Bioassay for detecting the susceptibility of sugar beet to mesotrione residues in different soils

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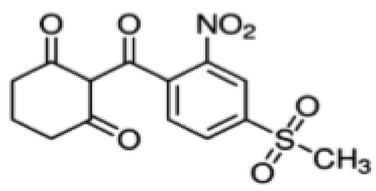
– INTRODUCTION –

Mesotrione is a p-hydroxyphenylpyruvate dioxygenase (HPPD)-inhibiting triketone herbicide. It is a non-persistent herbicide and is therefore presumably not phytotoxic for use in crop rotation. Although defined as non-persistent, mesotrione's persistence can vary depending on the soil's physicochemical properties and its residues can cause biological and economic damage to highly sensitive crops grown in rotation (Riddle et al., 2013).



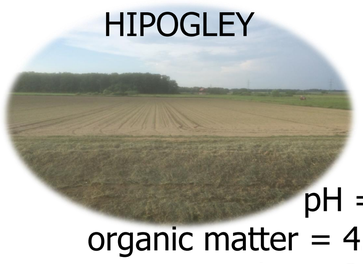
K_{oc}	p at 25 °C (mPa)	pK_a	S_w (mg l^{-1})	K_{ow}	DT_{50} (days)
122	5.70 x 10^{-3}	3.12	1500	0.1	5-15

– OBJECTIVES –

- to develop a rapid plant bioassay to accurately detect available mesotrione residues in soils that are injurious to sugar beet
- to determine the influence of physicochemical properties of soil on the susceptibility of sugar beet on mesotrione residues

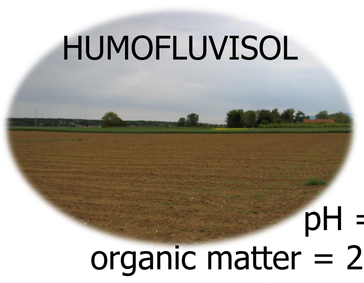
– MATERIAL AND METHODS –

HIPOGLEY



pH = 7.74
organic matter = 4.22 %
clay = 39.3 %
CEC = 33.8 cmol/kg

HUMOFLUVISOL



pH = 8.17
organic matter = 2.69 %
clay = 21.5 %
CEC = 21.8 cmol/kg

- soil samples were taken from untreated field
- soil sampling depth: 0 - 10 cm

- soil was sieved (5 mm) and left dried to room temperature for 72 hours

- 200 grams of dry soil were placed in plastic container and treated with herbicide solutions to achieve eight mass levels of mesotrione residues:

- soil was transferred to the pots and sown with six seeds of sugar beet
- the growing of sugar beet was conducted in a growth chamber

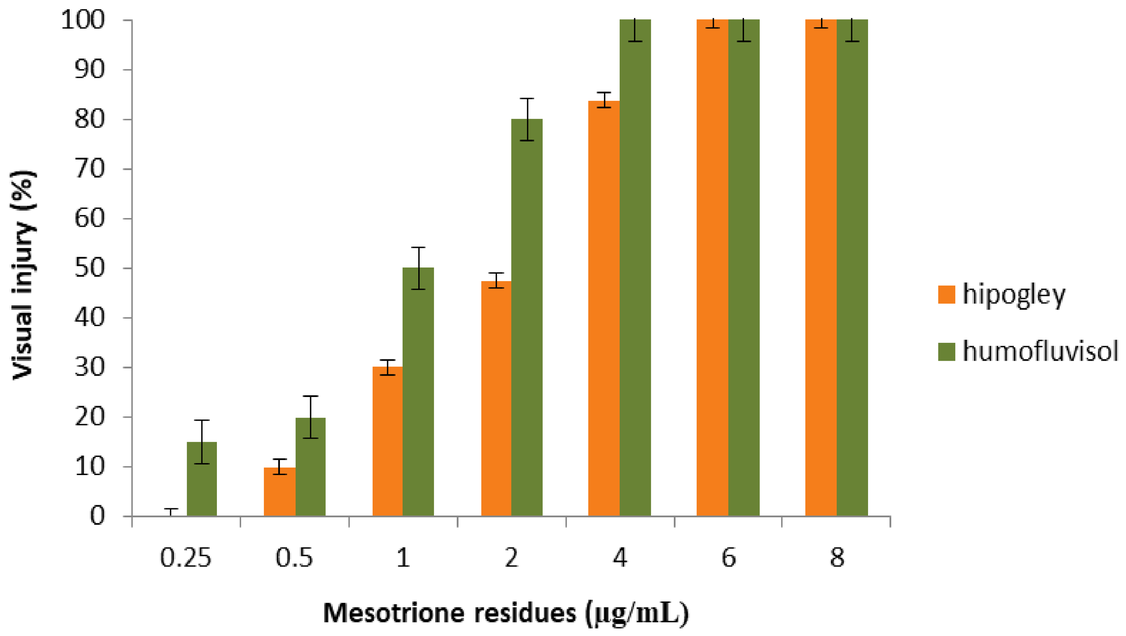
0; 0.25; 0.5; 1; 2; 4; 6 and 8 µg a.i. per 200 g of soil

MEASUREMENT PARAMETERS

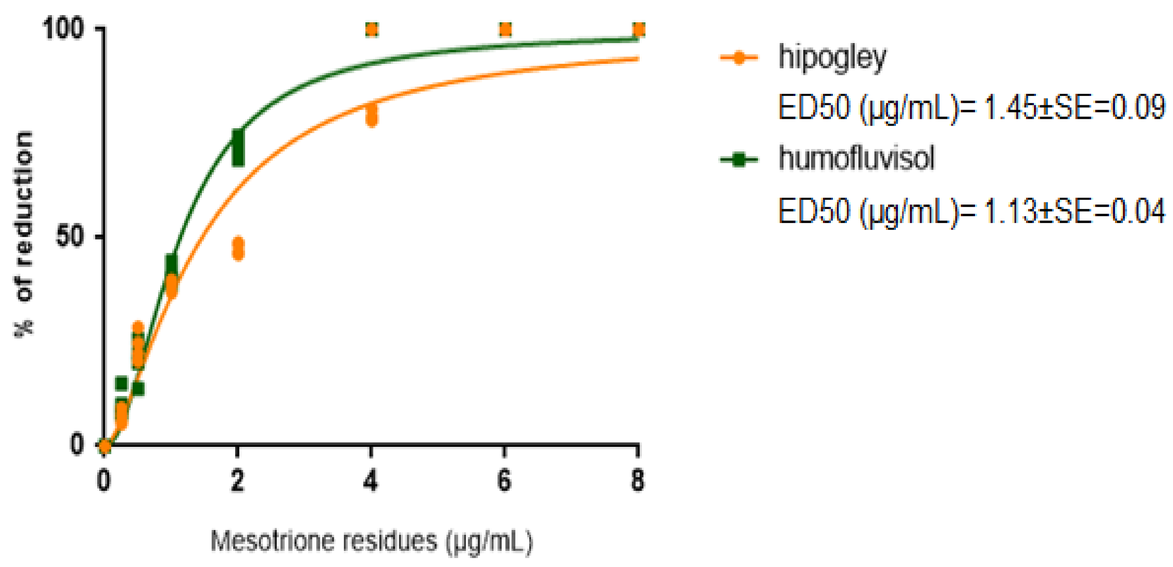
1. visual assessment (EPPO standard PP1/135 (4) Phytotoxicity assessment) at 7, 14 and 21 days after application (DAA) by using a scale 0 to 100 % (0 % = no effect and 100 % = plant death)
2. the fresh weight of sugar beet was determined on the 21st day
3. the total carotenoid content was determined by spectrophotometry

– RESULTS –

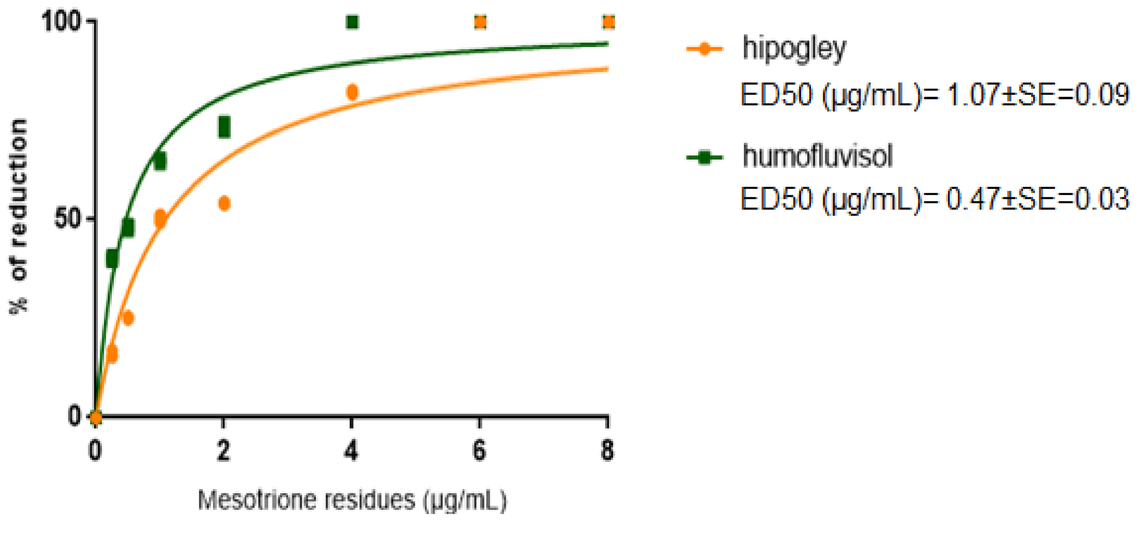
Graph 1. Visual injury (%) in sugar beet at 21 DAA



Graph 2. Effect of mesotrione residues on the reduction of fresh weight of sugar beet



Graph 3. Effect of mesotrione residues on the reduction of total carotenoids in sugar beet



– CONCLUSIONS –

- the highest visually evaluated phytotoxicity in both type of soils was determined 21 days after application
- the sugar beet plants were completely damaged at 4 µg and 6 µg of mesotrione in humofluvisol and hipogley soil, respectively
- the effective dose of mesotrione for 50 % reduction of sugar beet fresh weight (ED50) was 1.45 µg/mL in hipogley and 1.13 µg/mL in humofluvisol
- the ED50 for 50 % reduction of total carotenoids was 1.07 µg/mL in hipogley and 0.47 µg/mL in humofluvisol

– REFERENCES –

Riddle, R. N., O'Sullivan, J., Swanton, C. J., Van Acker, R. C. (2013). Field and Greenhouse Bioassays to Determine Mesotrione Residues in Soil. Weed Technology, 27: 565–572.