Water management

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IWMPRAISE

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Factsheet about integrated weed management

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Introduction

Because the response to the soil water level is most times different between weeds and crop plants during different growth stages, strategic water management can be integrated in a weed management strategy. While optimising the growing conditions for the crop, the weed can be held back by limiting water resources in a certain growth stage, at locations in the field or at different soil layers (e.g. by using drip irrigation). Next to temperature, soil moisture is one of the major environmental drivers controlling the germination of weed seeds and emergence of seedlings.

Applicability

Due to the low predictability of the growth, density, structure and ground coverage of weeds, it is challenging to define their spatial behaviour to determine the irrigation timing to control weeds.

Smart or efficient irrigation systems such as drip irrigation (figure 1 and 2), can already limit weed presence in the space between crop rows. Drip irrigation supplies water only close to the crop plant, leaving the rest of the soil dry and preventing weed germination and growth. Especially subsurface drip, that is buried into the soil leaving the top soil layer dry, is particularly appropriate to manage weeds. Because the tubes are buried, mechanical weeding can still be done without damaging the tubes while germination of weeds in the top soil layer is limited as well.

Efficacy

In dry regions efficient irrigation systems such as subsurface drip are effective to prevent weed germination and development at the surface away from the crop, thus saving herbicide applications or other weeding measures.

Although the effect of irrigation timing on weed pressure can be significant, knowledge is lacking to adapt irrigation timing in such a way that it promotes the crop while hindering weeds.

Costs

Depending on the crop and local conditions, the subsurface drip system may be used for several years or must be installed each season. This influences the investment costs tremendously.

Compared to irrigation with an irrigation reel, drip irrigation has high installation costs but saves the relatively high diesel and labour costs each time that an irrigation reel is used. In general, a drip irrigation system may only become cost-efficient in very dry summers, thanks to lower diesel and labour costs and lower plant stress resulting in higher productivity. At the moment investment and installation are expensive, especially for arable farming since you have to (de-)install the system each time that a new crop is sown (table 1).

Figure 1| Drip irrigation in Lily

1| Singh M, Kukal MS, Irmak S and Jhala AJ (2022) Water Use Characteristics of Weeds: A Global Review, Best Practices, and Future Directions. Front. Plant Sci. 12:794090. doi: 10.3389/fpls.2021.794090

Equipment

To adjust the water supply to the weed demands an irrigation system is required. Regarding weed management a subsurface drip irrigation system is preferred.

Core results

- In an experiment of weed management by irrigation timing in Alfalfa, the densities of the major weed species Black nightshade (*Solanum nigrum L.*) common lambsquarters (*Chenopodium album L.*) and de dominant species in the stand redroot pigweed (*Amaranthus retroflexus L.*) were significantly affected by irrigation timing[3].
- In a trial in an arid environment with tomato under subsurface drip compared to furrow irrigation, weed biomass under the subsurface drip irrigation without herbicides was similar to the furrow irrigation with herbicide treatment[4]. This suggests that herbicides may not be necessary in arid environments when using subsurface drip.
- Sub surface drip treatments were highly effective at suppressing weeds: less than 0.15 weeds per m^2 [5].

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Table 1. Fixed and variable costs of drip irrigation for the Dutch situation. Pipes are considered to be installed each year all over again. The variable costs depend strongly on the labour hours. Labour hours are based on practical experiences of farmers who work with drip irrigation for the first time. Adjusted from Van der Burgt et al. (2021)[2].

Fixed costs for a field of 10 ha				**Variable costs per ha**	
Investment irrigation tap		€ 175		**Drip hose**	€ 600 - 1000
Investment pump		€ 5500 - 9000		**Fuel costs pump**	€ 100 - 150
Investment pipes and connectors	Transport pipe from pump to drip hose €3,50/m	€ 150-1400		**Installation build up**	€ 100 - 150
	Distribution line €4,50/m	€ 150 - 200		**switch on/off (hose bridges)**	€ 50 - 100
Maintenance costs and/ or repairments	Adjustments ridge cultivator	€ 1000		**Tear down installation**	€ 100 - 150
Maintenance and ensu-rance		2%		**roll up disposable hose**	€ 150 -200
Depreciation		9%		**Tractor and roll up machine**	€ 150 - 200
Interest		2.2%			
Fixed costs irrigation material per year per ha		€ 53 - 90		***Variable costs***	€ 1250 - 1950

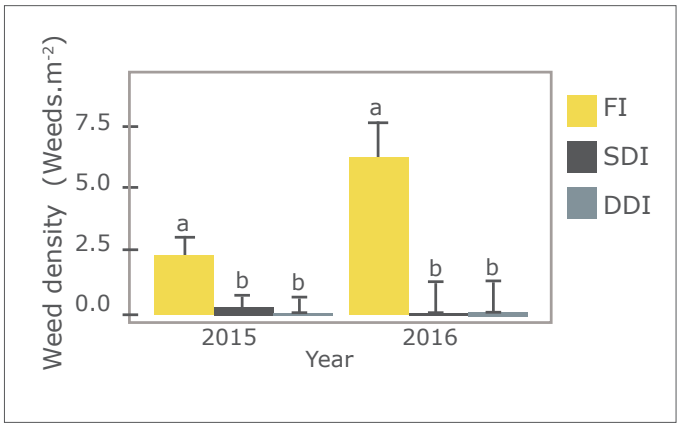

Figure 2| Weed density affected by irrigation. FI = furrow irrigation, SDI = subsurface drip irrigation, DDI = double drip irrigation. Letters indicate statistical differences between means at p = 0.05. From Schmidt et al. (2018)[5].

Extra information

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

Contact| Timo Sprangers
M| ***timo.sprangers@wur.nl***
T| (+31)320 29 12 37

Contact| Saskia Houben
M| ***saskia.houben@wur.nl***
T| (+31)320 29 12 09

Figure 3| Drip irrigation along the trees in an agroforestry field.

2| Van der Burgt, E., Verstand, D., 2021. De Kosten van irrigatiesystemen in beeld; Een kostenvergelijking van druppelirrigatie, peil-gestuurde drainage en de haspel. Wageningen Research, Rapport WPR 900. https://doi.org/10.18174/555260

3| Kanatas, P., Gazoulis, I., & Travlos, I. (2021). Irrigation Timing as a Practice of Effective Weed Management in Established Alfalfa (Medicago sativa L.) Crop. Agronomy, 11(3), 550. doi: 10.3390/agronomy11030550

4| Grattan SR., Schwankl LJ., Lanini WT. Weed control by subsurface drip irrigation. California Agriculture 1988; 42(3): 22-24. https://calag.ucanr.edu/archive/?type=pdf&article=ca.v042n03p22

6| Schmidt, J., Peterson, C., Wang, D., Scow, K., & Gaudin, A. (2018). Agroecosystem tradeoffs associated with conversion to subsurface drip irrigation in organic systems. Agricultural Water Management, 202, 1-8. doi: 10.1016/j.agwat.2018.02.005