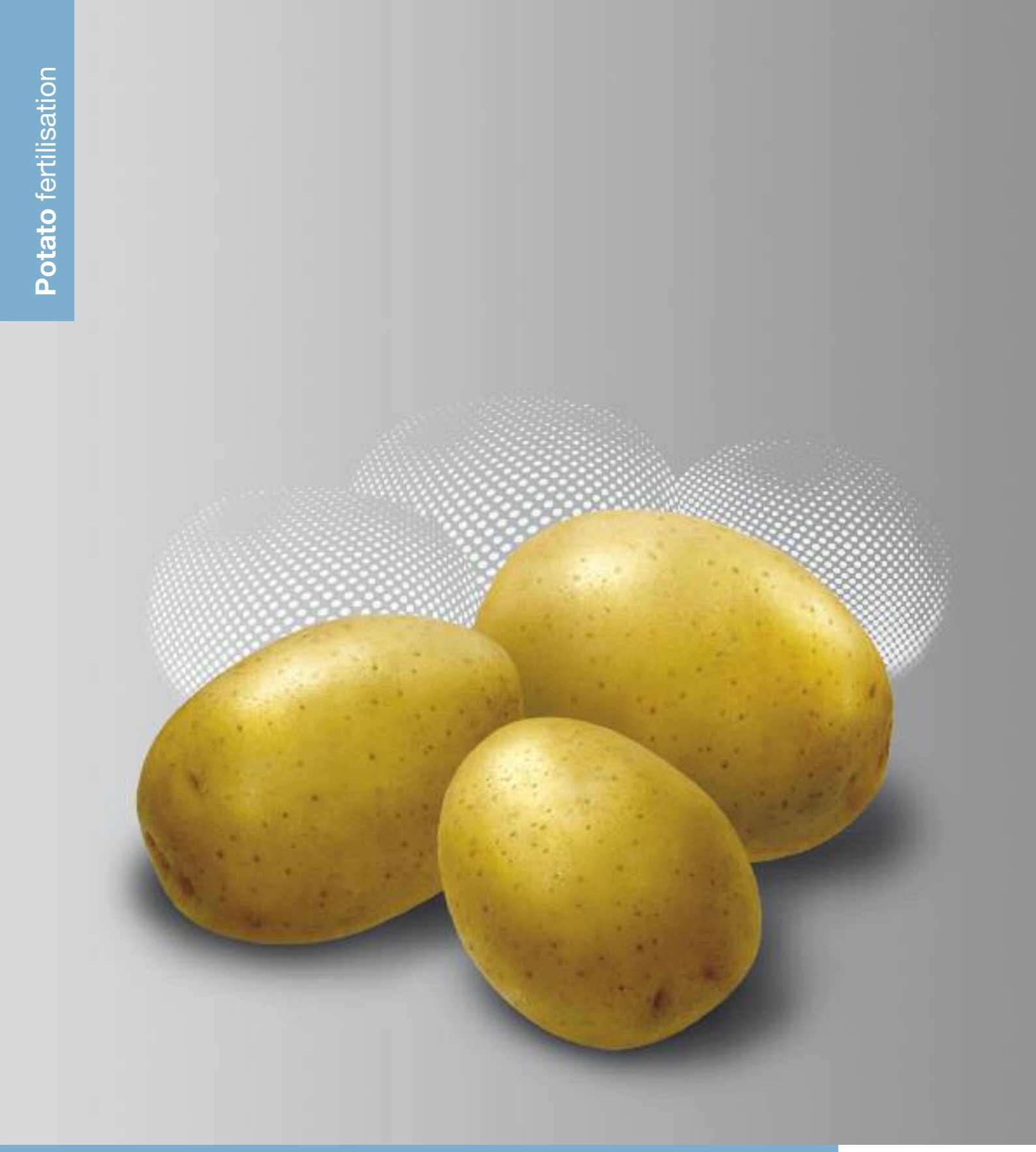


Potato Fertilisation

Information to cultivation

The Authority in potassium and magnesium

Yield and quality are nutrient dependent

Yield and quality dictate the profitability of potato production and fertilisation plays a major role in determining these parameters. Therefore, it is vital that fertiliser programmes are optimised. Of all nutrients, it is potassium, which is absorbed by the potato crop in the greatest quantities.

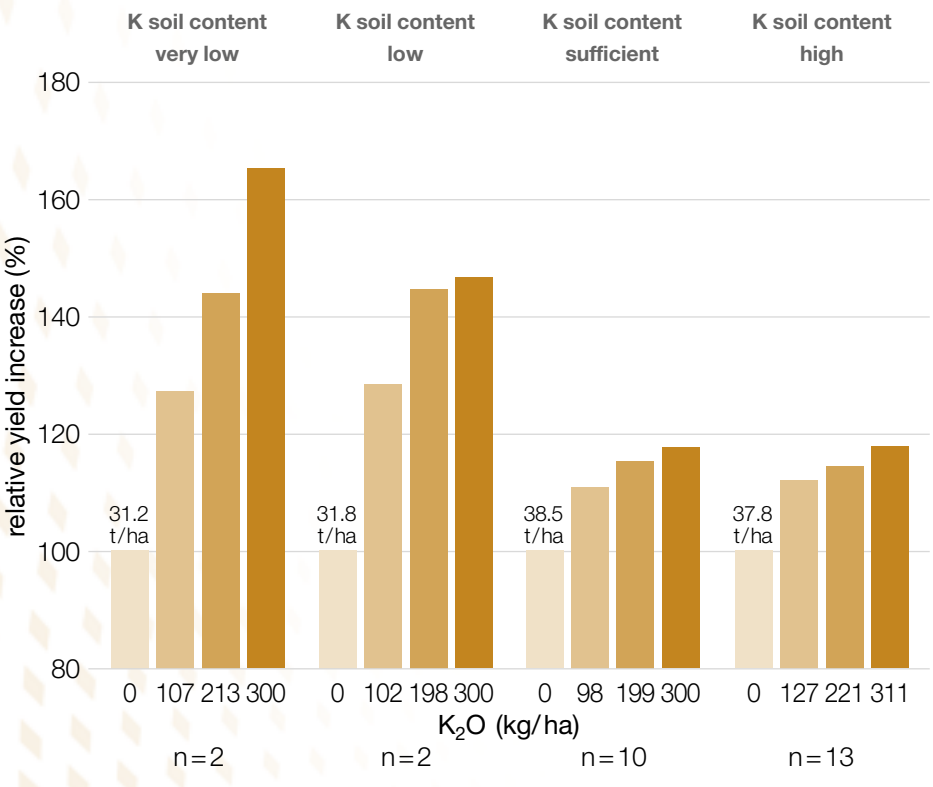
Nutrient uptake of potatoes
(kg/ha)

	tuber yield (t/ha) 40	50	(incl. tops)
N	140	175	(225)
P_2O_5	55	70	(90)
K_2O	240	300	(430)
MgO	35	45	(70)
S	12	15	(25)

Potassium

- is a major determinant of yield and quality.
- has a very positive effect on the production, translocation, conversion and storage of carbohydrates through the activation of the plant's enzyme systems.
- regulates the osmotic turgor of the cells and the water balance. Crops grown with adequate K availability use less water per unit weight of plant biomass and are therefore better able to survive periods of drought.
- secures economic yields.
- improves nitrogen efficiency.

Yield increase in potato as influenced by Potassium supply
(Control = 100%)

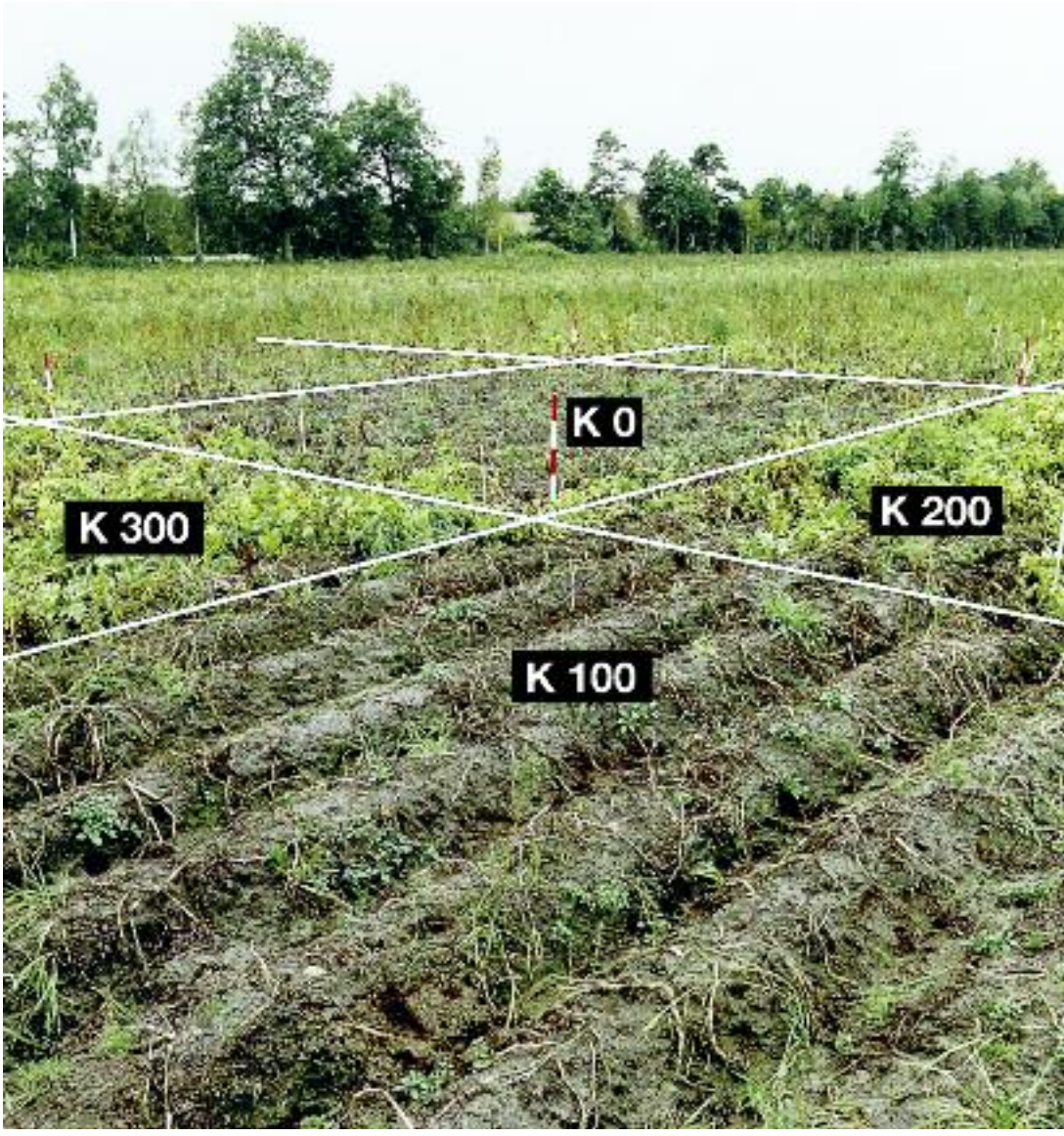


Potatoes require great amounts of K. K deficiency significantly reduces tuber yield.

Potassium for crop quality

Potassium

- is involved in the activation of the most important metabolic processes and thus has a major influence on tuber quality.
- reduces the susceptibility of the tuber to discolouration (internal bruising, black spot, discolouration of the raw tuber and after-cooking discolouration).
- increases the content of both citric acid and vitamin C.
- improves resistance to harvesting/handling damage and storability by allowing tubers to fully mature.
- minimises the content of reducing sugars thereby ensuring that tubers are better suited for processing (crisps, chips).
- has an influence on the starch content.



Under potassium deficiency the potato tops die off prematurely, therefore the assimilation is reduced and the yield potential cannot be fully exploited.

Where K is deficient

- plant growth is stunted.
- initially the oldest leaves turn pale green/yellow beginning at the leaf margins. Brown necrotic spots then develop, followed by the spread of these symptoms to the younger leaves.
- the foliage and haulms die off prematurely, thereby shortening the growing season and reducing assimilative efficiency and yield potential.
- quality is reduced as the susceptibility to internal and external damage increases significantly (enzymatic browning, bruising) and the shares of small tukers increases.

Leaf analysis indicates the nutritional state of the crop

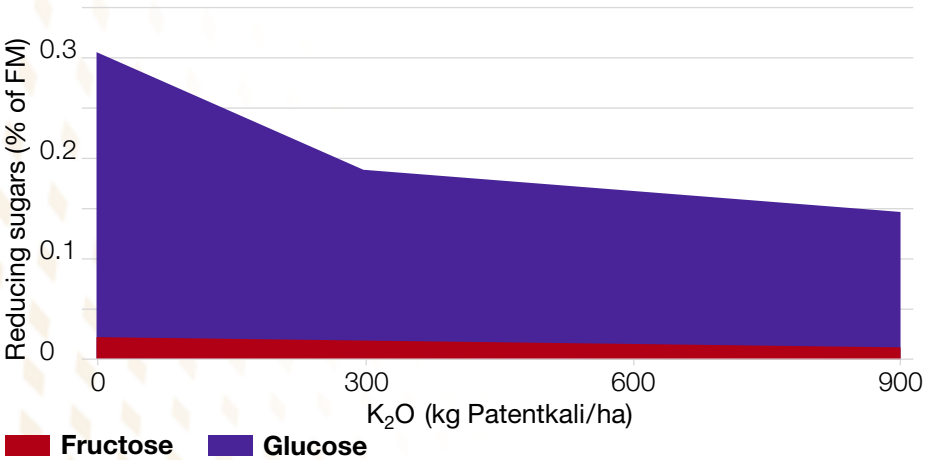
Sufficient K content in leaves (i. DM)

bud stage	4.5 – 7.0 % K
start of flowering	4.0 – 6.4 % K
end of flowering	3.7 – 6.1 % K
tuber formation	3.5 – 5.7 % K

K deficiency symptoms initially begin at the older leaves, followed by the spread to the younger leaves.

Influence of K supply on reducing sugar content in tubers

Germany 2002



With a sufficient K supply the content of reducing sugars can be reduced, ensuring a better processing quality of crisps and chips potatoes.

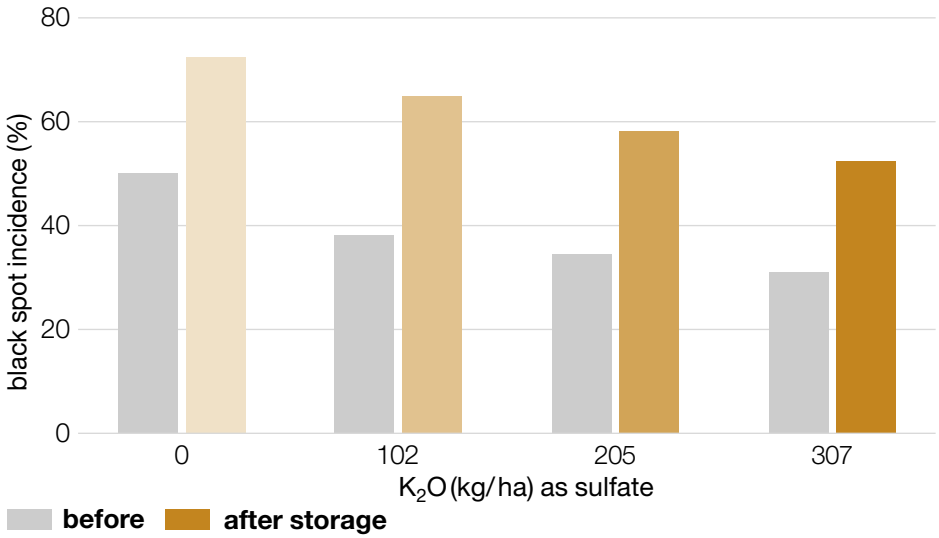
Potassium improves yield and quality

- high yields require, as a minimum, an adequate soil K supply which should be maintained by correct fertilisation.
- significant yield losses occur where soil K levels are low.
- in addition to soil analysis the plants nutrient status can be monitored by leaf tissue analysis.
- the K fertilisation programme should be tailored to the quality requirements of the crop.
- early applications of K fertiliser prior to planting or latest pre-earthing up, increases yield.

Potassium deficiency in leaves causes discolouration to pale green/yellow beginning at the margins. Continued severe deficiency causes that the tissue dies off subsequently.

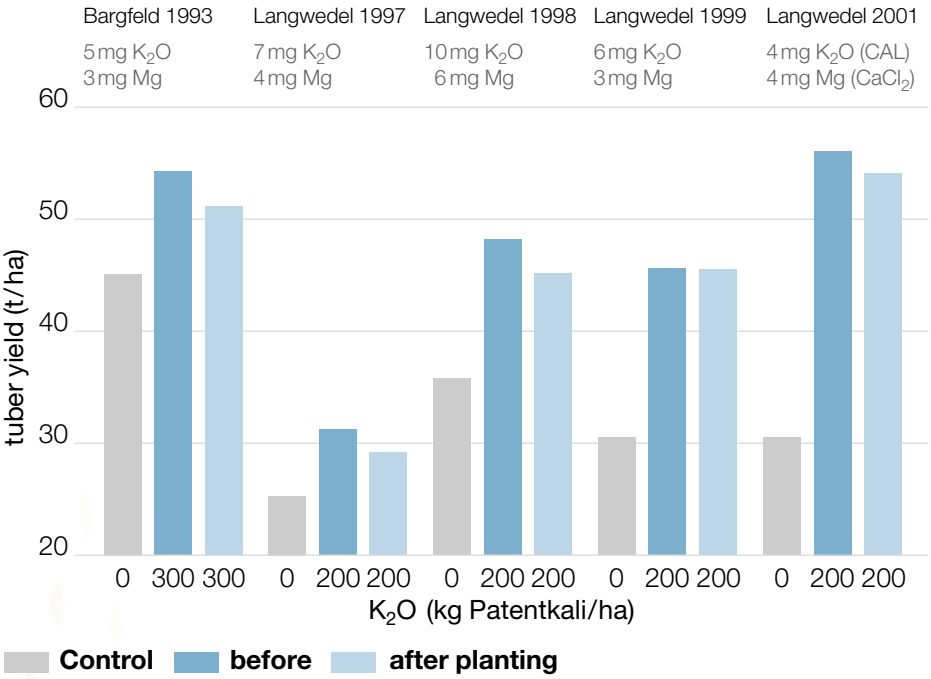
with Patentkali **without Patentkali**

Influence of K supply on black spot incidence
(means of 9 trials on light soils in North Germany)



K deficiency increases the susceptibility of the tuber to discolouration. Particularly the black spot incidence is reduced with a good potassium supply.

Tuber yield dependent on K supply
(different sites in Germany)



The K application before planting leads to yield advantages.

Quality requirements differ

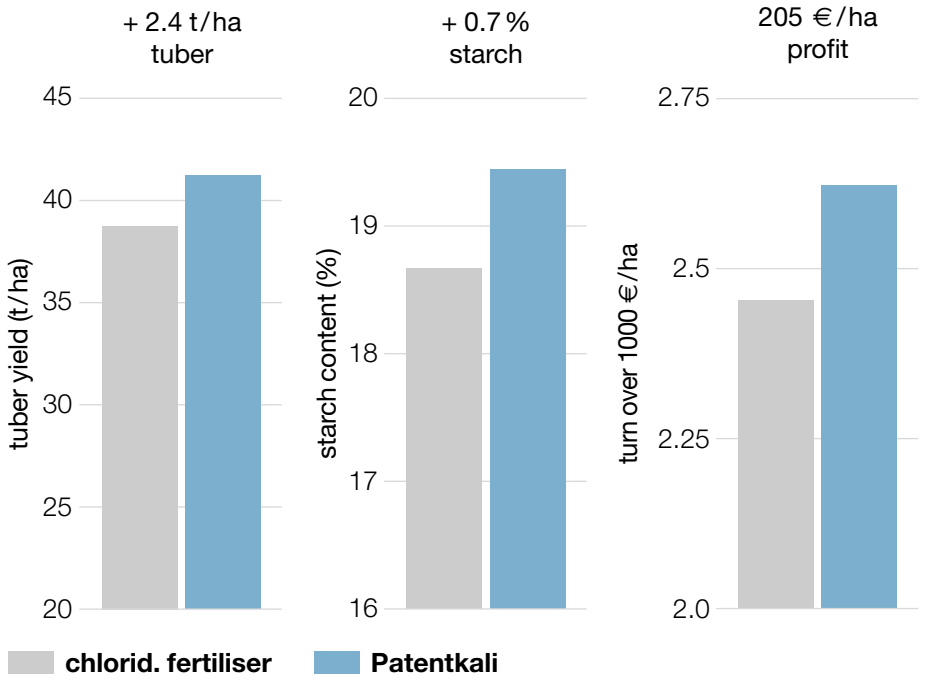
... for processing and starch production

Quality requirements vary greatly depending on the target market. Potatoes produced for the processing market (crisps, chips) require a medium starch content whereas those destined for starch production require a high starch content.

- K deficiency inhibits the formation and translocation of starch to the tuber. The starch content of tubers can be raised significantly on low K availability sites by the addition of moderate levels of K fertilisers.

- Tuber starch content is also influenced by the form of potassium applied, i.e. chloride or sulphate form. High levels of chloride in the plant restrict the formation and translocation of starch to the tuber. On average, K fertilisers based on the sulphate form produce approximately 1% higher starch content than the chloride form.
- Even when chloride form K fertiliser is applied early, e.g. 4–12 weeks pre-planting, the chloride may still affect tuber production as it may not have been leached to a sufficient depth to be unavailable to the plant roots. A re-ascent in the capillary water into the rooting zone increases further the risk of an excessive off-take of chloride by the plant resulting in a decreasing starch content.
- **Therefore: Sulphate based K fertiliser produces significantly higher starch yields, which fully justify the higher financial input involved.**

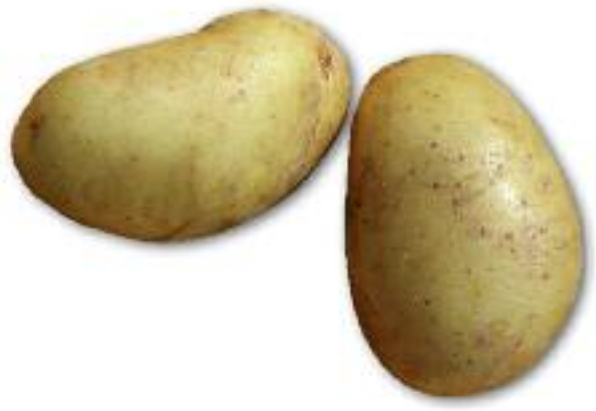
Comparison of chloridic and sulfatic K supply
Germany, 200 kg K_2O/ha



K fertilisers on sulphate base improve the profitability of processing potato.

... for potatoes for fresh consumption

- Potatoes for human consumption ideally should be free from skin damage and disease, should peel easily, not disintegrate during cooking, look good on the plate and have a pleasant taste.
- Discolouration in any form should be minimised i.e. internal bruising, black spot, discolouration of the raw tuber and after-cooking discolouration.
- Thus the objective of the fertiliser programme should be to produce a high tuber yield of optimum dry matter content for the variety grown and the target market.
- High inputs of K are thus required to produce a crop having a high percentage of marketable sized tubers, good storage attributes and minimal discolouration during preparation. Potassium thus improves these valuable quality parameters and most importantly, taste.



Influence of nutrients on yield and quality charachteristics of potato tubers.

Quality parameter	Nutrient N	P	K	Mg	Ca
tuber yield	++	+	++	+	+
starch content	–	+	+/–	+	+
protein content	++	++	+		
citric acid			++		
asorbic acid	+	+	++		
ripeness		–	+		
shell strength	–	+			
storage attributes	–		+	+	
taste	–	+	+		
Resistance to					
tuber damage	–	+	+	+	
black spot incidence	–		++	+	
after cooking discoloration			++		
brown discoloration			++		

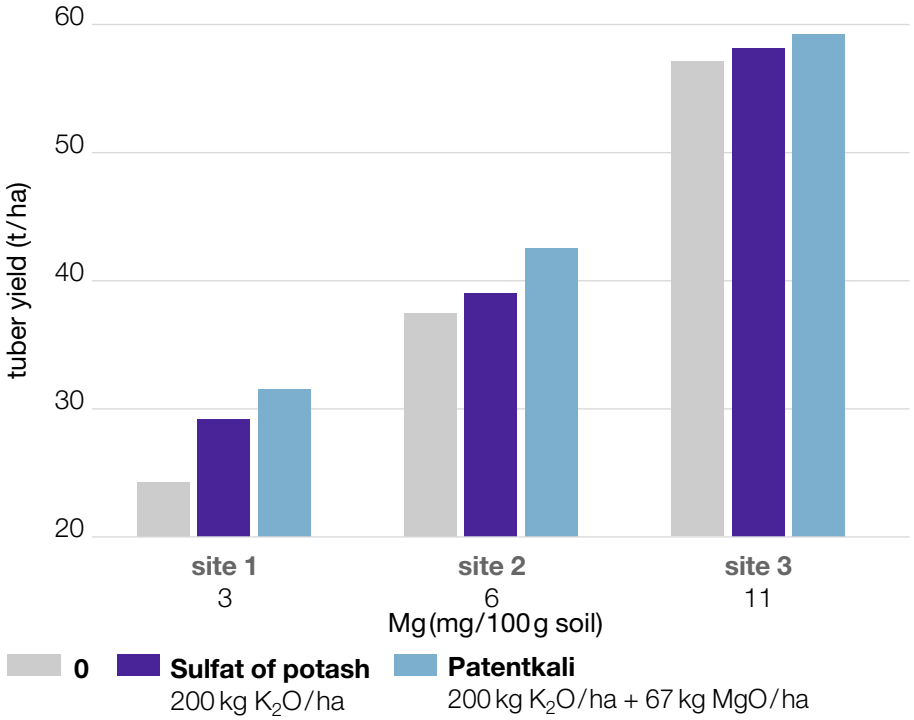
+ = positive influence ++ = very positive influence – = negative influence

Magnesium is important ...

- Potatoes are particularly susceptible to magnesium deficiency. Therefore it is essential to include magnesium in a balanced fertiliser programme.
- Magnesium plays a primary role in photosynthesis, protein synthesis and in the activation of various enzymes.

- Magnesium deficiency inhibits protein synthesis and is frequently accompanied by excessive nitrate accumulation in the tubers. Growth is stunted and results in reduced yields and crop quality.
- A considerable area of potatoes is grown on light soils which are inherently low in magnesium and therefore require Mg fertilisation.
- On light soils, it is particularly advisable to apply Mg and K fertiliser in spring for agronomic and efficiency reasons (see figure).
- Patentkali (30% K_2O, 10% MgO, 42% SO_3) contains the three nutrients potassium, magnesium and sulphur in the sulphate form, which are immediately available to the plant.
- High pH soils are, in the main, low in magnesium availability and need additional magnesium fertilisation to meet potato crop requirements. Magnesium sulphate, being completely water soluble irrespective of pH, is therefore ideal in high pH soils.

Influence of sulfate of potash and Patentkali on tuber yield
(3 sites in Germany)



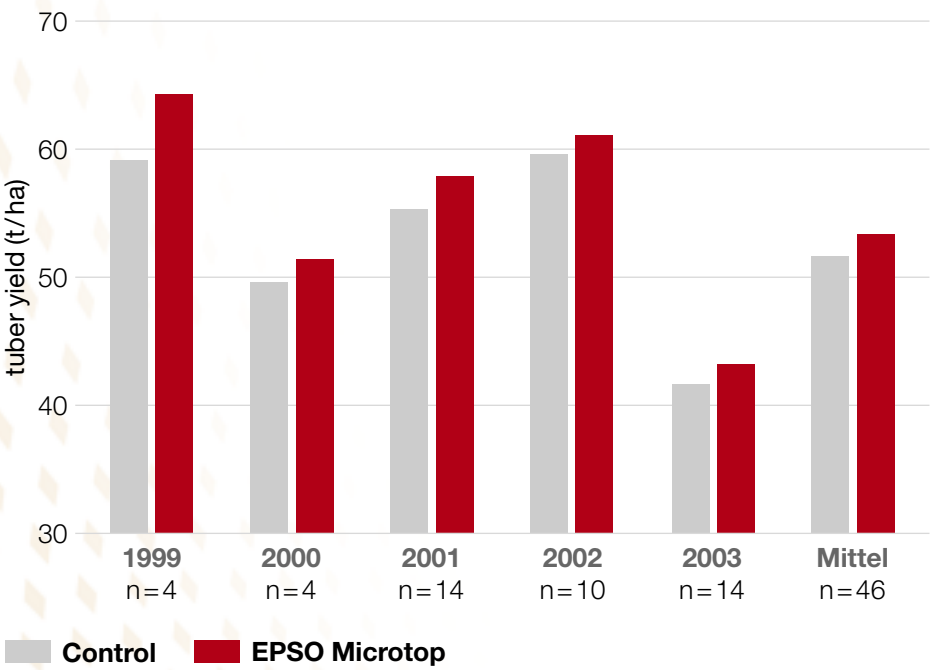
Also at high soil Mg Patentkali increases tuber yield.

Foliar fertilisation with magnesium

- The potato crop's major magnesium requirement should without question be supplied by soil application (40–70 kg MgO/ha).
- Magnesium is taken up by the plant much later in the growing season than potassium. Stress factors such as cold, drought and cationantagonism can significantly reduce the uptake of soil Mg resulting in temporary magnesium deficiencies in the sensitive potato plant.
- Applications of the foliar fertilisers EPSO Top (16% MgO, 32% SO_3) and EPSO Microtop (15% MgO, 31% SO_3, 1% B, 1% Mn), on their own or in combination with potato blight treatments, can prevent the damage of transient magnesium and trace element deficiencies.
- Trials conducted at various research institutes have confirmed yield increases of 4–10%, even at adequate soil magnesium levels, as result of foliar applications of EPSO Top. Significant dry matter and starch content increases were also noted.

Mg-deficiency in potatoes

Effect of EPSO Microtop® foliar application on tuber yield
(Foliar application with each 25 kg EPSO Microtop to bud stage and start of flowering)



With a foliar fertilisation in form of EPSO Microtop temporary deficiency of Mg, S, B and Mn can be prevented.

Foliar fertilisation with manganese and boron

- Manganese and boron can become unavailable due to soil moisture deficits and high soil pH levels.
- Potatoes remove about half as much boron as sugar beet (360 g B/ha). Despite this fact, however, a similar leaf boron content (25–35 ppm) is required to ensure optimum healthy growth. Consequently, the potato crop's boron requirement is in many cases underestimated.
- Boron is required for cell development and the synthesis of the energy components, sugars and starch. Boron also plays a role in stabilising the plant's cell walls and tissues.
- The potato while having a high demand for manganese is relatively inefficient at removing it from the soil.
- As manganese plays a broadly similar role to magnesium in the plant's metabolism, it is advisable from a nutritional and physiological viewpoint to apply both nutrients together.
- Foliar application of EPSO Microtop supplies Mg, S, B and Mn and lowers the risk of black spot incidence.

New field trails have proven:

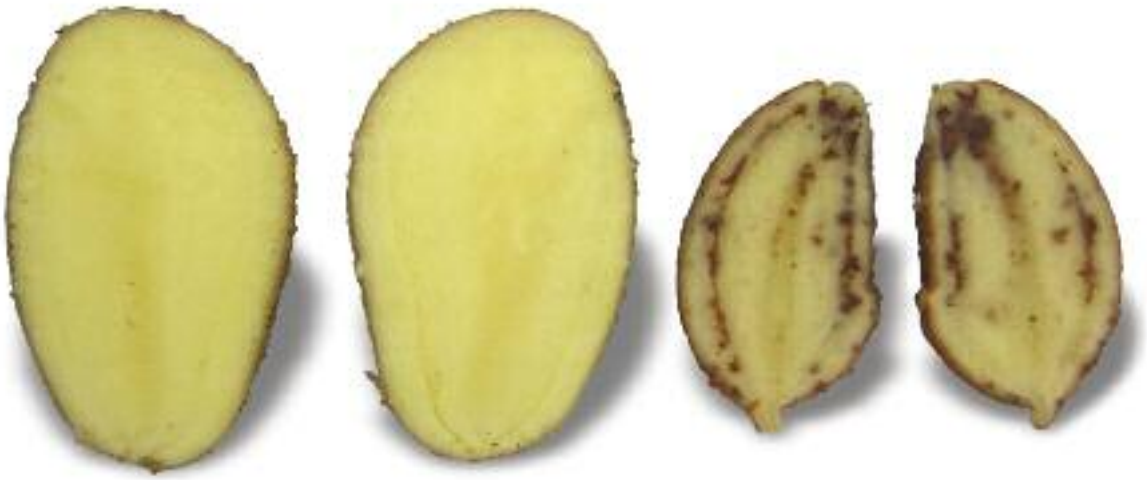
Foliar applications of EPSO Microtop (15% MgO, 31% SO_3, 1% B, 1% Mn) can prevent the yield losses caused by temporary soil nutrient unavailability (see data on previous and next pages).

EPSO Top® and EPSO Microtop® usage

- Depending on the severity of the deficiency, a total of 25–50 kg/ha should be applied by multiple (2–4) applications – the 1st before flowering or with the first potato blight treatment.
- The concentration should not exceed 5% i.e. 5 kg product/100 l water.
- Compatible with most fungicides, fertilisers and insecticides but always follow manufacturers' recommendations.

Manganese deficiency in potatoes

Micronutrient deficiency leads to yield and quality losses.



Boron deficiency in potato tubers (right)

Fertiliser recommendations

- Anticipated yield and target market are important factors in determining optimum fertiliser inputs.

- To ensure adequate soil K availability for high yield (40–50 t/ha) and good quality the following K fertiliser rates are recommended:

  Potatoes for fresh consumption and seed potatoes:
  800–1100 kg Patentkali/ha

  Potatoes for processing:
  700–800 kg Patentkali/ha

  Starch potatoes:
  600–700 kg Patentkali/ha

- The use of sulphate based K fertilisers allows both starch and tuber yields to be optimized and avoids the negative effects associated with chloride based K fertilisers. The optimal starch yield is close to the maximum tuber yield.

- Patentkali contains potassium and magnesium sulphate in the ideal ratio of 3:1, satisfying both the high K and Mg requirements of the potato crop.

- Additionally Patentkali meets the sulphur demand of the crop. The three nutrients K, Mg and S are immediately available.

- By applying 20–50 kg/ha of the foliar fertiliser EPSO Top or EPSO Microtop, split over several applications, temporary nutrient deficiencies of magnesium, sulphur, boron and manganese can be prevented.

All out of the hand

Patentkali®

EC-FERTILISER

Sulphate of Potash containing Magnesium Salt 30 (+10+42)

30% K_2O water-soluble potassium oxide
10% MgO water-soluble Magnesium oxide
42% SO_3 water-soluble sulphur trioxide (17% S)

Patentkali is a highly concentrated three-nutrient fertiliser with a potassium and magnesium basis especially suited to the production of high quality crops. It is specifically recommended for use on high value crops such as tobacco, vegetables, potatoes, fruits, nuts, spices and flowers.

EPSO Top®

EC-FERTILISER

Magnesium sulphate 16+32

16% MgO water-soluble magnesium oxide
32% SO_3 water-soluble sulphur trioxide (13% S)

EPSO Top is a quick acting magnesium and sulphur fertiliser developed specifically for fertigation and foliar application. He is the ideal fertiliser to cure acute magnesium and sulphur deficiencies in agricultural and horticultural crops as well as in forest trees by foliar application.

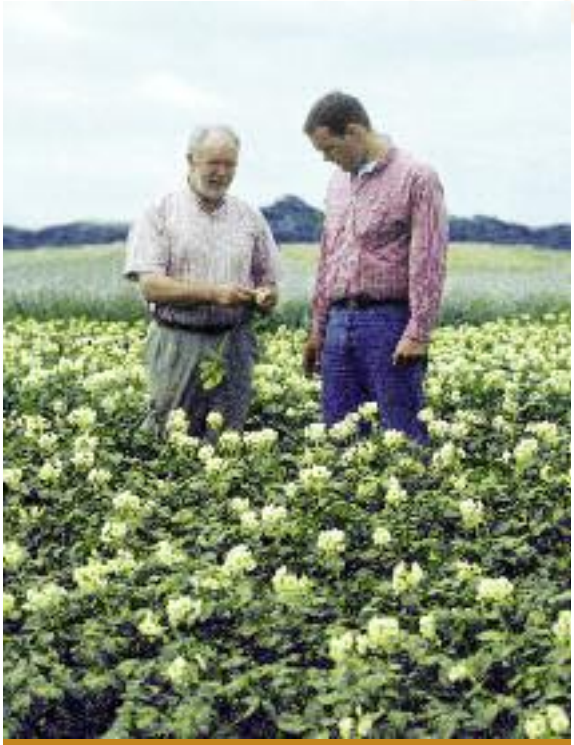
EPSO Microtop®

EC-FERTILISER

Magnesium sulphate with micronutrients 15+31

15% MgO water-soluble magnesium oxide
31% SO_3 water-soluble sulphur trioxide (12% S)
1% B water-soluble Boron
1% Mn water-soluble Manganese

EPSO Microtop is a quick acting and effective foliar fertiliser containing magnesium, sulphur, boron and manganese. Meets the increasing requirements for micronutrients of boron demanding crops and rapidly alleviates magnesium, sulphur, boron and manganese deficiencies in growing crops.



Detailed information can be found on the website of K+S KALI GmbH

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