

Weed seed collection and destruction

May | 2022



Factsheet about integrated weed management



Introduction

Collecting and destroying weed seeds during harvest is a strategy originally developed in Australia¹, now being studied elsewhere on the world.

Applicability

The systems as developed in Australia, the HWSC systems¹, has received little attention for targeting weeds of European cropping systems, despite the potential for high seed-retention levels as shown by several studies².

Based on the applications in Australia, Walsh et al. (2018)² distinguishes the following systems of weed seed collection and destruction:

- **Chaff carts:** In this quite simple HWSC system a chaff collection and transfer mechanism is attached to a grain harvester and delivers the weed-seed bearing chaff fraction into a bulk collection bin, e.g. a trailing cart. This system collects high portions of seeds from annual ryegrass, wild radish and wild oats but management of the large volumes of collected chaff material is difficult.
- **Narrow-windrow burning:** Chaff and straw residues are concentrated into a narrow windrow (50-60cm wide) by a chute that is attached to the rear of the grain harvester. Under the right environmental conditions, these narrow windrows are burned to destroy the weed seeds. Thanks to its high efficacy and low costs, it is the most commonly used system in Australia.
- **Bale direct system:** Bales from the chaff and straw residues that come out of the grain harvester, are constructed by a large square baler directly attached to the harvester. It captures weeds seeds and bales harvest residues for livestock feed.
- **Chaff tramlining and chaff lining:** During harvest chaff materials are confined into narrow rows on dedicated wheel tracks (chaff tramlining) or between stubble rows (chaff lining). They are established by attachments on the rear of a harvester that collect

and place chaff into the rows (about 20-30 cm wide). The concentration of the chaff material makes it an unsuitable environment for weed seeds to germinate and emerge. It is the second most popular system in Australia, although its efficacy have not yet been documented.

Efficacy

- In Australia substantial reductions of weed populations have been observed in the last two decades.
- The efficacy of seed collection and destruction depends on the percentage of seeds retained on the weed plants at harvest time and this varies among years and weed species³. The strategy reduces seed return to the soil seed bank and cutting seed heads that grow above the crop canopy can be an effective approach as well⁴.
- For both annual ryegrass and wild radish, seed kill levels of 99% have been recorded for the narrow-windrow burning of wheat, canola (*Brassica napus* L.) and lupin (*Lupinus angustifolius* L.) crop residues.
- Multiple studies have determined that very high proportions (95%) of annual ryegrass seeds are collected and removed from fields² with the bale direct system.

1| Harvest weed seed control (HWSC) systems

2| Walsh, M., Broster, J., Schwartz-Lazaro, L., Norsworthy, J., Davis, A., & Tidemann, B. et al. (2018). Opportunities and challenges for harvest weed seed control in global cropping systems. *Pest Management Science*, 74(10), 2235-2245. doi: 10.1002/ps.4802

3| Bitarafan, Z., Andreasen, C. (2020). Seed production and retention at maturity of blackgrass (*Alopecurus myosuroides*) and silky windgrass (*Apera spica-venti*) at wheat harvest. *Weed Science*, <https://doi.org/10.1017/wsc.2020.7>

4| Tavaziva, V.J., Lundkvist, A., Verwijst, T. (2019). Effects of selective cutting and timing of herbicide application on growth and development of *Cirsium arvense* in spring barley. *Weed Research* 59, 349-356.



Costs

The costs mainly depend on the chosen HSWC system. Flessner et al. (2021)⁵¹ described well what each system entails and estimates costs for the USA context:

- Chaff lining and tramlining: Combine modifications are inexpensive and involve removing the chaff spreader and making a chute to direct the chaff. The modifications can either be self-made or done with commercially available chaff lining kits. For tramlining a conveyor belt device needs to be added to the combine.
- Chaff carts: It is critical to direct the weed-seed-laden chaff into the HSWC device and keep the chaff and straw separate. A baffle inside the combine is necessary if the chaff and straw are mixed by the combine before spreading.
- Bale direct: The baler and combine are directly connected in this HSWC system and processes ready to sell bales.
- Narrow windrow burning: Modifications may not be necessary in this case or are minimal. Costs are related to burning of the windrows after harvest.

All approaches are for crops that are harvested with a grain header. While costs vary a bit among HSWC systems, Australian farmers say HSWC costs about the same as a cheap herbicide pass²¹. Weedsmart provides a cost calculator for HSWC in Australia (<https://www.weedsmart.org.au/content/calculating-the-cost-of-hwsc-for-your-farm/>) and suggests that weed seed control costs \$7 to \$19 per hectare.

Equipment

Most seed collection and destruction systems require some specific machinery, as described in the captions Applicability and Costs for each system.

Core results

- There have been few systematic studies to quantify seed retention at harvest time in black-grass, although a field study in the United Kingdom in 2014 estimated seed retention over 100 black-grass field populations over a period of 4 weeks prior to harvest of the crop. This survey indicates that ~80–90% shed by the commencement of winter wheat harvest (Neve P. unpublished data). Around the common

harvest time of winter barley (*Hordeum vulgare* L.) and canola crops in the UK, late July, seed retention was around 40–50%. This indicates some potential for reasonable levels of black-grass weed-seed control in earlier maturing crops³¹.

- Growers reduced the initially very high weed populations (>50 plants m⁻²) of annual ryegrass present in all 25 commercial production fields that were monitored on the long-term impact of HSWC on annual ryegrass populations in the Western Australian wheat belt. They reached more moderate levels of 1–10 plants m⁻² in 2008, compared to >50 plants m⁻² in 2001³¹.

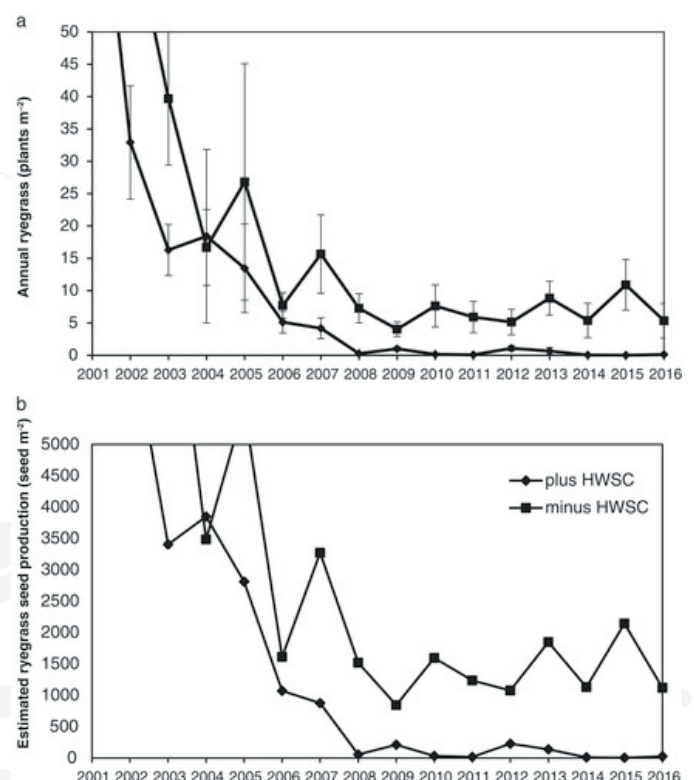


Figure 1| (a) Influence of long-term herbicide alone or herbicide plus HSWC weed-management programs on average annual ryegrass population densities and (b) predicted seedbank inputs (From Walsh et al., 2013)³.

⁵¹ Flessner, M., Mirsky, S., Schwartz-Lazaro, L., Bagavathiannan, M., VanGessel, M., & Shergill, L. et al. (2021). From Spreader to Predator: Killing Weed Seeds with the Combine. *Crops & Soils*, 54(5), 40–45. doi: 10.1002/crso.20140



Extra information

See <https://iwmpraise.eu/publications/> for all crop diversification strategies and their definitions.

Flessner et al. (2021)⁵¹ includes information for implementing HWSC in the USA, what weeds to target, potential costs and equipment.

The Australian government and Grains Research & Development Corporation provide tools and tips for setting up chaff lining: <https://grdc.com.au/resources-and-publications/all-publications/publications/2019/tools-and-tips-setting-up-for-chaff-lining>



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

