ARBORETUM KÓRNICKIE ROCZNIK XXXV-1990

MATCHIALS AND METHODS

Władysław Chałupka, Henryk Fober

Effect of polythene covers on the content of mineral elements in the needles and buds of *Picea abies* (L.) Karst. grafts

Abstract

Chałupka W., Fober, H., 1990. Effect of polythene covers on the content of mineral elements in the needles and buds of *Picea abies* (L.) Karst. grafts. Arbor. Kórnickie 35: 119 - 125.

In shoots of 15-year-old Norway spruce grafts the content of some mineral nutrients was analysed. Covering grafts with polythene from 29th of June to 20th of July significantly increased the levels of phosphorus, nitrogen and potassium, but this was not connected with the flowering intensity of the treated grafts. Possible relation between mineral status of shoots and strobili initiation is discussed.

Additional key words: Norway spruce, mineral nutrients, strobili initiation.

Address: W. Chałupka and H. Fober, Institute of Dendrology, 62-035 Kórnik, Poland.

After collection shoots were dried for 24 hrs. at 105°C, and then the needles and buds were separated and powde **MOITDUGORTRI** lyses were made for nitrogen, phosphorus, calcium, magnesium, polassium, and sodium content. Nitrogen was

Covering Norway spruce grafts with polythene during the time of strobili initiation appears to be an effective treatment stimulating flowering and the best time for the treatment was usually the turn of June and July (Brøndbo 1969, Remröd 1972, Chałupka and Giertych 1977, Olsen 1978, Chałupka 1981). Similar results were obtained by Tompsett and Fletcher (1977) in an experiment with Sitka spruce (*Picea sitchensis* (Bong.) Carr.).

Polythene covers cause many changes in the graft environment and the most significant is the rising of temperature (Brøndbo 1969, Chałupka 1985). It was also established that covering grafts with polythene significantly increased the content of less polar gibberellin-like substances in the shoots of Norway spruce (Chałupka et al. 1982), and retarded the metabolism of tritiated gibbrellin $A_{4/7}$ (Dunberg et al. 1983).

The present experiment was aimed at analysing another aspect of polythene cover treatment namely the changes in the levels of some mineral nutrients in the Norway spruce grafts.

MATERIALS AND METHODS

Four 15-year-old clones of Norway spruce from the clone archive of the Institute of Dendrology were selected, each represented by two grafts. Half of the grafts, one from each clone, were covered with polythene tubes for the period of 29th of June to 20th of July 1983. The remaining grafts acted as control. Samples for analysis were collected at eight different times (Tab. 1), taking randomly ten current growth shoots from each graft.

		All no rate Table 1 ying to toollo
	Chronolo	gy of field work a base selbeen out mi
		the second second states and the
Sampling time	Date	Notes
1	29 June	Collection shoots
		before covering
	29 June	Covering grafts
	COLA .CUEL.	with polythene at 9 a.m. and the abuid book subconnection
2	29 June	Collection shoots
om minera' aut fents was one-	5 30 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	\$ hrs. after covering
h of Eury significantly in clased	30 June	loted. Covaring grafts with polythene from 29 5 of
not Spread with the P-werica	5 July	id levels of phosphorus all room and possiblem b
lidonte bris stoort in in Sela		
	15 July	Uncovering grafts at 9 a.m.
6	15 July	Collection shoots
		5 hrs. after uncovering
7	16 July	ninni i antar songle kiwaan sinaa (si naanunne
8 035 LORAN POLO	20 July	tate the W. Chalupis and H. Folsen foxulate of

After collection shoots were dried for 24 hrs. at 105°C, and then the needles and buds were separated and powdered. Mineral analyses were made for nitrogen, phosphorus, calcium, magnesium, potassium and sodium content. Nitrogen was analysed by the Kjeldahl method (Piper 1957), and phosphorus by the modified method of Kuttner and Lichtenstein (Fink 1963). All the metalic elements were analysed by flame photometry using an Atomic Absorption Spectrophotometer – Zeiss AAS 1 (Humphries 1956). The results of mineral analyses were subjected to a variance analysis.

RESULTS ADDISIGNATION TO SMIRT THE FORMER STATE

Flowering of Norway spruce grafts in 1984 was poor and female strobili appeared only on 31 grafts and male on 85 grafts out of 623 growing in the clone archive. Covering grafts with the polythene did not increase the flowering this year (Tab. 2).

On the other hand polythene treatment significantly increased the levels of some mineral nutrients in Norway spruce grafts (Tab. 3 and 4). The levels of phosphorus,

Table 2

Clone	Covered grafts	Control
01-03	no flowering	2 9 and 3 3
07-04	no flowering	13
04-04	no flowering	no flowering
03-44	13	23

Female strobili were counted, and male flowering intensity was estimated on a 5-degree scale: 0-no flowering, 1-sparse strobili on a small part of crown, 2-strobili on half of crown, 3-sparse strobili on the whole crown, 4-numerous strobili on the whole crown

nitrogen and potassium were respectively 9.7%, 5.3% and 11.4% higher in covered grafts than in the controls (Tab. 4).

Significant differences between the collection times were established for phosphorus, magnesium and potassium (Tab. 3, Fig. 1). An increase of phosphorus level was noticed at least one day after covering grafts, and then a decrease wasobserved without any dependence on uncovering time. The content of magnesium

Table 3

Source of variance freedom	Minerals						
	P	N	Ca	Mg	K	Na	
Total	63	1			1 - 0	37.0	
Polythene	Sr 1973	1. 24644	NATEL AND	AVE & AR	Say of a 11	Seat A	
covers (P)	1.	10.95**	5.56**	1.36	3.53	11.49**	0.07
Times (T)	7	9.20**	1.08	1.63	4.84**	9.64**	1.38
P×T	7	0.78	1.47	0.76	0.44	0.25	1.08
Clones	3	5.57**	4.79**	7.71**	7.06**	2.41	0.89
Residual	45	And and a start of the		Baserer			

Effect of polythene covers on the level of mineral nutrients in Norway spruce grafts. Results of variance analyses

** -- Significant at 0.01 level: * Significant at 0.05 level

Table 4

Level of mineral nutrients in Norway spruce grafts, % of dry weight

Minerals	Р	N	Ca	Mg	K	Na
Covered grafts	0.181	1.40	0.617	0.063	0.803	0.044
Controls	0.165	1.33	0.588	0.051	0.721	0.042

constantly increased without any visible influence of treatment. As regards to potassium covering grafts caused a major decrease of its content, and after uncovering an increase to a more stable level of this mineral was noticed. In the case of nitrogen, calcium and sodium no significant changes in their content were observed during sampling time (Fig. 1).

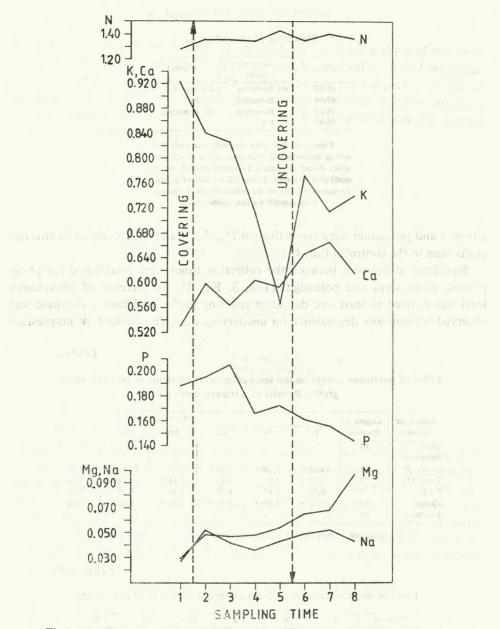


Fig.1. Effect of polythene covers on nutrients in spruce (% of dry weight)

A clonal variation was statistically significant for phosphorus, nitrogen, calcium and magnesium content (Tab. 3), but only in the case of calcium a significant difference was noticed between northeastern clones (01-03 and 07-04), and southern ones (03-44 and 04-04) (Tab. 5).

No interaction was observed between polythene covers and time of sample collection.

Clonal variation in the level of mineral nutrients,

Vawożenie drzew leśnych, PWRIL, Warszawa,

arshispect (hat buc		Clones				
rients. Such a hype	Minerals	01-03	07-04	03-44	04-04	
by angiosperms with	00 P bas	0.172b	0.160b	0.188a	0.172b	
1 (L. 11984) suppo	N	1.37a	1.27b	1.41a	1.41a	
where there is an i	Ca	0.553a	0.535a	0.659b	0.661b	
	Mg	0.049a	0.052a	0.045a	0.082a	
a a hypothesis in t	K	0.777a	0.721a	0.744a	0.806a	
a ris provident the sale	Na	0.043a	0.040a	0.039a	0.050a	

Values with the same letter are not significantly differed according to Duncan's test

DISCUSSION

Covering Norway spruce grafts with polythene positively influenced the total content of nitrogen, phosphorus and potassium in the needles and buds. The higher level of nitrogen remained nearly the same during the time of experiment, while the levels of phosphorus and potassium significantly changed during the time of sample collections (Fig. 1). An increase in phosphorus content during the first day after covering grafts was very similar to the dynamics in the activity of gibberellin-like substances observed in a similar experiment (Chałupka et al., 1982).

The rapid decrease of the potassium content after covering grafts was also of interest. It seems to be possible that the "greenhouse effect" created the favourable conditions for more intensive vegetative growth of covered shoots, and it was earlier noticed that such situation may result in decrease of potassium content in trees (Baule and Fricker, 1973). Unfortunately these significant changes in the content of some minerals caused by covering Norway spruce grafts with polythene were not clearly connected with flowering of the treated grafts.

There are not many data on the relation between the level of mineral nutrients and flowering in coniferous trees. According to some suggestions there exists a close relationship between nutritional status of shoots and the sex of initiated strobili: female strobili are induced on shoots with good mineral nutrient supply, and male ones in condition of limited supply of minerals (Wareing 1958, Sweet and Will 1965). Fober (1976) came to an opposite conclusion after his detailed studies on the distribution of mineral nutrients in the crowns of the Scots pine and Norway spruce.

Lack of flowering in the treated grafts in 1984 seems to confirm the suggestion of Wareing (1958) rather than the results of Fober (1976) (Tab. 2). The higher level of some mineral nutrients caused by polythene covers perhaps proved unfavourable to the initiation of male strobili. However the relationship is too low to be conclusive.

It is possible that the increased content of mineral nutrients in the needles and guds of covered grafts was the result of changed distribution of nutrients inside brafts. It is a well known fact in fruit trees a higher level of phosphorus in buds

was closely correlated with the number of flowers initiated (Baxter 1972, Grochowska 1979). Similarily in Douglas-fir nitrogen fertilization promoted flowering and simultaneously increased the content of that mineral nutrient in the treated trees (Puritch 1972, Ebell and McMullan 1970). One can suspect that buds during the time of strobili initiation act as a sink for mineral nutrients. Such a hypothesis was postulated by Sachs (1977) for herbaceous and woody angiosperms with respect to assimilates. The data of Sweet (1979) and Ross et al. (1984) support this suggestion also in the case of *Pinus radiata*.

Unfortunately we still have no adequate data to support such a hypothesis in the case of mineral nutrients and further detailed studies are needed to answer this question.

LITERATURE

- 1. Baule, H., Fricker, C., 1973. Nawożenie drzew leśnych. PWRiL, Warszawa.
- Baxter, P., 1972. The flowering process a new theory. In: Plant Growth Substances, Springer Verlag, Berlin: 775 - 779.
- 3. Brøndbo, P., 1969. Blomstringinduksjon ved varmebehandling hos granpodninger. Medd. Norske Skogforsoksvesen, 27 (98): 295 - 311.
- 4. Chałupka, W., 1981. Influence of growth regulators and polythene covers on flowering of Scots pine and Norway spruce grafts. Silvae Genet., 30 (4 5): 142 146.
- Chałupka, W., 1985. Regulacja kwitnienia na plantacjach nasiennych sosny zwyczajnej (*Pinus sylvestris* L.) i świerka pospolitego (*Picea abies* (L.) Karst.). Instytut Dendrologii PAN, Kórnik, pp. 1 - 146.
- 6. Chałupka, W., Giertych, M., 1977. The effect of polyethylene covers on the flowering of Norway spruce (*Picea abies* (L.) Karst.) grafts. Arbor. Kórnickie, 22: 185 192.
- Chałupka, W., Giertych, M., Kopcewicz, J., 1982. Effect of polythene covers, a flower inducing treatment, on the content of endogenous gibberellin-like substances in grafts of Norway spruce. Physiol. Plant., 54: 79 - 82.
- Dunberg, A., Malmberg, G., Sassa, T., Pharis., R. P., 1983. Metabolism of tritiated gibberellins A₄ and A₉ in Norway spruce, *Picea abies* (L.) Karst. Effects of a cultural treatment known to enhance flowering. Plant Physiol., 71: 257 - 262.
- Ebell, L. F., McMullan, E. E., 1970. Nitrogen substances associated with differential cone production responses of Douglas-fir to ammonium and nitrate fertilization. Can. J. Bot., 48: 2169 - 2177.
- 10. Fink, J., 1963. Wstęp do biochemii fosforu roślin. PWRiL, Warszawa.
- Fober, H., 1976. Distribution of mineral elements within the crown of Scots pine (Pinus silvestris L.) and Norway spruce (Picea abies (L.) Karst.). Arbor. Kórnickie, 21: 323 - 331.
- Grochowska, M. J., 1979. Zawiązywanie pąków kwiatowych. In: Fizjologia roślin sadowniczych, Ed. L. Jankiewicz, PWN, Warszawa: 371 - 408.
- 13. Humphries, E. C., 1956. Mineral components and ash analysis. In: Modern methods of plant analysis, Ed. Paech and Tracey, vol. 1: 468 502.
- Olsen, H. C., 1978. Blomstringsinduktion hos rodgran. Forstl. Forsogsvaesen Denmark, 36 (2): 231 - 266.
- 15. Piper, C. S., 1957. Analiza gleby i roślin. PWN, Warszawa.
- Puritch, G. S., 1972. Cone production in Conifers: a review of the literature and evaluation of research needs: with an economic analysis, by A. H. Vyse. Can. For. Serv. Inform. Rep. BC-X-65, pp. 1 - 94.
- Remröd, J., 1972. Försök med blomningsstimulering i en granfröplantage. Årsbok Föreningen Skogsträdsförädling, Inst. Skogsförbättring: 160 - 178.

124

- 18. Ross, S. D., Bollmann, M. P., Pharis, R. P., Sweet, G. B., 1984. Gibberellin A_{4/7} and the promotion of flowering in *Pinus radiata*. Effects on partitioning of photoassimilate within the bud during primordia differentiation. Plant Physiol., 76: 326 330.
- 19. Sachs, R. M., 1977. Nutrient diversion: an hypothesis to explain the chemical control of flowering. Hort. Science 12 (3): 220 222.
- Sweet, G. B., 1979. A physiological study of seed cone production in *Pinus radiata*. New Zeal. Journ. For. Sci., 9 (1): 20 33.
- 21. Sweet, G. B., Will, G. M., 1965. Precocious male cone production associated with low nutrient status in clones of *Pinus radiata*. Nature, 206 (4985): 739.
- Tompsett, P. B., Fletcher, A. M., 1977. Increased flowering of Sitka spruce (*Picea sit-chensis* (Bong.) Carr.) by high temperature in a polythene house. Silvae Genet., 26 (2 3): 84 85.
- 23. Wareing, P. F., 1958. Reproductive development in *Pinus sylvestris*. In: The Physiology of Forest Trees, Ed. K. V. Thimann, Rolland Press, N. Y.: 643 654.

Wpływ osłon polietylenowych na zawartość składników mineralnych w iglach i pąkach szczepów świerka pospolitego (*Picea abies* (L.) Karst.)

Streszczenie

W ośmiu terminach ze szczepów świerka pospolitego osłoniętych folią polietylenową oraz kontrolnych zebrano pędy bieżącego przyrostu. Zbioru dokonano w okresie od 29 czerwca do 20 lipca. Osłony polietylenowe spowodowały istotny statystycznie wzrost zawartości fosforu, azotu i potasu w analizowanych pędach. Zmiany te nie były jednak powiązane z kwitnieniem traktowanych szczepów.

IN TROPUCTION

Girseous at pollutants, depending on their doct out from and correctly automatic transformer and late out of the second ophysiology is provide and late out of the providence of the second ophysiology is an end of the second ophysiology is a second ophysiology is a second ophysiology in the form of the providence and the second ophysiology is a second ophysiology i

The most frequently used method in determining the determ of sending whether of sending and that is the plants to the action of toxic gases is the quantitative observation of visite provide to be very (needles). In practice this theorem and y sincle measurement one, one difficulties even when the so called actual injuries of or lines is a most of y unit of the name (shape, colour, quantitative relations of the given operation) of the given operation of the second of the time of the second of the secon

19. Sich S. R. M., 1977, Mittheff diversion: an in notices to explain the channel courtof

200 Swised OC BrittSUA Marsialogical study of study of

22. Tompsett, P. B., Fletcher, A. M., D.T. freifield hovering of Stick sprints (Flets) sife decision from the start of the start of the polyticate months Strac Gaussi 26 (1 - 3); refugite at balance are class when the refut to refut the start of the

 Warelay, P. F., 1938. Reproductive development in *Phue subcetus*. (a: The Physiology of Forest Trees, Ed. K. V. Thimann, Rolland Press, N. Y.: 661 - 674.

A THERE AND A THE PERSON

Wolyw osten polletytenowych na zawactość skladników miestalnych w 1916 b i polach arczegow awie zawactość skladników dokach (L.) karsu.)

- n provins Participante de trava compressiones en la travativa de la compressione de la compressione de la compre Reference de la compression de la compre
- A de de direction de la companya de la comp de la companya de l

vontre meh zebrika field klezaktow switch posta Zubrat dokonano w określe od 24 oretwos r o 20 lipca. O kony policij jenowe spowodbiwu z zolay stelystycznie u zawartości (ośloru, azoru i postali w zastrzówanych pedachi Zhatay i: nie były jed ak powazano z switajenicm craktow (doch schurpow, jed

- C space We can be determined as the affect of peripetation we are the developed of the second of the developed of the second of the second
- ¹⁰ Juli Barris, M., Friedrich, M., Komponewicz, J., 1987. Effect of polythene source, a figure of the Min. Mar. Substances of status of heavily of the Min. Mar. Substances of status of heavily of the substances of status.
- and the second secon
- and County Mechanics, A. P. 1997 and a second an and investor for the line of the count of the second s
- Etc. L. 1995, Son production of the matching of the Rith, Mathiaest
- (a) To be a start of the start of second descent and the second of the start of
- na stali svetskom svetskom vrana skolov konistavych, svetskog prodita stalov 1. stali svetskom svetskom svetskom svetskom stalov 1. stali svetskom sv
- ay lan management of the providence of the surface state in the surface of the su
- (2) If a first operation of the second state of the second state of the second seco
- the start of the start function with a start of the start of
- (1) "Buy Long Lange 1913. Compare the state to extend on the review of the constitute and evolvation of insection and the comparements and wells are April Materials. Phys. Lett. Rep. 107(4):461, pp. 314–33.
- (c) Remarking Construction and the second s second sec