Plant nutrition courier

The best bits of plant nutrition research 2019-01

Tractor-mounted tool to detect latent nitrogen deficiency

Belgian researchers detect nitrogen deficiency in potato before symptoms are visible by the naked eye. They do so by remote sensing with a tool that detects increased flavonoid contents instead of a reduction in chlorophyll contents.

A tractor with a front-mounted fluorometer linked to the rear-attached fertiliser spreader - that is what researchers at the Walloon Agricultural Research Center have in mind. In this way the Belgian researchers want to adjust the second nitrogen dressing in potato to the actual demand of the crop in real time. The fluorometer they are thinking off must measure the flavonoid content of the leaf epidermis. Field experiments with two potato cultivars demonstrated that the flavonoid content of the epidermis is a reliable and sensitive indicator of a crop's nitrogen status. Plants suffering from nitrogen deficiency show a significant increase of the flavonoid content, prior to a decrease of the chlorophyll content, say precision farming specialists Jean-Pierre Goffart and Feriel Ben Abdallah from the Gembloux-based research centre. Goffart concludes from the three-years spanning potato field experiment that the flavonoid content is a more promising indicator of the nitrogen status of a crop than the chlorophyll content. Moreover, the flavonoid content is not influenced by the water content of the canopy, he says, whereas chlorophyll readings do depend on the water content of a crop's foliage. A zero nitrogen zone or an over-fertilised zone is needed to properly interpret the flavonoid measurements.
The past years the researchers examined chlorophyll fluorescence tools to assess the nitrogen content of potato crops, with the objective to determine fluorescence indicator thresholds to help farmers in the decision whether in-season application of nitrogen is required. Goffart and his colleagues compared in-season plant readings of four handheld devices to test which approach offered the best results: two fluorometers (Dualex and Multiplex), a radiometer (Cropscan) and a chlorophyll meter (Yara N tester). A part of this work is published in the *Journal of Plant Nutrition*.

Continuous measurements
The current generation of fluorometers can only make point measurements. Goffart and his colleagues hope they can develop a tool that will be suitable for continuous measurements. They do this job with the French company Force-A, the manufacturer of the portable Dualex and Multiplex fluorometers. The objective is a fluorometer to mount on the front of a tractor and that steers a rear-attached fertiliser spreader. The flavonoid signal is too weak to measure it by a drone-mounted fluorometer.
The flavonoid approach is reminiscent of the tractor-mounted Yara N-Sensor that measures the crop's light reflectance at specific wave bands related to chlorophyll content and biomass. A more or less similar approach is developed by the Danish researcher Anton Thomsen during his work at the Aarhus University Department of Agroecology (Denmark). Thomson and his colleagues found that weekly measurements of the ratio vegetation index (RVI) and the leaf area index (LAI) are sufficient to detect nitrogen deficiency in potato crops.
The Belgian researchers have just started experiments in winter wheat to examine whether the leaf flavonoid content is a suitable measure for the rate of the widely practiced third nitrogen dressing. With these experiments they follow French researchers, who have previously established a relationship between the leaf flavonoid content and the nitrogen status of wheat.

Low-cost tool for on-site diagnosing of a crop's phosphorus status

A mortar and pestle, a garlic press, a glass vial, a sachet with a phosphate reagent, a handheld colorimeter and distilled water - that are the ingredients for a diagnostic tool to determine on-site a crop's phosphorus status. With these inexpensive implements and materials it is possible to measure the phosphorus concentration in extracts from fresh crop leaves within three to five minutes, according to a team of researchers at Japanese universities and the Philippine International Rice Research Institute. The researchers examined the usefulness of this technique for lowland rice, in order to offer agronomists and extension specialist a simple and low-cost diagnosing tool. They found that the phosphorus concentration in fresh leaves was closely correlated with the phosphorus concentration of oven-dried leaves measured with the standard molybdenum-blue method in the laboratory. Although not as accurate as the laboratory method, the new method can easily detect phosphorus deficiency of rice in the field (and possibly other cereal crops) without requiring costly, off-site equipment, according to the researchers. They present their method in a short article in the *Journal of Plant Nutrition and Soil Science*.

Reactive extrusion extends phosphate release profile of APP fertilisers

Ammonium polyphosphate hydrolyses in soil to plant-available orthophosphate. Chemical engineers at the Sichuan University have found a way to make the phosphate release profile of ammonium polyphosphate (APP) fertilisers more synchronous to the phosphorus demand of crops. For this purpose they prepared APP by reactive extrusion of a mixture of monoammonium phosphate and urea in a co-rotation twinscrew extruder. Increasing the screw rotation speed enhances the slow-release properties of the APP extrudate, the researchers reported in the journal *Chemical Engineering & Processing: Process Intensification*. In a second paper published in the *Chemical Engineering Journal* they report about process mechanisms and kinetics.
The Chinese scientists found that an improved phosphorus delivery profile does not depend on the molecular weight of the ammonium polyphosphate units; instead the multiformity of the phosphorus species is more significant. They therefore conclude that obtaining a higher molecular weight need not be the goal of the APP fertiliser production process, because APP with a broad molecular weight distribution is more effective. The molecular weight distribution of the APP oligomers/polymers can be characterized by the polydispersity index (PDI). This indicator is defined as the ratio of *weight-average* molecular weight to *number-average* molecular weight.