



TURNING INFORMATION INTO PROFITS

Soil Temperatures & Moisture for Seeding and Crop Emergence: Early Versus Late

General Factors Impacting Seeding and Germination

The important point to remember is not how early the seed should be in the ground, but what can be done to get it out of the ground as soon as possible, so that the plant is growing healthy.

- **SOIL TEMPERATURE** –The most critical factor is soil temperature. Soil temperature **drives all metabolic processes** and although many of the other factors such as moisture, aeration, nutrition and depth are also important, they do not begin to influence the seed until it's warm enough to start all the biochemical processes of **seed germination: >4°C to 6°C is preferred for cereal and oilseeds**
- **SOIL MOISTURE** - Soil moisture affects how quickly water penetrates the seed. Seeds require a percentage of moisture by its weight, before germination takes place. **Having adequate moisture in terms of stored soil water and early spring precipitation plays a large role in successful and rapid germination, at the correct temperature. Dependent on soil type: e.g. >25-30% VWC**



- **FERTILIZER RATES** - The amount of water available for germination **is affected by the type, amount and placement of fertilizer**. Fertilizers placed very close to or with the seed will reduce the amount of moisture available for seed germination because these fertilizers end up using some of the available moisture to dissolve the fertilizer and bring it into solution.
- **DEPTH OF PLACEMENT** - Seeding depth is the next factor that's important in rapid and even germination. Soil moisture, soil temperature, soil type, trash cover, and others, all affect seed depth each year. Depth will vary based on soil temperature and moisture – shallow with cold, wet soils. Deeper with dry and warm soils. **Generally, 3.5 to 7.5 cm.**
- **SPRING SPRAYING** – Pre-seeding spraying is very important. Weeds that emerge before the crop, will **out-compete the crop for moisture, nutrients and sunlight**. Just a small number of weeds, a few per square foot, emerging before or with the crop can be much more damaging to yield potential than a larger number of weeds developing later



Factors Affecting the Early Versus Late Approach

Seeding in Western Canada can range from April through May and sometimes into early June, if flooding occurs.

What is to early or to late for crop development and ultimately yield?

Fundamentally, seeding into warm soils ensures the best start for the crop. Proper germination and crop emergence is an important step for reaching the crop's yield potential.

There is plenty of evidence that shows seeding early (in April) will produce the best yields, but this is **very much dependent on soil temperature and crop type**.

Benefits include:

- Better soil moisture for germination and development
- reduced weed competition,



- less synchrony of the crop to susceptible insect stages,
- reduced heat stress/damage and
- better harvest conditions (warmer conditions in August and early September).

Most cereals and oils need an average daily soil temperature of 4°C to 6°C, while corn, soybeans, edible beans, flax prefer average daily soil temperature of 8°C to 10°C, otherwise you risk poor germination and uneven stand development.

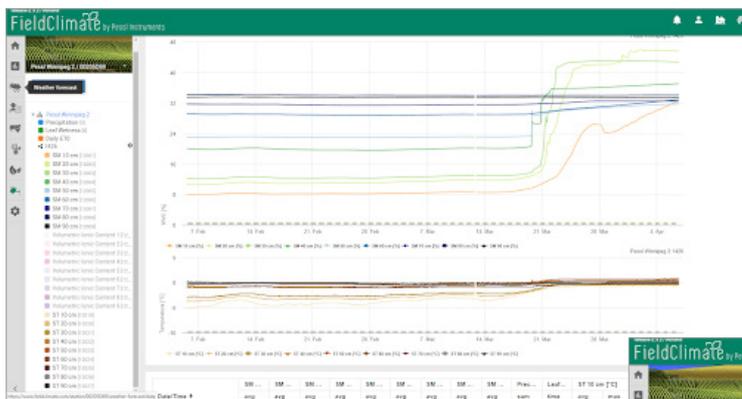
Seeding into cooler or cold soil can result in slower emergence and the chance for soil pathogens to affect the crop, which can affect yield potential.

What are the IoT Solutions required for Timely Sowing?



iMETOS 3.3 IMT300 Full Weather Station

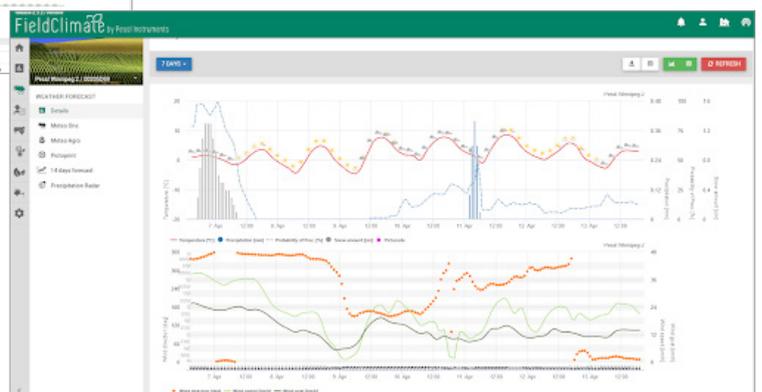
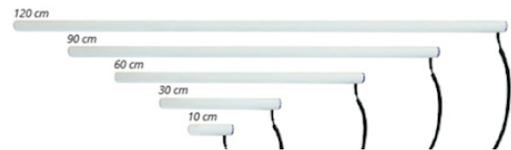
- Air temperature
- Relative humidity
- Rainfall
- Leaf wetness
- Global radiation
- Windspeed



Site Specific Forecast

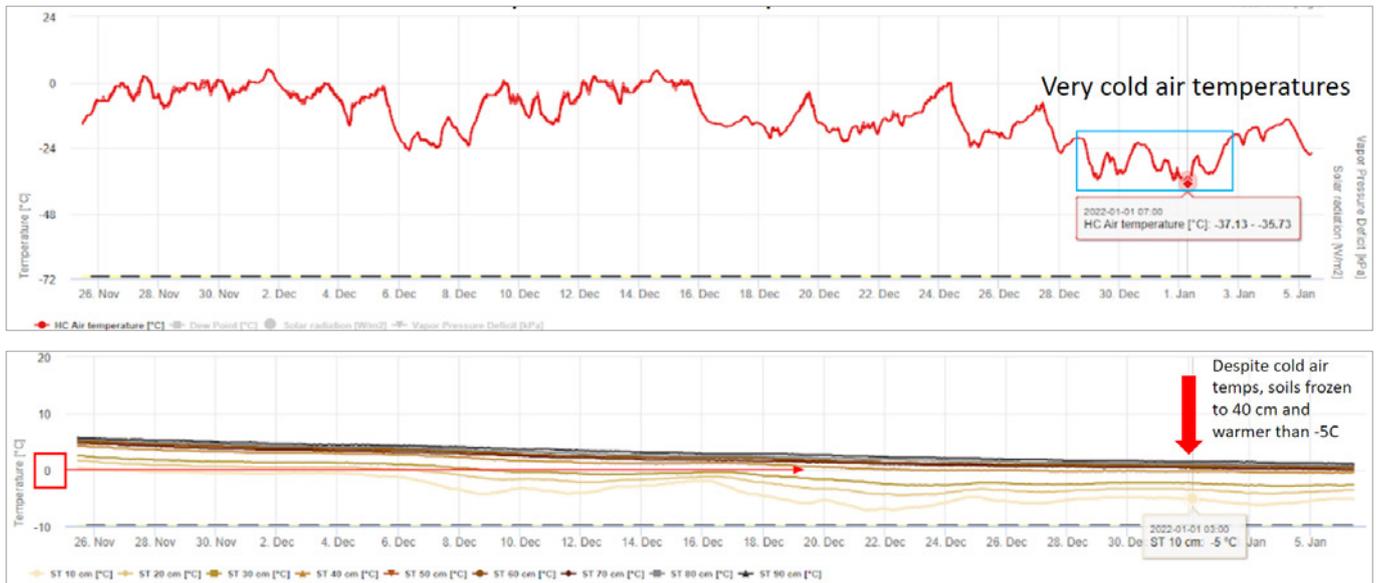
SOIL MOISTURE ADD-ONS

- Drill and Drop Soil Probe for Soil Moisture and Temperature

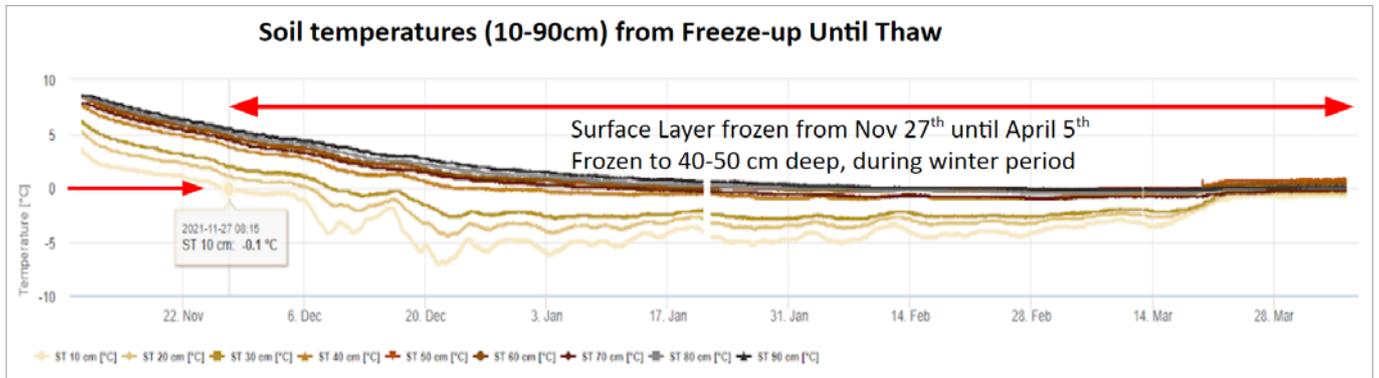


Use case - Winnipeg, Canada: A Look at Last Year Versus This Year:

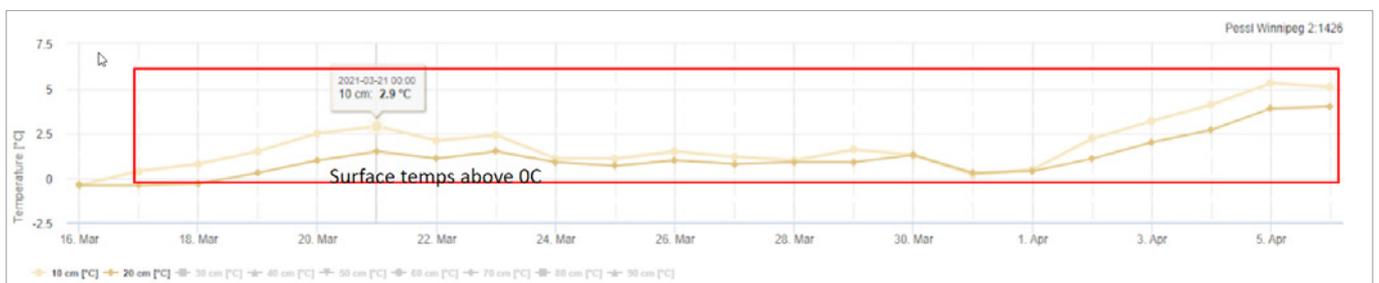
2021-2022 Average (10-90 cm) Soil Temperatures and Impact on Soil Temperatures



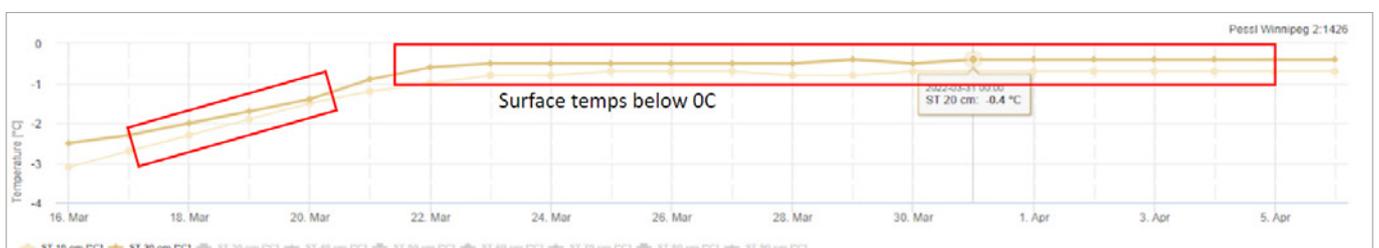
Soil temperatures (10-90cm) from Freeze-up Until Thaw



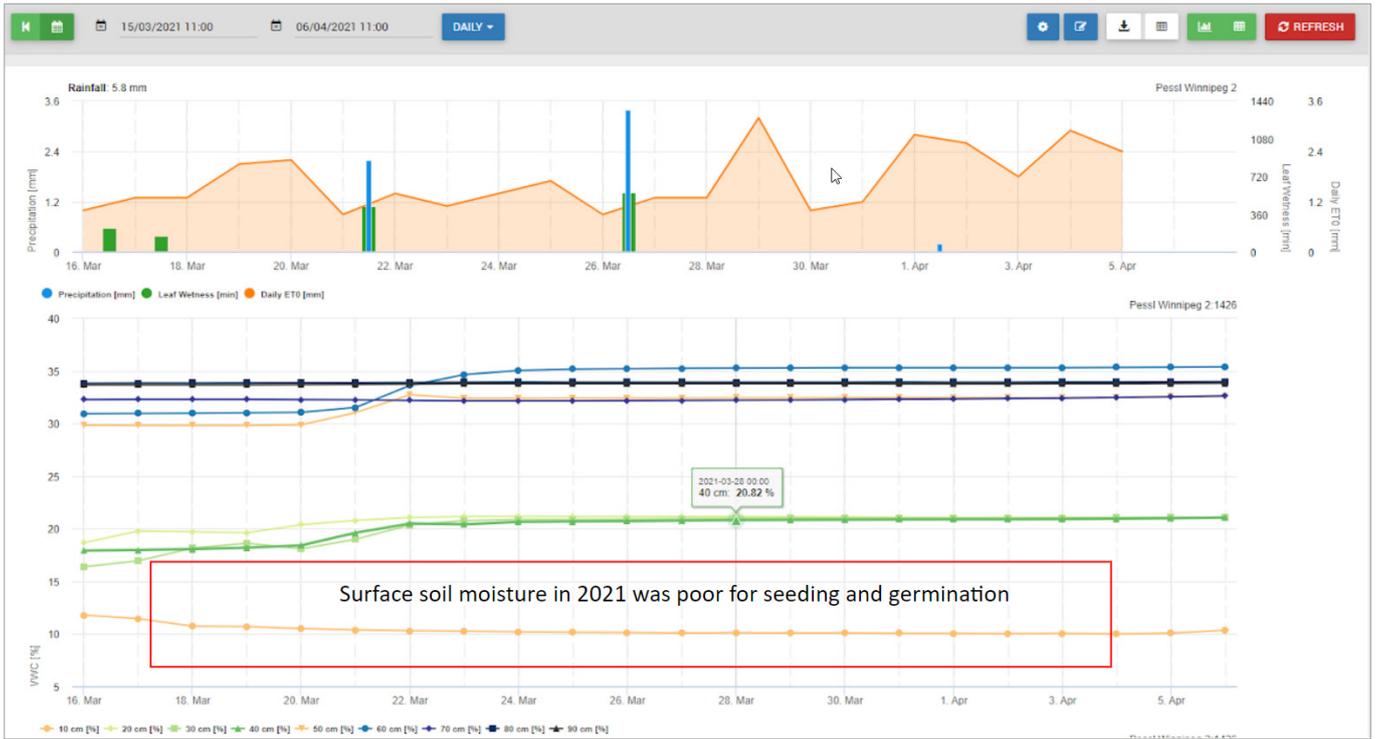
Last Year, 2021 March 16 to April 6 : Daily Average Surface (10-20 cm) soil temperatures



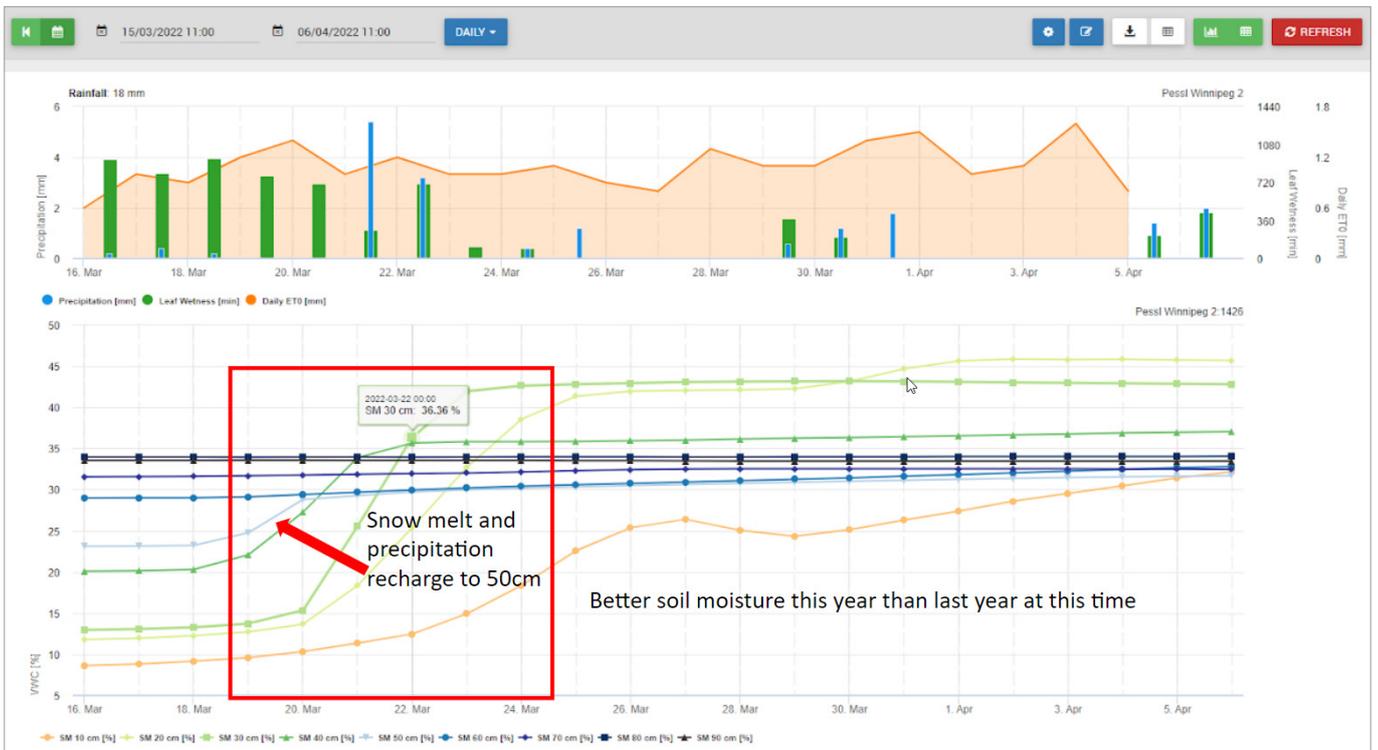
This Year, 2022 March 16 to April 6: Daily Average Surface (10-20 cm) soil temperatures



March 15 to April 6, 2021 Daily Average (10-90 cm) Soil Moisture (VWC%)



March 15 to April 6, 2022 Daily Average (10-90 cm) Soil Moisture (VWC%)



Can I Determine the Future Sowing Window for My Field?

- **Weather forecast**
- **Work Planning Tools**
 - Sowing Window
 - Plant Nutrition
 - Field Accessibility
 - Tillage Ability
 - Plant Protection
 - Harvest Window

HOLISTIC SOLUTIONS FOR PRECISION AGRICULTURE



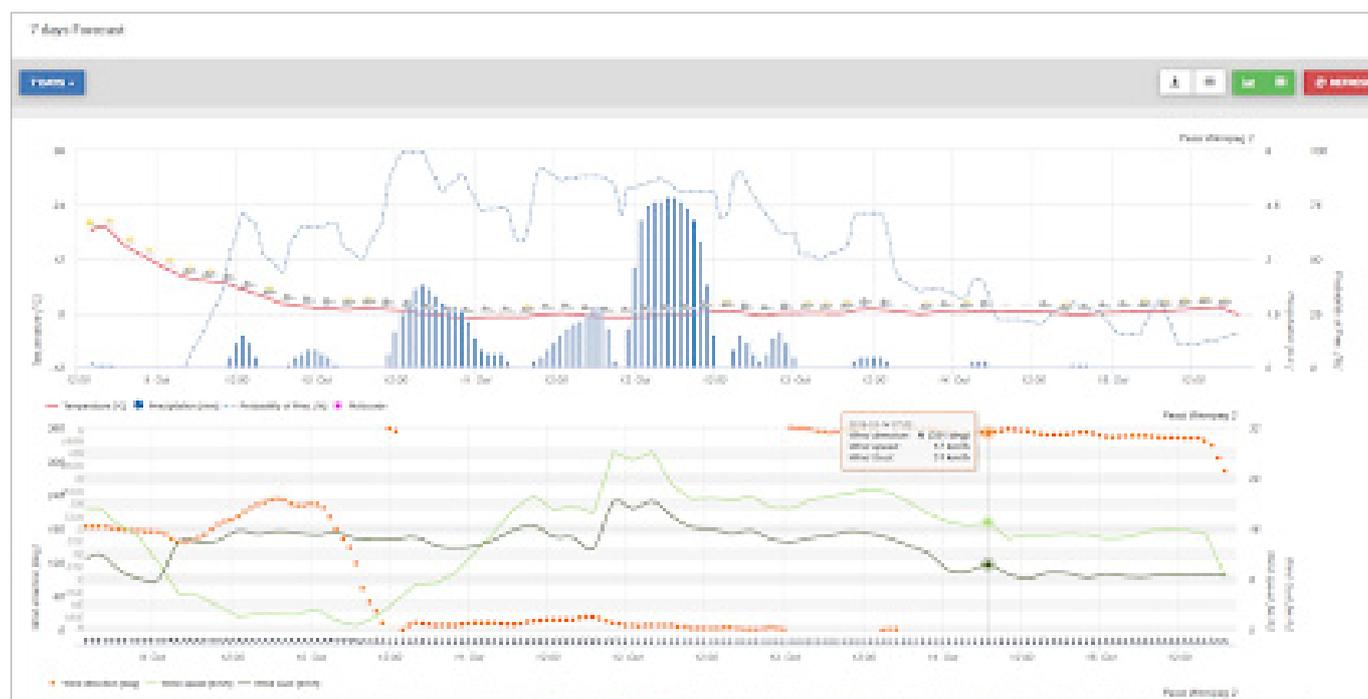
Note: Each of these process can have significant impacts on crop yield and quality

Value Proposition for Site Specific Weather Forecasts and Work Planning Actionable Tools

Hourly updated, location specific forecasts for work planning

- Optimally **plan and seed** based on site specific forecasts
- Know when fields are accessible based on forecasted rain amounts
- Know when to spray based on forecasted rain amounts and timing, wind speed and direction for early season spraying
- Control early season weeds
- Know when forecasted lows may impacted spray efficacy

Detail - Site Specific Forecasts



Output data for multiple forecast variables, every hour – wind speed/direction, gust, RH, temp., precip amount and probability, leaf wetness, global radiation, cloud cover and daily ET_0

Value Proposition = Less Risk, Efficient Management

Weather Forecast - iMeteo in FieldClimate Since 2008



meteoblue weather model

Weather forecast is provided by meteoblue



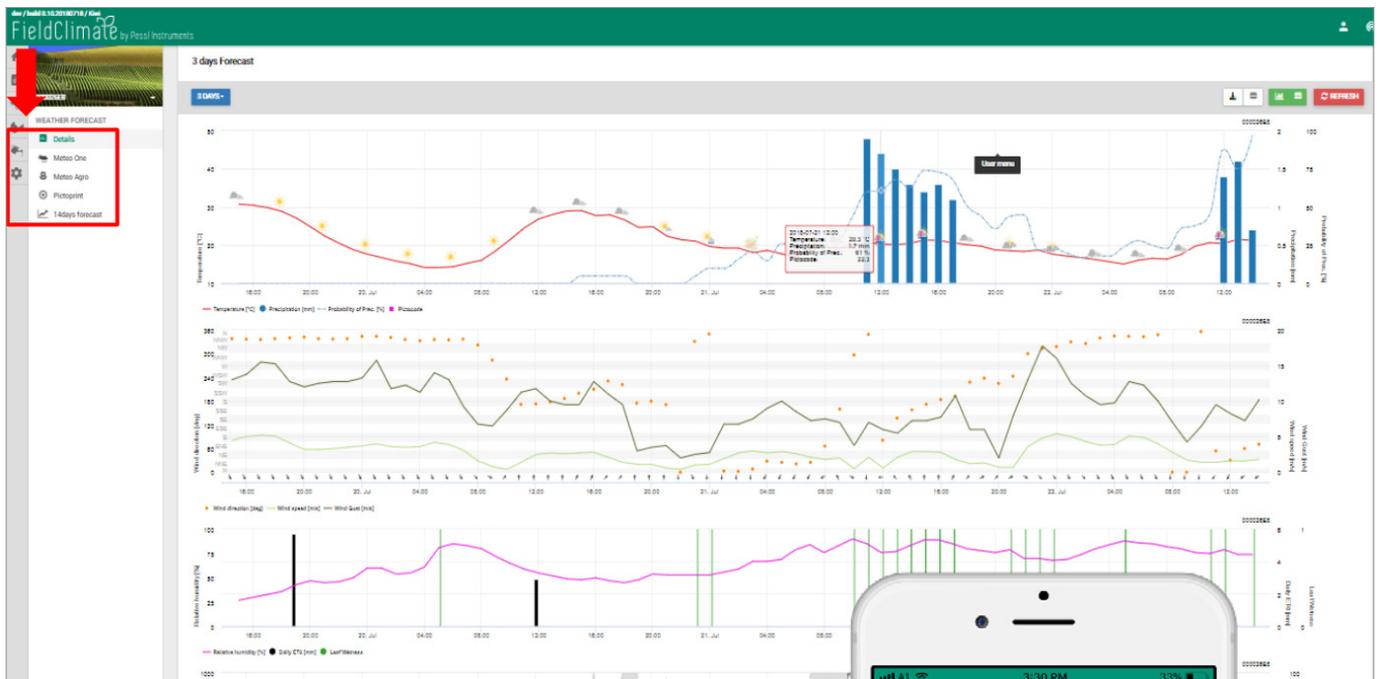
iMETOS station

Observation data are collected by each station



FieldClimate platform

Site-specific weather forecast



Work planning tools – Sowing window

Germination and **crop emergence** are phases with a significant influence on harvest yield and quality.

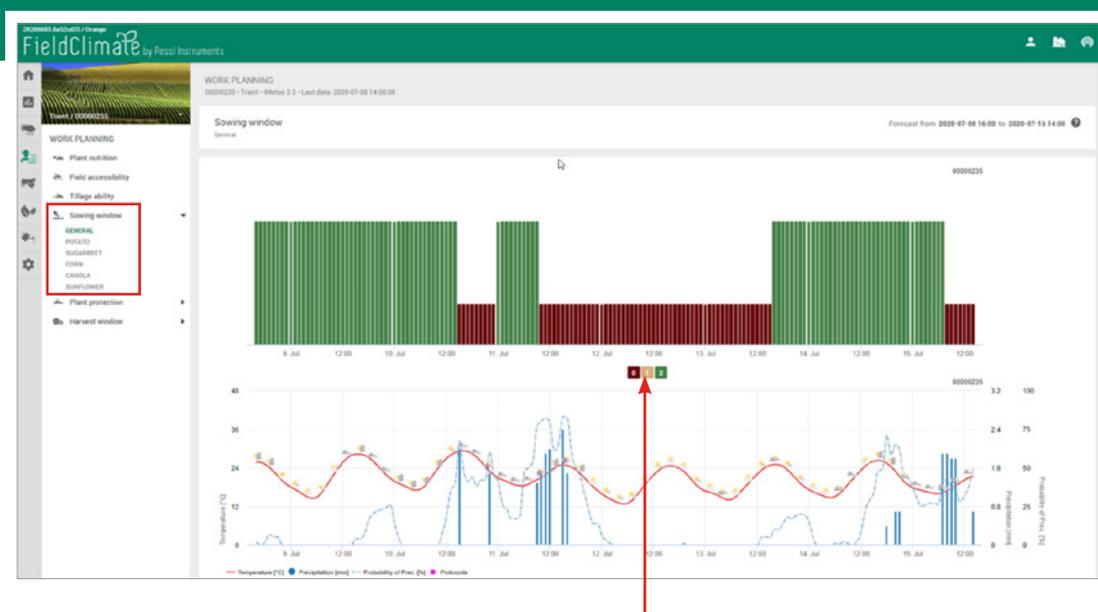
- For uniform, rapid germination and emergence, all seeds need correct moisture and optimal temperature ranges.
- Conditions are calculated from soil temperature, rainfall of the previous days and minimum air temperature of the next days.
- Cereal and oilseeds germination requires minimum temperature of 4 to 6°C in the seed zone.



- Soil temperature
- Soil moisture (10-20 cm depth)
- Air temperature
- Evapotranspiration

Based on the needs of the type of crop, there are dedicated windows for sowing conditions:

- **General**
- **Potato**
- **Sugar Beet**
- **Corn**
- **Canola**
- **Sunflower**



Suitable (green), less suitable (yellow) and unsuitable (red) periods to seed corn, potatoes, sugar beet, canola, sunflower and more general crops.

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