

Tables for farmers to evaluate the risk of leaching of plant protection products (PPPs) in Norwegian agricultural soils

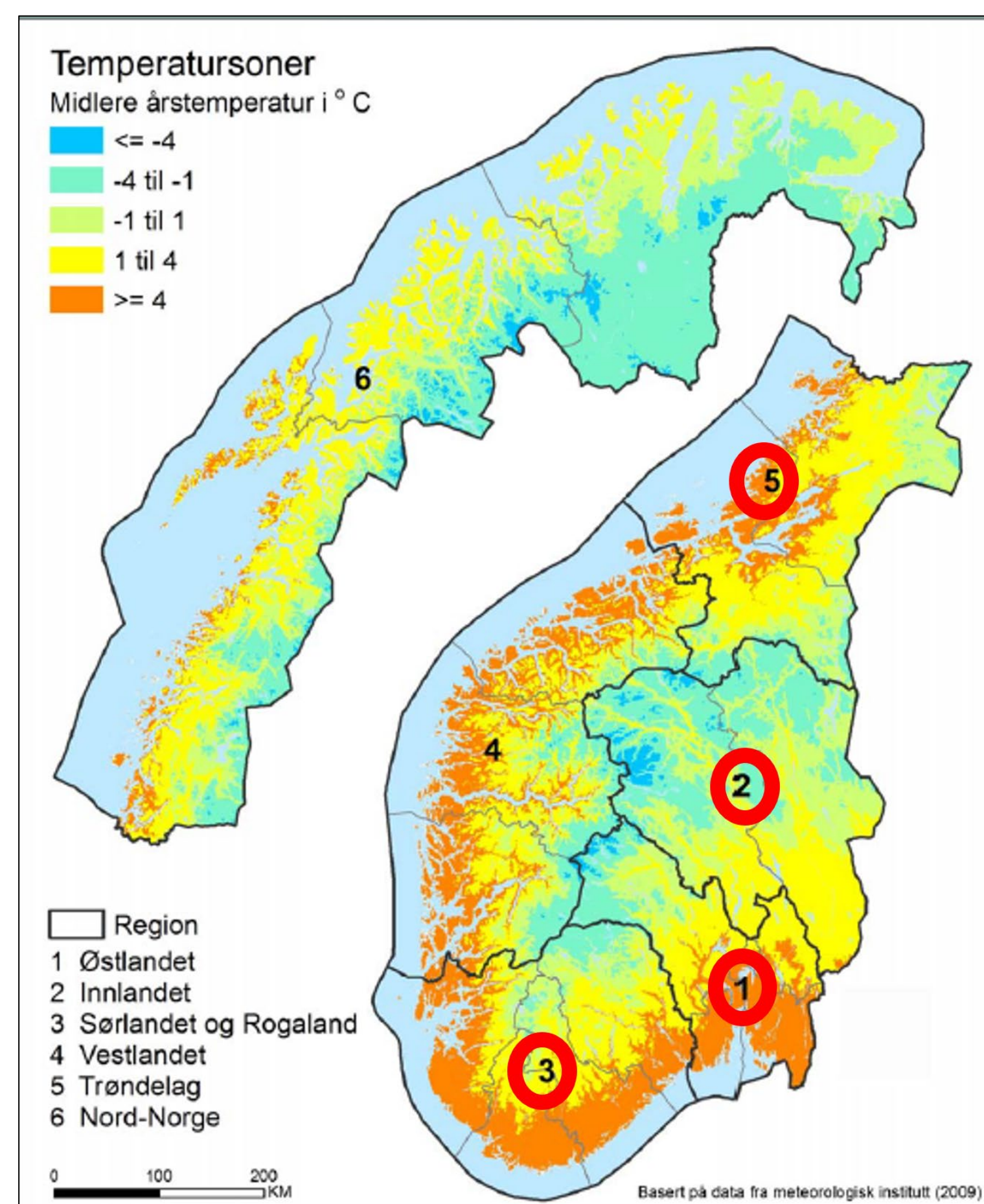
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Why

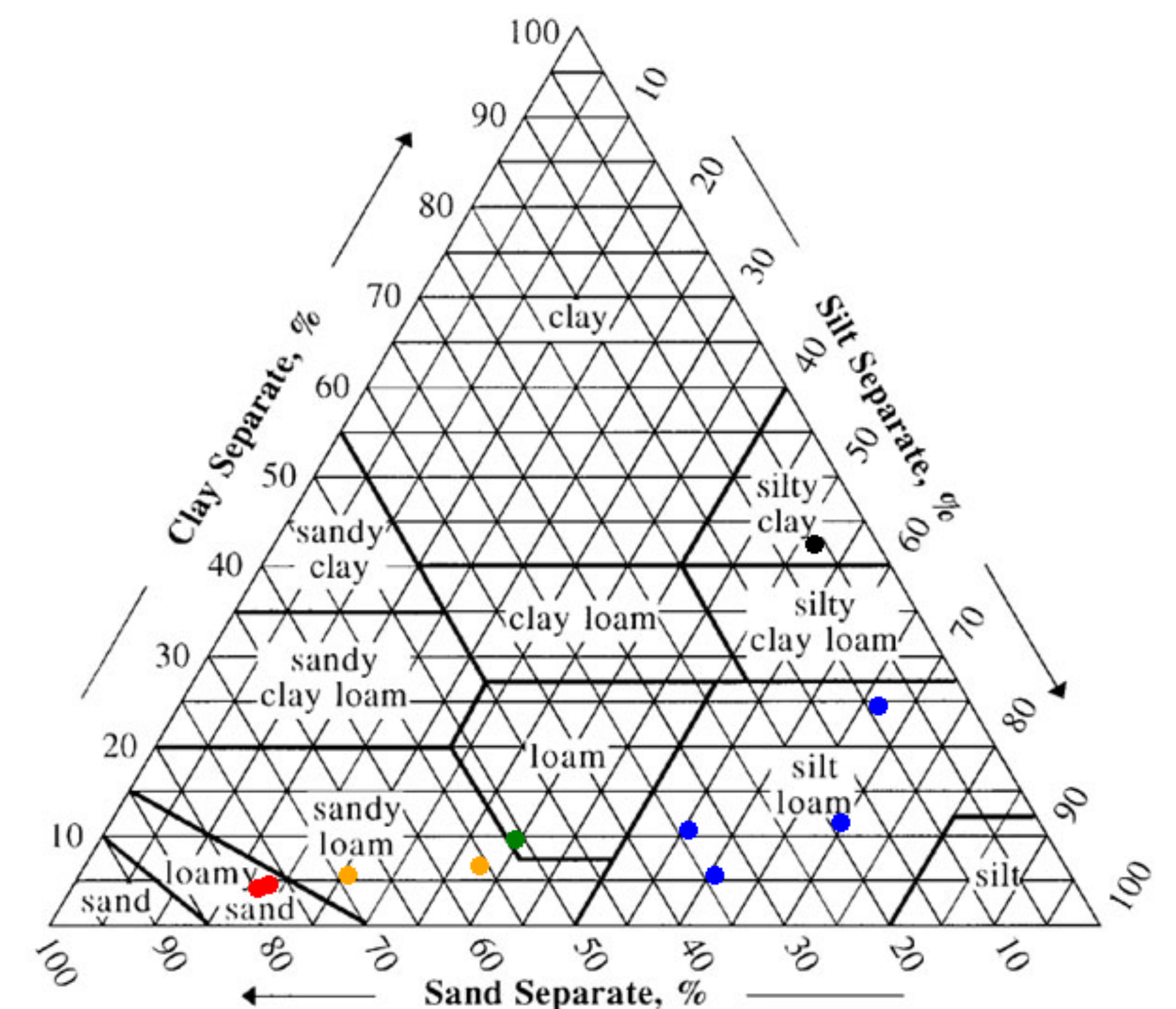
- Farmers are encouraged to practice farming as environmental and health friendly as possible.
- Farmers have few tools to help evaluate the lesser evil among the plant protection products (PPP) they can choose between.
- The risk of leaching is in some cases stated on the label of plant protection products, but just in very general terms.
- Farmers need a tool to evaluate the risk of leaching under their soil and climate conditions.

How

- Collecting
 - Data on the 10 most common soil types in agricultural areas in Norway.
 - Climate data from 4 major agricultural regions in Norway. Average temperature/precipitation from associated weather stations.
 - Data on the most commonly grown crops in Norway, i.e. potatoes, spring and winter cereals (growth and PPP application data).
- Implementing collected data in the soil water modelling tool MACRO-DB.
- PPP properties from Pesticide Properties Database (PPDB) implemented in MACRO-DB.
- Running MACRO-DB on all approved PPPs in the selected crops in Norway for estimation of the predicted environmental concentration in groundwater (PEC_{gw}) at 2 meters depth in 10 soils in 4 regions.
- Categorize PEC_{gw} values according to leaching risk.
- Make easy to read risk tables.



The 4 major agricultural regions simulated with the model.



Soil types placed in the USDA soil triangle. The different colours is for separating the soil types in the figure.

Results (example from spring cereals)

- Regions with more rain – higher risk of leaching.
- Low temperature seemed to increase the risk of leaching irrespective of less precipitation.
- 5 soil types showed no risk for leaching at 2 meters – must be investigated. Plan to compare with PECs at 1 meter.
- Tables to be published digitally and in print.

Example of how a risk table may look like for all registered herbicides in spring cereals in 5 soil types (named by WRB signature) in all four regions in Norway.

Spring cereals	Region 3, soil type					Region 1, soil type					Region 2, soil type					Region 5, soil type				
Plant Protection Product	KFu3	KKJ5	KLk4	LVl3	UTl3	KFu3	KKJ5	KLk4	LVl3	UTl3	KFu3	KKJ5	KLk4	LVl3	UTl3	KFu3	KKJ5	KLk4	LVl3	UTl3
MCPA 750 Flytende	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Nufarm MCPA 750	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Roundup	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Glyphomax Plus	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Roundup Flex	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Hussar OD	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Hussar Plus OD	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Puma Extra	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Axial	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Granstar Power	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Sektor OD	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Banvel	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Duplosan Meko	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Gratil 75 WG	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Ariane S	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Ally Class 50 WG	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Primus	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Starane XL	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Ratio Super SX	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
CDQ SX	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Starane 333 HL	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Lancelot	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Cleave	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Zypar	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Tomahawk 200 EC	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Express Gold SX	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Roundup PowerMax	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
MCPA 750 Nufarm	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Primus 250 WG	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Express SX	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Attribut SG 70	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Alliance	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Harmony Plus 50 SX	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
DFF SC 500	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
DMA 600	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Flurostar 200	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Glypper	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Broadwat Star	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Legacy 500 SC	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Mekoprop Nufarm	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Mixin	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Mustang Forte	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Nufarm Mekoprop-P	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Pixaro EC	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Primma Star	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Primus XL	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Roundup Flick	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Spitfire 333 HL	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Tripali WG	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green

Colour legend for the risk table

Concentrations ($\mu\text{g/L}$) simulated with MACRO-DB			
< 0.001	0.001 - 0.0099	0.01 - 0.099	≥ 0.1
No risk	Low risk	Moderate risk	High risk

References

- Jarvis, N. J., Hollis, J. M., Nicholls, P. H., Mayr, T., & Evans, S. P. (1997). MACRO—DB: a decision-support tool for assessing pesticide fate and mobility in soils. *Environmental Modelling & Software*, 12(2), 251-265. doi:https://doi.org/10.1016/S1364-8152(97)00147-3.
- Lewis, K. A., Tzilivakis, J., Warner, D. J., & Green, A. (2016). An international database for pesticide risk assessments and management. *Human and Ecological Risk Assessment: An International Journal*, 22(4), 1050-1064. doi:DOI: 10.1080/10807039.2015.1133242.
- Lågbu, R., Nyborg, Å., & Svendgård-Stokke, S. (2018). *Jordsmonnstatistikk Norge (Soil statistics Norway)*. NIBIO-rapport Vol. 4 Nr. 13 2018.
- USDA Natural Resources Conservation Service, Soil Survey Staff (2019). Soil Texture Calculator. Natural Resources Conservation Service, United States Department of Agriculture. https://data.nal.usda.gov/dataset/soil-texture-calculator. Accessed 2022-04-05.