Fiji 2; China 1)

- Acid Sulfate Soils Program

- 16 certifiable tests
- Between 7 and 17 laboratories provided results depending on the test
- Total of 20 laboratories participated all from Australia

All laboratories will experience times when they are operating at levels of measurement performance below their own expectations or below their peers (e.g. in a proficiency program). ASPAC is there to help; there is a lot of experience on offer from members of the Laboratory Proficiency Committee, Methods Committee and others. Go to the "Contact Us" icon on our website.

The Methods Committee

Reissue of NATA Technical Note 33 on Measurement Uncertainty

ASPAC recommends that all Members be familiar with estimating measurement uncertainty (MU), because it is only a matter of time before a client asks: "How good are your test results?". The ASPAC Methods Committee provided an introduction and guide to MU in the 6th edition of the *ASPAC Digest*.

Australian laboratories were introduced to MU when NATA issued version 1 of Technical Note 33 during 2006, and required an estimate of MU for test accreditation. Estimates of MU have since largely replaced previous measures of precision and reproducibility, bringing Australian laboratories into line with their international peers.

The ASPAC methods committee reported to NATA during 2016 that there appeared to be a technical flaw in the MU calculations in the Feb 2016 issue of Technical Note 33. . We are pleased to announce that NATA issued a revision of Technical Note 33 last month (April 2017).

Most Members have copious amounts of QC and PT data, and the current issue of Technical Note 33 describes how to use these data to estimate MU. Technical Note 33 can be downloaded free from the NATA web site. Members who have difficulty following these procedures should contact our PT partners, Global Proficiency, or their ASPAC representative.

Dedicated ammonia and nitrate analyser

The latest North American Soil and Plant Analysis Council Newsletter carries an advertisement for a dedicated ammonia and nitrate analyser. The manufacturer, Timberline Instruments, supplies the complete unit, not the component parts for attachment to other flow analysers. The contact at Timberline is: Sara Bury sara.bury@timberlineinstruments.com.

The principles are that the sample is mixed with an alkaline solution to raise the pH, converting ammonium ion to ammonia. Ammonia diffuses across a gas permeable membrane, where it is absorbed by a boric acid buffer, and the change in the electrical conductivity of the buffer is proportional to the concentration of ammonia dissolved.

$$NH_4^+ + OH^- \rightarrow NH_3 + H_2O$$

The complementary nitrate measurement employs on-column reduction to ammonia using 'activated zinc', followed by measurement of the ammonia as already described.

Australasian Soil and Plant Analysis Council Inc.
ABN 82 792 475 282 Reg. #: A0024099D ISSN: 1445-524 www.aspac-australasia.com

$$NO_3^- + 4Zn + 7OH^- \rightarrow 4ZnO_2^{2-} + NH_3 + 2H_2O$$

The combination of ammonia diffusion and conductivity measurement is unique to the Timberline analyser, and the principles are well-founded. For example, on-line gas diffusion is used to separate ammonia from matrices such as Kjeldahl digests prior to colorimetric or potentiometric measurement. And nitrate reduction to ammonia under alkaline conditions—by reaction, e.g. with aluminium foil, Devarda's alloy or titanous salts—was long the method of choice for nitrate measurement. However, since the 1960s, nitrate measurement has increasingly relied on either on-line reduction to nitrite and diazotization, or ion chromatography.

If you assess the performance of the Timberline analyser, please provide feedback to ASPAC members through the Newsletter.

2017 Training

Soil Technicians Worksop 31 OCT – 1 Nov 2017, Ravensdown Analytical Research Laboratories (ARL), Napier, New Zealand.

The workshop is intended for early career soil analysts and is an excellent opportunity to build networks with scientists in the same field of work. The programme is designed to provide ample opportunity for active participation and interaction.

The cost for the workshop is $300 for two days; this includes all daytime catering and dinner on Tuesday 31st October. In order to enable an interactive workshop places are limited; please email Warren Webber wwebber@outlook.co.nz if you wish to register

Registration closes on 21st August

Topics covered to include:

Why do we do soil analysis?
ASPAC proficiency test trends in historic data
Troubleshooting possible issues with poor performing analyses, sample preparation etc.
Method selection and fitness for purpose
Quality Control and Data reporting
Uncertainty of Measurement
Exchangeable Cations
pH measurement – Methodology, Hints and Tips
Emerging Technologies e.g. NIR
How soil analyses are used
Soil bicarbonate P extraction issues
How to handle large datasets
Bulk QC preparation
Modern Trace Element Analysis of Agricultural Samples
ARL lab tour and presentation – including overview of lean working and lab automation

Remember Registration closes on 21st August

Australasian Soil and Plant Analysis Council Inc.
ABN 82 792 475 282 Reg. #: A0024099D ISSN: 1445-524 www.aspac-australasia.com

Travel Awards 2017

ASPAC and the Plant Nutrition Trust congratulate the following recipients of annual travel awards:

2017 Roger Hill ASPAC Travel Award

This year's Travel Award has been granted to Dr Stephanie Watts-Williams. She has been awarded $2000 to attend the 18th International Plant Nutrition Colloquium. Copenhagen, Denmark, 21st-24th August 2017. Stephanie has just begun an independent Fellowship at the University of Adelaide and expects that attendance at this conference will progress her academic career in plant nutrition research, as well as establishing and maintaining networks in her field of study. She is also expecting that attendance at this conference will help her progress her research project and foster national and international collaborations.

Stephanie will be presenting a paper "Identifying the mechanisms behind mycorrhiza-enhanced plant zinc nutrition". The abstract for her paper is available here.

2017 Plant Nutrition Trust Award

These grants are provided on a competitive basis to enable graduate students and early career scientists to attend international meetings or to perform research in overseas labs. Successful applications need to be relevant to some aspect of plant nutrition or soil fertility. The amount of each grant will vary depending on the activity being proposed and the potential for other support. Most grants range from $200 to $2,000. The following are this year's recipients of the award.

Name	Institute	Going to
Chandee Ramkissoon	University of Adelaide	5th International Conference on Selenium in the Environment and Health, 13th – 17th of August 2017 in Stockholm, Sweden
FeiFei Wang	University of Tasmania	XIX International Botanical Congress, 23-29 July 2017, Shenzhen, China
Cui Li	University of Queensland	18th International Plant Nutrition Colloquium (IPNC), 21 - 24 August 2017 in Copenhagen, Denmark
Wenli Ding	University of Western Australia	18th International Plant Nutrition Colloquium (IPNC), 21 - 24 August 2017 in Copenhagen, Denmark
David Minemba	University of Western Australia	ASA/CSSA/SSSA 2017 International Annual Meeting, 22 - 25 October 2017 in Tampa, Florida.
Arjun Pandey	University of Melbourne	ASA/CSSA/SSSA 2017 International Annual Meeting, 22 - 25 October 2017 in Tampa, Florida.
Olivia Cousins	University of Adelaide	34th Annual Symposium on "Root Biology", 7 - 9 June 2017 in Columbia, Missouri.
Muhammad Kamran	University of Adelaide	ASPB Annual Plant Biology Meeting 2017, June 24-28, 2017 in Honolulu, Hawaii

Committee Contacts

Executive Officer	Warren Webber	wwebber@xtra.co.nz	Phone: +64 27 478 7758
Elected Executive Committee			
Chairperson	Dave Lyons	daveandtrish8@bigpond.com	Queensland
Vice-Chairperson	Paul Kennelly	Paul.Kennelly@incitecpivot.com.au	Victoria
Secretary	Matthew Wheal	mlbmsw@iinet.net.au	
Treasurer	Craig Newman	cnewman@agvita.com.au	Tasmania
Newsletter Editor	Rob De Hayr	Rob.dehayr@dsiti.qld.gov.au	
Regional Representative	Chris Gendle	Chris.Gendle@csbp.com.au	Western Australia

Australasian Soil and Plant Analysis Council Inc.
ABN 82 792 475 282 Reg. #: A0024099D ISSN: 1445-524 www.aspac-australasia.com

Regional Representative	Paul Milham	p.milham@uws.edu.au	New South Wales
Regional Representative	Ryan Walker	ryan@apal.com.au	South Australia
Regional Representative	Rebecca Withnall	Rebecca.Withnall@arllab.co.nz	New Zealand
Regional Representative	Janice Trafford	jmtraff@gmail.com	Aust. Capital Territory

Laboratory Proficiency Committee

Chairperson Roger Hill
Dave Lyons
Leigh Sparrow

Fertcare Advisory Committee

Graham Lancaster
Rob Norton
Craig Newman

Travel Award Assessment Committee

Rob De Hayr
Dave Lyons
Matthew Wheal

Methods Committee Convenor

Paul Milham

Plant Nutrition Trust, ASPAC Representative

Janice Trafford

Training Workshop Convenor

Janice Trafford

Liaison Officer with Consumer Affairs Victoria

Secretary Matthew Wheal

Membership Subcommittee

Chair Dave Lyons
Regional Exec. Rep. (applicant's location)

Australasian Soil and Plant Analysis Council Inc.
ABN 82 792 475 282 Reg. #: A0024099D ISSN: 1445-524 www.aspac-australasia.com

Australasian Soil and Plant ANALYSIS Council Inc.

Identifying the mechanisms behind mycorrhiza-enhanced plant zinc nutrition

Stephanie J Watts-Williams[1], Michael J McLaughlin[2], Timothy R Cavagnaro[1]

[1]Waite Research Institute and the School of Agriculture, Food and Wine, The University of Adelaide, Glen Osmond, SA 5064, AUSTRALIA (stephanie.watts-williams@adelaide.edu.au, tim.cavagnaro@adelaide.edu.au).

[2]Fertilizer Technology Research Centre, Waite Research Institute, The University of Adelaide, Glen Osmond, SA 5064, AUSTRALIA (mike.mclaughlin@csiro.au).

INTRODUCTION

Zinc deficiency, whether it occurs in soils, plants or humans, is a worldwide issue of high priority. Zinc deficiency is one of the most common and widespread micronutrient deficiencies in crop production, and is potentially the most limiting nutritional factor for cereal production [1].

The arbuscular mycorrhizal (AM) symbiosis is an association formed between a specialised group of soil fungi and around 80% of terrestrial plants [2], including most important agricultural crop species. Arbuscular mycorrhizal fungi (AMF) colonise plant roots and proliferate external hyphae into the rhizosphere (the plant root system and immediate soil environment – both biotic and abiotic) and beyond, maximising the volume of soil explored by the AM hyphae for inorganic nutrients such as phosphate (P) and Zn. This relationship with AMF can significantly improve the nutrition of the host plant; the benefits to plant nutrition from AMF are highest in soils depleted of these nutrients [3]. Alternatively, high concentrations of soil Zn can be toxic to plants, and the AM symbiosis has actually been shown to provide 'protection' to the host plant when soil Zn is in excess; that is, mycorrhizal plants have lower tissue Zn concentrations and greater biomass compared to a non-AM plant growing on the same, Zn-contaminated substrate [4, 5].

Zinc is taken up from the rhizosphere in its divalent form (Zn2+) into plants via ZIP (Zrt-Irt-like protein) membrane transporters, and some literature has focused on characterising ZIP transporters in plants [6]. However, compared to other nutrients such as P, our knowledge of the basis of plant Zn uptake is limited – even more so when considering Zn uptake via AMF. The first step in uncovering the mechanisms behind improved plant Zn nutrition through mycorrhizal symbiosis, is to demonstrate that the mycorrhizal pathway for Zn uptake is active, and the impact of soil Zn concentration on the activity of the pathway [7]. Then, we can begin to characterise the transporters and genes responsible for the activity of the mycorrhizal pathway of Zn uptake (via AMF structures) and the direct pathway of Zn uptake (via root hairs).

METHODS

We grew a mutant tomato (Solanum lycopersicum L.) genotype that is unable to form associations with AMF (named rmc) and its mycorrhizal wild-type progenitor (named 76R) in pots of field soil/sand mix containing a hyphal compartment (HC) accessible only by the external hyphae of AMF, and labelled with the radioisotope 65Zn. This set-up was repeated at three soil Zn concentrations, ranging from low (deficient soil Zn condition) to high (toxic soil Zn condition). Mycorrhizal Zn response (MZnR) was calculated as the Zn content of a mycorrhizal plant relative to

Australasian Soil and Plant Analysis Council Inc.
ABN 82 792 475 282 Reg. #: A0024099D ISSN: 1445-524 www.aspac-australasia.com

the mean Zn content of its relative non-mycorrhizal control plants. The amount of Zn delivered to the shoots via both the mycorrhizal and direct (root) pathways was also estimated.

RESULTS AND DISCUSSION

Mycorrhizal Zn response was postivie when the soil was Zn deficient, but reduced with increasing soil Zn. As much as a quarter of the plant's Zn was delivered to the shoots by the mycorrhizal pathway of uptake from the soil at the lowest soil Zn treatment [7]. A similar proportion of shoot Zn was delivered by the mycorrhizal pathway in the medium Zn treatment, but the proportion decreased significantly at high soil Zn, with less than a tenth of the plant's Zn coming through the mycorrhizal pathway. This observed decrease in MZnR with increasing soil Zn concentration may be related to the reduced contribution of Zn via the mycorrhizal pathway relative to the direct pathway. There was no ^{65}Zn detected in the shoots of the non-mycorrhizal control plants.

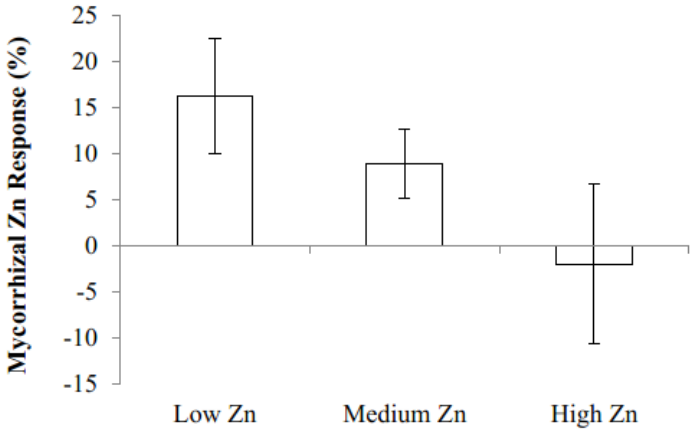

Fig. 1. Mycorrhizal Zn response in tomato plants grown at three different soil Zn concentrations. Values are mean ± standard error, n=5.

CONCLUSIONS

Mycorrhizal plants benefited the most in terms of increased shoot Zn content when soil Zn concentration was very low, and this benefit decreased as soil Zn concentration increased. The mycorrhizal pathway of uptake was active in terms of Zn uptake at various levels of soil Zn, from low to high. The results could have important implications for the nutrition of crops growing on Zn depleted soils.

ACKNOWLEDGEMENTS

SJWW wishes to acknowledge support from the University of Adelaide Ramsay Fellowship.

REFERENCES

1. Ruel MT, Bouis HE. Plant breeding: a long-term strategy for the control of zinc deficiency in vulnerable populations. *The American Journal of Clinical Nutrition*. 1998;68(2):488S-94S.
2. Smith SE, Read DJ. *Mycorrhizal symbiosis*. Third ed: Academic Press, New York; 2008.
3. Marschner H, Dell B. Nutrient uptake in mycorrhizal symbiosis. *Plant Soil*. 1994;159(1):89-102.
4. Chen BD, Li XL, Tao HQ, Christie P, Wong MH. The role of arbuscular mycorrhiza in zinc uptake by red clover growing in a calcareous soil spiked with various quantities of zinc. *Chemosphere*. 2003;50(6):839-46.

Australasian Soil and Plant Analysis Council Inc.
ABN 82 792 475 282 Reg. #: A0024099D ISSN: 1445-524 www.aspac-australasia.com

5. Watts-Williams SJ, Patti AF, Cavagnaro TR. Arbuscular mycorrhizas are beneficial under both deficient and toxic soil zinc conditions. *Plant Soil*. 2013;371:299-312.
6. Guerinot ML. The ZIP family of metal transporters. *Biochim Biophys Acta*. 2000;1465.
7. Watts-Williams SJ, Smith FA, McLaughlin MJ, Patti AF, Cavagnaro TR. How important is the mycorrhizal pathway for plant Zn uptake? *Plant Soil*. 2015;390(1-2):157-66.

Australasian Soil and Plant Analysis Council Inc.
ABN 82 792 475 282 Reg. #: A0024099D ISSN: 1445-524 www.aspac-australasia.com