

Innovative stored plant products in Germany

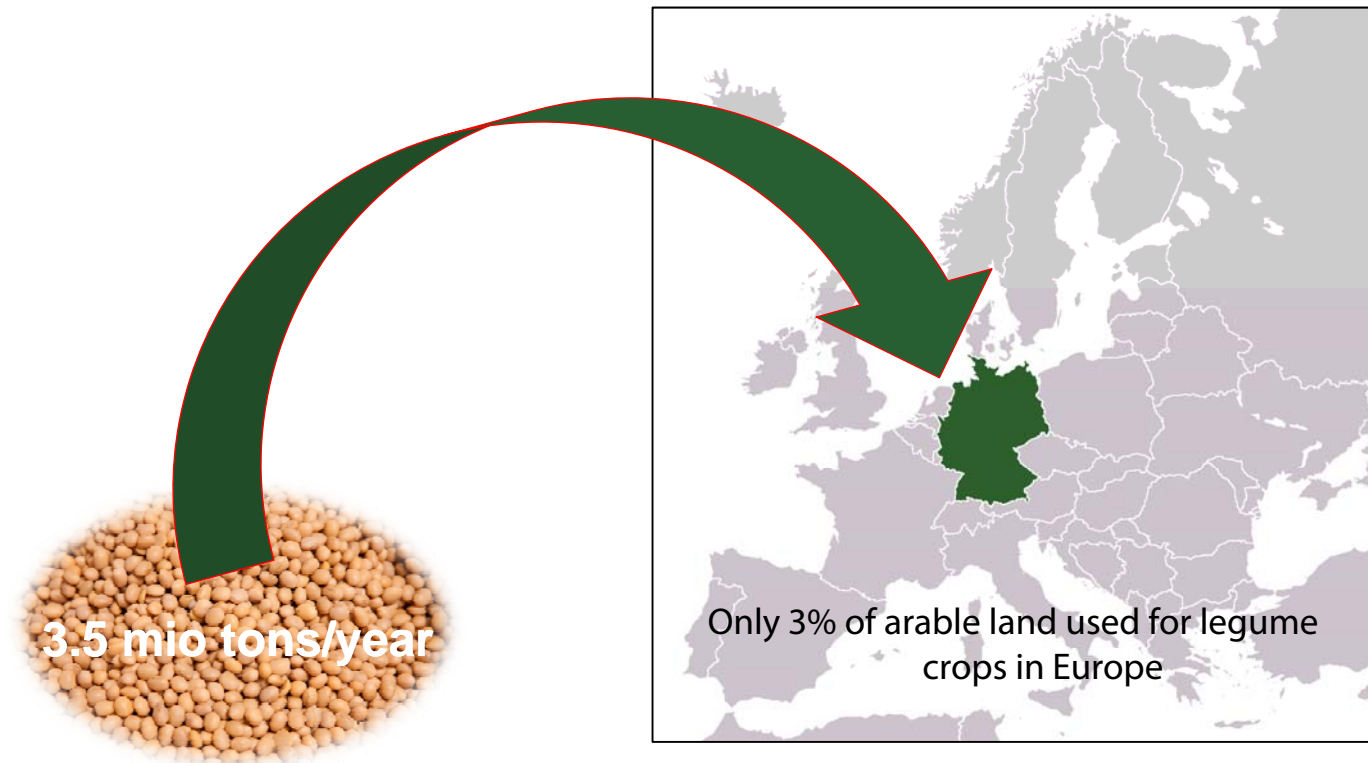
- the potential threat by native and invasive pest insects -

Benjamin Fürstenau & Garnet Marlen Kroos

Federal Research Institute for Cultivated Plants, JKI
Institute for Ecological Chemistry, Plant Analysis and Stored Product Protection

Situation in Germany: Cultivation of innovative plants

- **New trends in diet and in bio-economy**
- **Greater demand of protein sources**
- **Imports from non-European countries**



Cultivation of innovative plants and sustainability

- **Demand for plant protein sources** for food, feed and industry
- **Economic-political development programs**
 - UN-year of pulses (2016)
 - European Soy Declaration
 - Protein Crop Strategy (Germany)
- **Promotion of soybean cultivation**
 - Southern Germany, 'Soja- Förderring'
 - Climate change – supports cultivation factors

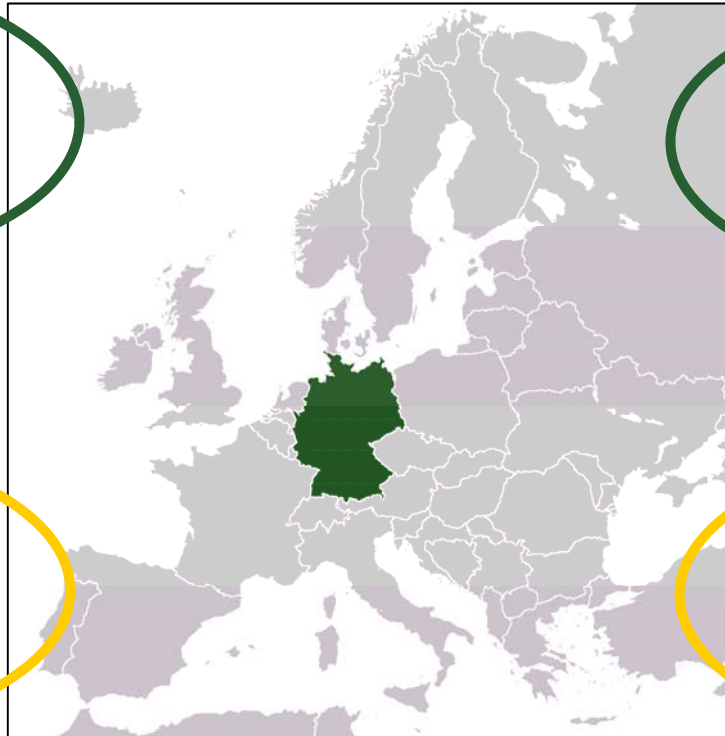
Acreage and harvested amounts: soybean and lupine in Germany

Area of cultivated lupine

2016: 30,000 ha
(blue sweet lupine)

Area of cultivated soybean

2011: 5,000 ha
2017: 19,000 h



Harvested amounts

2017: 53,000 t

Harvested amounts

2011: 13,000 t
2017: 66,000 t



Acreage of cultivated pulses expanded

Increasing yields => increasing stocks of novel commodities

Acreage and harvested amounts: soybean and lupine in Germany



Acreage of cultivated pulses expanded

Increasing yields => increasing stocks of novel commodities

Common insect pest on soybean and lupine

- Can local stored-product pests **infest** stored soy and lupine and **develop** successfully?
- How do they develop **compared** to those reared on their **standard (control) feeding substrate**?
- Does the **processing level/degree of plant products** have any influence on the development of pest insects?

From egg to eclosion

PEST INSECTS	CONTROL FEEDING SUBSTRATE	TEST FEEDING SUBSTRATE „New Stored-Products“							
		Soy	Lupine (6 varieties)						
		<i>Sultana</i>	<i>Boregine (bs)</i>	<i>Boruta (bs)</i>	<i>Mirabor (bs)</i>	<i>Probor (bs)</i>	<i>Sweet mix (bs)</i>	<i>Energy (ws)</i>	<i>Karo ZS (bb)</i>
<u>Moths</u>									
<i>Ephestia elutella</i>	Wheat bran (200g)	beans, grist, flour	--	--	--	--	beans, grist, flour	beans, grist, flour	beans, grist, flour
<i>Plodia interpunctella</i>	Wheat bran/almond grist (185/15g)	beans, grist, flour	beans	beans	beans	beans	beans, grist, flour	beans, grist, flour	beans, grist, flour
<u>Beetles</u>									
<i>Acanthocelides obtectus</i>	Black-eyed beans (100g)	--	beans	beans	beans	beans	--	beans	beans
<i>Callosobruchus chinensis</i>	Peas (200g)	beans, grist, flour	--	--	--	--	--	--	--
<i>Callosobruchus maculatus</i>	Mung beans (100g)	--	beans	beans	beans	beans	--	beans	beans
<i>Rhyzopertha dominica</i>	Wheat grain (200g)	--	beans	beans	beans	beans	--	beans	beans
<i>Sitophilus granarius</i>	Wheat grain (200g)	beans, grist, flour	--	--	--	--	--	--	--
<i>Tribolium confusum</i>	Wheat grist/yeast (191/9g)	beans, grist, flour	--	--	--	--	--	--	--

Lupine varieties

bs: blue sweet
Sweet mix: *Boregine, Boruta, Mirabor, Probor*
ws: white sweet
bb: blue bitter

From egg to eclosion

SOY

Beans



Grist



Flour



- 2-3 L (moths) / 250 mL (beetles) glass jars
- 200 g (soy)/100 g (lupine) of test substrate (beans, grist, flour)
- 22 (soy)/25 (lupine) \pm 1 °C
- 65-70 % RH
- N=6

Moths

Exp. 1. 100 eggs

Exp. 2. 1 male + 1 female adult

Beetles (50 adults)

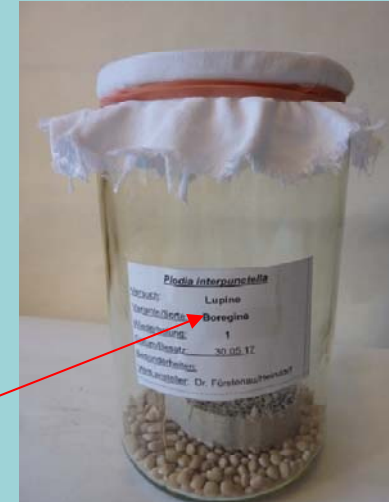
→ Removed after 1 week

Moths (10 adults)

Beetles (30 adults)

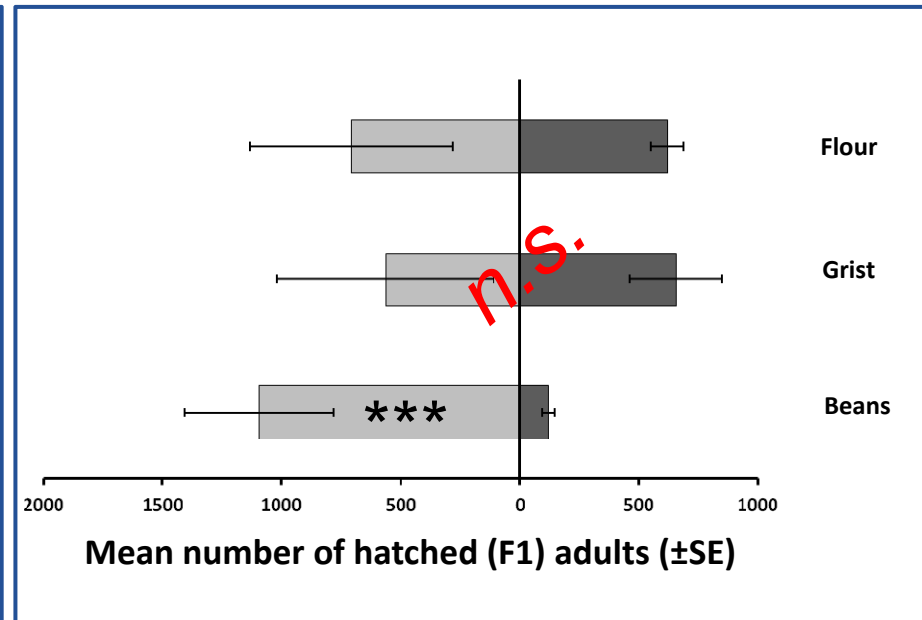
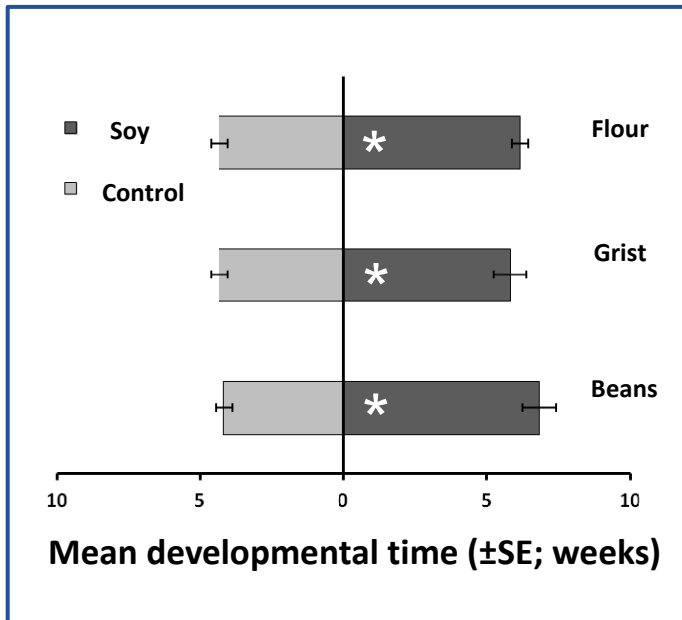
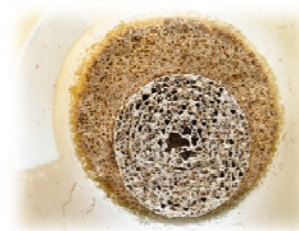
→ Removed after 1 week

LUPINE



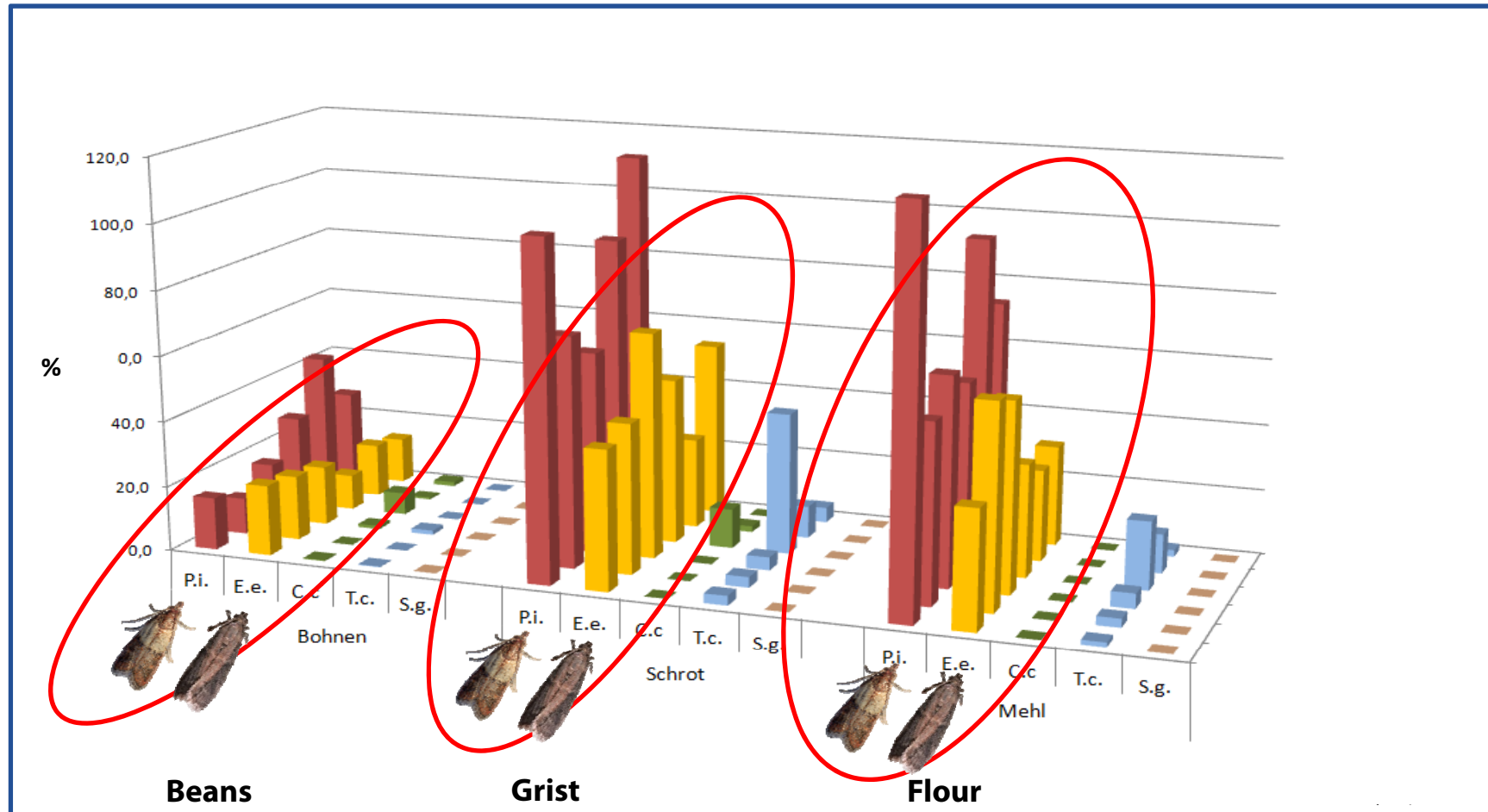
RESULTS

Soy – *Plodia interpunctella*



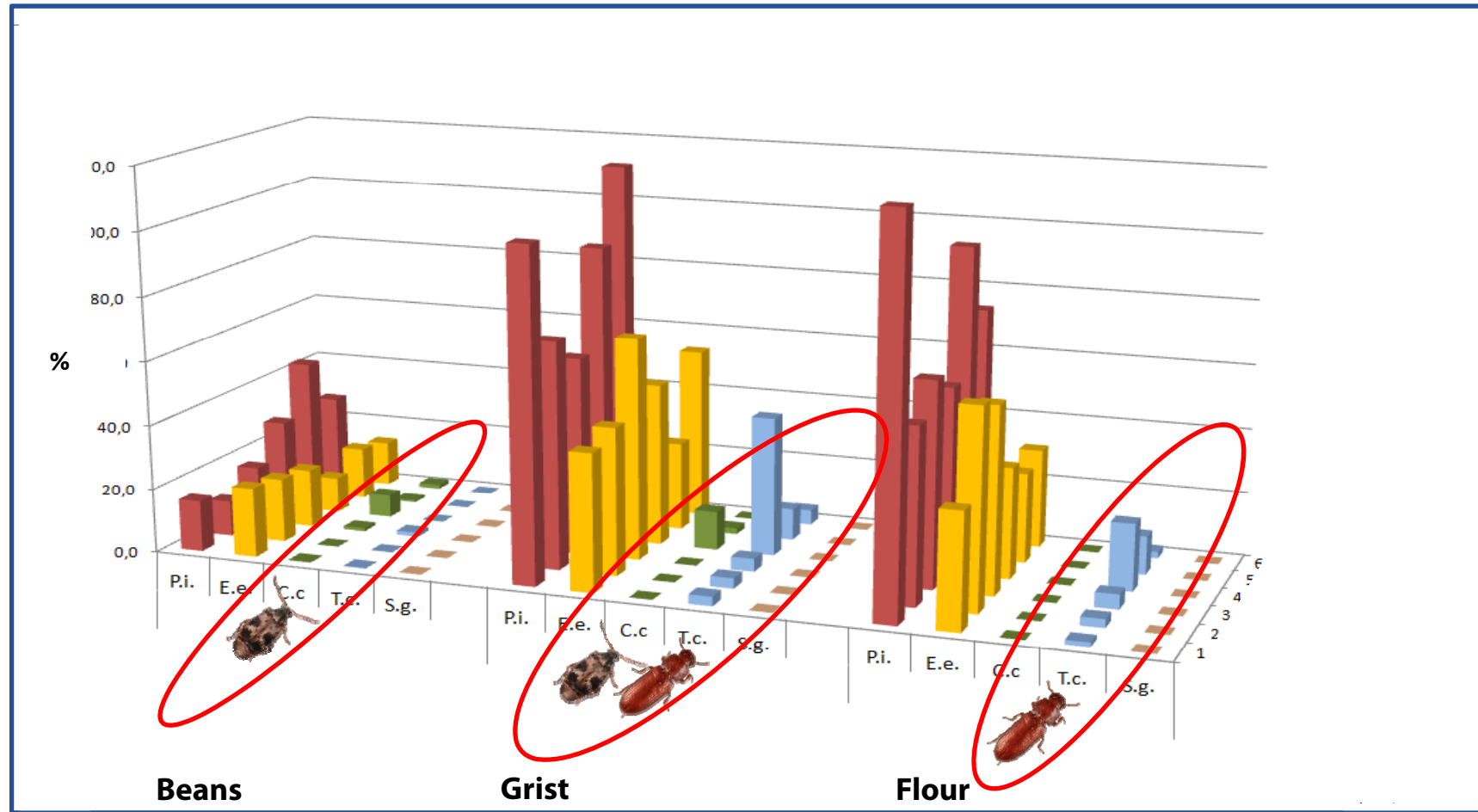
Soy - moths

Plodia interpunctella (P.i.) and *Ephestia elutella* (E.e.)



Soy - beetles

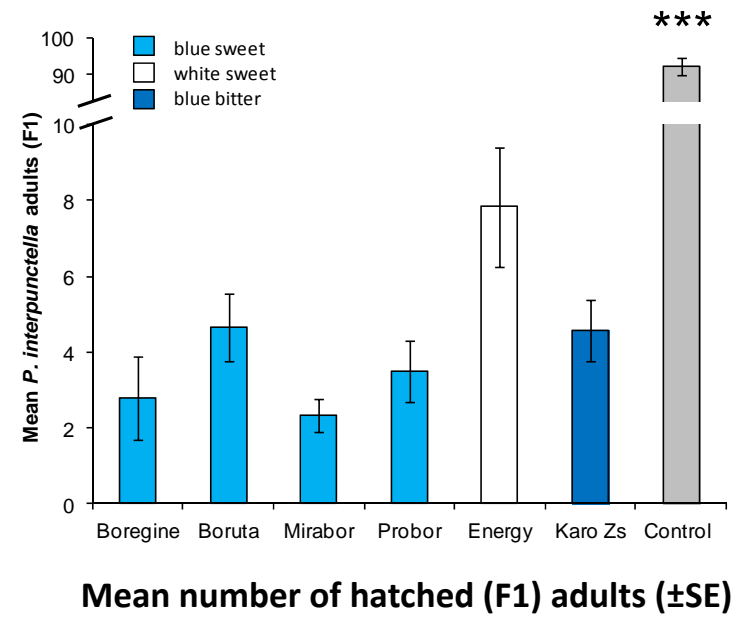
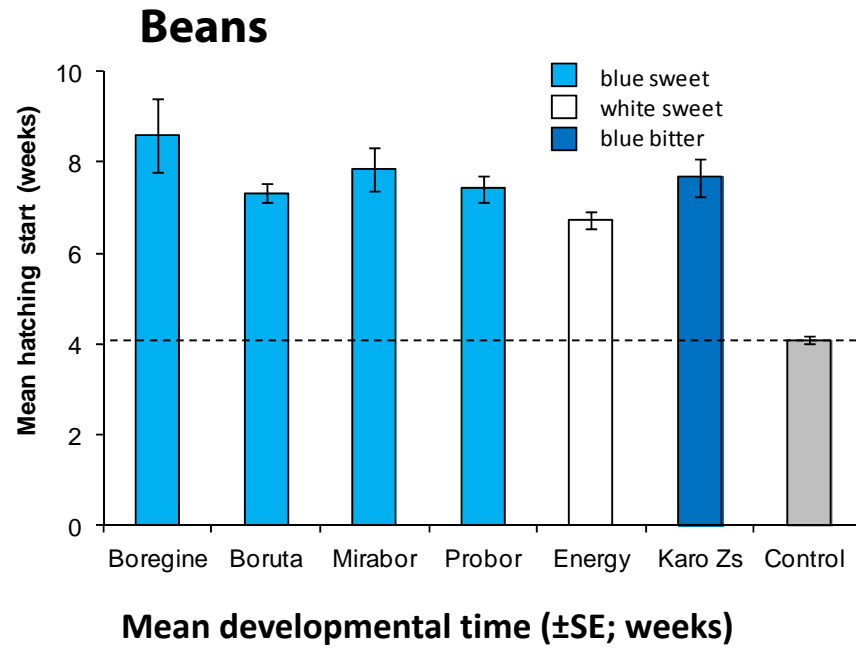
Callosobruchus chinensis (C.c.), *Tribolium confusum* (T.c.), *Sitophilus granarius* (S.g.)



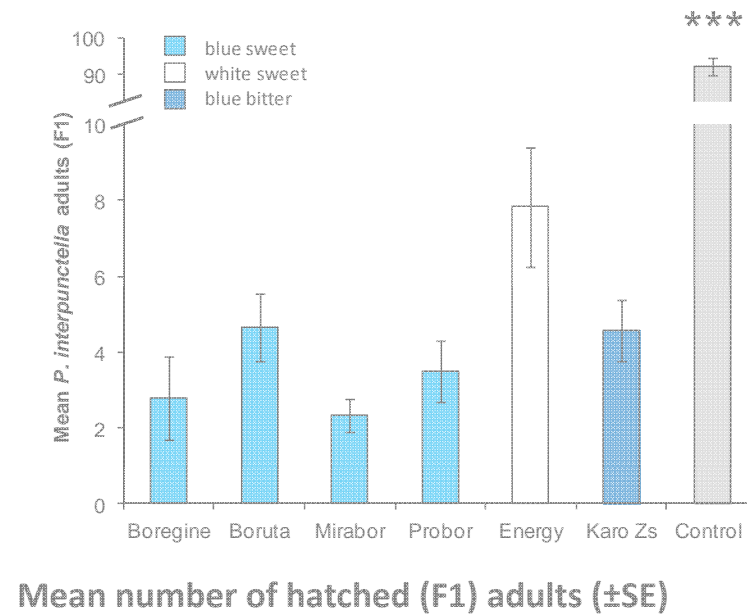
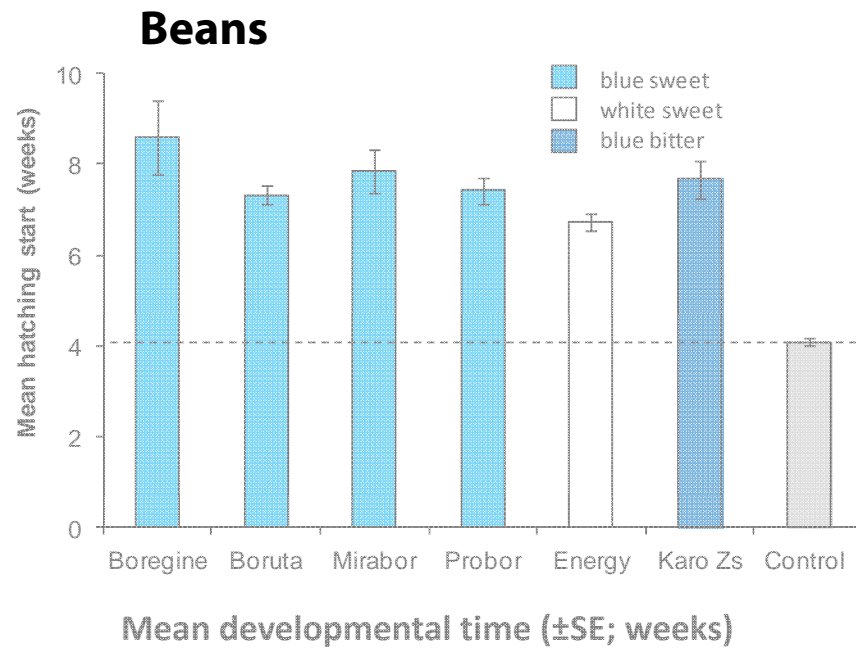
RESULTS



Lupine - *Plodia interpunctella*



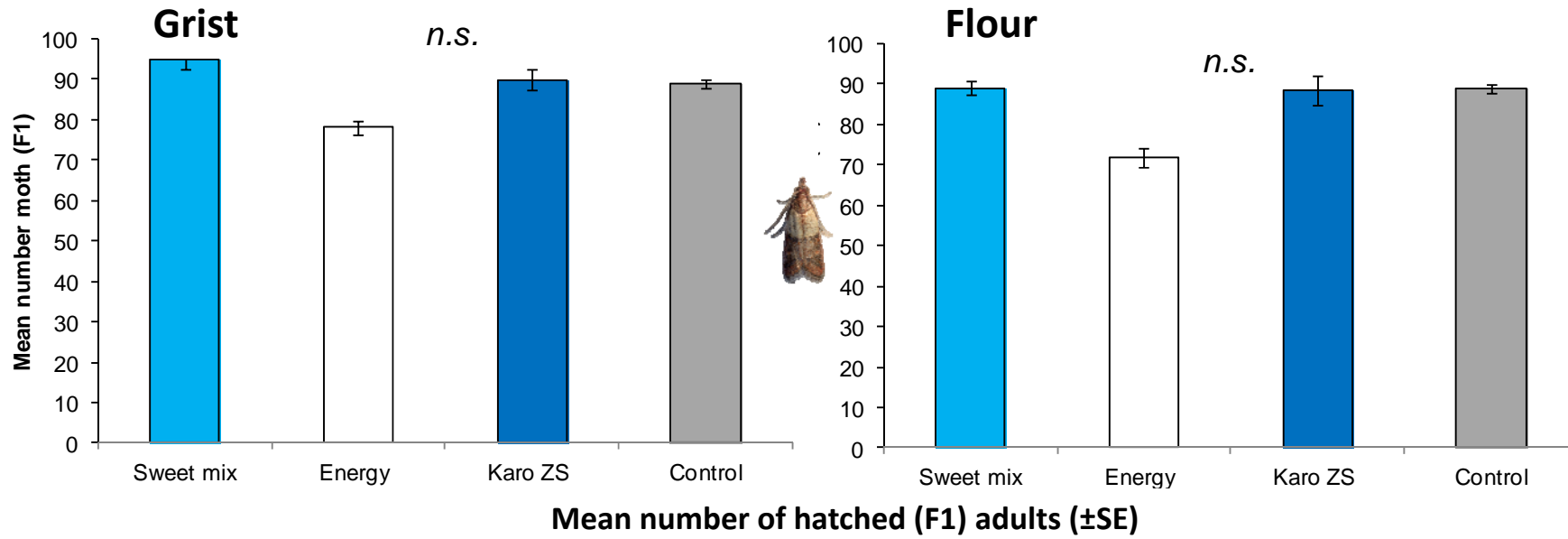
Lupine - *beetles*



Only a few number of *R. dominica* (1-3 ind.) developed successfully
 (ca. 0.3 % compared to those on control substrate)

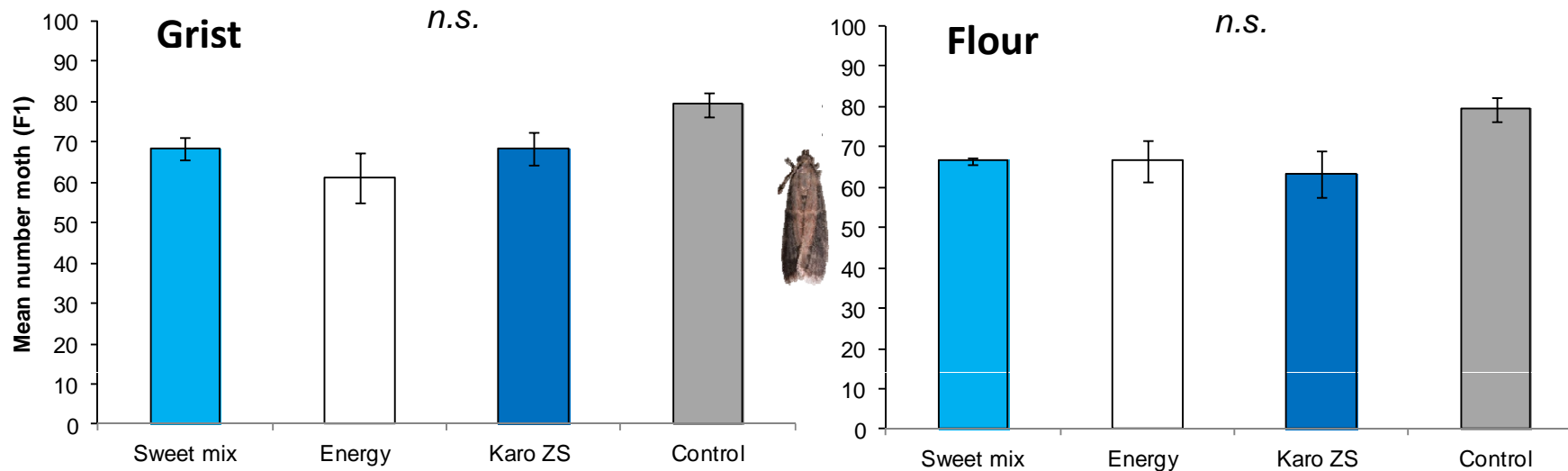
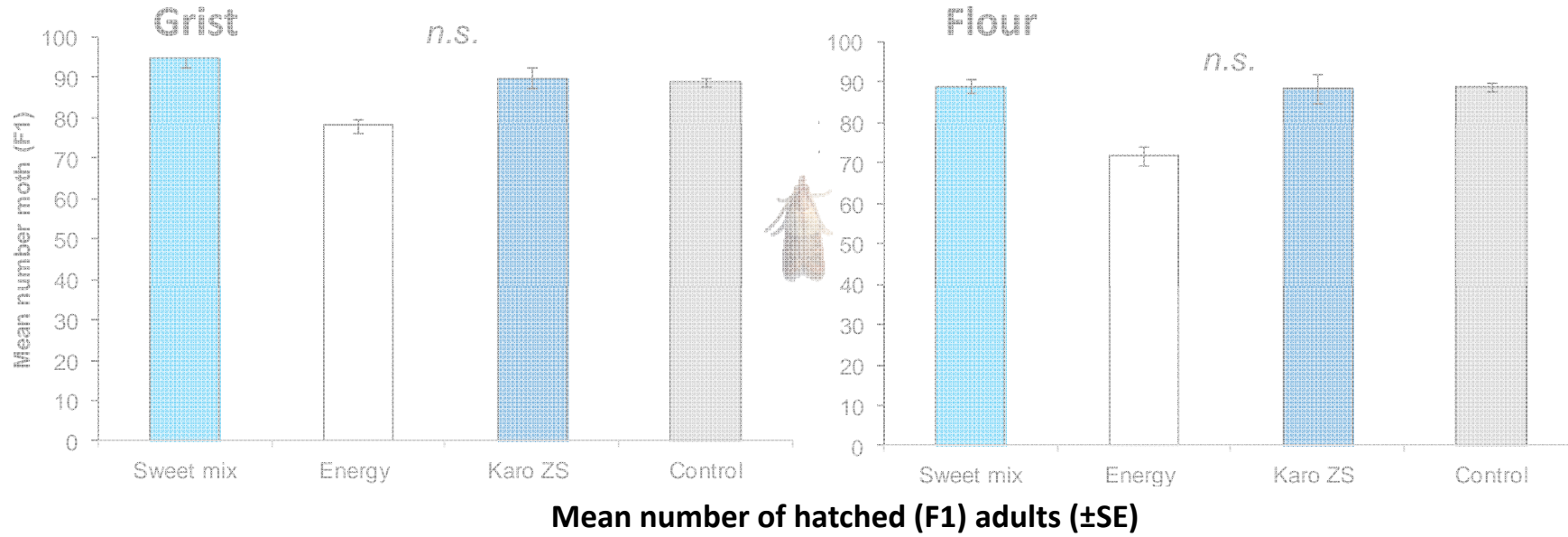
RESULTS

Lupine - *Plodia interpunctella*



RESULTS

Lupine - *Plodia interpunctella* and *Ephestia elutella*



Risk of infestation



PEST INSECTS	TEST FEEDING SUBSTRATE „New Stored-Products“							
	Soy	Lupine (6 varieties)						
	Sultana	Boregine (bs)	Boruta (bs)	Mirabor (bs)	Probor (bs)	Sweet mix (bs)	Energy (ws)	Karo ZS (bb)
Moths								
<i>Ephestia elutella</i>	beans, grist, flour	--	--	--	--	beans, grist, flour	beans, grist, flour	beans, grist, flour
<i>Plodia interpunctella</i>	beans, grist, flour	beans	beans	beans	beans	beans, grist, flour	beans, grist, flour	beans, grist, flour
Beetles								
<i>Acanthocelides obtecus</i>	--	beans	beans	beans	beans	--	beans	beans
<i>Callosobruchus chinensis</i>	beans, grist, flour	--	--	--	--	--	--	--
<i>Callosobruchus maculatus</i>	beans, grist, flour	beans	beans	beans	beans	--	beans	beans
<i>Rhyzopertha dominica</i>	--	beans	beans	beans	beans	--	beans	beans
<i>Sitophilus granarius</i>	beans, grist, flour	--	--	--	--	--	--	--
<i>Tribolium confusum</i>	beans, grist, flour	--	--	--	--	--	--	--

Risk of infestation



Risk of infestation



Control of pest organisms

Authorised Plant Protection Products (PPP) in Germany - stored soybeans (dried) and stored lupine (dried) -

(BVL, 2018-03)



9 PPP

Active substances:

Aluminium phosphide (I)
Carbon dioxide (I, A)
Deltamethrin (I)
Diatomaceous earth (I, A)
Zinc phosphide (R)

➔ Limited applications for special authorized uses!



11 PPP

Active substances:

Aluminium phosphide (I)
Carbon dioxide (I, A)
Deltamethrin (I)
Diatomaceous earth (I, A)
Phosphan (I)
Zinc phosphide (R)

A – Acaricide, I – Insecticide, R – Rodenticide

Authorized uses of PPP in Germany: stored soybeans and lupines

Crop/object-hierarchy	Area of application	Pests	Pesticide (active substance)
1. Stored plant product protection	in empty rooms; in rooms, mills and food stores (in the presence of stored products)	Insects, mites	SilicoSec Diatomaceous earth
	pressure chamber	Insects, mites	Aligal 2 Carbon dioxide
2. Products for storage	around the outside of buildings	House mouse	Ratron Giftlinsen Zinc phosphide
	in rooms		
3. Pulses (dried)	in granaries in sufficiently gasproved rooms	Insects	PHOSTOXIN BAG BLANKET Aluminium phosphide
	in rooms	Insects	PHOSTOXIN Tabletten Aluminium phosphide
	in granaries in sufficiently gasproved rooms	Insects	DETIA-GAS-EX P Aluminium phosphide
	stacked sacks for storage under gas-tight canvas on gas-tight floors or in gas-tight rooms (adequately gas-tight terms of TRGS 512)	Insects	DETIA-GAS-EX B Aluminium phosphide
	in empty rooms, before stockpiling pulses	Insects (adults + larvae)	K-Obiol EC25 Deltamethrin
3. Expeller	stacked sacks for storage under gas-tight canvas on gas-tight floors or in gas-tight rooms (adequately gas-tight terms of TRGS 512)	Insects	DETIA-GAS-EX B Aluminium phosphide
3. Oily seeds	shallow storage	Insects, mites	Aligal 2 Carbon dioxide
	Carvex-pressure chamber	Insects, mites	Carbo Kohlensäure Carbon dioxide
	stacked sacks under gas-tight canvas and in sufficiently gasproved rooms	Insects	Frisin Phosphan
4. Oilseed (used as food)	in granaries in sufficiently gasproved rooms	Insects	PHOSTOXIN BAG BLANKET Aluminium phosphide
4. Oilseed	in granaries in sufficiently gasproved rooms	Insects	DETIA-GAS-EX P Aluminium phosphide
	in rooms for storage under gas-tight canvas on gas-tight floors (adequately gas-tight in terms of TRGS 512)	Insects	DEGESCH-PLATE Magnesium phosphide

Lupine

Soybean

Conclusion

- Stored-product moth species *E. elutella* and *P. interpunctella* multiply on stored pulses, soy and lupine, especially on simply processed forms, **grist and flour** (comparable to control standard feeding substrate) → **High risk of infestation**

Conclusion

- Stored-product moth species *E. elutella* and *P. interpunctella* multiply on stored pulses, soy and lupine, especially on simply processed forms, **grist and flour** (comparable to control standard feeding substrate) → **High risk of infestation**
- Significant longer development time (hatching start is shifted for 2-3 weeks)

Conclusion

- Stored-product moth species *E. elutella* and *P. interpunctella* multiply on stored pulses, soy and lupine, especially on simply processed forms, **grist and flour** (comparable to control standard feeding substrate) → **High risk of infestation**
- Significant longer development time (hatching start is shifted for 2-3 weeks)
- Only a few beetles developed on soy or lupine
→ **Low risk of infestation**

Conclusion

- Stored-product moth species *E. elutella* and *P. interpunctella* multiply on stored pulses, soy and lupine, especially on simply processed forms, **grist and flour** (comparable to control standard feeding substrate) → **High risk of infestation**
- Significant longer development time (hatching start is shifted for 2-3 weeks)
- Only a few beetles developed on soy or lupine
→ **Low risk of infestation**
 - Stored product protection: **best practice and IPM**
 - **Monitoring**: especially in warm continental summers
 - **Risk: moths > beetles --- processed beans > whole beans**

A glass jar containing a mixture of ground almonds and other ingredients, with several moths flying around it. The jar is filled with a light-colored, textured substance, likely almond meal, and several moths are visible flying around it. The background is a plain, light-colored surface.

Thank you for your attention!

Special thanks go to:
Katrin Heindorf, JKI