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GERMINATION OF WEED SPECIES FROM *ASTERACEAE* FAMILY UNDER WATER DEFICIT CONDITIONS

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Introduction

Water is a basic requirement for germination. It is essential for enzyme activation, breakdown, translocation and use of reserve storage material (COPELAND and MCDONALD 1995). The availability of water is possible to express by means of soil water potential (SWP). Together with temperature, SWP belongs to the primary ecological regulators of seed germination (ALVARADO and BRADFORD 2002). According to SPRINGER (2005) is seed germination and seedling growth reduced as the water deficit potentials increased.

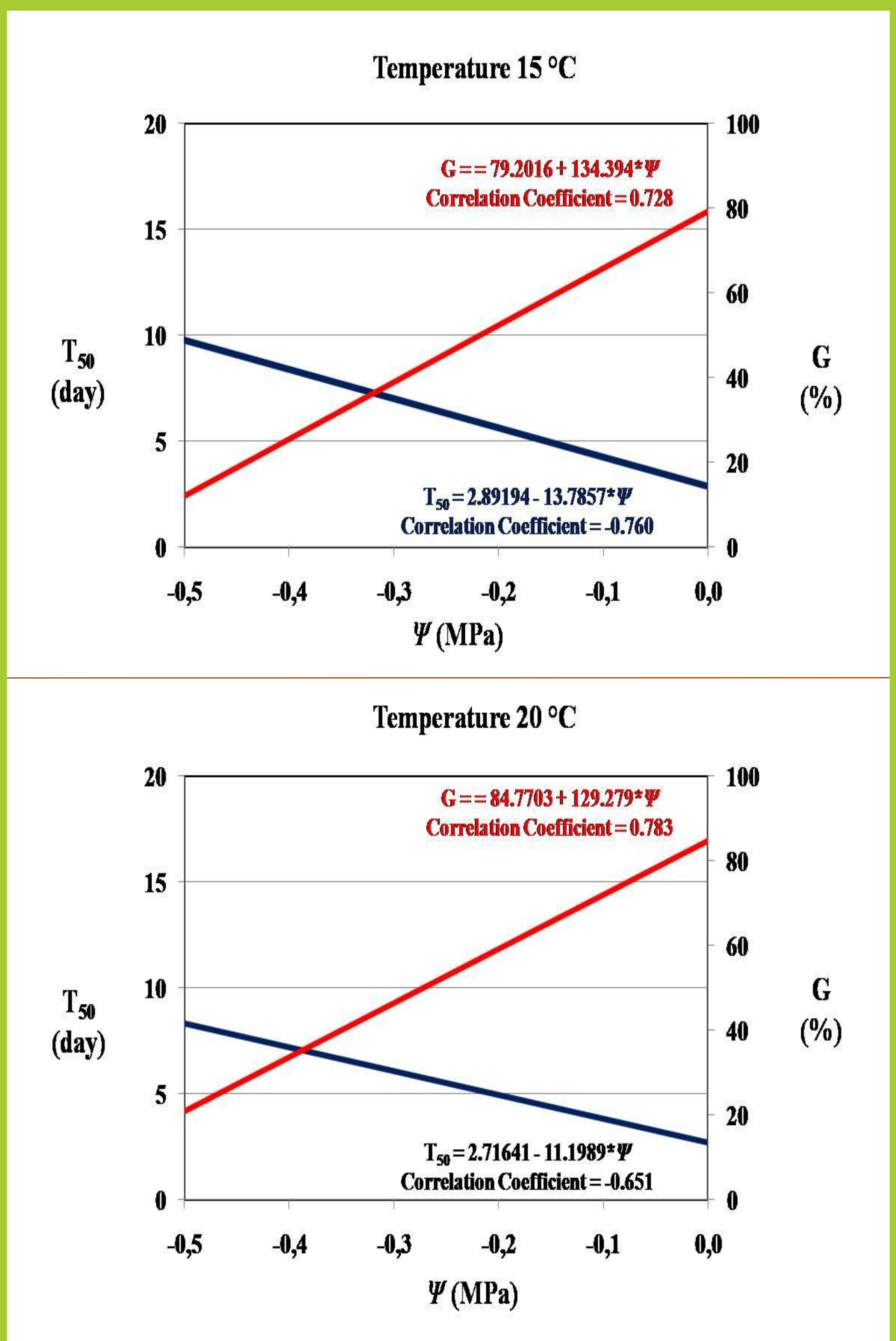

Fig. 1: Regression analysis for relationship between germination of achenes (G, %, linear model) and values of T_{50} (day, exponential model, R^2 – regresion coefficient) and water potential (*Ψ*, MPa), at temperatures of 15 and 20 °C for all tested species.

Materials and methods

In 2006 and 2007, the influence of water deficit conditions and different temperatures on germination of seeds from *Asteraceae* was observed in laboratory conditions. The achenes germination of *Arctium tomentosum* Mill. (ARFTO), *Artemisia vulgaris* L. (ARTVU), *Conyza canadensis* (L.) Cronquist (ERICA), *Galinsoga parviflora* Cav. (GASPA), *Lactuca serriola* L. (LACSE), *Senecio vulgaris* L. (SENVU), *Sonchus asper* (L.) Hill (SONAS), *Sonchus oleraceus* L. (SONOL), *Taraxacum sect. Ruderalia* (TAROF) and *Tripleurospermum inodorum* (L.) Schultz-Bip. (MATIM) was monitored. Achene collection was carried out in summer and autumn 2006. Water stress was simulated by means of polyethylenglycol solutions (PEG 6000) corresponding with values of water potential (*Ψ*, MPa) -0.05 MPa, -0.1 MPa and -0.5 MPa. Germination proceeded in climatic chamber with 16 h light period at temperatures 10, 15 and 20°C. Determination of real germination (%) and calculation of achene estimated germination in period under consideration for individual species and at defined values of *Ψ* was the result of experiment. For calculation of estimated germination was used modified algorithm according to NIELSEN *et al.* (2004):

$$y = c + \frac{d - c}{1 + e^{(-b * (\ln x - \ln T_{50}))}}$$

where *y* is estimated germination (%), *c* and *d* are coefficients corresponding with lower and upper limit, T_{50} is time (days), when germination is in inflection point between lower and upper limit (i.e. corresponds to 50 % of germinated achenes), *b* is parameter of slope and *x* is independent variable – germination (%). For calculation of estimated value of germination *y* and parameter T_{50} was used programme R, version 2.2.1. Statistical evaluation was carried out by means of programme STATGRAPHICS®Plus, version 4.0, method ANOVA according to Tukey (α = 0.05) and Simply Regression.

Results

By realized experiments, there was proved the influence of lower water availability on decrease of achene germination of assessed species from *Asteraceae*. The lowest values of germination were determined at values *Ψ* = -0.5 MPa in all temperature regimes. Germination of *S. asper, G. parviflora* and *L. serriola* at *Ψ* = -0.5 MPa exceeds value 50 % at temperature 20°C. Temperature decrease to 15°C reduced achene germination at *Ψ* = -0.5 MPa and in decrease to 10°C in this PEG 6000 concentration achenes already almost didn't germinate (Table 1). From figure 1 is evident dependence of achene germination and values of T_{50} (for evaluation were included all assessed species) on water availability expressed by means of *Ψ*. There was used linear regression for assessment of dependence of achene germination on *Ψ* from 0 to -0.5 MPa. From figure 1 is also noticeable that with increase of water availability achene germination also increases and T_{50} decreases.

Tab. 1: Germination of achenes (G, %) and values of T_{50} (day) in different values of water potential (*Ψ*, MPa) and temperature (°C)

Species		Temperature (°C)														
		10					15					20				
		Ψ (MPa)														
		0	-0.05	-0.1	-0.5	+/- limits	0	-0.05	-0.1	-0.5	+/- limits	0	-0.05	-0.1	-0.5	+/- limits
ARFTO	G (%)	0	0	0	0		24.5	4.0	2.0	0	***13.0***	88.5	69.0	24.0	4.5	***20.0***
	T_{50}(day)	-	-	-	-	-	6.9	7.6	11.3			5.0	5.7	6.4	19.0	
ARTVU	G (%)	36.0	10.0	3.5	0.5	***18.3***	82.0	64.0	56.0	2.0	***23.2***	76.5	80.5	64.0	18.5	***19.3***
	T_{50} (day)	7.0	-	-	-		3.1	4.0	5.4	8.7		1.8	2.2	3.2	6.6	
ERICA	G (%)	61.5	27.0	18.5	0.0	***19.0***	77.5	70.5	52.5	8.5	***17.1***	82.0	81.5	60.5	41.0	***28.3***
	T_{50} (day)	5.2	-	-	-		3.2	3.1	3.5	8.3		1.6	1.9	3.5	5.6	
GASPA	G (%)	95.0	94.0	85.0	0.0	***18.9***	95.5	95.5	84.0	17.5	***19.1***	96.5	94.0	78.5	58.5	***32.6***
	T_{50} (day)	5.9	-	-	-		3.1	4.0	5.4	8.7		3.1	4.4	5.0	6.5	
LACSE	G (%)	99.0	94.0	82.5	0.0	***19.1***	99.5	99.0	96.5	14.0	***16.7***	99.0	98.5	79.0	51.0	***39.4***
	T_{50} (day)	1.9	-	-	-		0.9	1.6	3.1	10.6		1.4	1.5	4.2	8.3	
SENVU	G (%)	74.5	58.5	45.5	1.0	***18.3***	73.0	74.5	67.0	17.5	***15.9***	72.5	68.5	67.5	15.5	***20.8***
	T_{50} (day)	4.6	-	-	-		2.2	2.6	3.5	9.1		1.7	2.1	3.1	6.0	
SONAS	G (%)	92.5	75.0	74.0	3.0	***20.5***	98.0	95.5	81.0	22.0	***22.9***	99.5	96.0	74.0	60.0	***35.0***
	T_{50} (day)	6.3	-	-	-		2.1	4.2	6.3	18.7		2.5	5.1	7.5	10.8	
SONOL	G (%)	98.0	81.0	24.0	0.0	***28.7***	96.0	89.5	85.5	6.5	***24.8***	96.0	93.0	61.0	22.0	***26.5***
	T_{50} (day)	5.7	-	-	-		2.6	4.6	6.1	12.7		2.3	4.2	5.4	11.4	
TAROF	G (%)	77.8	65.0	62.8	0.5	***18.3***	72.0	69.5	67.5	8.5	***14.0***	73.0	84.5	71.5	19.5	***13.9***
	T_{50} (day)	4.3	-	-	-		2.9	3.5	3.9	10.5		2.3	2.6	3.6	6.7	
MATIM	G (%)	69.0	57.0	54.5	6.0	***20.6***	69.0	69.5	65.5	22.0	***20.0***	76.5	74.5	59.0	44.0	***23.1***
	T_{50} (day)	4.5	-	-	-		2.1	2.5	3.3	7.7		1.2	1.8	3.1	6.7	
+/-limits	*G (%)*	***20.9***	***25.3***	***29.1***	***5.3***		***22.7***	***18.7***	***30.7***	***21.8***		***19.8***	***21.7***	***36.3***	***31.9***	

Discussion

In terms of accomplished experiments was proved hypothesis about ability of achenes from *Asteraceae* to germinate in conditions of water deficit. Herewith, in accordance with literature data was confirmed the influence of water deficit on decrease of seed germination (ALVARADO and BRADFORD 2002; BRANT *et al.* 2005). On the basis of determination of achene germination at 10°C and value *Ψ* = -0.5 MPa germinated most achenes of *T. inodorum*. Ability of these achenes to germinate at these conditions is probably caused by species biology, because it is typical winter species. That's why achenes has to be able to germinate also in late autumn at low temperatures and at possible low availability of water in soil. Good germination of achenes of *G. parviflora*, *S. vulgaris*, *S. asper* and *S. oleraceus* in conditions of water deficit proved adaptability of these species on natural field conditions in which start to present their selves. They are weeds which dominate to weed spectrum of late sawn crops. Thus, they germinate at higher temperatures of soil and often at water deficit. In majority of assessed achenes were determined low values of T_{50} at good water availability. In relation to climatic changes and thus also to lack of precipitation during vegetation, in term of good achene germination at water deficit in ambient, these species can become dominant components of weed spectrum of agrophytocenoses on drier localities. With higher occurrence of source of weediness of these species at non-agricultural soil (first of all species with long distant of achenes) is possible to expect secondary weediness of crops weakened before harvesting (especially at higher precipitation activity in summer period following after dry beginning of vegetation) or in early sown catch crops. For the future, there is possible to focus on explaining of mutual influence of temperature and water availability in ambient on dynamic of germination of other weed seeds. It can be expressed e.g. by T_{50} values with a view to optimalization of control methods of weediness. This knowledge should contribute to determination of proper term of herbicide application and assessment of adequate type of application (pre-emergent, post-emergent) and to good choice of herbicide.


Achenes of *Lactuca serriola*


Achenes of *Arctium tomentosum*


Achenes of *Artemisia vulgaris*


Achenes of *Tripleurospermum inodorum*


Achenes of *Galinsoga parviflora*

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