CHANGING HOW WE LOOK AT MUSHROOMS

– Increasing the efficiency of picking and packing with GTL technology

MushroomLink has written previously about GTL Europe's tilting shelf harvesting system. The system has now been refined further, with new tools soon coming online for both brand new growing rooms and those wanting to retrofit an existing farm.

Regular readers of this journal, and attendees at last year's AMGA conference, may already be familiar with the basics of how the GTL tilting shelf technology works. The system is designed to improve the efficiency of picking by allowing pickers to see the bed and use both hands to harvest mushrooms. It also takes trimming and packing out of the growing room:

- A central blade is used to divide the compost and casing as it is loaded into the modified shelves, scoring a line through the centre of the bed (Figure 1)
- Picking lorries attached to the beds are hooked up to a tensioned harvest belt (Figure 2)
    - The belts run the length of the room along the bottom bed, angling up through the picking lorries
    - The belts exit to either a mezzanine packing floor (preferred) or to the utility area outside the growing room
- The crop is grown normally until first flush
- Pneumatic pistons attached to shelves 1, 3 and 5 or shelves 2, 4 and 6 are used to crack the beds through the centre, tilting each half outwards to about 45° (Figure 3)
    - Surprisingly, the mycelium does not significantly bridge the division created at filling, so this break occurs cleanly and easily

Figure 1. A blade is used to cut a line through the centre of Phase 3 compost plus casing as it is fed into the room.

- Pickers are able to see all of the mushrooms on the tilted bed and can easily reach them
- Mushrooms are plucked from the bed using both hands and placed directly into the harvest belt
- The mushrooms are transported out of the room, past trimming knives that cut the stems
- Packers take mushrooms out of the belt and place into punnets (Figure 4)

Figure 2. Picking lorries attached to the shelves are hooked up to a tensioned harvest belt which runs the length of the room, demonstrated here by Tom Peeters and Dennis Tros from GTL Europe. Note that the picking lorries are also used to irrigate the beds.

Figure 3. When beds are ready to harvest, alternate shelves are cracked through the centre, with each side tilted at approximately a 45° angle; the picker can use both hands to harvest mushrooms directly into the belt; the belt then exits the room to the external packing area.

Figure 4. Mushrooms are trimmed as they pass into the packing area, where a packer transfers mushrooms from the belts into punnets.

Putting tilting shelves into commercial practice - Nesco, Eindhoven

The GTL system has now been installed in 12 farms in the UK, Netherlands, France, Germany, Switzerland and Northern America.

MushroomLink was recently fortunate to visit one of these - a brand-new organic farm in the Netherlands. Nesco Eindhoven has only been in full operation for just over six months, so it really is barely out of the plastic wrapping.

The farm is a rebuild of a facility destroyed by fire a few years previously. While this helped with finances, it also meant that the owners were limited by the farm footprint. Eleven parallel 40m long grow rooms have been installed, each containing two rows of six shelves. Why 11? Essentially, the designers started with how many mushrooms they needed to grow, developed a schedule to achieve that, and then worked backwards. With three flushes over a 5.5 week cycle, 11 rooms were required.

But, 5.5 weeks is surely too fast a turnaround – don't you need six weeks?

Figure 5. The transfer bridge used to move half a bed at a time from the pinning rooms to harvest rooms, the harvest rooms being equipped with tilting shelves.

So here's the next trick; four rooms are used only for pinning. These four rooms have the normal, static shelves, reducing cost. The beds are only transferred into the tilting shelves once they are ready for harvest.

This would be challenging enough if the pinning rooms led directly into the harvest area. However, the rooms are in parallel. What was needed was some lateral thinking; hence the invention of the transfer bridge (Figure 5).

This immense machine pulls half a bed at a time into its internal conveyor, rolls down to the new room, and feeds it back in. Simple. It takes around 2.5 hours to move the 12 shelves. Crop disruption appears to be minimal apart from the join in the middle of the room. There is even some thought that slight rummaging during the process may improve compost aeration, increasing rather than reducing mycelial health – but that remains to be proven.

The advantages of this system include:

- Biosecurity against disease: the pinning rooms can be kept sealed and clean, with nobody entering except the grower
- Reduced investment costs: the tilting shelves are used only when they are needed and not when the crop is still developing
- No disease means no cookouts: so far no cookouts have been needed on the pinning rooms, so they can be refilled almost immediately
- Packing activities centralised outside the tilting shelf harvest rooms, not spread through the whole facility

When using both hands to pick, it is quite feasible for a worker to harvest 100kg mushrooms per hour. Currently this rate has to be halved, however, as one packer is needed for each picker.

As a result, the farm currently employs 28 staff, of whom 24 are involved in harvest and packing. While not insignificant, this is considerably fewer than comparable farms without tilting shelves.

This, then, is the stage for the next great leap forward – mechanical packing.

Robot packers

But to go back a step. Visitors to the UK may have noticed that mushrooms are not arranged and displayed in their punnets in the way we are used to. Prices are low and margins are observed like a cat watching a goldfish – intently. The primary focus is therefore on yield and price.

Most mushrooms are packed relatively loosely into plastic punnets which are either wrapped, surface sealed or flow wrapped with perforated film (Figures 6 and 7). Unlike our tight overwrapping, these methods do not completely stop mushrooms moving during transport and retail display, so they can easily become slightly bruised.

Under these conditions, a small drop into a punnet does not seem a big deal, especially for the 'Heirloom' brown mushrooms grown at Nesco. Their firm texture, plus the brown colour of the caps, means that there is no visible bruising from this process.

Figure 6. Mushrooms on sale in the UK. The mushrooms at left were $2.49 for a 400g punnet ($6.22/kg).

In its simplest form the mechanical packing system designed by GTL relies on 'fingers' that flick mushrooms out of the belt and into waiting punnets. This is not dissimilar to systems used for other horticultural products, so is well-established technology.

However, mechanical packing systems normally weigh the apple or avocado and use this to determine where it exits the line. Mushrooms carried in a belt clearly can't be weighed. The alternative is to use a laser system to measure cap size. Calculations using cap size plus density to estimate weight have so far proven reliable, although they may need to change over the course of a flush. The system can use this method to fill punnets to the desired weight with minimal overpack.

Of course, simply popping mushrooms into punnets means the mushrooms are positioned randomly inside. If presentation is considered an issue, there are two possible solutions. One is to have an employee simply re-arrange two or three of the top mushrooms. This process is fast, so a single packer could potentially polish up the punnets from four pickers.

The second option is to use another robotic packing machine to place the last few mushrooms. A prototype has been developed by GTL, which uses suction cups to pick mushrooms directly from the belt and place into punnets. While this unit is relatively slow, it could potentially provide the final touches before wrapping. But the costs of this technology – compared to using human hands – would need careful consideration.

Figure 7. Organic mushrooms packed into a cardboard punnet with perforated flow wrap.

The Nesco packing area has been 'future proofed', allowing such a system to be easily installed. Moreover, the existing packing areas are portable, so can be moved to whichever room is harvesting. Once again, the aim is to prevent expensive equipment sitting idle.

What else is in the pipeline?

The picking brain drain

Picking mushrooms is both highly skilled and highly repetitive. Pickers have to look at the bed, decide which mushrooms to harvest, pick and trim, then place them in the correct punnets by size – a process that is mentally, as well as physically, demanding. While tilting shelves may help with physical demands, one of the other innovations presented at last year's AMGA conference

was designed to take the mental demand out of picking; a light pointer indicates mushroom size.

- The bed is scanned using a laser to measure mushroom size and record position.
- The computer then determines not only which mushrooms are the correct size, but also the order in which it is best to pick them.
- A laser pointer indicates the mushrooms to pick, taking out the decision process.

Apparently, pickers trialling the prototype liked it so much they didn't want to give it back. Even better, such a system could potentially be retrofitted on existing shelf farms, improving the consistency and speed of harvest.

Moreover, taking some of the skill requirements out of picking could mean that pickers become fully productive sooner. This is important given the relatively high staff turnover rate at many farms.

The unit is now under commercial development and testing with a European partner. It is hoped to be on the market within the next few months.

Cutting corners

While the laser pointer is an exciting development, it still doesn't solve the issues involved with seeing and stretching to the centre of the beds. However, there's a final potential development that could help address this issue.

The tilting shelves are constructed with a tapered outer corner to allow them to rotate (Figure 8). The GTL engineers noticed that this feature significantly increased vision into the centre of the bed, even without tilting. Cutting the corner also fractionally reduces the volume of compost, but no effects on yield have been found.

Manufacturing shelves with an angled outer edge could therefore be a simple way to improve picking performance.

Visibility could be increased further by separating the beds a few more centimetres and/or making the beds narrower. This could be done – perhaps with some difficulty – on an existing farm. It would be easy to implement in a new room, without greatly increasing infrastructure costs.

Attracting and retaining staff on mushroom farms is far from easy. It seems that the days when multiple generations would work on the same farm for decades are gone.

Although mushroom farms are in many ways good places to work, workers often prefer jobs where they don't get dirty, develop a sore back or get cold toes. Improving the working environment can increase worker retention, productivity and efficiency. Expensive in the short term perhaps, but the return on investment could well be worth it.

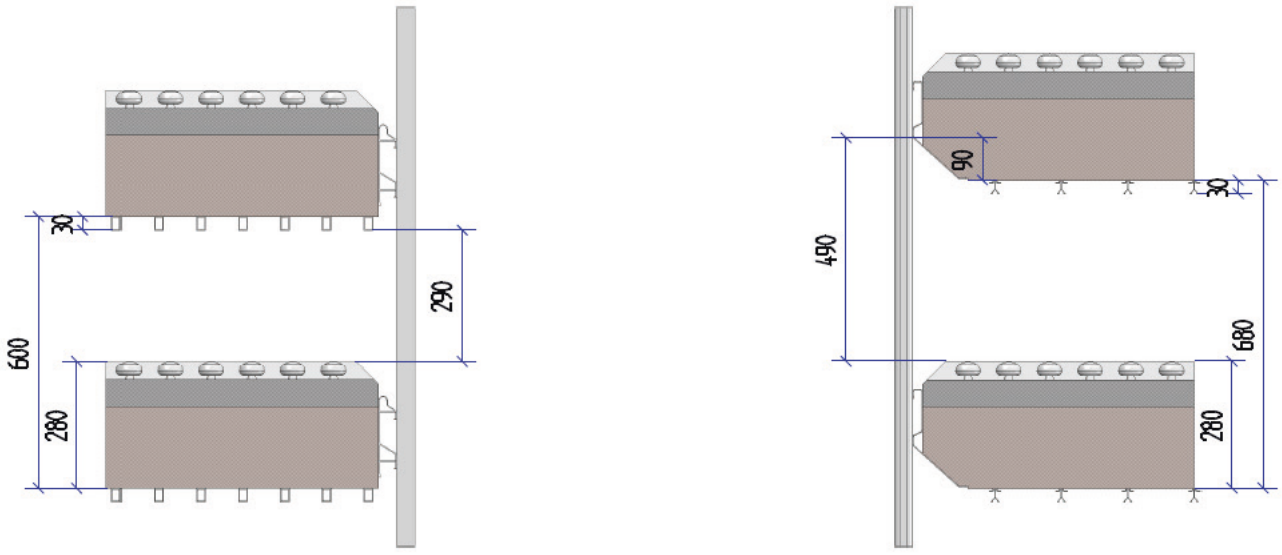

Figure 8. Traditional shelving design (left) and proposed new shelving design (right). (GTL Europe image supplied).