

## INVESTIGATION OF THE EFFECT OF PREPARATION No. 18-173 ON INTERCALARY GROWTH OF STEMS AND YIELD OF BARLEY

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**Abstract.** During 1991–1993, the preparation No. 18-173 of the Institute of Chemistry, Tallinn, on spring barley 'Auksiniai-3' in field tests has been studied at the Institute of Botany, Vilnius. Preparation No. 18-173 (300 g a.i./ha) increased the yield of grain 2.8–10.5% as compared to the control. With the known preparation, chloroethylphosphonic acid (E) (500 g a.i./ha), the yield of grain was not enhanced. The resistance of barley stems to lodging in grades were: preparation E 4.8–5.0; No. 18-173 4.2–4.9; control 3.0–4.8.

**Key words:** growth regulator, field test.

### INTRODUCTION

During the last decades, increasingly more attention has been paid to the synthesis, investigation and application of novel growth regulators with the purpose to enhance plant productivity and to stabilize harvest (Мельников, 1976; 1988; Шевелуха, Блиновский, 1990; Merkys et al., 1977). Search for compounds — retardants suppressing stem growth and the application of these in plant growing is expected to increase. Presently, quaternary ammonium salts are widely used. Under their influence, intercalary growth of corn stems (in particular wheat), is suppressed while development of generative organs and embryogenesis are not interfered with (Merkys et al., 1977; Калинин, 1984). Nevertheless, for many agricultural cultures, incl. barley, suitable retardants are still lacking (Prussakova, 1987; Меркис et al., 1984).

The aim of our study is to determine the biological activity of Preparation No. 18-173 synthesized at the Institute of Chemistry of the Estonian Academy of Sciences.

### METHODS

Biological activity of Preparation No. 18-173 has been investigated at the Institute of Botany. Field experiments have been carried out at Lithuanian Agricultural Institute, Department of Experimental Farm Tests, according to the scheme:

1. Control ( $H_2O$ );
2. No. 18-173 0.1% v.m. (0.3 kg a.i./ha);
3. No. 18-173 0.2% v.m. (0.6 kg a.i./ha);
4. 2-Chloroethylphosphonic acid (E) (0.5 kg a.i./ha).

2-Chloroethylphosphonic acid (E) was used as a standard. The area of experimental fields was 24.2 m<sup>2</sup>. Experimental barley fields were treated with preparations in the 7 th growth phase according to the scale of Fekes. Aqueous solutions of the investigated compounds, 300 l/ha, were used for spraying. The height of the stems, their internode mechanical resistance to fracture were determined, their diameter was measured, the anatomical stem structure was investigated. For anatomical investigations, the second internode of the main stem was selected because its growth is most strongly suppressed by retardants. The internode was fixed in Carnua mixture, covered with paraffin (Kublickiené, 1978) and straw walls were measured in microtomic sections under a microscope. Width of sclerenchyma and parenchyma ring and the number of vascular bundles in them were determined. Resistance to lodging was estimated visually in the phase of complete ripeness before harvest by a 5-grade scale: 5 grades — the stems of corn are upright, 1 — the complete area is lodged (Ламан et al., 1984).

The number and weight of grains of the main ear, the weight of grains of secondary ears and of 1000 grains as well as grain yield were determined. The data obtained were statistically evaluated.

## RESULTS AND DISCUSSION

Among a great number of growth regulators used today, retardants are more widely applied in agriculture. They are synthetic compounds which inhibit the intercalary growth of corn stem.

Retardant 2-chloroethylphosphonic acid (camposane) is successfully applied for suppressing of stem growth of barley and rye (Шевелуха, Блиновский, 1990; Романовская et al., 1989). A retardant suitable for forming barley stems resistant to lodging is being sought (Калинин, 1984; Меркис et al., 1984). Experimental data of 1991—93 on spring barley 'Auksiniai-3' demonstrated that Preparation No. 18-173 acted as a retardant. The preparation retarded growth by 7—10%, and had positive effect on the formation of mechanical tissues of the stem. Mechanical resistance of lower internodes was increased by 10—16% (Table 1). As to the stem growth, Preparation No. 18-173 was less active than 2-chloroethylphosphonic acid. However, mechanical resistance of the stem was increased almost to the same extent with the two compounds. Resistance of barley under the effect of Preparation No. 18-173 was found to increase by 1—1.5 grades as compared to the control.

The reason for the increase of the resistance of barley stem to lodging may be stimulation of the development of anatomic elements of the straw wall caused by Preparation No. 18-173. Under its effect, thickness of sclerenchyma and parenchyma ring increased by 7 and 12%, respectively (the average of 1991—93), the number of vascular bundles in sclerenchyma — by 8% and in parenchyma — by 10% as compared to the control (Figure). 2-chloroethylphosphonic acid retarded the stem growth, but did not effect straw wall development. Thus, the influence of Preparation No. 18-173 on anatomical stem structure partly determined mechanical resistance of stems.

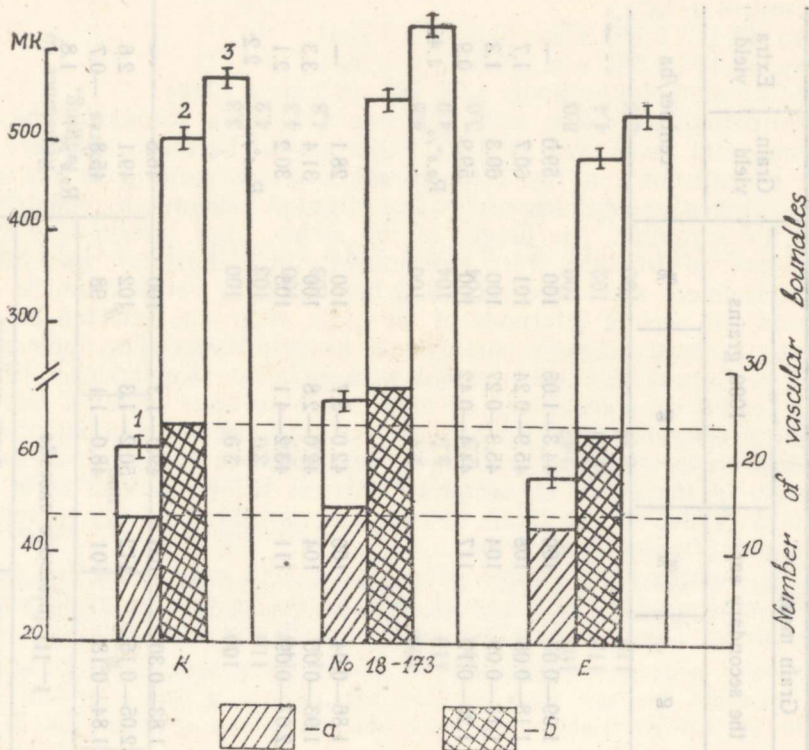


Table 1

Variant of experiment	Length of stem		Stem resistance to fracture			Stem diameter		Resistance to lodging, scores
	cm	%	g	I-III internode average		mm	%	
				%	mm			
			1991					
Control (H <sub>2</sub> O)	91-0.00	100	354	100	2.9	100	3.3	
No. 18-173 0.1%	85-0.64	93	412	116	3.0	103	4.2	
No. 18-173 0.2%	81-0.28	89	411	116	2.9	100	4.3	
E. 0.5 kg/ha	75-2.08	83	405	114	3.0	103	4.8	
			1992					
Control (H <sub>2</sub> O)	50-1.08	100	356	100	2.4	100	4.8	
No. 18-173 0.1%	46-1.2	92	396	110	2.5	104	4.9	
E. 0.5 kg/ha	40-0.47	80	394	110	2.5	104	5.0	
			1993					
Control (H <sub>2</sub> O)	68-0.07	100	372	100	2.47	100	3.0	
No. 18-173 0.1%	61-0.31	90	415	112	2.51	102	4.4	
E. 0.5 kg/ha	56-0.04	82	428	115	2.48	100	5.0	







The effect of preparation No. 18-173 on the anatomical structure of barley stems: 1 — sclerenchyma ring thickness, 2 — parenchyma ring thickness, 3 — straw thickness. a — vascular bundles number in sclerenchyma, b — vascular bundles number in parenchyma.

The results of yield analysis demonstrate stronger positive effect of Preparation No. 18-173 on grain yield and its structural elements. Using the preparation at the concentration of 0.1%, extra yield in 1991—93 amounted to 1.7—3.3; 2.6 cnt/ha, respectively (Table 2) due to increased grain weight of the main ear by 2—6%, of the secondary ears — by 8—12%, as well as due to increased resistance to lodging. However, statistically reliable extra yield under the influence of 2-chloroethylphosphonic acid was not obtained. A positive effect of Preparation No. 18-173 on grain yield is suggested to be associated with the distribution of assimilates as well as with their transport to the ear (Лясковский, Калинин, 1973).

In conclusion, Preparation No. 18-173 is a retardant increasing the resistance of barley stems to lodging and grain yield. We recommend continued investigations of Preparation No. 18-173 in the field and production experiments.

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## PREPARAADI NR. 18-173 TOIME ODRA KÖRRE INTERKALAARSELE KASVULE JA SAAGILE

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Aastatel 1991—1993 uuriti Eesti TA Keemia Instituudis väljatootatud preparaadi nr. 18-173 toimet odrasordile 'Auksiniai-3' põldkatsetel Vilniuses Botaanika Instituudis. Preparaadiga nr. 18-173 töödeldud (kulunorm 300 g toimeainet/ha) katselapp andis suurema terasaagi (2,8—10,5%) kui kontrollpõld. Võrdluspreparaat kloroetüülfosfoonhape (E) (kulunorm 500 g toimeainet/ha) saaki ei suurendanud. Vastupidavus lamandumisele oli pallides järgmine: preparaat E 4,8—5,0; preparaat nr. 18-173 4,2—4,9; kontroll 3,0—4,8.

## ВЛИЯНИЕ ПРЕПАРАТА № 18-173 НА ИНТЕРКАЛЯРНЫЙ РОСТ СТЕБЛЯ И УРОЖАЙ ЯРОВОГО ЯЧМЕНИЯ

Лайма МИЛЮВЕНЕ, Виргилия ГАВЕЛЕНЕ, Коит ЛЭЭТС,  
Хейно РАНГ

Действие препарата № 18-173, полученного в Институте химии АН Эстонии, было исследовано в Вильнюсе в Ботаническом институте в полевых опытах в 1991—1993 гг. на сорте ярового ячменя 'Ауксиний-3'. Использование препарата (расходная норма 300 г действующего вещества на 1 га) увеличивало урожай на 2,8—10,5% по сравнению с контролем. В результате применения известного препарата хлорэтилфосфоновой кислоты (E) (расходная норма 500 г на 1 га) урожай не увеличивался. Устойчивость к полеганию установлена следующая: при использовании препарата E — 4,8—5,0 балла, № 18-173 — 4,2—4,9 и в контроле 3,0—4,8 баллов.