R01

Are pesticide residue levels and MRLs affected by seasonal variability?

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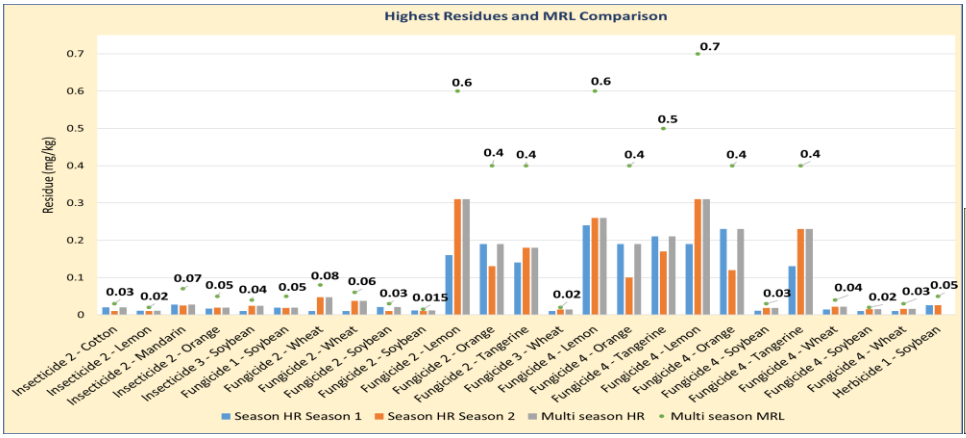
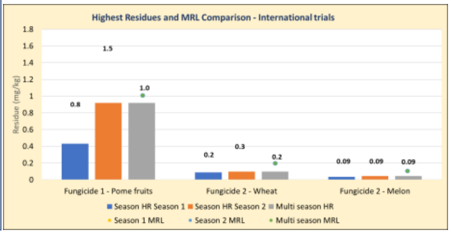
Introduction

Variability of pesticide residues obtained from crop field trials is known to be a significant factor in the field of residue chemistry. It is not unusual for pesticide residues in harvestable crops to vary by more than 10X despite identical product use parameters. This poster investigates the residue profiles of several active ingredient-crop combinations from residue trials conducted across single and multiple seasons.



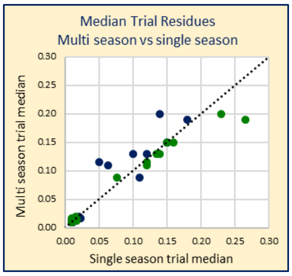
In the adjacent graphs, the highest residues and MRLs from each AI-crop combination are shown. On the left, the highest residues from the Argentinian trials (151) are compared to the calculated MRLs from the combined seasons. Below, the highest residues and MRLs from the international trials (38) are similarly presented.

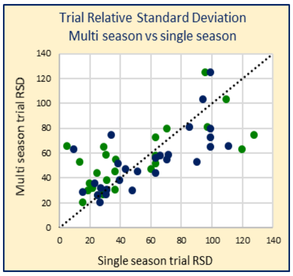


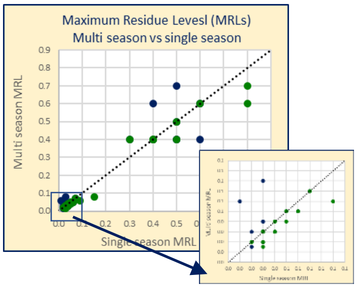
Evaluation of the data

For this analysis a total of 7 active ingredients, 7 crops and a total of 151 residue trials conducted in Argentina were evaluated. This resulted in 25 active ingredient-crop combinations which could be investigated across multiple years. All residue trials were conducted under GLP and local pesticide regulations. An additional set of two active ingredients and four crops from Brazil, United States and the Netherlands were also evaluated.

In a first step, the residue data were filtered to include only those AI-crop combinations where the trial GAPs (product formulation, application rate, timing and pre-harvest interval) matched over the multiple years tested. AI-crop combinations with only one residue trial in a studied year were not included. In the final filtered data set, trial residue averages, medians, and standard deviations were calculated for each AI-crop combination separately for each studied season. These values were compared to trial residue averages, medians and standard deviations calculated across the multiple seasons. In the same way, MRLs were calculated for each AI-crop combination for the individual seasons and compared to MRLs calculated from multiple seasons.







In these plots, individual season values are compared to multiseason values for each AI-crop combination. A 1:1 correlation results in points falling on the line. Season 1 vs multiyear is shown with blue points and season 2 vs multiyear with green points.

MRLs

The primary purpose for conducting crop residue trials is to establish MRLs. MRLs are derived from the residues measured in the field trials conducted according to local practice. They are calculated using the OECD MRL Calculator which takes into account average, median and standard deviation of the residue values. Typically, MRLs are 1.5 to 3x higher than the highest residue found in the field trials. In this analysis, MRLs calculated from individual seasons were comparable to MRLs calculated from multiple seasons (in general, 1 to 2x).

Statistical Tests

Statistical analysis of the data included the non-parametric Kruskal-Wallis test. AI-crop combinations which included at least three residue trials in each studied season were analyzed to see if the K-W test found evidence that the residues were statistically different in the individual seasons. Out of the 16 AI-crop combinations analyzed with Kruskal-Wallis, only one combination had a P-value less than 0.05 indicating that the trial residues from the first season were statistically different from the second season.

AI - Crop	Mean of Ranks	Chi-sq. value	K-W P-value
Fungicide 1 – soybean	3.83, 3.17	0.2	0.658
Insecticide 2 – lemon	4.50, 2.50	2.5	0.114
Insecticide 2 – mandarin	9.67, 5.44	3.2	0.074
Insecticide 2 – orange	2.83, 4.17	0.78	0.376
Fungicide 2 – lemon	2.00, 5.50	4.5	0.034
Fungicide 2 – orange	3.00, 4.00	0.43	0.513
Fungicide 2 - soybean	4.00, 3.00	1	0.317
Fungicide 2 - tangerine	3.17, 4.63	0.8	0.372
Fungicide 2 – wheat	5.50, 7.50	2.18	0.14
Fungicide 3 – wheat	3.00, 4.00	1	0.317
Fungicide 4 – lemon	6.50, 9.31	1.48	0.223
Fungicide 4 – orange	7.64, 7.36	0.02	0.898
Fungicide 4 – soybean	6.57, 7.50	0.28	0.6
Fungicide 4 – tangerine	6.36, 10.17	2.55	0.1
Fungicide 4 – wheat	5.25, 7.75	2.04	0.153
Herbicide 1 - soybean	3.83, 3.17	0.22	0.637

Conclusion

The result of this comparative analysis indicates that there is no statistical difference between crop residues collected from trials conducted in separate years, as long as the application parameters are the same. The citical point for evaluators and registrants is that MRLs derived from a single season are comarable to MRLs derived from multiple seasons. The data analysis would be even more robust if additional trials were available for each AI-crop combination. It is predicted that if more data were available, the results would be more conclusive. This project opens possibilities for future investigations on the behavior of residues and consequently to the MRLs derived from trials conducted across multiple seasons and MRLs derived from trials conducted within a single season.

References

- OECD MRL Calculator: https://www.oecd.org/env/ehs/pesticides-biocides/oecdmaximumresiduelimitcalculator.htm
- Kruskal-Wallis: https://www.statisticshowto.com/kruskal-wallis/