

# Valtra precision farming

## INTRODUCTION

Precision farming, also known as precision agriculture, uses satellite positioning, automated tractor and implement control, and data management to assist farmer with planting, tilling, spraying and harvesting. Today's precision farming systems can be used and controlled almost entirely from the tractor cabin. This white paper attempts to outline and quantify what this kind of technology means in everyday farm work and the benefits it can bring.

This white paper covers the following topics:

- 1 Requirements of a precision farming set-up**
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# 1 REQUIREMENTS OF A PRECISION FARMING SET-UP

A precision farming system requires at least one tractor equipped with a satellite receiver. The receiver picks up signals from positioning satellites and this enables the tractor and implements to be accurately placed in each field. Valtra offers receivers and positioning services from Trimble and NovAtel.

Next, the tractor must be equipped with ISOBUS. This is the industry standard communication protocol (ISO 11783). It is what lets the tractor connect to and control farm implements. Using ISOBUS, the tractor can control all basic implement functions, as well as precise and automated functions like Section Control and Variable Rate Control.

To enable automatic steering the tractor must be fitted with an automated steering system. Valtra tractors use a system called Valtra Guide. This type of system uses the signals from the satellite positioning equipment to automatically control the steering of the tractor. Automatic steering accurately and precisely drives the tractor along the length of a field without the driver needing to touch the steering wheel.

Once a farm has a tractor equipped with satellite guidance, ISOBUS and automatic steering, for example a Valtra tractor with Valtra Guide, they can use it to control implements more precisely.

Because the tractor is accurately placed in the field by the satellite positioning signal, the implements are always correctly positioned in the field, too. With ISOBUS control and work plans prepared in the FMS (see below), implements can be automated to vary the way they work in different parts of the field and in different rows. With Valtra tractors, for example, Valtra Section Control automates functions in implements and Valtra Variable Rate Control automates and controls variable rate application functions.

Note that in addition to a suitably equipped tractor, the farm will need a Farm Management System (FMS) in their farm office. This is software that enables the farmer to map their fields, plan seeding, fertilization and harvesting, keep records and so on. Work plans and other data can be exchanged between the FMS software and the tractor. This lets the farmer create instructions for the implements in the office and then send them to the tractor before beginning the work.

## 2 PRECISION FARMING AND EASE OF USE

Ease of use is a significant aspect of precision farming. Due to the many different technologies and systems involved, precision farming may seem too difficult to adopt, despite the benefits and cost savings it offers. Companies like Valtra know this and provide tractors that are “precision farming-ready”, enabling the farmer to get everything they need from a single supplier. For example, Valtra offers tractors with satellite guidance, Valtra Guide and ISOBUS pre-installed and ready to use. Obtaining everything from one supplier ensures that all the systems work smoothly together, and that there are no conflicts between software from different manufacturers.

In addition, farmers may worry that actually using precision farming systems may be too complicated. However, well-designed controls can overcome these concerns. For example, the Valtra SmartTouch armrest combines a touchscreen with clearly arranged buttons, levers and a joystick. The design is logical and straight-forward, which makes it easy for the farmer to control and access all the precision farming functions. The SmartTouch armrest can be used to control the tractor, the automatic steering, and the implement automation. It can also be used to record things like waylines and field boundaries, as well as to transfer data and documentation to and from the FMS.

## 3 ABOUT THE EXAMPLES\*

Throughout this white paper we have given estimates of the benefits precision farming can yield in a variety of use cases. Unless otherwise noted, these estimates have been calculated based on precision farming industry averages. However, you should note that the actual results may vary significantly depending on a range of factors, including climate, location, crop, market conditions etc. Therefore we encourage you to seek your own independent advice and perform your own calculations regarding the potential savings associated with the use of precision farming equipment on your farm.

*\* Neither Valtra nor AGCO represent or warrant the accuracy of the estimates and disclaims any liability associated with your use of, or reliance on, the estimates.*

## 4 VALTRA GUIDE COST SAVINGS

Valtra Guide brings many benefits. Some of these are easily calculable (e.g. fuel and input savings). Others are much harder to quantify. In this document we give example calculations for a number of situations and we will also list other benefits which are not so easy to give an exact figure for.

It is worth bearing in mind that in every application Valtra Guide brings the following benefits:

- Ability to drive accurately in poor visibility
- Ability to drive accurately in darkness
- Ability to have warnings for obstacles
- Driver fatigue drastically reduced
- Down time reduced
- Driver able to concentrate on work
- Better quality work – better yields
- Ability to drive the same lines year on year

For all calculations Valtra Guide with an RTK correction signal has been used.

## 4.1 Mowing

### 4.1.1 Mowing U-Turns

With Valtra Guide it is possible to drive skipping every other pass with a “Skip pass”, which saves about 5 seconds per turn because the operator does not need to turn a “Lightbulb” turn.

Other MAJOR advantages of this driving technique which are difficult to quantify in time or money are:

- Less damage to mowed grass due to less sharp turns (losses are lowered + cleaner crop)
- Less soil compaction due to less sharp turns (increase in yield + grassland stays in better condition which means machines can drive faster over headlands)
- The driver makes many less turns of the steering wheel and is therefore much less fatigued at the end of the day

**Traditional – No A-G**



**Skip Pass -With A-G**



### 4.1.2 Mowing straight lines

With traditional mowing the operator has to manually steer the tractor along the edge of the crop meaning there is usually an overlap of about 30 cm, which can increase in difficult conditions (hills, dust, darkness). With Valtra Guide the overlap is reduced to a consistent 5 cm (a small overlap is required for total coverage).

Other major benefits include:

- Much less stress and fatigue for the operator, because they don't have to monitor the driving line.
- Less compaction of the field as fewer passes are needed due to reduced overlap.
- A cleaner crop due to straighter lines (implements follow the same lines and don't need to drive on the crop)

**Traditional – No Valtra Guide**



**With Valtra Guide**



### 4.1.3 Mowing – example 20 ha field

A contractor is mowing a 20 ha (20 soccer fields) field with 9 m wide triple mowers. The field is 500 m long and 400 m wide. The driver drives an average speed of 12 km/h. So each pass takes 2 minutes and 15 seconds (headlands are 3 passes (25 m) wide hence the length of each pass up and down the field is a total of 450 m) at the end of each pass they turn around and head back up the field.

No Valtra Guide	
Time to mow headlands	15 min
Number of passes: 400 m/8.7 m	46
Time taken during passes:	1 h 43 min 30 s
Time taken during turning: 46 x 20 s	15 min 20 s
Total time to mow field	2 h 13 min 50 s

With Valtra Guide	
Time to mow headlands	15 min
Number of passes: 400 m/8.95 m	45
Time taken during passes:	1h 41 min 15 s
Time taken during turning: 45 x 15 s	11 min 15 s
Total time to mow field:	2 h 7 min 30 s

Time difference	6 min 20 s
Fuel consumption is 30 l/h so the saving is	3 liters = 3 €
Driver cost is 22 €/h so the saving is	2.27 €
Service cost is 3.75 €/h so the saving is	0.38 €
<b>Total financial saving</b>	<b>5.65 €</b>

### 4.1.4 Mowing – example 100 ha per day

The contractor mows 100 ha in one day	
So the time saved driving with Valtra Guide is	31 min 40 s
<b>Financial saving per day</b>	<b>28.25 €</b>

In one year the contractor mows 2000 ha	
So the time saved driving with Valtra Guide	10 h 30 min
<b>Financial saving per year</b>	<b>565 €</b>

<b>Saving per ha</b>	<b>0.28 €</b>
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On top of this the contractor can use the extra 10.5 h to do other work e.g. 10.5 h @ 115 €/h = 1207.50 €

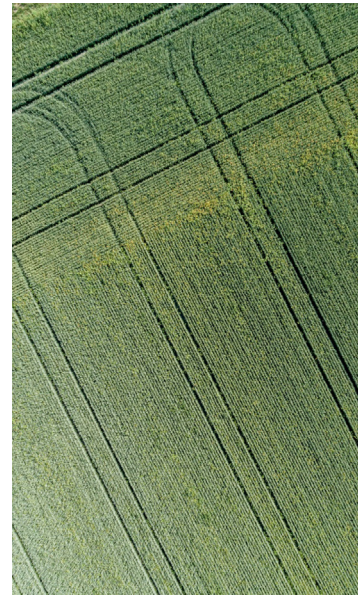
## 4.2 Fertilizer spreading - arable

When spreading fertilizer on arable crops the tractor operator follows the “tramlines” which are spaced by the seed drill at the correct intervals for the farm’s implements (sprayer/fertilizer sprayer). This means that the overlap when driving up and down the field is already very low. Therefore Valtra Guide will not give very large cost savings. It does still give some savings as it reduces operator error and ensures that the tractor travels along exactly the same tramlines each time, meaning that crop damage is minimized. Valtra Guide does potentially allow the operator to drive at a faster speed so some cost savings would be expected from this.

Section Control however can bring the arable farmer large cost savings for fertilizer spreading. It also ensures that fertilizer is only spread within the field boundary, providing environmental benefits.

When driving without Section Control the operator must guess the right point to switch the machine on and off. This leads to overlaps and also underlaps. Not only does this mean wastage of expensive fertilizer. It also affects crop growth. In some areas the crop will get a double dose of fertilizer. This is bad as the fertilizer can “burn” the crop, or the crop may grow too much and then fall over, making harvesting difficult. In areas where the crop doesn’t get enough fertilizer the crop will not grow enough and the yield will drop.

With Section Control the machine automatically shuts off at exactly the right moment. This means zero overlap. This is not only good for the crop cover. It also brings large input savings. Section Control can produce 5%-10% savings in fertilizer costs.



**Without Section Control**



**With Section Control**



## 4.2.1 Fertilizer Spreading – Arable – example 15 ha field

A farmer is spreading fertilizer on their wheat field with a spreader which has a 24 m working width. They apply fertilizer at 150 kg/ha. The fertilizer costs 396 €/ton\*. The field is 15 ha (15 soccer fields) and has tramlines at 24 m intervals.

Without Section Control	
15 ha + 5% overlap	15.75 ha
15.75 ha x 150 kg	2363 kg
Cost of fertilizer	935.75 €

With Section Control	
15 ha + 0% overlap	15 ha
15 ha x 150 kg	2250 kg
Cost of fertilizer	891 €

<b>Saving with Section Control</b>	<b>44.75 €</b>
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During the year the total area the farmer spreads fertilizer on is 750 ha.	
<b>Total saving due to Section Control is</b>	<b>2237.50 €</b>
<b>Saving per ha</b>	<b>2.98 €</b>



## 4.3 Spraying – arable

Spraying crops is very similar to spreading fertilizer on arable fields. However as sprayers can be up to 36 m wide the use of Section Control can be even more effective.

Section Control also brings environmental benefits as crops are not double sprayed. Double spraying can lead to poor plant coverage and crop damage.

Spraying is often done during hours of darkness as the weather conditions can be more favourable (less wind, cooler temperatures). In the dark it can be difficult to see any obstacles (e.g. telegraph poles) especially at the extremities of the booms. So having Valtra Guide give advanced warnings of obstacles can prevent potentially very expensive breakages and prolonged periods of down time.

### 4.3.1 Arable Spraying – example 20 ha field

A farmer is spraying a barley field for wild oats and at the same time they are applying a plant growth regulator. The field is 24 ha (24 soccer fields). They apply the wild oat herbicide (Axial 50 EC 88.59 € /l\*) at 0.8 l/ha and the plant growth regulator (Moddus EVO 46.02 € /l\*) at 0.25 l/ha. The sprayer has 24 m booms.

Without Section Control	
24 ha + 5% overlap	25.2 ha
Axial 50 EC 25.2 ha x 0.8 l	20.16 l
Moddus EVO 25.2 ha x 0.25 l	6.3 l
Cost of chemicals	2075.8 €

Without Section Control	
24 ha + 0% overlap	24 ha
Axial 50 EC 24 ha x 0.8 l	19.2 l
Moddus EVO 24 ha x 0.25 l	6 l
Cost of chemicals	1977.05 €

<b>Saving with Section Control</b>	<b>98.75 €</b>
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The farmer sprays a total area of 500 ha with these chemicals	
<b>Total saving</b>	<b>2055 €</b>
<b>Saving per ha</b>	<b>4.11 €</b>

## 4.4 Fertilizer spreading – grassland

When spreading fertilizer on grassland it is very difficult to drive accurately as the fertilizer spreader leaves no marks as to where it has already spread fertilizer. The operator has to drive on what they believe to be the correct line and as the working width of a fertilizer spreader can be up to 24 m, this can lead to very large overlaps. A 2 m of overlap is a conservative estimate of the average overlap.

Valtra Guide and Section Control can therefore bring large savings when spreading fertilizer.

**Other benefits include:**

- Much less stress and fatigue for operator, due to not having to monitor the driving line.
- Less compaction of the field as fewer passes are needed due to reduced overlap.

## 4.4.1 Fertilizer Spreading – grassland – example 15 ha field

A farmer is spreading fertiliser onto a field with a fertilizer spreader which has a working width of 24 m. The field is 15 ha (15 soccer fields) and the farmer is applying the fertiliser at a rate of 400 kg/ha. The fertilizer costs 320 €/ton\*. The field is 500 m long and 300 m wide. The operator drives at 12 km/h so each pass takes 2.5 minutes and the headlands take 3 minutes to drive.

<b>Without Valtra Guide or Section Control</b>	
Number of passes = 300 m/22 m	14 (13.6 machine widths)
Time taken to drive field	38 min
<b>Amount of fertilizer applied</b>	
Headlands 300 x 24 x 2	1.44 ha
Passes = 450 x 24 x 13.6	14.69 ha
Total area fertilizer applied = 16.13 + 5% overlap on headland	16.9 ha
Amount of fertilizer 16.9 x 0.4	6.76 tons
Total cost of fertilizer = 6.76 x 320	2163.20 €

<b>With Valtra Guide but no Section Control</b>	
Number of passes = 300 m/22 m	13 (12.5 machine widths)
Time taken to drive field	35.5 min
<b>Time saved with Valtra Guide</b>	<b>2.5 min</b>
<b>Amount of fertilizer applied</b>	
Headlands 300 x 24 x 2	1.44 ha
Passes = 450 x 24 x 12.5	13.5 ha
Total area fertilizer applied = 15 ha + 5% overlap on headland	15.75 ha
Amount of fertilizer 15.75 x 0.4	6.3 tons
Total cost of fertilizer = 6.3 x 320	2016 €

<b>With Valtra Guide and Section Control</b>	
Number of passes = 300 m/22 m	13 (12.5 machine widths)
Time taken to drive field	35.5 mins
<b>Amount of fertilizer applied</b>	
Headlands 300 x 24 x 2	1.44 ha
Passes = 450 x 24 x 12.5	13.5 ha
Total area fertilizer applied = 15 ha + 0% overlap on headland	15 ha
Amount of fertilizer 15 x 0.4	6 tons
Total cost of fertilizer = 6 x 320	1920 €

<b>Fertilizer saving with Valtra Guide and Section Control</b>	<b>243.20 €</b>
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## 4.4.2 Fertilizer Spreading – grassland – Example 345 ha farm

The farm has 345 ha of grassland to which the farmer applies the same amount of fertilizer.

<b>Time saved</b>	<b>60 min</b>
Fuel saved (1 €/l x 10 l/hr consumption)	10 €
Operator costs (22 €/hr)	22 €
Service costs (3.75 €/hr)	3.75 €
<b>Savings with just Valtra Guide</b>	<b>3421.35 €</b>
<b>Savings with Valtra Guide and Section Control</b>	<b>5629.35 €</b>

The farmer applies the same amount of fertilizer before every cut of silage. They take 3 cuts per year.

<b>Savings with just Valtra Guide</b>	<b>10264.05 €</b>
<b>Saving per ha</b>	<b>9.92 €</b>

<b>Savings with Valtra Guide and Section Control</b>	<b>16888.05 €</b>
<b>Saving per ha</b>	<b>16.32 €</b>

## 4.5 Seed drilling

Valtra Guide can bring many benefits when seed drilling. Traditionally the operator has had to use “bout markers” (arms which drop down from the side of the machine to mark the next pass in the soil) to be able to drive accurately. Although this can be a quite accurate, human error means that their can be overlaps of 1% of the machine’s width. On curved sections of land this can be increased. With Valtra Guide the overlaps are reduced to 0%

When turning on the headland traditionally the operator has had to do a “lightbulb” turn and head back down the field next to their previous pass. With Valtra Guide the operator can skip a pass and hence do a gentle U-turn. This type of turn can save about 5 seconds per turn. The operator also doesn’t have to turn the wheel as many times each turn, considerably reducing fatigue over the length of an entire day.

Traditionally the operator would drill the headlands first and then use the inner edges of the headland as markers to indicate when to lift the seed drill up. This leads to overlaps and underlaps on the headland, especially on angled headlands. With Section Control the drill will shut off each coulter at exactly the right moment, which can lead to input savings of 5%.

Other advantages of Valtra Guide and Section Control

- Reduced compaction on headlands
- Headlands can be drilled last – improved yields
- No double drilled areas – improved yields and uniform crop coverage
- Easier harvesting due to correct crop spacing (especially in precision drilled crops (e.g. maize))
- Vastly reduced fatigue during exceptional busy seasons (working days can be up to 20 hours)

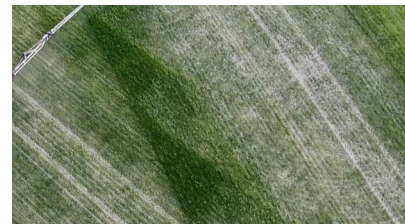
Without Valtra Guide



With Valtra Guide and Section Control



Without Section Control



With Section Control



## 4.5.1 Seed Drilling – example 25 ha field

A farmer is drilling wheat into a field with a 6 m seed and fertilizer drill. The farmer applies 400 kg/ha of fertilizer which costs 396 €/ton\* and they plant the wheat at a rate of 250 kg/ha which costs 450 €/ton. The field is 400 m long and 625 m wide so its total area is 25 ha. The farmer plants a 24 m wide headland. So the length of each pass is 352 m and driving at 12 km/h it takes 1 minute 45 seconds to complete one pass. Headlands require 4 passes so headlands take about 45 minutes and the amount of ground in the headland is 4.69 ha.

<b>Without Valtra Guide or Technology</b>	
Number of passes	97
Time taken to drive field = 97 x (1 min 45 s + 20 s) + 45 min	4 h 7 min
<b>Amount of seed drilled</b>	
Headlands	4.69 ha
Passes = 352 m x 6 m x 97	20.49 ha
Total area = 25.18 x 5% overlaps on headland	26.44 ha
Total seed drilled	6.61 tons
Cost of seed	2974.50 €
<b>Fertilizer</b>	
Total area	26.44 ha
Total fertilizer applied	10.58 tons
Total cost of fertilizer	4193.68 €
<b>Total cost of inputs</b>	<b>7168.18 €</b>

## 4.5.1

With Valtra Guide	
Number of passes	96
Time taken to drive field = 96 x (1 min 45 s + 15 s) + 45 min	3 h 57 min
<b>Time saved</b>	<b>10 min</b>
Amount of seed drilled	
Total area = 25 ha x 5% overlaps on headland	26.25 ha
Total seed drilled	6.56 tons
Cost of seed	2953 €
Fertilizer	
Total area	26.25 ha
Total fertilizer applied	10.5 tons
Total cost of fertilizer	4158 €
<b>Total cost of inputs</b>	<b>7111 €</b>
<b>Saving with Valtra Guide</b>	<b>57.18 €</b>

With Section Control	
Amount of seed drilled	
Total area = 25 ha x 0% overlaps on headland	25 ha
Total seed drilled	6.25 tons
Cost of seed	2812.50 €
Fertilizer	
Total area	25 ha
Total fertilizer applied	10 tons
Total cost of fertilizer	3960 €
<b>Total cost of inputs</b>	<b>6772.50 €</b>
<b>Saving with Section Control</b>	<b>395.68 €</b>

## 4.5.2 SeeD Drilling – example 400 ha farm

The farm has a total of 400 ha drilled land each year.

Time saved during the year	2 h 40 min
Fuel saved (1 €/l x 20 l/hr consumption)	53 €
Operator costs (22 €/hr)	58.50 €
Service costs (3.75 €/hr)	10 €
<b>Total saving with Valtra Guide</b>	<b>1036.38 €</b>
<b>Saving per ha</b>	<b>2.59 €</b>
<b>Total saving with Valtra Guide and Section Control</b>	<b>6452.38 €</b>
<b>Saving per ha</b>	<b>16.13 €</b>

## 5 REDUCED WORKING TIME

While reduced working time saves costs, it is also worthwhile considering the actual time that is saved.

We estimate that self-steering tractor technology can reduce working time by about 5%. For example, for a field of 1000 m x 1000 m with a 4 meter wide seed drill, a tractor will need to drive end to end 250 times. Driving at 20 km/h each pass will take 3 minutes with about 15 seconds per turn. Time for breaks and filling the machine are not included.

For a 1000 x 1000 m field with 4 m wide seed drills.	
250 x 3 minutes	750 minutes
250 x 15 seconds	62.5 minutes
Total working time	812.5 minutes
<b>Time saved with automatic steering</b>	
<b>5% of 812.5 minutes</b>	<b>40.6 minutes</b>

### 5.1 More free time in the cabin

When steering and implement control is automated, the driver still takes care of turning the tractor in headland but about 90% of their time in the cabin is “free time”. I.e. the driver does not need to have their hands on the controls and can therefore rest or do other things.

For the same 1000 x 1000 m field with 4 m wide seed drills.	
<b>Free time gained with automatic steering</b>	
<b>90% of 812.5 minutes</b>	<b>730 minutes (12 hours)</b>

### 5.2 Reduced farm office work time

In principle, free time in the cabin can be used to take care of any tasks that can be done on a mobile device. This means that some farm management work can be completed in the tractor cabin instead in the farm office. These tasks may include business emails, ordering, planning, checking the weather forecast, etc.

However, it should be noted that tasks which require detailed reading and long periods of concentration, such as invoicing, are less suitable for cabin work.



## 5.3 Automated documentation

Because precision farming automates control of farm equipment, it is easy to automate a lot of the accompanying planning and documentation, too – the data from each task is recorded accurately in digital form, anyway. Thus, when each task is planned or finished the data can be transferred automatically and wirelessly between the tractor and the farm office. In addition, work plans only need to be prepared once and can be reused in subsequent years, as long as the field and the crop are the same.

### **DIGITAL DOCUMENTATION:**

1. Records every farm task.
2. Ensures farm documentation is always up-to-date.
3. Provides accurate records to ensure compliance with regulations.
4. Reduces office work.
5. Can be transferred instantly between the tractor and the office.
6. Ensures work is done according to plan.

## 6 IMPROVED ACCURACY

Automatic steering systems use satellite guidance to place the tractor correctly on the field. There is a considerable difference in the accuracy of manual steering compared with automatic steering. Satellite guidance is available with different levels of pass-to-pass accuracy, ranging from +/-30 cm to +/- 2 cm. Different amounts of overlaps are used for different types of work.

For mowing, manual steering usually has an overlap of about 30 cm. With Valtra Guide the overlap is reduced to a consistent 5 cm (a small overlap is required for total coverage).

For fertilizer spreading, manual steering may give an overlap of about 5% on the headlands. With Valtra Guide and Section Control the overlap can be reduced to 0%.

For seed drilling, manual steering can be 1% of the machine width. With Valtra Guide the overlap is reduced to 0%.

In addition, human drivers also get tired so that their accuracy will decrease over the course of the working day. In contrast, a tractor fitted with Valtra Guide will maintain the same level of accuracy at all times.

## 6.1 All-weather accuracy

Human drivers can also have difficulty maintaining accuracy in poor visibility, such as rain and fog, and at night. Again, satellite guidance and automatic steering systems overcome this limitation, enabling accurate work to be carried out in any conditions.

## 6.2 Easier turning in the headland

Automatic steering helps the driver at headlands, too. Although the driver has to assume control, they only have to turn the wheel enough to direct the tractor towards the next row. The tractor will then align itself with the row automatically, and follow it exactly.

## 6.3 Reduced resource costs

Section control systems, such as Valtra Section Control, automate implements according to their location in the field. They control exactly how much seed, fertilizer or spray is applied to different sections of the field, such as rows, to avoid overlap and gaps in application. They can also accurately sow seed in the corners of the field, increasing its productive area. This reduces waste thus reducing costs.

## 6.4 Better yields

Variable rate systems, such as Valtra Variable Rate Control, precisely control the rate that input is applied to the field, i.e. how concentrated the dosage is. Because the soil conditions may vary across the field, the optimum dosage varies too. By applying the optimum concentration to each area of the field, variable rate systems ensure that crops have the right amount of fertilizer or spray applied, and not too much or too little.

This also results in reduced waste, as well as improved crop yields.

## 7 MACHINE UPTIME

Precision farming systems can include tractor tracking and condition monitoring services, such as, Valtra Connect. These record tractor activity, including kilometers driven and the number of working hours, as well as diagnostic information. This data can be shared over mobile data connections with an authorized service partner to predict maintenance needs. Because the service partner can access the data remotely, they can identify and resolve minor maintenance issues in the field. Because the tractor does not have to be taken to a service center and a service engineer does not have to come to the farm, the tractor is available for work for longer.