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Potassium nutrition and its effect on quality and post harvest properties of potato

Dr. Georg Ebert

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Introduction

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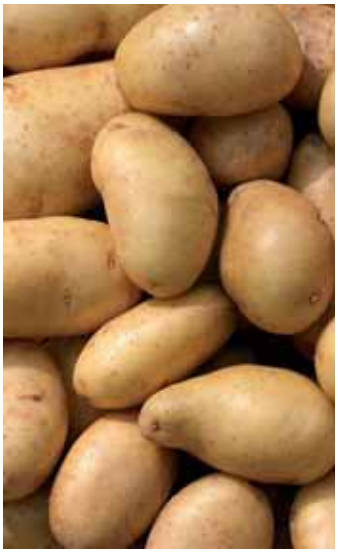
Potato – A high value crop

K nutrition in potato

K supply and quality – Field trial results

Conclusions and recommendations



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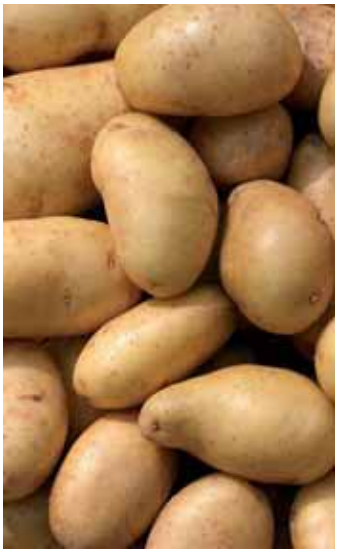

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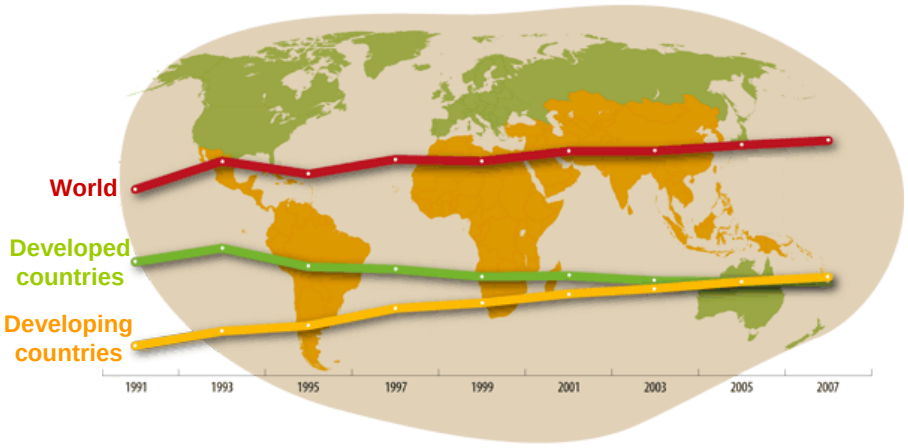
World potato production, 1991 - 2007



International year of the potato, 2008

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Top 10 potato producers (2007)

Country	Quantity (t)
China	72 040 000
Russian Fed.	36 784 200
India	26 280 000
United States	20 373 267
Ukraine	19 102 300
Poland	11 791 072
Germany	11 643 769
Belarus	8 743 976
Netherlands	7 200 000
France	6 271 000

International year of the potato, 2008

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Potato consumption by region (2005)

Region	Quantity (t)	Consumption kg per capita
Africa	**12 571 000**	**13.9**
Asia/Oceania	**94 038 000**	**23.9**
Europe	**64 902 000**	**87.8**
Latin America	**11 639 000**	**20.7**
North America	**19 824 000**	**60.0**
WORLD	**202 974 000**	**31.3**

International year of the potato, 2008

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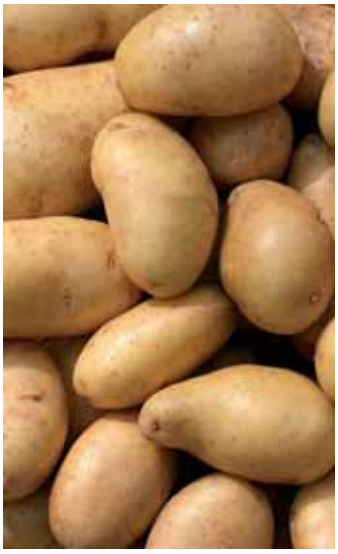

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Multiple uses of potato

Multiple uses of potatoes

- **Table potatoes**
- **Potatoes for processing (crisps, chips…)**
- **Seed potatoes**
- **Potatoes for starch production and industrial use (plastics, alcohol, energy…)**

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Quality parameters in potato

Quality parameter
Tuber yield
Starch content
Protein content
Citric acid
Ascorbic acid
Ripeness
Shell strenght
Storage attributes
Resistance to
Tuber damage
Black spot incidence
After cooking discoloration
Brown discoloration

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K nutrition in potato

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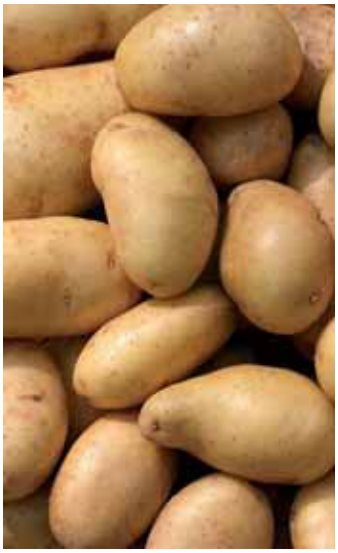

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Functions of K in potato

Of all nutrients, K is absorbed by potato plants in greatest quantities. K is involved in :

- production, translocation, conversion and storage of carbohydrates through enzyme activation.
- water use efficiency – potatoes grown with adequate K supply use less water per kg of tubers and withstand drought periods
- resistance to stress (frost, heat and impact) and diseases
- tuber quality and processing characteristics

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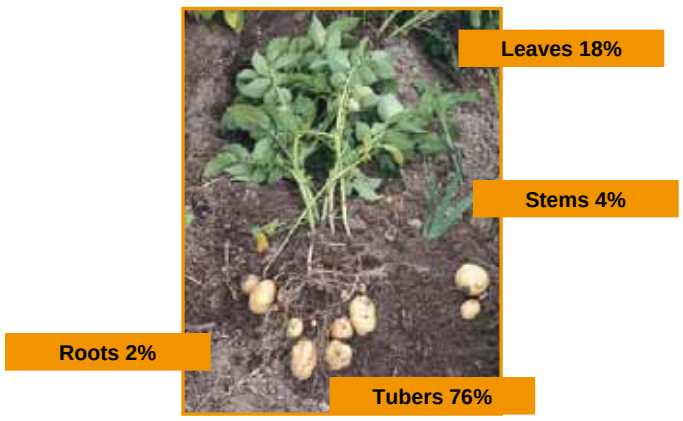
K distribution in potato plants



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K nutrient levels in potato plants

Sufficient K contents in potato leaves	
Developmental stage	**K (% of dm)**
Bud stage	4.5 – 7.0
Start of flowering	4.0 – 6.4
End of flowering	3.7 – 6.1
Tuber formation	3.5 – 5.7

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Nutrient uptake of potato plants

Nutrient uptake of potato plants (kg per ha)		
Nutrient	**Tuber yield 40 t/ha**	**Inclusive tops**
N	140	225
P_2O_5	55	70
K_2O	240	300
MgO	35	45
S	12	15

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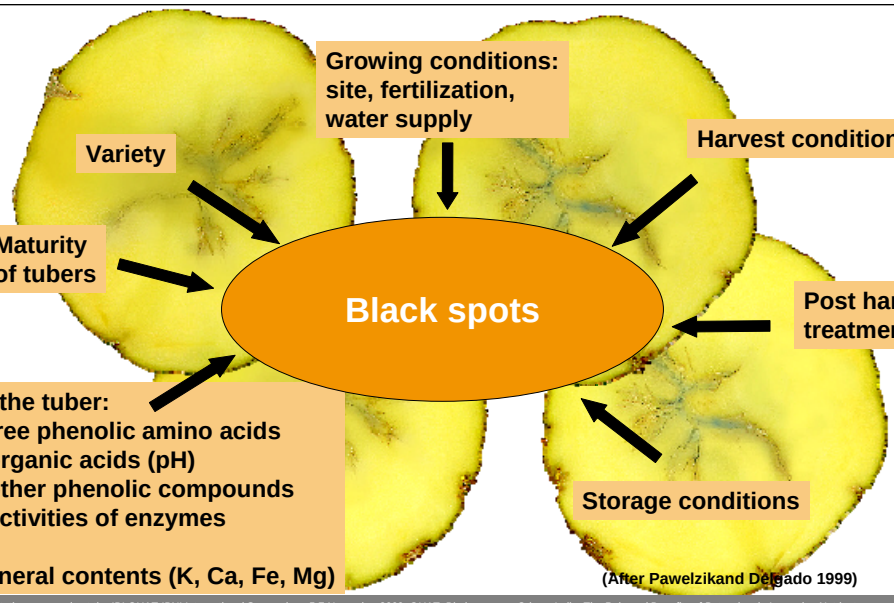
Black spots



(After Pawelzikand Delgado 1999)

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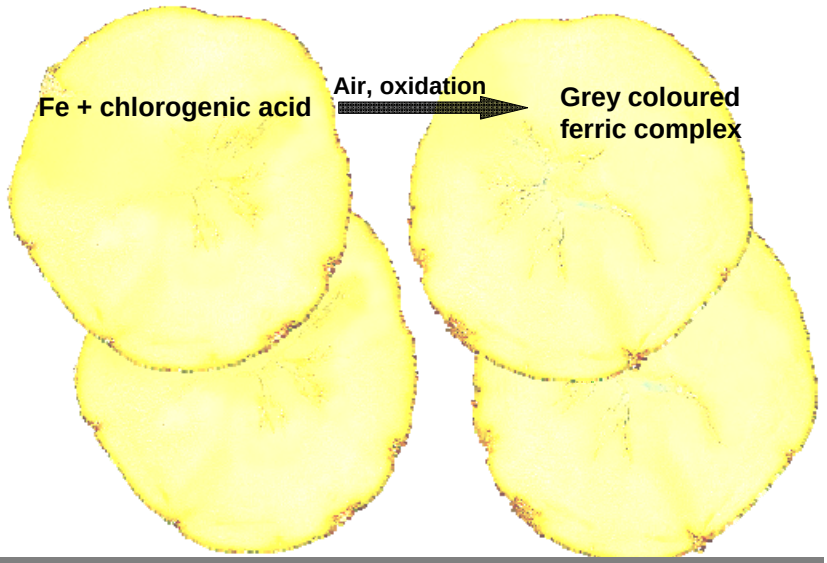
After cooking discoloration



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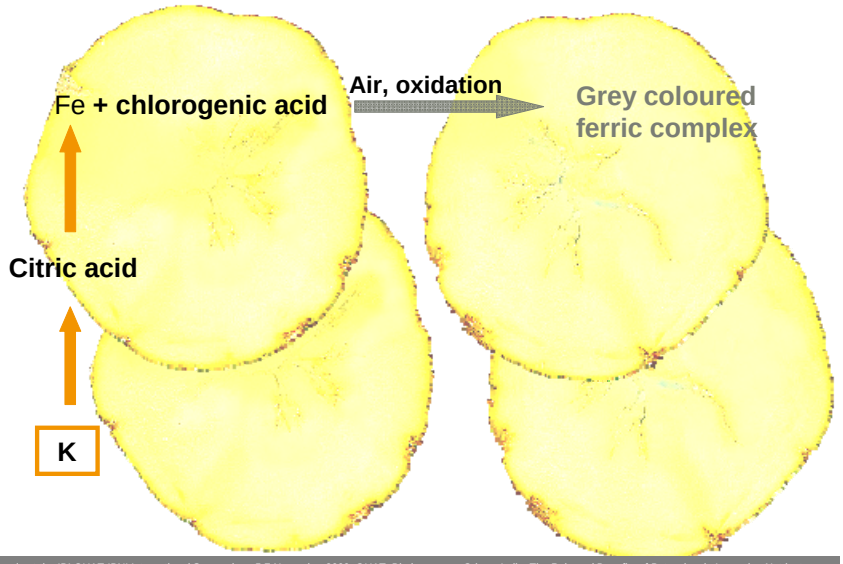
After cooking discoloration



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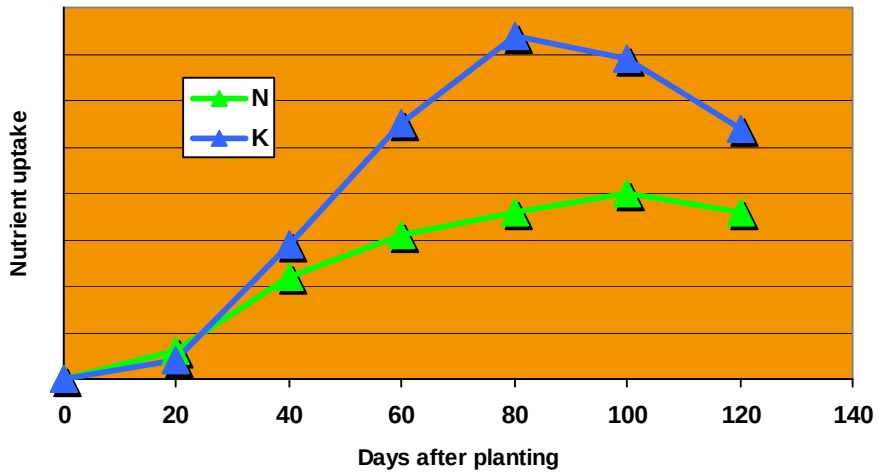
Nutrient uptake during the season



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Results

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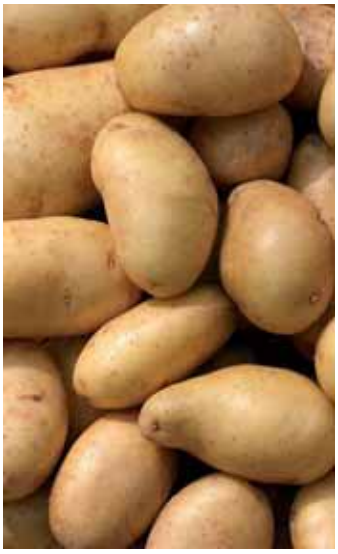

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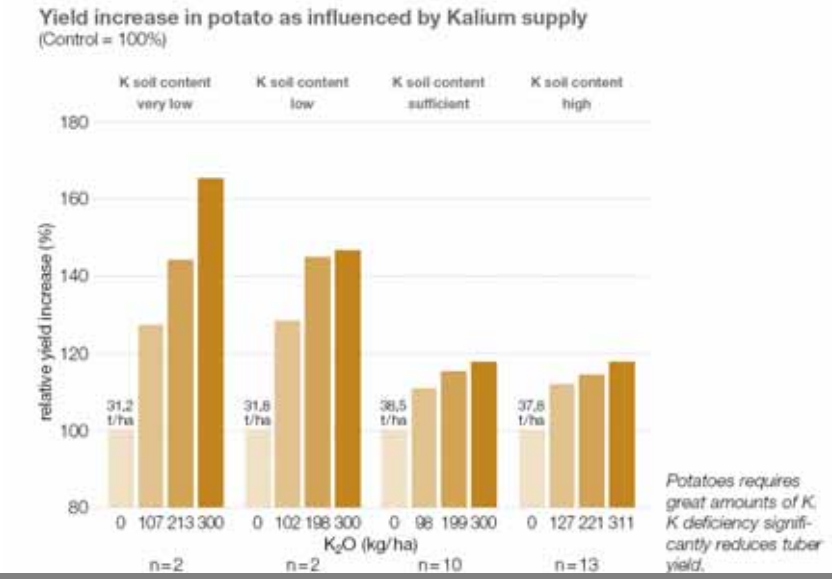
Yield increase in potato as influenced by K supply



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

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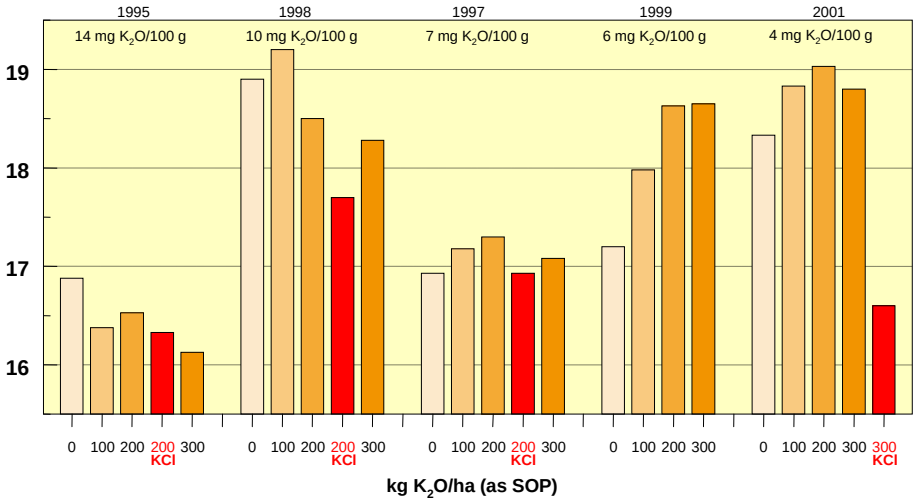
Effect of K fertilizer sources on starch content at different soil K supply

Starch content (%)



(Langwedel, University of Goettingen, Germany trials 1995-2001)

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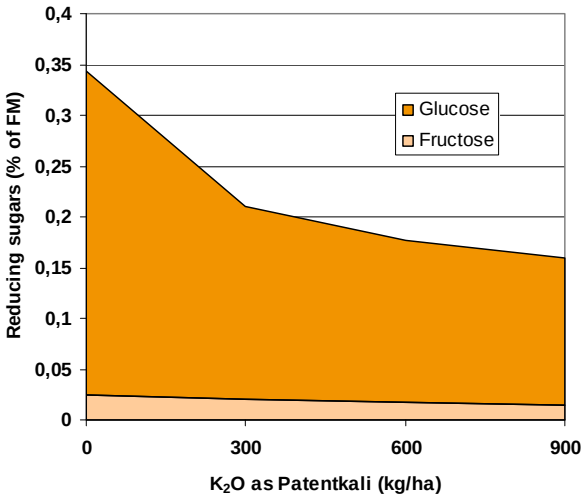
Influence of K supply on reducing sugar content in tubers



University of Goettingen, Germany, 2002

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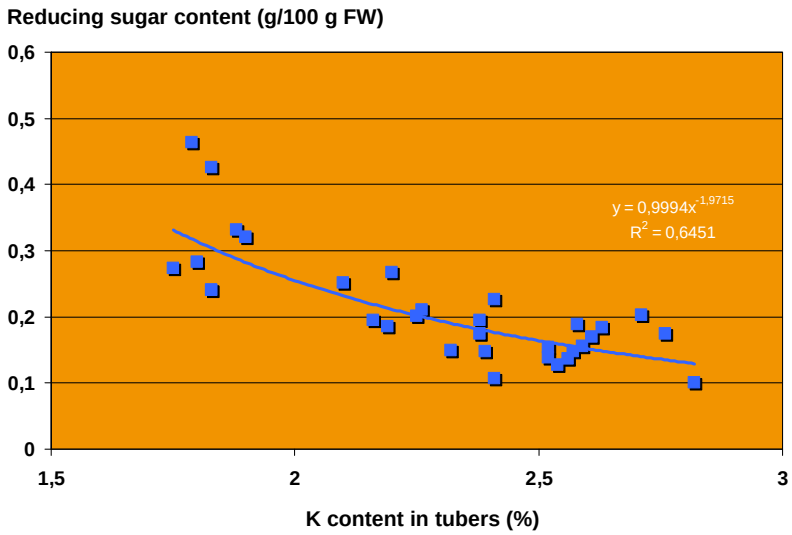
Effect of different K supply on reducing sugar content in potato tubers



(Langwedel, University of Goettingen, Germany 2002)

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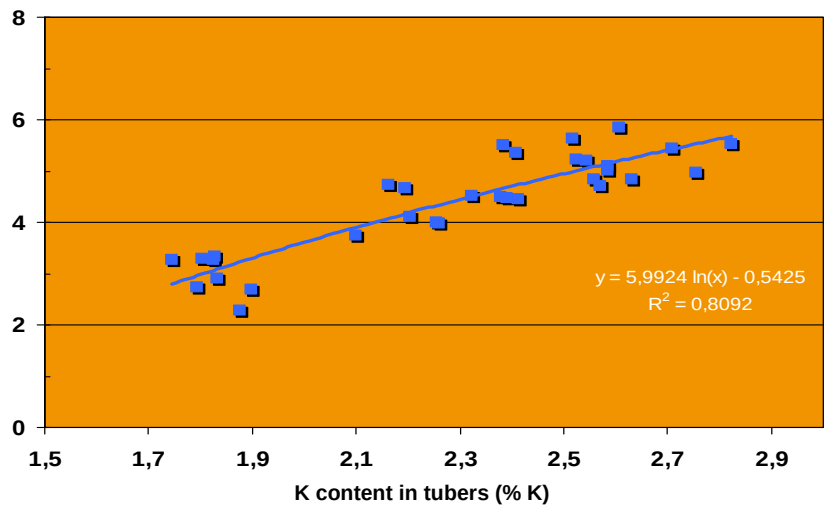
Effect of different K supply on the citric acid content in potato tubers



(Langwedel, University of Goettingen, Germany 2002)

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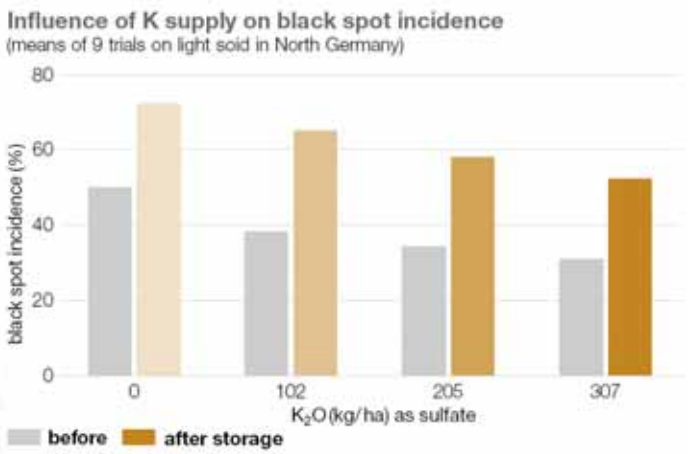
Influence of K supply on black spot incidence

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



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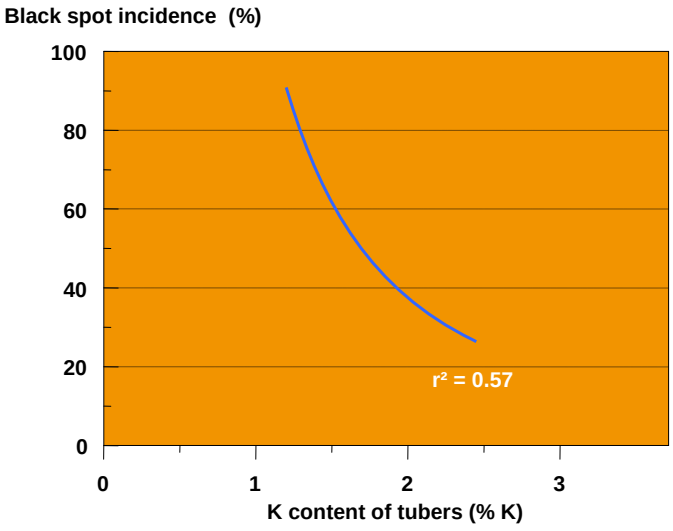
Relation of K content in tubers and black spot incidence



(Langwedel, University of Goettingen, Germany trials 1995-2001

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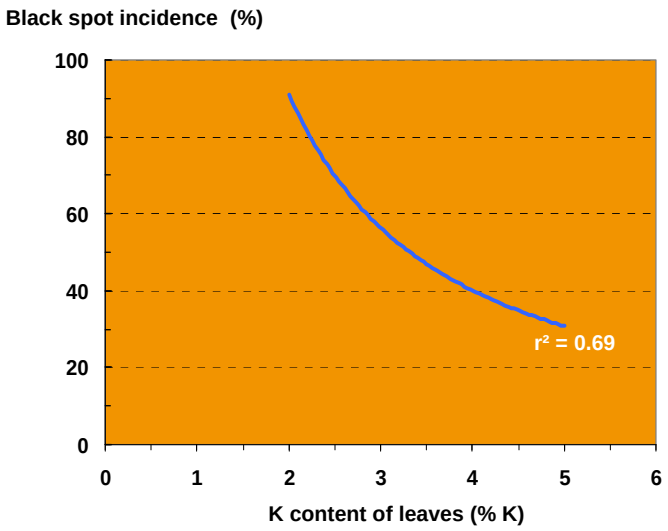
Relation of K content in leaves and black spot incidence



(Langwedel, University of Goettingen, Germany trials 1995-2001)

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Influence of different K supply on potato chip color

Influence of different K supply on potato chip color

Treatment			K source	Color score*
N	P	K		
150	100	0		6.5
150	100	100	MOP	5.8
150	100	100	SOP	5.5
150	100	150	MOP	5.2
150	100	150	SOP	4.9
150	100	225	SOP	4.0

*** Score > 5 not suitable for processing**

PRII, 1997/98, Gurgaon, India

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Relation of K content in tubers and black spot incidence

Effect of K source on enzymatic discoloration and phenol content of potato tubers

K level kg/ha	Enzymatic discoloration*		Phenol content (rel. to control)	
	SOP	MOP	SOP	MOP
0	0.458	0.479	100	100
50	0.478	0.390	90	88
100	0.456	0.328	83	82
150	0.454	0.278	81	72
200	0.453	0.282	81	75

*Absorbance at 465 nm

Sharma and Sud, 1995, Shimla, India

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Influence of different K supply on potato chip color

Influence of different K supply on storage losses of potatoes

Treatment			K source	Storage losses (% FW)
N	P	K		
150	100	0		6.2
150	100	150	SOP	4.6
150	100	150	MOP	4.9
150	100	200	SOP	4.6
150	100	200	MOP	4.6

PRII, 1997/98, Gurgaon, India

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Keeping quality

Influence of K supply on keeping quality of potatoes

K level kg/ha	Weight loss (%) after 14 weeks	Sprouting (%)	Rottage (%)
0	20.4	8.5	7.1
50	17.9	11.0	7.1
100	17.4	10.7	7.9
150	15.9	7.7	4.8

Sharma and Sud, 1995, Shimla, India

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Frost damage index

Frost damage index of potatoes related to N and K supply

K supply (kg/ha)	N supply (kg/ha)		
	0	100	200
0	3.5	4.1	3.7
100	0.7	0.8	1.4
200	0.5	0.5	1.0

Sharma and Sud, 1995, Shimla, India

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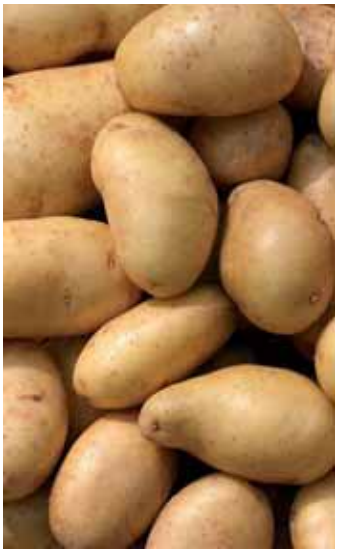

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Influence of nutrients on quality parameters of potato

Quality parameter	Nutrient				
	N	P	K	Mg	Ca
Tuber yield	++	+	++	+	+
Starch content	-	+	+/-	+	+
Protein content	++	++	+		
Citric acid			++		
Ascorbic acid	+	+	++		
Ripeness		-	+		
Shell strenght	-		+	+	
Storage attributes	-	+	+		
Resistance to					
Tuber damage	-	+	+	+	
Black spot incidence	-		++	+	
After cooking discoloration			++		
Brown discoloration			++		

Nutrient requirement of potato plants

Nutrient recomendation for different potato production lines

Potato type	Tuber yield (t)	N	P_2O_5	K_2O	MgO	CaO
Table potatoes	45	120	90	410	20-30	80
Starch potatoes	50	130-160	90-100	300	20-40	80
Crisps	45	130	70	300	20-30	80