NOVIA
UNIVERSITY OF APPLIED SCIENCES

Joshua Finch

The Conundrum of Tool Acquisition in Successional Agroforestry Systems

Cover picture: the author inspecting plant growth in a tree line from an alley on June 14th, 2024. Note the complexity of the tree line (left, 2 m wide) while the alleys (center and right, 12 m wide) are uniform. Intensive horticultural production meets mechanized arable farming at Lill-Nägels. Photo credit: Johan Ljungqvist, Multifoto Ab Oy

Joshua Finch, Novia University of Applied Sciences

The Conundrum of Tool Acquisition in Successional Agroforestry Systems

Publisher: Yrkeshögskolan Novia, Wolffskavägen 33, 65200 Vasa, Finland

Novia Publikation och produktion, serie R: Rapporter 5 / 2024

ISSN: 1799-4179

ISBN: 978-952-7526-44-6 (Online)

Introduction

Stacking multiple crops into the same space through successional agroforestry creates unique challenges for farmers looking to improve efficiency.[1] Finding the right tool for a job can sometimes be challenging even for more simple cropping systems, let alone one predicated on the impermanence of species through relay cropping with perennials.

Here at Novia, we manage such a successional agroforestry system as a pilot project. Located in Kirkkonummi, Finland, the Lill-Nägels Agroforestry Pilot Project is designed such that *all* the species are in crop associations of one kind or another. [2] Yet, even with our choice to mimic a larger scale implementation of these ideas by reducing cash crop diversity and systemizing their spatial arrangements, improving efficiency is not as straightforward as one might expect.

In this article, I will first discuss how we have approached the system design, some of the challenges that arise, and how a trial period with professional electrified tools was conducted to see whether they fit the bill for improving our work flow.

[1] For a longer form discussion of successional agroforestry, please see: Finch, Joshua. (2023). Successional Agroforestry Trip to Denmark, October 2022. Novia Publikation och produktion, serie R: Serie: R Rapporter 2/2023. https://www.novia.fi/assets/Publikationer/Serie-R-Rapporter/Successional-Agroforestry-Trip-to-Denmark-October-2022_Finch.pdf

[2] For in-depth system design information, please see the Lill-Nägels Agroforestry Pilot Project website: https://www.novia.fi/en/lill-nagels . The “Field Information” subpages deal with site analysis and design.

Author's note:

The Lill-Nägels site is managed as part of a development project, not as a business enterprise. Although the labor largely remains the same as a working farm until post-harvest, the assessment of cost and benefits related to purchasing new equipment must be evaluated with different criteria. Still, I hope that this article can do more to share some of the thought process behind why one would look to adopting new tools and ways to examine the pros and cons that will serve you even if you are a farmer and not a project manager.

The site is located at Lill-Nägels gård, owned and operated by Rikard Korkman, who has made the land available for use to test new methods of cultivation.

The site is the third work package of the Agroforestry in Nyland project, which runs from 2024-2026, and is funded through public and private financing provided through Nyland's (Uusimaa, in Finnish) ELY-Keskus, Svenska kulturfonden, and Novia University of Applied Sciences.

Funded by the European Union

NOVIA UNIVERSITY OF APPLIED SCIENCES

Svenska kulturfonden

Centre for Economic Development, Transport and the Environment

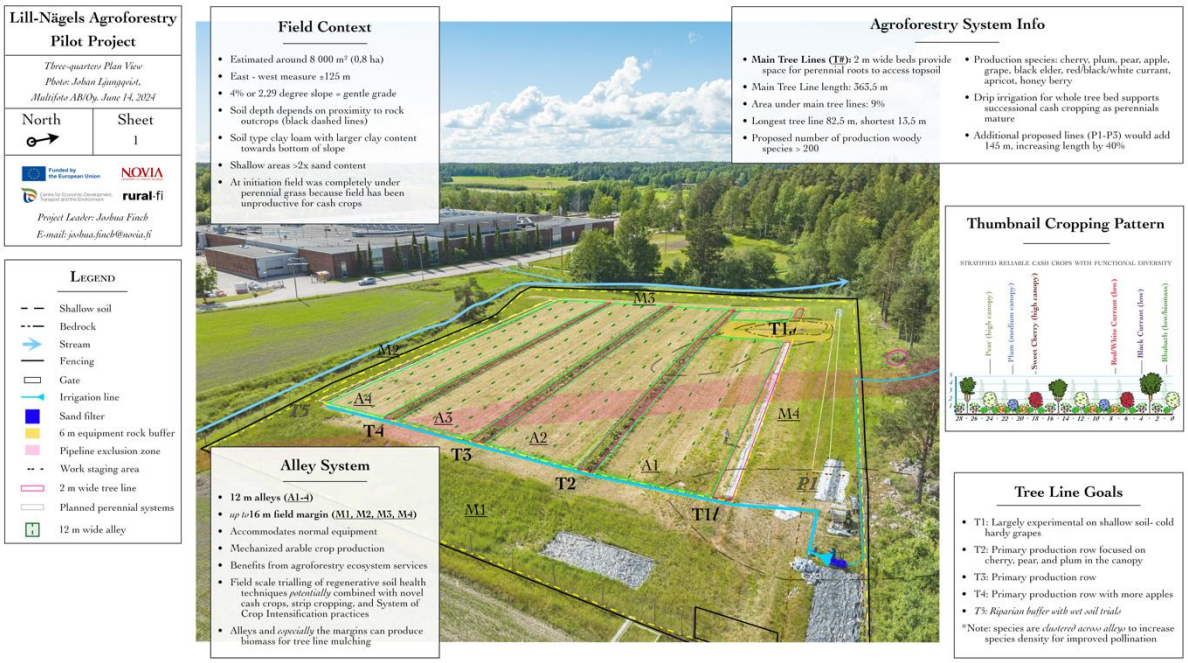
rural·fi

The Successional Agroforestry System at Lill-Nägels

The Lill-Nägels site has three management zones, which require different tools:

- tree lines (T) requiring cultivation, weeding, and pruning;
- alleys (A) designed for use with a tractor to cultivate, plant, and harvest;
- and margins (M) which are also tractor based, but have significant pressure to keep costs at a minimum as they serve an almost entirely ecological function.

On a working farm, the tree lines and alleys would directly produce revenue while the margins would provide ecological services, mulch production, and potentially forage for farm animals. While those are products which can improve profitability, they do not directly generate income by themselves, which can make placing a monetary value on them difficult. Hence, it becomes harder to justify investments in tools or inputs to maintain them when viewed in isolation.



Picture 1: Three quarters plan view of the site based on original work (Joshua Finch, Novia UAS) and drone imagery by Johan Ljungqvist, Multifoto Ab Oy, June 14th, 2024

The zone which makes this site an agroforestry system are the tree lines. People have different names for these, but I have decided to call them this because I like it. Each tree line is two meters wide with perennials planted down the center. We have focused on a mixture of fruit bearing trees and shrubs for the cash crops- such as cherry, plum, and pear with experimental plantings of cold hardy grapes. The width of the tree lines is perhaps narrower than ideal, but they allow the trees access to more topsoil than a narrow bed would. Topsoil is the place with the most biological activity and thus critical

for nutrient exchange, water infiltration, and the development of a soil ecosystem suited to the perennials.

In between are 12 m wide alleys, planned for strip cropping and other crop associations. Will be cultivating annual crops in novel arrangements with regenerative practices to trial new methods, which- if they are successful- can be scaled to any arable farm, whether or not they practice agroforestry.

Taking any amount of space away from a field and devoting it to trees and shrubs, which take time to bear fruit (pardon the pun), means that there is a delay in seeing a return on that investment (ROI) alongside the reduced yield of existing crops. This is where the economic understanding of successional agroforestry comes to the fore. In our project, we have decided to integrate the cultivation of garlic *into* the tree lines in the early years (about 4 years) to produce a cash crop while the trees and shrubs mature. Now, there are other project goals which change the discussion about *how* we grow that garlic, but the basic concept of growing something with direct economic value in the early years is a central part of successional agroforestry. The first cash crops may not cover the entire cost of implementing an agroforestry system, but in theory they should reduce the time required to see positive.

Cultivating “early succession” cash crops on a small scale – only one of the two 75 cm sections available are in garlic per season – restricts the kinds of equipment you can choose to use to manage those crops because their potential revenue is smaller than more extensive plantings. The essential tools necessary to do this task on the scale we operate were already available from private means, so the pressure to purchase new tools is quite low.

Tool-related Challenges for Managing Weeds in Lill-Nägels' Tree Lines

Picture 2: Early succession garlic on June 5th, 2024. Note the density of the garlic is half of what is possible to plant on higher fertility soils; yet this density is still quite intensive for our context of low soil fertility and high weed pressure. The clipped leaves are from sap analysis collection 9 days prior. Photo Credit: Joshua Finch, Novia UAS

In the tree lines, the plant spacing is quite close, much like an intensive market garden, and the total surface area currently under trees is just under 600 square meters: 597 to be precise. Before working at Novia, I operated a small-scale market garden with 675 square meters of biointensive beds. That work required the effort of myself and several interns each year to keep on a tight schedule producing fresh food for direct sales for months on end. The amount of labor required to take full advantage of even a small-scale system such as this and produce high yields is not inconsiderable. In this project, we have the good fortune to have a part time field assistant, but challenges from the initial vegetation composition (quite a lot of *Elymus repens*, known as couch grass) require a fair bit of work to keep the early cash crops like garlic ahead of the weeds.

Picture 3: managing the tree lines with manual tools is possible but requires a lot of labor. Here, Nayanadaree Banneheka Mudiyanselage (our 2024 field assistant), is putting the finishing touches on a bed with a simple tri-bladed hoe before planting a diverse cover crop. Photo Credit: Joshua Finch, Novia UAS

We have avoided the use of herbicide, trusting in organic methods. The divide between working my old farm's sandy soil with large amounts of compost and clay-loam soil with only a singular input of compost has been huge: tools and methods that were suitable in the former location are not so well adapted to these new site conditions and project constraints. Manual tools just do not work as quickly and efficiently in very dense soils. Also, with such high pressure from perennial weeds, the amount of mulch required to reduce their vigor is quite large. Buying bales of silage or hay for use mulch would have run contrary to the project goals (in effect at the time) to reduce outside inputs to the one-time application of compost and small amounts of nutrition delivered by foliar applications.

After one and a half years I wanted to try moving from purely hand tools in the tree lines to something more mechanized. One of the troubles with this is that power tools can be quite expensive. Either we purchase towed implements to use with the host farm's tractors and spend a significant amount of fuel doing relatively little work or we invest in a two-wheel tractor system and spend a lot of money on a new equipment system. Although a two-wheel tractor is initially attractive, the successional crop plan phases out the cultivation of annuals in the tree lines within the next couple of years. So, without a change in plan to continue biointensive annual vegetable production in the alleys, we would be investing a lot of money for a very short usage period.

On top of that, although the system is designed to mimic a broader scale system *pattern*, we are *not* expanding to new fields where these tools could continue to be used. Starting small, consolidating gains, and expanding the implementation of

successional agroforestry across new sites – which lengthens the lifespan of tool sets – is a strategy available to farmers, not development projects.

The question, then, is: could there be another set of tools available that would cost less (overall) and perhaps also be well suited to taking care of perennial vegetation such as grasses and trees?

Picture 4: Although the alleys measure around 4 000 square meters, this is still quite small to use a tractor for at times. In anticipation of an autumn cultivation, local farmer Mats Wikner (Wikner Hay Oy) is mowing the alleys and a stripe of the margins in mid-June to prevent the grasses from going to seed. Even this smaller mower is many times faster than a scythe or two-handled brush cutter. We want to avoid investing in tools whose jobs overlap. Photo Credit: Joshua Finch, Novia UAS

Professional Electric Horticulture Tools

An answer might be found in the world of handheld electric power tools. There are a number of manufacturers producing professional quality electric power tools that run for days at a time on durable batteries.

One such company is Pellenc, a business founded in France back in 1973. They are well known for their system of tools aimed at southern Europe's extensive viticulture

industry, with many of their tools also finding use in orchards of one kind or another. They also produce large field equipment and wine-making apparatus. Their tools have also become popular with the landscaping industry, where many providers are looking to move away from on-site fossil fuel consumption.

With everything from pruning shears (secateurs), power hoes, pruning chain saws, and brush cutters, Pellenc offers a number of different tools that could be useful for improving efficiency in a situation like ours which requires work be done in the soil and with the plants themselves. One of the chief attractions of their system is that their batteries are capable of powering multiple tools, so buying into the product line could serve the whole project quite well. The downside, of course, if that these tools require a bit of an investment: the pruning shears and battery alone will cost almost two thousand euros (2 000 €). Both build quality and battery technology is top notch, as one would expect at this price point.

Pellenc's high reputation is bolstered by choosing to assemble the batteries in their own factory in France, rather than purchasing ready-made units from, typically, China. This expertise in battery assembly leads to full control over the final product as well as the ability to repair and maintain batteries. Some of their batteries are rated to run for up to a decade without significant power loss. When compared to the price (both in euros and to the environment) of using gasoline powered tools over the long run, their electric line up makes a lot of sense for professional users. Finland has on average, some of the lowest non-household electricity prices in the EU, while also having some of the highest gasoline prices, increasing the attractiveness of electrification.

Note: Pellenc is in the process of updating their products and some of the recent tools may go by other names

Arranging for a tool trial period

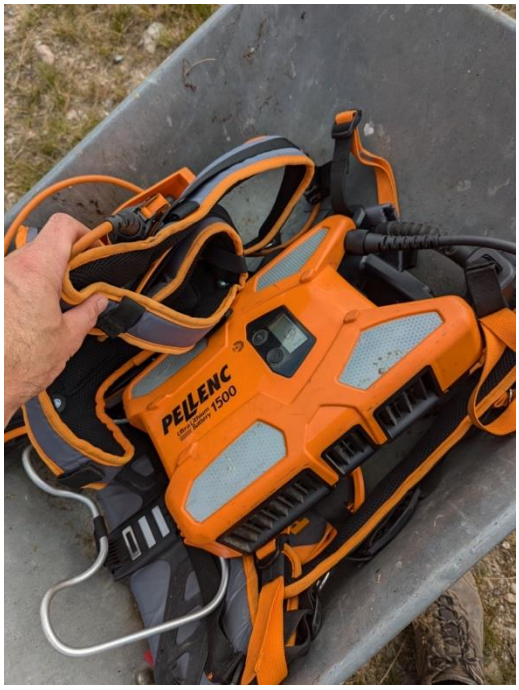
The cost of the power tools discussed below puts them in a category one order of magnitude over very good manual tools (higher than 1 000 €). The ROI on these tools is maximized when they are employed steadily for days at a time throughout the growing season, year after year. The pilot project aspect of our system makes it so that we just don't have that kind of daily work. Below, I will comment on the ROI period for one of the tools to illustrate the kind of decision making a farmer might go through when considering a purchase.

Still, managing the pilot site is not the only work that I'm engaged in with the Agroforestry in Nyland project, so it is not as if there is no advantage to speeding things up through mechanization. So we are stuck in a pickle: do we invest in time saving tools,

which *will* prove more costly in a strictly farm-labor savings equation, to free up work hours for other project tasks, or, do we continue to use the tools we have – reducing material costs but maintaining higher labor hours? This is not an easy challenge to overcome, especially if you do not have direct experience with the tools available on the market that appear to be fit for purpose. Without actually using the tools and understanding how they function in your situation, it becomes very difficult to sort marketing from reality when debating where to invest money.

To help answer this question, we contacted the Finnish importer of Pellenc's tools, Hautala Service Oy, and explained the situation. Arto Pahkala, a veteran Sales Manager serving our area, promptly contacted me by phone to discuss how we could go about trialing these tools. After visiting us in Kirkkonummi to show the tools, along with some other options, he then arranged to drop off selected tools for us to use for a generous period for evaluation. Artu was very kind and allowed us to trial nearly all the tools I envisioned us needing in the project.

Which tools did we test?



Picture 5: Pellenc ULiB 1500 with harness. Fills an entire wheelbarrow. A lot more energy than we would need for this project, but using it avoided downtime at a very busy time of the year and was a real eye opener to the potential work one could do with this system. Picture Credit: Joshua Finch, Novia UAS

Below I've listed the tools under the battery that powers them. Prices are not sales quotes from Hautala, rather, they were gathered from online retailers across the EU for illustrative purposes only.

- Battery ULiB 1500; Pellenc's largest battery, IP54 standard, 9,1 kg with harness; (market price around 2 000 €, harness another 150 €)

    - Cultivion; power hoe with interchangeable heads for mechanical weeding; (market price about 1 100 € without every additional head)
    - Excelion 2; two handed trimmer with interchangeable heads (plastic wire, triple conventional brush blade, and "Citycut" counter rotating trimmer); (market price around 1 350 €)
- Battery 250; Pellenc's largest battery for less energy demanding tools, 1,68 kg
    - Vinion; electric pruning shears cutting up to 35 mm; Vinion was used in lieu of the Prunion despite the Prunion being an overall better fit long term (market price for Prunion + 250 battery, around 1 800 €)

The only tool we did not use was the small pruning chain saw (Selion M12, [market price around 1 000 €]), which compliments the pruning shears by drawing from the same 250 battery. Unfortunately, our trees are still very young so I didn't have an immediate use for the saw. Though, as you will see, I believe that combination could be a potential winner in our context.

How did the tools perform?

Now let's get into how the tools worked for us during our trial period. I will discuss the tools in turn, starting with the one which I believed would be most beneficial to us currently.

Cultivion (Power Hoe)

The Cultivion power hoe was at the top of my list. I had the highest hopes for this tool as my manual hoes were not really equipped to deal with the very high-density clay-loam soil, even with a small layer of compost on the surface. Perhaps in another 3-4 years the soil could be friable enough to allow a co-linear hoe or, even better, a wire weeder to fly through the soil taking care of small weeds. But in the current condition, the soil is simply too dense to achieve the desired results with a regular hoe. This is also in part because we use drip irrigation. Drip lines do not wet the soil surface uniformly. In my experience, dry soil does not lend itself very well to being weeded with hoes: the hoes tend to push the weeds over rather than cut them.

Picture 6: Pellenc Cultivion with ULiB 1500 in action edging a tree line; note the soil scattering to the bottom of the image. Photo Credit: Joshua Finch, Novia UAS

I envisioned that guiding the motorized head along and letting the electric motor do the work breaking up the heavy soil would be much more effective than manual tools. Unfortunately, there were a couple of downsides that prevented us from getting the most out of this trial period with the Cultivion. First, the soil proved to be extremely dense even for this power tool. The tool's oscillating head feels like a jackhammer when working hard soil: your entire upper body shakes and it is quite unpleasant. On top of that you had to move a bit more slowly than you would initially think to ensure that the hoe was getting the weeds chopped. When moving slowly, the hoe tended to "dig" itself into the ground and you started working the soil very deeply, which is not at all the desired technique.

Another annoyance was that the hoe throws a considerable amount of soil around. This may not be a problem in a conventional orchard if you want bare soil, but here we have a high density of plants growing from the ground layer up to the canopy. Soil landing on leaves is a well-understood vector for disease. For example, getting soil lodged in the little cups formed by the leaves of a garlic plant at the stem is not good: not only can this increase the risk of disease, but also reduces the quality. Small-scale intensive horticulture can only be profitable if the crops are of such superior quality that customers notice the difference and become loyal shoppers. Dirty produce creates work and increases costs.

These downsides were less pronounced in the few places of our tree lines where the soil is looser from prior decompaction efforts. I have to admit I had flashbacks to working on my old farm and, when everything was going just fine, I could see the hours

this machine would have saved me then! In the right context – looser soil and a generous layer of fine compost – the Cultivion could perhaps save a lot of time and money over the years. Sure, it may be loud, but if it increased operational efficiency enough, I could make that trade-off. More time for tending plants without any noise at all.

Cultivion: Cost comparisons to manual labor

Despite the feeling that this tool would not be the best in our case, I compared the time it took to use the Cultivion against weeding sessions with manual tools. I could dig into my time sheets from prior years and use those as a basis for making this comparison.

When the Cultivion was moving quickly we could get our time down about 3,33 seconds per linear meter (s/m). It is likely that this time would decrease as use builds confidence operating the machine. For comparison, the fastest I can run a co-linear hoe through these field conditions (while doing a decent job) is about 4,25 s/m. At this rate, how long would it take to justify the purchase based on the time savings alone?

Cost Comparison for Cultivion at 3,33 s/m vs Manual at 4,25 s/m:

- Total linear length of current system where we cultivate: 244 m
- Total linear length required to weed the system with 3 lines of crop: 244 m * 8 passes = 1 952 m
- Cultivion: time in hours to weed at 3,33 s/m: 1,8 hours (1 hr 48 min)
- Manual: time in hours to weed at 4,25 s/m: 2,3 hours (2 hr 18 min)
- Cost in labor at 20 €/hour: 36 € and 46 €, respectively
- Total labor cost per season assuming 12 total sessions (April & October 1 x/month; May-September 2 x/month): 432 € and 552 €. Note: actual number of weeding sessions depends on the year and effectiveness, 12 is a rather high number.
- Labor cost savings with Cultivion per season: 552 € – 432 € = 120 €

Now that we have a figure for the labor savings, how long will it take to recoup the cost of the tool?

Cost of tool and a smaller battery, with full cost of battery attributed to the Cultivion: 1 100 € + 1 400 € = 2 500 €

Time to recoup cost of tool through labor savings: 2 500 € / 120 € = 20,3 years.

If you split the cost of the battery in half, attributing the other half to the Excelion 2 or another tool, then 1 800 € / 120 € = 15 years. At this rate, upgrading to this power tool does not make economic sense.

But, can you always use the manual tool that fast? What happens if we change our assumptions?

It is more likely that we could run the electric tool at 3,33 s/m regularly, but our average manual rate might be overstated. To find a more probable number, I took the median between the best manual time (4,25 s/m) and one of the worst I have on file (13,2 s/m): 8,73 s/m. Each weeding session would now require 4,73 hours (4 hr 44 min). At this rate, the cost savings would be 58,40 € *each time* you weeded.

Over 12 weeding sessions, one would save about 700 € in labor costs alone. Setting aside the cost of electricity to charge the battery, it would take only 3,57 years to recoup the investment cost in the tools from labor savings. Every year after that you would be 700 € ahead in maintaining the site. If you do not ask that the weeding tool pays for the entire cost of the battery, it would take 2,57 years to break even at our small-scale.

In terms of the hours saved each time you weeded, you would be ahead – from best case with the electric tool versus median case with manual tools – just shy of 3 hours each time. A more thorough analysis of the cost and benefits of changing to new equipment should also include the value *gained* by the time saved. This is particularly true of hours during the spring and early summer months in our short growing season. Each growing day early on is worth a lot more because of the beneficial conditions, so saving time during these critical periods is even more important. If you can use the saved time on revenue-generating activities, the value of that work can also be used to justify the investment in an upgrade.

Again, it would have been best to use this tool during that spring growing season to get a really accurate comparison, but like full-time farmers, we were busy with other tasks and had to wait to arrange the trial period with these tools.

Cultivion: Verdict

From the perspective of the project, despite the *potential* 3,57-year ROI of this tool, I do not see it fitting our situation because that best case scenario may not always play out. If you allow for the electric tool not always performing at its best, the numbers change dramatically once again. Simply by looking to the median between the shortest recouperation time and the longest, you'll find that instead of only 3,57 years to pay off, you could be waiting for up to 12 years to break even on the total investment with a battery. Considering that the project plan only includes garlic in the system for another two seasons, even 3,57 years is too long. Unless there is a change in plan to use the alley crop strips to also produce annuals, the need for the tool disappears. And once you start cultivating annuals in the alleys, you must compare this tool against of tractor based implements.

That said, in a regular farming operation, where certain kinds of cultivation are either not planned to be phased out or could move to other areas of the farm, I could see this tool making sense. But in our situation for the time being, it doesn't.

Hopefully the exercise above demonstrates why it is so important to understand how long different tasks take on a farm, even in a pilot project, to estimate costs and potential gains from different methods and tools. Choosing not to invest in a Cultivion does not mean that the current methods employed are by any means the best, nor that there are no other options available that could save us time. In fact, I made similar calculations not that long ago to determine that we need much more than four years to justify purchasing even a wheel hoe, which costs considerably less.

Vinion (Pruning Shears / Secateurs)

The Vinion is the little brother to the Prunion, cutting 35 mm branches *vs* 45 mm branches.[3] Of the two, the Prunion (C45) fits this project's needs better. One of the advantages, asides from having a larger maximum branch size, is that the Prunion also works with extension poles, allowing you to prune up to 4 meters. Neither the Vinion or recently released C3X pruners (a model with an integrated battery) shares this feature. A 4-meter pruning height would be just right for us since we plan to keep most of our fruit trees even smaller than that. The biomass trees ("tree cover crops") will grow taller, but we will pollard them at a height less than 4 meters. Also, 45 mm is an excellent diameter to cut branches at: cut branches much larger than this and trees can struggle to heal themselves before being infected by pathogens, especially fungi.

One neat function with these pruning shears is that they don't need to be continually operated at full cutting diameter. If you are working with smaller branches, as one would likely be doing with fruit trees and even the biomass trees, you can switch the tool into quick-cut mode, which only opens the blade halfway.

Both pruners run on a smaller battery, which additionally has a second plug for the Selion M12, a small (15 cm bar) pruning saw, also by Pellenc. That pruning saw would be very useful for managing the biomass trees in our system. In the future they will be cut out to reduce competition (mainly through light interception) with our target cash crop trees. Instead of breaking out a larger, gasoline powered chainsaw meant for felling proper trees, a pruning saw could be carried alongside in just one pass. No need to worry about stopping to refuel either.

The first thing I noticed when we tried the Vinion was just how powerful the tool is: it slices through the maximum diameter wood like a hot knife through butter. And it will

[3] Vinion has been replaced with the C35 and Prunion by the C45 models

do that every single time. I was actually quite surprised at how powerful and quick the cutting is with this tool.

Vinion: Cost

At around 1 800 € including the smaller 250 battery, how many hours would it require to break even on this investment? Unfortunately, we cannot say right now because the trees are still so young that the first pruning won't take place until the coming late winter (early 2025). This means we don't have data on what the system requires with manual tools. However, given that we have many hundreds of trees in our field, akin to a full orchard in much less space, would having the speed and consistency of this power tool improve our workflow?

Vinion: Verdict

Electric pruners are something I will have to consider as we head into the adolescent phase of the successional agroforestry project. I can foresee that the addition of the pole would be of great use, as anyone who has used fully manual pole pruners knows that they can be a little frustrating. Reducing that frustration and focusing on the cut, repeated hundreds of times over once the trees reach their desired size, might alone make investment in such a system worth it. Careful, precise, and clean pruning of trees – even those meant as biomass trees – contributes to the health of the whole system. Combining all of that with the pruning saw's ability to simply plug and play could add up over time, even in a field like this. Unlike the integration of garlic, the trees in our system are only going to get larger and will need care for many decades into the future. Plenty of time for the cost to be recuperated.

This is the tool set I will keep my eyes on!

Excelion 2 (Two handed trimmer)

The Excelion 2 operates with the larger battery pack and I wanted to give it a try for a few reasons. First, I thought it could be interesting to try to the counter-rotating CityCut head: the cutting diameter is small, it is designed not to "throw" materials, and it has a favorable ability to avoid cutting into larger diameter objects like tree trunks. This could conceivably be used around the trees where, given the polyculture nature of the planting pattern, we do not have the luxury of using a traditional in-row mower. A traditional in-row mower, which moves around the tree trunk through a spring mechanism, would destroy the rhubarb, likely damage the berry bushes, as well as eliminate the smaller biomass trees emerging from seed which are a key part of the

pilot project's design for stimulating soil formation. The CityCut itself worked alright, though we had very little plants to cut with it in the end due to vigorous and effective weeding. Another feature of the CityCut that is interesting is that you can turn the blade vertical and use it to edge (root pruning), but the working depth is perhaps a bit too shallow and the wear and tear from our soils and stones might be outside the design parameters.

Picture 7: a brush cutter makes light work of terminating a cover crop where a scythe may struggle in dry conditions. Also, a brush cutter allows you mow higher than this if you desire to remove less biomass. Photo Credit: Joshua Finch, Novia UAS

I employed the traditional 3-bladed brush/high grass blade more than the CityCut. I wanted to time trial mowing the edges of the tree lines against the use of my scythe, as well as see how it would work cutting down cover crops to make way for the upcoming garlic crop. I will spare you the details on that time trial though, because the two tools are actually fairly different even if they both "cut grass."

For managing the tree lines, it did a very good job, though the speed at which it works makes it easy to bring about costly mistakes. A scythe may be slower, but you do not need ear or eye protection while using it, which – at least for me – means I can focus better. To be fair, after using this tool for a few hours, one would gain better control and precision, just like anything else. In the future, we will not be growing annual cover crops on the two 75-cm beds of each tree line, but rather planting any space not taken by rhubarb with low-growing perennial herbs. A brush cutter could come in handy topping them to promote vegetative growth, allowing us to move around the rhubarb easier than any mower could. Since they are designed to also cut woody vegetation, it might fare better than a scythe for that task since perennial herbs can tend to produce woody stems as they age. We won't know until we get to that point, however, whether the scythe is worth using at this scale or not.

The Excelion 2 itself was very easy to use, well balanced, and so much quieter and more enjoyable than a gasoline powered tool. Even compared to a gasoline trimmer running on high quality fuel, the lack of fumes was remarkable. One easily switches between cutting modes and it was able to handle many kinds of grass at various stages of maturity and trees (birches which had sprung up in the alleys). The large battery pack had more than enough energy for us to complete any task without worry. Not stopping to refuel is a bonus.

Final Thoughts

I was very happy to have had this opportunity to trial these tools on our site. Arto's willingness to provide them to us for such a length of time was essential to give each tool its use in turn. While I was disappointed that the Cultivion struggled with our site conditions, I can see that in another setting it could really speed things up, if one wants bare soil around their plants. For us, we might benefit from a tractor-based system for cultivation given how tough our soil is.

The electric secateurs (Prunion/C45) are something I will keep in mind as our system grows. I need to have some data available from our existing tools and equipment to have any idea as to whether or not it would be an investment worth making. Likely, its value as a pole pruner and using the battery to operate the smaller pruning saw would be needed to bring out the full potential. I'd like to note that in many places, people manage commercial agroforestry systems almost exclusively with high quality manual tools. Even arborists use hand pruning saws in their daily work. We'll simply need to weigh the effectiveness of the tools we have when the time comes. A pilot system with hundreds of biomass trees is something quite rare and data from those systems is even more scarce, so it is up to us to track these needs over time.

A word about the batteries: I did not focus on those in this article, but rest assured that the batteries are of a high build quality. I did not feel like they were particularly fragile. They also charge quickly and have good environmental stress ratings. If you are interested in this system, be sure to try different size batteries and pay attention to what you actually need. You might be able to save a considerable amount of money by choosing a smaller battery and simply charging it during breaks, rather than expect to work on the same charge all day.

Lastly, mechanization does not always mean faster or better. But to truly know, one must have had the opportunity to try. I personally really enjoyed the fact that I could use tools that work in a similar way to the tools we currently use. They have the *potential* to save a lot of time and increase the quality of the work done over the long haul. They do not directly compete with the list of equipment that the tractor can

operate. They fit the bill for something “in between” that compliments, rather than takes away.

The biggest sticking point is clearly cost. The expense of the tools and batteries is not inconsiderable. The issues I’ve raised above about the pilot project needing to weigh the pros and cons of investing in tools always complicates things. Managing a project is, at the end of the day, very different than running a farm as a business.