

Calculating the number of available days

Choosing appropriate tools for the level of climatic risk

How can you reduce machinery costs and choose equipment suited to the size of your farming business, taking account of potential climatic risks? The available days calculation tool supplied by ARVALIS-Institut du végétal helps you find the best solution.



The farmer will have to deal with climatic constraints, which will have an influence on the equipment size choice.

The cost of using equipment (drill, stubble cultivator, combine harvester...) gets lower as the area over which it is used annually increases. Therefore, many farmers are tempted to increase the area they work. However, this could result in being in a weak position for coping with adverse weather conditions, often making it difficult to finish a particular task on time, or making it necessary to carry it out in poor conditions. When investing in equipment, the solution chosen must be the result of careful consideration, with a cultivation area big enough to dilute costs to an acceptable level, whilst remaining reasonable in order to also keep climatic risks down.

More generally, the decision-making process must also take account of the range of increasingly large and powerful equipment offered on the market, as well as of time saving considerations, which many farmers now find important (either because they farm larger areas, or because they wish to reduce labour costs, or even in order to develop another activity). It is therefore useful to have reference points regarding what can be done, within a given time scale, while at the same time dealing in the best possible way with climatic constraints.

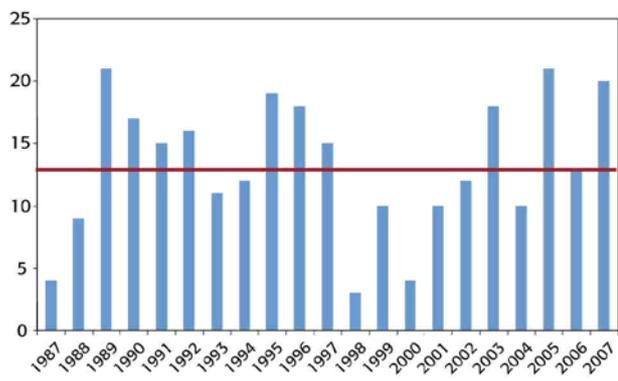
Calculating the number of available days depending on the local situation

The "Available Days" model developed by ARVALIS-Institut du végétal at the beginning of the 90s, can be a very useful tool to help decide for example between a 3, 4 or 6 m direct drill, a 24 or 36 m sprayer or what size of combine harvester to buy.

For each soil and climate combination studied, the model is based on two large sets of parameters:

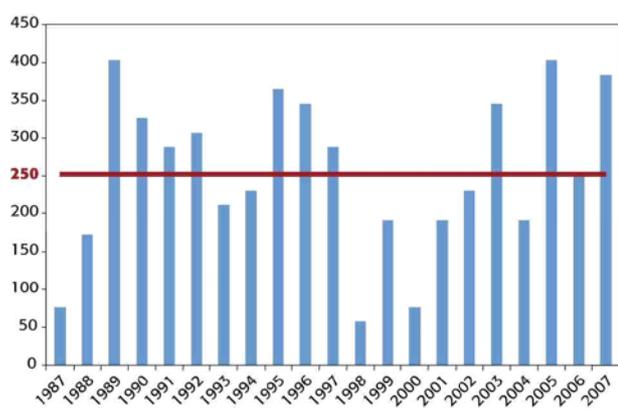
- first of all, meteorological data (rainfall, potential evapotranspiration, max and min temperatures), and daily data over 20 or 30 years. The Available Days approach is based on the strong hypothesis that the climatic sequence of the last 20 to 30 years will be roughly replicated in the future, with the same rate of recurrence of good and bad years (global warming is not taken into account, but it is unlikely that this factor should already have an impact on the size of the equipment used).
- secondly, soil description (clay content, stone content...) and more precisely an evaluation of the ability of the soil to drain and dry after heavy rain.

Available days for sowing - Wheat sown between 11/10 and 31/10 - Boigneville weather station (near Paris) (fig. 1)



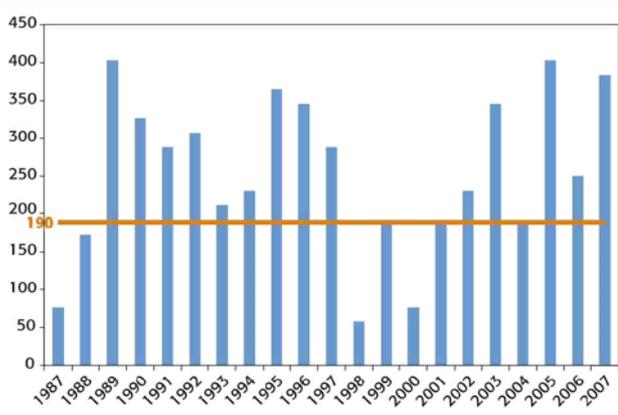
The 20 year average shows that there are 13 available days for sowing wheat in good weather conditions.

Size of area that can be sown, depending on the number of available days - wheat sown between 11/10 and 31/10 - Boigneville weather station (near Paris) - Hypothesis: 8 h/d, 2.4 ha/h - Climatic risk set at 5/10 (fig. 2)



Starting from a hypothetical 250 ha to sow, the climatic risk is 5/10, which is not acceptable.

Size of area that can be sown depending on the number of available days - wheat sown between 11/10 and 31/10 - Boigneville weather station (near Paris) - Hypothesis: 8 h/d, 2.4 ha/h - Climatic risk set at 2/10 (fig. 3)



In the situation presented by the Boigneville station, with a given climatic risk of 2/10, a 3 m drill can sow 190 ha.

This information helps to calculate daily soil moisture over 20 or 30 years, which gives an indication of the load bearing level of the soil. Agronomists have defined upper limits of soil moisture for most agricultural operations (sowing, shallow or deep cultivation, spreading, spraying, harvesting, planting). Those moisture limits help to ascertain whether the day in question is an available day (satisfactory load bearing level) or not (the soil load bearing level would mean the farmer would not be working in good conditions).

In addition to soil load bearing level, and depending on which cultural operation is being performed, the model also takes account of constraints linked to max and min temperatures (spraying), rain (harvest), drought (shallow cultivation)...

Evaluating the level of climatic risk

Over time, the model has been validated in various situations and its theoretical results do match real observations (*Perspectives agricoles No. 272*). Part of its testing took place at the ARVALIS- Institut du végétal Boigneville research station, near Paris, with a clayey-calcareous soil that drains and dries well. Weather records for the 1987 to 2007 period show that for autumn sowing, carried out between 11th and 31st October, (*figure 1*), the number of available days varies greatly. Good years and bad years alternate, with very positive extremes (in 1989, every day was available) as well as very negative ones (only 3 available days in 1998). The average over 20 years gives 13 available days, represented by the red horizontal line.

We then set two parameters: an 8 hour sowing day and a work rate of 2.4 ha/h (consistent with a 3 m direct drill). Multiplying those two parameters by the number of available days calculated each year, gives the number of hectares that can potentially be sown within the number of available days (*figure 2*).

Naturally, there is the same degree of variability as in *figure 1* and the range of areas that can be sown varies between 50 ha (1998) and 400 ha (1989), with an average of 250 ha.

Can this average of 250 ha be used as an acceptable objective for a 3 m drill? Of course not. In *figure 2*, we see that the 250 ha objective was not reached in 10 of the years represented, i.e. a risk of every other year. In other words, if aiming for 250 ha, there would be a risk that part of the area might be sown after 31st October, or sown in bad conditions every other year. This is a very high level of risk and is not acceptable.

Therefore, the next step is to lower the red line (objective line) and to set it to an area offering an acceptable risk level (variable depending on individual circumstances).

We decided to set it at 190 ha (*figure 3*), putting us in a safe position since the climatic risk is 2/10 (only 4 of the years did not reach the 190 ha orange line).

Each individual farmer must define what level of risk is acceptable to him, and adapt his tools according to the area he has to sow.



The number of available days depends on the ability of the soil to drain and dry after heavy rain

Increasing the number of simulations

This approach has the advantage of quantifying climatic risk with a score. It helps the farmer to choose equipment more rationally, weather vagaries usually being perceived subjectively (our memory tends to keep track of difficult years).

The Excel application lends itself to simulations and parameters can be changed ad infinitum: the above example, with a 4 m drill, and therefore a work rate of 3.6 ha/h, with the same climatic risk level (2/10), would allow sowing 280 ha.

If a farmer must choose between a 3 and 4 m drill, the Available Days approach will help him to gauge the size of the area that can potentially be managed by each of the machines. It gives a broad decision criterion. But to refine the decision-making process, the next step is to calculate the provisional cost of each of those machines and to determine time-saving objectives. Here again, ARVALIS-Institut du végétal can offer a helpful method involving the Compéti-LIS software.

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