Development of an easy-to-implement pesticide-related food product score: potential and limitations

Cédric Furrer[1], Laura Iten[1*], Thomas Nemecek[1] and Gérard Gaillard[1]

[1] Agroscope Reckenholz, Reckenholzstrasse 191, CH-8046 Zurich, Switzerland
E-mail contact: cedric.furrer@agroscope.admin.ch
* current address: agroecology.science Ltd., Horngasse 5, CH-5070 Frick, Switzerland

1. Introduction

There is a rising interest of customers to be informed about what they eat and how it is produced. Retailers and supermarkets already have realized such needs and start to introduce sustainability rating systems to facilitate customer information. Migros, one of Switzerland's largest retail company and supermarket chains, has developed an own sustainability rating system named "M-Check" together with different partners (M-Check, 2022). Depending on the impact a specific food product has on the environment, the system labels food products with a scoring system consisting of five scores, depending on whether impacts are high or low, respectively. Migros' sustainability rating system currently considers two impacts, namely climate change and animal welfare. According to customer surveys, a rating system which assesses the ecotoxicological consequences of pesticide use from food production is of great interest and has not yet been introduced. The aim of the project "M-Check PPP" (plant protection product) was to develop an easy-to-implement method, which outlines possible impacts of pesticide use from agricultural production of plant-based food products. In order to label a wide range of food products, the "M-Check PPP" method should rely on data easily available. In a first step, the "M-Check PPP" method should be able to calculate the freshwater ecotoxicity potential of pesticides used for crop production. For that, an indicator based on a LCA impact assessment methodology should be considered using characterization factors from different sources. In a second step, the values for freshwater ecotoxicity potential should be converted into the scoring system according to the general concept of the M-Check sustainability rating in order to communicate the results in an easy way to the customer. The developed "M-Check PPP" method was tested on a set of seven food products (i.e. apple, wheat) from different origin (i.e. Europe, Switzerland) and production or labelling systems (e.g. conventional, organic).

2. Materials and Methods

Following the recommendations of the "UN Life Cycle Initiative" (UNEP, 2019) and the "Product Environmental Footprint" (European Commission, 2017), "M-Check PPP" applies the midpoint freshwater ecotoxicity indicator proposed by USEtox which is regularly updated and under constant development. The USEtox method integrates information of fate, exposure, and effect of pesticides to evaluate the potential toxicity of chemicals in aquatic ecosystems. It estimates the expected effect on aquatic organisms but does not perform a risk assessment. To estimate the theoretical ecotoxicity potential of food products, the pesticide consensus approach as defined by the OLCA-Pest project (Nemecek *et al.*, 2022) using characterization factors from USEtox (Fantke *et al.*, 2021; Rosenbaum *et al.*, 2008), OLCApest (Fantke *et al.,* 2020) and EF (European Commission (EC), 2013) has been used. The lists of legally approved PPP products (LPPP) from different countries and the production guidelines of certain production or standard/label systems acted as baseline data. Active ingredients in the LPPP were linked to specific characterization factors to estimate ecotoxicity potential. These characterisation factors were adapted to consider the emissions to the different compartments (air, agricultural soil, natural soil, surface water) according to Nemecek *et al.* (2022). Active substances were systematically included or excluded in the calculation of the ecotoxicity potentials, depending on whether or not they might be used according to the production guidelines. Several options have been evaluated. On the one hand, it was assessed how the in- or exclusion of different types of available data, e.g. pesticide application rate or the number of applications of an active substance, influenced the estimation of the ecotoxicity potential. On the other hand, it was checked how the selection of PPP products and/or active substances present in the LPPP influenced the estimation of the ecotoxicity potential. Aggregation of data in the LPPP was needed because estimating the ecotoxicity potential with all approved PPP products from the LPPP would have led to an overestimation and would have not been correct for the comparison between food products, because in practice hardly ever all approved active substances are used. The ecotoxicity potentials were subsequently transferred into a scoring system, considering the distribution within the entire food product range, i.e. all plant-based food products. The score distribution was based on the estimated ecotoxicity potentials from the first step. Ecotoxicity potentials have been classified into five groups with fixed percentiles. The lower the ecotoxicity potential, the higher the scores. For a plausibility check, practical field data from pesticide use from crop production has been used to calculate ecotoxicity potentials (instead of using the theoretical data from LPPP). These ecotoxicity potential were then transferred into scores.

3. Results and Discussion

Differences between the scores in Figure 1 depended on the estimation of the ecotoxicity potential, which had been shown to be mainly affected by data availability (DA) and data aggregation. A clear pattern, however, was not observed. Whereas carrot was always rated with five scores for DA1, the five score rating was more inconsistent for DA2. Differences in score ratings between means of aggregation (i.e. median or arithmetic mean) seemed to appear similar (with few exceptions), both for DA1 and DA2. In some cases, the additional aggregation using available information of pests in the LPPP improved the rating of wheat production systems. This might be due to the fact, that there were many substances and PPP's available to treat the same pests. Considering the aggregation by pests therefore might have reduced the impact, which in turn resulted in higher scores. Since no farm-specific, collected PPP data but only theoretical data from LPPP has been used, the method does not cover the following aspects (among others): use of robust crop varieties, specific breeding programs, yields, site parameters (e.g. soil properties, rainfall, etc.), preventive and non-chemical plant protection measures, emergency approvals, technological developments in the field of application techniques, voluntary replacements of PPPs with particular risk potential or measures to reduce the emission of PPPs into the environment (such as buffer strips or drift reduction). The method "M-Check PPP" evaluates exclusively the freshwater ecotoxicity potential for aquatic organisms. Terrestrial and marine ecotoxicity were not part of the "Method M-Check PPP", as the available corresponding methods were currently not recommended by international bodies for the context of environmental product declaration. The effects of PPPs on human health as well as PPP residues on food were not the purpose of the "M-Check PPP" and were therefore excluded from the analysis. An under- or overestimation of the ecotoxicity potential compared to reality is likely possible, since the estimation corresponds by definition to a potential and not to the actual ecotoxicity calculated by measured data. The proposed "M-Check PPP" allows to include further parameters in the assessment in the future, if data would be available (e.g. further developments in breeding research or PPP reduction, or easy availability of the information on emergency approvals).

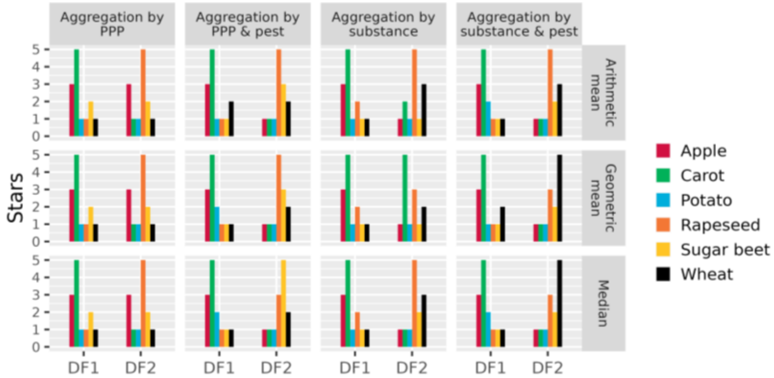

Fig. 1: Calculated scores for six Swiss food products based on the estimation of ecotoxicity potentials considering two types of data availability (DA), four types of data aggregation and three types of means for data aggregation.

DA1: ecotoxicity potential estimated based on data from characterization factors
DA2: ecotoxicity potential estimated based on data from characterization factors and pesticide application rate

4. Conclusions

The developed "Method M-Check PPP" provided plausible results for the investigated food products within the range of production- and label systems analysed and could be used with reasonable effort. However, the "M-Check PPP" was developed and checked for plausibility on the basis of a rather small sample of food products. In order to ensure its robustness, the method should be applied to a larger selection of foods with an additional plausibility check. Aspects such as the availability of information from LPPP's of different countries, the integration of new LPPP data into the ecotoxicity calculation, and the rating of compound foods are some of the points that have not been conclusively clarified here and should be further elaborated.
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5. References

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