

VÄDERSTAD

**Establishment solutions
for your conditions**



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Our farm profits - our driving force

Our driving force is to create versatile machines for soil tillage and drilling that do an excellent job whatever the cropping system used. Most of our machines carry out several operations in a single pass and have high work capacity - everything to save time, energy and money.

In the following pages we present some of the existing knowledge and experiences of different establishment methods. We have chosen some typical examples of machine systems that best suit different situations.

Chemicals and fertilisers are often applied several times during the season, but with establishment there is only one chance to succeed. Our aim is to provide establishment solutions for every situation. We hope that you will find a system that is suitable for your conditions!

We would like to thank all those who have assisted in the production of this folder. In particular we express our gratitude to agronomist Sverker Bertilsson, Sweden, for his contribution with knowledge and text, and to Dr. Dietmar Schmidt, Germany, for his input.

Väderstad-Verken AB

Definitions

Ploughed systems. In these systems the plough creates the base and performs the majority of soil cultivation. The following cultivations are intended to break up, reconsolidate and create a seedbed in which the seed can germinate and develop successfully. Depending on soil texture, crop, weather conditions and seed drill, widely different inputs may be required to achieve this goal.

Ploughless tillage is simply defined by the absence of the plough from the soil tillage programme. Ploughless systems include e.g. cultivator work, deep loosening and direct drilling.

Reduced tillage actually refers to all systems where there is a deliberate intent to reduce soil cultivation. It can include for example ploughed systems with shallow ploughing or systems with drilling following a single cultivating pass. But the term reduced tillage is most commonly used for ploughless systems.

Direct drilling - drilling directly into stubble with full top soil disturbance, about 10 cm deep.

No-till drilling - drilling directly into stubble with very little, (5-20 percent) disturbance of the top soil.

ECO-tillage/Min-Till etc. are all more or less well defined systems for ploughless cropping.



Deep cultivation - with plough

Ploughing is one of the oldest and most investigated processes in agriculture. Its advantages include minimal problems with straw-borne diseases and a relative insensitivity to rainfall conditions during tillage. The disadvantages are primarily the high cost and time requirement, and the increased risk of erosion and water losses.

With ploughing, the aim is to bury the previous year's seedbed and crop residues to a depth of around 15-30 cm, and to create a new seedbed in the upturned soil. Well-executed ploughing creates a practically straw-free surface and seedbed, which leads to relatively few problems with diseases that are transmitted via straw and crop residues.

The greater tillage depth also leads to good control of volunteer seeds, which is particularly important in cereal cropping.

Crop rotation

Ploughed systems cope better with a poor crop rotation than reduced tillage systems. This is mainly due to better control of volunteers, and lower fungal pressure when the crop residues are buried. Therefore, ploughing can be a way of increasing the proportion of a certain crop in the rotation. However, certain diseases such as take-all in wheat cannot be avoided. And in most cases a good crop rotation pays off also in ploughed systems.

Methods

In ploughed systems tillage depth often varies only a little between years. This leads to a compacted layer, a plough pan, just below tillage depth. In extreme cases with

large amounts of straw present, very high concentrations of straw can develop directly above the plough pan. These layers are difficult for crops to penetrate, leading to poor root development. To avoid this, the ploughing depth should be documented and varied between years. If large amounts of straw are present, it can also be an idea to make a pass with e.g. Carrier before ploughing to mix the straw into the soil.

Machinery

Modern ploughs come in many different designs, with different types of share, mouldboard, etc. Tillage after ploughing has traditionally been dominated by fine cultivators, power cultivators, rollers and levelling boards. Also disc implements such as Carrier are often used.

Drilling has traditionally been dominated by older coulters types that place high demands on the seedbed. Seed drills such as Rapid and Spirit with disc tines have become increasingly popular

"In most cases a good crop rotation pays off also in ploughed systems."



After ploughing NZA levels the field and works the soil well to produce a good seedbed.

Factors in ploughing

Problems

- loss of moisture
- loss of CO₂ (burning of carbon)
- decreased activity of earthworms
- risk of plough pan
- risk when wet: smeared clods
- risk when dry: clodding
- more passes needed afterwards to make a fine seedbed
- destroys soil structure

Benefits

- let rain in
- bury straw, residues and manure
- weed control
- possible to use even when soil is a bit wet
- deep loosening
- wellknown - tradition and trust in plough

These machines carry out a degree of cultivation in conjunction with drilling, and thereby saves several cultivation passes. They also have a good ability to maintain their depth even in coarse conditions. Both these facts reduce the demands on seedbed structure. Demands on the seedbed and seed placement are in essence a question of moisture. In areas where drilling is often followed by dry weather, Rapid and Spirit with their precise seed placement are preferable.

Economics

The plough is not the most expensive implement in the machine pool but its low capacity means that the cost per hectare is extremely high. In addition, the number of hectares that can be covered by one person is limited. There are huge differences between different soils in the cost

of a ploughed system. On light soils, it is possible to plough with a greater furrow width and it is also easy to create an acceptable seedbed after ploughing. On heavy clays, however, the furrow width may have to be reduced and 3-5 passes may be necessary to prepare the seedbed after ploughing. Ploughed systems are generally quite competitive on light soils because of the few passes required. In addition, these soils often require deeper loosening in reduced tillage systems, which decreases the difference between these systems.



After ploughing Carrier work the clods. By choosing a Carrier equipped with a Crossboard, you get even more cultivation power. The Crossboard is available on models with up to 6.5 m working width.



Both Spirit and Rapid have a strong cultivation ability, and perform a final cultivation before placing the seed. The drill also consolidates



the soil after placing the seed, which means that several passes can be saved. This saves both time, fuel and soil moisture.

Väderstad recommendations

On heavy soils or fields with clods

This cultivation concept is recommended in fields with a lot of clods and when the fields needs careful cultivation before drilling. The

Rexius roller will crush the clods, and one or two passes with NZA will work the soil into smaller aggregates. A last soil cultivation before

drilling is conducted by Rapid itself. It also reconsolidates the soil after placing the seed.



Model	7-farrow plough	Rexius 1020	NZA 1000	Rapid RDA 600S	Total
Time (h/ha)	0,71	0,13	0,11	0,23	1,18
Fuel (l/ha)	19,3	5,1	4,9	7,9	37,2

For more capacity

This cultivation concept is recommended when time needs to be saved. After ploughing, one or two

passes with Carrier with Crossboard will create a tilth. A last soil cultivation before drilling is

conducted by Rapid itself. It also reconsolidates the soil after placing the seed.



Model	7-furrow plough	Carrier 650 CB	Rapid RDA 600S	Total
Time (h/ha)	0,71	0,17	0,23	1,11
Fuel (l/ha)	19,3	7,7	7,9	34,9

On light soil

This cultivation concept is recommended in light soil conditions. If needed a Carrier (or the Spirit drill

used as a Carrier) is used in a first pass, to cultivate and even the field. A last soil cultivation is conducted

by Spirit during drilling. It also reconsolidates the soil after placing the seed.



Model	7-furrow plough	Carrier 650 CB	Spirit 600	Total
Time (h/ha)	0,71	0,17	0,23	1,11
Fuel (l/ha)	19,3	7,7	7,9	34,9

Low cost in humid climate

On light to medium soils and favourable conditions, Carrier Drill with rubber roller and Crossboard can fit very well. A first cultivation

pass with Carrier Drill equipped with Crossboard creates a tilth. A last soil cultivation before placing the seed is conducted by Carrier

Drill itself, in the same pass as drilling.



Model	4-furrow plough	Carrier Drill 300	Carrier Drill 300	Total
Time (h/ha)	1,23	0,46	0,46	2,15
Fuel (l/ha)	19,2	7,6	7,6	34,4

*We have let the drills decide tractor size and thereby the working width of cultivation machines
More machine figures on p. 34*



Deep cultivation - without plough

Ploughless tillage can involve cultivation depths from 3 - 25 cm. The choice of cultivation depth is determined to a large extent by soil texture. Light soils often benefit from a deeper cultivation while the opposite is true for heavy soils.

In reduced tillage systems with deep cultivation, cultivators are used to loosen the soil to greater depths (10-25 cm). The primary motives for deep cultivation without ploughing are the decreased risk of crusting and saking, the decreased risk of erosion and the potential to work more hectares per hour.

Crop rotation

Despite a cultivation depth of 10-25 cm, relatively large amounts of

straw are left on the surface after deep cultivation with cultivator tines compared to ploughing. A positive effect of this organic layer is a decreased risk of erosion and evaporation. But it also leads to an increased risk of fungal attack, which creates a great demand for a good crop rotation. Two years in succession of the same crop should be avoided and, if possible, cereal should not follow cereal. If it does, a general recommendation is to remove the straw. Then deep cultivation can provide the potential to include more cereals in the crop rotation compared with shallow cultivation or when drilling directly into stubble. However, this problem is not as big when drilling spring crops, since there is a lot of time between harvest and drilling for the straw in the soil to decompose.

Deep cultivation without plough

Important factors to be successful

- crop residues need to be well distributed
- a varied crop rotation decreases the risk of transmitting plant diseases
- disease-free crop residues with no fungal attack apparent

Benefits

- improves soil structure
- decreased risk of erosion and crusting or saking, due to the organic surface layer
- level fields
- less time needed compared to ploughing

Methods

A deep cultivation can be preceded by shallow cultivation to create a false seedbed (make volunteers and weeds germinate). In the next deeper pass the plants are killed. Depending on the cultivator and the tillage results, one or more additional cultivations may be necessary after the cultivator to level the field and create a good seedbed.

“A rule of thumb in deep cultivation is to use 2 cm working depth per tonne of straw.”

Straw management. In all ploughless tillage, straw management is important. Well-chopped and evenly distributed straw is a basic requirement for a good outcome. However, the large volume of soil involved in deep cultivation and the mixing ability of the cultivator tines mean that larger amounts of straw and somewhat poorer straw distribution can be accepted with deep cultivation than with shallow cultivation. A rule of thumb in deep cultivation is to use 2 cm working depth per tonne of straw. That means if your yield of wheat is 6 tonnes/ha, you will need to work to a depth of around 12 cm to incorporate all the straw.

Soil structure. Soils with low or non-existent clay content often lack the natural structural build-up and stabilisation of aggregates seen in clay soils. Without loosening, they become compacted and impenetrable over time. On such soils, deep cultivation with a cultivator is one way to exploit the advantages of ploughless tillage without decreasing yields. On clay soils too, deep cultivation can be required to repair compaction damage after slurry tankers or harvesters working at wet conditions.

Machinery

The most common machines in ploughless deep cultivation are



Cultus has different equipment possibilities depending on if it shall run on light or heavy soil. Heavy soil shits combined with a steel roller gives it strong power on heavy soil. On lighter soil the rubber roller is suitable combined with the light soil shits.



In deep cultivation without plough, the straw management is very important. With a straw harrow on the Carrier, the straw is distributed once more before cultivation.



TopDana is a multi cultivator with high capacity. The working depth can be varied between 1 to 25 cm.



TopDown



TopDown



Cultus



Cultus



Cultus

Both TopDown and Cultus can be equipped with a range of different use tips (there are more options than the ones shown here). And the potential to fit a big blade makes the machines very versatile. On Cultus there is also a choice between light soil chews and heavy soil chews.

cultivators such as Cultus combined with a disc implement such as Carrier. An alternative for large farms in particular is our versatile TopDown. With this machine, deep and shallow cultivation, leveling and reconsolidation occur in a single pass. However, with a single pass one has to rely on crop protection chemicals or soil cultivating seed drills such as Rapid or Spirit to control volunteer plants and weeds.

Deep cultivation creates a coarser tith than shallow cultivation, which places greater demands on the ability of the seed drill to maintain depth and finish off the seedbed. Rapid and Spirit have a strong cultivating ability and this,

together with their ability to keep a consistent drilling depth, makes them very suitable for the task.

Economics

A cultivator requires somewhat greater draught force than a plough to move the same volume of soil. But often we do not necessarily need to move the same amount of soil. Instead we want to loosen and create cracks to a certain depth. In this the cultivator has a higher capacity. A TopDown can cover much more area than a plough in the same time. This means a great time saving. In practice, most farmers alternate between deep and shallow cultivation, which can also provide overall cost savings.

Subsoiling

Deep cultivation can sometimes be below ploughing depth (35-50 cm), which is commonly referred to as subsoiling. The frequency of deep loosening can vary from every 3rd or 4th year or even more seldom. Subsoiling gains an advantage mainly when the soil has severe compaction damage, or before specific crops. It is also relevant on lighter soils with a single-grained structure (coarse and medium sands), which require regular loosening for best results.

Väderstad recommendations

Straw cultivation and false seedbed

By using two cultivation passes a false seedbed is created to manage weeds. The first pass with Carrier works the straw into the soil and

encourages volunteers and weeds to germinate. Cultus (or TopDown) works the soil to depth, and kills the germinated weeds. A fast soil

cultivation before drilling is conducted by Rapid itself. It also reconsolidates the soil after placing the seed.



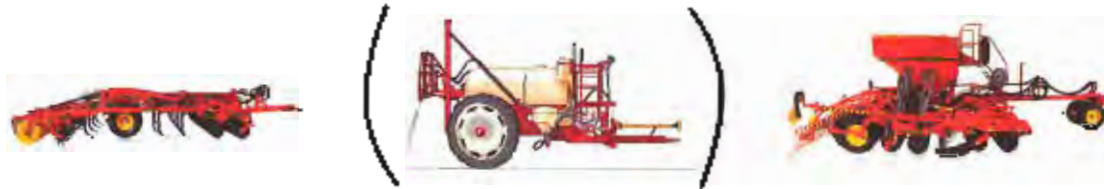
Model	Carrier 650	Cultus 420	Rapid RDA 600S	Total
Time (h/ha)	0,17	0,34	0,23	0,74
Fuel (l/ha)	7,7	12,5	7,9	28,1

Maximum time saving

This cultivation concept is recommended when you want to save as much time as possible. The pass with TopDown works the soil both

shallow and deep. If needed a sprayer can be used to kill off the germinated weeds and volunteers. A last soil cultivation before drilling

is conducted by Rapid itself. It also reconsolidates the soil after placing the seed.



Model	Top Down 400	Sprayer 24 m	Rapid RDA 600S	Total
Time (h/ha)	0,36	0,05	0,23	0,64
Fuel (l/ha)	13,1	1,2	7,9	22,2

Mechanical weed control - few machines

This cultivation concept is recommended when you want to do all the work with a TopDown and a Rapid, but also want to control the weeds mechanically. The first shallow

pass with TopDown mixes the straw into the soil, and makes weed and volunteers germinate. In the next pass some time later, the TopDown works deep, and at the

same time kills the germinated plants. A last soil cultivation before placing the seed is conducted by Rapid itself. It also reconsolidates the soil above the seed.



Model	TopDown 400	TopDown 400	Rapid RDA 600S	Total
Time (h/ha)	0,36	0,36	0,23	0,95
Fuel (l/ha)	13,1	13,1	7,9	34,1

On light soil

A first shallow pass with Cultus (or Carrier) mixes the straw into the soil. A second deeper pass with Cultus will loosen the soil, and also

kill off germinated weeds and volunteers. A last soil cultivation before drilling is conducted by Spirit during drilling. It also recon-

solidates the soil after placing the seed.



Model	Cultus 420	Cultus 420	Spirit 600	Total
Time (h/ha)	0,34	0,34	0,23	0,91
Fuel (l/ha)	12,5	12,5	7,9	32,9

We have let the drills decide tractor size and thereby the working width of cultivation machines. The figures of fuel consumption are for average working depth. In practice the first pass is often more shallow, while the second pass often is deeper. More machine figures on p. 34.



Shallow cultivation

As deep as necessary but no deeper. With Carrier as the foundation in a shallow cultivation system, crop yields can be maintained with a low time outlay.

In reduced tillage systems with shallow cultivation, the aim is to mix crop residues into the upper soil layer to create a good seed bed. And at the same time leave the structure of the lower soil layers undisturbed. A prerequisite for this to be successful is that there is no compacted layer in the field.

Crop rotation

With shallow cultivation the risk of disease transmission from crop residues is great and therefore this creates a great demand for a varied crop rotation. The ideal is a crop rotation in which cereal crops are alternated with crops of other

species. The same crop should not be grown two years in a row, while cereal should only be grown after cereal if the disease pressure as regards e.g. *Fusarium* is low, and if the farmer is prepared to use fungicide treatments. The financial benefits of having a good crop rotation are attractive regardless of tillage system. Nowadays a number of break crops also pay relatively well, especially oilseed rape.

Methods

Cultivation depth with shallow cultivation is roughly 1 cm per ton of crop residue/ha. After straw rich crops such as rye and winter wheat, and with high yields, the cultivation depth can be somewhat less per ton crop residue per ha. In

practice, the normal tillage depth is 2-10 cm.

Shallow cultivation is a relatively new system. So is Carrier, which is a machine designed for this type of tillage. Even in shallow cultivation, there is probably a risk of compacted layers developing if the cultivation depth is not varied sufficiently. In order to vary tillage depth, it is advisable to cultivate somewhat deeper deeper rooted crops, such as peas, sugarbeet and oilseed rape.

Straw management. The foundations for a good outcome in shallow cultivation are laid by the combine. Good chopping and distribution of crop residues are essential. Short chopped straw is easier to mix into the soil, resulting in a better tillage outcome. Since all volunteer and weed seeds remain in the seedbed in shallow cultivation, weed

If there is a compacted layer in the field - do not use shallow cultivation!

“With “false seedbed” we mean that we make the seeds germinate in a first pass with Carrier. Then the germinated seeds are killed off in a second pass some time later.”



control is especially important. The weed control can be achieved either by spraying with herbicides or by creating a false seedbed. With “false seedbed” we mean that we make the seeds germinate in a first pass with Carrier. The germinated seeds are killed off in a second pass some time later.

For a successful false seedbed, a first cultivation should be carried out to a depth of 2-4 cm very soon after harvesting. The cultivation should be followed by reconsolidation. When weed and volunteer seedlings have emerged, they can be eliminated with herbicides or with an additional cultivation pass.

Machinery

Carrier is the number one machine for shallow cultivation. One or two passes with Carrier should be sufficient, when followed by a cultivating drill like Rapid or Spirit. Depending on the weed pressure, spraying might also be required.

Modern cultivators with a reconsolidating action such as Cultus also work well in shallow cultivation, although it may be difficult to achieve full cut out at very shallow depths. In such systems, the cultivator works best as an alternative implement for deeper tillage, before e.g. oilseed rape and peas, and for correcting any tracks, wheelmarks and compaction on headlands.

Carrier is the primary choice for spring tillage too. But in the spring, a conventional cultivator such as NZ-Aggressive can also do a very good job in situations with moderate amounts of straw.

In all volunteer and weed seeds remain in the seedbed in shallow cultivation, weed control is especially important. The weed control can be achieved either by spraying with herbicides or by mechanical control.



To be successful in shallow cultivation the straw management is very important. Good chopping and distribution of straw is essential to be able to work it into the soil.



In shallow cultivation it is especially important to avoid creating tracks in the field. One way to avoid this is using dual wheels on the tractors, to reduce the pressure on the soil.

For drilling, Rapid or Spirit are the main alternatives in shallow cultivation, especially if drilling is usually followed by dry weather. If rainfall can be relied on, and fields are even, then Carrier Drill will do a good job and reduce costs.

Economics

Shallow cultivation is an economically attractive option, as working a smaller volume of soil lowers tillage costs. In addition, this system requires fewer machines and lower draught requirements.

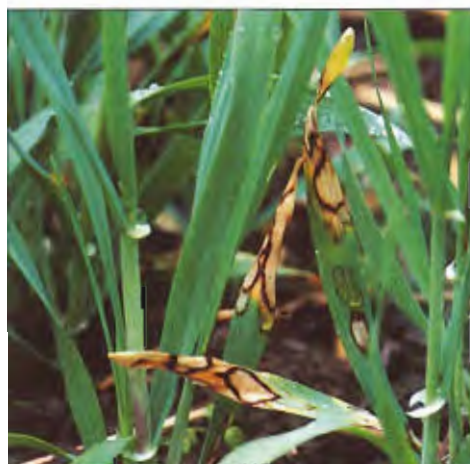
Carrier is the foundation of the system, complemented with Rapid, Spirit or Carrier Drill. The minimal use of the cultivator (TopDown or Cultus) means that this can be co-

owned or hired in, reducing the capital requirement

Providing that there is a good pre-crop, yield levels with shallow cultivation should be about the same level as in a ploughed system. However, crops like peas and sugarbeet, appear to need deeper loosening to receive really good yield levels. The cost that increases most is that of crop protection chemicals. Even with a good crop rotation there is generally a need for somewhat higher doses of herbicide and possibly an additional early fungicide treatment.



With shallow cultivation the risk of disease transmission from crop residues is great and therefore this creates a great demand for a good crop rotation. The ideal is a crop rotation in which cereal crops are alternated with crops of other species



Leaf blight in barley is easily transmitted by crop residues.

Look out for fungal diseases to ensure high yield

Disease	Cereal affected	Risk pre-crop
Pink snow mould	Winter cereal	Cereal
Eyespot	Winter cereal	Winter cereal, spring barley
Glume blotch	Wheat, triticale	Wheat
Wheat net blotch	Wheat, triticale	Wheat
Ear fusarium	Wheat, barley	Cereal, maize
Barley net blotch	Barley	Barley
Leaf blotch	Barley, rye, triticale	Barley, rye, triticale
Yellow stripe	Winter cereal	Winter cereal, some grasses
Common bunt	Winter wheat	Winter wheat
Dwarf bunt	Winter wheat	Winter wheat
Ergot	Cereal, esp. rye	Cereal, some grasses

Source: Goran Gustafsson & Peder Wuern, SJV Crop Protection Centre, Sweden

Väderstad recommendations

Few machines - false seedbed

A first pass with Carrier mixes the straw into the soil, and encourages weeds and volunteers to germinate. In the next pass some time later, the

germinated plants are killed, and the remaining straw is even further mixed into the soil. A final soil cultivation before drilling is conducted

by Rapid itself. It also reconsolidates the soil after placing the seed



Model	Carrier 650	Carrier 650	Rapid RDA 600S	Total
Time (h/ha)	0,17	0,17	0,23	0,57
Fuel (l/ha)	7,7	7,7	7,9	23,3

Fields with only a little straw on the surface

This cultivation concept is possible when you have only a small amount of straw on the surface. The Carrier passes mixes the straw into the soil,

and encourages weeds and volunteers to germinate. Some time later they can be killed off with a herbicide treatment. A final soil cultivation

before drilling is conducted by Rapid itself. It also reconsolidates the soil after placing the seed.



Total

Model	Carrier 650	Sprayer 24 m	Rapid RDA 600S	
Time (h/ha)	0,17	0,05	0,23	0,45
Fuel (l/ha)	7,7	1,2	7,9	16,8

Light soil

This cultivation concept is recommended on light soil. A first pass with Carrier (or Spirit working as a Carrier) will mix the straw into the soil, and encourages weeds and

volunteers to germinate. If needed a deeper second pass with Cultus (or with Carrier) is made some time later. The germinated plants are killed, and the remaining straw is

even further mixed into the soil. A last soil cultivation before drilling is conducted by Spirit during drilling. It also reconsolidates the soil after placing the seed.



Total

Model	Carrier 650	Carrier 650	Spirit 600	
Time (h/ha)	0,17	0,34	0,23	0,74
Fuel (l/ha)	7,7	12,5	7,9	28,1

Low cost in humid climate

This cultivation concept is recommended on light to medium soils in a climate with good potential for rainfall. A first cultivating pass with Carrier Drill mixes the straw

into the soil. This pass also encourages weeds and volunteers to germinate. If needed a second pass is made some time later. The weeds are killed, and the straw is even

further mixed into the soil. The last cultivation is made in the same pass as the seeding of the crop. The roller reconsolidates the soil over the seeds.



Total

Model	Carrier Drill 300	Carrier Drill 300	Carrier Drill 300	
Time (h/ha)	0,46	0,46	0,46	1,38
Fuel (l/ha)	7,6	7,6	7,6	22,8

We have let the drills decide tractor size and thereby the working width of cultivation machines. The figures of fuel consumption are for average working depth. In practice the first pass is often more shallow, while the second pass often is deeper. More machine figures on p 34



Drilling directly into stubble

The battle to reduce costs in agriculture continues. To increase profitability, some farmers have excluded all soil tillage and replaced it with drilling directly into the stubble. The savings can be great but to be successful you need both high skills and some degree of luck.

When drilling directly in the stubble, the aim is to place the seeds of the new crop directly in the previous year's seedbed with as little disturbance as possible. Straw and crop residues from the preceding crop lie undisturbed on the soil surface. This provides good protection against erosion and evaporation. But this also poses great risks of transmitting straw-borne diseases.

When yields are limited by other factors

Today, drilling directly into the stubble is particularly widespread in drier areas of the world, where access to water sets definite limits on yield. Canada, parts of the USA and Russia, Ukraine etc. have a relatively large proportion of farms who are using this system. When maximum cereal yields are 2-5 tonnes per ha, there is very little scope for spending too much on establishment. Drilling directly into the stubble has proved to be very competitive in this regard. The types of seed drill used are mainly based around disc, cultivator tines or knife openers.

Crop rotation

Since the crop residues from the previous year will remain on the soil surface during the entire

season, choice of crop must be given careful consideration. Achieving high yields in direct drilling requires a varied crop rotation. A more monotonous crop rotation is possible with direct drilling in drier climates, where yields are restricted by water and the fungi diseases are inhibited by drought.

Methods

For establishment to be successful, fields have to be level and free from tracks, since there is no cultivation to level these out. The soil also needs to be free from compacted layers.

Straw management. Depending on the seed drill, differing demands are placed on the degree of chopping of crop residues. But independent of drill, the straw must always be well-distributed.



Control of weeds and volunteers places particular demands on direct drilling. In favourable weather conditions with rain after harvest, volunteers and weeds can germinate and provide an opportunity for control before drilling. But the action of the seed drill is likely to encourage additional seeds to germinate. It is therefore important to have the potential to control volunteers from the previous crop in the new crop that is drilled. Here, a varied crop rotation is the best weapon. A more intensive cultivation by the seed drill usually causes more weeds to germinate. This is a fact that should be considered when direct drilling with Rapid or Spirit – should the front tools be used or not? If the toolbar is used it will work up loose soil to cover the seed, but will at the same time loose soil moisture and encourage weeds to germinate.

Machinery

Seed Hawk is a specialist no till precision drill with a number of unique advantages. The narrow coulter cause minimal disturbance of the soil. The coulter shape

is designed to remove straw from the seed furrow so that in optimal conditions the plant emerges into a straw free environment. This reduces the risk of fungal infection. The coulter design together with the packer wheels contribute to place the seed in moist soil but with only a short distance to the surface. This gives a quick emergence and thus good competitive ability against weeds.

Rapid and Spirit both function well for direct drilling but do not have

all Seed Hawk's advantages. Therefore somewhat greater care must be taken, particularly with regard to straw residues and volunteers/weeds. However, for farmers who may employ direct drilling when conditions are optimal, Rapid and Spirit work exceptionally well.

Economics

By excluding prior tillage, we have of course the ultimate in cost effective crop establishment. In addition to the seed drill, the calcula



tions must also include an increased use of crop protection chemicals to control volunteers and weeds. Yield levels with direct drilling depend greatly on the establishment outcome. If a full crop stand is successfully established, there is every chance of achieving the same yield levels as with other methods of establishment. However, the risk of failure is still greater and in preliminary calculations a certain average yield decrease should be assumed.

Comments on 25 cm row spacing

Seed Hawk works with 25 cm row spacing, which is a normal (or narrow) spacing in no till work. The advantage of working at 25 cm row spacing, or even wider, is that it increases the capacity of the drill to cope with straw and crop trash. The draught requirement and costs of wear and tear are also reduced. In climates with limited rainfall, water is often the limiting factor for yield levels and drilling with a narrower row spacing does not result in higher yields in such cases.

The ability to spread out in a wider row spacing differs between crops. Rape and oilseed plants have a good ability to spread, so 25 cm row spacing is actually an advantage in establishment, even in areas with more favourable amounts of rainfall. Generally winter crops have relatively good ability to spread, while spring crops are a bit weaker in this respect. However, barley and oats can spread better than spring wheat and peas.



A paired crop rotation is the best way to ensure high yields. Grain crops should be alternated with, for example, oil seed rape. The Seed Hawk drilled crop is successfully protected by the stubble, and the emergence is quick and even.

Pests to be aware of

Insects and other pests are often less affected by soil tillage than fungi, since they can actively seek out fields. However, there are some exceptions.

Slugs can cause great damage to autumn-sown crops, especially after rainy summers.

To develop, slugs need places to be covered from sun and heat. So if your tillage system creates holes slugs can develop. And if the system prevents holes, then the conditions are good to prevent slugs. If the straw distribution is bad it can also be used by slugs to be protected against sun, thereby making it possible for the slugs to develop. If the slugs are discov-

ered early, an edge or spot treatment is often sufficient until the crop passes its sensitive stage. Winter rape is often most affected, but damage to cereals can also occur.

The striped dwarf leafhopper carries wheat dwarf disease, which can cause great damage to winter wheat. Volunteer plants of winter wheat attract the leafhoppers, which can then spread the virus onto the emerging wheat. Controlling volunteer plants etc. decreases the subsequent risk.

Wheat blossom midge and gall midge overwinter in the topsoil and are also favoured by reduced tillage.

Väderstad recommendations

Low disturbance

Seed Hawk - specially designed for low disturbance drilling

Seed Hawk is specially designed for no-till drilling with excellent ability to place the seed. It creates minimum disturbance in the soil, and

follows the soil contour very well and is forgiving to uneven fields. By minimum disturbance of the soil, the moisture is kept in the soil,

which is especially important in a dry climate. The low disturbance also means a low draught force requirement.



			Total
Model	Sprayer 24 m	Seed Hawk 600	
Time (h/ha)	0,05	0,26	0,31
Fuel (l/ha)	1,2	6,6	7,8

High disturbance

Rapid - possible in good conditions

The Rapid can be used for direct drilling in good conditions. This means even fields and only a little

straw left in the field. After harvest the straw should be removed before drilling.



			Total
Model	Sprayer 24 m	Rapid RDA 600S	
Time (h/ha)	0,05	0,23	0,28
Fuel (l/ha)	1,2	7,9	9,1

*We have let the drills decide tractor size, and thereby the working width of cultivation machines.
More machine figures on p.34.*



Choice of cultivation system

All is not black and white when it comes to choosing a tillage system. Most farmers using reduced tillage employ a number of different methods depending on the actual conditions in each field.

However, there are a number of factors that call more or less for a particular tillage system.

Ploughing

In crop rotations where cereal is followed by cereal, in the worst case by the same species, ploughing is both the most reliable and cheapest option. The savings that can be made with reduced tillage are often eliminated in such cases by the cost of crop protection chemicals or reduced yield reliability. On very light soils where a

seedbed can be produced with only one or two passes, ploughing is also a relatively cheap system.

The greatest drawbacks are the increased risk for erosion, the water loss and the high time requirement per hectare.

Deep reduced tillage

Deep cultivation without the plough has the advantage of a lower time and fuel requirement. It also gives a higher content of organic material in the surface layers, providing protection against slaking, erosion and evaporation. Deep reduced tillage is particularly relevant on weak structured soils that require regular tamping. It can also be useful on other soils before some crop species that are sensitive to soil compaction, e.g. peas and oilseed crops.

Shallow reduced tillage

Shallow reduced tillage aims to control weeds and volunteers with minimal disturbance of the soil and to mix crop residues into the upper soil layer to speed up decomposition. Shallow cultivation gives great savings in cost and time compared with deep cultivation.

Due to the shallow tillage depth, this system provides limited opportunities to correct compaction and wheel tracks. In addition, the shallow incorporation of crop residues places greater demands for a good crop rotation to achieve an acceptable degree of crop reliability.

One of the strongest arguments for ploughless systems is the ability of soils which haven't been ploughed over years, to carry heavy machines without being damaged



or compacted. Every pass with machines after ploughing leads to deep tracks and new compaction.

No-till drilling

In no-till systems, the drillings are conducted directly into the stubble. This places great demands on the crop rotation, management of crop residues and the soil structure. At the same time, no-till drilling provides absolutely the cheapest method of establishment. In areas where yields are limited by climate factors such as rainfall and length of the growing season, drilling directly into the stubble may be the only way to achieve profitability where these factors limit yields more than controllable factors such as diseases, plant nutrients and weeds. Direct drilling with cultivating seed drills such as Rapid is more similar to shallow cultivation than pure direct

drilling, since the entire soil surface is cultivated.

The "happy medium"

The best results are often obtained by adapting the tillage system to the actual conditions instead of opting for a particular system. There is nothing to say that ploughing and direct drilling cannot be used in the same field within a crop rotation.

The great disadvantage with not adhering to one tillage system can be the large number of machines required. If the area to be cultivated is not extremely large, the best solution financially may be to have a main system and lease or hire any machines that are not used very often.

Choice of cultivation system - on the farm



Answer the 10 questions on the opposite page and see where your conditions place you regarding what system to choose.

The questions are of distinctly different value and the results cannot be totalled.

Limiting factors

Questions to which your answer is 1 - 2 show the factors that most limit your choice of tillage system and that could cause problems if you attempted to introduce ploughless tillage or direct drilling.

Things to improve?

When you have answered all the questions, identify the questions with the lowest scores and ask yourself the question: Can I improve these? Remember that even in ploughed systems there is an advantage to be gained in having good conditions.

How freely can you choose?

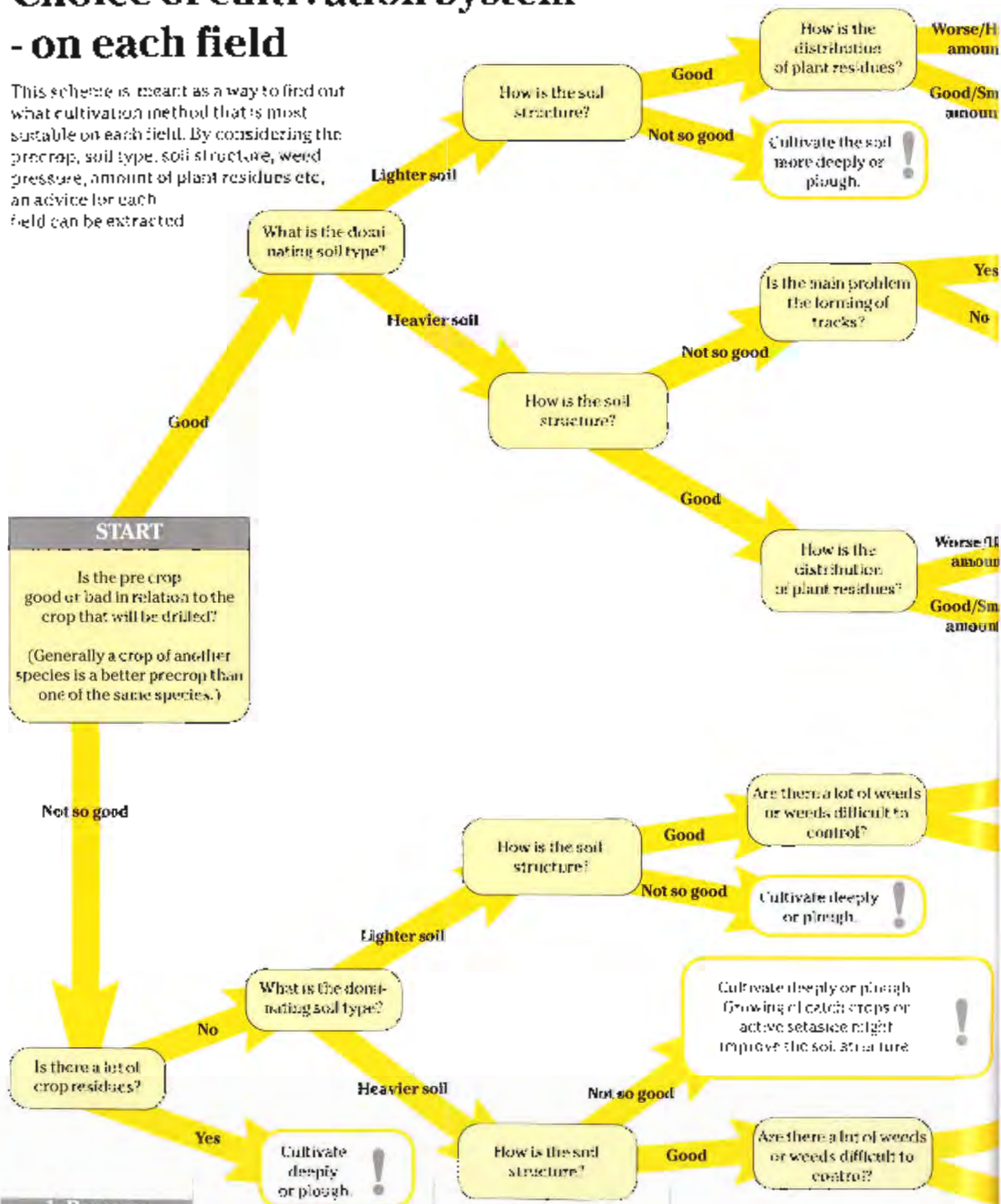
The tillage systems suggested are only a guide. If all your answers are between 4 - 5 this only indicates that you can choose freely between tillage methods, while if your answers are between 1 - 2 you should probably be more careful about using the most reduced tillage system before the existing problems are remedied.

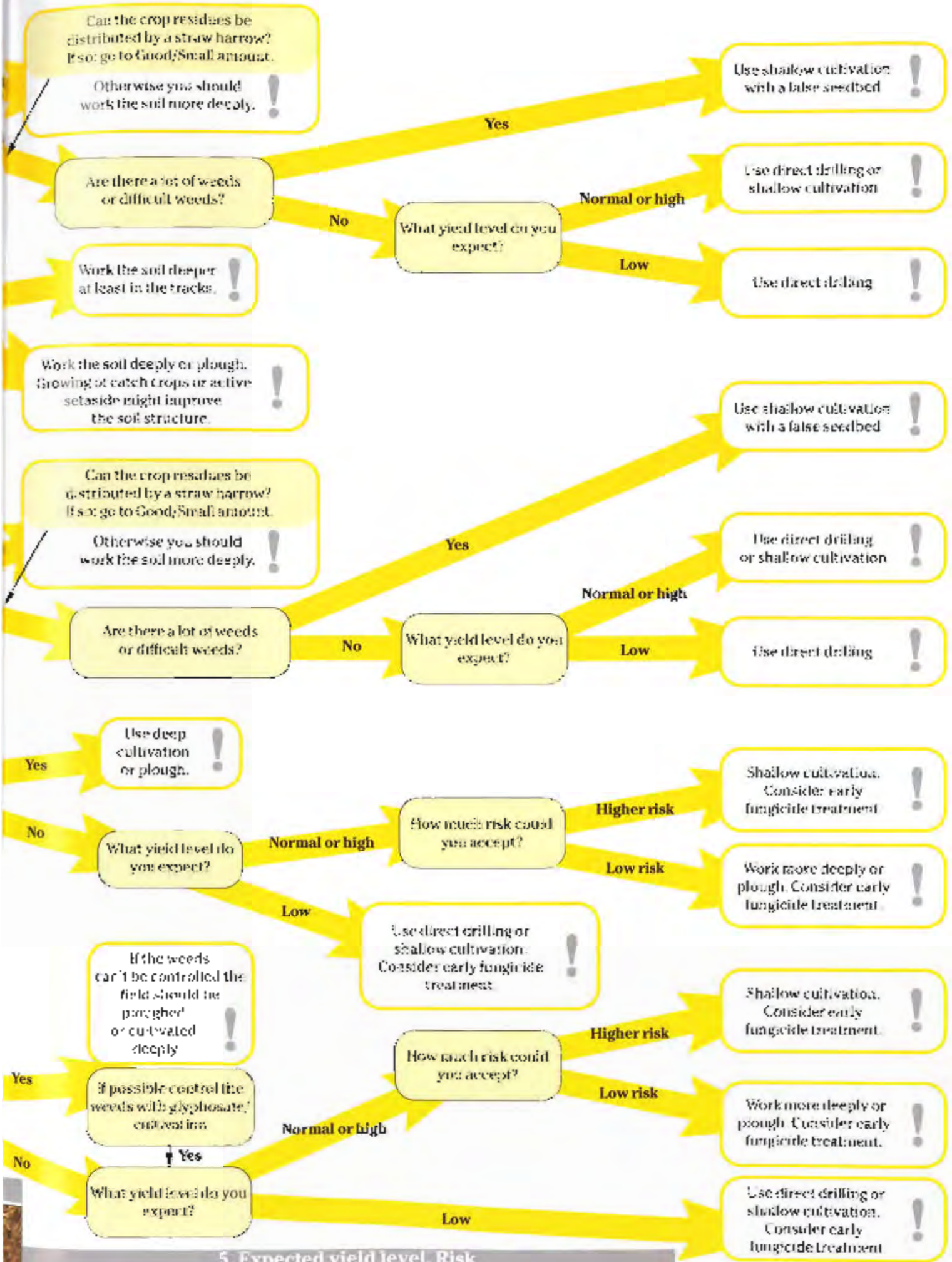
Time efficiency

Finally, a small comment about question 10. How can a lot of available time be a disadvantage? Of course it is not, but the machines for reduced tillage have a high capacity and need to be fully utilised to spread the cost. High available time indicates too little usage. If time is not a limiting factor the interest in using time saving methods as reduced tillage and direct drilling is probably lower.

Choice of cultivation system - on each field

This scheme is meant as a way to find out what cultivation method that is most suitable on each field. By considering the precrop, soil type, soil structure, weed pressure, amount of plant residues etc, an advice for each field can be extracted







Single pass system saves time and money

-The Väderstad TopDown is a versatile one-pass cultivator that will achieve whatever you want it to, says Philip Reck, farm manager at Walter Furlong's Dranagh Farm, Ireland.

-By moving to a true one-pass system with the 6m wide TopDown we have cut the tractor hours spent cultivating by a third from 500 h to 350 h, saving time and fuel, says Mr Reck.

The subsoller has been eliminated

The TopDown is now responsible for all the cultivations on 1,000 ha of owned, rented and share farmed land. The all-rounder rotation, including winter wheat, winter barley, winter oats and winter oilseed rape, is all established using minimum tillage.

-We needed to achieve the tillage required in one pass, and remove any pan that may have formed at the same time. It was important not to have any subsequent passes, and this has now eliminated the use of a subsoller in the establishment regime

Leaves level and even fields

The TopDown is a very versatile machine that is easily changed from shallow tillage, using the discs to incorporate straw, through to deeper working using the tines to remove a pan or rutted translines, adds Mr Reck.

The machine incorporates all the straw and leaves a very level and smooth finish. This makes the following pass with the drill much easier.

-The machine is extremely versatile. With individual adjustments for each element it is easy to set it up to produce the exact tillage and finish we require, explains Mr Reck. The combination of the min-till system using the Väderstad TopDown and the Rapid drill produces a very even surface on the field.

Improved soil structure lowers draught requirement

-The land has been in min-till for the past six years and, with the humus from the chopped straw, the soil is noticeably more friable. This, undoubtedly, helps make the

TopDown easier to pull, adds Mr Reck.

Working in medium loam soils, the tractor and TopDown have no difficulty achieving workrates of about 4ha/hr at speeds of 12-14 km/h. Average fuel consumption is about 12 litres/ha.

-We needed an economical, one-pass cultivator. In our experience of working the machine you are not going to find any better than the TopDown - it can't be faulted, adds Mr Reck.

FACTS

Farm: Philip Reck, Walter Furlong's Dranagh Farm, Wexford, Ireland

Acreage: 1000 ha

Soil type: Medium to heavy, wet mineral soil.

Crop rotation: Winter cropping including wheat, barley, oats and oilseed rape.



With Cultus I save both soil moisture and time

-The main advantage of minimum tillage is saving time. Fuel costs are reduced as well, but it obviously depends on the desired drilling depth. Another important advantage of reduced tillage is keeping moisture in the soil.

Jerzy Świerczek, owner of Barlewiczki farm in Northern Poland, agrees.

-The minimum tillage system has been used on our farm for two years. The autumn tillage consists of one pass with a Carrier 420, one pass with a Cultus 420, and finally drilling with a Rapid 300S. In spring, the soil is ploughed before drilling.

Saving soil moisture is important

Though it is sometimes necessary to plough, the result is drying the soil to a large extent, which is not desirable as we know how important a factor water is for the proper growth of plants.

-If harvest is delayed and there is

not much time for the straw to lay mixed with soil after a pass with a Carrier, then we plough, cultivate and drill with a Rapid. But if the harvest is done relatively early, as happened this year, they are reduced tillage.

-As for straw decomposition, in my opinion oxygen is the most important factor. Of course some nitrogen must be added, but the results are best when there is an appropriate amount of oxygen in the soil, explains Jerzy Świerczek.

Reliable machines

Jerzy did not have to pay any additional costs when he decided to introduce the reduced tillage system in his farm.

-Appropriate machines and a tractor with sufficient horsepower will do. Since our Cultus was the first one in Poland, I had no chance of seeing it at work before buying it. Still, my previous good experience with Väderstad machines and my trust in this brand encouraged me

to invest in a Cultus, explains Jerzy Świerczek.

We have never faced a problem with equipment failure. The materials used are extremely durable, which is essential because of necessity of eliminating any breakdowns during tillage.

FACTS

Farmer: Jerzy Świerczek, The Barlewiczki farm, northern Poland

Acreage: 500 ha fields, 100 ha meadows

Soil type: Medium soil

Crop rotation: Yellow pea, oilseed rape, wheat



Shallow tillage frees valuable hours

For Per Dolk time is a bottleneck. Shallow tillage is the answer. Carrier fits into this strategy like a hand into a glove

Shallow tillage frees up time for Per Dolk outside Sparreholm in Sörmland, Sweden. He farms 500 hectares, has a growing herd of 220 suckler cows and 500 young cattle and a building and contracting business with five employees. Time is in short supply, but with shallow tillage there are more hours to spare.

- The aim is to till as shallow as possible in order to save time for other work, is how he explains his strategy.

Variation in working depth

- Carrier is incredibly good for shallow tillage to around 5-7 cm. It mixes harvest trash well into the soil, tillage is fast, work rate is high

and it takes little diesel per hectare. However, Per Dolk is careful to vary his tillage depth. Approximately every fourth year the land is ploughed to vary the tillage depth and thus avoid creating a tillage pan.

Rescued emergence

However the aim is still shallow cultivation in the first instance. In this year's spring tillage, the method and the Carrier were able to show their true colours. Drought set in and two shallow passes with Carrier followed by drilling with Rapid was the tactic used to save moisture and establish spring barley.

It came up perfectly. If we had tilled deeper with the cultivator the soil would have been too dry and if we had ploughed in spring I can guarantee we would have had nothing at all.

The benefit of shallow

When Per Dolk summarises his views on shallow tillage with Carrier, the words growth and yield figure heavily. However crop economics are at the centre. With ploughing they can manage 1ha/yr and still need a pass with a harrow afterwards, but with Carrier they cover 4-5 ha/yr.

- We save time and fuel. That's the benefit of shallow cultivation, says Per Dolk.

FACTS

Farmer: Per Dolk, Sparreholm, Sweden

Acresage: 500 hectares

Soil type: Silty clay loam

Crop rotation: Ley, winter wheat, triticale, field beans, peas, oats/peas, spring barley



No-till saves time, fuel and soil

-If I wasn't no-tilling I wouldn't have been able to handle the larger acreage to try to expand and make the whole operation more profitable, says Don Zwar, Wirrabara, South Australia.

It was a neighbour who encouraged him to try direct drilling in the 1980s. Part way through ripping up a field one March they decided to direct seed the remainder of the area. At harvest time they couldn't see any difference.

No-till is more profitable

His son Russell Zwar believes that no-till is far more profitable than conventional farming, mainly due to timeliness of seeding.

- We can get our crops in early and get them away before it gets too wet. The fields are a lot more trafficable when they are wet so we can get onto them sooner, he says.

Seed Hawk places the seed well

Don and Russel have tried different drills with different results. They

have just purchased a Canadian built Seed Hawk.

- We wanted to grow more oilseed rape and believed the Seed Hawk would be an advantage in getting a good establishment. This year's crop has been in for a week and it's coming up thicker than we've ever seen it, even if it was sown at a lower rate.

Less erosion

The no-till system has a lot of advantages. In recent years they have reduced N rates at seeding as the system seems to be becoming more self sufficient. Crop chemical costs are marginally higher "but it is minimal compared to the damage you do to your soil through conventional cultivation."

The risk of erosion is virtually eliminated. On steep hills we find with direct seeding and residue protecting the soil that even heavy rainfall events cause virtually no erosion. Our soil is also a lot more friable and our structure is improving all the time, explains Don.

Significant fuel savings

The Zwar's have noticed significant fuel savings since the introduction of no-till.

- This year we have a bigger air seeder, pull it with the same tractor and we are using less fuel than we used to. That's not only because we are making fewer passes but because it's easier to move through the ground, Russell explains.

FACTS

Farmer: Don and Russel Zwar, southern Flinders Ranges, Wirrabara, South Australia
Acreage: 1000 ha
Rainfall: 530 mm/year
Crop rotation: Cereal, hay, cereal, oilseed rape

Rapid

- On all soil types
- Excellent seed placement
- Strong cultivation on all soil types



Spirit

- On light soil
- Strong cultivation ability
- Excellent seed placement at high speed



Carrier Drill

- Two machines in one
- On light to medium soils in favourable conditions
- Low cost



Light soil

Heavy soil

Seed Hawk

- No-till drilling
- High capacity
- Excellent seed placement



Light soil

Heavy soil

NZ Aggressive

- Stable working depth
- High surface clearance
- Powerful levelling capacity



TopDown

- Works both shallow and deep, 3 - 25 cm
- Saves time
- All cultivation in one pass



Cultus

- Intensive cultivation down to 25 cm
- Equipment for both light and heavy soil
- High surface clearance

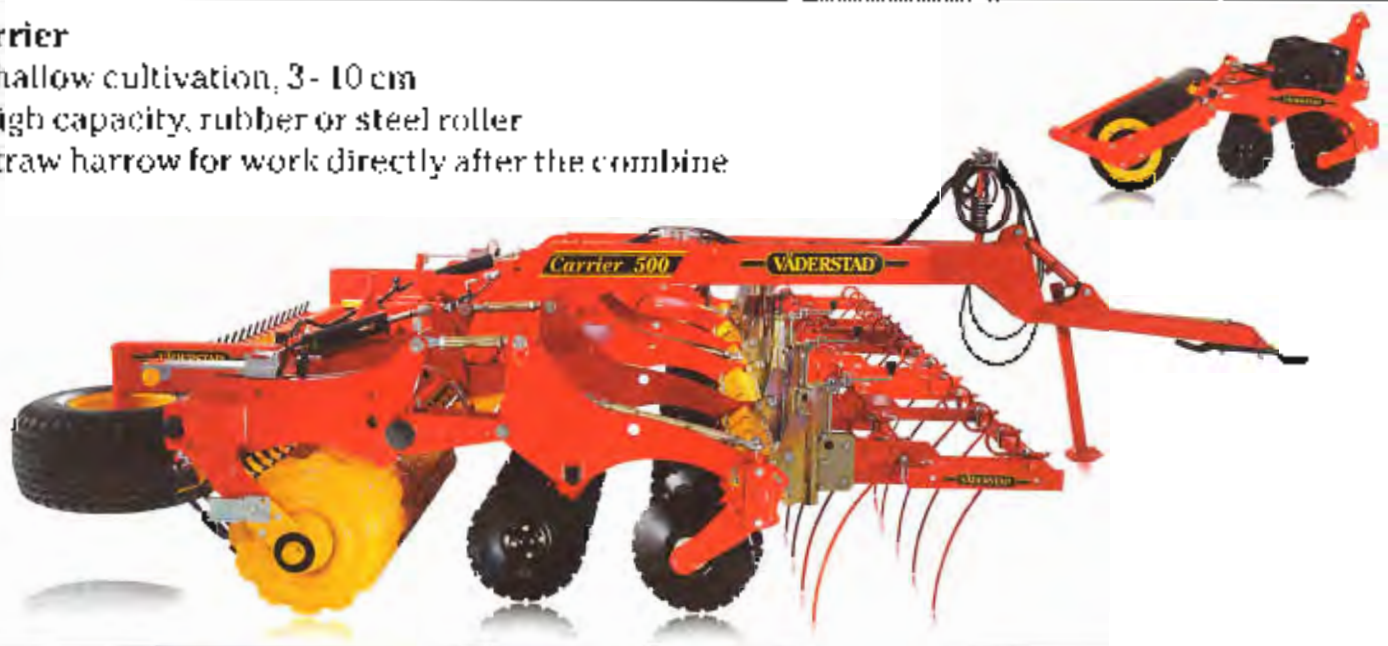


Rexius

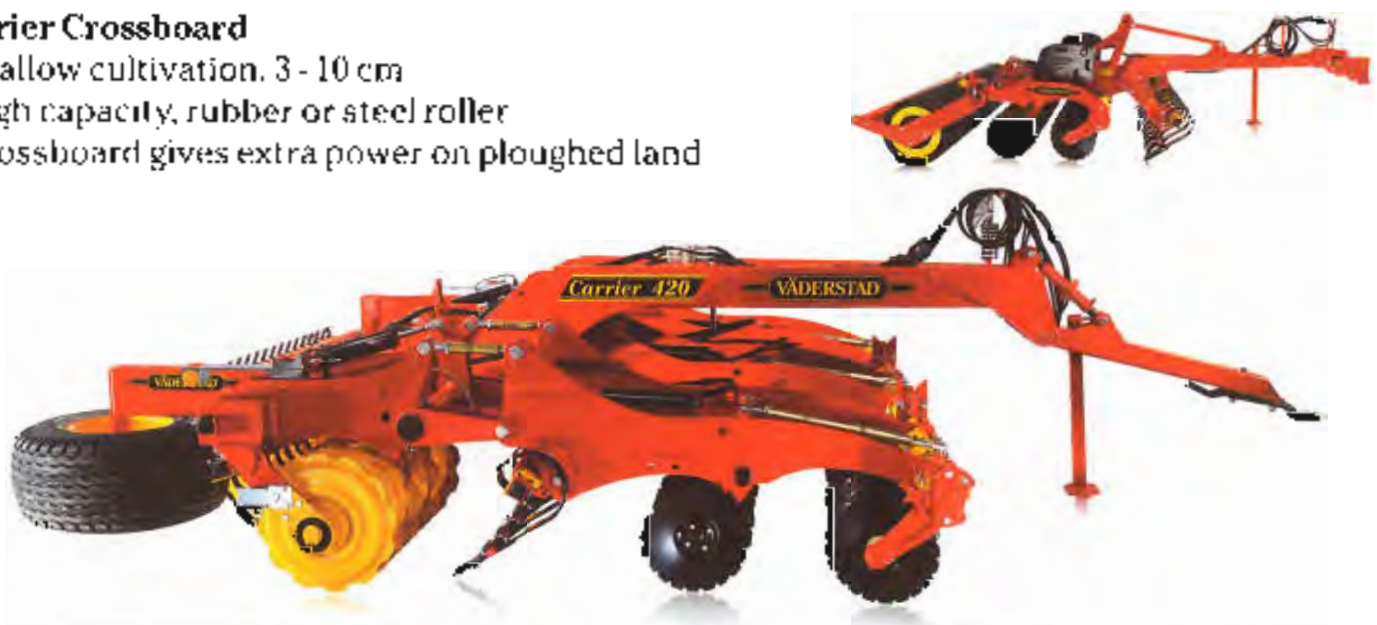
- For both reconsolidation and levelling
- Robust construction
- Low maintenance due to rubber suspension

**Carrier**

- Shallow cultivation, 3-10 cm
- High capacity, rubber or steel roller
- Straw harrow for work directly after the combine

**Carrier Crossboard**

- Shallow cultivation, 3-10 cm
- High capacity, rubber or steel roller
- Crossboard gives extra power on ploughed land



Model	Working width meter	Driving speed km/h	Efficiency factor*
Plough			
9-furrow	4,1	8	0,55
7-furrow	3,2	8	0,55
6-furrow	2,75	8	0,55
5-furrow	2,3	8	0,55
4-furrow	1,85	8	0,55
Rexius			
RS 1020	10,2	10	0,75
RS 820	8,2	10	0,75
RS 650	6,5	10	0,75
NZ Aggressive			
NZA 1000	10	12	0,75
NZA 900	9	12	0,75
NZA 800	8	12	0,75
NZA 700	7	12	0,75
Carrier			
CR 820	8,2	12	0,75
CR 650	6,5	12	0,75
CR 500	5	12	0,75
TopDown			
TD 700	7	10	0,7
TD 500	5	10	0,7
TD 400	4	10	0,7
TD 300	3	10	0,7
Cultus			
CS 620	6,2	10	0,7
CS 500	5	10	0,7
CS 420	4,2	10	0,7
Rapid			
RDA 800	8	12	0,6
RDA 600	6	12	0,6
RDA 400	4	12	0,6
RD 400	4	12	0,6
RD 300	3	12	0,6
Seed Hawk			
SH 600	6	9	0,7
Spirit			
ST 600	6,0	12	0,6
Carrier Drill			
CRD 300	3	12	0,6
Sprayer	2,1	11	0,7

* The efficiency factor includes turning on broadlands, tilling, overlap and transport to field.

** The capacity (h/ha) is calculated by: (working width x driving speed x efficiency factor) / 10

Capacity ha/h	Capacity** h/ha	Tractor hp	Fuel l/ha
1,8	0,55	300	19,2
1,4	0,71	235	19,3
1,2	0,83	200	19,1
1,0	0,99	170	19,4
0,8	1,23	135	19,2
7,7	0,13	250	5,1
6,2	0,16	175	4,5
4,9	0,21	135	4,4
9,0	0,11	280	4,9
8,1	0,12	250	4,9
7,2	0,14	200	4,4
6,3	0,16	175	4,4
7,4	0,14	360	7,7
5,9	0,17	285	7,7
4,5	0,22	220	7,7
4,9	0,20	425	12,8
3,5	0,29	300	12,6
2,8	0,36	250	13,1
2,1	0,48	200	14,0
4,3	0,23	400	13,5
3,5	0,29	300	12,6
2,9	0,34	250	12,5
5,8	0,17	360	7,9
4,3	0,23	270	7,9
2,9	0,35	180	7,9
2,9	0,35	180	7,9
2,2	0,46	135	7,9
3,8	0,26	150	6,6
4,3	0,23	270	7,9
2,2	0,46	130	7,6
18,5	0,05	150	1,2

Your cropping profits – our driving force

Our driving force is to create flexible machines for soil tillage and drilling that do an excellent job regardless of the cropping system used. All our machines carry out several operations in a single pass and have a high work capacity – all of which saves time, energy and money. The long life of the machines and high second-hand value make them cost-effective and keep machinery costs low.

Väderstad invests a great deal in product development. Ten percent of our work force are involved in product development and a number of important patents have been registered over the years.



Väderstad has been supplying high quality machinery and methods to farmers since 1962. Väderstad is a Swedish family-owned company that is represented in 30 countries around the world.

www.vaderstad.com

