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Rotary toppers can effectively chop the rape stubble, but have a lower suction effect than flail toppers.

FIELD HYGIENE AFTER OILSEED RAPE

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In future, successful arable farming will increasingly maintain field hygiene and soil health through rotation planning rather than focusing on individual crops. With approvals becoming more difficult to obtain for chemical dressings and sprays, the focus is being shifted to direct and selective control and integrated crop protection measures. This involves a new approach to the overall crop management that takes phytosanitary aspects into far greater account.

There are essentially three factors to bear in mind when considering field hygiene after the oilseed rape harvest (Fig. 1).

1. Apart from common weeds, oilseed rape itself is increasingly becoming a problem weed in rape rotations. The targeted prevention and reduction of volunteer oilseed rape is therefore a key element of field hygiene in rape rotations.

2. Diseases such as phoma and downy mildew are also transmitted from previous rape crops to new oilseed rape crops. Club root can contaminate a current oilseed rape crop by infecting the previous rape crop and producing new resting spores which lie dormant in the soil.

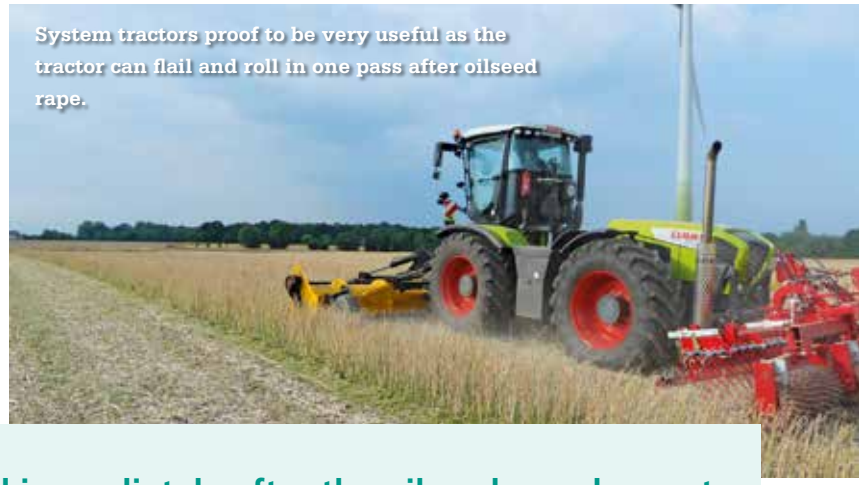
Fig. 1: Aspects of field hygiene after oilseed rape

	Problem	Source of infection	Prevention measures
Weed control	Problem weeds (**volunteer oilseed rape,** creeping thistle, camomile, shepherd's purse, black-grass, etc.)	Potential of weed seed in the soil, straw etc.	Shredding, cultivating, spraying
Breaking the 'green bridge' effect	Phoma, downy mildew, club root etc.	Rape stubble (resprouting) **volunteer oilseed rape**	Yield losses, shredding, cultivating
Pest control	Grey field slug, cabbage root fly, aphids etc.	Rape stubble, **volunteer oilseed rape**	Yield losses, shredding, cultivating

Flail toppers have an excellent suction effect and can cut very close to the ground.

Shallow cultivation after harvest should be carried out only in wet soil and weather to avoid inducing seed dormancy.

Rolling after harvest is a good option in wet conditions but hardly removes any of the rape stubble.



System tractors proof to be very useful as the tractor can flail and roll in one pass after oilseed rape.

3. Pests such as grey field slugs, cabbage root flies and aphids can potentially cause significant damage in the following crop and to adjacent fields.

Therefore, very careful attention should be paid to these three factors during soil cultivation. Volunteer oilseed rape and rape stubble are the main sources of infection and other problems and so this is where the focus of post-harvest management must lie (see Fig. 1). As a rule, prevention is better than cure. So efforts to control shed oilseed rape seeds should start right from the time of harvesting. Timing the harvest to suit the variety and optimising the combine harvester settings are part of a targeted prevention strategy. Moisture levels in seed and straw may vary significantly during the course of one day, while straw consistency may vary throughout the harvesting season. Combine harvesters are now fitted with sensors that help the operator set the machine up correctly, but the settings should still be checked manually. This is done by determining the actual losses more frequently during combining and using these readings to optimise the machine settings. Having made the greatest possible efforts to prevent losses, the next step is post-harvest tillage!

Tillage and field hygiene

The main objectives of any primary cultivation after harvest are to encourage weed seeds and

Don’t till immediately after the oilseed rape harvest

Fields where oilseed rape has been grown intensively for several years have increasing problems with volunteers.
This creates a variety of problems:

> Uncontrolled competition from volunteer oilseed rape
> Volunteers overrun the main crop, leading to a loss of winter hardiness
> Problems with disease control (e.g. club root)
> Lodging due to overcrowding
> Reduced harvest quality
> Threshing problems
> Increased losses during threshing and further build-up of seeds in the soil
> Subsequent reduction in yield

Under normal conditions 1000–5000 seeds per m² can be shed, sometimes significantly more. Varying percentages of these seeds go on to develop secondary dormancy triggered by unfavourable environmental conditions (drought, absence of light), allowing seeds to persist in the soil for several years. Research shows that delaying tillage until the wheat is sown is a far more effective way of reducing seed numbers in the soil than tilling immediately after harvest. This is because the seeds are then not exposed to the conditions which trigger dormancy. In addition, during this rest period seed numbers on the soil surface are further reduced by germination and wilting or consumption by animals. Systems where cultivation takes place immediately after harvest were found to increase the number of seeds in the seed bank significantly over systems that delay cultivation until the wheat is sown. Also, emergence rates of volunteer oilseed rape in wheat were also greatly reduced where cultivation did not take place immediately after the oilseed rape harvest. We must rid ourselves of the idea that prompt cultivation after harvest will stimulate the germination of volunteers. In most cases this approach simply adds to the seed bank, especially if the soil is not sufficiently moist. These findings and the results from the subsequent wheat crop support recommendations to leave shed oilseed rape seed on the soil and delay cultivation for at least three weeks. A longer period would be desirable if the sole aim were to minimise the number of volunteer seeds in the soil, but this conflicts with phytosanitary aspects of oilseed rape cultivation.

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shed oilseed rape seeds to germinate, remove the emerging plants and destroy the oilseed rape stubble. There are three different cultivation methods (Fig. 2):

Fig. 2: Cultivation methods to destroy oilseed rape stubble

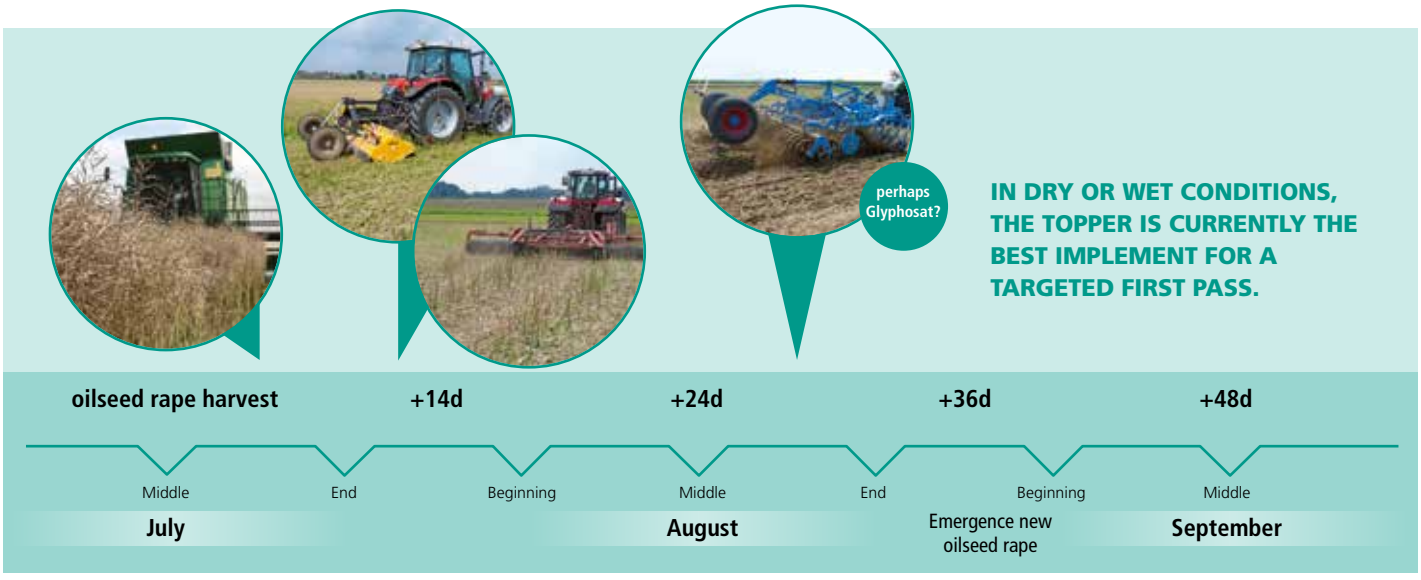
Non-invasive tillage	Minimally invasive tillage	Invasive tillage
Rotary topper	Roller	Discs
		Spring-tine harrow (wide tines)
Flail topper	Tine harrow	Cross cutter/power harrow
		Cultivator

Non-invasive tillage means cultivating above the soil surface only. Rotary or flail toppers are ideal for this purpose. The aim is to work as close to the ground as possible, with flail toppers providing also significant suction power. The straw residue is sucked up from the ground, chopped and spread over a wide area to form a layer of mulch which protects the soil from the warming and drying effects of intense solar radiation and wind. Since this process does not inhibit capillary action, water can still rise, but evaporation from the soil is reduced by the mulch layer. A moist but not too warm atmosphere develops between the mulch cover and the soil surface, creating the perfect conditions for the volunteer seeds to germinate. Furthermore, the layer of mulch then begins to rot and fungal infections take hold, thus reducing the viability of the shed seed. The topper also destroys oilseed rape stubble, effectively eliminating the home of field slugs which like to shelter in among the stubble. Birds, which are natural predators of slugs and mice, may be attracted to these ‘stubble-free’ fields and yet the straw mulch still provides a very good refuge to pests, so these measures alone are not sufficient to control slugs.

Minimally invasive tillage refers to cultivation at surface level using traditional rollers and tine harrows. The roller basically presses the volunteers more firmly onto the surface and may destroy some closed pods in dry conditions. Although rolling flattens the oilseed rape stubble, a high percentage of it will remain intact and may regrow from the basal axes. The tines on the harrow scrape across the soil, briefly carrying material along with them. This shakes the stubble vigorously and mixes it with soil dust, causing some of the oilseed rape seed to fall from the stubble to the ground, where it germinates if moisture levels are sufficient. This kickstarts the stubble rotting process, but the drawback is that the volunteer seeds are not pressed straight onto the moist soil. Another drawback is that not all the stubble is collected. So rather than relying on a single cultivation pass, it makes more sense to do several passes and combine harrowing with rolling.

Various cultivators and discs are available for invasive tillage. Provided they are fitted with the right tools, they can be used for shallow cultivation. Gi-ven good reconsolidation and sufficient soil moisture, volunteer seeds can germinate quickly. However, invasive tillage can be a problem if the shed seed is buried deep and dry, triggering secondary dormancy. It is not easy to reactivate these ‘sleepers’ without sufficient moisture and a light trigger. Volunteer seed that has developed secondary dormancy can cause prob-lems in subsequent years. Furthermore, the very shallow action of many cultivation implements does not reliably collect all the oilseed rape stubble; much of it is left standing to form a green bridge and slug refuge. Field slug

When to cultivate after harvesting oilseed rape:



numbers fall significantly under very dry conditions, but this control method is completely at odds with the control of volunteer oilseed rape (drought induces secondary dormancy).

Since there are advantages and disadvantages to each method, a combination of different tillage practices is the best approach. The question is which problem to tackle at what time and in what weather conditions. Cultivation in wet conditions is easier, because invasive methods, too, target certain issues. It is more difficult in July and August when the weather is extremely dry.

In both dry or wet conditions, the flail mower is currently the best implement for a specific first pass. However, the timing must coincide with the first wave of volunteer oilseed rape. Topping should start as soon as the first cotyledons appear. At this stage many of the emerging seedlings are still not firmly anchored in the soil and can be removed by the suction of the flail topper. Therefore topping should be carried much sooner in years with heavy pre-harvest losses. In dry conditions, a roller should be used immediately after topping to maximise seed-soil contact. Then the field should be rested (a) until the volunteer rape has reached the 2- to 3-leaf stage or (b) before the newly sown rape emerges. This cuts off the transmission path from the previous oilseed rape crop to new crops and at the same time it helps to prevent the spread of club root since the cumulative temperature up to the third true leaf stage is below the temperature that is needed for the resting club root pathogen spores to germinate. It can also be controlled with glyphosate. Alternatively, an initial, very shallow invasive pass can remove sufficiently all plants. If this is carried out under very dry conditions, it will also help control slugs. When the second wave of volunteer oilseed rape emerges, it can be selectively destroyed with primary cultivation/seedbed preparation.

Summary

In future, we must aim to deal with a problem field before this starts creating problems, even if this may lead to a conflict of interests. The control of volunteer oilseed rape remains at the heart of any tillage, but in future the motto will be less is more! Flailing the stubble as the first cultivation pass after harvest will already deal with the main issues in terms of phytosanitation. Volunteer oilseed rape should not be left standing too long and must be removed by the 3-leaf stage at the latest or by the time winter rape is typically sown. Only a strict tillage regime involving non-invasive tillage, a sufficient rest period and adapted invasive tillage can reliably control volunteer oilseed rape and minimise the spread of diseases from old rape fields.

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