The effect of different rates and forms of potassium fertilizers on the yield and morphine content of poppy (*Papaver somniferum*, L.)

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The Growing of Poppy in the Czech Republic

- 3.2 mil ha of arable land in CZ
- 58,000 ha of poppy
- An average yield 0.60 t/ha
- The consumption of poppy seed is 0.3 kg/person
- The largest exporter in the world – 88 % of whole production

The area of poppy in the world - 2005

(Data source: FAOSTAT.FAO.ORG., 07.01.2007)

Land	ha
Turkey	32,000
Czech Rep.	**44,613**
France	13,000
Germany	3,800
Hungary	6,326
Rumania	3,000
Austria	3,095
Slovak rep.	1,300
Europe	**77,064**
Asia	32,100
World	***109,164***

Use of poppy:

a) Seed as food

b) Straw

(empty capsule

+ 15 cm of stem) for pharmaceutical industries – alkaloids (morphine)

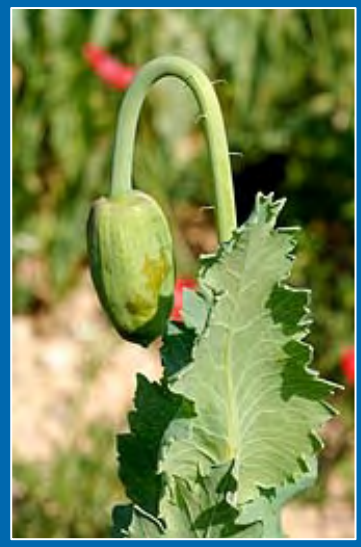
Prices and Species of Poppy

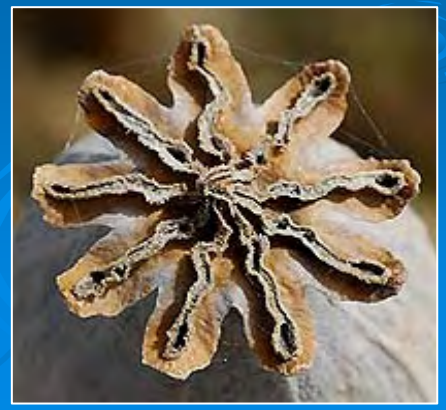
- Seed: 26-30 CZK/kg (about 0.9-1.1 EUR/kg)
- Straw: 11-15 CZK/kg (0.4-0.5 EUR/kg) – manufacturing industry is Zentiva (Slovak rep.)

- Species with low concentration of morphine (0.53 %): Opál, Major, Malsar, Maraton
- Species with high concentration of morphine (1-2 %): Lazur, Buddha

Pot trial

- The start of experiments on 1th April 2004 and 28th March 2006 (Species „Opál“)
- Plastic pots with 9.5 kg of soil
- Application of 0.9 g N/pot in all variants
- Content of K in soil (Mehlich III):
  - 2004: 239 ppm (good)
  - 2006: 147 ppm (satisfactory)
- Content of K in soil in accordance with the decree: very high – high – good – satisfactory - low





Experiment Scheme

Var. No.	Scheme	Description	K_2O dose (g K_2O/pot)
1	NK0	control	0
2	NK1	K_2SO_4	0.845
3	NK2	K_2SO_4	1.69
4	NK1	KCl	0.845
5	NK2	KCl	1.69

Calculation of K-doses

(0.845 and 1.69 g K_2O/pot)

- 270,000 poppy plants/ha take up 92.7 kg K/ha (Edelbauer, Stangl, 1993)
- 1 plant takes up 0.34 g K
- 4 plants per pot take up 1.36 g K = 1.69 g K_2O

Content of K and S in plants
(stem elongation growth, 2004)

Var. No.	Sche-me	Description	% K	% S
1	NK0	control	5.23	0.43
2	NK1	K_2SO_4	5.38	0.40
3	NK2	K_2SO_4	5.87	0.36
4	NK1	KCl	5.38	0.34
5	NK2	KCl	6.00	0.33

Content of K and S in plants
(stem elongation growth, 2006)

Var. No.	Sche-me	Description	% K	% S
1	NK0	control	5.26	0.34
2	NK1	K_2SO_4	6.49	0.37
3	NK2	K_2SO_4	7.06	0.39
4	NK1	KCl	6.57	0.34
5	NK2	KCl	6.92	0.31

One variant in stage of stem elongation growth (DC 41)

Average experimental yields of seed

Var. No.	Scheme	2004		2006	
		g/plant	rel. %	g/plant	rel. %
1	control	3.03 a	100	2.11 a	100
2	K_2SO_4	3.80 b	125.1	2.61 b	123.7
3	K_2SO_4	3.58 b	118.0	2.38 c	112.8
4	KCl	3.16 ac	104.3	2.42 c	114.6
5	KCl	3.40 c	111.9	2.41 c	114.5

Variants with same superscripts were not different at the significance level of P=95%

Average experimental yields of morphine in straw

Var. No.	Scheme	2004		2006	
		%	rel. %	%	rel. %
1	control	0.82 a	100	0.74 a	100
2	K_2SO_4	0.84 a	102.4	0.72 a	97.3
3	K_2SO_4	0.91b	110.9	0.68 b	91.9
4	KCl	0.80 ac	97.5	0.64 b	86.5
5	KCl	0.74 c	90.2	0.71 a	95.9

Variants with same superscripts were not different at the significance level of P=95%

Conclusions - Yield:

- K as K_2SO_4 increased the yield of seeds from 18 – 25.1 % (2004) and from 12.8 – 23.7 % (2006) compared to the control
- Lower dose of K as K_2SO_4 had a more positive effect on the seed yield
- K as KCl increased the yield of seeds from 4.3 – 11.9 % (2004) and from 14.5 – 14.6 % (2006)

Conclusions – Morphine:

- The concentration of morphine in poppy straw was increased statistically significantly by 10.9% only in interaction with a higher level of K in K_2SO_4, compared to the all variants in year 2004
- The effect of KCl in both years and K_2SO_4 in year 2006 on the content of morphine in poppy straw was negative

General Conclusions

- Potassium sulphate and potassium chloride are suitable fertilizers for poppy
- The positive effect is above all the increase of seed yield
- Potassium chloride is for Czech farmers financially more acceptable
- In The Czech r. was applied (2006) only 9.4 kg K_2O/ha (11.7 kg P_2O_5/ha and 77.4 kg N)

Thank you for your attention

The present study was funded by the International Potash Institute

Mendel University of Agriculture and Forestry in Brno, Czech Republic

- The cooperation of the Department of Agrochemistry, Soil Science, Mikrobiology and Plant Nutrition of Mendel University of Agriculture and Forestry Brno with International Potash Institute has been active for many years.

- The previous leader of our Department Prof. Richter has started this cooperation with Dr. Uebel as former IPI – Coordinator.

A) Activities of Mendel University of Agriculture and Forestry Brno supported by IPI in last years:

1) My colleagues have prepared special brochures in Czech language for farmers about potassium fertilisation of some plants:

- Potassium as an important element for yield and quality of vegetables.
- Potassium as an important element for yield and quality of vine.
- Potassium as an important element for yield and quality of fruits.

  Author: Prof. Hlušek

- Potassium in the system of optimum fertilisation of winter rape.

  Authors: Prof. Richter, Dr. Hřivna

A) Activities of Mendel University of Agriculture and Forestry Brno supported by IPI in last years:

2) We have carried out at our university two pot trials with poppy – 2004 and 2006 (I spoke about it yesterday).

The results of the poppy experiment 2004 was presented at the international conference in Warsaw in year 2005. A paper with the title „Potassium and its forms in the nutrition of poppy (*Papaver somniferum*, L.)“ has been published in the scientific Journal „Fertilisers and Fertilisation“.

B) Activities of Mendel University of Agriculture and Forestry Brno supported by IPI this year:

- The replication of the pot experiment with poppy (the third year).
- It will be prepared a brochure in Czech language for farmers about potassium fertilisation of maize.

(prof. J.Hlušek, dipl.- ing. Tomáš Lošák, Ph.D.)

B) Activities of Mendel University of Agriculture and Forestry Brno supported by IPI this year:

- The establishment of pot trial (Mitscherlichs pots) with one sort of vegetables and 5 treatments: control and two doses of K_2SO_4 and KCl.

  It will be assessed:

  - the concent of N, P, K, Ca, Mg, S in plants
  - the yield
  - the content of nitrates
  - the content of vitamin C

B) Activities of Mendel University of Agriculture and Forestry Brno supported by IPI this year:

- The financial support of our international conference "**Plant Nutrition and its Prospects**".

  This conference is held on 5th – 6th September 2007 at the Mendel University of Agriculture and Forestry Brno, Czech Republic.

  Having any questions I can provide you with more information myself or e-mail: *losak@mendelu.cz*
  The deadline for applications has been postponed till 30th March 2007!

Thank you for your attention