

P 508: Overview

Horsetail, *Equisetum arvense* L. has long been known in botanical folklore as having a preventive effect on fungal plant diseases. The traditional hot water extract from *E. arvense* has long been used by organic and biodynamic (as P508) farmers (Marchand, 2017). *E. arvense* water extract is intended to be used as plant strengthener and preventive treatment of pathogenic fungi. In this way, we are presenting some papers about the effect of the natural silica (silicic acid) used for the control of powdery mildews and fungal diseases in some cultures. *E. arvense* extract is a foliar stimulator of natural defenses and fungicide for use as a spring post-emergence treatment in all cultivars of grapevine and apple trees. In literature, the described mode of action would be based on the high percentage of silica in the plant that works on lowering the impact of moisture. Silicon would reduce the effects of excessive water around plants that would lead to fungus. It would also act as an activator of plant defense mechanisms. Silicon (Si) is a bioactive element associated with beneficial effects on mechanical and physiological properties of plants. Silicon alleviates abiotic and biotic stresses, and increases the resistance of plants to pathogenic fungi. *E. arvense* extract was also shown to possess a broad spectrum of a very strong antimicrobial activity against all tested strains. The radical scavenging activity of extracts significantly correlated with total phenolic content. The antimicrobial tests showed that ethyl acetate and n-butanol extracts inhibited the growth of tested bacteria.

Plant extracts recipe

The decoction is processed as follows: 200 g of the aerial part of *E. arvense* dry plant tissues are macerated in 10 l of water for 30 min (soaking) and then boiled for 45 min (Marchand, 2016). After cooling down, the decoction is filtrated with a fine sieve or more generally with a stocking and then further diluted by 10 with water. The solvent for extraction and preparation is water (spring water or rainwater) and the optimal pH is 6.5. Decoction is described in the implementing regulation (EU, 2014) and a further "Report Review" is available in EU pesticide database (Marchand, 2015).



Extract composition

The decoction contains **flavonoids** (0,6 to 0,9%) like apigenin-5-O-glucoside, genkwanin-5-O-glucoside, kaempferol-3,7-di-O-glucoside, kaempferol-3-O-(6'-O-malonyl-glucoside)-7-O-glucoside, kaempferol-3-O-sophoroside, luteolin-5-O-glucoside, quercetin-3-O-glucoside; **caffeic acid ester** (up to 1%) including chlorogenic acid, dicoffeoyl-meso-tartaric acid and **silicic acid** (5 to 7,7%) to some extent water soluble.

Extract	Proteins	Lipids + Sterols + Terpenes	Sugars + polyols	Ashes	Polyphenols	Total characterised After analysis
<i>E. arvense</i>	13 %	34 %	38 %	18 %	5 %	100%

Agriculture Uses as plant protection means

Field typical suitable concentration is 200 g of active ingredient (a.i.) hl⁻¹. The aqueous extract of horsetail as decoction is intended to be used in fields for plant protection on grapevines (Darnand, 2016) and apple trees and vegetable gardening to control diseases such as mildew, downy mildew and others caused by foliar fungi such as *Pythium* and *Alternaria* spp. Horsetail has long been known in the botanical tradition, organic and biodynamic (P508) agriculture as having a preventive effect on fungal diseases of plants. The effect is based on the high percentage of silica in the plant, which helps to reduce the impact of moisture. Silica would reduce the effects of excess water on plants that lead to the growth of fungi. *E. arvense* decoction shows anti sporulation activity (Marchand, 2016). It would also be an activator of the defense mechanisms of these plants (elicitor).

	Maturation period for winter eggs (locations)						Time gained with Horsetail treated	Easter day (Sunday)	Date of application Horsetail decoction
	Arlay control	Arlay Horsetail	Vernois control	Vernois Horsetail	Montaigu control	Montaigu Horsetail			
2011				13-Apr.	13-Apr.	>27-Apr.	> 7 days	24-Apr.	20-Apr.
2012				10-Apr.	13-Apr.	16-Apr.	3 days	08-Apr.	5-Apr.
2013				21-Apr.	23-Apr.	02 - 06-May	9 - 13 days	31-March	27-March
2014	10-Apr	10-Apr	07-apr	7-Apr.	23-Apr.	23-Apr.	0 day	21-Apr.	3-Apr.

Fig. 1. Effects on mildew: Gain (in days) without recovery in vineyards with horsetail decoction treatment.

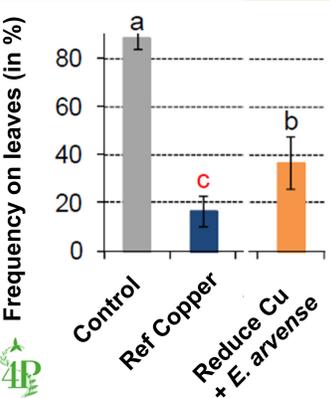


Fig. 4. Reduction of mildew on leaves with *E. arvense* decoction treatment with reduced copper dose compare to full copper dose treatment.

The aqueous extract of horsetail (*E. arvense* decoction) was used in fields for plant protection on grapevines to control diseases such as mildew, downy mildew. This example shows moderate effect of *E. arvense* decoction treatment with reduce copper quantities.

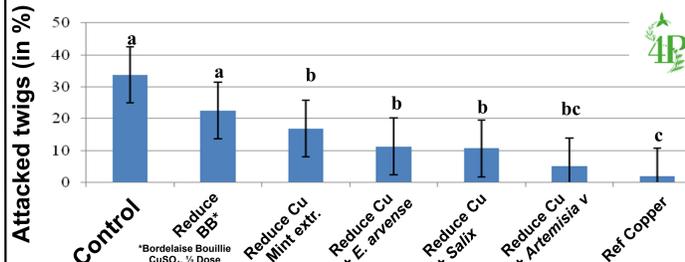


Fig. 5. Effectiveness of plant extracts with reduced (1/2) copper dose.

Mode of action

Efficiency of P508 preparation is often tested in different trials, *in vitro*, *in vivo* and *in campo*. *In vitro*, we established that efficacy may be due to anti-sporulant properties of the extract as germination of spores of mildew may be temporarily stopped by addition of the *E. arvense* extract (Marchand, 2016). *In vivo*, treated foliar discs show protection from inoculation. In fields (*in campo*), potential efficiency of P508 is measured by the delay of mildew re-infestation in vineyards (Darnand, 2016).

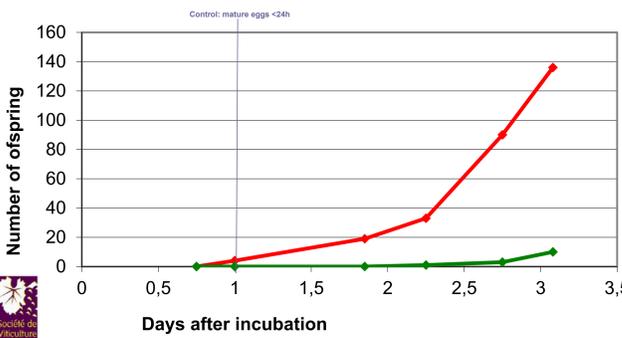


Fig. 2. Evolution of mildew spores maturation in spring (in number of mature eggs) - Lot 2 (23/04/13)
Legend: control —, horsetail treated —

Action/effect	<i>E. arvense</i> decoction
Anti germinative	effective
Anti sporulant	effective
Curative	none
Preventive	mild

Fig. 3. *In vitro* effect of *E. arvense* decoction against mildew spores versus different Mode Of Action

Horsetail: Environmentally friendly extract

The aqueous extract of horsetail shows almost no effect on aquatic organisms: EC50 (*Daphnia pulex*) = 55 mg/mL and EC50 (*Artemia salina*) = 8.9 mg/mL compare to chemicals (< 0,05 mg/mL).

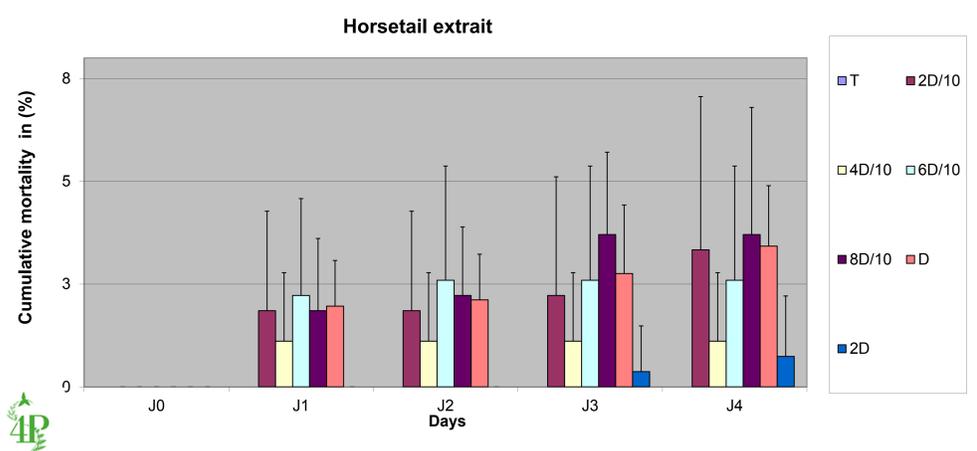


Fig. 3. Cumulative bee mortality exposed to horsetail extract

Legend: T = control, D = normal dose, 2D/10, 4D/10, 6D/10, 8D/10 = diluted doses, 2D = double dose

Conclusion

Horsetail (*E. arvense*) decoction, useful in organic and biodynamic (P508) agriculture is the first biodynamic preparation allowed at the general EC 1107/2009 phytopharmaceutical regulation. Our work during the 4P program for assessing the efficacy of diverse plant extract demonstrated the usefulness of biodynamic preparations. Applications in order to legalize them were submitted accordingly.

References

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