



## PAT and machinery solutions to practical barriers

### ABSTRACT

Multi-species plant teams offer promising opportunities to improve crop yield, reduce pest and disease burden and enhance the resilience of agricultural systems to stresses such as climate change and market pressures. Implementation of such approaches can, however, be prevented by practical barriers. For at least some of these barriers, and particularly those related to the practicalities of drilling, agronomy and harvesting of plant teams, **Precision Agriculture Technology (PAT) and machinery/product development may offer available or near-market solutions**, easing transitions to intercropping and promoting plant team uptake.

Below, we give a brief overview of solutions to practical plant team barriers that were identified in discussions with industry stakeholders as part of the DIVERSify project. Solutions can be grouped by the practical barrier type that they resolve, whether they apply to unstructured or structured plant team designs, and whether they are suited to most operations or require pre-existing engagement with PAT or high-level investment in machinery.

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## CONTEXT

Species-rich systems often show higher productivity than monocultures<sup>1</sup>, supported by mechanisms such as resource sharing and complementarity that improve resource capture<sup>2,3</sup>. The same ecological principles used to understand the mechanisms promoting productivity in diversity experiments can also be applied to agricultural crops. By increasing diversity in crop systems, plant teams could enhance stability, yield and resource-use efficiency<sup>3</sup>, and these potential benefits have led to increased interest in plant team usage. At the same time however, **current production models, which are often developed around monocropping, have led to practical barriers that can limit plant team uptake and implementation**<sup>4, 5</sup>. PAT, machinery development and novel products could provide some practical solutions to support transitions to plant team approaches.

To feed into the development of industry solutions to the barriers to plant team uptake, information on PAT and machinery/product options was gathered from project participants. Project partners and farmer networks provided industry knowledge of **on-farm machinery modifications and developments that were already being implemented**, and over 40 PAT, machinery and product manufacturing companies were engaged directly in one-to-one meetings or at industry events.



**Fig. 1** In the DIVERSify project we have tried different practical solutions, such as strip-till, to address the challenges around drilling, agronomy and harvesting of plant teams. Credit: Jennifer Banfield-Zanin

## SOLUTIONS EXIST: AN OVERVIEW

Identified solutions were categorised by the barriers they addressed: **drilling** (e.g., differences in seed sizes or sowing depths), **agronomy** (e.g., differences in nutrition or pest control needs), **harvest** (e.g., timing and separation), or **planning and other barriers**. Solutions were also grouped by whether they could be used to overcome barriers in **unstructured (e.g., fully mixed intercrops) or structured (e.g., intercropped rows) plant teams**. Finally, they were categorised as being either **accessible** - suited to most operations, and implementable by most end users with minimal investment, **available** - implementable with prior engagement in PAT or high levels of investment in machinery solutions, or **attainable** - theoretically available, but only with highly specialised equipment, and so not yet widely accessible.

In unstructured plant teams, **18 solutions resolving 29 specific barriers** were found, while in structured plants teams, **27 solutions resolving 55 specific barriers** were identified. You can read the full report [D4.6 - Trouble Shooting Matrix of PAT practical solutions](#).

## ACCESSIBLE SOLUTIONS: EXAMPLES

Solutions that are accessible or available were identified for all barrier categories in both plant team designs, with many resolving barriers across multiple groupings.

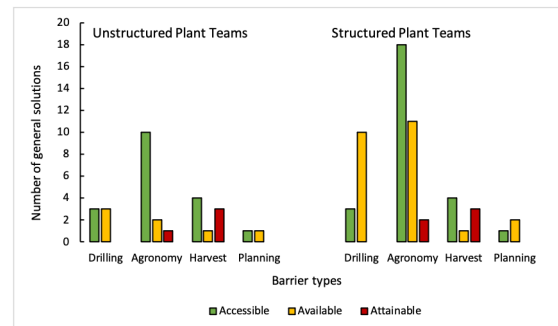
Selected examples included:

- **Fertiliser spreaders that can be modified** on-farm and used to distribute certain crop seeds, while **direct, precision or dual seeding drills** and seeders are available on the market.
- **Mowers, weed wipers and crimper rollers** that may be modified to support management for crop competition as well as weeds.
- High-spec on- or near-market **automated precision sprayers** that could be useful in delivering plant protection products.
- **Harvester and stripper header combinations** that might facilitate crop separation under specific plant team combinations, and even allow for in-combine separators to be reconfigured for use in cleaning grain in certain circumstances.
- Harvest product separation is known to be a key barrier, and other solutions for this ranged from **on-farm machinery builds separating by simple parameters** (e.g., size or shape) through to systems capable of separating seed based on spectral scanning, usually provided through **external contractors**.

## CONCLUSION

**Practical solutions to overcome the barriers to plant team uptake exist across varying levels of accessibility, and for all barrier categories, in both unstructured and structured plant team designs.** PAT and modern machinery developments play a role in providing solutions, with deployment of the latter often dependent on the former.

**While engagement with PAT is likely to facilitate plant team cropping by supporting access to an increased number of solutions, a broad range of practical barriers can be overcome through machinery and novel product solutions independently of PAT uptake.** Solutions to barriers may be more readily realised when adopting structured plant team designs, where these better lend themselves to delivery of solutions through PAT placement technologies. These will, however, often require increased engagement with specialist technology, such that the benefits of structuring plant teams must be balanced against the need for investment.



**Fig. 2** Solutions were identified across barriers relating to drilling, agronomy, harvest, and planning. The most accessible solutions related to agronomic barriers in structured plant teams

Overall, machinery and product solutions can facilitate plant team cropping at various levels of accessibility and across different plant team designs. While engagement with PAT can facilitate this, some barriers can be resolved through existing machinery and product solutions.

## REFERENCES

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5. Tippin L. *et al.* (2019) [D4.5 – Report on practical restrictions imposed by plant teams](#). Developed by the EU-H2020 project DIVERSify

## FURTHER INFO

- > Read the full report to find out more: [D4.6 - Trouble Shooting Matrix of PAT practical solutions](#)
- > For more details on the practicalities of cereal-legume intercropping, we recommend watching [some of the recordings from this event](#)
- > Read on to consider how a specific challenge in plant team use might be addressed by agronomic or technological solutions: [DIVERSify Factsheet no. 15](#)



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