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EX-ANTE ASSESSMENT OF HERBICIDE REDUCTION BY IMPLEMENTING EARLY PRECISION WEED CONTROL IN SPRING CROPS

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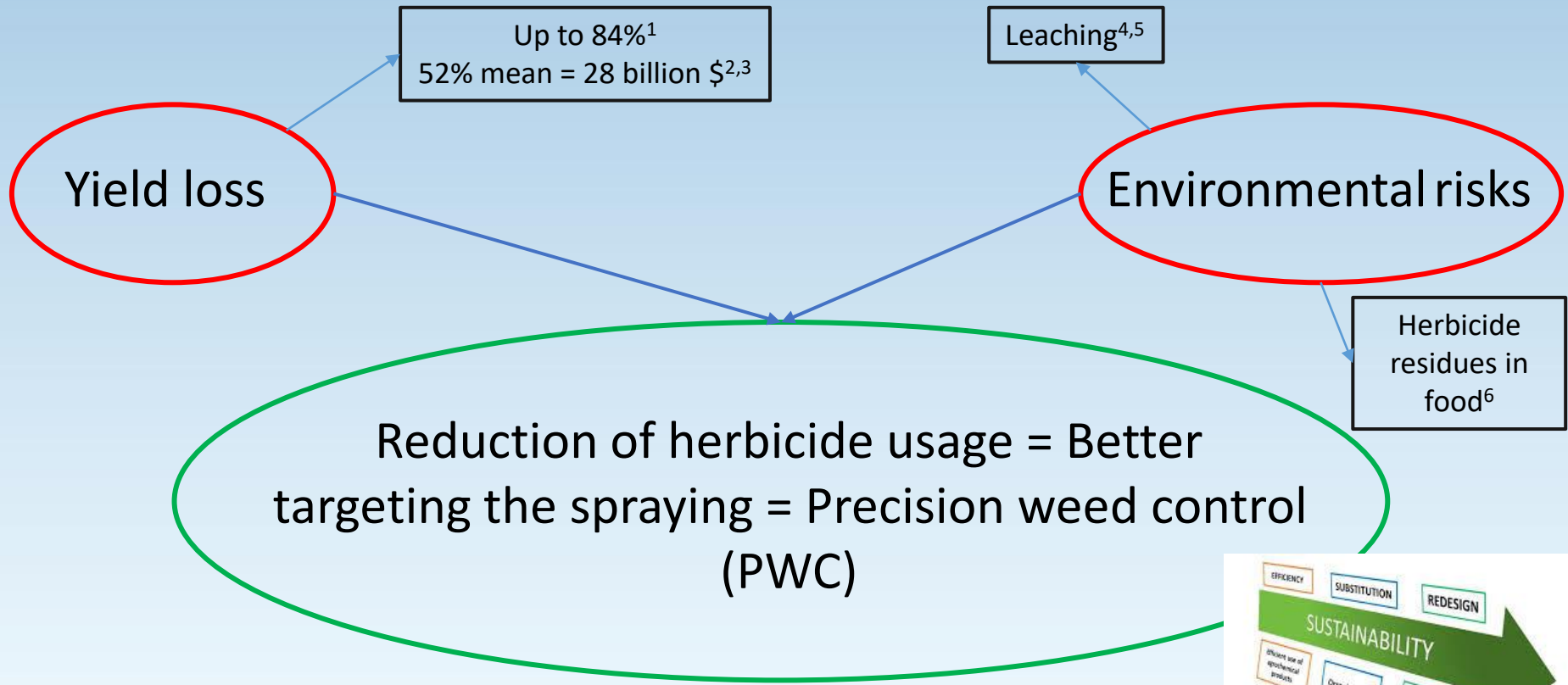
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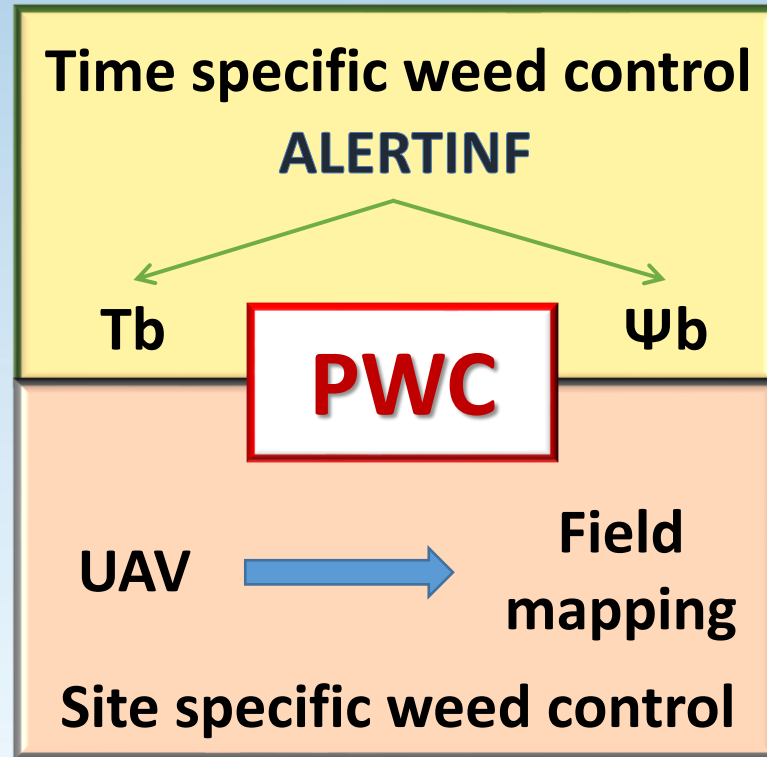
EX-ANTE ASSESSMENT OF HERBICIDE REDUCTION BY IMPLEMENTING EARLY PRECISION WEED CONTROL IN SPRING CROPS

*Nebojša NIKOLIĆ – Roberta MASIN – Pierre SAULET – Elisa MARRACCINI –
Alicia AYERDI GOTOR – Davide RIZZO*



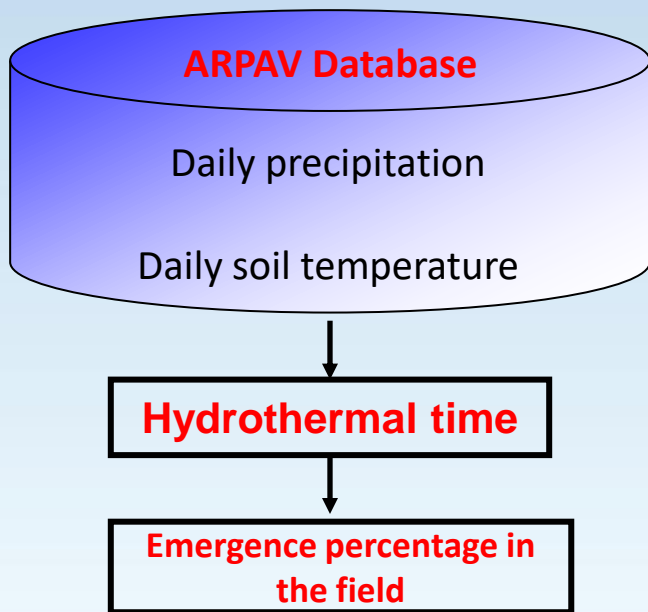


How to
obtain
more
precise
spraying?

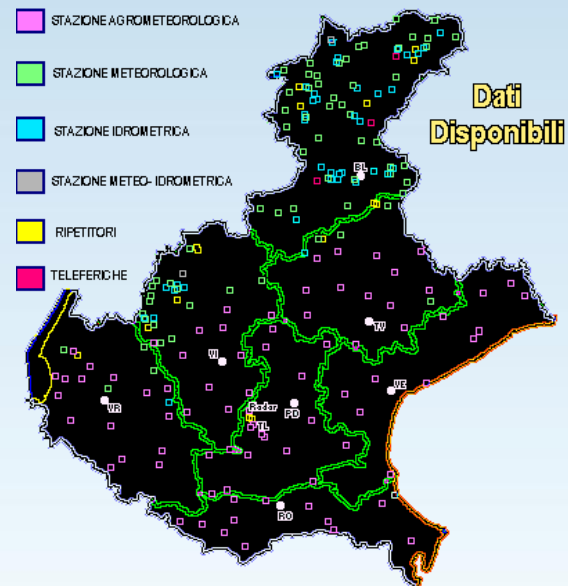


TIME SPECIFIC WEED CONTROL

Emergence predictive model: *Alertinf*⁷ - informs the farmers about weed emergence in maize and soybean and suggests the best timing for weed control.



Meteorological data from stations present in the area.



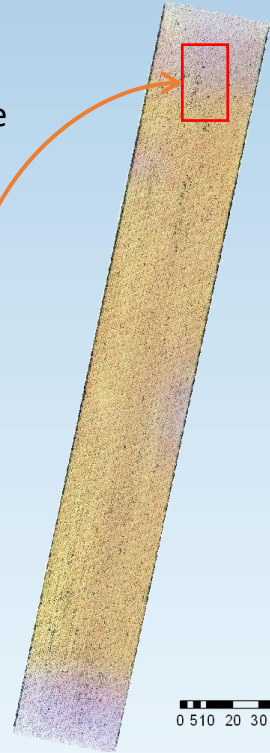
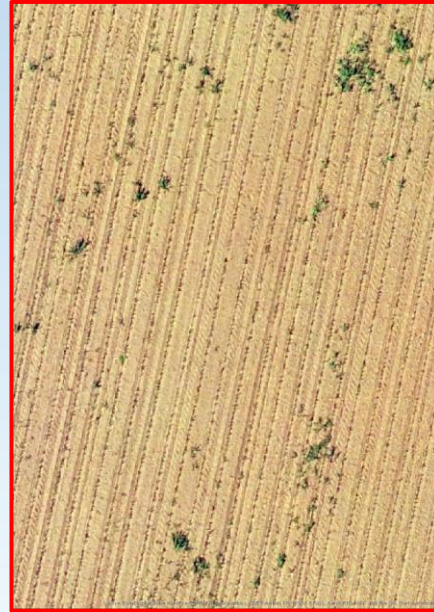
The information is useful to select correctly weed control timing, both chemical and non-chemical control.

SITE SPECIFIC WEED CONTROL

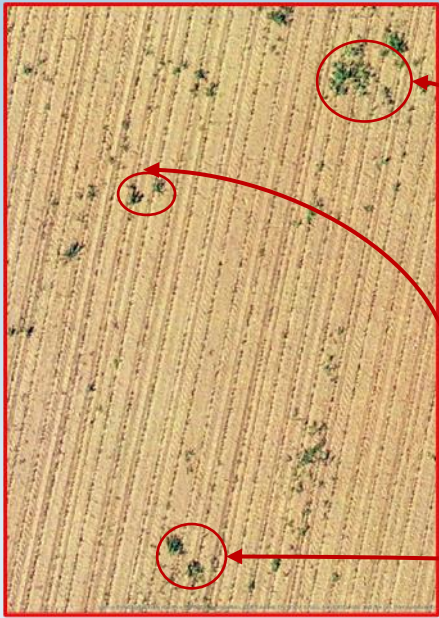


DJI Matrice 100 UAV coupled with DJI X3; DJI X5 visible sensors

Maiz field June 2019, early growth stage



Meters
0 5 10 20 30 40



Alertinf – 96% of emergence at the date of the flight

... Majority of weeds- *Sorghum halepense*



Some additional ground surveys...

Weed spatial distribution was assessed by the exploratory comparison of two algorithms



ArcGis Pro

VARI - Visible
Atmospherically
Resistant Index



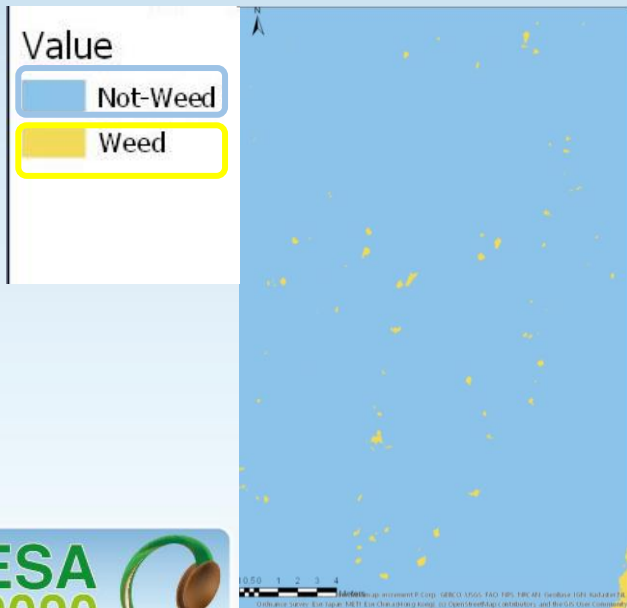
Artificial Neural Networks



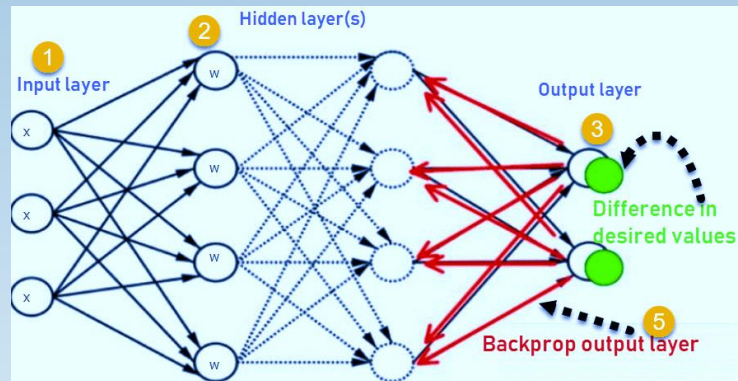
ArcGis Pro

$$\text{VARI} = \frac{\text{Green} - \text{Red}}{\text{Green} + \text{Red} - \text{Blue}}$$

Reclassification



→ Backpropagation →



Value

- Not-Weed
- Weed



Based on the technical specifications of different models of sprayers...



Credits: Buquet Christophe/Shutterstock.com

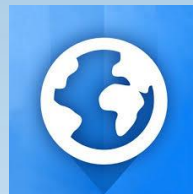
...several maps were created:

3 m²

2 m²

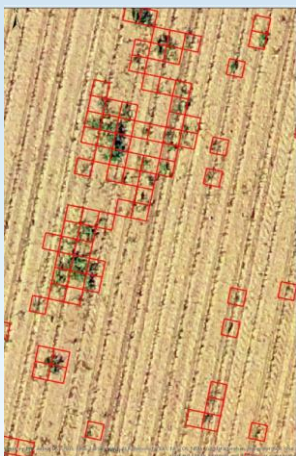
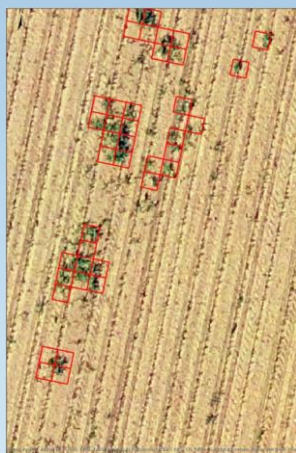
0.25 m²

With three different thresholds for treatment decision depending on each cell infestation (i.e., >1%, >5% and >10% of pixel labelled as weed)

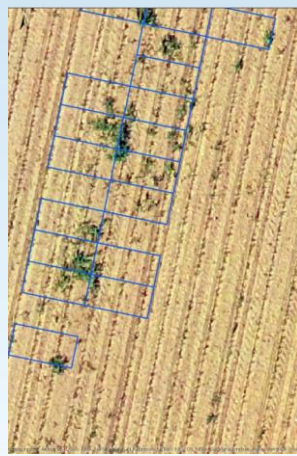


ArcGis Pro

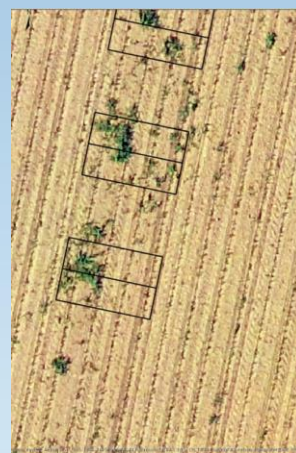
5% infestation



0.25m²



2m²



3m²



Total field area = 1ha

Table 1. Possible spraying area reduction

ArcGis Pro- VARI						
	1% infestation		5% infestation		10% infestation	
Cell size	Area to be sprayed (ha)	Reduction %	Area to be sprayed (ha)	Reduction %	Area to be sprayed (ha)	Reduction %
0.25 m ²	0.35	65.29	0.19	80.59	0.15	85.36
2m ²	0.15	85.33	0.15	84.82	0.11	88.88
3m ²	0.12	88.05	0.09	91.42	0.07	93.35
SAGA- Artificial Neural Network						
	1% infestation		5% infestation		10% infestation	
Cell size	Area to be sprayed (ha)	Reduction %	Area to be sprayed (ha)	Reduction %	Area to be sprayed (ha)	Reduction %
0.25 m ²	0.58	42.43	0.3	69.97	0.21	78.94
2m ²	0.5	49.7	0.26	73.72	0.17	83
3m ²	0.22	77.57	0.16	84.03	0.12	87.82

Case study with two herbicide formulations

Equip



Foramsulfuron 2.33% (= 22.5 g/L)
Isoxadifen-etile 2.33% (= 22.5 g/L)

2.3 l/ha = 48.3 €

Titus Mais Extra



Nicosulfuron p.a. pure 30 g
Rimsulfuron p.a. pure 15 g
Coformulants q.b. 100 g

80 g/ha = 67.2 €

Equip

Table 2. Reduction of costs and quantity of herbicides used

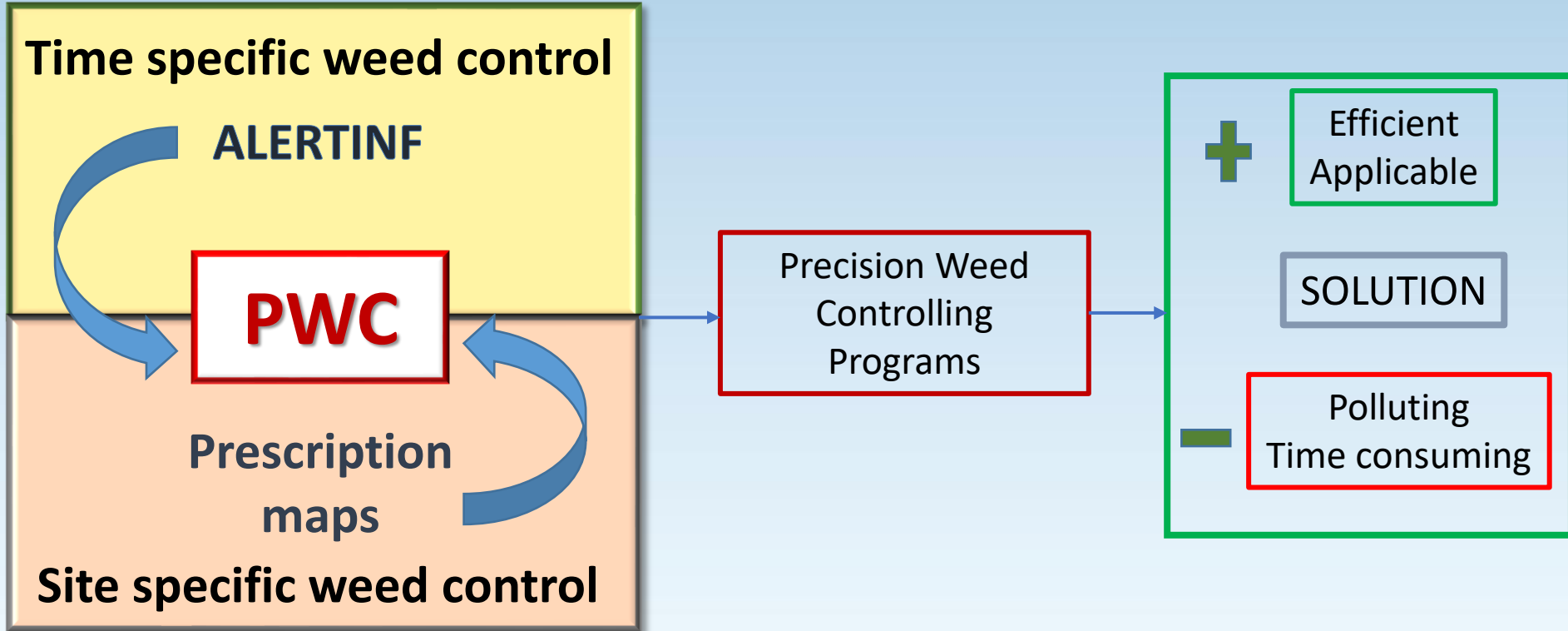
SAGA									
Cell size	1%			5%			10%		
	Quantity (l/ha)	Cost (€/ha)	Savings (€/ha)	Quantity (l/ha)	Cost (€/ha)	Savings (€/ha)	Quantity (l/ha)	Cost (€/ha)	Savings (€/ha)
3m ²	1.32	27.81	20.49	0.69	14.5	33.8	0.48	10.17	38.13
2m ²	1.16	24.3	24.01	0.6	12.69	35.61	0.39	8.21	40.09
0.25m ²	0.52	10.83	37.47	0.37	7.71	40.59	0.28	5.88	42.42
VARI									
Cell size	1%			5%			10%		
	Quantity (l/ha)	Cost (€/ha)	Savings (€/ha)	Quantity (l/ha)	Cost (€/ha)	Savings (€/ha)	Quantity (l/ha)	Cost (€/ha)	Savings (€/ha)
3m ²	0.80	16.77	31.54	0.45	9.38	38.93	0.34	7.07	41.23
2m ²	0.34	7.09	41.21	0.35	7.33	40.97	0.26	5.37	42.93
0.25m ²	0.28	5.77	42.53	0.20	4.15	44.15	0.15	3.21	45.09

Titus Mais Extra

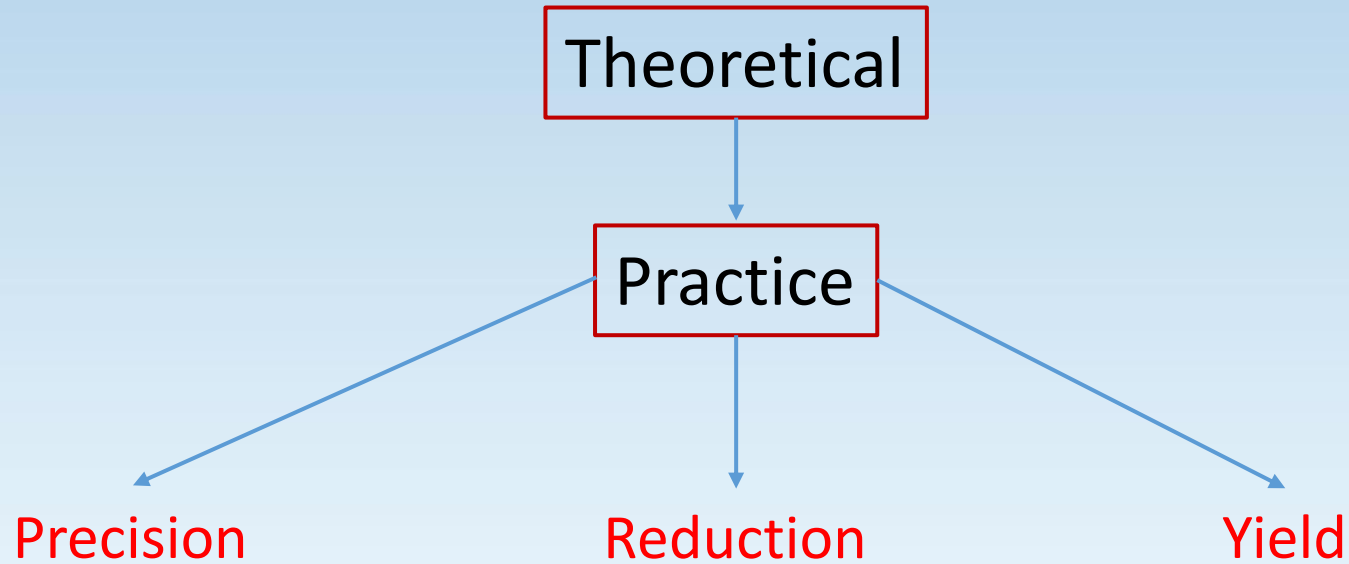
Table 3. Reduction of costs and quantity of herbicides used

SAGA									
Cell size	1%			5%			10%		
	Quantity (g/ha)	Cost (€/ha)	Savings (€/ha)	Quantity (g/ha)	Cost (€/ha)	Savings (€/ha)	Quantity (g/ha)	Cost (€/ha)	Savings (€/ha)
3m ²	46.06	38.69	28.51	24.02	20.18	47.02	16.85	14.15	53.05
2m ²	40.24	33.8	33.4	21.02	17.66	49.54	13.6	11.42	55.78
0.25m ²	17.94	15.07	52.13	12.78	10.73	56.47	9.74	8.19	59.02
VARI									
Cell size	1%			5%			10%		
	Quantity (g/ha)	Cost (€/ha)	Savings (€/ha)	Quantity (g/ha)	Cost (€/ha)	Savings (€/ha)	Quantity (g/ha)	Cost (€/ha)	Savings (€/ha)
3m ²	27.77	23.33	43.88	15.53	13.04	54.16	11.71	9.84	57.36
2m ²	11.74	9.86	57.34	12.14	10.2	57	8.9	7.48	59.73
0.25m ²	9.56	8.03	59.17	6.87	5.77	61.43	5.32	4.47	62.73

PRECISION WEED CONTROL



Future Perspectives





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Thank you for Your attention



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References

1. EO, I.; JO, O. Weed Infestation, Growth and Yield of Maize (*Zea mays* L.) as Influenced by Periods of Weed Interference. *Adv. Crop Sci. Technol.* 2017, 05.
2. USDA-NASS (2014) Total herbicide applied, and the proportion of US corn acres treated with herbicides, 1990 to 2014. [Online] Available: <http://www.nass.usda.gov/>
3. Statistics Canada (2015) Corn: Canada's third most valuable crop [Online]. Available at: <http://www.statcan.gc.ca/pub/96-325-x/2014001/article/11913-eng.htm>
4. Tiktak, A.; De Nie, D.S.; Piñeros Garcet, J.D.; Jones, A.; Vanclooster, M. Assessment of the pesticide leaching risk at the Pan-European level. The EuroPEARL approach. *J. Hydrol.* 2004, 289, 222–238.
5. Gimsing, A.L.; Agert, J.; Baran, N.; Boivin, A.; Ferrari, F.; Gibson, R.; Hammond, L.; Hegler, F.; Jones, R.L.; König, W.; et al. Conducting groundwater monitoring studies in Europe for pesticide active substances and their metabolites in the context of Regulation (EC) 1107/2009; 2019; Vol. 14; ISBN 0000301901211.
6. European Food Safety Authority The 2016 European Union report on pesticide residues in food. *EFSA J.* 2018, 16.
7. Masin, R.; Cacciatori, G.; Zuin, M.C.; Zanin, G. AlertInf: Emergence predictive model for weed control in maize in Veneto. *Ital. J. Agrometeorol.* 2010, 5.