TESTING THE EFFECTS OF NITROGEN AT THE MLMRU

Project MU17004 (*Optimising nitrogen transformations in mushroom production*), led by Professor Michael Kertesz at the University of Sydney, aims to understand the influence of soil microbes on nitrogen transformations occurring in compost and casing during mushroom production. The objective of this ongoing project is to optimise nitrogen management, reducing losses from compost and improving yield and quality.

Nothing grows without nitrogen. It is a key building block of DNA, a component of the amino acids that form proteins, and is essential for growth. It is also necessary for respiration, the process by which all living cells break down carbon compounds to produce energy.

The ability of fungi to use a wide variety of nitrogen sources is one of the factors that allows them to colonise so many challenging environmental niches, outcompeting microbes such as bacteria and yeasts in low nitrogen conditions.

Nitrogen is added at the start of composting to stimulate microbial activity. Additional nitrogen supplements may be incorporated with spawn or added at casing. However, such protein-rich supplements generally provide a transient pulse in ammonia (NH_4^+), followed by a continual rise in nitrite (NO_2^-) and nitrate (NO_3^-) in the casing during cropping. As *Agaricus* mycelia are intolerant to ammonia and do not absorb nitrate well, this is not an efficient process. There must be a better way.

A series of trials is currently being conducted at the MLMRU examining use of fertigation to add nitrogen during cropping, looking to determine the best form and concentration of nitrogen to improve yield without increasing disease pressure.

Trial One - Urea

Method

The aim of this trial was to observe the effect of applying urea at pinning on yield and quality. Twenty-four blocks of un-supplemented compost and peat (Elf Farm Supplies and Elf Mushrooms) were set up in the MLMRU growing room, with half allocated for the urea treatment.

Figure 1. Installation of drip lines between mature Phase 3 compost and casing.

Drip lines were installed on top of the 'treated' compost blocks prior to casing. However, they were not used immediately, with both treated and control blocks initially irrigated using a watering wand (Figure 1).

Once the beds started pinning, 100g of urea (46% nitrogen) dissolved in 3L of water was applied across the 12 treated blocks using the installed drip lines. The same amount of water was added to the control block casing using a small watering can. This process was repeated at pinning prior to both the second and third flushes. The quantity of nitrogen in the form of urea applied throughout the trial equates to the amount of nitrogen generally applied via a slow-release protein-based supplement at the end of the spawn run, while the 3L correspond to the total volume of the piping system, to be flushed completely to deliver the above-mentioned amount of urea.

Mushrooms were harvested daily during flushing, then weighed and graded as P/A+ (grade 1); A/A- (grade 2); or B/C (grade 3).

Trichoderma appeared during the second flush. Diseased areas were treated by removing the affected mushrooms, applying salt, and covering with plastic. The number of diseased patches were counted as they appeared.

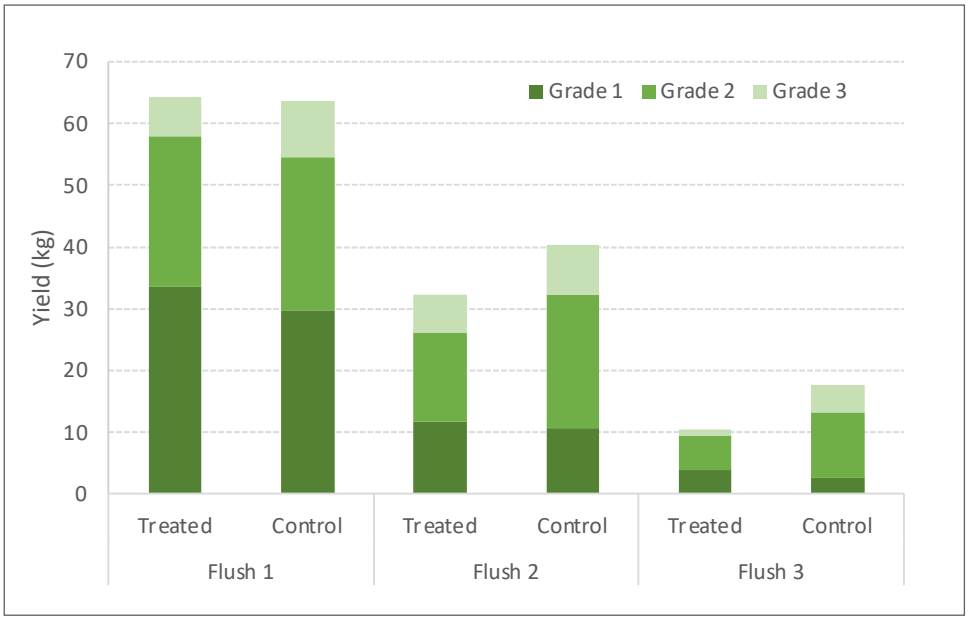

Figure 2. Yield from flushes 1, 2 and 3, divided into three quality grades, from blocks fertigated with urea at pinning or irrigated with water only.

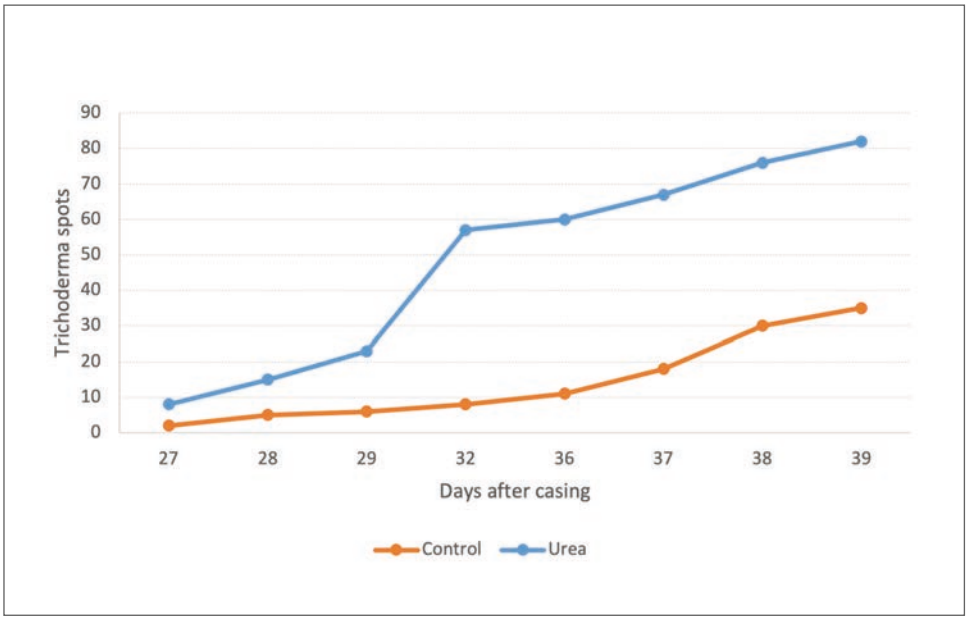

Figure 3. Cumulative outbreaks of Trichoderma on blocks fertigated with urea at pinning or irrigated with water only at pinning.

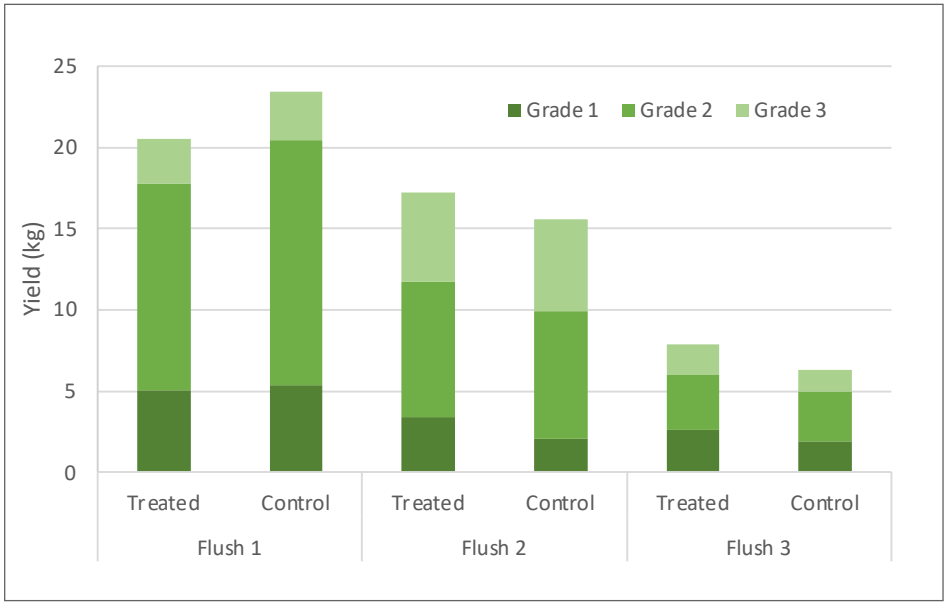

Figure 4. Yield from flushes 1, 2 and 3, divided into three quality grades, from blocks fertigated with amino acids at pinning or irrigated with water only

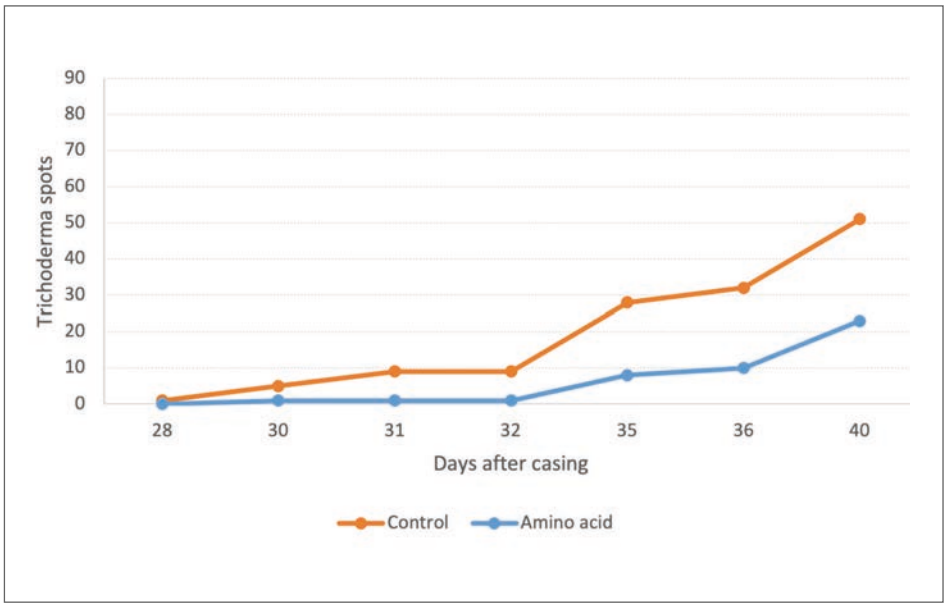

Figure 5. Cumulative outbreaks of Trichoderma on blocks fertigated with amino acid solution or irrigated with water only at pinning.

Results

Total yield over the three flushes was slightly lower for the treated blocks than for the controls (Figure 2). This can be attributed in part to the high incidence of *Trichoderma* in the treated blocks. It was estimated that 5% of flush 2 and 40% of flush 3 mushrooms were lost due to *Trichoderma* in the urea-treated blocks. While *Trichoderma* also appeared in the untreated blocks, they were less affected. (Figure 3).

Trial Two - Amino acid powder

Method

In this trial, urea was replaced with powdered amino acids with a lower nitrogen content (13.9% vs 46%). As nitrogen from amino acid powder is released slowly, it was hypothesised that this could avoid the stimulation of disease observed in trial 1.

In a further change to the experimental design from the previous trial, the 24 blocks were divided into four plots of six blocks each and set up with drip irrigation systems. Each system consisted of 6 x 1.8m drip lines, with downward-facing drippers staggered at 30cm spacings to provide even coverage over the compost.

The amino acid powder was applied at its maximum solubility of 250g/L for the same volume of water per block as in the urea trial, delivering a total amount of nitrogen of around six times the standard rate. This was done to force a response from the mushroom crop.

The treatment was applied during pinning prior to each flush. At 15-, 24- and 33-days post-casing, freshly

Third flush mushrooms fertigated with a solution of amino acids.

prepared amino acid solution was pumped into the system and delivered to the treated blocks. The control blocks were run with water only for the same amount of time. All systems were then purged with clean water, ensuring the nitrogen solution was fully discharged.

Results

In this trial, total yield was almost identical for the blocks fertigated with amino acids and those irrigated with water alone. However, it was noted that the controls tended to yield more in first flush, with the amino acid treated blocks catching up in later flushes (Figure 4). Trichoderma was less of an issue in this trial, particularly in the treated blocks (Figure 5), even though the total amount of nitrogen delivered was much higher than in Trial 1. This suggests that the form of nitrogen applied and its complexity are important not only for the mushroom mycelium, but also for the parasitic green mould.

While yield (kg) benefits of the amino acid treatment were only apparent in the later flushes, mushrooms from the treated blocks appeared to be firmer and heavier than the controls. If this can be verified, it would mean that fewer mushrooms are needed to fill a 250g punnet – a potential benefit to growers.

While the low pH of the amino acid solution (4.2) seemed to have no obvious ill-effects on yield, further verification is required.

Further studies

Subsequent trials at the unit will explore further optimisation of the added N via amino acid powder. This will include reducing the concentration of the solution to more accurately mimic the N-release profile of supplements. Nitrogen via fertigation might also be delivered in later flushes only, trying to improve the declining yield, as the first flush the mushroom mycelium can easily utilise the nitrogen in the compost and supplementation might not have an economically relevant result.

Seaweed extract is another option that might be interesting to explore. As the nitrogen concentration is very low, it would not be used as a fertiliser, but rather as a stimulant, to help the mycelium takeup more of the nitrogen already present in the compost.

Hort Innovation MUSHROOM FUND

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