Success factor **Soil**

Thinking farming economically and sustainably

Fewer pesticides, less fertiliser, but more sustainability and resilience – the social and political demands on agriculture are high and rising. Add to this climate change, with increasingly frequent periods of drought, heavy rainfall and hail.

But how can stable yields of the required quality be achieved in the future with less costly inputs? And above all, how can a company's long-term profitability be secured under these conditions?

As the most critical production factor, soil is at the heart of all the issues raised. Healthy, well-maintained soil provides stable yields with less pesticide and fertiliser use, increases biodiversity, contributes to climate change mitigation and reduces the risk of extreme weather events. But healthy soil is not something we can take for granted. As these recent figures show:

- About half of all soils in Germany show structural damage due to compaction.
- Soil loss through wind and water erosion is enormous. On average, Germany loses about 20 tonnes of soil per hectare per year.
- The average humus loss is about 0.6 tonnes per hectare per year, with a total stock of about 600 tonnes/ha.
- New soil formation is extremely slow. A maximum of one tonne of soil per hectare can be formed in a year.

  This increases the risk of reduced fertility and yield. To counteract this, fertiliser and chemical inputs must be kept high.

Soil as a success factor

What harms the soil?

Tight crop rotations with few high-yielding crops, increasingly heavy machinery and intensive tillage are the norm in conventional farming. This affects soil life, increases the risk of compaction in the long term and leaves bare soil that easily turns to mud and dries out quickly.

The best for the soil: tranquillity

Despite these disadvantages, nearly 60 percent of Germany's arable land is ploughed and nearly 40 percent is tilled before sowing. On the other hand, the most soil-friendly and sustainable form of crop establishment, direct seeding without soil disturbance, is only used on just under one percent of the land. This system in particular has tangible benefits for both the soil and the farm.

No-till improves the soil:

- More soil life and greater aggregate stability.
- Humus formation (C-bond).
- Increased water infiltration and retention.
- Less evaporation.
- Improved nutrient availability.
- Significantly reduced risk of wind and water erosion.
- Better trafficability and reduced risk of compaction.

No-till improves margins:

- Savings in time, fuel, crop protection, fertiliser and machinery costs.
- Increased production and yield security in increasing climatic extremes such as drought and heavy rainfall.
- Yields comparable to conventional tillage in all crops.
- Reduced weed and pest pressure.
- Elimination of problem weeds such as blackgrass and brome.

How does no-till farming work?

The concept of no-till farming is also known as conservation agriculture. It focuses on the needs of healthy soil. Three principles defined by the Food and Agriculture Organization of the United Nations (FAO) are fundamental to the successful implementation of no-till farming:

1. No soil disturbance by plough or cultivator. Instead, each crop is sown directly into the stubble of the previous crop using unique no-till technology.

2. A permanent soil cover of organic residues or living plants.

3. A diverse crop rotation, consistent use of intercrops and, where necessary, undercropping.

No-till, or conservation agriculture, is much more than just not tilling the soil. It is a complete farming system in itself.

The bill, please!

What are the concrete benefits of switching to no-till for my farm?*

Time saving
of up to

4 h/ha/a

or approx.

- 60 €/ha/a

Up to

50 %

Less fertiliser use

Up to

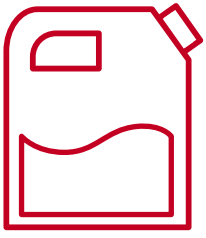
90 %

less Erosion

Up to

3 x

Rain
Water absorption
(infiltration)



Diesel savings

up to 29 l/ha/a

or approx. **- 50 €/ha/a**

*compared to conventional seedbed preparation before main crops.

At least

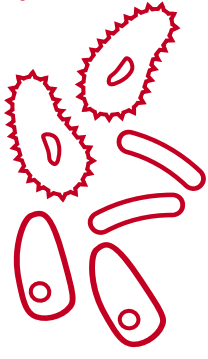
4x

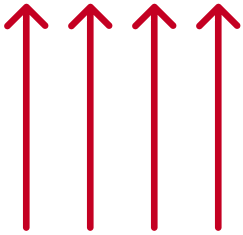
more earthworms

At least

2x

more microorganisms

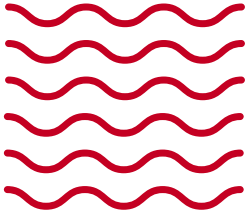


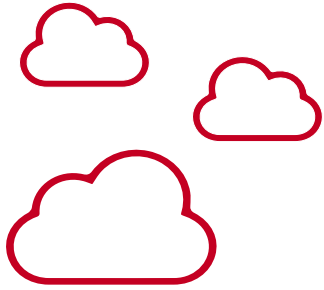


Up to

50%

less Evaporation





CO_2 savings of

1.4 to 4.5 t/ha/a

due to lower fuel consumption and humus build-up

Up to

10x more birds

Conversion to no-till Questions & answers

How do I prepare for the changeover?

Many soil properties change, from nutrient dynamics to spring warm-up. This requires adjustments such as crop rotation, fertilisation and crop protection. The conversion should be planned at least a year in advance and the process should be thoroughly researched.

In addition to theoretical knowledge, information exchange with farmers and experts with experience of the system is essential. Before conversion, the first step is usually to adjust the crop rotation and then to work towards continuous soil cover.

A transitional period of minimum tillage (using only cultivators) has also proved successful. Conversion can also be done gradually, field by field, to gain experience step by step.

Does no-till work for all locations and crops?

In principle, no-till can be successfully implemented on all soils. It is particularly beneficial in areas prone to erosion and drought. But the benefits are worthwhile even on good land. The key is to tailor the process to the specific site conditions. There is no one-size-fits-all solution. No-till can be used successfully to grow all crops, from cereals to pulses, silage, grain maize and rape.

Does no-till lead to lower yields?

Scientific results from several long-term conservation agriculture trials and real-world farm experience show that yields remain at similar levels for all crops after switching to no-till. This is true even for demanding crops such as sugar beet and maize. The longer the system is established, the more visible the benefits become and the more stable the profits. Ultimately, however, the profitability of the whole rotation is more important than the yield.

Again, most studies show the benefits of no-till in terms of labour, diesel and machinery costs. In addition, no-till buffers the extremes and makes the cropping system more resilient.

When it comes to seeding technology, what is essential?

Professional seeding technology is crucial to the success of no-till farming. Precise seed placement is even more critical than after tillage. The challenge is to ensure a uniform seeding depth and good seed-soil contact despite large amounts of organic matter.

Sowing into stubble, straw or catch crops requires a particularly robust machine and significantly higher downforce than conventional drills. No-till seed drills typically use discs to minimise soil disturbance.

The opener cuts the soil, places the seed, and closes the furrow with closing rollers. The opener must ensure that no residue gets into the furrow. This is because straw or other plant residues can surround the seed and prevent it from making contact with the soil (hairpinning).

How does fertilization change with no-till?

Because of the continuous organic cover, the soil warms up more slowly in a no-till system than in a conventional system. This slows down mineralisation and nitrogen release in spring and autumn. For this reason, it is advisable to apply nitrogen and phosphate fertiliser under the soil at sowing time. With professional drilling technology, this is easy to achieve.

In principle, the constant conversion of organic matter in living soils leads to a very even supply of nutrients. Fertiliser applications can therefore be reduced. In addition, the high microbiological activity in the soil improves the efficiency of mineral fertilisers.

Is weed control possible without glyphosate?

Glyphosate is broad spectrum and very cheap. For this reason, it is used by many farms following a no-till strategy. However, farms with sufficient no-till history report that they are now successfully practising the concept without glyphosate. In particular, they rely on catch crops, undersowing and selective herbicides for weed control to keep weed pressure low.

Is no-till also suitable for livestock farms with organic fertiliser?

The addition of organic matter with slurry or manure fits well within the no-till concept. To avoid gaseous N losses in the form of ammonia and nitrous oxide, slurry should be applied as close to the ground as possible in growing stands (20 cm). Losses are no greater than with conventional tillage. This is ensured by the growing crop, the rapid transformation of the manure by soil organisms and the rapid nutrient uptake by the crop.

Does no-till lead to an increased population of slugs, mice, and pathogens?

Farms that have switched to no-till have reported an increase in slugs and mice on their land. However, the level of pest pressure varies greatly from year to year and from field to field. Slugs are easily controlled by applying slug pellets at drilling time. Mice can be controlled with poisoned baits and indirectly by placing perches for birds of prey.

The pressure from plant pathogens is no greater with no-till than with conventional tillage. It is true that pathogens can overwinter more easily on the organic matter present. On the other hand, conservation agriculture has more beneficial insects and natural antagonists that keep harmful pathogens in check.

Is no-till also possible for potatoes, beets, or root vegetables?

No-till is possible for beet and some root crops. Potatoes can also be included, with a minimum tillage approach before planting. Hills can be covered with mulch or grass to protect the soil.

Harvesting is an operation that is not in line with no-till principles. However, the advantages of the system outweigh the disadvantages throughout the rotation. No-till areas generally have a better soil structure, reducing the risk of structural damage and compaction.

Directly successful? Practical experience ...

Interviews with Lutz Decker, Henning Stapelbroek and Claus Schmid

Lutz Decker, age 46
No-till since 2019 \ Arable farm with dairy farming and biogas plant in Hohenhameln (Hildesheimer Börde) \ 230 ha arable land \ very good soils (Ø 90 soil points)

Machine: T-ForcePlus 640 (6 m)

Henning Stapelbroek, age 31
No-till farming since 2020 \ Arable farm in Tangermünde, Saxony-Anhalt \ 1,300 ha \ Strongly variable soils, sandy to loamy \ Rainfall: < 500 mm

Machine: Novag T-ForcePlus 650 (6 m)

Claus Schmid, age 40
No-till since 2021 \ Arable farm in Hattingen \ on the southern edge of the Swabian Alb \ 150 ha

Machine: Novag T-ForcePlus 450 (4 m)

“I see in the soil, that the calculation works”

Interview with Lutz Decker, 46 years old

Why did you switch to no-till despite the excellent soils?

For a long time we farmed conventionally with plough and minimum tillage. At some point, we noticed that the soil was becoming increasingly compacted and that the crops were suffering from deficiencies, despite sufficient fertilisation. This was particularly true of the silage maize we grow for fodder and as a substrate for biogas. In my search for solutions, I came across the legendary “Oberacker” long-term project in Switzerland, where no-till was the best in terms of yield and quality.

What was the transition like for you?

I really had to flip a switch in my brain. After all, I still had in my head the classic training from my apprenticeship and studies on fertilisation, soil cultivation and seedbed preparation. We have expanded the crop rotation and have introduced one or even two intercrops between the main crops.

We sow maize and sugar beet directly into the standing biomass. I had to get used to the uncleared view of the fields with all the crop residues.

What changes has no till brought?

The soil structure has developed very positively and we now have the fine crumbly texture we wanted. As far as cereals are concerned, I quickly realised that you can do without herbicides, fungicides and growth regulators, largely without reducing yields. As the soil is not disturbed, the weed seed reserve does not germinate. In the case of sugar beet, slug infestation has been higher. We will therefore use slug pellets in the future.

What advice would you give to other farmers who want to adopt Conservation Agriculture?

I do not see myself as a missionary for this type of farming. It requires a complete transformation and is much more than just planting seeds in unworked soil. It is about developing the nutrient dynamics in the soil and improving and stabilising the structure. You pay for a lesson here and there, but it is worth it. I have spent more time on my land in the last four years than ever before. And it is exciting to see how the soil and the plants respond to small adjustments.

“Farming here only works with no-till”

Interview with Henning Stapelbroek, 31 years old

Why did you switch to no-till farming?

We have poor, highly variable soils and little rainfall. The spring-summer drought has increased significantly in recent years. Therefore, my approach is that the cost of growing cereals should not exceed the income from two tonnes of cereals per hectare. We achieve this yield even in the worst years. But this is only possible with no-till.

How did you switch to no-till?

We have completely turned our cropping upside down. The rotation has been extended to include grain maize, rape, sunflowers, broad beans and peas. Catch crops are also the rule. Fertilisation and crop protection have also had to be adjusted. And, of course, we have invested in a no-till drill, which we use for all crops.

When it comes to technology, what is essential?

The direct seed drill is the central machine in no till. Here, robustness and a consistent sowing depth are required, even in changing soils and organic layers. Our machine copes very well with the often hard soils. The hydraulic coulter pressure adjustment works well and gives a consistent sowing depth. It even worked well in maize. And that is the ultimate no-till discipline.

How has no-till affected yields?

Yields are absolutely comparable to conventional tillage.

What other changes have you seen?

After two years I have noticed a reduction in brome, a problem weed in our cereal crops. Sandstorms used to occur in the village whenever the soil was exposed after conventional cultivation.

This is now a thing of the past because the soil is much better protected by catch crops or a layer of residue. There is also definitely more water in the soil because evaporation is much lower.

What about soil life?

After two years I have already noticed some changes. For example, we have many more earthworms. In addition, the topsoil has a better texture because of the excretions of the micro-organisms. You can get to the land earlier, the soil is more resilient and doesn't stick.

What about the costs?

With the Novag I can work up to four hectares an hour. I also save time and money by not having to plough, cultivate and prepare the seedbed.

The bottom line, depending on the crop, is around 200 euros per hectare per year. This allows me to work economically even in dry years.

“Leisure time is nice too”

Interview with Claus Schmid, 40 years old

Why did you switch to no-till?

Mainly because of two observations: I had been cultivating my land superficially for a long time. At some point I noticed that the more I used the cultivator, the more weeds I had. Then I saw old pictures of my fields. 40 years ago, they were more than 30 centimetres higher than the road. That’s when I realised: my farming system is not optimal.

How did you prepare for the change?

As there weren’t any no-till farms in the area, I did a lot of research on the internet. The information provided by an international social media group was particularly helpful. I also attended several demonstrations of no-till machinery.

How have your earnings developed?

Despite my adviser’s advice against it, I immediately switched all crops to no till, from oilseed rape to cereals, maize, peas and all catch crops, including grass. Everything went well. Yields were stable for all crops and even better for winter cereals.

Have you started to see the soil changing?

Yes, the increase in soil life was particularly striking. The earthworms, beetles and other animals that are now on the move are crazy! Evaporation has also decreased. I noticed this when sowing catch crops after a long drought. There was still enough moisture on my land for a good emergence.

This was different from neighbouring farms using conventional tillage. After the conventional cultivator, the water was completely gone.

Were there any problems?

There was a slug infestation in maize and oilseed rape. With minimum tillage, I was fine. However, slug pellets are a good way of controlling the infestation. I apply them from an extra tank right next to the seed. This works very well.

Have the hoped-for savings in working hours and diesel consumption materialised?

That was particularly pleasing. Instead of going over the field three or four times with the cultivator, I only have to go over it once. With the Novag I use an average of 13 litres of diesel per hectare. It used to be three to four times as much. In addition, the time saved by not having to cultivate the soil is huge. I have a lot less stress and have realised that free time is also nice.

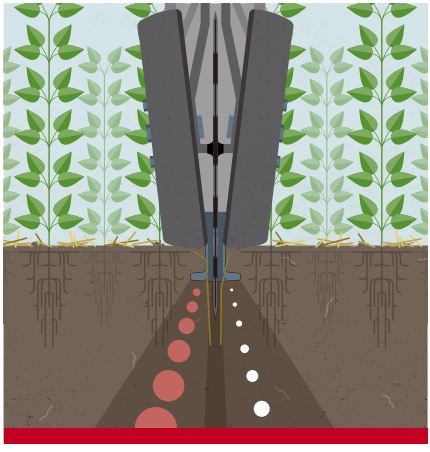
Novag – advanced technology for newcomers and experienced no-tillers alike

Professional seeding technology is the key to successful no-till farming. After all, the drill is the central technology of the farming system and must provide solutions to a wide range of challenges. It must be robust and at the same time precise, it must be adaptable and deliver a consistently high quality of work.

To meet these requirements, Novag no-till machines offer unique solutions:

T-shaped slots

Novag openers combine a cutting disc and a pair of seed boots that form an inverted T in the ground. The disc cuts through the overlying organic material and opens the soil, while the T-shaped boots form and clear the slot and place seed and/or fertiliser on the side.



Intelligent ground adaptation

Uniform seeding depth is even more critical in direct drilling than in conventional tillage. Local compaction, changing soil properties or varying stone levels can affect uniform seed placement.

Novag therefore offers automatic coulter pressure adjustment as standard, which reacts to changing soil conditions. With the IntelliForcePlus control system, the machine continuously senses the soil resistance and optimally adjusts the coulter pressure. This is achieved by means of hydraulic cylinders on each opener, which apply a variable pressure of between 100 and 500 kilograms. This ensures absolutely uniform sowing depths, even on heterogeneous soils.

Versatile hopper system

The main tank on Novag machines is divided into two compartments. This allows seed, fertiliser or a second crop to be applied at the same time. In total, up to four tanks can be filled in a single operation, optionally with slug pellets, companion crop seed, fine seed or micronutrients.

The benefits of the T-shape at a glance:

- Abundant crop residue does not affect seed placement as even straw is not pushed in with the seed. Hairpinning doesn't compromise seed-soil contact.
- The narrow T-shape of the blades/boots allows minimal soil disturbance. The seed slot can be closed firmly and securely and the seeds are protected from slugs or birds, even in difficult soils (clay) and dry conditions.
- Hardly any organic material is mixed into the soil. Even when drilling into stubble with chopped straw, around 90 % of the crop residue remains on the surface.
- Seed and fertiliser can be applied at the same time, separated by an optimum distance.

Adopting no-till farming is a big step towards healthier soils, greater crop security and increased profitability. With Novag's advanced seeding technology, you can be sure of success right from the start.

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