KUHN

GUIDE

Find out all about
Min-Till or
No-Till practices

be strong, be KUHN

Summary

About the author

KUHN is a French company, headquartered in Saverne (Bas-Rhin, France). It specialises in the design and manufacture of trailed/mounted agricultural equipment (tillage, sowing, fertilisation, spraying, hay and silage making, baling, wrapping, shredding of residues and landscape maintenance). KUHN is a manufacturer that offers many solutions for min-till or no-till cultivation practices.

be strong, be KUHN

Introduction

The KUHN Group has supported farmers for more than 190 years by designing, manufacturing and marketing a full range of innovative, high-quality agricultural machinery and services to meet the diverse needs of global agriculture. Our agricultural systems have evolved and adapted to meet the demands of tomorrow's agriculture.

What are the main challenges?

9.7

billion people on earth in 2050 (+ 25 % by 2050)
Urban population growth of
50 to 70%

Global food production must increase by approximately

50%

Nevertheless, cultivated areas will diminish by 70 million hectares in developed countries and increase by 120 million hectares in developing countries

+3.5%

90%

of the agricultural production growth will come from yield growth

To meet these issues, people all over the world are working together to create alternatives to existing models. Specific techniques such as min-till practices are developing day after day for more sustainable agriculture. KUHN provides innovative solutions to develop these new techniques and thus meet the challenges of tomorrow in collaboration with farmers.

How to do better with less?

This agronomic guide aims to provide information to professionals of the agricultural world and support them in the use of min-till and no-till practices.

I - MEETING THE MANY CHALLENGES

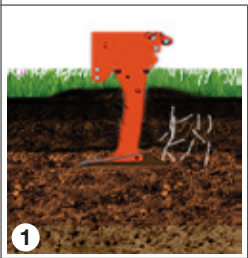
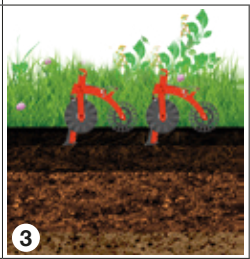
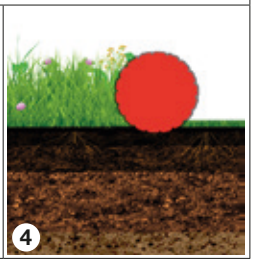
Climatic variations have a huge impact on crops:
Volatile seasons, recurrent droughts, soil erosion, floods… These events upset yields and promote market volatility. The environment is at the center of European and international debates. The trends are aimed at sustainable agriculture to reduce its impact on biodiversity. The depletion of natural resources leads to sharp price fluctuations. Fossil fuels increase operating costs. Reducing tillage operations and therefore the cost they represent for farms becomes essential. The emergence of precision agriculture, equipment, knowledge and new technologies have allowed players in the agricultural world to evolve. They realised the importance of new techniques and the benefits they bring to farming systems. Several economic, environmental, meteorological and ethical factors impact crops and production methods. KUHN meets these expectations by offering a wide range of machines suitable for min-till and no-till.

II - MIN-TILL METHODS

Minimum tillage practices appeared in Europe at the start of the 1970s. They developed in the 1990s, in particular following the reform of the CAP. At that time, the idea was to reduce mechanisation costs and establishment costs to compensate for the losses linked to poor yields. Cropping systems have been developed to minimise operational costs and thus achieve economic balance.

Minimum tillage is a general expressions that groups several cultivation techniques and doesn't necessarily mean the cultivations used are minimised.

[1] European Common Agricultural Policy

Min-till	Sub-soiling	Deep cultivation	Strip-till	Shallow cultivation
No cultivation	20 to 40 cm	12 to 25 cm	5 to 25 cm	2 to 15 cm
Function	Restructuration		Seedbed preparation	
No soil turning or mixing of horizons	 1	 2	 3	 4

The different techniques used depend on the nature of the soil and the problems encountered. Good soil diagnosis and knowledge is necessary before embarking on these simplified cultivation practices. These operations are part of an agroecological approach, which aims at reducing the impact of agriculture on the environment and in particular on soils.


1


2


3


4

A REAL ECONOMIC OPPORTUNITY

Economic interests of min-till techniques

- Reduced number of passes and increased work output
  - Lower labour costs
    - Increased free time
      - Time for other tasks
      - Time for private life
  - Lower operating costs
- Reduced power requirement
  - Lower mechanisation costs

IN SHORT:

Min-till practices differ depending on the degree of tillage. They vary depending on the type of soil and the conditions encountered. Adopting these cultivation methods helps to reduce working time in the field and the operating costs of the farm. Beyond economic and organisational interests, min-till practices represent a real agronomic interest.

BENEFICIAL EFFECTS ON SOIL FERTILITY, STRUCTURE AND BIOLOGY

What does the organic matter provide?

Organic matter is present on the first few centimetres of the soil and improves its fertility. It represents 4 to 5% of the volume of a cultivated soil's components[2] and is made up of these 4 components:

Former crop residues

Organic fertiliser

ORGANIC MATTER

Once applied or broken down, this biomass covers the soils surface. In the presence of heat and humidity, the organic matter is broken down by microorganisms in the soil which turn it into nutrients which are more readily available to the plant. Soil organic matter is a major agronomic lever for good crop establishment.

Green cover

Micro-organisms

ORGANIC MATTER PROVIDES

1

An increase in nutrients.
Mineralisation of organic matter and release of nitrogen and phosphorus for the plant[2].
Crop growth requires high nutrient requirements.
A high level of organic matter provides essential nutrients for plant or seedling development.

[2] UNIFA, 2005

2

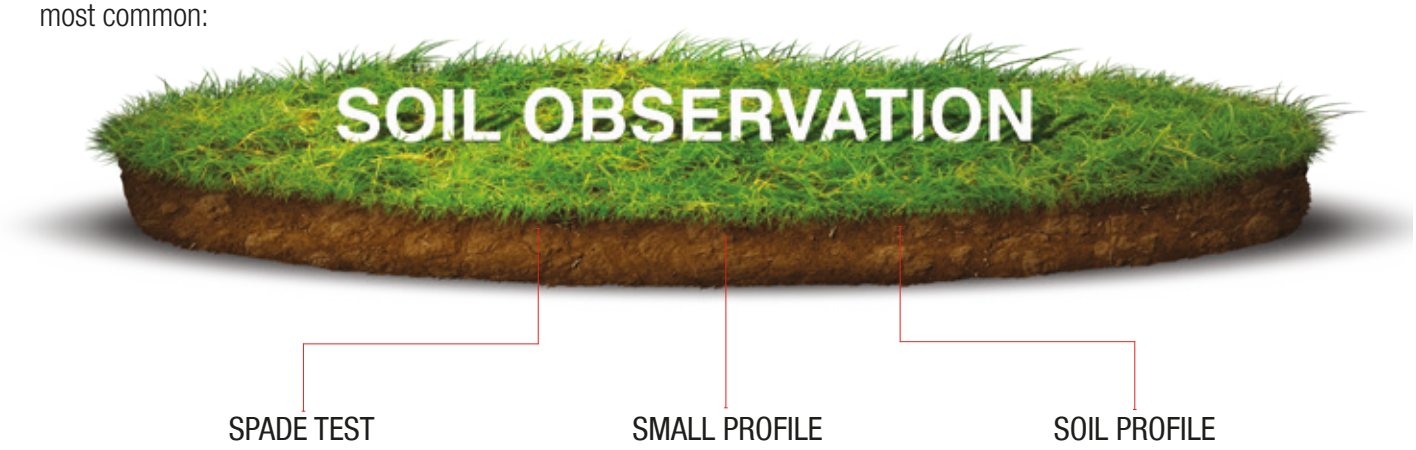
Improving the soil's structure on the surface and thus limiting soil damage related to weather conditions (heavy rains, storms, etc.). The risks of soil capping and erosion are limited.

3

Increased water retention capacity and improved resistance to water stress.
Moisture on the soil surface is preserved thanks to this layer of organic matter which promotes water retention and provides moisture for crop emergence.

SOIL STRUCTURES

Good crop development is promoted by good soil structure. This structure can be observed by looking at the soil profile and with the help of tests: drop test (drop of soil block to classify the aggregates according to their size) and penetrometer (metal rod pushed into the soil vertically). There are different ways to study your soil, here are the most common:



Remove a block of soil, 20cm square and 25cm deep

⊕ Quickly carried out
⊕ Observation on the soil surface
⊖ Observation limited in depth

Remove a block of ground using the forks of a forklift

⊕ Quickly carried out
⊕ Observation of the soil's horizons
⊖ Observation limited in depth

Dig a trench about one meter deep depending on the type of soil

⊖ Lengthy to carry out
⊕ Observation of all soil horizons
⊖ Destructures the part observed

The small profile is the best compromise between fast implementation and agronomic observation[1].

IT IS RECOMMENDED TO CARRY OUT THESE OBSERVATIONS:

- During the period between crops
- During cultivation to observe rooting
- Following a high load on the soil (harvest) to observe the effect of the passage of machines

In general, it is not recommended to take a sample from a soil that is too dry because the observation of the soil's structure will be more difficult.
Soil observation sheds light on its structural condition.

THE VARIOUS CRITERIA SELECTED:

- Tillage horizons
- Soil appearance
- Soil's state of porosity, its compaction
- Microbiological activity
- Rooting

When implements cultivate the soil on the surface or at depth, it changes the soils structure.
Compaction areas limiting good root development can appear over the years if no steps are taken.

[1] *Methodical guide of the mini 3D profile, Agro-transfert 2017*

HOW TO IMPROVE THE SOIL'S STRUCTURE?

The use of min-till practices improves soil structure. Tillage is carried out at shallow depth, soil is only slightly disturbed and keeps its natural structure at depth.

1 Mechanical intervention

The use of a soil loosener makes it possible to break up the soil over its entire width without destroying it or disrupting the horizons. Loosening the soil creates porosity and promotes root development of crops as well as gas exchange.

2 Minimise tillage

Reducing the passage of agricultural machines related to tillage helps reduce soil compaction.
In some soils the intensive use of certain tillage tools can create pans.
These layers of packed earth form a physical barrier to good penetration of roots and greatly limit exchanges between the plant and it's environment.

3 Establishment of a plant cover with a root development

Cover crops with deep routing (tap roots) improve the soil structure. For example, a multi-species plant cover including Chinese radishes can improve soil porosity. The cylindrical shape of its root can reach a diameter of 5 cm and a length of more than 20 cm, which allows the soil to be aerated at depth.

4 Soil's organisms

The presence of earthworms promotes soil porosity. Their action of mixing the earth creates galleries in the same soil profile where the roots develop, which allows soil improvement at depth. This highlights the interest of preserving and increasing their populations by minimising tillage.

Increasing active storage, water stored at the service of the crop	Improved porosity	Improved water infiltration, reduced risk of asphyxia	Better root development

IN SHORT: Thanks to good soil structuring, the crop benefits from better root development, easier access to water and thus secures yields.

STALE SEEDBED

Consists in exhausting the seed stock of weeds or regrowths from the previous crop by stimulating their emergence and then destroying them mechanically or chemically between crops.

CROP ROTATION

Is another lever for managing weeds. The establishment of longer and more diversified rotations, as well as the alternation of sowing periods, make it possible to break the weed cycle. Depending on the crop and the establishment method, different weeds will emerge. The objective is to find a compromise between the agronomic benefits of a crop and it's value.

MECHANICAL / CHEMICAL WEEDING

Is a means of action to fight weeds. The lengthening and diversification of rotations promote the effectiveness of chemical weed control by varying the active ingredients.

GOOD ADVICE

The transition to min-till practices requires certain prerequisites. For example, the management of weeds and regrowth from previous crops is sometimes problematic when tillage is minimised. Stopping or reducing cultivation is accompanied by a repositioning of the seed stock on the surface and promotes the development of weeds. Several **means of fighting** exist to cope with their development.

IN SHORT: The main interest of min-till practices is to improve soil fertility and increase the level of organic matter. A high level of organic matter is able to provide essential nutrients for crop germination and plant root development. Good soil structure is essential for root development, hence the importance of preserving the horizons. Min-till practices require certain essential prerequisites for the proper development of the technique and its success. KUHN group invests in research and development to design innovative products facilitating operator work in the implementation of min-till practices.

KUHN

MACHINES ADAPTED TO ALL SITUATIONS

KUHN Group offers a complete range of innovative tools that can work at the required depth during the period between crops

PERFORMER
DEEP CULTIVATOR

DEEP CULTIVATION, LOOSENING

4 actions in a single pass
- **Chopping up residues**
- **Restructuring**
- **Levelling**
- **Consolidation**

3 TO 7 M WORKING WIDTH | WORKING DEPTH 10 CM WITH DISCS / 35 CM WITH TINES

CULTIMER
TINE STUBBLE CULTIVATOR

DEEP CULTIVATION, LOOSENING

Consistent depth even on heavy ground
Stubble cultivation, residue incorporation and soil profile structuring

3 TO 6 M WORKING WIDTH | 5 TO 35 CM WORKING DEPTH

OPTIMER
DISC STUBBLE CULTIVATOR

SHALLOW WORK

Intensive mixing at high speed
Stubble cultivation, mixing of residues and destruction of plant covers

3 TO 12 M WORKING WIDTH | 3 TO 10 CM WORKING DEPTH

PROLANDER
TINE CULTIVATOR

SHALLOW WORK

The ideal ally in periods between crops
Refining the shallow profile, reducing clods for seedbeds and stale seedbeds

4 TO 7.5 M WORKING WIDTH | 3 TO 15 CM WORKING DEPTH

DC
SOIL LOOSENER

LOOSENING

No mixing of horizons
Soil restructuration for optimum porosity and good root development

3 TO 4 M WORKING WIDTH | 20 TO 35 CM WORKING DEPTH

STRIGER 100

STRIP-TILL

STRIP-TILL

Build on the row!

Good root development and controlled establishment costs by working the seeding line only

3 TO 6 M WORKING WIDTH | 5 TO 25 CM WORKING DEPTH

MEGANT

MOUNTED SEED DRILL FOR MIN-TILL SEEDING

MIN-TILL SEEDING

Powerful tines for fast seeding

Obtain the best work output

SEEDING UNIT: TINES | HOPPER CAPACITY: 1800 L

ESPRO

TRAILED SEED DRILLS FOR MIN-TILL SEEDING

MIN-TILL SEEDING

High-quality seeding at high speed

Cultivate, consolidate and sow in a single pass

3 TO 8 M WORKING WIDTH | SEEDING UNIT: CROSSFLEX | HOPPER CAPACITY: 2500 TO 5500L (SPLIT OR SINGLE HOPPERS)

III - NO-TILL SEEDING AND SOIL PRESERVATION

CROP ESTABLISHMENT

Developed in North America to address the problem of soil erosion and the increase in work output, direct seeding came to Europe thanks to its precursors. The emergence of this technique responds to environmental and economic constraints. Direct seeding is becoming more democratic and the percentage of European soil cultivated by direct sowing continues to increase. This progression is correlated with the increase in soil structuring issues.

"25-30% of EU soils are currently either losing organic carbon, eroding or are compacted, or have a combination of both while 60-70% of EU soils were found to be “unhealthy." Zoran Radosavljevic 2020

Direct seeding is defined by the total absence of tillage during crop establishment. In the conventional method, three to four tillage operations are necessary to establish a crop, while one is sufficient for direct seeding. There is no passage dedicated to preparing the seedbed. There are different practices, direct sowing on crop residues, direct sowing under permanent plant cover and direct sowing under plant cover intended to be destroyed.

DIRECT SEEDING

Crop residues

Reduces work and operating costs
Less yield loss*

Under plant cover

Temporary

Less yield loss*
Less aggressive bio-agents*

Permanent

Less mechanization costs
Increased biological regulation*

COMPOSITION:
One variety or multiple varieties to take advantage of the benefits provided by the mixtures

COMPETE WITH WEEDS:
An alternative to chemical weeding
Returning nitrogen to the soil

*CA-SYS platform – INRAE, 2019

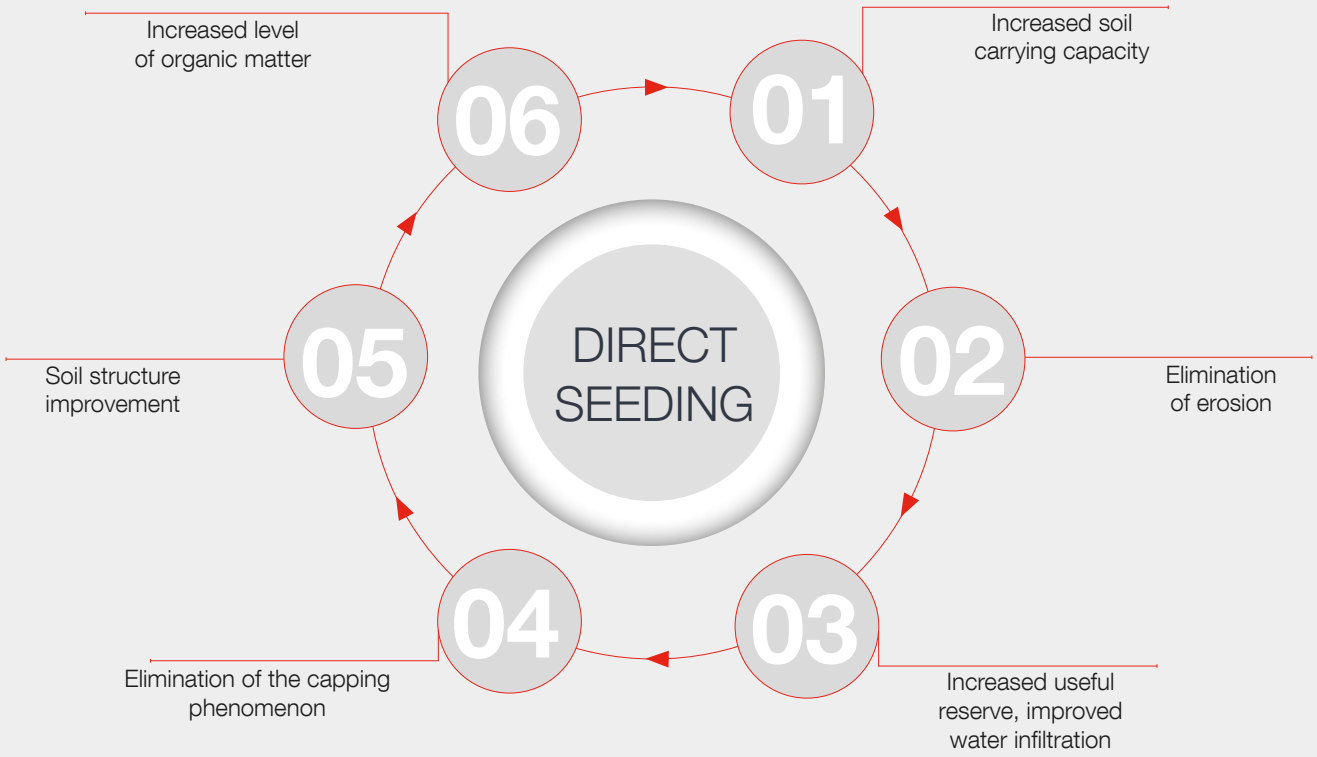
DIRECT SEEDING

Direct seeding is the most successful version of the policy to simplify tillage, but also one of the most complex to master. Setting up a direct seeding system requires adaptations and involves a whole change in the cultivation system of the farm. This transition requires dedication and patience. It takes an average of 3 to 5 years minimum to observe positive effects linked to the establishment of direct seeding[3].

6 AGRONOMICAL INTERESTS OF DIRECT SEEDING

In direct seeding systems, fauna and microfauna play a major role in soil structure and fertility.
“Soil microbes are the workhorses of the soil. They break down crop residues and release nitrogen, phosphorus, potassium, and other nutrients back to the soil so they’re plant-available. We want a healthy, diverse microbial community so that those processes can happen and improve our soils." Stacy Zuber[4]

By completely stopping tillage, various agronomic levers are able to function, as shown in the illustration below:



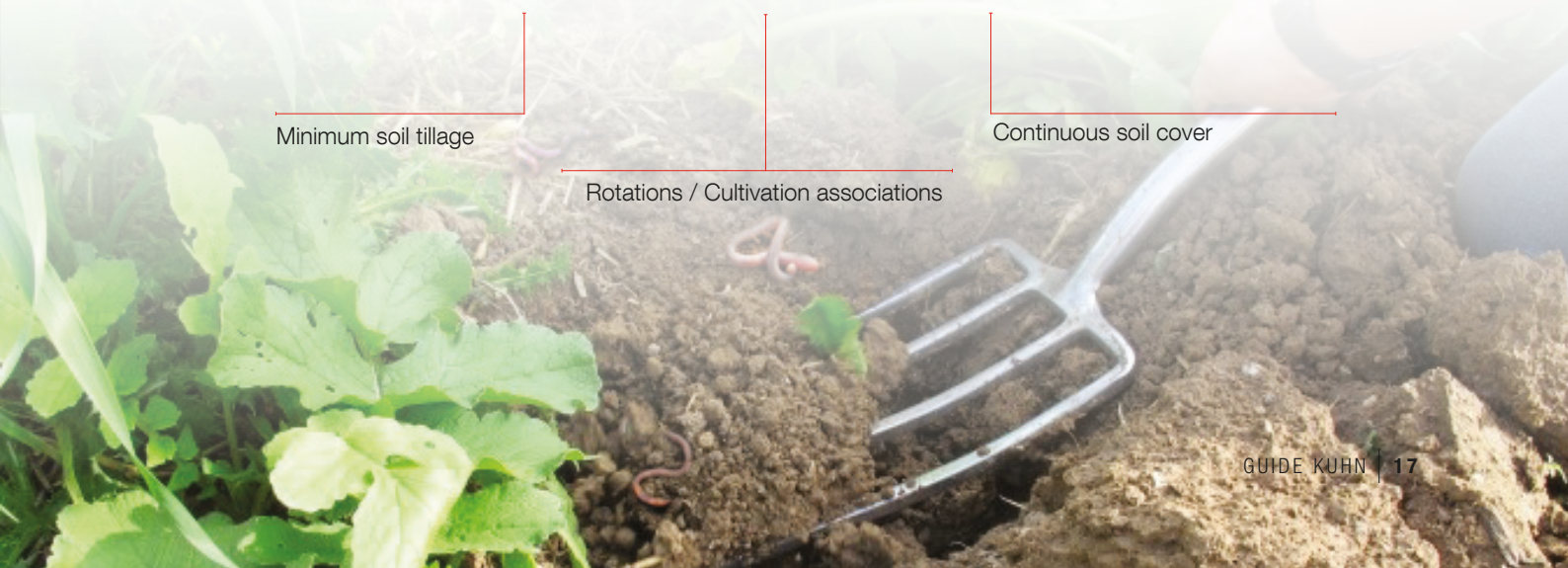
[3]ARVALIS, Plant institute (France)
[4]Stacy Zuber, Research agronomist at the Missouri university

A GLOBAL VISION

*Conservation agriculture is a cropping system that promotes minimal mechanical soil disturbance (no tillage), keeping a permanent soil cover, and the diversification of plant species. (United Nations Organization for food and agriculture)

"Globally, the total area of cultivated land in conservation agriculture increased from 50 million hectares in 2000 to 180 millions (12.5%) in 2016, showing that it increased at a rate of 6.8 million hectares (9%) per year" Sustainability (T. El-Shater, A. Mugera and Yurezu) 2020

CONSERVATION AGRICULTURE



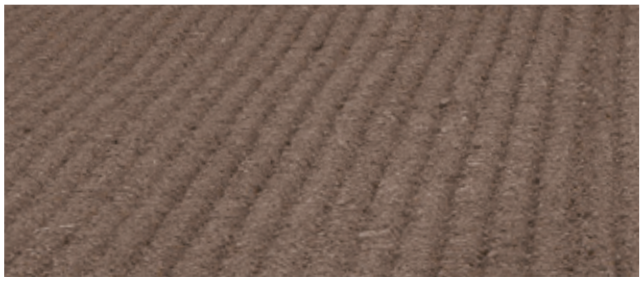
GOOD ADVICE

THE DIRECT SEEDING TECHNIQUE INVOLVES CHANGES WHICH MUST BE MONITORED TO PROMOTE GOOD CROP DEVELOPMENT:

It is possible to rethink rotations, diversify plant cover and fight weeds and pests chemically and mechanically. Having a global vision and getting support, learning, sharing... are factors in for successfully developing direct seeding on your farm.

Fertiliser usage will evolve. During the first few years, the soil is still relatively compacted because of previous practices, and the use of cover crops will take up additional nutrients in the first years. Soil structure and organic matter take time to build up, so additional fertiliser may be required at the start.

The management of crop residues is an important step. A homogeneous distribution of residues is necessary for a good development of the next crop. The use of a shredder is not systematic but it is possible to shred rapeseed, maize, sunflower stalks... It is better to shred the residues after seeding so as to not jam up the furrow and thus hinder the seeding units.



Worked ground warms up better during the day than an unworked ground. Even though it cools further at night, the accumulated temperature sums are higher. The presence of greater biomass explains the difficulties of unworked soils to heat up more quickly. Thus in direct sowing, special attention must be paid to the soil temperature, in order to best adapt the seeding dates. Whatever the cultivation system, it is essential to sow in sufficiently warmed soil.

Weed management is a priority in this cropping system. In the absence of tillage operation, weeds develop and compete with the existing crop.

MECHANICAL / CHEMICAL WEEDING

Is a means to fight weeds. The lengthening and diversification of rotations promote the effectiveness of chemical weed control by varying the active ingredients.

The appearance of secondary fauna and pests (field mice, slugs, etc.) is facilitated with the increased level of organic matter on the surface and crop diversity.

OVER 40 YEARS OF EXPERIENCE IN THE FIELD

KUHN is one of the pioneers in the development of no-till seed drills. In 1974, KUHN designed the SD 300 seed drill fitted with the triple disc seeding unit. Forty years later, the AUROCK seed drill is considered a versatile seed drill capable of seeding in all conditions.
With its 6-meter working width, the AUROCK allows sowing in the presence or absence of plant cover.
Thanks to a chopping roller in front of the opener discs, the seed drill destroys the plant cover during seeding.

6 M WORKING WIDTH | SEEDING UNIT: TRIPLE DISC | HOPPER CAPACITY: 3500 TO 5000 L (PARTITIONED OR NOT)

Martin Lines, president of the nature-friendly farming network in the United Kingdom farms 600 hectares in the Cambridgeshire county.
"By having a machine I can be really flexible with, I can cut out other operations, I can add things in so actually our cost is reducing all the time."
"It's just opening my mind to what we can achieve as a farmer and actually how we farm in a better way and actually farm with nature."

In general, the AUROCK is a versatile seed drill allowing the transition from min-till cultivation methods to direct seeding. It allows for a gradual transition in the change of cultivation practices by intervening in all types of soil.

FRONT CRIMPING ROLLER

The combination of the crimping roller with the AUROCK seed drill allows the cover crop to be destroyed and seeding in a single pass. This combination reduces the number of passages and provides various benefits

ECONOMICAL BENEFITS:
• Lower operating, mechanisation and labour costs.

AGRONOMIC BENEFITS:
• Reduced soil compaction
• Reduced terrain deformation linked to wheel tracks in wet conditions.

THE RC VERSION OFFERS A WIDE RANGE OF POSSIBILITIES

Equipped with a split hopper, the AUROCK RC seed drill allows a multitude of combinations. Main crop, companion crops, different varieties, localized fertiliser input... so many possibilities for a diversified crop rotation in the management of crops in direct seeding.
The SH 1120 additional hopper adapted to the AUROCK offers other possibilities for crop combinations. The AUROCK is available with two possible spacings (15 or 18.7 cm). The user is free to choose the spacing that will suit his operating system.

ADAPTED TO ALL SOIL TYPES

The seed drill is capable of seeding in all conditions, even the most extreme.
The triple disc allows good furrow opening whatever the type of soil, whether it is structured or not. The versatility of the AUROCK allows a good transition between conventional farming and direct seeding.

Conclusion

How to do more with less?

Min-till cultivation and direct seeding practices seem to provide answers to this daily challenge. These cropping practices are being developed in particular for their economic and agronomic benefits. By allowing a reduction in operating, labour and mechanisation costs, they represent undeniable economic gains for farms which are constantly under pressure.

Many experts are committed and invested in developing consistent rotations in order to limit the use of herbicides.

Agronomically, min-till cultivation and direct seeding improve soil structure and fertility. The levers mentioned in this guide aim to enable sustainable cultivation and production. Although these techniques require continual adaptation of cultivation practices to to suit the pedoclimatic environment and constant learning, it is certain that machinery will be able to offer new opportunities and perspectives to the farmers of tomorrow.

This guide is offered by

BIBLIOGRAPHIC SOURCE

Arvalis, 2016. La rotation, un moyen efficace pour limiter les adventices [WWW Document]. URL https://www.arvalis-infos.fr/raisonner-le-desherbage-a-l-echelle-de-la-rotation-avant-qu-il-ne-soit-trop-tard-@/view-22802-arvarticle.html **Basch, G., Estrade, Jean-Roger, 2014.** No-till in northern, western and south western Europe: A review of problems and opportunities for crop production and the environment 56. **Foote, N., 2020.** No-till farming: traditional ideas with new technologies to tackle current challenges. www.euractiv.com. URL https://www.euractiv.com/section/agriculture-food/news/no-till-farming-traditional-ideas-with-new-technologies-to-tackle-current-challenges. **L'orphelin, S., 2017.** Techniques culturales simplifiées et couverts végétaux : où en est-on en bio ? Produire Bio. URL https://www.produire-bio.fr/articles-pratiques/techniques-culturales-simplifiees-couverts-vegetaux-on-bio/ **Nations Unies, 2015.** La population [WWW Document]. URL https://www.un.org/fr/sections/issues-depth/population/index.html **Non labour et semis direct, 2020.** Les TCS. NLSD. URL https://nlsd.fr/tcs/ (accessed 10.8.20). non_labour_TSL_zanella.pdf **Ritchie, H., Roser, M., 2013.** Crop Yields. Our World in Data. semis-direct-oise.pdf, **xian, n.d. Ses constituants.** [WWW Document]. URL https://fertilisation-edu.fr/le-sol/ses-constituants.html **Debarge Sophie, 2015 ADEME.** (Agence de l'environnement et de la maitrise de l'énergie), f36_4-technique-culturales-simplifiees.pdf. **Chambre d'agriculture Champagne Ardenne, 2016-2017.** 10_Guide_Technique_agriculture_integree_-_internet.pdf,**Chambre d'agriculture d'Occitanie, 2020.** GuidePO_Tome1_chapitre_2.pdf.**Isabelle Savini, INRA, Sciences sociales N 4-5, Février 2012.** Les rendements des grandes cultures stagnent-ils ? » **GF - SC, INRAE., 2019. Plateforme CA-SYS.** 18 experts ont discuté de la destruction non chimique des couverts et adventices en SD pour CA-SYS ! [WWW Document]. URL https://www6.inrae.fr/plateforme-casys/Actualites/18-experts-ont-discute-de-la-destruction-non-chimique-des-couverts-et-adventices-en-SD-pour-CA-SYS. **Arvalis, 2013**. Evaluer l'état structural du sol par des méthodes simplifiées. https://www.arvalis-infos.fr/profils-culturaux-les-nouvelles-methodes-de-diagnostic-@/view-13824-arvarticle.html **Vincent Tomis, Agro-transfert 2017**. Guide méthodique du mini-profil 3D. http://www.agro-transfert-rt.org/wp-content/uploads/2017/04/Guide-m%C3%A9thodique-du-mini-profil-3D-version-web-6M.pdf

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