THE EFFECT OF ALGINATE PREPARATIONS FOR FORMATION OF ABOVE-GROUND ORGANS OF ALFALFA (*MEDICAGO SATIVA* L.) IN THE FIRST YEAR OF VEGETATION

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Alfalfa (*Medicago sativa* L.), variety Zuzana, was sown into 12 l pots in spring and summer season into freely poured clay-loam soil from degraded chernozem (reduced bulk density Or = 0.95–0.98 $g.cm^{-3}$) or with soil artificially compacted to Or = 1.28–1.34 $g.cm^{-3}$. Alginate preparations S-90 and Micro-mist were applied on seed (10 $ml.kg^{-1}$) or on the leaf at the stage of 4-6 right leaves (22 $ml.l^{-1}$). Length and thickness of stems, number of leaves, branches and stems per 1 plant, weight of 1 stem were measured. Soil compaction significantly decreased length of stems (on average by 8–31%), thickness of stems (by 3.5–13.5%), leafiness (by 5–17%), branching (by 41.2%) and weight of stems (by 14.6%), particularly in earliest phases of the plant development. The effect of alginates was more significant in summer sowings and on compacted variant. Seed treatment by preparations Micro-mist and S-90 increased length of stems on average by 7.5% and 10.7%, thickness of stems by 2.3% and 9% and number of leaves by 17 and 30%. The effect did not occur in non-compacted variant. The effect of foliar spraying on different indicators was not proved. Alginates had negative effect in some cases.

alfalfa; alginates; seed treatment; foliar application; length and number of stems; thickness of stems; weight of stems; branching of stems; leafiness

INTRODUCTION

A prerequisite of favourable yields, sufficient stability and at the same time preservation of weedless state of alfalfa stands above all is a suitable method of establishment including treatment at the beginning of plant development. Economic situation leading many years to limiting of inputs into fertilizers and pesticides requires searching for alternative ecological methods of culti-

vation of field crops, not except forage crops. The use of extracts from sea algae – alginates in plant production, production and ornamental horticulture has been tested in the CR since the middle of the 1980s, in the USA it is dealing with almost 40 years. Alginates, applied on seed, plant cuts or leaf, act on plants by the contents of plant hormones and microelements in active forms. They were tested on many crops, e.g. on white clover (Goh, Whitton, 1975), wheat (Mooney, Staden, 1985; Becket, Staden, 1990) or barley (Featonby-Smith, Staden, 1987). Their effect on emergence of alfalfa (Šantrůček, Svobodová, 1995) under different soil conditions (Šantrůček, Svobodová, 1996) and on emergence of grass seeds (Svobodová, Cholenský, 1997; Svobodová, Šantrůček, 1998) were researched in our department.

MATERIAL AND METHOD

Pot trials were established in the volary of the glasshouses of AF of Czech University of Agriculture in Prague. Alfalfa (*Medicago sativa* L.), variety Zuzana, was sown in spring and summer period into 12 l plastic pots with freely poured clay loam soil from degraded chernozem (reduced bulk density after compaction Or = 0.95–0.98 $g.cm^{-3}$) or into artificially compacted soil on Or = 1.28–1.34 $g.cm^{-3}$ into 10 mm depth. The number of plants was reduced to 50 plants per pot at the stage of 2 right leaves. Alginate preparations S-90 (manufactured by Bioalgeen Schulze and Hermsen GmbH – representative in CR Bioalva Praha) and Micro-mist (Castle International) were used to treat the seed before sowing (10 $ml.kg^{-1}$ of seed) or applied on the leaf at the stage of 4–6 right leaves (22 $ml.l^{-1}$). The length and thickness of stems, number of leaves, branches and stems per 1 plant, weight of 1 plant were investigated. The trials had four replications and results were evaluated by variance analysis by the program Statgraphics.

RESULTS AND DISCUSSION

Reduced soil bulk density in pots with freely poured, naturally settled soil corresponded to optimum values for emergence of alfalfa plants. In the pots with soil artificially compacted Or ranged from 1.28 to 1.34 $g.cm^{-3}$ what are the values less suitable for emergence and initial development of alfalfa. A lot of our previous trials showed that for emergence and initial development of alfalfa the most suitable Or is 0.98–1.16 $g.cm^{-3}$ (Svobodová, Šantrůček, 1989). Soil compaction significantly reduced length of stems (on

average by 8-31%), thickness of stems (by 3.5–13.5%), eventually leafiness (by 5–17%) particularly in earliest phases of plant development (first sampling of spring and summer sowing).

The effect of application of alginate preparations on the length of stems, their thickness and number of leaves per 1 stem is presented in Table I. It was more manifested on compacted variants. Similar results were obtained in our previous trials (Šantrůček, Svobodová, 1995), where the effect of any method of application of alginate preparations was also manifested more significantly only under less favourable conditions for the growth of plants. In the variants where the seed treated with the preparations Micro-mist and S-90 was applied the length of stems was greater by 7.5 and 10.7% than in the control, the thickness of stems by 2.3 and 9% and number of leaves by 17 and 30%. Differences in different values were significant in many cases (Table II), particularly in the preparation Micro-mist. This effect was not manifested on non-compacted variant. The effect of foliar spraying as exerted on different parameters was not proved. Increase in length and thickness of stems, eventually leafiness was recorded mainly in summer sowings on compacted as well as on non-compacted soil. However, on the contrary the investigated values (particularly length of stems) were lower than in untreated variant in different cases.

The number of stems per 1 plant (Table III), the same like the number of branches per 1 stem (Table IV) was with exceptions (first sampling on non-compacted soil) significantly higher when treated seed or foliar application was applied than on untreated control. Differences were marked mainly in summer sowings on compacted variant what well corresponded with very significant decrease in the number of branches per 1 plant due to soil compaction (by 41.2% compared with non-compacted variant). Weight of 1 stem (Table III) was lower on average by 14.6% on compacted variants than in the plants growing in soils with lower Or. Positive effect of both methods of application of preparations on the weight of stems due to their better leafiness was more apparent in later summer sowings where plants grew under generally worse vegetation conditions. Here the effect of alginates was also more marked in the variants with stronger compacted soil where after foliar application (concentration recommended by manufacturer is 22 $ml.l^{-1}$) weight of stems increased in the first two months after emergence of the stand in some cases even by 44.3% (on average over all measurements by 9.2–9.9%), after seed treatment even by 84.6% (on average by 21.7–37.3%). There were also some cases where particularly foliar application, above all the preparation S-90, had negative impacts on the growth of plants. Other authors came to similar results which followed from our experiments. For example Goh and Whitton (1975) did not find significant difference of the effect of appli-

I. Length and thickness of stems, number of leaves per 1 stem

Compaction	Treatment		Length of stems (mm)			Thickness of stems (mm)			Number of leaves per 1 stem		
			spring sowing		summer sowing	spring sowing		summer sowing	spring sowing		summer sowing
			first sampling	second sampling	first sampling	first sampling	second sampling	first sampling	first sampling	second sampling	first sampling
Non-compacted	control		235.8	241.2	184.7	1.77	1.62	1.07	10.07	13.73	9.36
	seed treatment	M-M	229.9	267.4	193.5	1.76	1.78	1.13	9.48	15.07	9.99
		S-90	224.3	257.1	186.4	1.68	1.64	1.09	10.07	15.77	9.25
	spraying	M-M	216.0	225.3	207.1	1.69	1.59	1.13	9.83	13.68	10.90
		S-90	200.8	203.4	209.5	1.66	1.56	1.13	9.18	13.17	11.36
Compacted	control		152.8	217.3	169.6	1.49	1.64	1.00	7.94	12.78	8.10
	seed treatment	M-M	176.6	224.4	191.9	1.56	1.68	1.20	10.13	14.52	12.11
		S-90	147.5	259.0	180.9	1.47	1.66	1.07	8.04	16.26	9.92
	spraying	M-M	133.0	215.7	186.5	1.36	1.72	1.09	6.79	13.26	9.69
		S-90	155.8	234.9	169.7	1.51	1.56	1.00	7.75	14.18	8.54
Non-compacted	average		221.5	238.9	195.9	1.71	1.64	1.11	9.73	14.29	10.14
Compacted			152.8	229.2	179.8	1.48	1.66	1.07	8.10	14.11	9.63
Average	control		194.5	228.3	177.3	1.63	1.63	1.04	9.01	13.22	8.74
	seed treatment	M-M	203.4	244.8	192.7	1.67	1.73	1.17	9.80	14.78	11.02
		S-90	187.4	258.0	183.9	1.57	1.65	1.08	9.09	16.01	9.56
	spraying	M-M	171.7	220.1	196.3	1.51	1.66	1.11	8.21	13.45	10.27
		S-90	176.9	220.1	190.2	1.58	1.56	1.07	8.42	13.71	9.99

M-M = Micro-mist

II. Length of stems, thickness of stems and number of leaves per 1 stem (relatively – control = 100%)

Compaction	Treatment		Length of stems (mm)			Thickness of stems (mm)			Number of leaves per 1 stem		
			spring sowing		summer sowing	spring sowing		summer sowing	spring sowing		summer sowing
			first sampling	second sampling	first sampling	first sampling	second sampling	first sampling	first sampling	second sampling	first sampling
Non-compacted	control		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	seed treatment	M-M	97.5	110.9	104.8	99.4	109.9	105.6	94.1	109.8	106.7
		S-90	95.1	106.6	100.9	94.9	101.2	101.9	100.0	114.9	98.9
	spraying	M-M	91.6	93.4	112.1	95.5	98.1	105.6	97.6	99.6	116.5
		S-90	85.2	84.3	113.4	93.8	96.3	105.6	91.2	95.6	121.4
Compacted	control		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	seed treatment	M-M	115.6	103.3	113.1	104.7	102.4	120.0	127.6	113.6	149.5
		S-90	96.5	119.2	106.7	98.7	101.2	107.0	101.3	127.2	122.5
	spraying	M-M	87.0	99.3	110.0	91.3	104.9	109.0	85.5	103.8	119.1
		S-90	102.0	108.1	100.1	101.3	95.1	100.0	97.6	111.0	105.4
Non-compacted	average		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Compacted			69.0	95.9	91.8	86.5	101.2	96.4	83.2	98.7	95.0
Average	control		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	seed treatment	M-M	104.6	107.2	108.7	102.5	106.1	112.5	108.8	111.8	126.1
		S-90	96.3	113.0	103.7	96.3	101.2	103.8	100.9	121.1	109.4
	spraying	M-M	88.3	96.4	110.7	92.6	101.8	106.1	91.1	101.7	117.5
		S-90	91.0	96.4	107.3	96.9	95.7	96.4	93.5	103.7	114.3

Bold are the values statistically significantly different from the control (alpha = 0.05)

III. Number of stems and their weight

Compaction	Treatment		Number of leaves per 1 stem		Weight of 1 stem (g)		
			spring sowing		spring sowing		summer sowing
			first sampling	second sampling	first sampling	second sampling	first sampling
Non-compacted	control		1.112	1.121	0.235	0.273	0.115
	seed treatment	M-M	1.048	1.100	0.221	0.335	0.131
		S-90	1.420	1.129	0.200	0.294	0.117
	spraying	M-M	1.050	1.280	0.206	0.263	0.136
		S-90	1.143	1.167	0.184	0.243	0.147
Compacted	control		1.008	1.042	0.132	0.259	0.088
	seed treatment	M-M	1.008	1.205	0.156	0.284	0.162
		S-90	1.085	1.116	0.130	0.305	0.131
	spraying	M-M	1.230	1.134	0.110	0.264	0.127
		S-90	1.089	1.162	0.151	0.270	0.096
Non-compacted	average		1.077	1.157	0.209	0.281	0.129
Compacted			1.085	1.148	0.135	0.275	0.121
Average	control		1.058	1.077	0.183	0.265	0.102
	seed treatment	M-M	1.028	1.153	0.189	0.308	0.146
		S-90	1.063	1.123	0.166	0.299	0.123
	spraying	M-M	1.142	1.255	0.153	0.263	0.131
		S-90	1.114	1.164	0.166	0.258	0.122

Compaction	Treatment		Number of leaves per 1 stem		Weight of 1 stem (g)		
			spring sowing		spring sowing		summer sowing
			first sampling	second sampling	first sampling	second sampling	first sampling
Relatively (control = 100%)							
Non-compacted	control		100.0	100.0	100.0	100.0	100.0
	seed treatment	M-M	94.2	98.1	94.0	122.7	113.9
		S-90	93.7	100.7	85.1	107.7	101.7
	spraying	M-M	94.4	114.2	87.7	96.3	118.3
		S-90	102.8	104.1	78.3	89.0	127.8

Continuation of Tab. III

Compacted	control		100.0	100.0	100.0	100.0	100.0
	seed treatment	M-M	100.0	115.6	118.2	109.7	184.1
		S-90	107.6	107.1	98.5	117.8	148.9
	spraying	M-M	122.0	118.4	83.3	101.9	144.3
		S-90	108.0	111.5	114.4	104.2	109.1
Non-compacted	average		100.0	100.0	100.0	100.0	100.0
Compacted			100.7	99.2	64.6	97.9	93.8
Average	control		100.0	100.0	100.0	100.0	100.0
	seed treatment	M-M	96.5	107.1	103.3	116.2	143.1
		S-90	100.5	104.3	90.7	112.8	120.6
	spraying	M-M	107.9	116.5	83.6	99.2	128.4
		S-90	105.3	108.1	90.7	97.4	119.6

IV. Number of branches per 1 stem (relatively control = 100 %)

Compaction	Treatment		Sowing		
			spring		summer
			first sampling	second sampling	
Non-compacted	control		100.0	100.0	100.0
	seed treatment	M-M	78.7	157.4	115.3
		S-90	84.0	124.5	107.0
	spraying	M-M	78.7	121.3	131.2
		S-90	88.3	119.1	142.6
Compacted	control		100.0	100.0	100.0
	seed treatment	M-M	276.7	151.7	876.9
		S-90	180.0	136.0	619.6
	spraying	M-M	90.0	167.4	444.6
		S-90	193.3	103.4	369.6
Non-compacted	average		100.0	100.0	100.0
Compacted			63.3	100.0	58.8
Average	control		100.0	100.0	100.0
	seed treatment	M-M	127.9	154.9	211.8
		S-90	109.8	130.8	171.9
	spraying	M-M	78.7	146.2	170.6
		S-90	114.8	111.0	171.0

cation of foliar preparations in white clover as exerted on its growth and yield. A lot of authors report in congruency with our results that a positive effect in various crops is significantly manifested only under stress conditions as a consequence of deficiency of nutrients in wheat (Becket, Staden, 1990), deficiency of water in the same crop (Mooney, Staden, 1985) etc. Micro-mist was more efficient preparation in our trials compared with both preparation at the beginning of plant development.

With respect to their price and results obtained we recommend application of preparations on seed, particularly under prerequisite of worse growth conditions, soil compaction, summer sowings etc. However, the results obtained are not fully unambiguous in all cases. The use of alginate preparations, the same like other growth stimulators, is connected with a great risk of low returnability of invested finance, because their influence depends on many other, hardly controllable factors in agricultural practice.

References

BECKET, R. P. – STADEN, J. C., VAN: The effect of seaweed concentrate on the yield on nutrient stressed wheat. Bot. Mar., *33*, 1990: 147–152.

FEATONBY-SMITH, B. C. – STADEN, J. C., VAN: Effect of seaweed concentrate on grain yield in barley. S. Afr. J. Bot., *53*, 1987: 125–128.

GOH, K. M. – WHITTON, J. S.: Kelp extracts as fertilizer II. Effect of chemical composition and elemental uptake of white clover. N. Z. J. Sci., *18*, 1975: 391–403.

MOONEY, P. A. – STADEN, J. C., VAN: Effect of seaweed concentrate on the growth of wheat under conditions of water stress. S. Afr. J. Sci., *81*, 1985: 632–633.

SVOBODOVÁ, M. – CHOLENSKÝ, J: Použití alginátových přípravků k ovlivnění vzcházivosti trav (The use of alginate preparations to affect emergence rate of grasses). In: Proc. Conf. Zamyšlení nad rostlinnou výrobou (Thoughts over plant production), ČZU Praha, 9. 12. 1997: 246–249

SVOBODOVÁ, M. – ŠANTRŮČEK, J.: Počáteční vývin vojtěšky po jarním výsevu u odrůd Palava a Rambler ve vztahu ke zhutnění půdy (Starting development of alfalfa after spring sowing in varieties Palava and Rambler in relation to soil compaction). Sbor. VŠZ v Praze, Fak. Agron., Řada A, *51*, 1989: 251–270.

SVOBODOVÁ, M. – ŠANTRŮČEK, J.: Vliv alginátového preparátu S-90 na vzcházení vybraných druhů trav (The effect of alginate preparation S-90 on emergence of selected grass species). Rostl. Výr., *44*, 1998: 525–528.

ŠANTRŮČEK, J. – SVOBODOVÁ, M.: Vliv aplikace alginátových preparátů (Micro-mist a S-90) na vzcházení a počáteční vývin vojtěšky seté (The effect of alginate preparations /Micro-mist and S-90/ on emergence and starting development of alfalfa development). In: Proc. Int. Conf., České Budějovice, 29.–31. 8. 1995: 221–232.

ŠANTRŮČEK, J. – SVOBODOVÁ, M.: Alginány a vzcházení vojtěšky (Alginates and emergence of alfalfa). Úroda, *3*, 1996: 32–33.

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ŠANTRŮČEK, J. – SVOBODOVÁ, M. (Česká zemědělská univerzita, Agronomická fakulta, katedra pícninářství, Praha, Česká republika):

Vliv alginátových přípravků na utváření nadzemních orgánů vojtěšky seté (*Medicago sativa* L.) v prvním roce vegetace.

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Vojtěška setá (*Medicago sativa* L.) odr. Zuzana byla vyseta do nádob o objemu 12 l v jarním a letním období do volně nasypané jílovitohlinité zeminy z degradované černozemě (objemová hmotnost redukovaná Or = 0,95–0,98 $g.cm^{-3}$) nebo do zeminy uměle zhutněné na Or = 1,28–1,34 $g.cm^{-3}$. Alginátové přípravky S-90 (vyráběn firmou Bioalgeen Schulze a Hermsen GmbH – zástupce v ČR Bioalvia Praha) a Micro-mist (Castle International) byly aplikovány na osivo (10 $ml.kg^{-1}$) nebo na list ve fázi 4–6 pravých listů (22 $ml.l^{-1}$). Byla sledována délka a tloušťka lodyh, počet listů, větví a lodyh na jednu rostlinu a hmotnost jedné lodyhy.

Zhutnění půdy průkazně snižovalo délku lodyh (o 8–31 %), tloušťku lodyh (o 3,5–13,5 %), případně olistění (o 5–17 %), a to zejména v nejranějších fázích vývinu rostlin (1. odběr jarního i letního výsevu).

Vliv aplikace alginátových přípravků na délku lodyh, jejich tloušťku a počet listů na jednu lodyhu je uveden v tab. I. Projevil se výrazněji na zhutněných variantách. Na variantách, kde bylo použito osivo ošetřené přípravky Micro-mist a S-90, byla délka lodyh v průměru o 7,5 a 10,7 % vyšší než na kontrole, tloušťka lodyh o 2,3 a 9 % větší a počet listů o 17 a 30 % vyšší. Rozdíly jednotlivých hodnot byly v mnohých případech průkazné (tab. II), zejména u přípravku Micro-mist. Na nezhutněné variantě se tento vliv neprojevil. Vliv foliárního postřiku na jednotlivé ukazatele nebyl prokázán. Zvýšení délky a tloušťky lodyh, případně olistění bylo zaznamenáno především u letních výsevů na zhutněné i nezhutněné půdě. V jednotlivých případech však byly sledované hodnoty (hlavně délka lodyh) naopak nižší než u neošetřené kontroly.

Počet lodyh na jednu rostlinu (tab. III), stejně jako počet větví na jednu lodyhu (tab. IV) byl až na výjimky (1. odběr na nezhutněné variantě) průkazně vyšší při použití ošetřeného osiva nebo foliární aplikaci než na neošetřené kontrole. Rozdíly byly výrazné zejména u letních výsevů na zhutněné variantě, což korespondovalo s velmi podstatným snížením počtu větví na jednu rostlinu v důsledku zhutnění půdy (o 41,2 % oproti nezhutněné variantě). Hmotnost jedné lodyhy (tab. III) byla na zhutněných variantách v průměru o 14,6 % nižší než u rostlin rostoucích na půdě s nižší Or. Kladný vliv obou způsobů aplikace přípravků na hmotnost lodyh v důsledku jejich lepšího olistění byl patrný spíše u pozdnějších letních výsevů, kdy rostliny rostly za všeobecně horších vegetačních podmínek. Účinek alginátů byl i zde výraznější na variantách se silněji zhutněnou půdou, kde se po foliární aplikaci (22 $ml.l^{-1}$) zvýšila hmotnost lodyh v prvních dvou měsících po vzejití porostu v některých případech až o 44,3 % (v průměru všech měření o 9,2 až 9,9 %) a po ošetření osiva až o 84,6 % (v průměru o 21,7 až 37,3 %). I zde se vyskytnuly případy, kdy zejména foliární aplikace, především přípravku S-90, působila na růst rostlin nega-

tivně. Účinnějším přípravkem při porovnání obou preparátů v prvopočátku vývinu rostlin byl Micro-mist.

vojtěška setá; algináty; ošetření osiva; foliární aplikace; délka a počet lodyh; tloušťka lodyh; hmotnost lodyh; větvení lodyh; olistění

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