Scientific Papers. Series A. Agronomy, Vol. LXV, No. 1, 2022
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

VISUALISATION OF PLANT PROTECTION PRODUCTS PROPERTIES VIA TABLEAU DESKTOP SOFTWARE

Donyo GANCHEV

Agricultural University of Plovdiv, 12 Mendeleev Blvd, Plovdiv, Bulgaria

Corresponding author email: donyo@abv.bg

Abstract

The paper present visualization techniques of properties of plant protection products via Tableau Data Visualization software for the purposes of safe and effective selection of pesticides towards different abiotic, biotic and antropogenic conditions. Although one plant protection product has many and different properties which determine its application, via Tableau was able all of these properties to be presented (showed) in the only one visualization, which make the process of selection of the right plant protection product extremely fast, easy and effective. Tableau Desktop is interactive data visualization software which is based on spreadsheets and relational databases. During the recent years this software founded in 2003 from Christian Chabot, Pat Hanrahan and Chris Stolte, researchers at the Department of Computer Science at Stanford University, became one of the most popular solution in the world from this type, used widely in all human areas for creation of high level graph-type data visualizations via easy to be used graphical user interface. In 2008 Tableau received award for "Best Business Intelligence Solution" by the Software and Information Industry Association.

Key words*: data visualization, Tableau Desktop Software, plant protection products, agriculture, pest management.*

INTRODUCTION

During recent years, data science and visualization became extremely popular in all scientific areas (Rettberg, 2020; Burch et al., 2021). The software tools as Tableau Desktop (Tableau Software, 2020), Power BI (Microsoft PowerBI, 2021; Becker & Gould, 2019), R language for Statistical Computing (R Core Team, 2020; Ihaka & Gentleman, 1996) Google Data Studio (Google Data Studio, 2021; Aan, 2022) and other continue to gain more and more popularity after each day, especially in world COVID-19 pandemic where an enormous number of data must be possessed and analyzed (Chen et al., 2020; Iliinsky & Steele, 2011; Bowe et al., 2020). Although the agriculture is not among the sphere where computer modeling and graphics pay significant roles, there is increasing number researches in this aspect (Řezník et al., 2020; Kushwaha et al., 2020; Zhai et al., 2020). Plant protection products are a substantial part of modern day agriculture. However, nevertheless that pesticides are associated with industrial age and present day pest management, there application dates back even from the ancient times when people used various natural, non-organic and organic substances like salts, plant extracts and soaps to defeat pests which threatening cultural crops (Costa, 1987).

Plant protection products for a long time ago are not simple products - actually they are extremely complex having numerous properties which determine their effective and safe application in the field. These products p especially during recent years are under enormous pressure and critics due to their harmful and dangerous effects on humans and the environment. Therefore the application of pesticides requires significant knowledge and strategically approach - there are numerous pesticides/plant protection products on the market with many different properties. The purpose of present day agricultural specialist is to secure as safe as possible application of the pesticides towards humans and environment from one hand and as effective as possible - from the other, taking into consideration extremely variable abiotic, biotic and anthropogenic conditions of the terrain.

That is why, data analysis and visualizations can be critical and extremely essentials for choosing the right pesticides/plant protection products for a given application. The purpose of this paper is to present a study for evaluation of the best possible way for visualization of plant protection properties data in order

maximal and comfortable information delivery to the pest management specialist for best safe and effective pesticides selection.

MATERIALS AND METHODS

The properties (data) for the plant protection products were taken from various sources: the websites of the producers, lists of approved for application in the territory of Republic of Bulgaria plant protection products (Bulgarian Food Safety Agency, 2021), Pesticides Properties Database (PPDB, 2007), EU Pesticides Database of approved plant protection products on territory of EU member states (EU Pesticides Database, 2021). The data initially was inserted into MS Excel sheet.

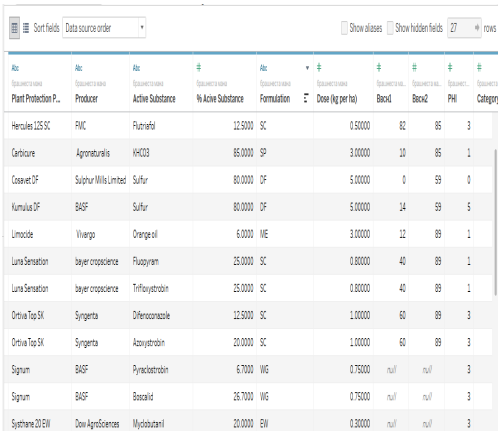
In this study as an example was used strawberry as cultural crop. The plant protection products can be 3 basic types: fungicides - used to defeat fungal pests; insecticides - used to defeat insect pest and herbicides - used against weeds.

The one plant protection product has these major properties which determine its application in practice (Akamatsu, 2011):

Trade name - string variable
Producer - string variable
Active Substance i.e. pesticide - string variable
Percent Active Substance into given plant protection product - decimal number variable
Formulation type of the given plant protection product - string variable
Dose (kg or l per ha) - string variable
BBCH for the initial applications - BBCH for the final applications - the fenophase interval for application of the given plant protection product - whole numbers varaibles
PHI - post harvest interval - whole numbers varaibles
Category of usage - whole numbers varaibles
Mode of action - string variable
Major group - string variable for fungicides; whole number - for insecticides and herbicides
Type major group - string variable (only for for insecticides and herbicides)
Target group - string variable (only for fungicides)
Chemical group - string variable
log p (octane - water coefficient) - decimal number variable
Vapor pressure - decimal number variable
GUS (Groundwater Ubiquity Score) - decimal number variable

RESULTS AND DISCUSSIONS

The list above clearly shows the complexity of the one plant protection product - 17 different properties which must be taken into account during the process of choosing the right one. Without specialized software for data analysis and visualization, this is completely impossible. The need of visualization of these properties is more necessary due to the fact that selection of the right plant protection product is often done under pressure of time and need of urgent taken of the measurement. Treatments with pesticides against giving pest/pests and the increasing international and national requirements for safe use of pesticides (Marer, 1988). One of the most popular and usable data visualization tool in the world is Tableau Desktop. The software provide very intuitive and user friendly interface, similar to Ms Excel Pivot Tables but with much more improvements and capabilities (Hamersky, 2016; Murphy, 2013) In the graphic below (Figure 1) is presented the initial data import from Excel to Tableau - in the given case - fungicides used against powdery mildew on strawberries


Sort fields Data source order Show aliases Show hidden fields 27 rows

Plant Protection P...	Producer	Active Substance	% Active Substance	Formulation	Dose (kg per ha)	BBCH1	BBCH2	PHI	Category
Hercules 125 SC	FMC	Fluxriafol	12.5000	SC	0.50000	82	85	3	
Carbicure	Agroneturalis	KHCO3	85.0000	SP	3.00000	10	85	1	
Cosavet DF	Sulphur Mills Limited	Sulfur	80.0000	DF	5.00000	0	59	0	
Kumulus DF	BASF	Sulfur	80.0000	DF	5.00000	14	59	5	
Limocide	Vivargo	Orange oil	6.0000	ME	3.00000	12	89	1	
Luna Sensation	bayer cropscience	Fluopyram	25.0000	SC	0.80000	40	89	1	
Luna Sensation	bayer cropscience	Trifloxystrobin	25.0000	SC	0.80000	40	89	1	
Ortiva Top 5K	Syngenta	Difenoconazole	12.5000	SC	1.00000	60	89	3	
Ortiva Top 5K	Syngenta	Azoxystrobin	20.0000	SC	1.00000	60	89	3	
Signum	BASF	Pyraclostrobin	6.7000	WG	0.75000	null	null	3	
Signum	BASF	Boscalid	26.7000	WG	0.75000	null	null	3	
Systhane 20 EW	Dow AgroSciences	Myclobutanil	20.0000	EW	0.80000	null	null	3	

Figure 1. Importing the plant protection products properties data in Tableau Desktop from MS Excel Sheet

The conducted different variations of presenting (visualizing) of the data reveal that the most appropriate and effective way is this presented on graphic below (Figure 2)

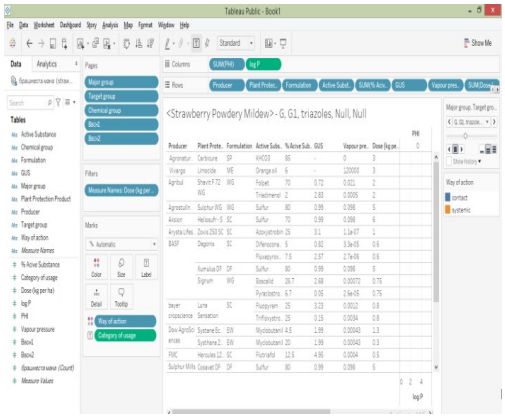


Figure 2. Designing the plant protection properties visualization in Tableau Desktop

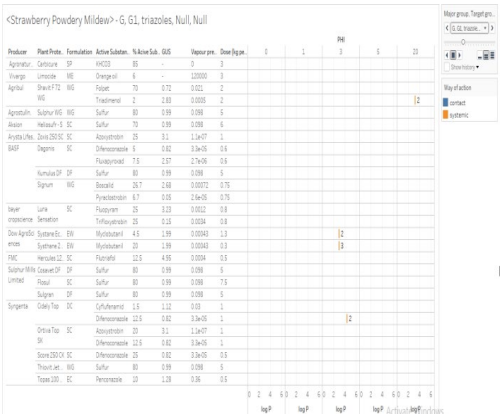


Figure 3. Final look of the plant protection properties visualization in Tableau Desktop towards fungicides used to defeat powdery mildew on strawberries

In this way, all of listed properties of the plant protection products used against giving pest can be seen in one visualization. On the row are string variables are: producer, plant protection product name, formulation, active substance. The variables: Percent Active Substance, GUS, Vapour Pressure and Dose are also put on the row of visualization, but their properties were changed to "Dimension" and "Discrete". The columns present properties of PHI (post-harvest interval) and log p (octane-water coefficient). PHI has the same properties "Dimension" and "Discrete" like Percent Active Substance, GUS, Vapour Pressure and Dose in the rows, but log p –" Dimension" and "Continuous"

In the section of "Marks" are listed properties of "Way of action" and "Category of usage". There are two ways of action of one pesticide (plant protection product): systemic and contact and the best possible way is this property to be presented as colour visualization. Category of usage is a whole number – there are 3 types: first (1), second (2) and third (3) category of usage of the plant protection products. This property is also placed in the "Marks" but as text. In the "Pages" section is placed properties concerning the mode of action of the active substances of the plant protection products (Major group, Target group and Chemical group) and BBCH interval (the time period between the BBCH stages for the initial and the final plant protection products applications).

In the graphics below (Figure 3 and Figure 4) is presented how the visualization looks like

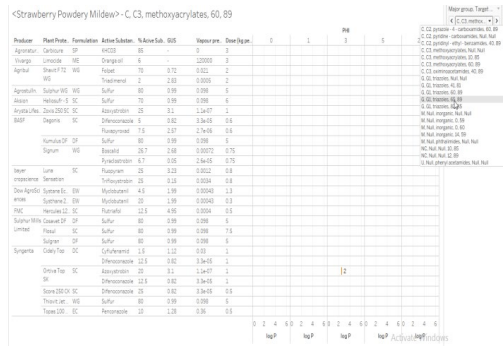


Figure 4. Final look of the plant protection properties visualization in Tableau Desktop towards fungicides used to defeat powdery mildew on strawberries

In the graphics below (Figure 5 and Figure 6) is presented visualization towards pesticides for defeat aphids infected strawberries:

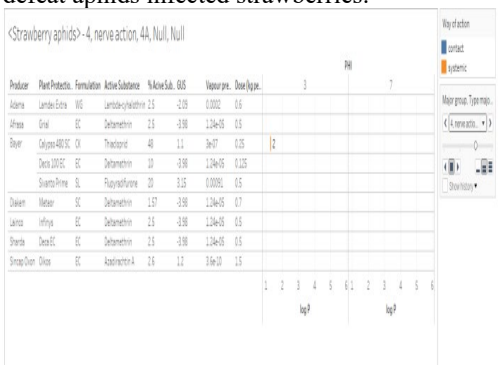


Figure 5. Final look of the plant protection properties visualization in Tableau Desktop towards insecticides used to defeat aphids on strawberries

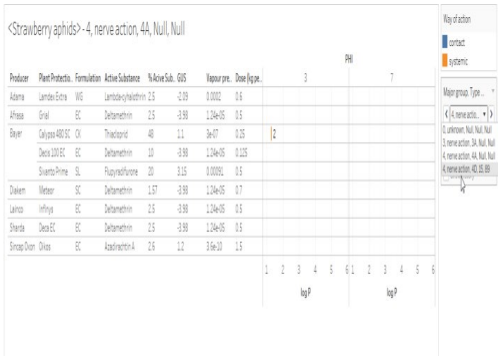


Figure 6. Final look of the plant protection properties visualization in Tableau Desktop towards insecticides used to defeat aphids on strawberries - second part

The only one difference is that in the "Pages" Section, instead Target group, there is Major group type.

CONCLUSIONS

The presented way of data visualization shows that such approach can be extremely useful and applicable in the area of agriculture, in particular – pest management. Tableau Desktop software has user friendly interface which make process of creation and use of visualization fast and easy to be done with minimal education endeavours. Although one plant protection product has many and different properties which determine its application via Tableau was able all of these properties to be presented (showed) in the only one visualization, which make the process of selection of the right plant protection product extremely fast, easy and effective.

REFERENCES

Aan, M., Apriani, D., & Saputra, W. E. (2022). Data Visualization Using Google Data Studio. *International Journal of Cyber and IT Service Management, 2*(1), 11–19.

Akamatsu, M. (2011). Importance of physicochemical properties for the design of new pesticides. *Journal of agricultural and food chemistry, 59*(7), 2909–2917.

Becker, L. T., & Gould, E. M. (2019). Microsoft power BI: extending excel to manipulate, analyze, and visualize diverse data. *Serials Review, 45*(3), 184–188.

Bowe, E., Simmons, E., Mattern, S. (2020). Learning from lines: Critical COVID data visualizations and the quarantine quotidian. *Big Data & Society, 7*(2), 2053951720939236.

Bulgarian Food Safety Agency (2021). Available: http://www.babh.government.bg/en/

Burch, M., Wallner, G., Broeks, N., Piree, L., Boonstra, N., Vlaswinkel, P & Van Wijk, V. (2021). The power of linked eye movement data visualizations. In ACM Symposium on Eye Tracking Research and Applications (pp. 1–11).

Chen, B., Shi, M., Ni, X., Ruan, L., Jiang, H., Yao, H., ... & Ge, T. (2020). Visual data analysis and simulation prediction for COVID-19. arXiv preprint arXiv:2002.07096.

Costa, L. G. (1987). Toxicology of pesticides: A brief history. In Toxicology of Pesticides (pp. 1–10). Springer, Berlin, Heidelberg.

EU Pesticides Database (2021). Available: https://ec.europa.eu/food/plant/pesticides/eu-pesticides-db_en

Google Data Studio (2021). Available: https://marketingplatform.google.com/about/data-studio/

Hamersky, S. (2016). Tableau desktop. *Mathematics & Computer Education, 50*(2), 148–151.

Ihaka, R., & Gentleman, R. (1996). R: a language for data analysis and graphics. *Journal of Computational and Graphical Statistics, 5*(3), 299–314.

Iliinsky, N., Steele, J. (2011). Designing data visualizations: Representing informational Relationships. " O'Reilly Media, Inc."

Kushwaha, M., Bissa, A., Raghuveer, V. R. (2020). Visualization of Agriculture Data of Rajasthan: An Application of R. Materials Today: Proceedings, 29, 286–294.

Marer, P. J. (1988). Safe and effective use of pesticides (No. 3324).

Microsoft PowerBI (2021). Available: https://powerbi.microsoft.com/en-us/

Murphy, S. A. (2013). Data visualization and rapid analytics: Applying tableau desktop to support library decision-making. *Journal of Web Librarianship, 7*(4), 465–476.

PPDB - Pesticide Properties Database (2007). Available: https://sitem.herts.ac.uk/aeru/ppdb/

R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/

Rettberg, J. W. (2020). 2. Ways of knowing with data visualizations. Data visualization in society, 35.

Řezník, T., Kubíček, P., Herman, L., Pavelka, T., Leitgeb, Š., Klocová, M., & Leitner, F. (2020). Visualizations of Uncertainties in Precision Agriculture: Lessons Learned from Farm Machinery. *Applied Sciences, 10*(17), 6132.

Tableau Software. (2020). Available: https://www.tableau.com

Zhai, Z., Martínez, J. F., Beltran, V., & Martínez, N. L. (2020). Decision support systems for agriculture 4.0: Survey and challenges. *Computers and Electronics in Agriculture*, 170, 105256.