

Die Arbeiten wurden mitfinanziert aus Mitteln des Bundesministeriums für Ernährung, Landwirtschaft und Verbraucherschutz (*Diabrotica*-Forschungsprogramm).

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Dust drift during sowing of maize and oilseed rape – effects on honey bees

Staubabdrift bei der Aussaat von Mais und Raps – Auswirkungen auf Honigbienen

In 2008 bee poisoning incidents in southern Germany revealed drift of insecticidal dusts on adjacent areas with flowering bee forage plants during sowing of maize as a considerable route of exposure. Consequently, several improvements have been proposed as possible risk mitigation measures e.g. for seed dressing quality regarding dust abrasion, taking into account Heubach values and residue content of dust. To assess potential effects on honey bee colonies following insecticidal dust drift on adjacent non-target areas, in 2010 and 2011 two large-scale drift experiments were carried out during maize sowing using seed batches from two different years (2010: seed batch from 2008; 2011: seed batch from 2011).

In addition, two further drift experiments in 2009 and 2011 were conducted during sowing of Clothianidin-treated winter oil seed rape (= WOSR). Aim of these experiments was to gain more information on dust drift at the sowing of other important crops by pneumatic sowing techniques, the residues in adjacent crops and the potential effects on bees colonies compared to the sowing of treated maize seeds. Heubach tests at JKI demonstrated a significantly better seed treatment quality for WOSR seeds in 2011 than for maize. In both drift experiments using maize two different approaches were used: 2010 the experimental area (flowering WOSR) was in the middle of two areas reserved for maize drilling, in contrast 2011, the drill area was surrounded by two areas with flowering WOSR. The maize was sown by a pneumatic vacuum operated precision air planter with at least 90 % drift reduction due to a deflector.

In 2010, on both sides directly along the edge of the WOSR (distances to the drilling area: 0 and 90 m) 4 hives for the field exposure as well as three gauze-covered tunnel tents (16 x 6 m) with bee hives for the semi-field experiment were exposed, with the side exposed in opposite to the wind direction used as control. Before sowing bee hives in the tents were closed and the gauze from the tunnels at the distance of 0 m to the drilling area was removed. Immediately after sowing, the tunnels were covered again and the hives reopened. Bee hives in the field approach were left open during the drilling process, so they were continuously exposed to contaminated dust. Other hives were set up in about 90 and 800 m distance from the exposed WOSR.

In 2011 a similar experiment was performed with tunnels located in WOSR in wind direction and opposite to this and outdoor bee hives in distances of 0, 50 and 500 m to the exposed WOSR. The impact of dust drift on bee colonies in semi-field and field trials were examined by assessing flight activity and mortality in dead bee traps (type "Gary"). Dead bees were documented, collected, frozen and analyzed for residues. In both drift experiments with WOSR, the drilling area was surrounded by two experimental areas with flowering mustard. Sowing was done by a conventional pneumatic seed drill. Experimental procedures, samplings and documentations were similar to the drift experiments during maize sowing in 2011. Only in 2009, the design of the semi-field approach differed in tent size (4 x 4 m) and number of replications (n = 4).

The results of drift experiments during maize sowing showed a clear treatment related increase of bee mortality, especially in the worst-case semi-field approach, but also in the field approach at a much lower level. Bee mortality in 2011 was slightly lower than in 2010, presumably due to a slightly lower exposure (Heubach-values 2010: 0.86 g / 100000 kernels with 10.6 % Clothianidin; 2011: 0.45 g and 19.2 % respectively). Further improvements of the seed treatment quality of maize and of the sowing technique are needed to exclude adverse effects on bees. In contrast to sowing maize, during sowing WOSR in 2009 and 2011, no treatment related increase of mortality was observed. Even in the "treated" variant of the worst-case semi-field approach, only low mortality, similar to the control was detected, barely exceeding the natural rate of mortality. The amounts of abrasion dust and its insecticidal residue content were clearly lower compared to maize (Heubach value WOSR 2011: 0.38 g / 700.000 kernels with 6.33 % Clothianidin). A good seed treatment quality of WOSR and the use of a conventional pneumatic seed drill did not result in any adverse effect on bees.

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