

Autonomy in experimental work

Plot Seeder and Spraying with Autonomous
vehicles

Speakers: **Morten Nygaard**, TS Agro

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AGENDA

Plot Seeding and Spraying with Autonomous Vehicles II

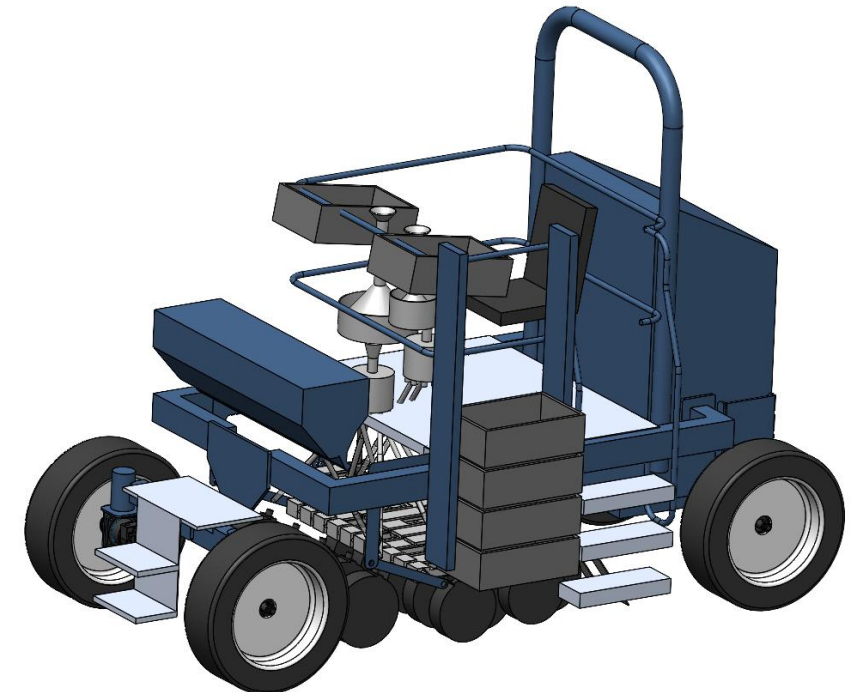
- PrecisionPlot Seeder – status
- Next step in the development
- Projects outline
- PrecisionPlot Sprayer
- New ideas

Autonomy in experimental work for practical handling of tasks in field trials



Plot Seeder – variety testing

By: Speakers: **Morten Nygaard**, TS Agro
and **Sven-Åke Rydell**, Hushållningssällskapet



- Status on the 15th of January 2025 in the assembly hall
- All components are available as expected including cones from Zürn
- The team from HarvestMaster are to visit the site for SPARGO™ implementation end of Jan.
- Project on plan for indoor test primo Feb. and going in field in 2nd half of Feb. 2025
- Field demo and test March/April 2025 and follow www.tsagro.dk





Key focus and WHY entering of autonomy on the seeding unit

- **Variety and fertilizer testing** – key customers – **Breeding and Research industry**
- **Attracting and maintaining qualified field scientist** are facing severe challenge and the platform delivers significant - **reduction of workers from 2 to 1 field scientist**
- **Static work - autonomous driving** solves a significantly static task and generates effectiveness
 - Seeding today involves GPS control/steering of the tractor – engine unit and a technician for turning
 - PrecisionPlot Seeder incorporates GPS control/steering and being the engine including automatic turning of the machine without the technician
- **Effectiveness** – implementing autonomy is the key answer
- **Heavy lifting** is avoided implementation of elevation options from ground level to platform
- **Agile** – the platform can be transported on a standard trailer by light versicle

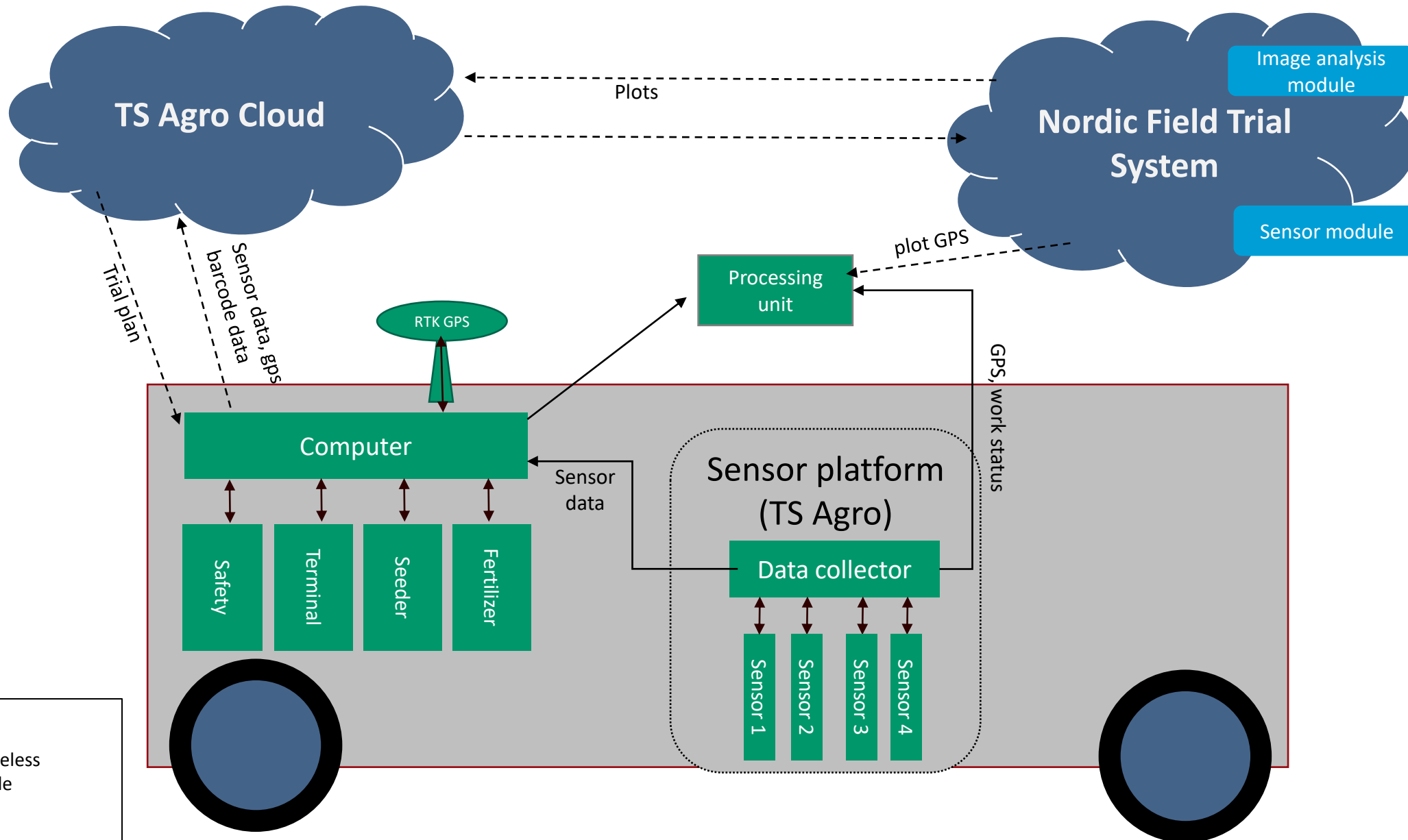
Single seeder unit from e.g. Kramerstart.nl

- PrecisionPlot Seeder to include seeding disc for single seeding, row crops....
- Row spacing 16 cm to 50-75cm
- Single seeding of
 - OSR, canola
 - Cereals
 - Peas
 - Beans
- Row crops
 - BEAVA, Sugar beets
 - Carrots
 - Onions



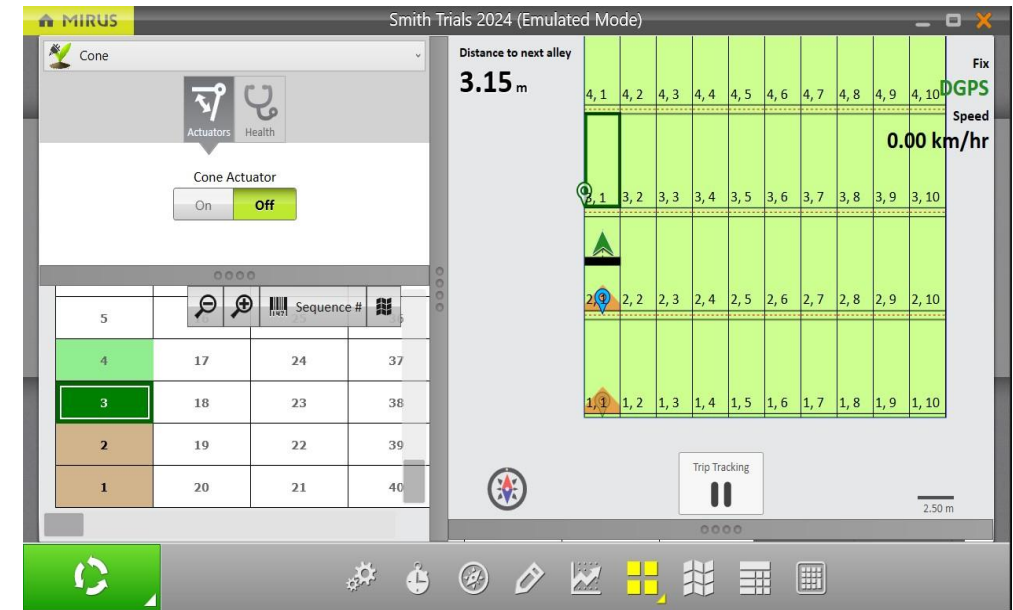
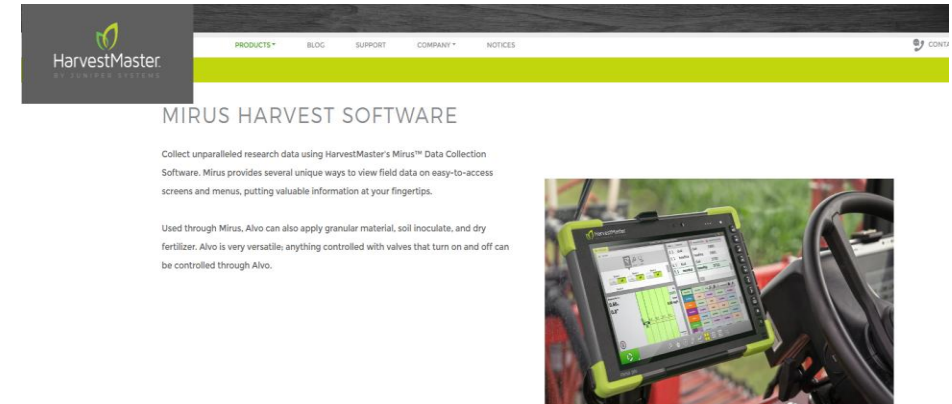
PrecisionPlot seeder/fertiliser

Infrastructure (SLU/DTI)

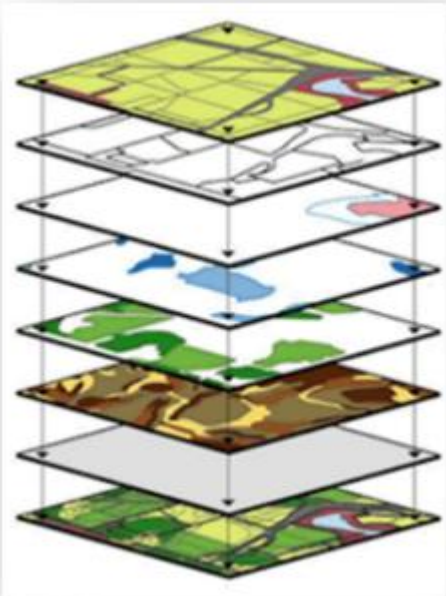


Design and data management

- NFTS or any planning tool
- Design push direct to MIRUS Planter by HM
 - Bar code scanning of seed bag linked to GPS position of single plots
- The project aim are to collect:
 - Texture measurement
 - Seeding depth and soil moisture on the go
 - EC at 0-60 cm
 - Organic Matter
 - ETC
- The project aim - future:
 - Assessment by camera post seeding for crop assessments
 - Bio diversity is a goal
 - ETC



Sensor implements – Staked Soil data on plot level



FurrowScan

EC – 0-60cm
Carbon/Organic Matter
Moisture
Temperature
Soil Texture



Moisture
Make sure each field operation is optimized with real-time soil moisture.

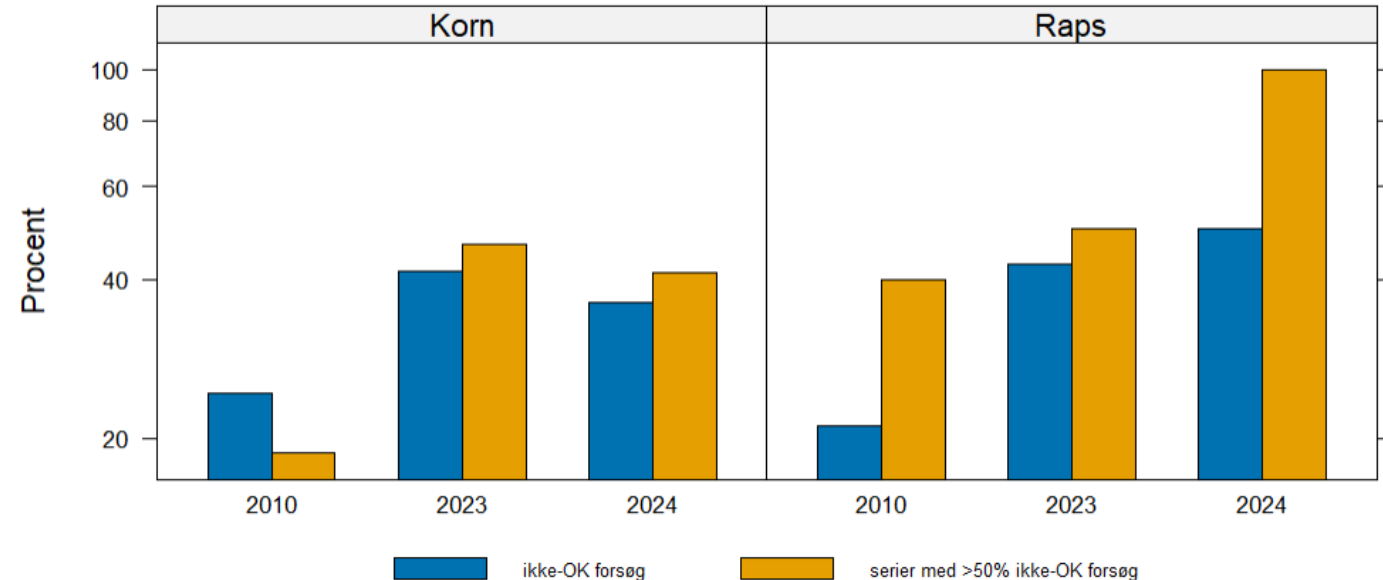
Temperature
Avoid yield robbing damage from germination at the wrong temperature.

Carbon/Organic Matter
Minimize the cost of building management zones and benchmarking carbon variation.

Soil Texture
Clay behaves differently than loamy soil, especially when moist. Texture is a critical gauge for sense-and-act implement adjustments and a key layer for optimizing inputs.

Drafted project ideas for 2025 season and going forward

- **Innovative Landscape Trials for Climate-Resilient Crop Variety Testing Using Automation and Advanced Phenotyping"**
- The primary objectives of the project are:
 1. To design and evaluate climate-resilient field trial methods that mitigate the risk of failure under extreme weather conditions.
 2. To assess the environmental and phenotypic variability in crop performance, focusing on flooding and drought sensitivity.
 3. To incorporate a sensor-based(semi-autonomous platform to optimize field operations in large-scale trials, including enviro- and phenotyping operations.
 4. Suggest Partners – drafted: DTI, AU, TS Agro, Breeding industry and SEGES



Drafted project ideas for 2025 season and going forward

- **Variety testing and On-the-Go Soil Sensors, and Phenotyping**
- **Subtitles**
- Innovative Testing Solutions to Ensure Food Security in a Changing Climate
- From Sensors to Phenotyping: Transforming Agricultural Research
- Pioneering Next-Generation Crop Testing for Resilient Farming Systems
- Bridging Technology and Agriculture for Smarter Crop Development
- Maximizing Yield Potential with Automation and Climate-Adaptive Strategies

- Project group building: SLU, AgTech Sweden, Lantmannen Seed, HS Östergötland and TS Agro

Draft design of the Plot Sprayer

Plot Sprayer for the future



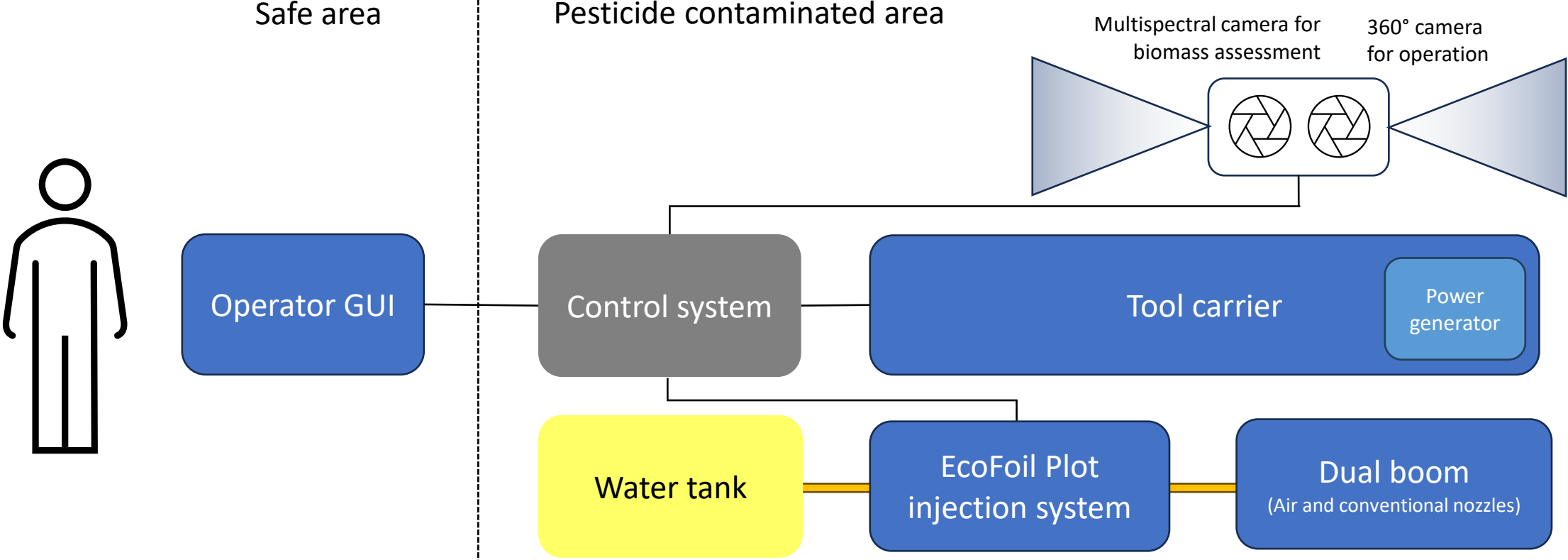
Key focus and WHY entering of autonomy on the spraying unit

- **Pesticide testing** – key customer – **AgChem and Research industry**
- **Attracting and maintaining qualified field scientist** is severely challenged and a solution to this is **NO direct contact to pesticides at time of application** in the spraying process.
- **Static work implementation of autonomy** solves a significantly static task and generates effectiveness
- **No research scientist in applied field area** is a future MUST. The sprayer can apply up to 24 treatments in 3-4 replicates by itself.
- **Agile** – the platform can be transported by light versicle
- **No additional mix of water and sample** leads to no waste and reduced sample amount



- **PPSspray - specification**
- Plot size – variable from 1.75 to 3.0 meter
- The Field Scientist are the operator in field, overall control of the spray unit
- Frame height e.g. 1.80 meter and boom height 2.3 meter (50cm above canopy)
- Weight of sprayer: max 750 kg
- Number of treatment, 1-24, automatic design import from NFTS, ARM, AgMatix or Excel
- Clean water tank and injector system for application
 - The Injector system removes pre spraying samples measurement of pesticides, rinsing of sample glass and exceeded use of samples. The unit are only using the amount allocated for the specific treatment.
- Standard field spraying always includes 25-35% additional amount to be safe not running empty
- Documentation to be stored in combination with design file and will contain speed, water volume, treatment volume, pressure and GPS position which can be loaded into management platform
- Spray section: Including air provided by Danfoil system; 2nd boom to included conventional spray tech. The spray section for spray tech comparison/testing
- Plot border equipment for glyphosate and mechanical borders
- Compressor including pressure tank
- Fully electric starting with gasoline engine for electricity production and when batteries become efficient enough (low weight) the engine will be replaced - Propulsion by electric engines
- Extension of the machine and boom lifting system by electric actuators
- CE declaration 2025 requirements

Project overall description's/elements included - illustrated



✓ Remote supervision by single operator

✓ Safe, waste-free CTS system

✓ 10x variable dosing multi-fluid mixing

✓ Precision spraying approvals

Sprayer - Configuration and timelines

PrecisionPlot Sprayer

- Project start 1st of February 2025
- The project team/reference group will set the demand specifications
- The project team will work on external funding and TS Agro will/are continuously looking for more partners
- Draft delivery of the first prototype expected by autumn 2025 for first field testing and the platform to be available in March 2026

- **Sustainability**
 - Working environment in high focus by removing the applicant from the pesticide applied field and the sprayer and hereby decreasing/eliminating contamination of pesticides; No heavy lifting of spray containers; Automation = efficiency in field trial execution
- **Safety and pollution**
 - By removing the applicant from the applied field and the spraying platform – safety to contamination is clear
 - Injector system – the platform works with no pre-mix which will lead to 25-35% reduction of sample use in field applied science
- **Capital allocation**
 - A standard field application within field applied science includes two scientist – the platform reduces this to one scientist – 50% human capital reduction
- **Net zero and carbon neutrality goals**
 - Introduction of electrification of the sprayer increases the efficacy of energy used per unit, e.g. oil engines efficiency are 60-70% of applied energy whereas electrified solutions utilize the energy input by 96 to 98%
 - The platform can apply 24 treatments in 4 replicates which exceeds by far any other plot spraying platform – increases the efficiency significantly

To come in 2025
Automatic yield
measurement \pm 2% level of
accuracy and tuber size
quantification in SOLTU
- This means no heavy bags of
potatoes and no size
estimates at storage



Thank you for your
attention and looking
forward to co work
with you