Intercropping

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Factsheet about integrated weed management

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Introduction

In intercropping systems two or more crops are grown in the same field for at least part of their growing period[1]. It is a way to increase the spatial crop diversity in agroecosystems, allowing optimized resource use and weed control at crop rotation level.

Applicability

Intercropping can involve multiple cash crops or a combination of a cash crop and subsidiary crop, more commonly referred to as a crop that is not harvested but used as living mulch to cover the soil (Figure 1). For more information about subsidiary crops you can check out the factsheet Cover crops. There are many categories of intercrops based on their spatial arrangement: row intercropping, mixed intercropping, strip intercropping and relay intercropping. The applicability very much depend on the design, chosen species and local conditions. In multiple pilots intercrops are tested for different regions in Europe. See e.g. https://www.diverimpacts.net/ for practical information and experiments with intercrops across Europe.

Figure 1| inclusion of flower strips in fruit orchards not only functions as living mulch but also attracts polinators and natural enemies.

In orchards and vineyards it becomes increasingly common to grow living mulches between the vines to control weeds and prevent soil erosion. Especially in dry regions control of the living mulch biomass should be taken into account to prevent competition for water between the living mulch and the vines. Preferably this is done by choosing plant species that form dry biomass in summer, or alternatively by cutting, mowing or superficial tillage near the crop[2].

Measures like spraying crop-specific herbicides should be considered for the spatial design and chosen crop combinations. It is possible that a herbicide is not allowed in one of the crops, thus can also not be applied for the other crop if the design is a mixture of both crops.

Efficacy

Systems combining two annual cash crops are widespread and the positive impacts of this type on land utilization efficiency, resource use efficiency, crop disease and pest suppression, yield have been demonstrated in several meta-analyses and reviews[3]. Growing crops with complementary morphological and physiological characteristics together is believed to leave less space and resources for weeds to develop. No overarching meta-analysis has been done on the effect of intercrops of two annual cash crops on weed suppression but the following effects on weed suppression were found in research:

In 86% of the cases intercrops suppressed weeds more than either of the sole crops[2].

Weed biomass was lower in intercrops than in pure stands of both component crops in 50% of the reviewed studies, intermediate between component crops in 42% while in only 8% it was higher than in both component crops[3].

1| Wiley, R.W., 1990. Resource use in intercropping systems. Agric. Water Manag. 17 (1–3),215–231. https://doi.org/10.1016/0378-3774(90)90069-B.

2| Stomph, T.J., Dordas, C., Baranger, A., de Rijk, J., Dong, B., Evers, J., Gu, C., Li, L., Simon, J., Jensen, E.S., Wang, Q., Wang, Y., Wang, Z., Xu, H., Zhang, C., Zhang, L., Zhang, W., Bedoussac, L., van der Werf, W., 2020. Designing intercrops for high yield, yield stability and efficient use of resources: are there principles? Adv. Agron. 160, 1–50.

3| Liebman, M., Dyck, E., 1993. Crop rotation and intercropping strategies for weed management. Ecol. Appl. 3, 92–122.

Consistent with the outcome of this review, in a meta-analysis it was found that weed suppression was better in intercrops than in both component crops in 45% of all the cases, and intermediate between the component crops in another 46% of the cases[4].

On average, weed biomass was 58% lower in intercrops than in the weaker suppressive component crops, although weed biomass was not significantly different from the weed biomass in the stronger suppressive component crops.

The efficacy of intercropping on weed suppression depends on a wide range of factors, including:

- The choice of crop species.
- Spatial arrangement (e.g. fully mixed in the row or grown in rows).
- Sowing density of the component species in a mixture.
- To which extent the component crop species are temporally separated as a result of differences in sowing and harvesting dates and fertilizer regime.
- The use of additional weed control measures (e.g. herbicides)[4].

Costs

The costs depend on the chosen intercropping system and to what extend alternative weed control measures become no longer needed as a result from the impact of the intercrop on weed suppression. Depending on the sowing and harvesting time of the multiple cash crops grown together, special machinery for harvesting may be required but as long as the timing and spatial design of the intercrop matches well, there is no investment required for extra machinery.

Labour requirements can either decrease (if less other measures are required for weed control) or increase because the different crops may require management at different moments. It all depend on the complexity level of the intercrop and chosen crop combination.

Equipment

Intercrops can be sown or planted with the common available machinery. However, the spatial design should be adjusted to the working width of the available machinery that is used for sowing, fertilizing, weed control and harvesting.

Core results

- Weed biomass was 58% lower in intercrops than in weaker weed suppressive crops[4].
- Weed suppression was largest in an additive design compared to a replacement design[4].

Extra information

See https://iwmpraise.eu/publications/ for all crop diversification strategies and their definitions, and for more information on integrated weed management and the following inspiration sheet:

- Crop diversification through use of intercrops and subsidiary crops.

Figure 2| A mixture of barley and pea.

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4| Gu, C., Bastiaans, L., Anten, N.P.R., Makowski, D., Van der Werf, W., 2021. Annual intercropping suppresses weeds: a meta-analysis. Agric., Ecosyst. Environ. 322, 107658 https://doi.org/10.1016/j.agee.2021.107658.