GRAINSENSE USER MANUAL APRIL 2019

GrainSense

GrainSense

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Contact details can be found on the back page of this manual.

Information
The information included in this manual corresponds with our current state of knowledge and is no claim for completeness. The recommended usage instructions are non-binding.

Always refer to the latest version of the User Manual.

Declaration of conformity
GrainSense device comes with type label included.
It proves that the device conforms with applicable regulations. The Declaration of Conformity is available upon request.

GrainSense

Table of contents

1. Information for correct use

Please read this user manual carefully before using the GrainSense solution. Incorrect use of the GrainSense device can lead to wrong measurements of grain quality which may affect decision making.

1.1 Correct use
The following points must be observed in order to use the device in a correct manner:

- 3.2 Requirements for reliable measurements from Operation part (page 14)
- Adherence to the maintenance and servicing instructions from (page 20)

The device can be used during light rain. The device must never be completely soaked or immersed in water.

1.2 Measurement errors
Observe the following points in order to avoid incorrect measurements:
- Do not take measurements when kernels are green or unripened, GrainSense calibration does not include green colors and measurements results cannot be assured to be accurate in such case
- Do not perform all measurements on the same plant when measuring a component average content for the field
- Do not perform all measurements on a small area of the field when measuring a component average content for the field
- Do not measure using an old calibration version, remember to connect regularly the device to your phone to save data and update the latest calibrations
- Do not measure if there is water/humidity on the tray as it will affect moisture measurement
- Do not measure if batteries are too low, change the batteries every 50 to 150 measurements depending on battery quality and type of use

1.3 Exclusion of warranty
The manufacturer is not liable for the following damages to the device:
- Damage to the device following impacts or vibration
- Damage to the device resulting from penetrating moisture or dust
- Damage to the display resulting from pressure application and scratches
- Malfunctions from cleaning the sample tray with cleaning agents containing alcohol or other chemicals
- Damage caused by heat or intensive solar radiation: The device must not be placed in the immediate vicinity of heat sources or be exposed to direct sunlight
- Incorrect storage (see Transport and storage on page 20)

2. Products

The key components of the GrainSense solution are the GrainSense device, mobile application, and cloud-based database.

GrainSense
Measuring
Device

GrainSense
Mobile App

GrainSense
Cloud
Services
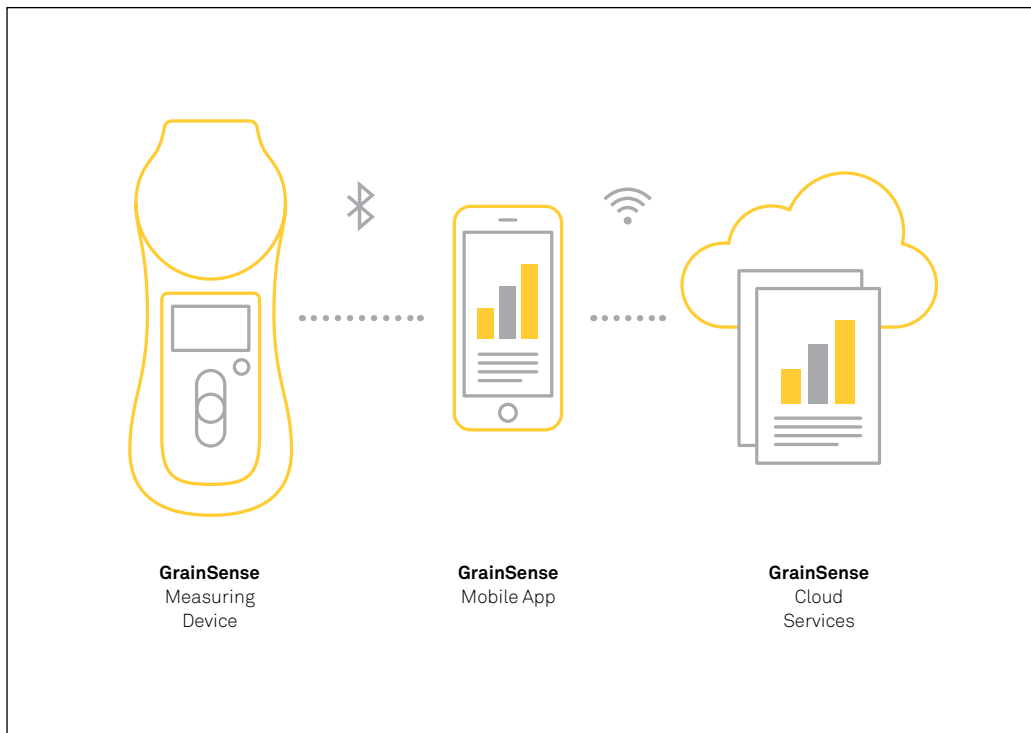
The three pillars in the GrainSense system are connected as follows:
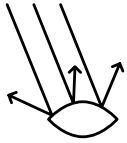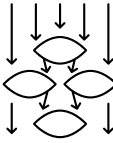
1. GrainSense Device measures and analyzes protein, moisture, carbohydrates and oil contents from any calibrated species and interacts with the GrainSense Mobile application via Bluetooth.

2. The mobile application connects with cloud account and uploads calibration and other settings to the Device and measurements results to the database.

3. A cloud-based database and API to store the measurement results and provide updated calibrations to the Devices (via Mobile application). The cloud services include the GrainSense Mobile App and the Farmer Dashboard.

GrainSense

2.1 The GrainSense device

2.1.1 Mode of function

The technical principle of the device is based on near-infrared spectroscopy by transmittance in the third overtone spectral range. This technique has been available in labs for years, but GrainSense is the first that has been able to incorporate it into a handheld device.

Optical method comparison

Diffuse reflection
Traditional laboratory method

- Small fraction of the sample is measured
- Requires expensive infrared detectors
- Long measurement time

Diffuse transmission
Advanced laboratory method

- Wet sampling not possible
- Requires large sample
- Long measurement time
- Technology complicated for portable and affordable devices

GrainSense
360° light penetration method (integration sphere)

+ Works with simpler and more affordable technology
+ Device can be small
+ Enables small samples
+ Wider use than grain as other types of samples possible
+ Short measurements time

2.1.2 Scope of supply

When buying a GrainSense device, the end-user receives a package that includes the following content:

- GrainSense device
- AA batteries (installed)
- A set of 4 GrainSense sampling spoons
- Official Cap
- Carrying case
- Quick guide

GrainSense

2.1.3 Technical specifications

Technical specifications	
Size	Hand-held (footprint 270 mm x 115 mm)
Weight	820 grams (without batteries)
Batteries	6 x AA Alkaline (recommended to use batteries designed for industrial/heavy use)
Battery operation	50 to 150 measurements depending on battery quality and type of use
Measurement principle	Near infrared transmittance spectroscopy
Sample size	≈ 3 grams (60–80 cereal kernels)
Measurement time	About 30 seconds, including the device warm-up and the user loading the sample
Species	E.g. wheat, barley, rye, oat and rapeseed New species can be added according to needs / Note: Species are country specific
Operational conditions	+5 to +45 C 20 to 90 % RH (non condensing)
Storage temperature	-10 to +60 C
Protection	Designed for outdoor use - except raindrops on the sample tray will affect the moisture result
Bluetooth	LE 4.1
Language	Multiple languages (based on ISO 8859-1 character set)
Mobile application	Android/iOS

2.1.4 Overview of the device

GrainSense device is a handheld and battery-powered device which measures grain kernels in the field and determines protein (% dry base), moisture (% wet base), carbohydrates (% dry base), and oil (% dry base) contents. Those concentration units are default units for cereals in European countries; calculation of percentages can be of any combination of wet, dry or fixed moisture.
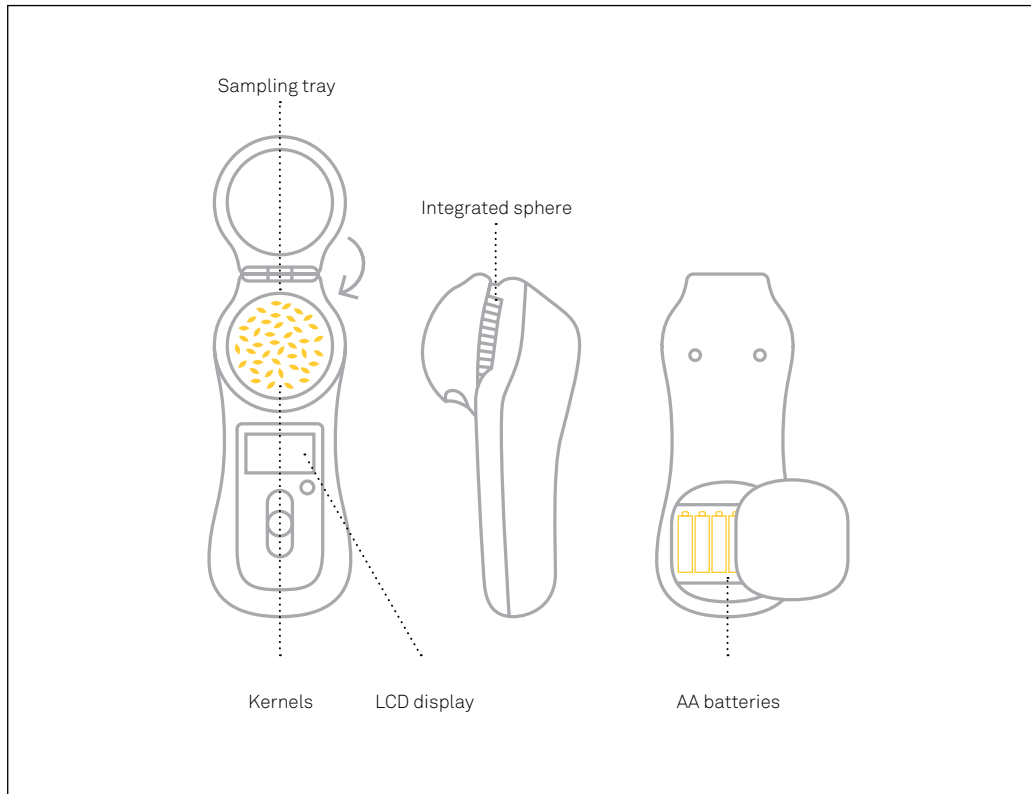
The device has:

- A LCD display
- A dedicated power button
  - Power off by pressing the button until the display turns off
- Up and down arrow buttons to select and change view content
  - If arrows are shown in the screen
- A confirmation button to move to the next phase of the measurement process
- A Bluetooth LED to indicate a connection
  - Blink: seeking connection
  - Steady: connected
- A power LED to indicate battery levels
  - Green: battery good
  - Red: change batteries as soon as possible

Note! As batteries differ widely in performance, the LED color is a rough indication and the user should change the batteries regularly (every 100 measurements).

2.2 GrainSense cloud services
Grainsense gathers data of all registered users to:

- Provide calibration and other data to users and their devices
- Verify account status and level
- Store all measured data to provide an access to it from different devices and backup
- Communicate any issues, guidance or other important messages

Grainsense gathers the following information:

- User details: email, address, phone number, profession
- Measurement results with user id, GPS location, time and date, and notes

2.2.1 GDPR Guidance
GDPR is active after 25.5.2018 and involves all companies handling data from EU citizens. Data controllers (i.e. company) and data processors (company or subcontractor) are required to comply and give more power to a person regarding his data, that includes to:

- Ask explicit consent for all different data types (GPS, email marketing, etc), describe how to data is used and for what purpose
- Allow users to control the data (delete and export)

Companies must also have an internal guidance (this chapter of the User Manual) on GDPR.

Note! GrainSense is fully compliant with GDPR.

2.2.2 Data infrastructure and protection
Grainsense acts as a data controller and processor, but for processing, it uses outsourced infrastructure (Amazon AWS). Graisense has taken measures to protect user data by:

- Applying standard encrypted HTTPS (TLS) communication
- Using proper authorization and authentication methods
- Using enterprise level framework (Java Spring)
- Taking nightly backups of the data (last 30 days)
- Limiting admin rights to the databases (two key persons have access to user's personal data)

2.2.3 User registration
The user registers to Grainsense cloud via the web registration wizard (www.grainsense.com/register). The user is asked to fill personal details, which some are optional, in the end, the user is asked to consent to: Terms of use*, Privacy policy*, Location data use, Marketing use.

*Terms of use and privacy policy are compliant to GDPR

2.2.4 Data handling

The user's personal data is used for authorization/authentication and for communicating with the user. The user's measured data is used for:

- Giving the user access to all his measurement data via multiple devices (User has only access to his own data)
- Calculating statistical analyses of the user-specific data, and to showing it only to the user itself
- Calculating higher level statistical data of a specific reason (anonymized) and providing it to all users

2.2.4 User data control

The user has a way to delete and export all data by sending a request to support@grainsense.com from the account email address (At a later point user will be able to do this via web portal). Deletion is made by completely anonymizing the user data: User details (email, address, etc) are anonymized and GPS locations changed. However, measured data itself is not deleted and will be used for statistical purposes.

2.3 Mobile application

GrainSense provides a mobile application for iOS and Android platforms. The applications communicate with the device via Bluetooth and with the cloud database via REST API. They download calibration and user settings from the cloud and send measurement results back.

When launching the app, it synchronizes with the cloud. The app contains 5 main pages:

1. Measurements: The app main page is "Measurements" page and allows the user to access any of the previous measurement he did.
2. Device: Allows the user to connect the device to the phone by selecting "Connect device", change the language of the App and device and select calibrations.
3. Account: Details about user´s account (email, first name, last name, phone number), allows the user to change the password
4. Guides: Give straight access to the Quick Guide and to the FAQ
5. Contact: Primary contract and technical support email

2.4 Farmer DashBoard

The Farmer Dashboard is a great web tool to analyse and manage the measurements on computer or tablet.
Visit it at https://dashboard.grainsense.com/. Use the same login and password than for logging in the App. The Farmer Dashboard also allows the user to export the data via an .xls or .csv file.
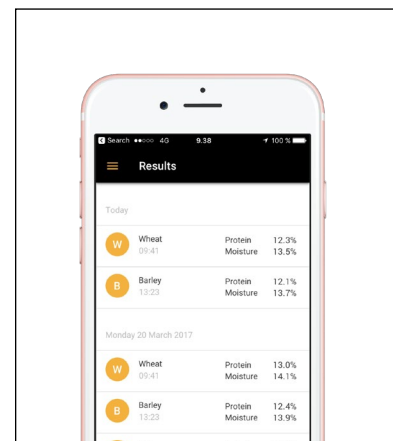
3. Operation

Note! Multiple videos including tutorials and testimonials can be found on the GrainSense youtube channel (www.youtube.com/channel/UCFhTX9bab5gHfvbz2G8ABUA).

3.1 Starting up
The procedure to start the device and the measuring principle are explained in the Quick Guide booklet available in the device´s bag.

Starting out the device

The setup includes the following phases:

1. Unboxing the package
2. Downloading the application from the app store
3. Registration to the cloud service
4. Login for the first time
5. Connecting to the device
6. Configuring the device
7. Doing the first measurement
8. Viewing the results from the phone
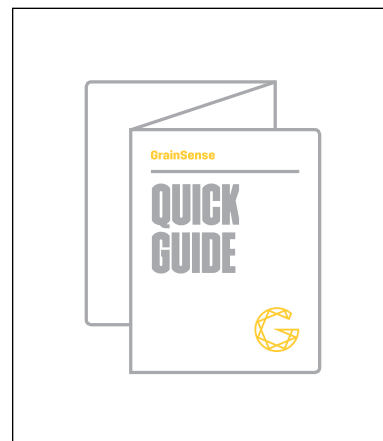
3.1.1 Downloading the application from the app store
GrainSense device requires a mobile phone with Bluetooth LE connectivity and an application to configure the device and store the results. GrainSense application is available at official Google Play and iOS app stores. Search using "grainsense".

Download and install the app for compatible Android (OS 6.0 or higher) and iOS (OS 9.0 or higher) phones.
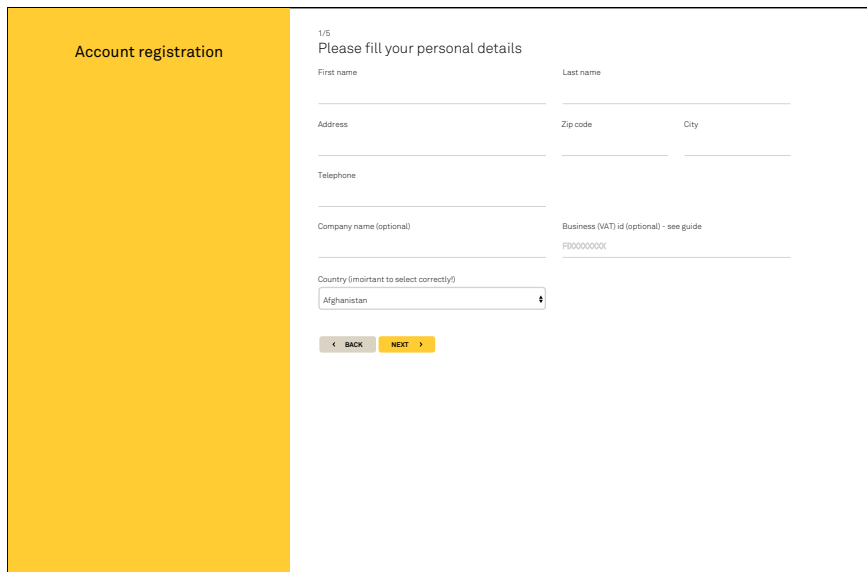
3.1.2 Registering to GrainSense cloud
Registration is done via separate web application at www.grainsense.com/register. There are several ways to do the registration.

1. Open the application from the app on the phone and click "Not yet registered?" link
    a. A web browser is opened from the phone, fill in the details
2. Open a laptop or tablet and go to the registration URL
    a. www.grainsense.com/register

Follow the instructions in the registration application. Add an email and a password, input a confirmation token that is sent to the email address. You have now registered an account successfully.

Note! During the registration a verification token is sent to the user's email address, so the user must have a way to check email during registration.

Note! Please select the country in which you will use the GrainSense device, this is important for receiving the right calibration updates.

Account registration	1/5 Please fill your personal details

First name / Last name

Address / Zip code / City

Telephone

Company name (optional) / Business (VAT) id (optional) - see guide
F00000000X

Country (imoirtant to select correctly!)
Afghanistan

< BACK   NEXT >

3.1.3 Login to an account
After successful registration, the user can open the app and log in using the email and password provided in the registration application.

If you have already registered, add your email and password and login. All previously measured data should update from the cloud to the application.

3.1. 4 Connecting the device and mobile phone
See 3.3.2.1 Pairing the device and the phone (page 17)

Note! The connection to the device can always be disconnected or re-connected from the app, left menu and "Device".

Note! The initial connection can be skipped using the link in the upper right corner.

Note! Some Android phones have known issues with Bluetooth (e.g. Huawei and HTC). It is important to have a backup solution if the connection does not work. Grainsense recommends Samsung Android phones Galaxy Xcover 4 as an alternative phone.

Note! Device must be shut down and restarted when the initial setup configuration is uploaded from the phone.

3.1. 5 Configuring the device

Please connect to the device first with the mobile application (see 3.3.2.1 Pairing the device and the phone, page 17).

All configurations are uploaded automatically to the device when changed.

Note! You can select a maximum of four species to be uploaded and stored in the device.

3.2 Requirements for reliable measurements

The cornerstones to get reliable measurements with the GrainSense device are representative samples and a correct use of the device (see 3.3 Doing a measurement, page 15).

Obtaining a representative sample from a lot of grain is an important and essential part of the grain inspection process. If the sample is not representative, the final quality results will not reflect the true quality of the lot.

In the field

- In order to obtain a representative average reading, the measurements must be carried out randomly distributed across the field.
- When measuring, avoid any atypical areas of the field (e.g. areas with distinctly different soil properties, such as sand banks or similar)!

From the truck/silo

Different guides about grain sampling already exist, including:

- AHDB, UK: Grain sampling guide for cereals and oilseeds.
- USDA, USA: Grain Inspection Handbook - Book I - Sampling.

Note! It is not GrainSense's role to provide a sampling guide, only advice can be given.

3.3 Doing a measurement

Please follow the quick guide to do the first measurement, the measurement procedure is also detailed below.

3.3.1 Sample size and placement of kernels on the tray

For most cereals, the size of the sample should be about 60–80 kernels corresponding to 3–5 grams. When kernels are bigger, the number of kernels can be reduced. For rapeseed, the amount of seed should correspond to about 2g. (Figure)

Species	Sample Size	Placement
Wheat	3g	Even spread across tray
Barley	3g	Even spread across tray
Oats	3g	Even spread across tray
Rye	3g	Even spread across tray
Rape Seed	2g	Towards bottom of tray, non overlapping

The user can use the grain measurement cup to sample the right amount of grains. If you are using the older GrainSense yellow measurement cup, only a thin layer of grain covering the bottom of the spoon is enough. For a more precise sampling, use the set of GrainSense spoons and choose the proper spoon size according to the grain type selected (2,5ml for rapeseed and 5ml for cereals: wheat, barley, oats and rye). The device will also tell you rather the sample is too big or too small with an error message. In this case, take the sample away from the tray and start from the begin (as for a new measurement).
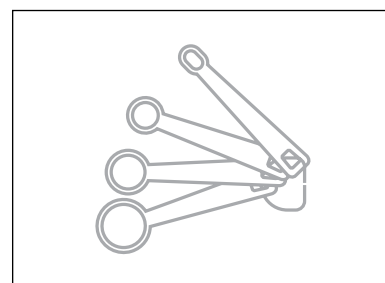
When taking measurements from a larger batch of grain, it is important to remember the following:

• Make sure the subsample taken has come from a larger sample that has been mixed as well as possible.
• For better results, it may be best to take more than one subsample and average the results together in the app.
• Try to avoid any foreign matter from being placed on the tray in addition to the species being tested.

How the tray should be loaded:


Wheat

Barley

Oat

Rye


Rapeseed

3.3.2 Measurement procedure
Please note:

• Use the appropriate spoon for getting the right amount of kernel on the tray
• Place the sample nicely on the tray so kernels are not overlapping
• Keep the measurement device straight in your hand and avoid moving during the measurement (when the light is sent)
• Intensive solar radiation can influence the result. Hold the GrainSense device so that it is covered by the shadow of your body in extreme conditions
• Make sure the sampling tray is well engaged

3.3.2.1 Pairing the device and the phone

1. Open the GrainSense application, go to "device" in the menu
   a. Make sure that Bluetooth is enabled
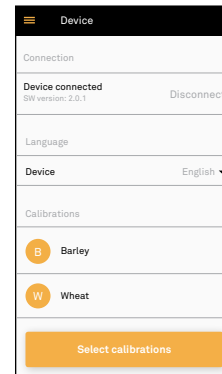
2. Power on the device

Syncing...

Done!
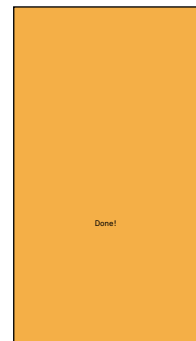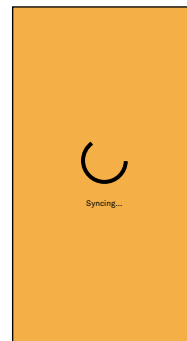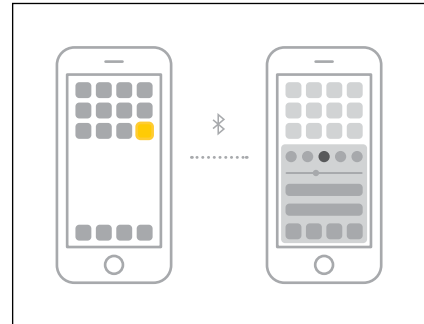
3. Click "Connect to device" from the application
   a. The application should discover and connect the device
   b. Configurations are uploaded automatically
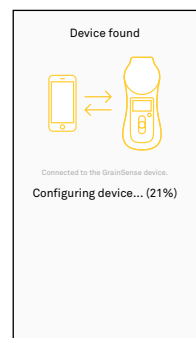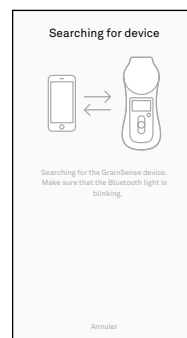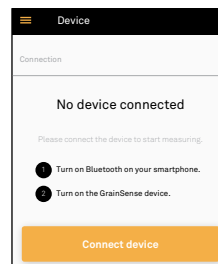
During the first login the application will ask to connect with the device:

1. Power the device and wait until the display says "Updating settings…".

2. Click "Connect" from the application to connect to the device
    a. This might take up to 20 seconds

3. The application displays a successful connection and automatically updates the initial settings to the device

4. User can go to "Device" and changed the device and app language

5. User can go to "Device" and add more calibrations

3.3.2.2 Taking a measurement

1. Power the device by pushing the power on button.

2. Select the type of grain you want to measure from the device
    a. Use arrows up and down to change option
    b. If the grain type is not available, configure the device first (see 3.4.1 Updating the calibrations on the device)

3. Check that the sphere is empty and close it carefully

4. Click confirm button to start
    a. Wait until the reference measurement has been done
    b. **Note!** The sphere should be empty during the reference measurement.
        Note! If you opened the sphere while the reference was taken, shut off the device and start from the beginning.

5. Open the sphere and insert a small amount of grain (see 3.3.1 Sampling size and placement of kernels on the tray)

6. Close the sphere and click the confirm button

7. View results using up and down arrows

8. Click confirm to send results to a mobile phone or discard the results
    a. If not connected to a mobile phone, then results are not stored
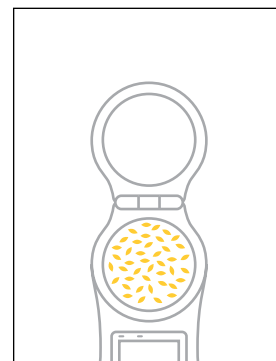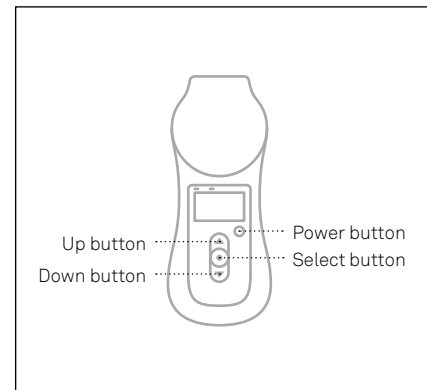
Note! You can carry in your GrainSense bag, a sample of grains that has known protein and moisture content. You can verify that the device works properly once in a while.

Note! Grainsense application automatically stores location information of every measurement if location rights are granted to the application. The measurement location corresponds to the location of the phone.

Note! The device has no memory to store any results.

3.3.2.3 Viewing the results, adding notes and averaging and sharing results

For viewing the results

1.   Open GrainSense mobile application, go to "Measurements"
2.   Click any result to open a result view

For adding notes

1.   Open GrainSense mobile application, go to "Measurements"
2.   Click any result to open a result view
3.   Click on "Comments" to add any comments.
4.   Click on "show on maps" to see the location of the measurement

For deleting measurements

1.   Open GrainSense mobile application, go to "Measurements"
    a.   Click on the pencil on the right up corner
    b.   Select the measurement(s) to delete
   c.   Click on the bin "Delete"

Or

1.   Open GrainSense mobile application, go to "Measurements"
2.   Click any result to open a result view
3.   Click on "Delete measurement"

For averaging several measurements

1.   Open GrainSense mobile application, go to "Measurements"
    a.   Click on the pencil on the right up corner
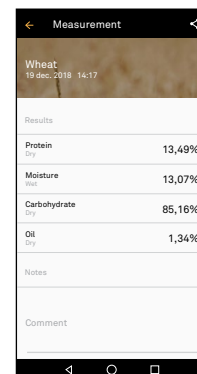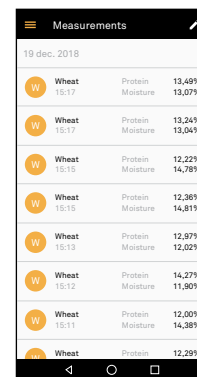   b.   Select the measurement(s) to average
    c.   Click on the "Average" icon

For sharing results

1.   Open GrainSense mobile application, go to "Measurements"
2.   Click any result to open a result view
3.   Click on the share button
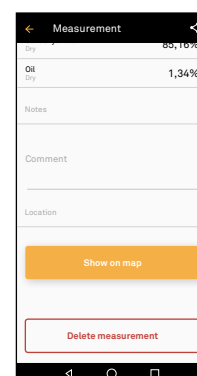
3.4 Maintenance and servicing

The sampling tray should be kept clean and the batteries changed when needed. To assure the accuracy of the measurement, the device should be regularly connected to the phone to upload the latest updates from the cloud to the device.

3.4.1 Updating the calibrations on the device

When new calibration updates are available (usually in the summertime - user informed by the distributor or the GrainSense Newsletter), the pairing of the phone and the device should be done again.

For that, the app should be completely closed and the device turned off. Then, the app should be opened with a working internet connection (to synchronize with the cloud) and the device connected to the phone. To be sure that the calibration updates have been uploaded to the device, close again the app and turn off the device.

3.4.2 Replacing the batteries

Turn off the device. Open the battery cap with a flathead screwdriver and replace the old batteries with batteries of the same type: 6 x AA Alkaline.

We recommend using AA batteries labeled for industrial use for maximum performance (i.e. optimized for high drainage).

Note! Please make sure the batteries are inserted into the device properly.

Note! Please make sure that the cap is well closed.

AA batteries

3.4.3 Cleaning

The tray is removable and opens by turning it counter clockwise about 40 degrees.

Never use running water or chemical cleaning agents on the sample slot (e.g. domestic cleaner, alcohol or cleaning solvent). If required, clean the sample slot with a dry, clean and soft cloth.

3.4.4 Transport and storage

The device should always be transported and stored in the carrying bag (see 2.1.3 Technical specifications, page 8).

When transporting the GrainSense, avoid knocking and scratching the display. Keep the GrainSense device in the supplied belt bag. Only take the device out from the carrying bag for measuring.

3.4.5 Disposal

The device and batteries may not be disposed of in normal domestic rubbish.
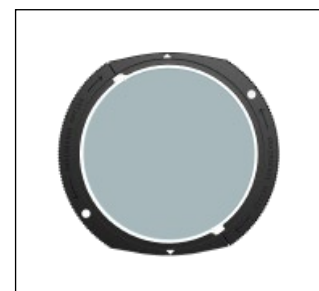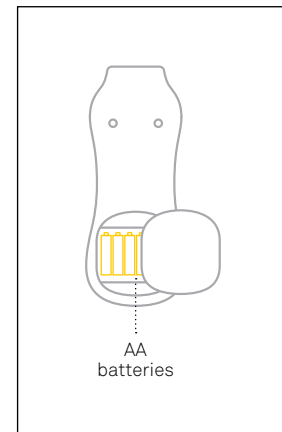
4. Help

Note! FAQ and Troubleshooting can be found on GrainSense´s website, in the support page: www.grainsense.com. You can also the tutorials on GrainSense youtube channel.

4.1 Troubleshooting

My device shows "Wheat" but it shows "Barley" in the app

Make sure that the device is paired with the phone. After shutting down both the device and the app, turn them on. On the app, go to "Device", click on "Connect to device" and wait for pairing.

I am trying to measure rapeseed but the device keeps saying "Too small"

For rapeseed, the amount of seed should correspond to about 2gr. After loading the seeds on the tray, take the device in your hand and move it around so all the seeds slide down the tray without overlapping. About 40% of the tray surface should be covered.

My device shut off when I tried to take a measurement

Unfortunately, different branded batteries can behave differently, which means our software doesn't capture the capacity correctly. In these cases, the batteries can stop working without any indication of battery led. Change the batteries.

We always recommend by best possible Alkaline batteries (AA) that are optimized for high drains (e.g. for remote controlled cars).

My device won't turn on

Just be sure to make sure that all batteries are full, installed correctly and that the back of the device is screwed on properly. Simply hold the power button until the screen turns on.

My device is broken, what can I do?

Please contact the local salesperson or distributor. They will help you with further actions. You can also contact the support service of GrainSense at support@grainsense.com. Please contact us clearly stating the problem, your contact details, device serial number, and the email of your registered account.

The arrows on the device are not changing the species

The device is connected to the app and only shows the species that are selected on the app. To change or add other species to the device, make sure that your device and the phone are connected. Then on the app, go to "device" and click on "Select calibrations", choose the species you want to upload to the device.

4.2 FAQ

What do I get in the package?

The package includes the following items:

- GrainSense device
- AA batteries (installed)
- Grain measurement cup
- Official Cap
- Carrying case
- Quick guide

How accurate is the device?

If used properly, based on the guidance, the accuracy is the same level expected from a laboratory level device.

What species are included in the price?

At the moment, GrainSense developed five calibrations: wheat, barley, oats, rye, and rapeseed. New species can be added according to needs and available species are country specific. Please check which harvest updates are available in your selected region. Event though all 5 species are visible in the app, only the species calibration supported for your country will give an accurate result. Please check with the salesperson or distributor.

What technology is behind GrainSense?

The basic measurement principle is identical to that used in laboratory devices, namely near-infrared spectroscopy. The main difference behind the GrainSense device is it's patented sphere design to make measurements. The sphere design reduces the amount of light that escapes, thereby allowing the device to be battery operated and handheld.

How big should the sample size be, and is it representative?

The sample size should be 60–80 kernels, which is a statistically representative sample size (3–5 grams). If the sample is too large, there is a risk of kernels covering each other and distorting the results. If you have a large batch, we recommend taking 3–4 samples from different places. The GrainSense app will then help you calculate the average values.

Where will my data go and who can access it?

When you send your results from your device to the GrainSense app, your data will be securely stored in our database. Only you will be able to access your personal data via the GrainSense app and the Farmer Dashboard.

If I make a measurement, can I send the results to someone else?

After saving a measurement to your GrainSense app, you can share your results via WhatsApp, Email, Facebook and many other networks.

Can I use GrainSense without a phone?

You need a phone and an account to upload your settings into your device, including your selected species. When that is set, you can use the device without a phone. Please note, without a phone you will not be able to store your results anywhere, neither get the GPS location of the measurement.

What sort of guarantee is included?

The device comes with a 1-year technical guarantee. The grain species calibrations are kept up-to-date on a yearly basis, which will automatically be available for download on the GrainSense app. (See the Terms of Use available of GrainSense website, in the "Support" page).

Do the grain calibrations work for grain from anywhere in the world?

We can only guarantee lab-level accuracy for the grain calibrations in the countries we are currently supporting. In countries where we are not officially selling GrainSense yet, the results may vary as laboratory devices per country are annually calibrated with different samples.

CONTACT

For any support, please
contact your salesperson or
support@grainsense.com