



PROFITABLE PLOUGHING

VISION

Kverneland Vision

We want to be a leading provider of intelligent and efficient ploughs and soil equipment in order to ensure the perfect soil preparation for the best crop in the most sustainable way.

Kverneland Mission

We want to create the highest value for customers by developing and producing innovative solutions in the most process optimised way.





WHEN FARMING MEANS BUSINESS

Building a profitable operation. Investing in the future, using economies of scale. Farming is about growing, not only a crop or livestock, but also a profit. Because in the end farming comes down to business.

It starts with clear goals, the right strategy and holding on to your plan. Proven technology can help realize your goals, as long as the investment in machinery contributes to efficiency, precision and lower cost.

Kverneland is a partner for entrepreneurs in agriculture. By providing top quality implements with the lowest total cost of ownership. Smart solutions to manage your success in agriculture.



TILLAGE





PROFITABLE PLOUGHING

GROUNDWORK FOR BETTER YIELDS

We know that your land and crops are your life. They depend on you, like you depend on them. What is best for your land and crops, is best for you. All of our efforts and solutions are dedicated to this belief. That goes for ploughing as well.

When farming means business, tillage is an investment in a fertile, healthy soil and consequently, in a sustainable arable farming. Ploughing can play an essential role in realising sustainability. So we call it “profitable ploughing”.

1**HIGH YIELD**

The best tillage and a fertile soil will bring you higher yields.

2**LOW INPUT**

The right seedbed preparation results in a healthy soil, an efficient use of nutrients and minimised costly inputs.

3**MAXIMUM EFFICIENCY**

With the best implements and technology you can operate efficiently with the lowest running cost and the highest precision.



FARMER CHALLENGES IN THE ARABLE CHAIN

KNOWLEDGE AND DECISIONS

Stubbleing, tillage or ploughing, seeding, fertilizing, crop care and harvesting: these are important steps in the never ending cycle of arable farming.

Of course, some crops may require a certain climate, extremely fertile soil or flatland to flourish and generate maximum yields.

Crop rotation may be necessary to help prevent depletion of the soil's nutrients. But overall, the basics are the same whether you are an arable farmer in the UK, China or Australia and whether you are into wheat, maize, oats, peas, sugar beets, potatoes or carrots.

In theory the **arable process** may appear as a very simple one: before being able to grow crops and harvest the fruit of the land, the land has to be prepared, followed by seeding. Ploughing breaks up the soil, prepares it for further cultivation and planting. Then, the seeds are planted with the option of adding fertilisers and pesticides or other disease control chemicals.

All this may sound familiar and self-evident. Yet each step in arable farming depends on a very specific and **detailed knowledge**. Not to mention the use of the right techniques and tools to handle each step. Tools that are strong, reliable and user-friendly to help you **make more profits**.

Naturally, the huge advances in the agricultural technology and the introduction of new plants have helped arable farmers cultivate more easily and generate more profits. Yet, you will have to make the **right decisions** at the right time according to such factors as local soils and weather conditions. Decisions that may in the end make the difference when aiming at the maximum yields and revenues.

Some may say ploughing isn't necessary to get the best out of the land. Others may say it is far too expensive. What if we told you it isn't?



"I have tried to work my land without a plough for some years, recently. This was due to a common trend in order to save cost. But I have to admit that the result turned into the opposite: I had to face fewer yields together with an increase of weeds which were difficult to control. In addition, the drainage was not as good compared to even shallow ploughing as long as I used a compact disc harrow for soil preparation. I am convinced that ploughing safeguards yield. It does not necessarily have to be carried out every year – but I will definitely not do any crop rotation without, anymore."

Taneli Hyttinen, Maaninka, Finland
122 ha farm; barley, wheat, oats, oil seed rape, cumin.

YOUR CHOICE FOR THE ECONOMICAL TILLAGE

PLOUGHING, YES OR NO?

You want to get the best possible yield from your land, within your specific farming conditions. This starts with the correct tillage: the most suitable combination of operations at the right time to achieve the best possible soil condition with a minimum amount of energy, time and investment.

The choices you make depend on various aspects. Your approach has to match your specific circumstances, like soil type, your crop rotation plan and weather conditions at a specific moment. It must also help you deal with environmental considerations or legal issues.

In general, we make a distinction between reduced tillage, conventional tillage, conservation tillage, direct seeding and strip tillage. Even 'zero tillage' is a serious option to some arable farmers.

When considering which tillage system is best, one subject that gives much food for discussion is ploughing. Some farmers swear by it, others consider it as traditional or even too expensive. Yet, there are many strong arguments that speak in favour of ploughing.

When ploughing, plant residues and other organic matters are completely buried:

- Less growth of weed and volunteer crops, which leads to lower requirement for herbicides.
- Lower potential for fungi diseases, as new crop will get less exposed to infected plant residues, thus leading to lower requirement for fungicides.
- Better dry-off and faster increase of soil temperature, especially in springtime.
- Higher mobilisation of nutrients.
- A clean seedbed allows use of more basic seed drills.

In a recent survey (2015), carried out by Kverneland among German and French arable farmers, ploughing is recognised as the most important tillage system. For more than 60% of all farmers, it is a fundamental step in farming. An advantage mentioned by almost 80% of the farmers, is that it saves chemicals to prevent weeds, especially blackgrass.

More than 60% of all farmers consider ploughing as an essential step

ASPECTS OF THE CORRECT TILLAGE SYSTEM

Aeration	for carbon dioxide/oxygen exchange
Soil temperature	for germination & development
Soil moisture	for infiltration, storage and drainage
Soil fracture	for the removal of crusts and pans
Weed control	for less utilisation rivalry
Plant nutrition	for the availability of vital nutrients
Plant health	for less need of fungicides

PLOUGH OR CULTIVATOR?

COST AND QUALITY OF SOIL PREPARATION

Is working with a cultivator really more cost efficient than working with a plough?

You would expect that a stubble cultivator, working with a wide width and used at high speed, would manage more ha/h than a plough. But to achieve the same result quality wise, you would need repeated crossings in the field and more herbicides and fungicides – products that have been under close scrutiny for many years now.

Plough and cultivator have approximately equal fuel demands

Test - fuel consumption and slippage

Let's compare a plough with a cultivator regarding costs. A test performed on the same field, in similar soil conditions, should show whether the plough is really that much harder to pull and consumes more fuel.

The two "test candidates", a cultivator with 10 tines (3 m) and a 6-furrow plough work closely together in the field. Both are adjusted to a working depth of 23 cm and both are mounted on a 185 HP tractor.

Less slippage with a plough

Slippage and fuel consumption are constantly measured. The results (see the table) are very surprising. When working with the same depth, width and speed, the fuel consumption is approximately equal between both candidates. Looking at the slippage, the results are even somewhat more favourable for the plough.

Looking at the slippage, the results are more favourable for the plough

Author: Prof. Dr. Wolfgang Kath-Petersen

Cologne University of Applied Sciences, Institute of Construction Machinery and Agricultural Engineering, 2015

EFFECT OF TILLAGE SYSTEM ON FUEL CONSUMPTION

Variant	Slip	Effective speed	Acreage performance *	Fuel consumption
Plough, in-furrow	5,6%	7,5 km/h	2,24 ha/h	12,9 l/ha
Plough, on-land	6,4%	7,4 km/h	2,22 ha/h	13,4 l/ha
Cultivator	7,2%	7,3 km/h	2,20 ha/h	12,7 l/ha
Cultivator v = max.	8,8%	8,7 km/h	2,61 ha/h	14,1 l/ha

* Effective output without considering headland-driving.
Source: Top Agrar 07/2015, page 93



Prof. Dr. Wolfgang Kath-Petersen with one of his students.

HEALTHY SOILS PROVIDE HIGHER YIELDS

BENEFITS FROM PLOUGHING

Ploughing is an essential step towards higher yields and revenues because of its effect on the soil. Let's have a closer look at some of the features of ploughing.

Lower potential for fungal diseases

Ploughing helps reduce fungal diseases as clearly shown in a study by Kiel University in 2012 (see table on the right side). Crop rotation combined with ploughing gives the best results.

Reduction of mycotoxine content in soil by more than 80%

Ploughing safeguards yields

Ploughing not only safeguards yields, it is environmentally friendly and has a positive effect on soil health.

PLOUGHING HELPS REDUCE FUNGAL DISEASES

System	Average mycotoxine content DON* [µg/kg]	Reduction (%)
Maize monoculture without ploughing	7971	-
Maize monoculture + ploughing	1393	-82
Crop rotation + ploughing	1120	-86

* *Deoxynivalenol* = metabolite of different fungi (*Fusarium culmorum*, *Fusarium gramineum*, etc.)
 Source: Ph.D. thesis Tim Birr (2013): *Supraregional monitoring of epidemic- and damage dynamics of Fusarium pathogens plus strategies for risk prevention of mycotoxin contamination in wheat and maize cultures of Schleswig-Holstein (2008 - 2012)*, Kiel University

PLOUGHING SAFEGUARDS YIELD AND IS ENVIRONMENTAL FRIENDLY

Indicator (plough = 100)	Conservation tillage	Direct seeding
Yield	-2%	-4%
Humus content (upper soil layer)	7%	6%
Emission of CO ₂	23%	32%
emission of N ₂ O	0%	348%

Source: Aggregation of 291 long-term experiments initiated by "Catch-C Project", 2014. www.catch-c.eu. Catch-C: *Compatibility of Agricultural Management Practices and Types of Farming in the EU to enhance Climate Change Mitigation and Soil Health*.



"In my opinion ploughing yields good crops, even during extreme conditions. The simple and robust construction and the easy adjustments are the main advantages of our Kverneland plough."

Johannes Bendele
German national ploughing champion

Performance

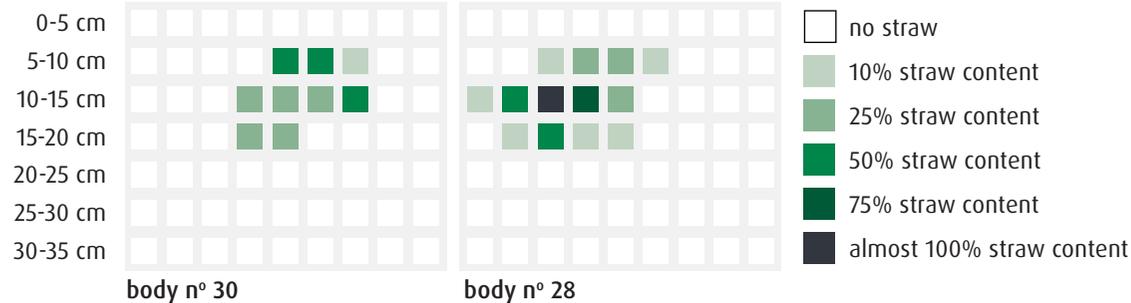
Ploughing buries plant residues and other organic matters completely. The figure underneath shows how efficient the straw is mixed in the soil. The result is influenced by the different type of bodies used.

Conclusions

We can conclude that ploughing enables residues to be buried efficiently, reduces potential for fungi diseases, preserves soil health and secures high yields. We can conclude that ploughing is a profitable tillage method for both short and long terms.

PERFORMANCE EVALUATION AFTER PLOUGHING

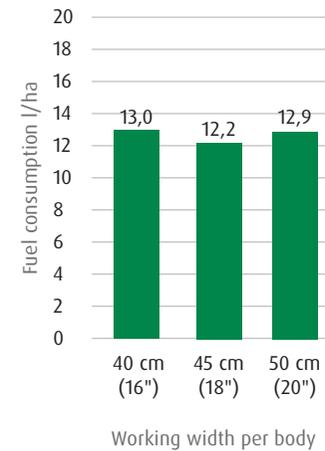
working depth



Source: Kevelaer/Cloopenburg/Kremer, Cologne University of Applied Sciences, Institute of Construction Machinery and Agricultural Engineering, 2013

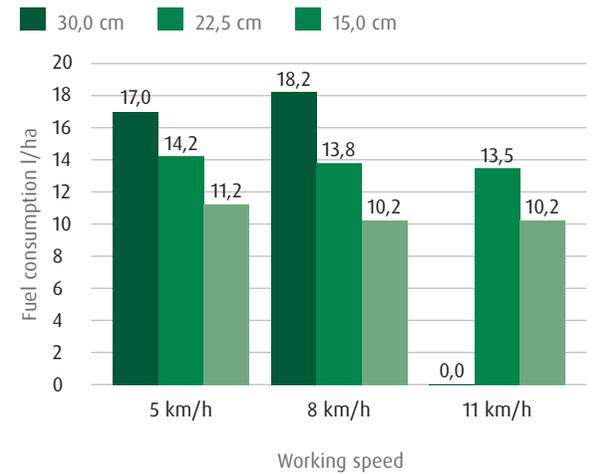


WORKING WIDTH AND FUEL



Source: Project report, Cologne University of Applied Sciences, Institute of Construction Machinery and Agricultural Engineering, 2012

WORKING DEPTH AND FUEL



Source: Master thesis S. Hagemann (University of Hohenheim, 03/2013) and Project work Bauschulte (Cologne University of Applied Sciences, Institute of Construction Machinery and Agricultural Engineering, 09/2014)

BEST ADJUSTMENTS FOR EFFICIENT PLOUGHING

WORKING DEPTH AND WORKING WIDTH

While ploughing has many advantages, there is much you can do to influence its efficiency.

You are able to optimise both pulling forces (traction) and work rate by considering matters such as:

- working depth
- furrow width
- plough body
- speed during ploughing

Each of these factors will hence influence the level of fuel consumption as well as the wearing of parts. Substantial savings and high yields will result in maximising profits.

Reduction of fuel consumption by 32% when changing the working depth from 30 to 20 cm

Research from Hagemann: Master thesis, 03/2013 (University of Hohenheim) and Bauschulte: Project work, 09/2014 (Cologne University of Applied Sciences) give interesting insights on how the ploughing depth and working width can influence both fuel consumption and the resulting yield.

Working depth

In a test with tough and wet soil conditions, Hagemann found a reduction of fuel consumption by 32% when changing the

working depth from 30 to 20 cm. Bauschulte tested with 3 working depths and 3 working speeds. When working at 8 km/hr the fuel consumption declined with almost 25% when switching from 30 to 22,5 cm working depth.

At 22,5 cm the furrow was clean, while the yield was at the same level as with the 30 cm working depth. It shows that reducing the working depth does not influence the yield significantly.

Best results are achieved at 45 cm working width per body

Working width

Another important feature is the working width of the plough and how it impacts the pulling forces. Tests show that, depending on soil type and pre-work, narrow ploughing does not always lead to lower pulling forces. As the University of Cologne indicates, the best results are achieved at 45 cm working width per body.

Naturally, the specific adjustments to your plough depend on location, crop rotation and climate. As a result the actual savings may vary from year to year. A plough that can easily adapt to different soil conditions is a very powerful and efficient tool to prepare a clean and re-consolidated seedbed.

MAXIMISE PROFIT VIA LOW INPUT BODIES AND FUEL CONSUMPTION

Why is it necessary to choose the right plough supplier?

Well, the right plough saves you a lot of fuel and therefore money. The secret? An optimal pulling force in various working conditions and working depths. Just compare the ploughing performance and fuel consumption of Kverneland ploughs with those of some competitors.

The Cologne University of Applied Sciences (2014) and Wilmsmann (University of Hohenheim, 2013) have compared the pulling forces of a Kverneland plough with

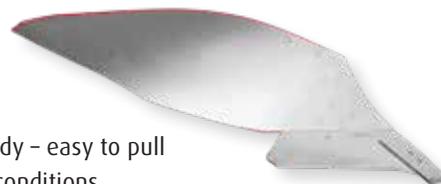
its equivalent from 2 other brands. The pulling force measurements at 20 cm and 30 cm depth on the 2nd and 3rd bodies indicate clear results. The Kverneland plough offers the lowest pulling forces regardless the working depth. Low draft, low wearing of soil parts, low fuel consumption result in a higher profitability.

The 2014 study by the Cologne University of Applied Sciences shows that the Kverneland plough needs from 19% up to 28% less fuel than competitors. This is a difference that you can surely appreciate!



Body No. 30

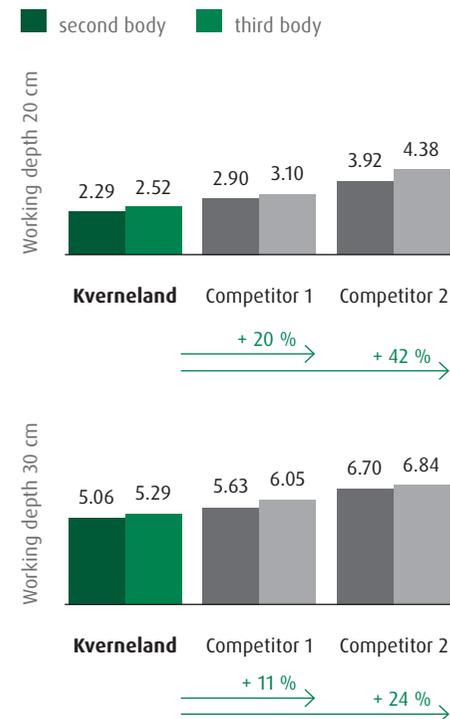
- finger mouldboard with 4 exchangeable strips
- shape of body no.19
- for any soil conditions
- **intensive crumbling**
- working depth: 18-35 cm
- working width: 30-55 cm



Body No. 28

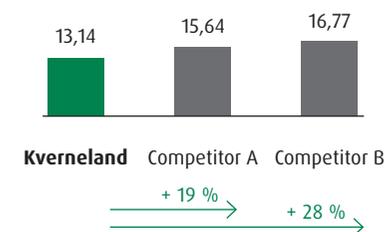
- universal body – easy to pull
- for any soil conditions
- **recommended for tractors with large tyres**
- creates a flatter profile for improved tilth
- perfect turning of the furrow slice
- working depth: 12-30 cm
- working width: 30-55 cm

PULLING FORCE (KN)* at working depth 20 and 30 cm



Source: Wilmsmann, BA-thesis, University of Hohenheim, 2013

FUEL CONSUMPTION (L/HA)*



Source: Cologne University of Applied Sciences, Institute of Construction Machinery and Agricultural Engineering, "Plough comparison", 2014

* The reference body is Kverneland No. 28 and the equivalent from competitors.



Low draft

"I have just changed to a Kverneland plough. It's hard to understand just where the improvements have come from - perhaps it's the No. 28 body or the quality of metal used - but we can now plough three hours extra every day without having to refuel. There is just something about the way the plough handles soil - it really is impressive."

Gary Farley
UK

CONTROL LOW INPUT LOW WEARING OF PARTS

The **Kverneland technology** applied to the ploughs pays off. More than 135 years of experience in developing special steels and heat treatment processes have resulted in an unsurpassed quality and wear resistance. The heat treatment processes are carried out and adapted not only to a few selected parts but to the complete plough. This results in ploughs lighter than competitors' and **extremely robust** while delivering outstanding ploughing performance.

For instance, the induction hardened frame allows using lesser steel than competitors, therefore less weight to pull and lift, while ensuring a higher resistance.

Kverneland ploughs are reputed for reaching some of the highest prices on the second hand market. The **durability and reliability of Kverneland** ploughs contribute by far to a higher profitability.

Low wearing of parts

There is another way in which you can make profitable ploughing a reality: by working with original Kverneland spare parts. Of course, you are free to choose cheaper copies than our durable quality products. There are a lot of those around.

A test carried out in Sweden compared the wearing of Kverneland parts with 4 non-original parts perceived identical. The results indicated that Kverneland original parts wear far less. The actual difference in the wearing between the cheaper non-original parts and Kvernelands' was as high as 41% for shares and 44% for the reversible points. More wear means more time spent changing parts. While your time is your money!

Buying Original Kverneland spare parts will save you time and money.

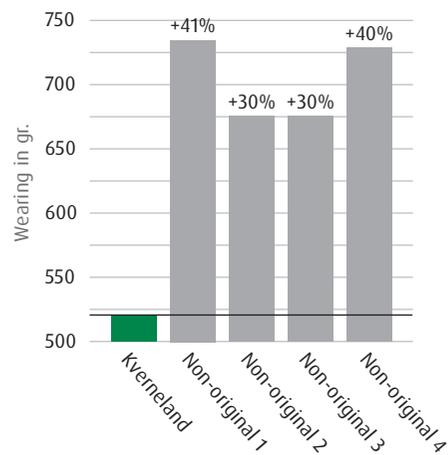


Kverneland 12 hours carburising process results in creating 2 steels in 1 sole mouldboard: flexible inside to absorb shocks and hard as a diamond on the outside for optimum wear resistance.

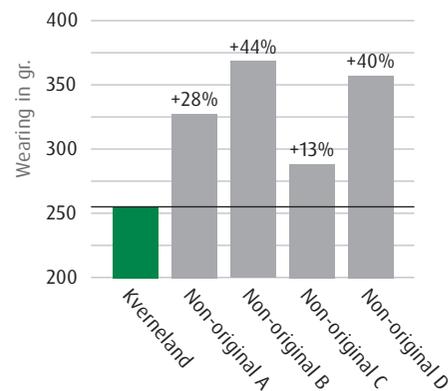


We do not compromise quality with cheap solutions. Kverneland Original Parts will always work and fit as intended to optimise your high quality ploughing performance.

COMPARISON OF WEARING OF SHARES (gr)
Percentage of extra wearing/Kverneland



COMPARISON OF WEARING OF POINTS (gr)
Percentage of extra wearing/Kverneland



Source: Kverneland Group Sweden, Västergötland. 2013



"Since 1999 I have worked 6.000 hectares with my EG plough. It is very reliable, easy to handle and has low pulling forces. Compared to neighbouring farmers with other brands, my plough is one of the oldest around. Inspired by the fantastic performance of the plough, I have almost all implements from Kverneland: seeder, precision drill, plough and cultivator."
Frédéric Sonveau, France

Low running costs

"I did try other ploughs in the past, but I like the Kverneland for the job it does, and the low running costs."
Michael & Gabriel Hoey, Ireland

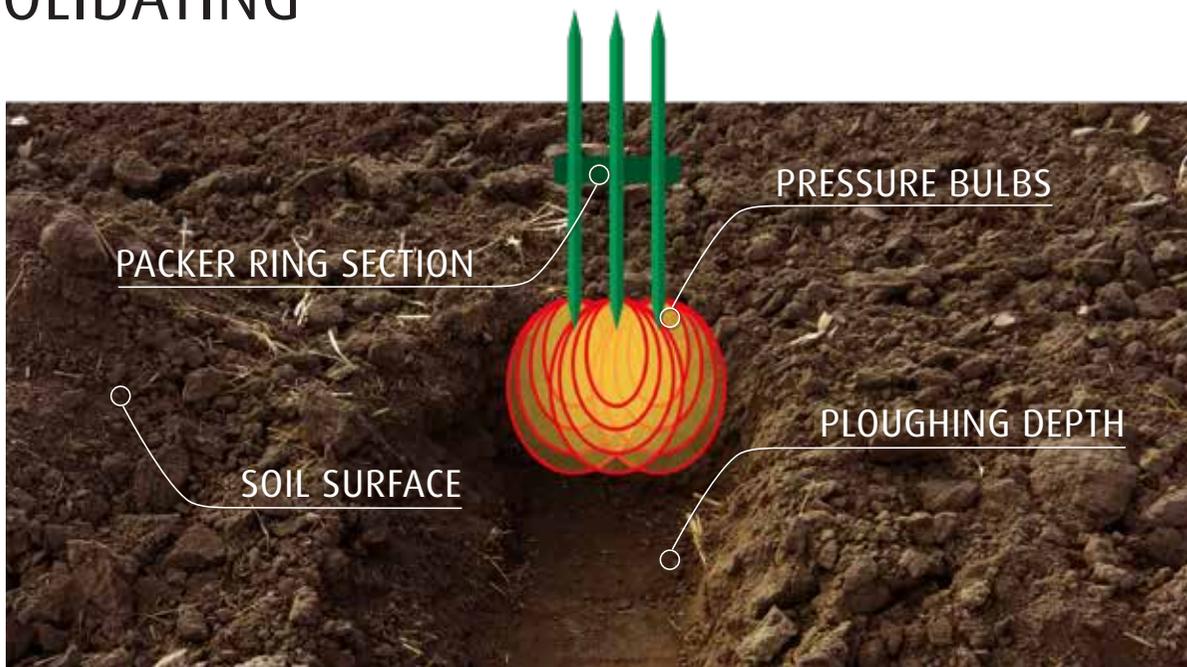
PLOUGHING EFFICIENCY BY RE-CONSOLIDATING

The soil packers are positioned beside the plough. They re-consolidate the plough furrow while the soil still contains moisture.

Kverneland soil packers suit different soil conditions and local customs.

The ring profile compacts the soil from the top down to the ploughing horizon. A crumbling roller is available to crumble the top layer which limits erosion and creates a seedbed.

The packer rings consolidate the freshly ploughed land in order to reach a better soil structure. Kverneland's packers enable soil re-consolidation, seedbed preparation, crumbling and levelling of the plough furrows. The soil is hence ready for a fast and good plant growth.



Visualisation of pressure bulbs spreading throughout the entire working depth

CHOOSING THE CORRECT TOOL

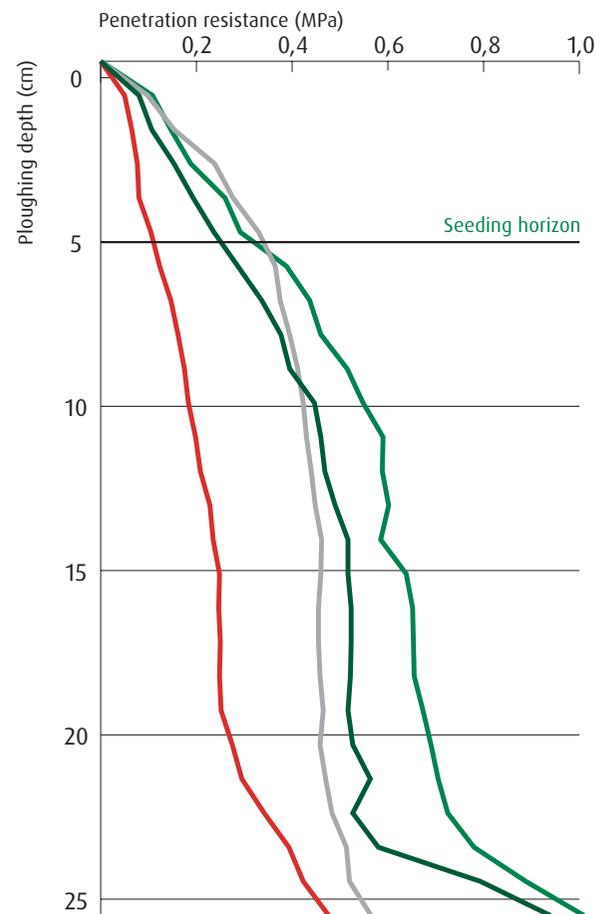
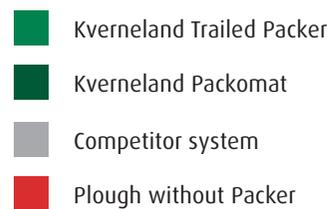
IDEAL SOIL PREPARATION

The soil re-consolidation is influenced by the choice of packers.

Kverneland made a test in 2016. It compared and measured the re-consolidation results when using 3 different packers:

- Kverneland Packomat
- Kverneland Trailed Packer
- Integrated competitor system

The graph compares the results from the actual re-consolidation.



Conclusions

- using a packer has a significant re-consolidation effect compared to ploughing alone.
- from an agronomic point of view, the Packomat and the trailed packer positively impact the entire ploughing depth.
- the competitor system shows a lower degree of re-consolidation directly underneath the seeding horizon (5 cm).

Source: Kverneland Group, Klepp, Haus Düsse, 2016

EFFICIENCY BY IMMEDIATE RE-CONSOLIDATION

STANDARD PACKER VS. PACKOMAT

Re-compaction with the packer while ploughing has a lot of useful advantages.

First of all the soil has the correct moisture for crushing clods easily. This makes leveling easier, because hollow spaces will be closed and the useful water is then not lost by evaporation. Different packer systems are available. Either the packer system is hooked to the plough and pulled during work or it is integrated to the plough, firmly connected and switches-over when the plough reverses, ie the Kverneland Packomat. Which of the two systems is the most efficient?

Cologne Institute of Construction Machinery and Agricultural Engineering (Cologne University of Applied Sciences) has tested both systems in action, compared their traction requirement, re-compaction and crumbling capacity. See tables on right page.

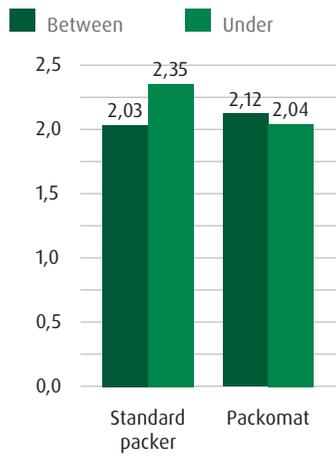
In principle, the much heavier cast iron packer – 1.343 kg as opposed to the 281 kg weight of the Packomat – gains more re-compaction because its weight penetrates further into the ground. That is really important on light soil. But the Packomat has more advantages on the surface and needs less traction power by far. This beneficial effect in the seeding horizon is measurable and can be proven with the shear force in 15 cm depth. Here we see the advantages for the Packomat, which, by the way, is priced comparably to the standard packer. The ring diameter is clearly smaller than the one from the cast iron model. Therefore the implement weight cannot be supported by the soil and the effect is more punctual than with the big ring from the standard packer. Besides, the integrated Packomat is much more practical and more favourable for transport. You only need 1 tractor to transport 2 implements at the same time. Time is money. A valid aspect if you work on smaller plots and have to move often from field to field.

Author: Prof. Dr. Wolfgang Kath-Petersen

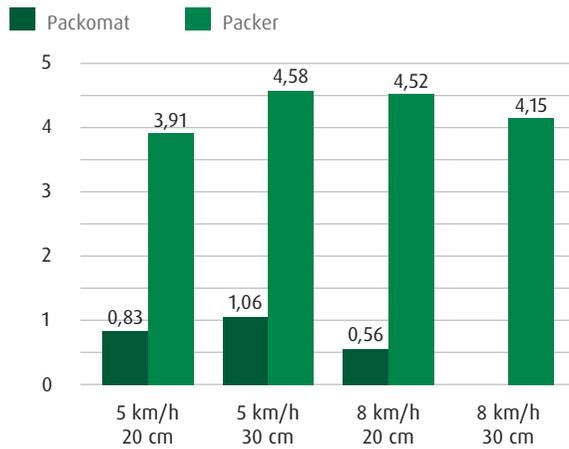
“Re-compaction after ploughing – is it only the weight which counts?”, September 2015, Cologne University of Applied Sciences, Institute of Construction Machinery and Agricultural Engineering

TOP SOIL DENSITY (g/cm³)

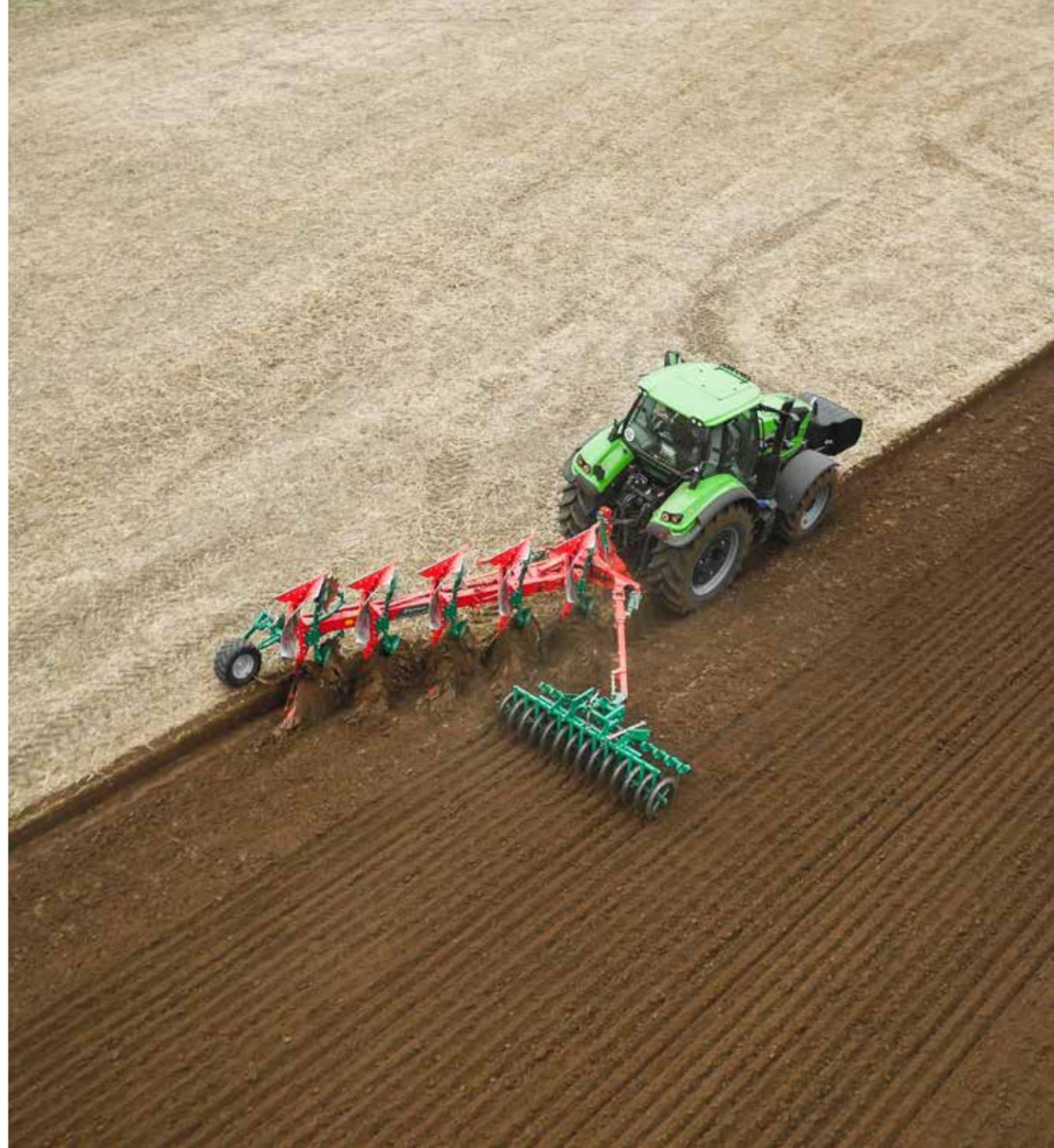
Speed: 5 km/h Working depth: 20 cm



TRACTION FORCE NEEDED (kN)



Source: "Re-compaction after ploughing - is it only the weight which counts?", September 2015, Cologne University of Applied Sciences, Institute of Construction Machinery and Agricultural Engineering



SMART INNOVATIONS CONTRIBUTING TO PROFITABILITY



Knock-on®

Variomat®, Auto-reset, Knock-on®.
Innovations that facilitate the daily work.

A reliable plough is of course important. Due to increasingly changing weather conditions, the window to be able to plough is sometimes very short. Kverneland ploughs are also known for being easy to set and to adjust. Start working efficiently immediately.

Variomat®

The Kverneland Variomat® has a lot of benefits. By adjusting the ploughing width from the tractor, you do not waste time stopping to make the working width adjustments. It allows the optimal match between the soil conditions, the plough and the tractor for the maximum output. It ensures the correct parallel linkage along the whole plough. The pulling line adjustments are hence automatic. Consequently, low draft requirements, low wear and tear, keep running costs low while the field is remarkably ploughed. The following operations are then eased.

Auto-reset

The Kverneland Auto-reset guarantees a quality ploughing. The legs release independently one from another. Once the obstruction is passed, the plough body automatically returns to the correct ploughing depth. No downtime. The simple multi-leaf spring system does not require any maintenance either. In addition, the Kverneland Auto-reset system works by decompression, which reduces the stress on the tractor and guarantees its life time. When considering the price of a new tractor, these substantial savings are real contributors to your profitability.

Knock-on®

Kverneland Knock-on® points are changed in a few seconds. It makes sense to save 90% of your time in changing points when working in abrasive soils or when having a 5+ furrow plough.



"A Kverneland plough is strong, light and easy to adjust. You adjust once and you're done."
Bjarne Strøm, Denmark



"With its ability to work on-land the Kverneland PW plough saves us a lot of time by allowing the dual wheels to stay on the tractor when switching between ploughing, cultivating and drilling. While the plough is equipped with ATS – automatic-turning-sequence – its isobus capability allows it to plug into the tractor and have all information available on the control screen. The use of ISOBUS on PW makes life and handling easier."

Philip Green (right) and Glyn Jones
Farmer and operator in Oxfordshire (UK)

"It has never been so easy to set a plough from a transport position to the perfect ploughing from the tractor seat"

Ad Buys, Dutch National Champion in Ploughing,
after testing a Kverneland 2500 i-Plough®



EFFICIENCY VIA ISOBUS TECHNOLOGY

QUICK AND SIMPLE OPERATIONS



New technologies improve the performance of existing mechanical farming equipment. By applying electronics, software, satellite-technology, online tools and big data, equipment are used more efficiently which maximizes productivity.

ISOBUS maximizes efficiency

The ISOBUS technology, our way forward into intelligent farming, is the perfect example. ISOBUS offers a complete compatibility from tractor to machine and vice-versa. They communicate to each other, enhance your comfort and **maximise efficiency while reducing costs.**

User friendly technology

You don't need to bother about difficult installation procedures. Cables, linkages and softwares are standardised. The **plug-and-play farming** concept has a reality! Both ISOBUS terminals, IsoMatch Tellus GO and PRO are ready to connect together all ISOBUS machines (any brands) for precision farming applications.

ISOBUS and ploughing

Kverneland semi-mounted wagon plough PW/RW and the mounted plough Kverneland 2500 i-Plough® benefit from the ISOBUS technology. Easy to operate, the **perfect furrows can be achieved effortlessly.**

For instance, the Kverneland 2500 i-Plough® enables 4 essential operations from the tractor cabin: ploughing, transport, marking and parking. Any relevant plough settings can be adjusted from an ISOBUS screen by **finger tips.**

For easy straight furrows, Kverneland has developed **FURROWcontrol**. Once an A-B line is defined, FURROWcontrol automatically adjusts the working width by following this A-B line. The RTK/DGPS signals guide the plough while the Variomat® adjusts the working width from 12" to 24" for **parallel furrows**. Not least, the pulling line adjusts automatically too. Ploughing can be followed by other operations. These will be easier to carry out if furrows are straight in the first place.

Kverneland intelligent farming technology contributes to maximise your profitability.

WHEN FARMING MEANS BUSINESS

kverneland.com