USE OF DEHUSKING IN PLANT PROTECTION PRODUCT RISK ASSESSMENT FOR BIRDS & MAMMALS

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Abstract

Use of seed dehusking as an exposure refinement option for birds and mammals is discussed in EU guidance documents and zonal reviews of risk assessment information. Various criteria are set in EFSA (2009) which must be fulfilled before using dehusking as a quantitative refinement option. However, the use of dehusking as a refinement option is not applied consistently by EFSA nor by member states. Research is available on different aspects of dehusking including species which are confirmed to dehusk, the proportion of seed dehusked during feeding and the level of seed residue reduction achieved during dehusking behaviour of different species. This literature review of the available research on dehusking and feeding behaviour of birds and mammals presents a discussion of the regulatory situation at EU and national level with regards to acceptability of dehusking as a refinement option. This review also identifies species for which dehusking is a suitable option for refinement and presents suitable default values for proportion of seed dehusked and residue reduction achieved during dehusking which can be used in risk assessment for different species. This review then presents a method of calculating an exposure reduction factor (dehusking factor) which can be used as a quantitative refinement in risk assessment.

Introduction

Dehusking of seed by birds and mammals may lead to reduced exposure to plant protection products (PPP), as the outer shell is removed and with it a certain amount of the PPP residue. In previous risk assessment guidance for birds and mammals (SANCO 2002) a dehusking factor of 0.15 was considered appropriate for species known to dehusk. Dehusking is also considered relevant in current guidance (EFSA 2009). This is observed in several previous EU risk assessments (e.g. Prochloraz, Epoxiconazole) for which dehusking is accepted as a higher tier refinement. Current guidance (EFSA 2009) states that a number of points must be considered if dehusking is to be used to refine exposure. These include a requirement for evidence that dehusking may play a role in exposure reduction under field conditions for the scenario in question, and that studies with the appropriate focal species and seed type are preferred over those requiring extrapolation.

- Case-specific evidence must be provided that it may actually play a role under field conditions for the relevant focal species
- Available information on actual extent of dehusking and on relevant environmental conditions for such behaviour should be thoroughly discussed
- Studies with the relevant focal species, the relevant seed type and the relevant product should be considered in preference to other studies requiring extrapolation;
- Particularly for birds, a risk assessment for a dehusking species should always be accompanied by an assessment for a second species that does not dehusk, in order to conclude on the actual species of concern

Northern zone guidance document (KEMI 2014) provides a summary of available research on dehusking, and makes recommendations for use in risk assessment where appropriate. This guidance also highlights bird and mammal species which are confirmed to dehusk seed. Dehusking species are also highlighted in Buxton *et al.* (1998).

Dehusking is generally favoured as a qualitative refinement at present by EU member states. However, it is possible to produce realistic and worst case estimates of dehusking for use in a quantitative risk assessment based on currently available data.

Extent of dehusking

Birds

An observational study which used video equipment to monitor seeds provided at bait stations (Prosser 1999) provides details the extent of dehusking for recorded species. Details are provided in Table 1.

Table 1. Dehusking behaviour of bird species at bait stations for several seed types (after Prosser 1999)

Species	EFSA Diet Guild (gran=granivorous, herb=herbivorous, omn=omnivorous, insect=insectivorous)	% seed dehusked (Number seeds eaten by all birds)			
		Wheat	Barley spring / winter	Oil seed rape	Sugar beet
Yellowhammer	Gran	100 (384)	99 (684)	100 (85)	-
Chaffinch	Insect / omn	90 (1040)	48 (96) / 0 (3)	43 (2501)	-
Greenfinch	Not included (gran)	100 (1372)	100 (24) / -	96 (1352)	100 (3)
Tree sparrow	Insect / herb/ gran / omn	97 (496)	100 (108) / -	-	-
House sparrow	Insect / herb/ gran / omn	20 (84)	100 (20) / -	-	-
Meadow pipit	Not included (insect / gran)	-	100 (32) / -	-	-

No dehusking was observed for Red-legged partridge, Pheasant, Dunnock, Robin, Starling, Woodpigeon, Magpie, Rook, Crow, Jackdaw nor Jay for any seed type

Dehusking species in Prosser (1999) can be considered small species (approx. > 50 g). Prosser (1999) provides evidence that dehusking plays a role under field conditions for relevant species. Effect of dehusking on residue intake was not measured it Prosser. Residue reduction information for birds is available in Avery *et al.* (1997) as presented in Table 2.

Mammals

Information on dehusking by mammal species is available from laboratory studies (Brühl *et al.* 2011, Morris and Thompson 2011). Compared to Prosser (1999) these studies provide more detailed information for the most relevant EU focal species (woodmouse and vole). Brühl *et al.* and Morris and Thompson both provide suitable information to calculate dehusking factors for use in risk assessment. Effect of dehusking on residue intake is measured in these studies. Estimates of residue removed during dehusking from available studies is presented in Table 2 below.

Table 2. Proportion of seed residue removed during dehusking for birds and mammal as presented in the literature

Reference	Source for residue remaining calculation	Dehusking Test Species	Residue remaining after dehusking
Edwards *et al.* (1998)	Dehusking small seeds lowers mean residues by 86%	Manual husk removal	0.15
Avery *et al.* (1997)	60 to 85% residue remained on seed hull (millet, rice sunflower and sorghum seed)	All bird test species	0.41
	Mean proportion of residue remaining on seed hull: 0.85 millet, 0.82 rice, 0.61 sunflower	House finch	0.39
	Mean proportion of residue remaining on seed hull: 0.69 millet, 0.78 rice, 0.68 sunflower	Red-winged blackbird	0.32
	Mean proportion of residue remaining on seed hull: 0.71 rice, 0.59 sunflower	Boat-tailed grackle	0.41
Brühl *et al.* (2011)	Mean reduction - Wheat: Pigment 58.04%, Fungicide 61.38%; Barley: Pigment 79.47%, Fungicide 83.95%; Maize: Pigment 58.97%, Sunflower: Pigment 98.78%	Woodmouse	0.42
Morris and Thompson (2011)	Ingestion of residues remaining on seed after dehusking: 45% barley, 11% peas, 60% oilseed rape, 34% beans, 40% wheat, 1.4% sugar beet (pelleted), 38% maize	Woodmouse	0.60

Quantitative estimates of dehusking for use in risk assessment

Suitable quantitative estimates of dehusking are available for mammal focal species in Thompson and Morris (2011) and Brühl *et al.* (2011). Estimates for birds are not readily available from any source. By combining quantitative estimates of proportion of seed dehusked by each bird species with estimates for proportion of residue removed during dehusking it is possible to produce a conservative estimate of exposure reduction from dehusking. A quantitative estimate of dehusking exposure reduction (Dehusking factor DH_f) can be calculated using the following equation:

$$DH_f = (Seed_{DH} \times Residue_{DH}) + (Seed_{NotDH} \times Residue_{NotDH})$$

Where

DH_f = Dehusking Factor

$Seed_{DH}$ = Proportion of seed dehusked

$Residue_{DH}$ = Proportion of residue remaining on dehusked seed

$Seed_{NotDH}$ = Proportion of seed not dehusked

$Residue_{NotDH}$ = Proportion of residue remaining on non-dehusked seed

It is possible to vary the level of conservatism in an assessment by considering a range of potential focal species and the differing proportion of each seed type dehusked by each species (Table 1) and by considering the range of potential sources of information on proportion of residue remaining on seeds after dehusking (e.g. similar taxonomic species vs. overall worst case in Table 2). An example for Chaffinch is presented in the table below:

***Table 3.* Dehusking factor (DH_f) calculation for Chaffinch based on dehusking rate from Prosser (1999) and proportion of residue remaining on seed from Morris and Thompson (2011) and Avery *et al.* (1997). Worst-case (WC) and more realistic (based on House finch, a granivorous bird) values for proportion of residue remaining on dehusked seed ($Residue_{DH}$) are used.**

Species	$Seed_{DH}$	$Seed_{NotDH}$	Worst case $Residue_{DH}$	Realistic $Residue_{DH}$ (House finch)	WC DH_f	Realistic DH_f
Chaffinch: Worst cast $Seed_{DH}$	0.43	0.57	0.6	0.39	0.828	0.738
Chaffinch: Mean $Seed_{DH}$ = (0.48+0.43+0.90)/3	0.60	0.40	0.6	0.39	0.759	0.632

Conclusion

It is possible to calculate estimates of exposure reduction resulting from dehusking behaviour for birds and mammals. It is possible to maintain conservatism in risk assessments by using worst case estimates of proportion of residue remaining on dehusked seed and proportion of seed dehusked and by selecting data from appropriate dehusking species as is recommended in EFSA (2009). Consideration of dehusking as a quantitative refinement in risk assessment can allow a more balanced estimate of the potential risk to strongly granivorous species.

References

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