DIVERSify Factsheet no. 6

RESILIENCE AND ECOSYSTEM SERVICES

Intercropping as a method to increase resilience to drought

ABSTRACT

In the future, European agriculture will face increasing temperatures and lower precipitation rates. This will result in increasing drought and negatively affect food production and food security.

Below, we introduce intercropping as a solution to enhance resilience of crop production to drought. The differences in rooting depth and water uptake patterns among crop species, as well as cultivation practices that take advantage of these morphological differences are discussed. Furthermore, the benefits of trees in the cropping system with regard to drought-resilience are outlined for consideration.

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PEDO-CLIMATIC ZONE

Continental, All

CONTEXT

Negative impacts on food production, e.g., yield loss, are expected across Europe in the face of ongoing climate change effects such as rising temperature and lower precipitation rates[1]. Intercropping offers a potential solution as the cultivation of multiple crops in the same field allows for **greater resource use efficiency**[2]. A wide range of crops show properties such as a deep rooting depth[3] that are beneficial under drought conditions. A **deeper rooting depth enhances water uptake in lower soil layers**[4], where water is less limited. The combined **cultivation of deep rooting crops with others** can lead to a more efficient use of available water sources in the field[5]. Thus, intercropping could serve as a solution for resilience to drought.

ROOTING DEPTHS AND WATER UPTAKE OF MAIN CROPS

Root distribution varies significantly among crop species[6,7]. Nevertheless, the majority of root biomass is found in the first meter of the soil[2]. Maximal rooting depths of up to 2 m have been reported for some crops (**Figure 1**). Differences in rooting depth are mainly influenced by the physiology of the crop. Importantly, **root growth shows high levels of responsiveness (plasticity) to environmental conditions** and can vary depending on topography and water availability in the field[8].

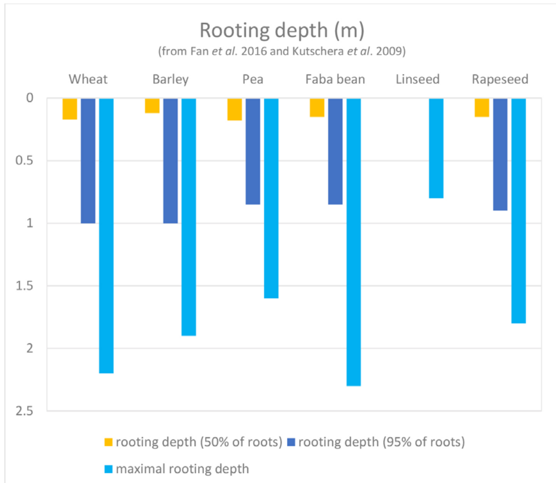

Fig. 1 The majority of root biomass is found within the first meter of the soil, although 50% of roots for common crops do not exploit beyond 20 cm

As root distributions differ, so do the depths of primary water uptake among crops. Our research has found that depth of **water uptake is not only influenced by the crop species but also by cultivation practice**. For example, when rapeseed was intercropped with one or two other crop species, rapeseed used water from a deeper soil layer compared to rapeseed grown in a monoculture (**Figure 2**). This demonstrates the plasticity of root growth and water uptake of crops and how this can change in relation to neighbouring plants. The combined cultivation of crops with **spatial differences in water uptake does not only reduce water competition but also enhance resilience to drought and secures crop yield**.

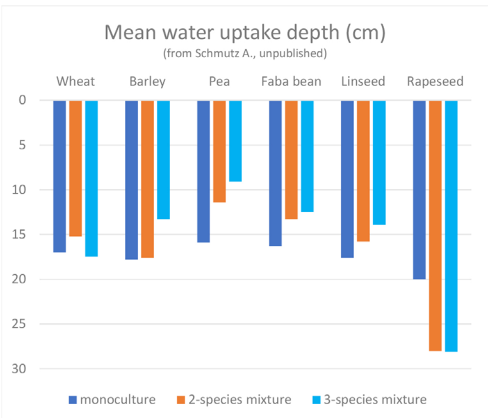

Fig. 2 Water uptake depth can vary in response to the environment, including being grown in a plant team rather than monoculture

ADDING TREES

There are other ways that intercropping can enhance resilience to drought. For example, the introduction of perennial plants such as **trees into the cropping system** (i.e. agroforestry) can reduce water loss through **shading of the soil** and a consequent **reduction in the evaporation of water**[9]. Furthermore, trees have much higher rooting depths and thus can use water from lower soil layers[10]. Finally, plants that **can tap into deep-lying water sources** do also passively redistribute water to the upper soil layers overnight, thereby providing a potential water source also for neighbouring plants with shallow roots[11]. Agroforestry systems have not been researched within the DIVERSify project, but are worthy of consideration as another diversification option when researching how to build resilience to environmental change on your farm.

Fig. 3 Integrating trees in agricultural systems has the potential to increase resilience to drought

CONCLUSION

In the future, agriculture in most areas of Europe will have to adapt to lower precipitation rates and more frequent and extreme drought events. **Intercropping of plant species that show differences in water uptake depths can reduce competition for water and lead to a more efficient use of available water sources. Intercropping therefore can buffer climate change effects, and we have observed reduced chances of complete yield failure due to drought.**

In particular, the introduction of perennial plants such as trees into the cropping system will bring multiple benefits under drought conditions, such as lower water losses due to shading, increased water use efficiency due to complementary water sources and beneficial effects of trees on understorey herbaceous plants through the redistribution of soil water from deep to shallow soil layers.

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FURTHER INFO

> Read on to discover more about resilience in plant teams: DIVERSify Factsheet no. 7

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