DIVERSify Factsheet no. 15

PRACTICAL EXPERIENCES AND INNOVATION

Addressing seed size challenges in plant teams

ABSTRACT

Different seed sizes in plant teams can complicate sowing and harvest. This challenge can be addressed by only **selecting varieties** with complementary seed sizes, e.g., for separating, or **adapting how we grow plant teams** via agronomic or technological solutions. Alternatively, seed size challenges could be addressed by **breeding**.

Breeding is an expensive long-term process that takes several years with uncertain success. At the end there may be only a few cultivars with the new desired trait, which may be limited in cultivation area as they may not be adapted to a wide range of climatic conditions. Resulting in the need for extended breeding work. Furthermore, the new crop property must be accepted by the industry and/or consumers.

On the other hand, in many cases **only slight adaptations of machinery settings compared to monocropping** might be needed if seed size or germination requirements of the plant partners (e.g., sowing depth or sowing time) are too divergent. Below, we outline a proposal whereby machinery should follow the demands of the crop wherever possible and breeding programmes can be developed to solve the problems that cannot be addressed by adaptations of agronomic or technical solutions directly.

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CONTEXT

Fig. 1 Consider all options when using plant teams. For example, a drill with separate seed tanks can be used for plant team components with different seed sizes. Credit: Mr. Eiteljörg Heribert

When growing plant teams, different seed sizes can complicate sowing and harvest. This challenge can be addressed by either **shaping the system using breeding** (e.g., change of seed size of one crop) or **changes in how we grow plant teams via agronomic or technological solutions**. In many cases only slight adaptations of machinery settings compared to growing as sole crops might be needed if seed size or germination requirements of the plant partners differ significantly. For example, if faba bean and wheat seeds are mixed and drilled at the same time, segregation of the seeds in the seed tank can happen. Additionally, the sowing depth of for example 3 cm that is needed for wheat is too shallow for faba beans, since the beans needs large amounts of water for germination.

ADAPTATIONS FOR SEED SIZE DIFFERENCES

To avoid segregation of seeds with slightly different seed sizes or to enable sowing seeds with large differences in seed size in one step, we have found that the drill can be **adapted to allow separate seed tanks for each partner** (see **Fig. 1** – sowing of *Phaseolus* beans and corn in one step). Another option would be to fill the tanks on one side of the drill with partner one and on the other side with the other and then **turn round and drive back in the same wheel tracks**. In this case, after drilling at an inappropriate sowing depth for one of the partners, **seed bed rolling could enhance water availability for seeds**.

Drilling in two stages might also be considered too. For a wheat and faba bean plant team, it could be worth first **sowing faba beans at 8 cm depth with 40 cm row width** followed by **drilling wheat at 3 cm depth with 10 cm row width**. Drilling or sowing on different dates is also possible. For example, runner beans can be sown at 8 cm depth up to 14 days later than maize corn sown at 4 cm depth.

Fig. 2 Harvesting a bean-corn plant team with a combine harvester for wheat

Harvesting of crops with different seed sizes may also require small adaptations of standard harvesters as well. For example, a bean-corn plant team can be harvested with a combine harvester for wheat in which the **distance between the cylinder and threshing drum** is at maximum width position and sieves with large mesh size are used (**Fig. 2**). After threshing, the harvest is sorted by grain size and the different fractions are dried separately.

Wheat and faba beans can be harvested with a combine harvester for wheat using **sieves** appropriate for faba beans. Nevertheless, many settings are **compromise solutions between loss of harvest and degree of cleaning** and further **downstream processing** may be required depending on the end market (see DIVERSify Factsheet no. 13). If partner crops cannot be sown within the same row/plot, **alternative spatial arrangements**, such as sowing in strips, could be explored depending on the crops and benefits that are trying to be achieved. Practical solutions exist for both structured and unstructured plant teams[1].

ADAPTING CROPS FOR PLANT TEAMS?

Crop choice and field design must be adjusted in line with the minimum operating ranges of the machinery available. However, we believe that a range of options are available with existing machinery. Such **agronomic and technical adaptations offer a range of existing solutions for consideration**. If these do not solve the problems, then breeding for new traits can be considered. Depending on the plant trait that need improvement, **breeding can take several years and be costly**.

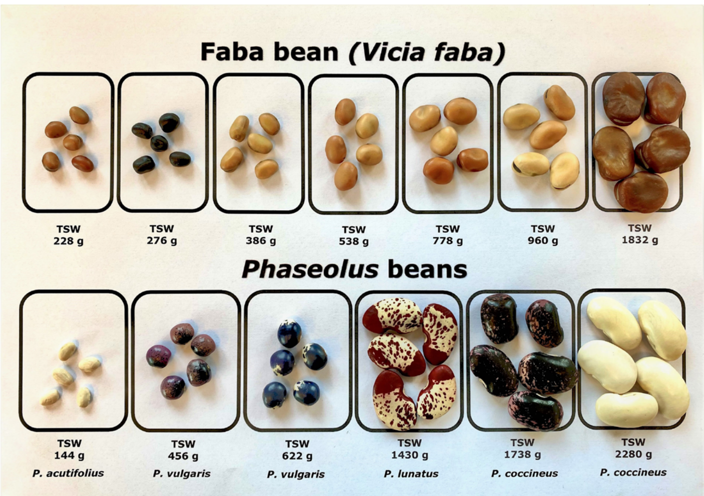

Fig. 3 Range of seed sizes of faba and *Phaseolus* beans

Breeding targets that are of beneficial use within plant teams must be identified. An example could be faba bean seeds with smaller seed sizes (**Fig. 3**) being developed for a seed mixture for whole cropping and not for grain use. In such a case seed costs and weight should be minimised. Breeding for intercropping traits is challenging, as many crop interaction mechanisms are still not fully understood and therefore **definition of the breeding traits is not clear** although work is underway to address this.

CONCLUSION

When facing challenges around growing plant teams, such as seed size differences, in many cases only slight adaptations of machinery settings compared to monocropping might be needed. We think that machinery should follow the demands of the crop wherever possible and that precision agriculture, including the use of GPS technology, will facilitate the uptake of plant teams. For example, growing mixture components in crop strips and swapping the position of the strips the next year to address crop rotation issues.

Breeding is available to focus on challenges that cannot be addressed by agronomic or technical adaptations such as quality parameters, resistances to pathogens or plant architecture traits. Breeding is however an expensive long-term process taking several years with uncertain success. Breeding for intercropping has further challenges as the definition of target traits is not clear. Many factors such as technology, agronomy, a changing environment and changing market demands influence each other as well as placing demands on crop breeding and breeding for improved plant teams.

REFERENCES

1. George D.R. *et al.* (2020) D4.6 – Report on Trouble Shooting Matrix of PAT practical solutions. Developed by the EU-H2020 project DIVERSify

FURTHER INFO

> Watch ‘Managing Complexity’ - episode 2 of the DIVERSify web series Growing Beyond Monoculture which profiles some of the challenges of working with plant teams in the field and solutions that we have identified across the course of the project.

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