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ПРИЛОЖЕНИЕ НА БЕЗПЛАТНИЯ СОФТУЕР ЗА ВИЗУАЛИЗАЦИЯ НА ДАННИ TABLEAU PUBLIC В ПРОЦЕСА НА ПОДБОР НА НАЙ-ПОДХОДЯЩИТЕ ПЕСТИЦИДИ НА БАЗА BBCH КОДОВЕ
APPLICATION OF TABLEAU PUBLIC FREE DATA VISUALIZATION SOFTWARE IN THE PESTICIDES TREATMENTS DECISION TAKING PROCESS ON THE BASE OF BBCH CODES

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Abstract

BBCH-scale is a scale used to identify the phenological development stages of a plant. BBCH officially stands for "Biologische Bundesanstalt, Bundessortenamt und Chemische Industrie". The abbreviation of the scale is also said to unofficially represent the four companies that initially sponsored its development. From 2001 BBCH became officially standard in the agricultural and biological science and practice.

Due to BBCH codes, the agronomist can surely and safely apply pesticides. However taking the right decision about using given pesticide, respectively – plant protection product is a lot of complication process due to numerous properties as an octanol-water coefficient, vapour pressure, leaching potential, mode of action, formulation and others, plus necessity to be taken into account the BBCH intervals for the application.

For such purposes, different kind of software products for decision making and data visualization, which gained enormous popularity during recent years, can be used successfully to facilitate this process and ensure the correct, profitable and environmentally safe selection of the plant protection products.

Keywords: BBCH, phenological stages, Tableau Public, data visualization, pesticides, plant protection products.

INTRODUCTION

BBCH-scale is a scale used to identify the phenological development stages of a plant. BBCH officially stands for "Biologische Bundesanstalt, Bundessortenamt und Chemische Industrie". The phenological development of the plants is divided into ten major stages signed with numbers from 0 to 9. Each of the major stages is divided into yet another 10 stages (secondary stages), signed also

with numbers from 0 to 9. Combination of numbers of the major and secondary stages represent given BBCH stage (phenological stages). (Bleiholder et al., 2001).

The process for selection of the right pesticide (plant protection product) is very complicated due to numerous properties of such kind products as octanol-water coefficient, vapour pressure, leaching potential, and mode of action, formulation and others, which are often in contradictions and often are listed in different sources /databases – plant protection products labels, online databases provided by government, non-government or business institutions. Summarizing and rationalize all data is extremely difficult without data visualization and analysis software (Wang, 2016).

The correct and quick plant protection products selection according to the given pest, treated plants, abiotic conditions of the treatment and given pesticide properties is critical in the plant protection practice and right pest management (plant protection), especially in the area of integrated pest management and organic agriculture (Ganchev and Kutseva, 2016; Shen and Wania, 2005; Guénard et al., 2014).

Taking into account the BBCH stages (BBCH interval for treatments) additionally complicate the situation. In this case is almost impossible the good decision about the use of given plant protection product/s to be taken without help from computer software. During recent years various easy to use, cheap or completely freeware software products for decision making and data visualization became increasingly popular, including in the area of agriculture.

One of the most popular and famous is Tableau Public, which is a free software and service that lets anyone create and publish interactive data visualizations to the web. The visualizations can be embedded into web pages and blogs, they can be shared via social media or email, and they can be made available for download to other users (Tableau Software, 2017). However, this software is still quite unknown in the agricultural area and among agricultural specialists and farmers although it can provide them with a very good and useful method for their work, knowledge and education (Smiciklas, 2012; Ganchev, 2017).

While traditional presentations like list, tables, graphics by using software like Microsoft Word, Excel, PowerPoint and est. can provide very limited eyesight on the various pesticides properties and diversity, Tableau from the other side, can achieve the almost unlimited capability of presentation, organization and filtering the data of relational databases plus much more better ability for graphical presentations and easy to be learn process plus user friendly interface.

In this paper is presented the power of the Tableau in case of right selection of pesticides (plant protection products) according to the BBCH intervals (stages) and their properties.

MATERIALS AND METHODS

Microsoft Excel 2007 (Microsoft, 2017), was used for the creation of initial sets of information about pesticides (plant protection products) properties.

Tableau Public version 10.2 (Tableau Software, 2017) was used for the data visualization process and creation of the infographics.

RESULTS AND DISCUSSION

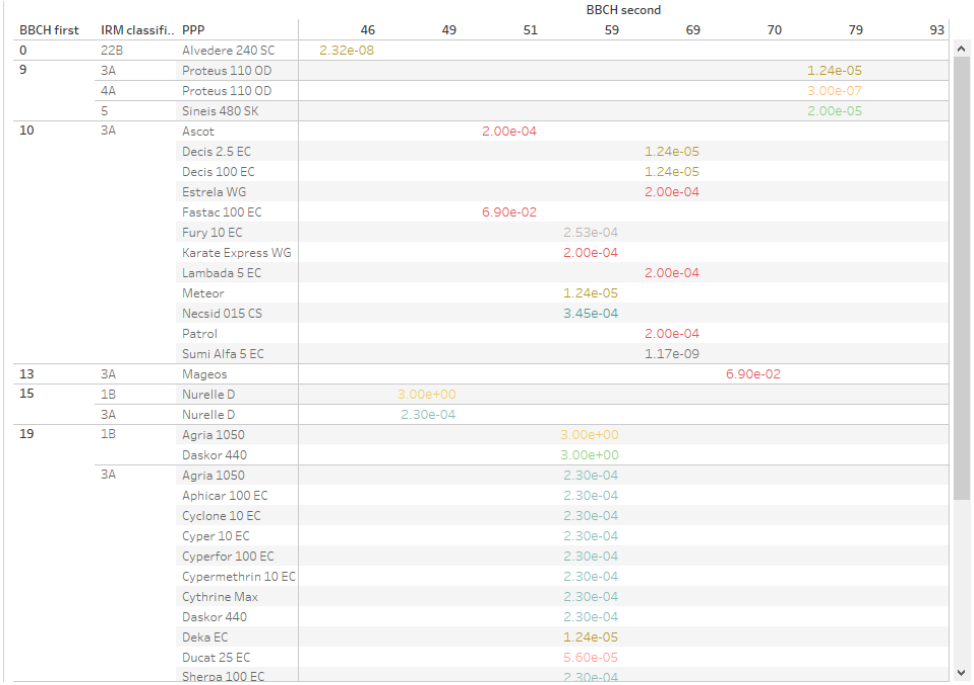
The common way of presentation of data according to plant protection products as a standard table look with traditional text or electronic tables software like Microsoft Word or Excel can provide very basic and often confusing and difficult to assume and understand interface. However, even the simplest Tableau table look can provide much better possibilities for the analysis of the data (Fig. 1).

PPP	Active Substance	IRM classifi..	BBCH first	BBCH sec..	Log P	Vapour Pr..
Actara 25 WG	Thiamethoxam	4A	31.00	69.00	-0.13	6.60e-06
Agria 1050	Chlorpyrifos	1B	19.00	59.00	4.70	3.00e+00
	Cypermethrin	3A	19.00	59.00	5.30	2.30e-04
Alvedere 240 SC	Metaflumizone	22B	0.00	46.00	4.60	2.32e-08
Aphicar 100 EC	Cypermethrin	3A	19.00	59.00	5.30	2.30e-04
Ascot	Lambda-cyhalothrin	3A	10.00	51.00	5.50	2.00e-04
Biscaya 240 OD	Thiacloprid	4A	31.00	69.00	1.26	3.00e-07
Calypso 480 SC	Thiacloprid	4A	31.00	59.00	1.26	3.00e-07
Coragen 20 SC	Chlorantraniliprole	28	31.00	93.00	2.86	6.30e-09
Cyclone 10 EC	Cypermethrin	3A	19.00	59.00	5.30	2.30e-04
Cyper 10 EC	Cypermethrin	3A	19.00	59.00	5.30	2.30e-04
Cyperfor 100 EC	Cypermethrin	3A	19.00	59.00	5.30	2.30e-04
Cypermethrin 10 EC	Cypermethrin	3A	19.00	59.00	5.30	2.30e-04
Cythrine Max	Cypermethrin	3A	19.00	59.00	5.30	2.30e-04
Dantop 50 WG	Clothianidin	4A	31.00	69.00	0.90	2.80e-08
Daskor 440	Chlorpyrifos-methyl	1B	19.00	59.00	4.00	3.00e+00
	Cypermethrin	3A	19.00	59.00	5.30	2.30e-04
Decis 2.5 EC	Deltamethrin	3A	10.00	69.00	4.60	1.24e-05
Decis 100 EC	Deltamethrin	3A	10.00	69.00	4.60	1.24e-05
Deka EC	Deltamethrin	3A	19.00	59.00	4.60	1.24e-05
Ducat 25 EC	Beta-cyfluthrin	3A	19.00	59.00	5.90	5.60e-05
Eforia 035 ZC	Thiamethoxam	4A	31.00	69.00	-0.13	6.60e-06
	Lambda-cyhalothrin	3A	31.00	69.00	5.50	2.00e-04
Estrela WG	Lambda-cyhalothrin	3A	10.00	69.00	5.50	2.00e-04
Fastac 100 EC	Alpha-cypermethrin	3A	10.00	51.00	5.50	6.90e-02
Fury 10 EC	Zeta-cypermethrin	3A	10.00	59.00	6.60	2.53e-04
Karate Express WG	Lambda-cyhalothrin	3A	10.00	59.00	5.50	2.00e-04
Lambada 5 EC	Lambda-cyhalothrin	3A	10.00	69.00	5.50	2.00e-04
Mageos	Alpha-cypermethrin	3A	13.00	70.00	5.50	6.90e-02
Meteor	Deltamethrin	3A	10.00	59.00	4.60	1.24e-05
Mospilan 20 SG	Acetamiprid	4A	31.00	69.00	0.80	1.73e-04
Mospilan 20 SP	Acetamiprid	4A	31.00	69.00	0.80	1.73e-04
Necsid 015 CS	Gamma-cyhalothrin	3A	10.00	59.00	4.96	3.45e-04

Fig. 1. *Visualization of the plant protection products data with Tableau Public*

From the figure above (in this case insecticides registered against Colorado beetle – *Leptinotarsa decemlineata*), can be seen that with Tableau, the specialist can extract and put in the table only this pesticide properties which he counts for important in the given situation. For the plant protection products Agria 1050, Daskor 440 and Eforia 035 ZC, Tableau automatically "recognize", these plant protection products consist of two active substances from different MoA groups. If the traditional text or electronic table software products were used, for these plant protection products will because of a lot of confuses.

The same table can be created with a much better interface providing much more better visualization about the correct selection of the insecticide for treatment of the Colorado beetle on the base of the active substance properties and BBCH interval (Fig. 2).



			BBCH second							
BBCH first	IRM classifi..	PPP	46	49	51	59	69	70	79	93
0	22B	Alvedere 240 SC	2.32e-08							
9	3A	Proteus 110 OD							1.24e-05	
	4A	Proteus 110 OD							3.00e-07	
	5	Sineis 480 SK							2.00e-05	
10	3A	Ascot			2.00e-04					
		Decis 2.5 EC					1.24e-05			
		Decis 100 EC					1.24e-05			
		Estrela WG					2.00e-04			
		Fastac 100 EC			6.90e-02					
		Fury 10 EC				2.53e-04				
		Karate Express WG				2.00e-04				
		Lambada 5 EC					2.00e-04			
		Meteor				1.24e-05				
		Necsid 015 CS				3.45e-04				
		Patrol					2.00e-04			
		Sumi Alfa 5 EC					1.17e-09			
13	3A	Mageos						6.90e-02		
15	1B	Nurelle D		3.00e+00						
	3A	Nurelle D		2.30e-04						
19	1B	Agria 1050				3.00e+00				
		Daskor 440				3.00e+00				
	3A	Agria 1050				2.30e-04				
		Aphicar 100 EC				2.30e-04				
		Cyclone 10 EC				2.30e-04				
		Cyper 10 EC				2.30e-04				
		Cyperfor 100 EC				2.30e-04				
		Cypermethrin 10 EC				2.30e-04				
		Cythrine Max				2.30e-04				
		Daskor 440				2.30e-04				
		Deka EC				1.24e-05				
		Ducat 25 EC				5.60e-05				
		Sherpa 100 EC				2.30e-04				

Fig. 2. *Visualization of the plant protection products properties with an emphasis on BBCH stages*

From Fig. 2 can see, that the same properties can be combined and represented by a much more better look. With different colour is presented different octanol-water coefficient.

Such kind visualization clearly shows to the given agronomist or agricultural scientist which pesticides (plant protection products) can be used in the initial phenological stages and which – in the final and which have the biggest BBSH interval.

Such kind of information is additionally connected with data about octanol-water coefficient and vapour pressures of the active substances as well as – their classification according to the Integrated Resistance Management.

The next visualization present the organized data for fungicides registered against apple scab (*Venturia inaequalis*) (Fig. 3).

The organization of information is similar to the Fig. 1 but with Tableau, such kind of table can be made a little bit more informative by putting the data for the category of use and formulation type.

Again, data can be organized (visualized) more clearly by putting the first and second BBCH numbers on the coordinate system X and Y – axis (Fig. 4).

PPP	IRM classifi..	BBCH first	BBCH second	Vapour Pressure	Log P	Category of Use: first professional	free	second professional
Antracol 70 WG	M3	1	79	0.16	-0.26	WG		
Captan 50 WP	M4	0	72	0.0042	2.5	WP		
Captan 80 WG	M4	0	72	0.0042	2.5			WG
Champion WP	M1	0	72	1e-06	0.44		WP	
Cuproxat FL	M1	0	10	3.4e-10	0.44		FL	
Delan 700 WG	M9	53	79	1e-07	3.2		WG	
Difcor 250 EC	G1	1	79	3.3e-05	4.36			EC
Difo 25 EC	G1	1	79	3.3e-05	4.36			EC
Dithane DG	M3	1	79	0.013	1.33			DG
Dithane M45	M3	1	79	0.013	1.33			WG
Faban	D1	53	77	1.1	2.89			SC
	M9	53	77	1e-07	3.2			SC
Flint Max 75 WG	C3	1	81	0.0023	4.5		WG	
	G1	1	81	0.0013	3.7		WG	
Folpan 80 WG	M4	0	72	0.021	3.02	WG		
Fontelis SC	C2	10	74	0.0064	4.62		SC	
Horus 50 WG	D1	10	71	0.51	4		WG	
Luna Experience	C2	53	79	0.0012	3.3	SC		
	G1	53	79	0.0013	3.7	SC		
Manfil 75 WG	M3	1	79	0.013	1.33			WG
Merpan 80 WG	M4	0	60	0.0042	2.5	WG		
Polyram DF	M3	0	60	0.01	1.76		DF	
Sancozeb 80 WP	M3	0	60	0.013	1.33			WP
Scab 80 WG	M4	0	72	0.0042	2.5			WG
Score 250 EC	G1	1	79	3.3e-05	4.36		EC	
Shavit F 72 WG	G1	0	72	0.0005	3.18			WG
	M4	0	72	0.021	3.02			WG

Fig. 3. *Visualization of the plant protection products properties with Tableau Public according to apple scab (Venturia inaequalis)*

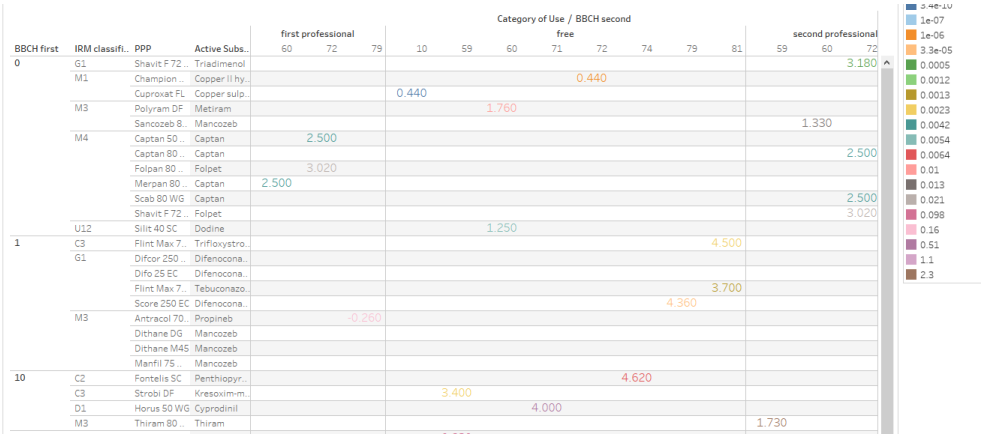


Fig. 4. *Visualization of the plant protection products properties with Tableau Public according to apple scab (Venturia inaequalis) emphasis on BBCH stages*

Additionally in such interactive table (visualization) can be put information about IRM classification, Log P, category of use and vapor pressure (presented in this case with different colours). The next visualization presents the herbicides used against cereal weeds in grape fields (Fig. 5).

The visualization organize data by typical for herbicides way: group registered plant protection products into MoA groups and different MoA groups into a different type of action. The table includes BBCH interval as well as log P, GUS, vapour pressure, the category of use and formulation.

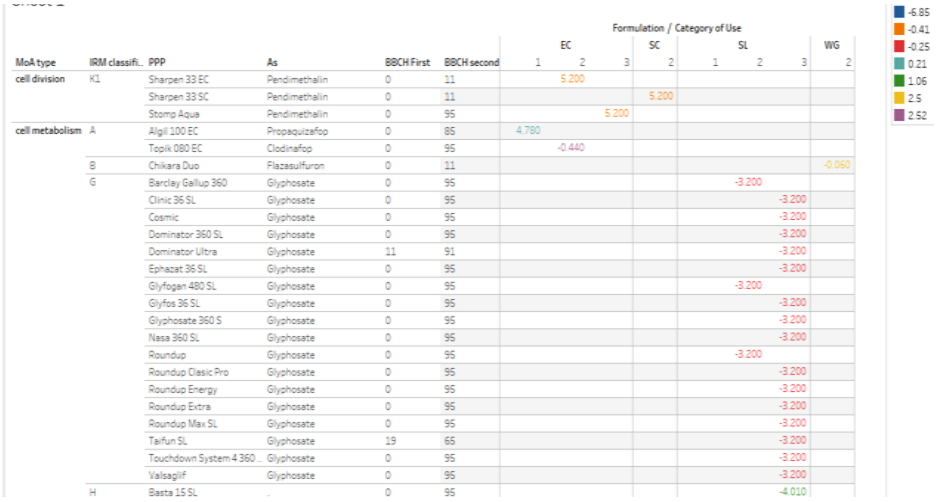


Fig. 5. *Visualization of the plant protection products properties with Tableau Public according to the herbicides used against cereal weeds on grape fields*

The visualization on the next figure – present again the more appropriate way of organization of data for better selection of the best possible plant protection product (Fig. 6).

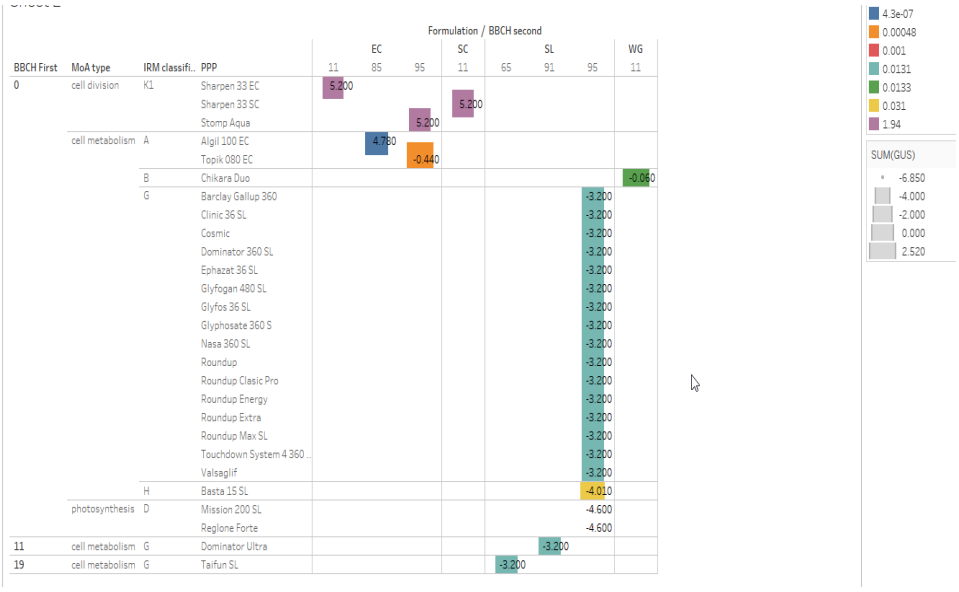


Fig. 5. *Visualization of the plant protection products properties with Tableau Public according to the herbicides used against cereal weeds on grape fields, emphasis on BBCH stages*

Just like the other similar visualization above, BBCH number are on the X and Y axis while another useful information is between them - with numbers are presented log p coefficients, with different colours – vapour pressure values and with different size of the squares – GUS indexes.

CONCLUSIONS

1. It's surprising how the software for data visualization and analysis like Tableau can be so useful and handy for selection and decision taking about the right, proper and safe use of pesticides.

2. Times, when agronomists and agricultural scientists take such kind decisions without the help of any special software products, is far away in the history.

3. The numerous properties of the pesticides plus BBCH stages, expel any other approach as unprofessional, risky and dangerous for crops, humans and the environment.

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