	F. <u>Limiting ammonia emissions from the use of mineral fertilizers</u>		
	<u>Ammonia losses from mineral nitrogen fertilizers</u>	**Comments following Copenhagen meeting**	**Comments February/march 2014**
49.	Most ammonia comes from livestock manures and slurries, but in many countries or member states around 10% is emitted following nitrogen fertilizer application. Losses from ammonium nitrate are usually small, often less than 1% of the total nitrogen applied. Losses from other N fertilizers, e.g. ammonium phosphate, ammonium sulphate, urea and urea ammonium nitrate (UAN) may be much greater.		Helmut Döhler: We should add: "N losses from ammonium nitrate make 0,5 …5 %" (source : GD) HM: I agree
	Losses from urea may range from 5% up to 40 % under certain conditions which is why urea is often perceived to be a less efficient source of nitrogen.		Helmut Döhler: in Germany scientific studies show losses to be mostly significantly and systematically below 10 %. This losses comply with numerous research work by official adv services, showing the equality of commercially available N fertilizers and urea regarding yield and nitrogen uptake by crops. This is HM: These are the values from

			the GD. As the range includes the German values, I would not change the text. Bad conditions or practice are also possible.
	Favourable conditions for the efficient absorption of ammonium ions in the soil include i) when fertilizer is incorporated into the soil, ii) when the soil has a high absorption capacity, (iii) when the soil is sufficiently moist (iv) when the soil has a low pH, (v) when the temperature is low.	Harald Menzi: this should be in the general part (after para 49) Christian Pailliere: I agree to position this statement in the general part.	Helmut Döhler: agree with proposal by HM and CP. But in should be kept since it is an important issue for a code of good agricultural practice (COGAP). Proposal for an amendment: (vi) when there are rainy weather conditions, (vii) when crops grow intensively and nitrogen uptake is high. HM: under rainy Weather conditions only with "on flat land…"
	<u>Urea</u>		
	50. To be useful as a fertilizer, urea needs to be broken down by the naturally occurring enzyme urease. Ammonia and carbon dioxide are released during this process.		

	If this happens on the soil surface, then ammonia will be lost to the atmosphere. If the breakdown does not take place until the urea has been mixed into the soil then the ammonia can be 'captured' by clay and organic matter in the soil or form more stable compounds. Urea application therefore needs to be well managed use it more effectively as a fertilizer and to reduce the likelihood of ammonia emission. It is, therefore, important that urea is mixed or washed into the soil before it begins to break down.		
51.	Ammonia losses from urea application are often greatest on light, sandy soils due to their low clay content and limited capacity to absorb ammonium-N. Despite their high pH, losses on chalk soils may be less than on some other soil types because of their greater clay and calcium content and their capacity to retain ammonium-N. Hydrolysis of urea placed in bands tends to cause a local increase in pH which can lead to high emissions unless the urea bands are injected or well incorporated into the soil which will trap the volatilized ammonia.		
52.	In dry periods, ammonia losses may be greater from urea applied to grassland than to arable crops.		
53.	Ammonia emissions from aqueous solutions containing urea are the same as for solid formulations. The amount of water applied in solution fertilizers is very small and not usually enough to wash the urea into the soil. However, absolute losses may be less if the application rates are significantly smaller.	Shabtai Bittman: We see equally high rates of UAN as Urea.	Helmut Döhler : agree
54.	. Foliar sprays of urea can increase the grain-protein concentration of milling		

	wheat and other cereals but can result in emissions of ammonia.		
	Ammonium sulphate, ammonium phosphate and ammonium nitrate		
xx.	The potential for ammonia losses from ammonium sulphate, ammonium phosphate and ammonium nitrate largely depend upon soil pH. Losses will be smaller with pH < 7.0. Despite their high pH, losses on chalk soils may be mitigated by closed slot injection or rapid mixing (incorporation) into the soil.	Shabtai Bittman: I don't disagree in principle with including amm nitrate but in the opening sentence we say that emissions are typically 1% (which actually I find low)- but this sentence implies higher emisisons for AN	
	Recommendations for limiting ammonia emissions from mineral fertilizers	Christian Pailliere: General comment: for each measure listed in this chapter, the indicative efficacy which is mentioned should be identical to the one mentioned in the Guidance Document	
xx.	On calcareous soils (pH > 7,5), do not use ammonium phosphate, or ammonium sulphate fertilizers if a rapid incorporation, injection into the soil, immediate irrigation or the use of polymer coated fertilizer is not possible.	Christian Pailliere: **NO**: it should be specified "ammonium sulfate and ammonium phosphate". AN is an ammonium based fertilizer which can be used on any soil. Bittman Shabtai: JW I think this is not in contradiction with what you are saying. [This contradicts what is written above where we state	Helmut Döhler: I cannot agree with that. Under certain conditions even the use of AN is not recommendable. On high pH soils and especially on calcareous sites Ammonium nitrate is also susceptible to remarkably high NH3 emission rates.This fact has been proven by several scientific studies.

		that NH3 losses following urea application to calcareous soils are not greater, and may be less, than following application to other soils. See Lloyd et al. (1997) who found the agronomic efficiency of urea to be similar to that of AN on calcareous soils (Lloyd A, Webb J, Archer JR, Sylvester-Bradley R. (1997). Urea as a nitrogen fertilizer for cereals. Journal of Agricultural Science, Cambridge 128, 263-271.)]	
	55. To minimize ammonia emissions from urea fertilisers, the following guidelines should be adhered to:		
	(a) Incorporate the urea into the soil. Quickly mix urea into the soil wherever possible. This option reduces emissions for urea by around 50-80 %. This option is not available where urea is top-dressed onto cereals or grassland but can be used where urea is applied to seedbeds or between seed rows. cultivation. Loss reduction by injection may be 80-90 %.		
	(b) Inject urea into the soil if possible. The closed slot injection of the solid and liquid urea is more effective than incorporation by [Something missing] Emission reduction is up to 90 %. Improperly closed or incorporated bands of urea are prone to very high emission losses due to a rise in pH within	Jim Webb: Something missing !	Helmut Döhler: yes ! “shallow incorporation”

	the band when the urea hydrolyzes. Rise in pH is mitigated by slow release urea products and urease inhibitors. As for all nitrogen fertilizers, if seedbed applications are made, care must be taken to avoid large amounts of urea close to the seed because this may inhibit germination/sprouting. Risk of crop injury is reduced by products that slow urea hydrolysis.		
	(c) Spread urea during appropriate weather conditions. Apply urea just before there is sufficient rain to wash it directly into the soil or at least on moist soils. Where urea is used as a top dressing, the best time to apply is just before rain or before irrigation with water. Avoid top dressing urea in dry and windy periods when there are heavy dews at night or light rains but when the weather is changing to a dry or windy period. Under these conditions urea needs to be incorporated without delay or a slow release form used. On grassland, it is particularly important that urea be applied only in the early season, for first-bite or first-cut silage, to increase the likelihood of rain occurring soon after application; controlled release urea may be applied earlier.	Bittman Shabtai: Christian, I agree with you. I think there is plenty of agronomic information to support this point and it should not be suppressed	Helmut Döhler If dry and windy conditions would play an important role for the release of ammonia, we would have found much higher losses in German trials, which indeed is not the case. Urea is highly water-soluble and it is characterized by a rapid dispersion in the soil matrix. Whether or not dews at night and light rain may promote this process strongly depends on specific site and weather conditions. When the soil surface is really dry, urea may lie there over days nearly without hydrolytic activities up to the soil's remoistening or rewatering. There will consequently **no** release of N.

	(d) Irrigate the field after urea application. Irrigation of at least 5 mm immediately after application of urea leads to an emission reduction of 40-70%. This technique is only considered to be practical where there is a water need for irrigation,	Harald Menzi: By not in agreement with GD	
	(e) Urease Inhibitors. Urease inhibitors can be used to delay the breakdown of urea until it has been washed deep enough into the soil, and to prevent sharp increases in pH especially in bands, to greatly reduce ammonia loss by 40 % for liquid urea ammonium nitrate and 70 % for solid urea. They offer a potentially effective but costly method.		
	(f) Polymer coated urea granules provide a slow release fertilizer that may reduce NH3 emissions by **about 30%** by delaying hydrolysis. They are more expensive and not much practical experience is available by now.	Christian Palliere: Efficacy not mentioned (up to 30%): WHY? Helmut Döhler Ok, added in bold	
	(g) Switching from urea to ammonium nitrate fertilizer may reduce NH3 emissions. A possible negative side effect is the potential increase in nitrous oxide (N2O) emissions, but this effect occurs mainly under wet conditions and on fine textured soils. Furthermore ammonium nitrate fertilizers can be more expensive (10-30% higher costs), than urea but the net cost may be negligible because of the lower N losses. In some countries ammonium nitrate is not readily available.	Helmut Döhler: What does "wet soil" mean in this context ? Helmut Döhler: I tried to find a neutral wording: has not yet been assessed exactly. If we have a 30 % higher cost, the cost cannot be "negligible"	Helmut Döhler: From our experience there is not much evidence for significant differences between the Nitrogen Use Efficiency (NUE) levels of CAN and urea. This has been shown by numerous field trials comparing CAN and urea. This has been established already by UK Studies. Mit "may" scheint mir die Aussage korrekt

	On sites with soil pH > 7.0, several of the techniques described above for urea can also be used to reduce ammonia emissions from ammonium sulphate and ammonium phosphate based fertilizers or alternative sources of N, P and S should be sought.	Christian Palliere: Again: to be consistent with the Guidance Document, this paragraph should be kept, but the text should be in line with the GD "wording Helmut Döhler ok. Alternative added Christian Palliere: Again: to be consistent with the Guidance Document, this paragraph should be kept, but the text should be in line with the GD >> "wording	
	<u>Ammonium bicarbonate</u>		
57.	Ammonium bicarbonate may be available in some UNECE areas. Gaseous N losses of up to 50% have been measured following its application. Ammonium bicarbonate should therefore not be used as N fertilizer.		