

# Efficiency of three fungicides in leaf disc assays against *Phytophthora infestans* isolates from fields with different late blight management

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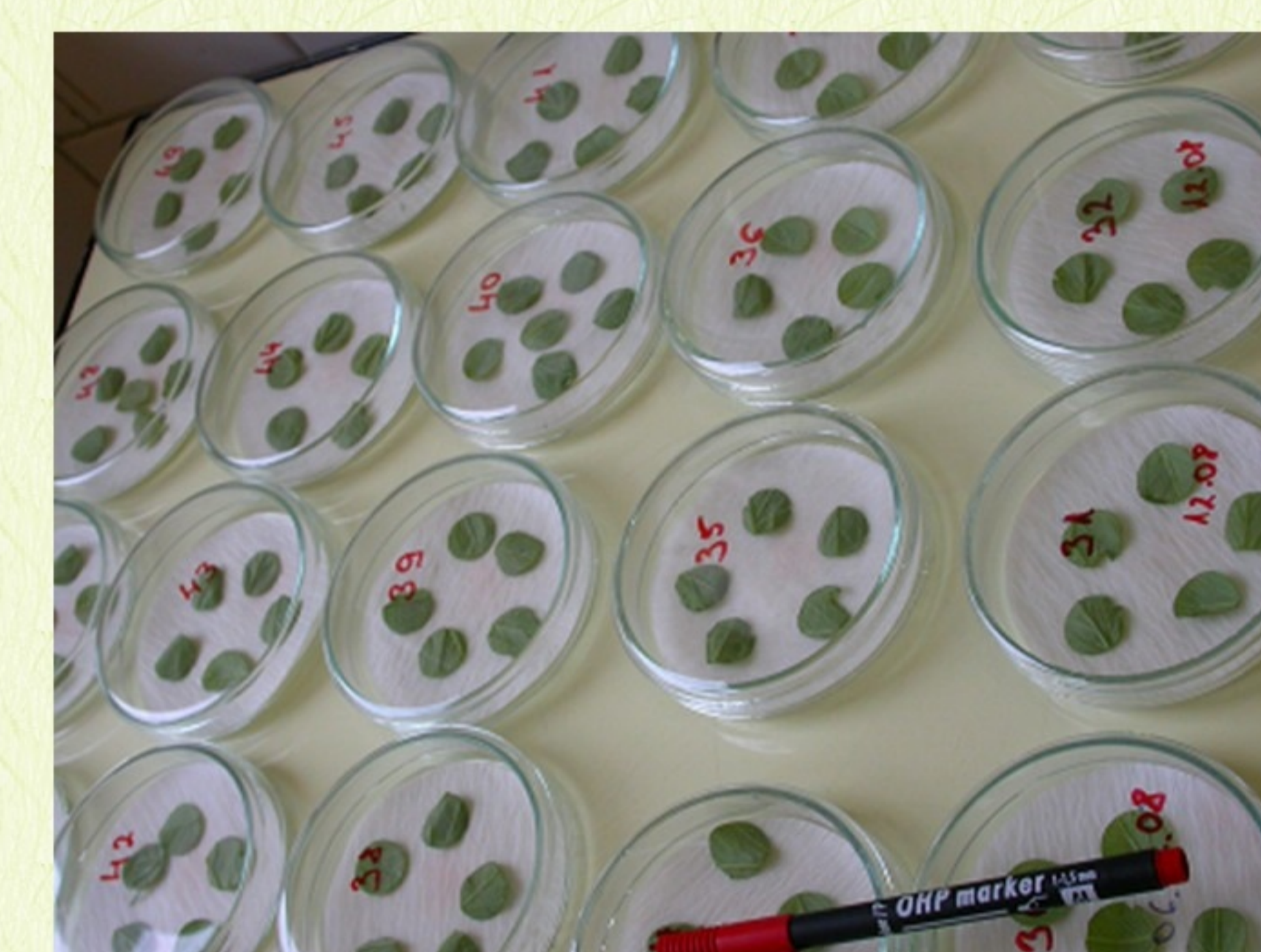
*Phytophthora infestans*, the causal agent of potato and tomato late blight is one of the most destructive pathogen in agriculture. To prevent the damage of the crop, chemicals are still the main factors in potato late blight management in Hungary. The risk of fungicide resistance/tolerance in the pathogen population increases with the increased number of treatments with a specific active ingredient. Insensitivity of *Ph. infestans* to phenylamids has been a well-known phenomenon (e. g. Dowley & O' Sullivan: Potato Res. 24: 417-421.) and was also published from Hungary (Bakonyi & Érsek: Növényvédelem 33: 221-228.). Other systemic fungicides such as cymoxanil, dimethomorph and azoxystrobin, all with specific target site, are commonly used in potato late blight management by Hungarian growers. Therefore, our aim was to test the sensitivity of field isolates of *Ph. infestans* from potato to these active ingredients.



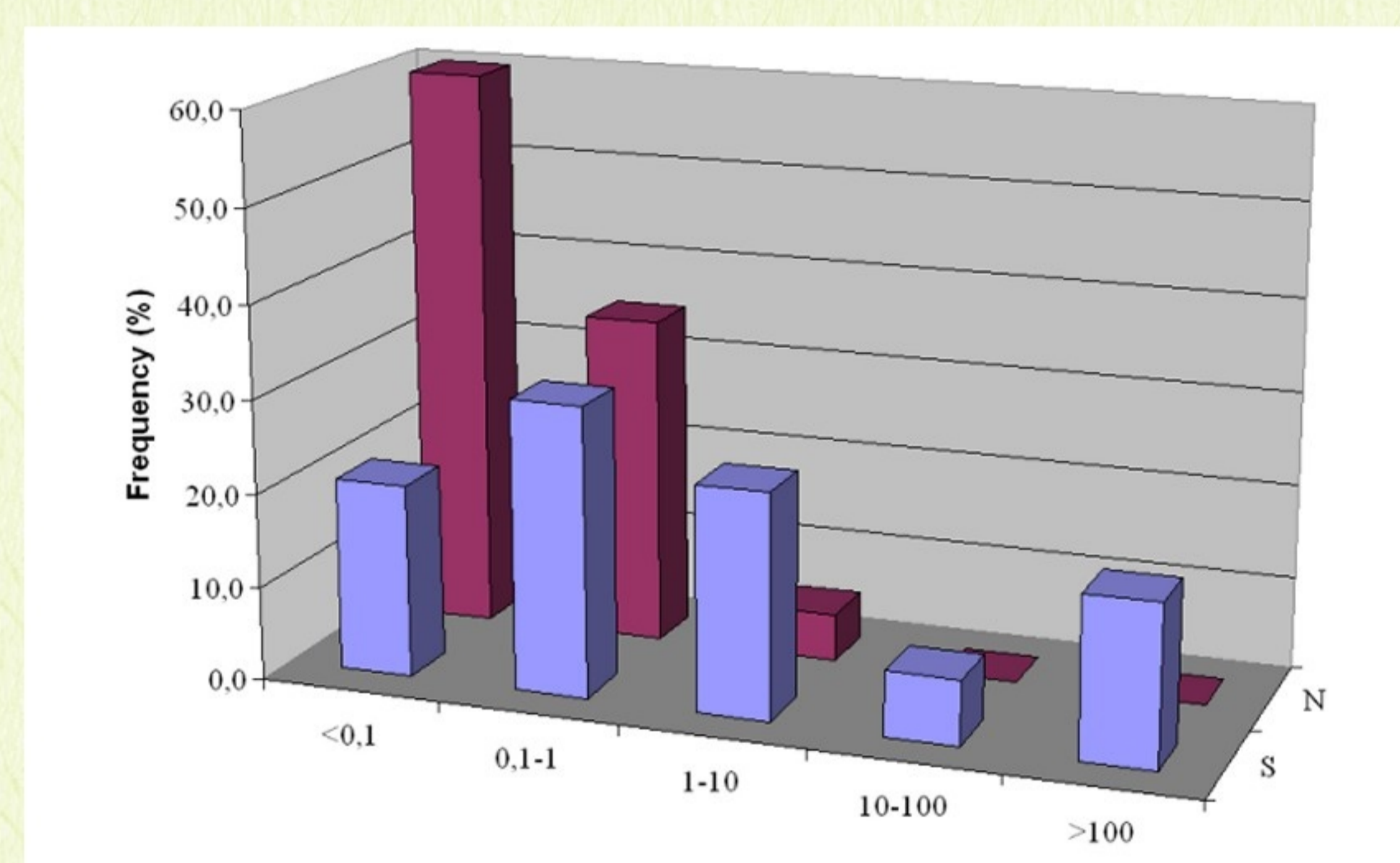
Date of treatment	Fungicide (active ingredient)	
	Nagykálló	Solt
6th June		Tanos 50 DF (cymoxanil+famoxadone)
13th June		Kupfer Fusilan WG (copper+cymoxanil)
19th June	Cuproxtat FW (copper)	
26th June		Altima (fluazinam)
30th June	Cuproxtat FW (copper)	
7th July		Acrobat MZ & Kupfer Fusilan WG (dimethomorph+mancozeb+ copper+cymoxanil)
14th July	Cuproxtat FW (copper)	
	Manzate 75 DF (mancozeb)	
24th July	Cuproxtat FW (copper)	
	Manzate 75 DF (mancozeb)	
	Acrobat MZ (dimethomorph+mancozeb)	
	Amistar (azoxystrobin)	
28th July		Acrobat MZ (dimethomorph+mancozeb)
9th August		Kupfer Fusilan WG (copper+cymoxanil)
10th August		Altima (fluazinam)
11th August	Cuproxtat FW (copper)	
	Manzate 75 DF (mancozeb)	
	Acrobat MZ (dimethomorph+mancozeb)	
	Amistar (azoxystrobin)	
24th August	Cuproxtat (copper)	
	Manzate 75 DF (mancozeb)	
	Acrobat MZ (dimethomorph+mancozeb)	
	Amistar (azoxystrobin)	

Tomato leaf discs ready for inoculation with *Ph. infestans*. EC<sub>50</sub> values of isolates were assessed using a dilution series of 100, 10, 1, 0.1 and 0 mg active ingredient/L for cymoxanil (Curzate 50 WP) and of 1000, 100, 10, 1 and 0 mg a. i./L for azoxystrobin (Quadris) and dimethomorph. The inoculated plant material was incubated at 16-18 °C for 7 days.

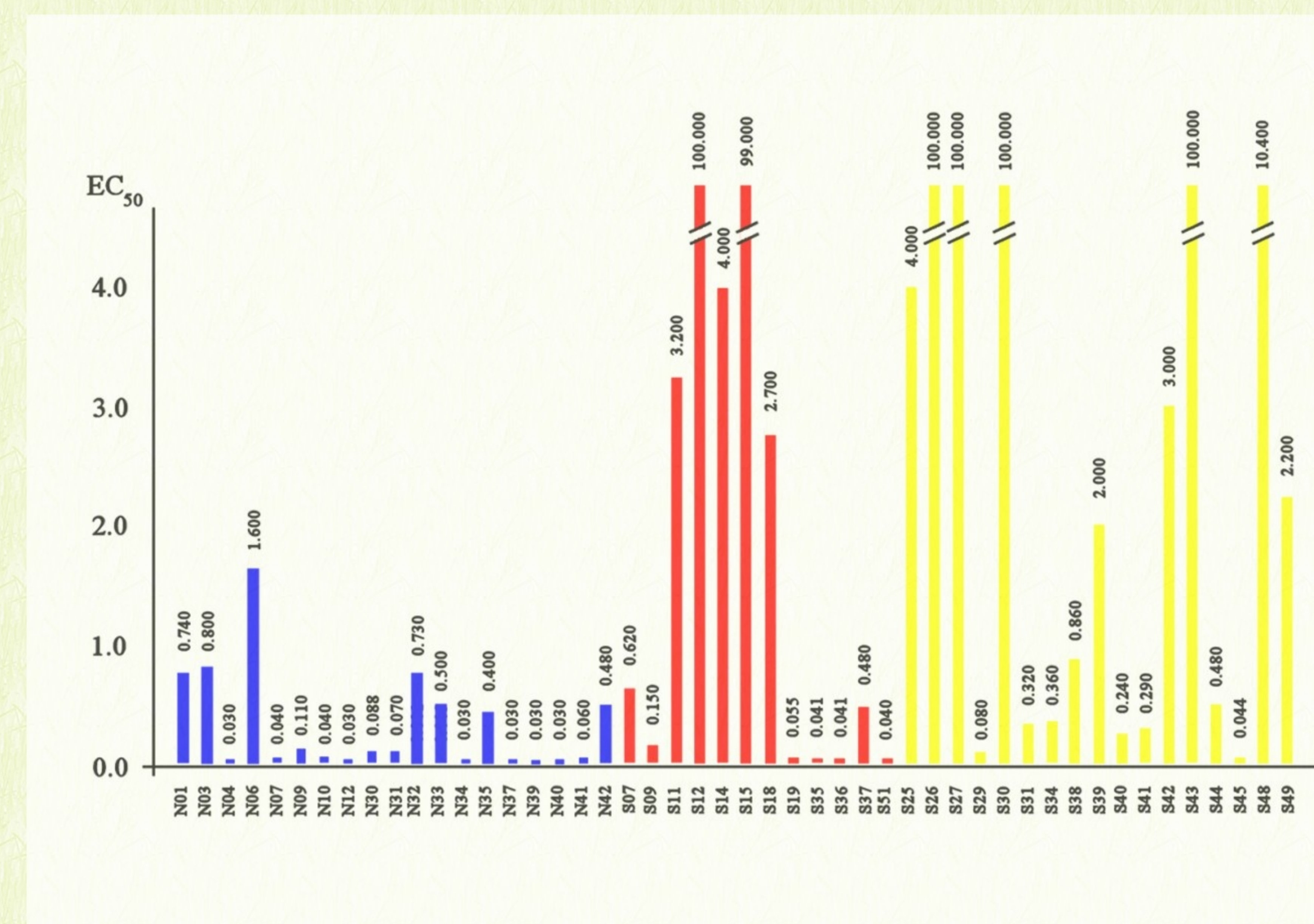
The correlation between the number of fungicide treatment and EC<sub>50</sub> values was checked with an independence test. Distribution of lg(EC<sub>50</sub>) values for the two sampling sites were checked in a homogeneity test.



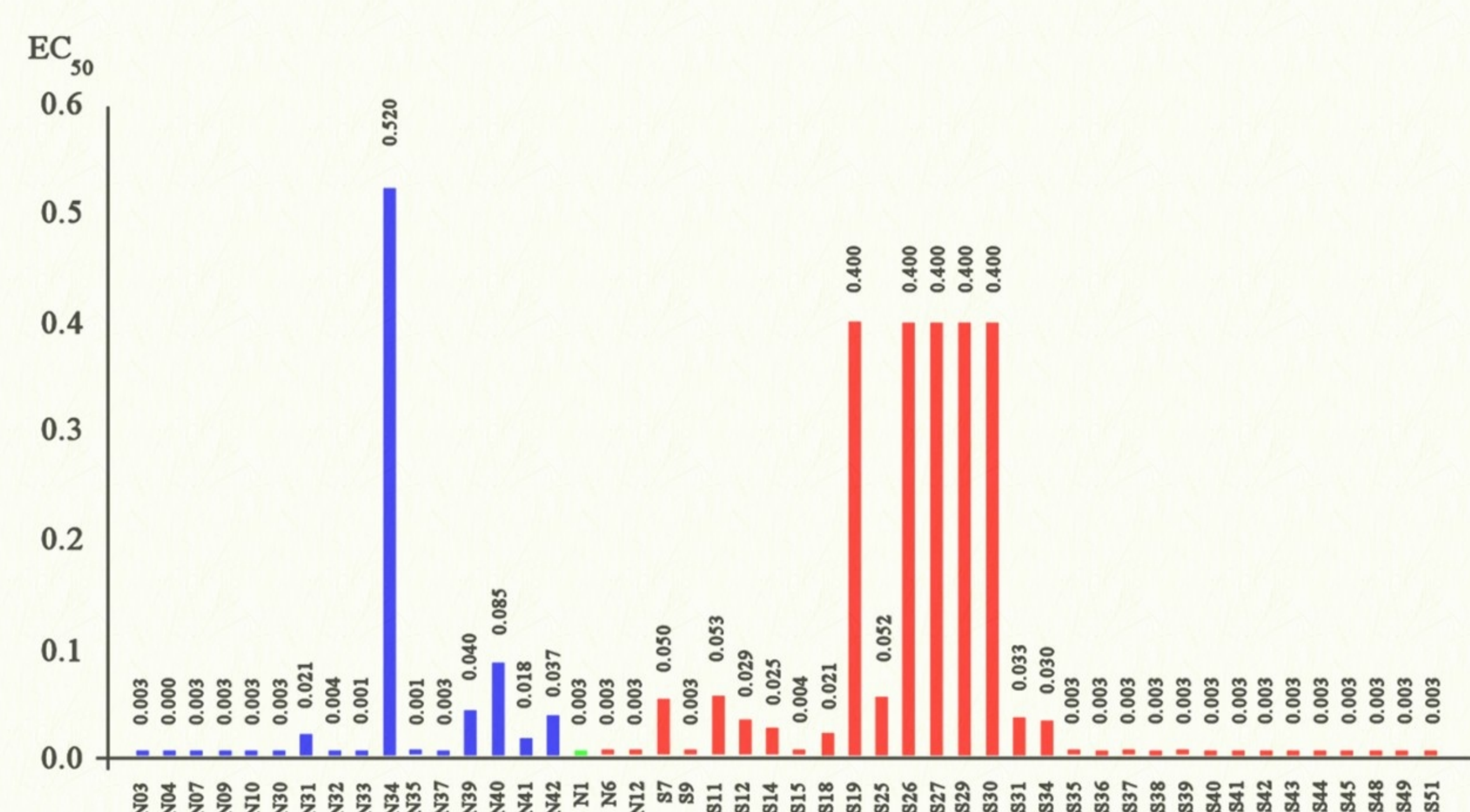
Blighted leaves and tubers were collected at different dates at two locations about 200 km far from each other. Fields were treated according to the farmers's practice. Isolates from Nagy-kálló originated from an experimental field divided into several small plots, each treated with the same contact and one of the 2 systemic fungicides, (dimethomorph or azoxystrobin) plus a non-treated control plot. Isolates from Solt originated from 3 fields treated with the same chemicals, except for the last spray with copper + cymoxanil or fluazinam.



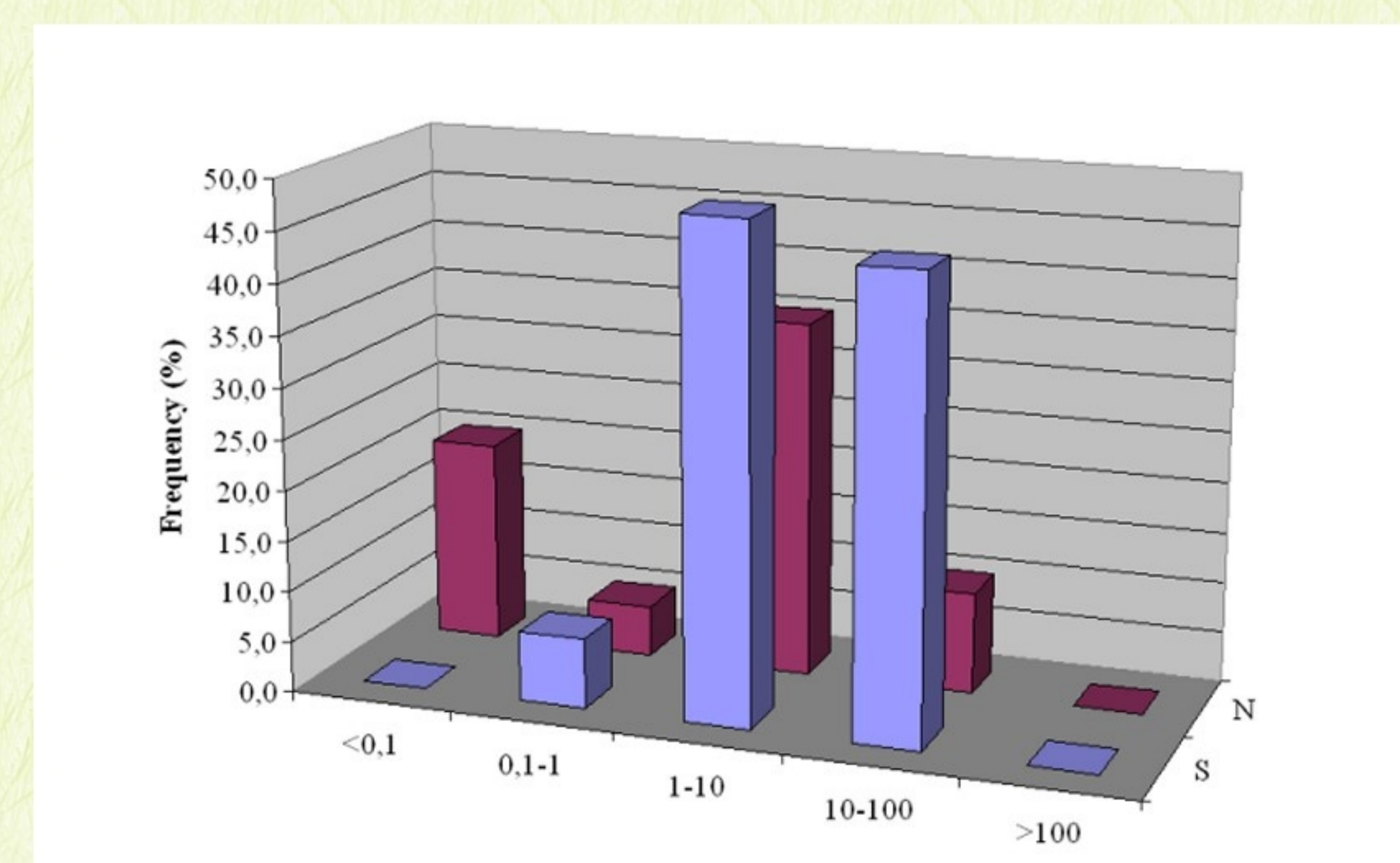
Distribution of EC<sub>50</sub> values for cymoxanil. At Nagy-kálló (purple), where cymoxanil was not applied, isolates were highly sensitive, whereas at Solt (blue), where cymoxanil was used, several isolates exhibited much higher resistance/tolerance. The distribution of EC<sub>50</sub> values between the two locations (treated and untreated crop) differed significantly ( $\chi^2 = 11.642$ ;  $P = 0.05$ ).



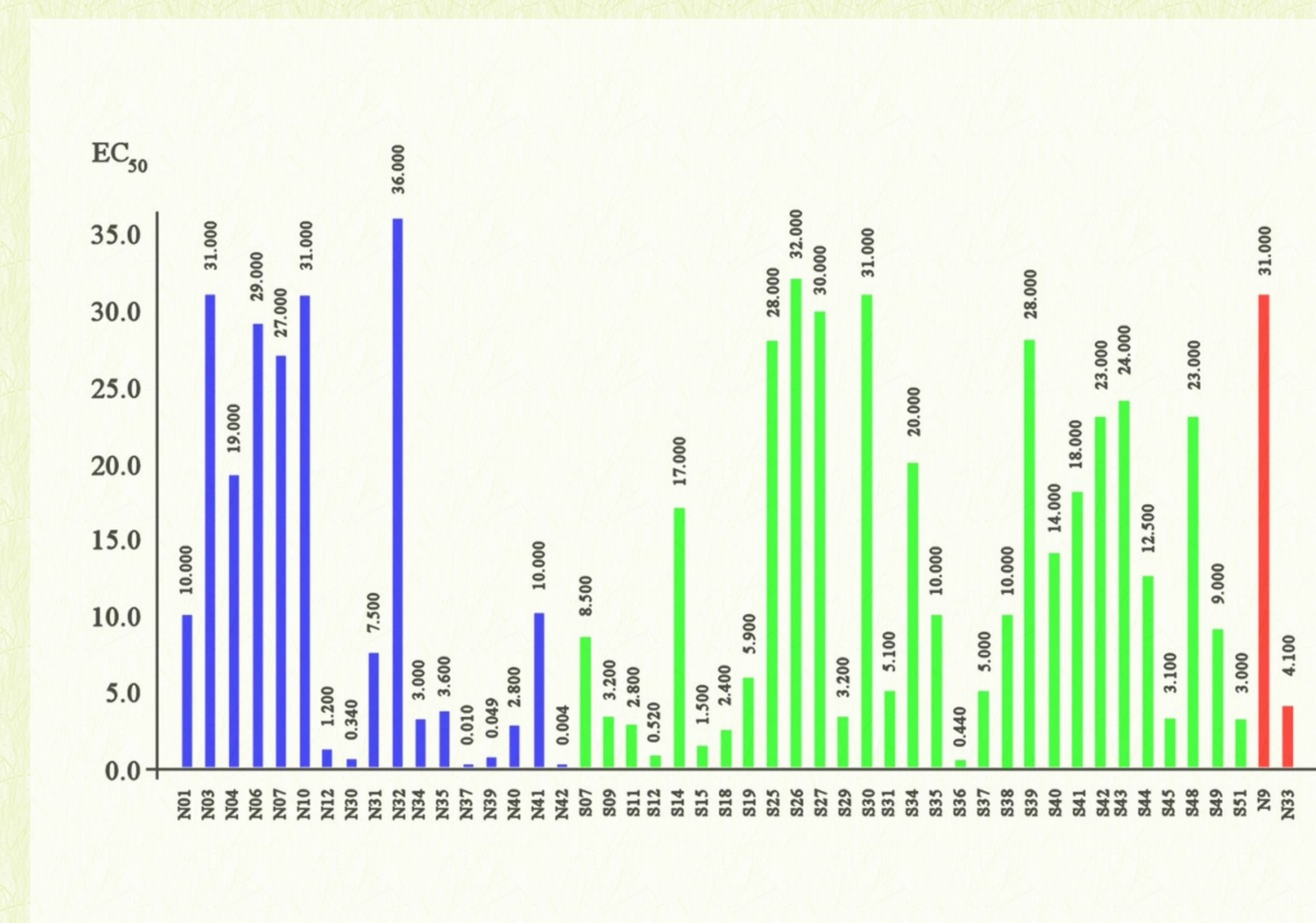
EC<sub>50</sub> values of individual isolates of *Ph. infestans* for cymoxanil (blue: isolates from untreated crop; red: 3 treatments; yellow: 4 treatments). In the fields where cymoxanil was used several isolates with increased tolerance or resistance (EC<sub>50</sub> > 5 ppm) were present. However, independence test did not show significant correlation between the number of treatments and the EC<sub>50</sub> values of the isolates ( $\chi^2 = 14.460$ ;  $P = 0.05$ ).



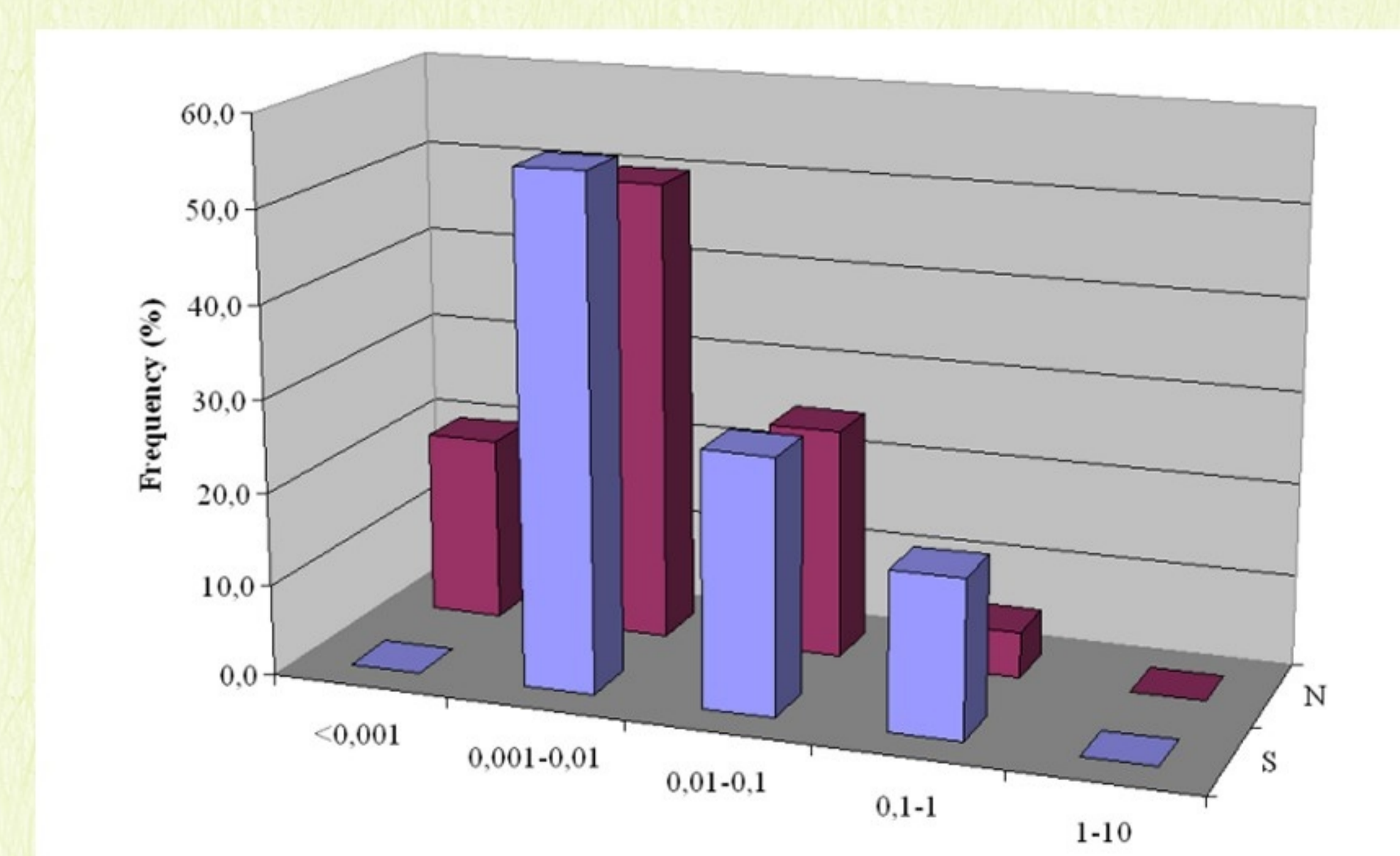
The *Ph. infestans* isolates tested were most sensitive to dimethomorph. EC<sub>50</sub> values for this fungicide were lower than 0.6 mg/L. No statistical difference was observed in distribution of EC<sub>50</sub> values between untreated and treated fields ( $\chi^2 = 8.139$ ;  $P = 0.05$ ). Blue: isolates from untreated crop; green: 2 treatments, red: 3 treatments.



Distribution of EC<sub>50</sub> values for azoxystrobin did not differ significantly between Nagy-kálló (purple) and Solt (blue) ( $\chi^2 = 8.139$ ;  $P = 0.05$ ).



EC<sub>50</sub> values of isolates for azoxystrobin ranged from 0.004 to 36.000 mg a. i. /L. Blue: isolates from untreated crop; green: 1 treatment; red: 3 treatments with QoI fungicides.



Distribution of EC<sub>50</sub> values for dimethomorph in two *Ph. infestans* populations. No significant difference occurred between the two sites sampled ( $\chi^2 = 8.139$ ;  $P = 0.05$ ). Purple: isolates from Nagy-kálló; blue: isolates from Solt.

The results suggest that the frequent application of cymoxanil may result in accumulation of highly tolerant/resistant isolates to this fungicide. This should be taken into consideration in the late blight management strategy. The lack of difference in EC<sub>50</sub> values for dimethomorph and azoxystrobin between the two locations suggests that the results may represent the whole *Ph. infestans* population in Hungary.