ARABLE FARMING WITHOUT GLYPHOSATE

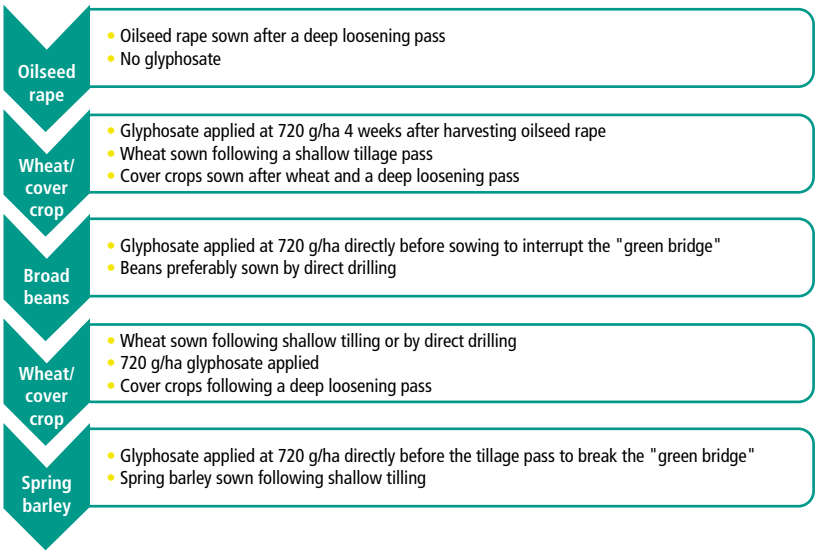
WHAT IS THE IMPORTANCE OF STUBBLE CULTIVATION?

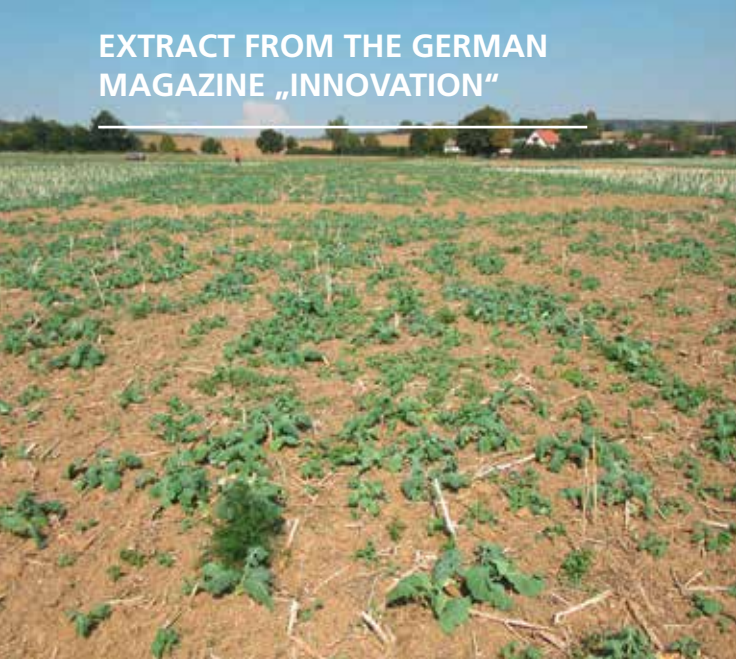
The approval of glyphosate is under scrutiny. In Germany, current insect protection measures are paving the way for the phase-out of the herbicide which has been the cornerstone of no-till farming from the very beginning. Yet, in the recent past, conservation tillage schemes have become a viable option thanks to technical developments and because they offer environmental advantages for arable farming and, not least, help reduce costs. If glyphosate is no longer used to control the green bridge in min- and no-till systems, stubble cultivation will become particularly important.

Which farming systems use glyphosate?

Glyphosate is of outstanding importance worldwide, particularly for growers of genetically modified crops. This means that glyphosate is the most widely used herbicide, but at the same time it draws a lot of attention from critics of genetic engineering. In Germany, using glyphosate for genetically modified crops is prohibited. In fact, in Germany glyphosate is used in cropping systems to control perennial and grass weeds and to control resistant grass weeds before sowing. It is also used to control the green bridge in ploughless cropping systems, to rejuvenate grassland and, to a lesser extent, for crop desiccation. Abandoning traditional tillage schemes has played a leading role in recent decades – particularly in the development of environmentally sound cropping systems. The benefits of this move are wide-reaching for agricultural ecosystems: soil erosion is prevented and as a result less pesticides and phosphate enter surface waters and mineralisation of nitrogen in autumn is reduced, thus protecting groundwater. Apart from these environmental arguments, farmers benefit from lower costs. In the past, environmental advice backed by the government advocated ploughless farming, for example in areas of water protection. Our own surveys conducted among farmers as well as our evaluations of long-term tillage trials repeatedly came to the following conclusion for conventionally managed farms: Glyphosate forms an inherent component of resource-efficient and environmentally-sound farming practices. This is illustrated by the practical example in Figure 1. Modified cropping systems counteract the problematic aspects of crop

FIG. 1: PRACTICAL EXAMPLE - USE OF GLYPHOSATE IN A SUSTAINABLE ARABLE FARMING SYSTEM





1 Heavy harrow

2 3-bar cultivator

3 Large spring tine harro

production, such as soil erosion, biodiversity, nutrient efficiency, weeds and high pesticide use due to short crop rotations. Despite the use of glyphosate, the overall pesticide application rate is lower than in short winter cereal rotations that are intensively tillaged. This intensive cultivation, including ploughing, guarantees the long-term feasibility of short crop rotations. The use of glyphosate here is the exception rather than the rule. It is, however, misleading to focus on glyphosate when it comes to the environmental sustainability of arable systems. This becomes clear when we compare planting cover crops or spring crops into stubble with traditional winter ploughing. In the practical example given, cover crops are deliberately integrated before spring crops and legumes. These important crops in the rotation promote tilth and minimise the intensity of intervention, meaning that crops can be sown without using the traditional plough and even by direct drilling (Figs. 1-6). This, in turn, is beneficial to soil life and, accordingly, soil biodiversity. Despite the use of glyphosate, soil biodiversity is significantly higher here compared to soils that have been intensively ploughed. This has also been demonstrated by scientific studies.

Glyphosate ban - what consequences can be expected?

If policy makers enforce a ban on all glyphosate-based products, farming systems will have to be realigned. Possible options that are frequently discussed have, to date, failed on account of the costs involved as well as a lack of practical, real-life ways of implementing them. The idea of using competitive cover crops in combination with a no-till scheme to suppress volunteer cereals and weeds is an approach that works for only a few sites and types of farms. Practical, flexible and manageable solutions must be available on a much broader scale. In many cases, this means intensifying a tillage scheme, which has led to those environmental consequences we have already seen in the past decades. Meanwhile, in economic terms, marginal farmland will be most affected by intensifying cultivation practices. This is exactly where the advantages of conservation tillage, such as reduced labour, machine costs and fuel use have been most obvious. If ploughless tillage is to continue in these areas, the ideal tillage dates must be chosen very precisely. This becomes a real challenge in view of capricious weather conditions and workload peaks.

In addition, competitive weeds and grasses are becoming more resistant. Planting cover crops is also becoming more problematic because if a cover crop has failed or has not frozen over it is difficult to produce a competitive seedbed without using glyphosate. Furthermore, ploughing a heavy soil in spring is a questionable practice. Ultimately, in mulch sowing systems, cover crops must ideally be cultivated after harvesting winter crops such as winter barley in order make enough time for tillage before sowing. Summer ploughing before sowing cover crops could therefore experience a renaissance. The plough clears weeds quite thoroughly, thus providing good conditions for mulch sowing in the spring. On the other hand, however, costs are rising and

6 Disc harrow with wavy discs

7 Ring cultivator

w with duckfoot shares

4 Large spring tine harrow with narrow shares

5 Ultra-shallow cultivator

workload peaks in the summer are becoming more acute.

A stubble cultivation trial provides more information

Working with farmers from the "Gesellschaft für konservierende Bodenbearbeitung e.V." (GKB - "Society for Conservation Tillage") in the Federal State of Hesse, we tested nine different machines on a harvested oilseed rape field. The main focus of the study was controlling the volunteer oilseed rape and developing the N_{min} values in the autumn up until sowing wheat. The companies that took part were free to choose the dates, frequency and depth of tillage as deemed appropriate and in line with their equipment. The aim was simply to eliminate volunteer oilseed rape as completely as possible and to achieve low N_{min} values. The fields were assessed before wheat was sown. These approaches were compared with the common practice of applying glyphosate followed by a shallow oilseed rape stubble incorporation pass, which is carried out by many farmers. An average of 717 oilseed rape plants per square metre grew on the plot. The growth of oilseed rape reduced the N_{min} value from 77 kg/ha directly after harvest to 32 kg/ha, i.e. the reduced N_{min} value was in the non-critical range. After applying glyphosate, the volunteer rape had died off completely.

Summary

If glyphosate is no longer used, tillage after the oilseed rape harvest requires a shallow and full-width cultivation pass which at best separates residues from the soil. This is the only way that the requirements for sufficient field hygiene and acceptable N_{min} values in autumn can, to some extent, be met. Considerable development work still needs to be done for crops with high post-harvest input levels in order to keep mineralisation of nitrogen in autumn under control. Cultivating fast-growing cover crops after the oilseed rape harvest or undersowing could be further measures to protect water quality without using glyphosate. One thing seems certain, however: When it comes to managing cultivation, the costs and demands are increasing.

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SOIL CULTIVATION IMPLEMENTS AND THE CONTROL AGAINST VOLUNTEER OILSEED RAPE

Equipment	Tillage frequency	Tillage depth	Control of volunteer oilseed rape	N_{min} in autumn
1 Heavy harrow	3	0-4 cm	64%	102 kg/ha
2 3-bar cultivator	1	15 cm	96%	144 kg/ha
3 Large spring tine harrow with duckfoot shares	2	9 cm	100%	203 kg/ha
4 Large spring tine harrow with narrow shares			91%	
5 Ultra-shallow cultivator	1	3-5 cm	85%	130 kg/ha
Topping off the weed			Insignificant	25 kg/ha
6 Disc harrow with wavy discs	1	5 cm	92%	110 kg/ha
7 Ring cultivator	1	10 cm	Almost completely under control	101 kg/ha