Società Italiana di Agronomia
50° Convegno Nazionale

Evoluzione dei sistemi agronomici in risposta alle sfide globali
Udine, 15-17 settembre 2021

Is It Possible To Apply An Economic Threshold For Herbicide Applications In Common Wheat?

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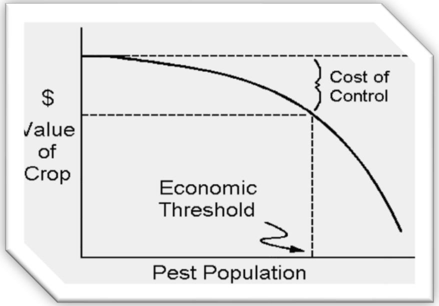
Introduction Among the actual targets to transform the EU food system, the objective of reducing the use and risk of pesticides and fertilizers by 50% and 20%, respectively, is one of the most ambitious measures that will require the development of alternative and effective solutions (EU Commission, "Biodiversity Strategy to bring nature back into our lives"; "Farm to Fork Strategy for a fair, healthy and environmentally friendly food system"). To pave the way for alternatives and to promote a responsible use of pesticides, it is crucial to recover the basic principles on which the Integrated Pest Management (IPM) was founded. The IPM system stipulates that a treatment is justified only if the damage caused by the pests is greater than the cost of the intervention itself (Berti *et al*., 2001).
In this context, monitoring activities are crucial to avoid calendar-based herbicide applications especially for weeds that do not warrant treatments. In addition, strategies to control weeds with less herbicide to reduce production costs and to protect the environment could represent an interesting challenge, also in developing countries.

Materials and Methods Monitoring activities were organized in 4 Farms located in Emilia Romagna Region (Italy), during the 2019/20 growing season. In each farm, a randomized complete block design was adopted, with 2 replicate blocks, comparing for the herbicide treatment factor (treated and no-treated). At BBCH 23-30, in 10 areas (1 m^2) within each experimental plot, a visual assessment was realized to identify weed species and the number of plants for each species. Using the competitive index "i" and "a", a prediction of yield loss based on weed density were estimated applying the rectangular hyperbola model (Cousens, 1985; Berti *et al.,* 1998). Data on yield and quality production (i.e. protein content, % of impurities in the harvested wheat) were also evaluated. The cost of the herbicide treatments carried out in the field will be used to establish an economic threshold. Finally, to verify the accuracy of the model, the observed economic loss value was calculated for each farm.



Results
The visual assessment allowed to calculate the Total density equivalent (Deqt) parameter and to predict the relative Yield loss (YL).

Table 1 – Predicted and observed Yield Losses (YL) in 2019/2020 and 2020/2021.

	Predictive relative Y_L (%) 2019/2020	Observed relative Y_L (%) 2019/2020
Farm 1 (FE)	-3,2 ± 0,8	0,9 ± 7,5
Farm 2 (FE)	-3,7 ± 0,3	-4,1 ± 1,5
Farm 3 (FE)	-4,4 ± 2,2	-9,3 ± 4,8
Farm 4 (MO)	-5,6 ± 0,2	-4,0 ± 0,4

As reported in Table 1, in 2019/2020 predicted relative yield losses were lower or slightly higher than that estimated by the model, with the exception of Farm 3 where, due to a discrepancy in timing between the visual assessment and the herbicide treatment, a significant difference was observed. In none of the farms a significant difference in the protein content (g/100g) was observed; moreover, the % of impurities was always below the limit required by the mills (1%).
In 2019/20, in 3 out of 4 cases (Farm 1, Farm 2 and Farm 4), the observed economic loss was similar or lower to the cost of the herbicide treatment, providing beneficial advice for the farmer (Table 2) for the reduction of herbicide application.

Table 2 – Cost of herbicide treatment (€/ha), predicted and observed economic losses (€/ha), in 2019/2020.

	Cost of herbicide treatment (€/ha)	Predicted economic loss (€/ha)	Observed economic loss (€/ha)
Farm 1 (FE)	69	48	0
Farm 2 (FE)	69	58	67
Farm 3 (FE)	67	42	161
Farm 4 (MO)	50	76	53


Visual assessment

Conclusions In conclusions, observed data are certainly preliminary, and must be confirmed during the following growing season. However, the model provides results that appear promising, particularly for the control of dicotyledonous weeds, which are mainly found on farms 1, 2 and 4.
The validation of this model, built considering the competitiveness and persistence of the seeds of the observed weeds, could represent an interesting challenge to improve and consolidate a more sustainable weed management system.