

POTATO PRODUCTION FOR HIGH TUBER QUALITY

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Introduction

Since liberalization of the potato industry in Switzerland, the crop has been dropping constantly during last 10 years. The number of farmers regressed but some more are cultivating larger surfaces and getting more specialized. Potatoes, as other field crops, are produced according to the integrated and organic production techniques. The integrated system is the standard and the organic production covers about 10% of the total area (around 4% of potato area). Integrated and organic potato production systems produce healthy potatoes of high quality and maintain a good soil fertility on the long term. A sound ecosystem is preserved with optimal agricultural practices, as plant nutrition, protection and breeding. These farming systems are applied on a holistic basis and combine the use of natural resources and the regulation of mechanisms. Consumer's demand for a more ecological produced food is not only in progress in Switzerland but in most European countries. The farmers' challenge is to produce food of high quality with limitation of chemicals and fertilizers. No soil treatment is authorized at all, organic and other brands totally banned chemicals (e.g. sprout inhibitors, desiccants).

Integrated production (IP)

The main IP features are:

- Balanced nutrient cycles on the whole farm unit in order to minimise losses
- Sound and local adapted crop rotations, humus management, erosion and compaction control in order to achieve a sustainable soil fertility
- Minimal application of pesticides
- Soils should be covered with a green intercrop for a maximal duration
- A sufficient ecological compensation area network is required to host a large number of species and a diversified fauna population.

Farmers must be well-educated to be successful, making it possible for them to choose the best management practices. Crop rotations should be well-balanced with at least a three-year break between two potato crops. This allows the elimination or limitation of many diseases and pests. A good soil structure is particularly important for potatoes and favours a high biological activity. Healthy (certificated) seed tubers with an optimal growth vigour (pre-sprouted seed) are used to promote a rapid emergence, and therefore limit parasite attacks like black scurf, as well as early tuberisation and crop maturity.

The crop fertilisation requirements must be correctly estimated in accordance with the expected yield, potential of the variety and in accordance to the utilisation. N fertilizer experiments with different doses may allow an estimation of the variety's capacity to absorb nitrogen from soil but also to transform in yield.

- Cultivars should be rustic with good resistances and high tuber quality. Late blight disease *Phytophthora infestans* is one of the most severe potato parasite causing enormous loss; an adapted decision support system is recommended to reduce and optimize fungicide applications (www.phytopre.ch). Besides their expected high tolerance and resistance, new cultivars (Idiotyp) should be able to reach at the same time their genetically based yield potential and the particularly high rates of commercial potatoes.

Consumers demand a multiple choice of varieties with different cooking types as well as an unbiased traceability of all the steps during the production process.

From 2006 the guarantee label of IP quality will be replaced with the brand "Suisse Garantie". This new label which will exclusively be used for Swiss production demands to respect very strong rules for food production and ecological requirements.

Farmers are not allowed to produce GMO varieties additionally to IP-Production, and crop and food are regularly checked.

Organic farming

Historic of organic production

1924	Rudolf Steiner founded organic-dynamic farming and anthroposophy
1940	Dr Hans Müller and H.-P. Rusch founded "biologisch-organischen Landbau" (organic farming)
1946	Foundation of SGBL, Swiss society for organic production / Bioterra
1954	Registration of DEMETER "Schutzmarke" (maker's mark)
1974	Foundation of the Research Institute for organic (biological) farming (FiBL) in Oberwil (today Frick), Switzerland
1976	First conference of IFOAM - International Federation of Organic Agriculture Movements - in Ebenrain, Switzerland
1983	EU-Order 2092/91 concerning organic farming came into force
1987	Organic-order (Bioverordnung, CH) came into force

What does organic farming mean ? (FiBL)

Moderate use of resources - **A**s closed fertilisation cycle as possible - **A** high rate of ecological compensation areas - **M**aintain and increase of soil fertility - **P**revention in spite of direct plant protection - **S**pecies adapted cattle rearing - **P**roduction and maintain of quality - **N**o GMO's - **B**ehaviour in the interest of consumers - **H**igh value production - **F**arming with future - **U**se of market niches as the following labels in Switzerland: the bud (bourgeon), Demeter and Migros Bio.



Organic farming 1993-2004 in Switzerland (all crops)

	1993	2001*	2004*
Number of farms	1'228	5'852	6466
Part of all farms (%)	1.8	9.0	about 10%
Surface (ha)	28'908		107'000
Part of surface (%)	1.8	9.0	10%

* FiBL

The principle aims of organic production and processing

Produce food of high quality - Interact in a constructive and life-enhancing way with natural systems and cycles - Encourage and enhance biological cycles within the farming system - Maintain and increase long-term fertility of soils - Maintain the genetic diversity of the production system and its surroundings - Promote healthy use and proper care of water - Create a harmonious balance between crop production and animal husbandry - Minimise all form of pollution - Process organic products using renewable resources (IFOAM Basic Standards).

The potato is an important and traditional crop in organic farming.

Potato culture is a useful previous crop with high fertilisation requirement, expensive mechanisation costs and much handwork, but it brings high income. However, organic farming needs very resistant cultivars to fungi and other pests. Low nutrient availability may strongly limit yield formation. To prevent pest attacks the potato should not come directly after meadows in the crop rotation.

Choice of varieties

Varieties should have a high resistance to late blight and other pests and diseases. Late blight caused by *Phytophthora infestans* is still a very serious disease in potatoes. And organic farmers have no or very few alternatives to copper spraying. Genetic diversity should be taken into consideration. The requested qualities for the different kind of utilisation are also very important. External and internal quality of organic tubers must be as good as in other production systems.

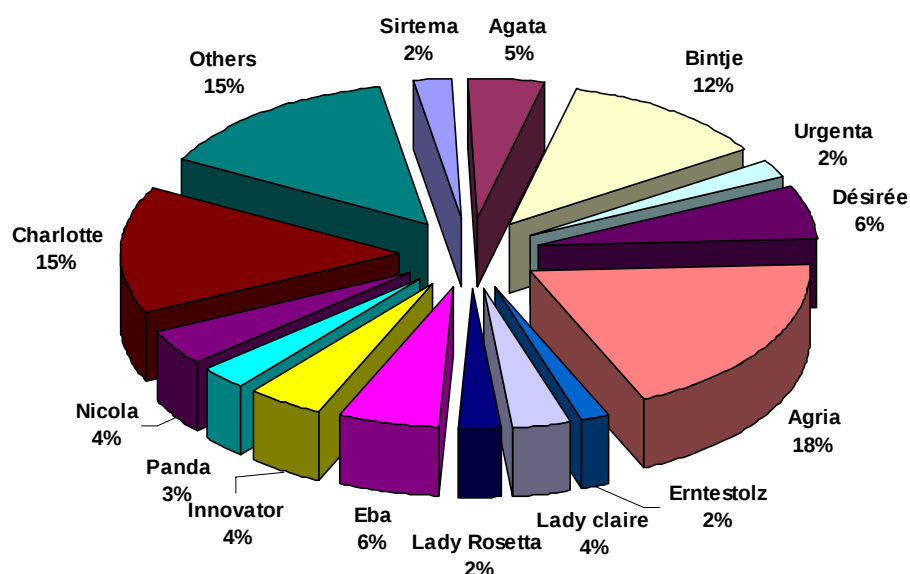


Figure 2. Most important varieties cultivated in Switzerland, 2004 (swisspatat)

Seed

Seed must be produced in an organic farm and certified. When certified organic seed and plant materials are not available, chemically untreated conventional materials shall be used. The use of genetically engineered seeds is not allowed.

Quality control

Quality control is carried out according to the “Swiss regulation for potato market” elaborated by the professional organisation “swisspatat” (www.swisspatat.ch).

Ware and processing potatoes use to go through a quality control performed by the market companies and retailers before admission. For a lot of 5 tons, a sample of at least 10 kg tubers is checked; for more than 12 tons, three samples of 10 kg each are examined. For processing companies but also in case of consumption potatoes for household frying products as French fries and röstis (hash brown), an additional control is done by frying potato slices (chips) from at least 10 tubers. The checking is realized by inspectors of the “Swiss Centre for services concerning quality questions of fruits, legumes and potatoes” - “Qualiservice” - (www.qualiservice.ch).

Chronology of Quality control

- 1 Labelling of package
- 2 Sampling
- 3 Determination of dirt tare
- 4 Checking of tuber temperature
- 5 Variety identification
- 6 Grading
- 7 5-tubers-test
- 8 Grading by hand
- 9 Weighting, calculation of percents, fill up report
- 10 Before rejecting the lot, the control is repeated

Several important damages and disorders

- Mechanical and animal damages
- Green tubers
- Blue or black spot
- Rust spot or hollow hart
- Common or powdery scab
- Misshaped and cracked tuber

Storage

After admission by the quality control, the potato is stored. Storehouses are well ventilated and mechanically cooled. To enhance skin set and wound healing, tubers should be kept, according to the variety, at least 2 - 3 weeks at 15° C with good ventilation. Temperatures can then slowly be reduced to 8° C or less depending the final utilization. Processing and ware potatoes for frying should not be stored under 8-7° C, to prevent accumulation of reducing sugars responsible for dark colour and high acrylamide content in the frying product. Beneath temperatures and humidity recording, carbon dioxide (CO₂) is also recorded; threshold values of CO₂ are: 0,3% for processing and 0,5% for fresh consumption potatoes.

For long-term storage, chemical compounds, as CIPC, or natural compounds, as Carvon oil for label production, are applied for sprout inhibition. These substances can be applied by unloading with liquids on belt conveyor or by fog insufflations with ventilated air in the storehouse.

Market

The Swiss potato area of 2004 reached 13'300 ha and the whole production about 550'000 tons of which 30'000 t seed potatoes. About 60% is consumed as ware potatoes and 40% as animal forage, seed and exportation. Ware potatoes are sold for 60% in fresh market and 40% for processing. The Swiss variety list 2005 contains 28 varieties, of which 16 are for fresh market and 12 for processing.

Fresh potatoes in retailer shops are offered in different colour lines and grading:

- Green bag = firm flesh potatoes for salads (type A-B)
- Brown bag = medium mealy flesh potatoes (type B)
- Blue bag = mealy flesh potatoes (type C or C-B type)
- Special blue bag for frying, mealy flesh potatoes (low reducing sugar content)

Several special varieties, as for example the firm flesh Amandine, are sold as potatoes of premium quality. Amandine is an exclusive niche product of a farm group with higher return value.

Organic potatoes and legumes are offered separately in the shops, prices are 20 - 40% higher. A certain amount of ware potatoes are sold directly on farms or in open city markets.

Consumers preferences and good quality

About 80% of ware potatoes are sold in supermarkets. Consumers have the choice of washed and brushed tubers. The preference goes to washed potatoes with a clear fine skin. Russet skin potatoes are rejected by our consumers. Tuber flesh should be yellow like Agria or Nicola. The new consumer trend gives preference to small tubers, for example baby potatoes (25 – 35 mm) square; normal size of ware potato in Switzerland is 42,5 – 70 mm. Special varieties as Juliette with a high tuber number per plant and firm flesh are in assessment. Cropping techniques have to be adapted with high plant density (around 100'000 plants per ha). The tuber's appearance and skin are getting more importance; silver scurf or black scurf sclerotia depreciate largely external quality.

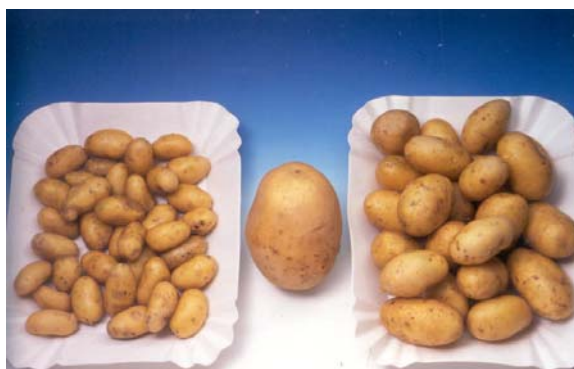


Figure 4. Baby potatoes: left 15-25 mm, right 25-35 mm, between 50 mm normal size

Conclusion

Moderne time, WTO regime, free market, low product prices, hurrying of clients and consumers ..., there is a big challenge for the potato industry to promote this crop. For the farmers the tuber quality (external and internal) requirements are increasing, and on the opposite, cropping techniques have to be more nature friendly. That

means that farmer need very high knowledge concerning soil and the whole ecosystem to produce a high quality standard food with low costs. Fertilization, irrigation, crop protection and other techniques have to be optimized: the right crop in the adequate soil and climate.

Trade and retailers require a perfect tuber with a fine skin who can be presented in shops, if possible under a spotlight without greening! Tubers must be free of residues, must have low reducing sugar contents (acrylamide) and present an optimal flesh consistence (firm, medium, etc).

Consumers are hurry and the potato has serious concurrents as rice and pasta, of quicklier and easier cooking. Some consumer prefer brand crops as IP or organic, some other take the price as their criterium (hard discounter).

I think that the consumers need more information on food health and quality, so as essential contents of vitamins and micronutriments. Actually the population's most important health problem is overweighting !

Eating potatoes is an ideal food in this modern time and cooking receipts have to be rethought (less fat, low energy and preserving of micronutriments...).

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