Potatoes

Adapting cropping techniques to culinary use

The potato sector's commercial strategy for ware potatoes destined for the fresh market, is based on a segmented supply according to variety and culinary use. Such demands require production adjustments.

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Each culinary use has its potato! Suitability for specific culinary uses is the main piece of information required by consumers. In order to supply products that are adapted to different culinary segments, and meet the requirements of the interprofessional classification grid for the fresh market (CNIPT, 2005), production factors must be adapted according to the intended use. This article focuses more particularly on chipped and mashed potato. The tubers used to make them must:

- be of even size, maturity and appearance, and free from internal defects,
- flake easily with cooking (for mashed potatoes),
- have an average floury texture (for chipped and mashed potatoes alike), be light coloured to moderately golden and have a moderately oily appearance (for chipped potatoes).

In addition, tubers destined for chip making, should be quite large (50-75 mm), preferably oblong or with an elongated oblong shape.

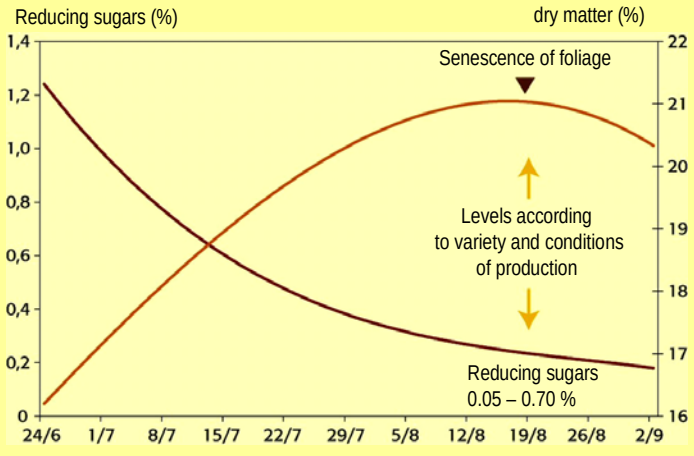
Monitoring dry matter and reducing sugar contents

Dry matter and reducing sugar content plays a crucial part in the quality of chipped and mashed potatoes. Dry matter consists of the starch synthesised in the tuber from the sugars produced by the leaves.

During growth, it increases in line with the yield and reaches its maximum towards full maturity (yellowing of haulm).
High dry matter content makes chips crunchier and improves the consistency of mashed potato, as well as helping to reduce the greasy aspect of chips. Most varieties, and Bintje in particular, should have a dry matter content of between 19.5 and 23%. If it is too high, tubers are more susceptible to internal bruising ("black spot"), mashed potatoes are floury and chips are too dry.

Conversely, the reducing sugar content (glucose and fructose) decreases during the cycle, to reach its lowest level at maturity *(figure 1)*.

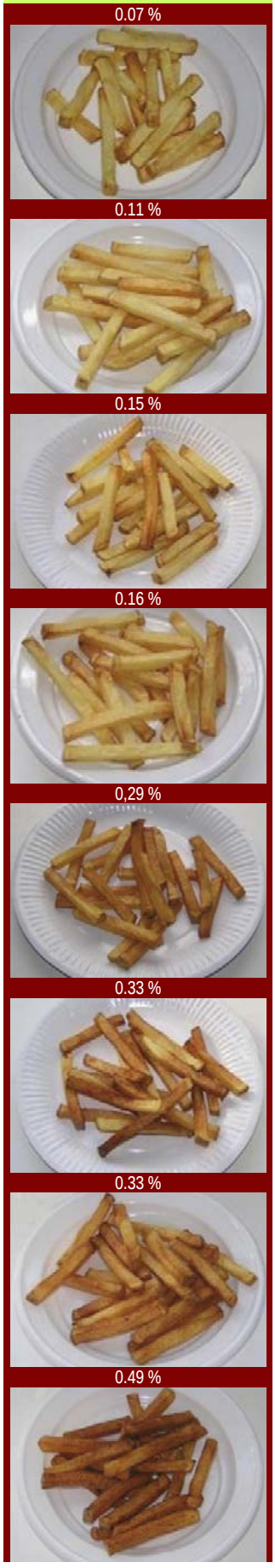
Example of the way reducing sugars and dry matter change duringthe vegetative cycle *(fig. 1)*



Harvest at full maturity helps to obtain optimum dry matter and reducing sugar contents.

Immature tubers, rich in water and sugars, or tubers of an inappropriate variety or inappropriately stored produce soft, greasy and/or dark chips with an unpleasant taste, and watery, runny or sometimes sticky mashed potatoes.

Glucose content (% in juice) and colour of chips for various samples taken from the distribution sector (Var. Monalisa, CNIPT, November 2005) *(fig. 2)*



The reducing sugar content must be low to moderate in order to obtain lightly to moderately coloured chips with a pleasant taste. The maximum limit aimed for is around 0.4 to 0.6% of the fresh weight. The glucose level measured from the tuber juice using the Gluco-LIS® tool (made available by ARVALIS), is the only way of obtaining a good indication of the colour once fried. The upper limit was set at 0.4%, which corresponds to a colour index (CI) between 3 and 3.5 on the CNIPT/ARVALIS-Institut du végétal/ITPT scale *(figure 2)*.

Using key cropping techniques as action levers

Monalisa, a variety very popular on the ware potato market, can sometimes be suitable for chipped and mashed potatoes, especially early in the season. However, its dry matter content is often below 19% and it rapidly gains in sugar content during storage.

In addition to choosing an appropriate variety, judicious production and storage techniques can help to hone varietal characteristics towards the required quality standards. All the factors encouraging dry matter accumulation and reducing sugar levels have a positive impact on the suitability for use as chipped or mashed potatoes.

With similar weather conditions, a silt soil produces potatoes with higher dry matter contents than a sandy soil. But weather conditions can result in significant variations: as a rule, dry hot summers encourage dry matter production; cold and damp summers produce potatoes with lower dry matter contents.

All varieties have a predominant grade, as well as characteristic dry matter and reducing sugar contents. Preference should be given to a variety with a characteristic grade of 50-70 mm (with a tuber size score between 6 and 8 – potato varieties French Catalogue). Priority should also be given to varieties producing tubers which have a high enough dry matter content (score between 4 and 7), with a low sugar content (moderately suitable, suitable and highly suitable for frying). Since the 2006 registrations, coloration during frying has been described more precisely with a score ranging from 1 (very dark) to 9 (very light coloured).

The choice of seed rate is also important. The aim is to produce maximum numbers of 50-70 mm tubers. At harvest time, the size of the tubers depends on their number, and therefore on the number of stems per hectare and on the number of tubers per stem. Seed rate will also be affected by seed size and chitting management.

As for fertilisation, we know that the dry matter content of tubers reduces with increased quantities of nitrogen or potash. Finely fitted inputs are therefore crucial, in particular for varieties with naturally low contents (score of 4). Nitrogen encourages tuber growth but, in excess, it may result in the production of tubers of more than 75 mm and lead to the appearance of hollow hearts, misshaped tubers and cracks, as well as significant nitrogen residue levels after harvest.

In addition, potato crops require large amounts of phosphate and potash. If they do not receive enough potassium, tubers are more prone to black spot.

Regular water inputs are certainly one of the most important factors. In a dry year, well managed irrigation is the only way of controlling the quality of the crop through to the harvest stage. Too much water, however, can encourage growth and discourage the accumulation of dry matter.

Unless the soil was dry at the planting stage, no application is necessary until tubers start forming, which marks the beginning of the period of high sensitivity to lack of water supply. Decisions regarding irrigation can be made using the Irrinov® method (tool for managing water supply) or based on water balance monitoring. Irrigation will have to stop around 10 days before haulm destruction. In a dry year, a 15 mm input two days before harvest reduces the risk of damage.

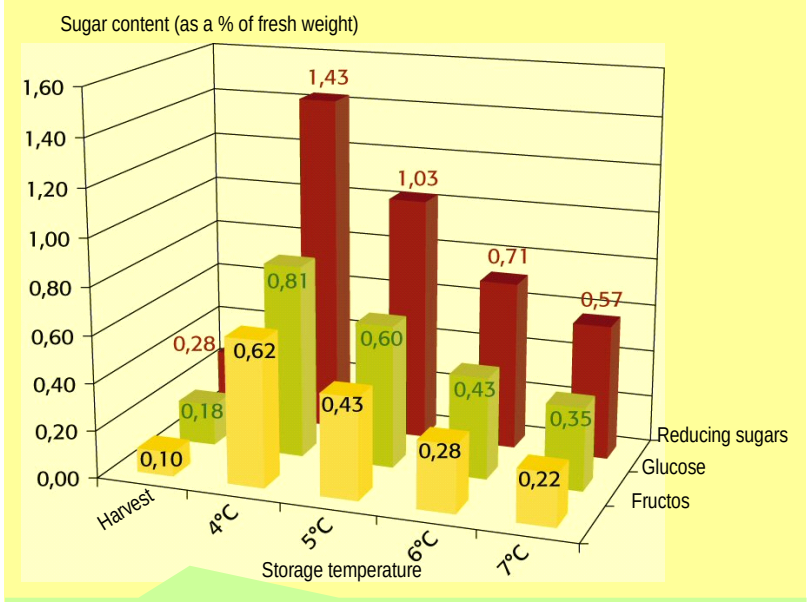
From planting to exiting the warehouse, including fertilisation and irrigation, each step of crop management must be well thought out in order to satisfy quality criteria specific to the end use.

Taking care with harvest and storage

At the haulm destruction stage and at harvest time, it is important to maintain the vegetation for as long as possible, so that the tubers can reach an appropriate size and a dry matter content above 20%, the latter possibly dropping by 0.5 to 1% when the tubers stay in the ground after the haulm has been destroyed. The plants should actually have reached maturity before destroying the haulm. Once the foliage has been destroyed, keeping the tubers in the ground for around three weeks encourages skin set, needed to protect the tuber against mechanical damage, as well as to ensure good storability. However, excessively long periods in the ground should be avoided in order to reduce the risk of contamination from silver scurf, black scurf or black dot.

Tubers with relatively high dry matter content can be susceptible to internal black spot. They must be harvested carefully, limiting drop heights to 30 cm along the whole harvest and storing chain. In the warehouse, storage temperatures below 8-10 °C (reducing the development of pathogens and risk of sprouting) quickly cause reducing sugar levels to increase ("cold or low temperature sweetening") *(figure 3)*. The maximum quantity of sugar formed is even greater at low temperatures. This reaction occurs quickly but is partly reversible by warming up the tubers to 15-18 °C for 10 to 20 days, a proportion of the sugar build up being converted back into starch or consumed by respiration (reconditioning). But reconditioning is difficult for ware potatoes destined for the fresh market because of the potential risk of altering their display quality (silver scurf, sprouting, wilting).

Effect of storage temperature on reducing sugar content of tubers (measurements carried out after 5 weeks in storage – average of 21 varieties) *fig. 3)*



On average, from 9 °C, lowering storage temperature by 2 °C causes the reducing sugar content to double.

There are significant differences in varietal behaviour in terms of "low temperature sweetening". Generally, varieties with the lower sugar levels at harvest time also store better.

For chip making, storage temperature must be a compromise between a relatively high temperature (8-10 °C) to limit a build up of sugar, and a temperature which is low enough (5 °C) to preserve display quality.

It is advisable to:

- properly dry tubers before cooling them down quickly (0.7 to 1.0 °C / day) to around 10-12 °C to help wound healing,
- then lower the temperature more slowly (0.4 °C / day) down to the required level according to the variety. As an example, the minimum possible storage temperatures are 5 °C, 6 °C and 7 °C respectively for varieties which are highly suitable (score of 8-9), suitable (score of 7) and relatively suitable (score of 6) for frying.

Judicious choices of production and storage techniques help to hone the agronomical and culinary characteristics of a variety, including its dry matter and reducing sugar contents, as well as its grading characteristics. However, varietal choice is still crucial. A variety which tends to produce tubers with low dry matter content (score below 4) is not advisable for chipped or mashed potatoes. Likewise, different weather conditions and geographical situations can cause significant differences between batches of the same variety, making some of them unsuitable for chipped and / or mashed potatoes. Those batches which are not up to standard can easily be redirected towards "soup", "potage", or even "oven" uses.

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