Observations 2009

Exposition Paths of Neonicotinoids

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Paris, 10.12.2009

Wintering problems as acute symptoms

- Recommendation for nucs 15 years ago:

  30 %

- Nuc recommendation 2009:

  100 %

Possible Causes?

- Pollen and nectar contamination (sublethal doses)
- Increase of neonicotinoid usage in agriculture
- Guttation Drops as possible cause in discussion in Germany since beginning of 2009
- Exposure to neonics through other water sources

Activities in Germany regarding guttation/water/clothi in 2009

- Feb.: Girolami
- Apr.: Call for pictures of drinking bees
- May: guttating crops
- July: Presentation at BVL
- Aug.: Viewed Poncho files
- Sep.: Presentation at Agric. Ministry
- Oct.: Tests of canola guttation

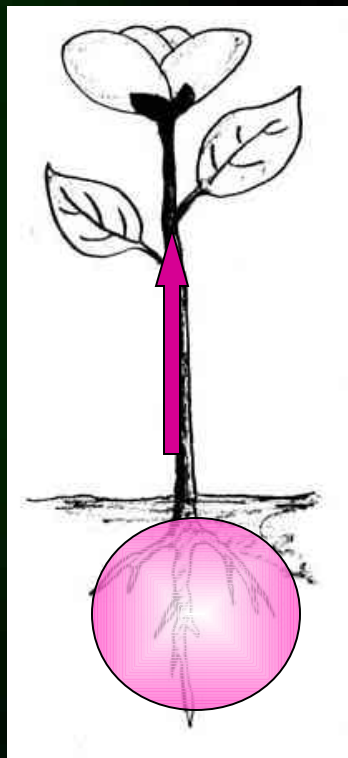
Guttation ./. Dew

Guttation ./. Dew - 2 hours later

Plant sap & Seed coating

- Xylem = Water from roots to leaves
- Phloem = Water from leaves downwards
- Seed coating =

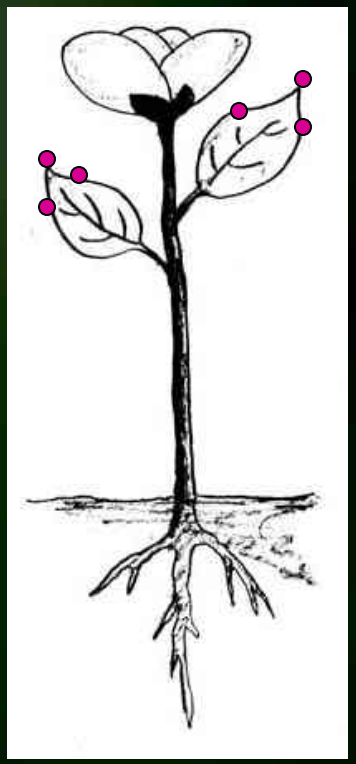
  Poison dissolves in water, dissolves in dressing zone, absorbed through roots and distributed in entire plant



Guttation Droplets

- **Guttation droplets = Xylem**

Minerals, proteins, sugars, Insecticide, Fungicide



Studies / thesis / publications

- Doc. Thesis Michael Schneider, 1988:
  „Aufnahme von (^{14}C) Triadimenol über Korn und Wurzel nach Flüssigbeizung von Wintergerste: Einfluss von Bodenfeuchte und Saattermin auf Radioaktivitätsverteilung und Wirkstoffgehalt in Pflanze und Boden“
- Doc. Thesis. Ulrike Stein-Döneke, 1993:
  „Beizhofausbildung, Aufnahme, Translokation und Wirkung von [^{14}C]Imidacloprid bei Winterweizen und Zuckerrüben nach Saatgutbehandlung und unter dem Einfluss verschiedener Bodenfeuchten“ (Infuence of soil moisture on the formation of dressing zones and uptake of imidacloprid after seed treatment of winter wheat)
- Hughes R. N., Brimblecombe P., 1994:
  „Dew and guttation: formation and environmental significance“
- Guttation water content 1966; various studies mentioning guttation referenced in thesis

A few facts about guttation

- Not limited to a specific time of year or specific groups of plants
  - Spring (observed)
  - Summer (observed)
  - Fall (observed, also Doc. The. Schneider)
  - Winter ? (unless frozen)
    (guttation observed on Dec. 9, 2009)
  - Guttation and dew available for at least two hours in the morning (Pub. UK)

Water requirements of bees

- Why water in the morning??
  - Dilution of honey/nectar to feed larvae
  - Water reserve against ‚thirst' after heating at night
  - High water demand by nurse bees digesting pollen for jelly production (average water content is 67 %)

Water homeostasis in bees, with the emphasis von sociality ,
S. W. Nicolson, Journal of Experimental Biology 212, Feb. 2009

Observations 2009

- Neonicotinoid seed coatings
  - Exposure of bees
  - (Sublethale Effects)
- Exposition in non-relevant crops
- Brood damage through blossom treatments?
- Residues in honeys after blossom treatments

Known danger?

Doc. The. USD, p. 149:

„Es gilt zu prüfen, inwieweit die Wirkstoffausscheidung mit der Guttation neben einem Wirkungsverlust für die Pflanze auch eine Gefährdung von Nützlingen wie Marienkäfer und Bienen darstellen kann, da diese die Guttationstropfen als Wasserquelle nutzen (Poehling, 1992; Schmidt, 1992b).“

„It still needs to be tested in how far the loss of a. i. through guttation poses a danger to beneficial insects like ladybugs and bees, because they use guttation drops as a water source (oral communication, Poehling, 1992; Schmidt, 1992b).“

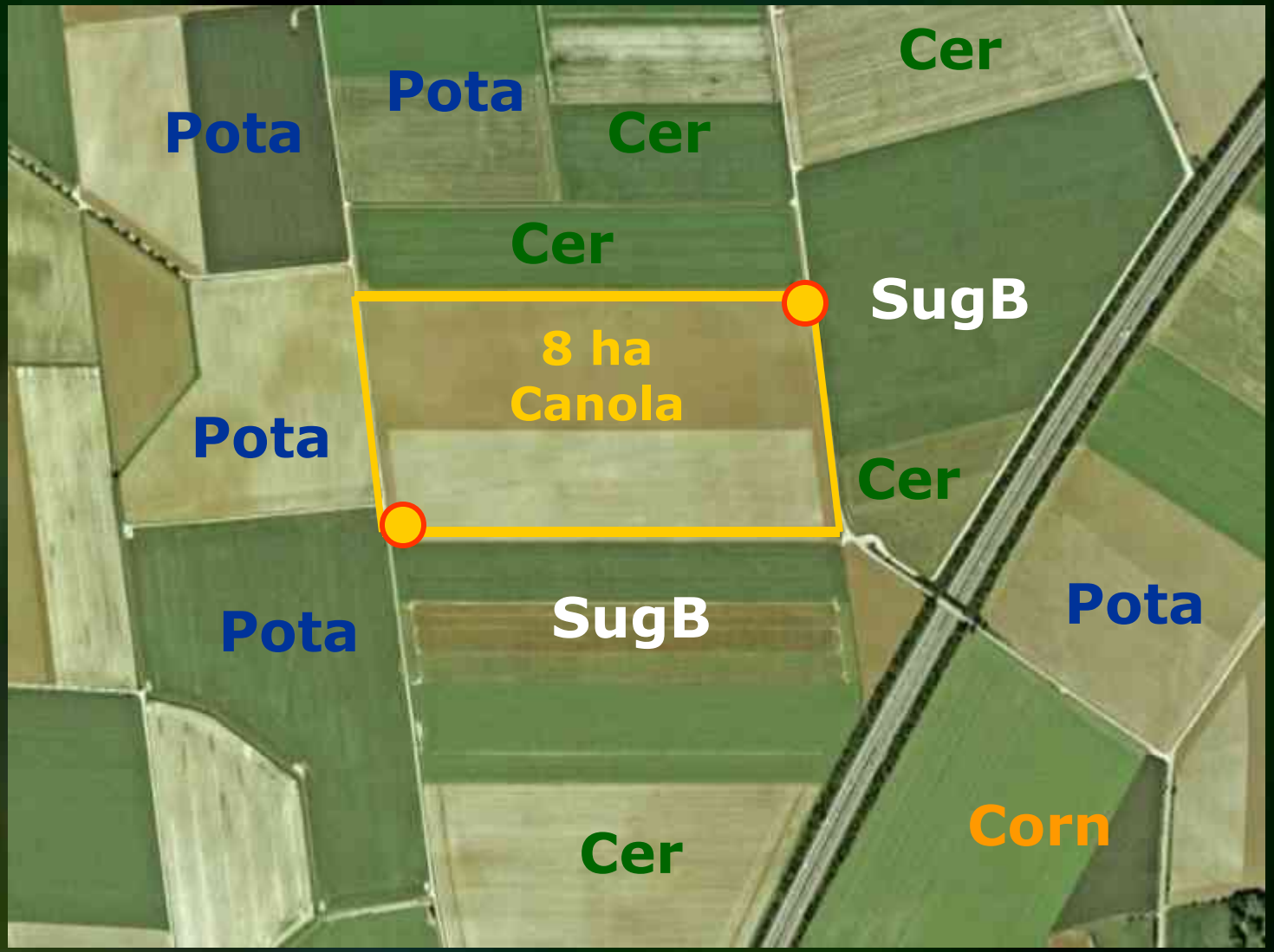
Poehling, M.-H. (1992): Pers. Mitteilung. Institut für Pflanzenpathologie und Pflanzenschutz, Universität Göttingen

Schmidt, H.-W. (1992b): Pers. Mitteilung. Bayer AG, Geschäftsbereich Pflanzenschutz, Entwicklung/Insektizide, 5090 Leverkusen, Bayerwerk.

Documentation of Guttation

- 1 beekeeper
- 1 canola field
- 2 apiaries
- Small digital camera
- Location: northern area of county Düren, Germany
- 85 % agricultural use

Canola field & surroundings



Everything‘s guttating!

Some observations ...

- Water puddle, but bees collect guttation drops as long as available
- Bees prefer sunny spots for water collection
- Water collectors in sunny field seam strips up to 40 m from hives
- Dew in shaded spots (driving lanes) still available after everything else dries

Bee drinking guttation drop

They do drink it!

Everything‘s guttating: Canola

Everything‘s guttating: Sugar Beet

Everything‘s guttating: Potatoes

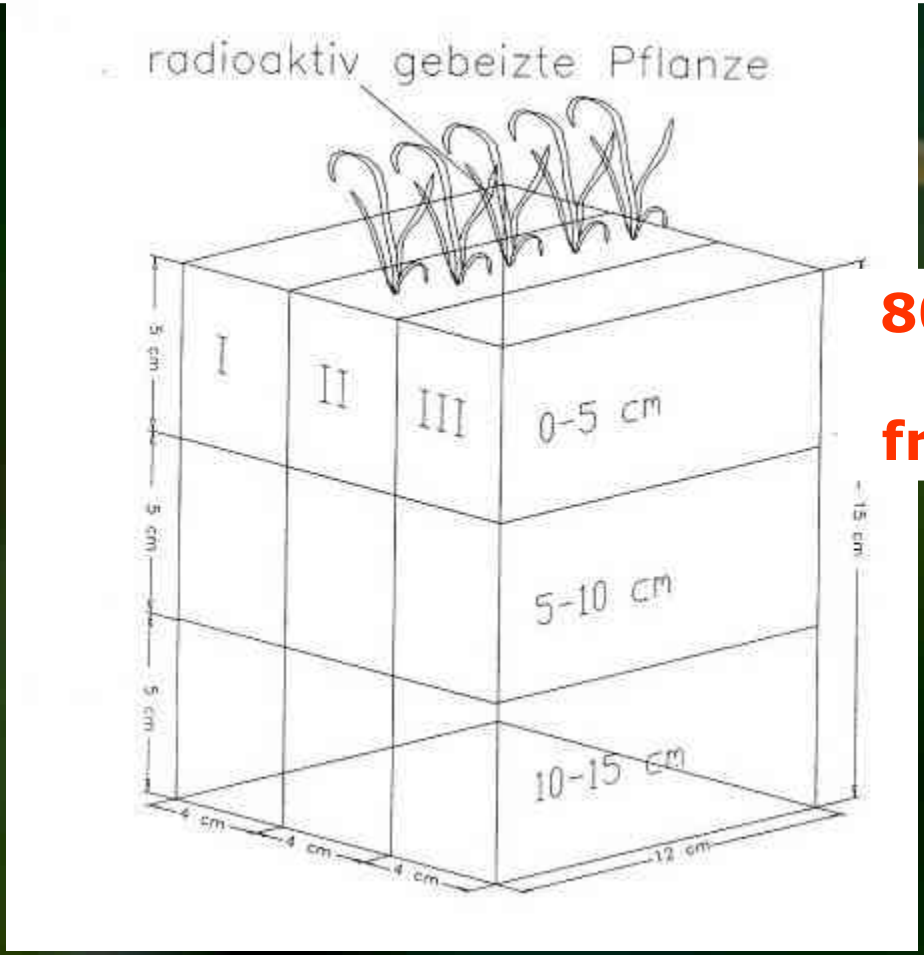
Everything‘s guttating: Cereals

Everything‘s guttating: Corn

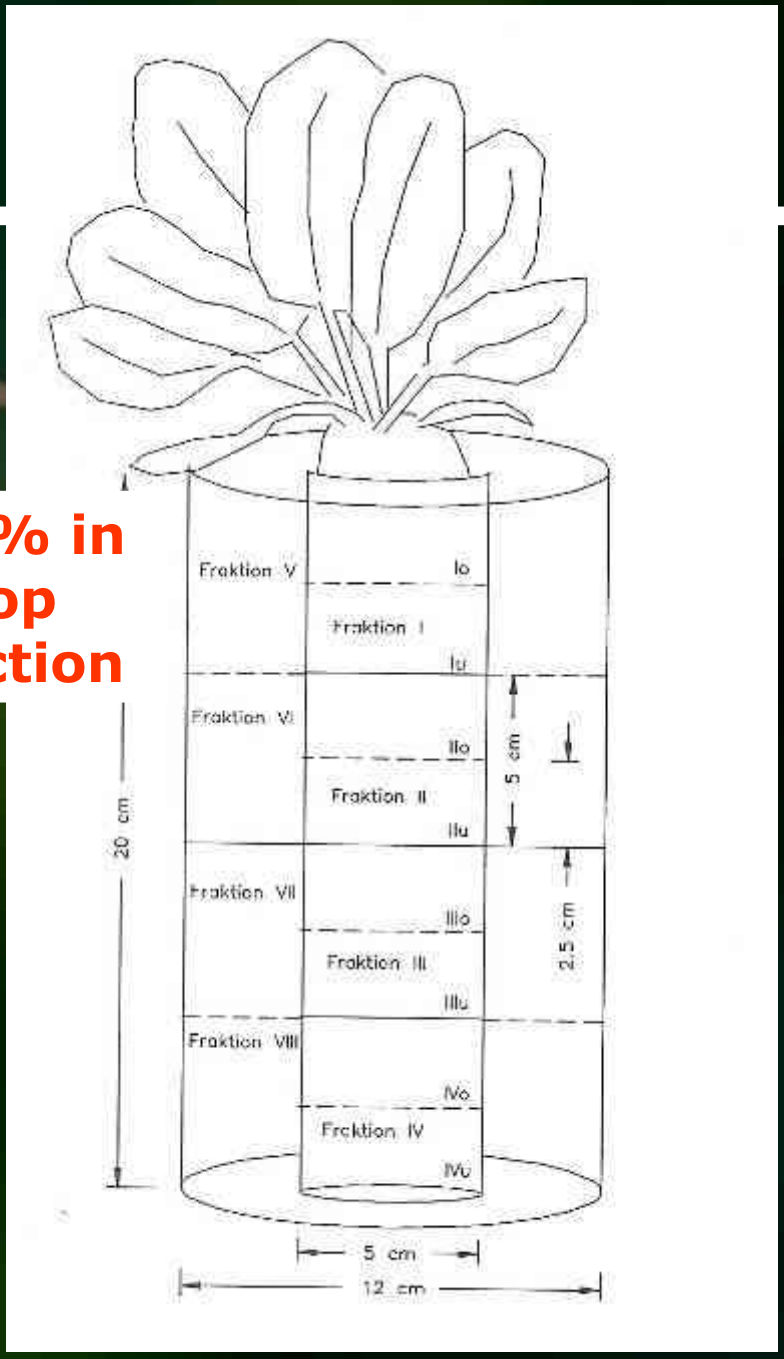
Active Ingredients

- Per sugar beet seed 0,9 mg Neonicotiniode (Poncho Beta+)
- Per Corn seed 0,5 mg Neonicotinoid (PONCHO) resp. 1,25 mg (PONCHO PRO)
- Main distribution in top 5 cm of soil with r = 5-6 cm around plant

Dressing zones



80 % in top fraction



Concentration of seed coating

- Concentration in first few drops acc. USD 0,3 % of total a.i. per seed
- Higher concentration of a.i. in leaf tips (and thus in guttation drops) than compared to rest of plant and xylem

Distribution of A. I.

Makroautoradiographie wheat plant (45 days after seeding)

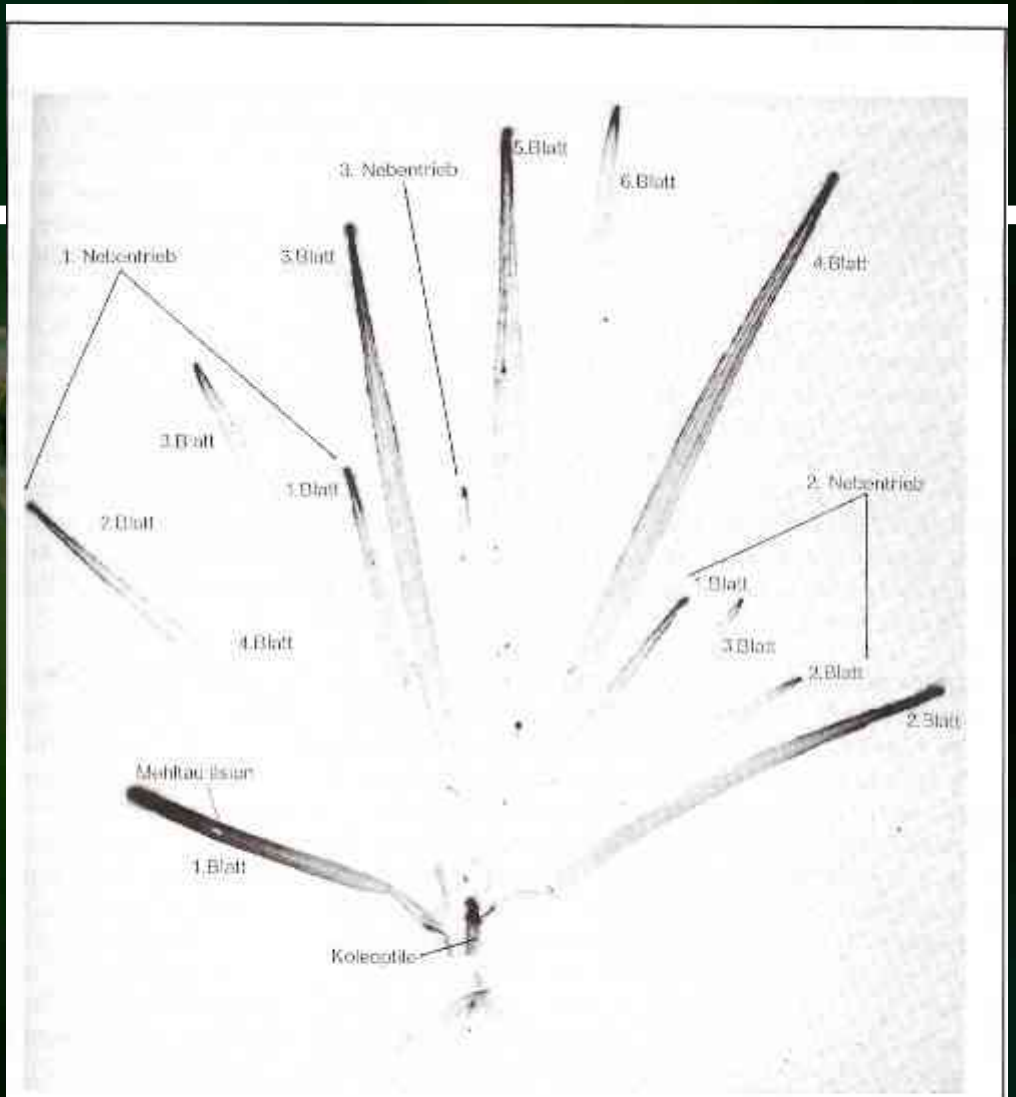


Abb. 20. Gefäßversuch mit Winterweizen: Makroautoradiographie einer Weizenpflanze zur Hauptbestockung (45 Tage nach der Saat).

Distribution of A. I.

Makroautoradiog-
raphie of sugar beet
plant in 6-leaves stage
(32 days after seeding)

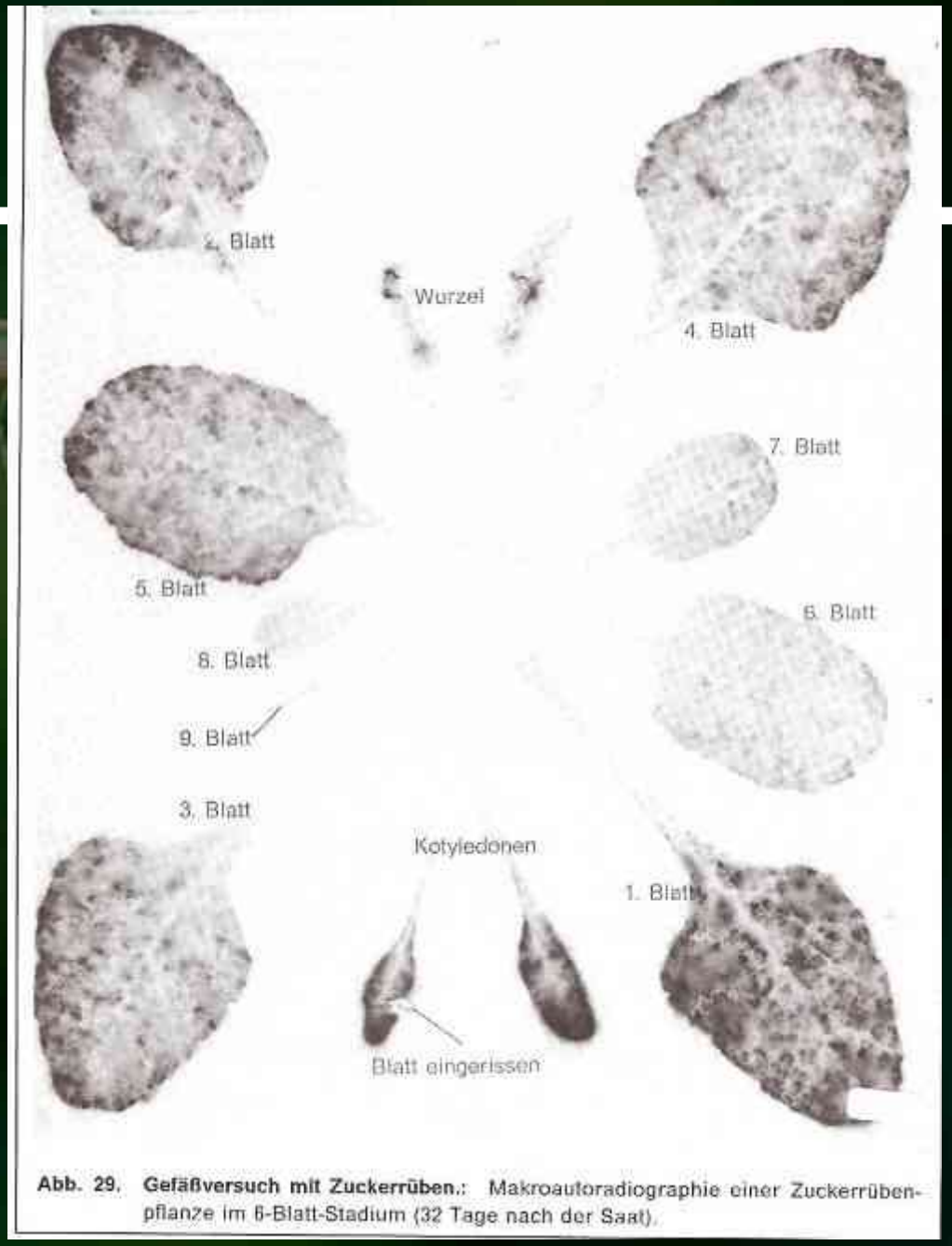


Abb. 29. Gefäßversuch mit Zuckerrüben.: Makroautoradiographie einer Zuckerrübenpflanze im 6-Blatt-Stadium (32 Tage nach der Saat).

Bon appetit!

Weeds in dressing zones

Weeds in Corn

Long term poisoning effects

- Concentration of a. i. in guttation droplets in fall and spring?
- Which concentrations in the different crops?
- Potatoes, salads, other plants?
- How much a. i. remains in soil and becomes available later on, e. g. fertilizer plants like ‚Senf‘ (sinapis alba)?

Seed coating expositon

- Guttation droplets of crops
  - Direct consumption of drops by bees
  - Dried and re-soluted remains of guttation drops on leaf surfaces
- „Leaching“
- Water collection from soil in dressing zone, eventually increased by fallen guttation droplets?
- Guttation of weeds growing in dressing zones

Guttating Canola

Dried residues of guttation droplets

Guttating Cereals

Dried residues of ? on potatoes – Pesticide Spray?

Dew as water source

- Especially in areas with intensive agriculture guttation drops and dew are the most important water sources in the morning
- A. I. dangerous for bees may be used on crops, which are not attractive for bee foraging
- Danger of transfer from leaf (phloem) to dew (or rain) on leaf = „Leaching“ (Diss. Schneider)

„Hoover-Biene“

Dew as water source

Water collector on soil

7:30 h in the morning, at the hive

Noon 12:20 h, in front of the hive

Noon 12:21 h, in front of the hive

Relevance

- Why dead bees?
- How many water collectors does a hive lose?
- „Der Herr schickt den Gockel aus …“

Research required!!!

Bee loss per hive

- Daily loss in Canola: 1.500 bees
- „what does it matter, if 200 more die?“

+ 13 % - daily

- Continuous weakening of hive!

Dew & „Leaching“

- Transfer of a. i. from leaf to dew possible (acc. to Doc.Th. Schneider)
  - Neonicotinoids (seed coating)
  - Other insecticides (seed coatings)
  - Topical sprays from previous day?
- Italian results: Leaching + Dew or a mix of guttation & dew?

Additional exposition paths of neonics through water

- Lost seeds in puddles
- Washed out seeds
- Puddles in driving lanes
- Puddles between potato dams

Lost seeds in puddles

Washed out seeds

Puddles in driving lanes

Water between potato dams

Clothianidin has permit for seed potatoes, soil treatment before laying of potatoes.

Neonicotinoids in adjacent crops

- High a. i. dosis in sugar beets
- High a. i. dosis in corn
- Soil treatment for seeding potatoes

- Effects on subsequent fertilizer plants?

Hive poisoning in fall?

Neonicotinoids in Fall

- Young canola plants
- Winter cereals
- Guttating fertilizer plants

Canola guttation in Fall

Neonicotinoid content in Canola guttation, fall 2009

4-leaf-stage 6-leave-stage

Speyer, 27.10.2009/ne

UNTERSUCHUNGSBERICHT- PFLANZENBEHANDLUNGSMITTEL -

Proben-Nr.:	**R 58836/09**	Auftraggeber-Nr.:	**2b Hawei 22.09.09**	Probeneingang:	23.09.2009
Probenahme am:		Probenehmer:	Riebe	Verpackung:	
Probenahme bei:				Plombe:	nein
Probenbezeichnung:	**Guttationswasser**				

Untersuchung auf: Parameter	Gehalt ← in µg/l →
Clothianidin	15,3
Imidacloprid	0,3
Metalaxyl	2,4
Metazachlor	0,4
Prosulfocarb	0,1
Spiroxamin	0,25
Thiamethoxam	157

Neonicotinoide

Neonicotinoid seed coatings …

- … poison agricultural crops and soils for months
- … poison for month and indiscriminatingly any and all insects, not just the targets
- … still require carefull handling of the treated seeds

Neonicotinoids in Germany

- Direct application B1
- - no application - ~~B2~~
- Seed coating ~~B3~~
- Sprays B4

Contamination of nectar and pollen by blossom sprayapplications

Brood losses?

Brood damage by neonicotinoids

- Neonics through water into hive
- ‚Harmless' substances, e. g. Thiacloprid → blossom spray application → Nectar, Pollen
- Distribution of contaminated water and/or nectar through thropalaxix and snowball-system in entire hive population of collectors, hive bees, and open larvae

Literatur about „snowball system“

- Food transmission within the honeybee community,
  H.L. Nixon + C. R. Ribbards, 1952
- The flow of incoming nectar througha honey bee colony as revealed by a protein marker,
  G. DeGrandi-Hoffman + J. Hagler, 2000
- Inner nest homeostasis in a changing environment with special emphasis on honey bee brood nursing and pollen supply,
  T. Schmickl, K. Crailsheim, 2004

Schneeball-System

- Marked sugar syrup
- After 2 hours:
  65 % hive bees, 42 % nurse bees,
  35 % Larvae
- After 8 hours:
  100 % hive bees, 90 % nurses,
  75 % Larvae
- After 48 hours:
  100 % hive and nurse bees as well as all open Larvae

Brood damage through „safe“ a.i.?

- Nectar storage right next to brood for direct larvae feeding
- Danger for nurse bes?
- Can poison be passed on through royal jelly?
- ‚Long term damage‘ of adult bees raised as larvae with these substances?!

Fungicides as blossom sprays, e. g. CANTUS

- Nectar storage right next to brood for direct larvae feeding
- Danger for nurse bes?
- Can poison be passed on through royal jelly?
- Effects of fungicides on microorganisms important for the productionof bee bread (G. DeGrandi-Hoffman)

GMO plants

- Nectar storage right next to brood for direct larvae feeding
- Danger for nurse bes?
- Can poison be passed on through royal jelly?
- GMO plants produce their own poison – danger to bees through guttation drops?
- Leaching of GMO poison into dew/rain, drops falling to the soil, weeds?

Demands of DBIB

- Immediate stop of all neonicotinoid seed coatings in crops
- No blossom spray applications (during daylights)
- Larvae tests for all substances to be applied to blossoms

Bees drinking phloem?

Latest results

- Girolami publication
- Canola guttation in spring at approx. 20 ppb (UFOP research, Wallner)
- JKI greenhouse results presented in Sept. in Brussels
- AFSSA presentation at SETAC in Sept. in Brussels