

Effectiveness of HELP application on the protection of fruit plant flowers against frost

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ABSTRACT

In the years 2001 – 2002 at the Department of Pomology at the Agricultural University of Poznań the investigations were carried out on 8-9 year old peach trees of 'Reliance' and on 26-27 year old apple trees 'Idared' on the effectiveness of the protective spraying with HELP (mixture based on vitamin E and C with glycerol) against low temperature damages of flower buds, flowers and fruitlets. The spraying was applied 24, 42 or 44 hours before the frosts occurred. In the years of the experiment the natural spring frosts did not occur in the area of Poznań. Therefore, frost resistance tests were all done in laboratory conditions. The 165 tests included various HELP concentrations, time of spraying prior to the frost occurrence and the developmental stage of the plants. In 52% of tests carried out the protective effect of spraying was proved. The spraying with 4% HELP, done 24, 42 or 44 hours before low temperature occurred, increased the survival of flowers and fruitlets in 6-36% in peach trees and 2-31% in apple trees in comparison to the control samples. These results, however, need confirmation in the natural conditions in the orchard.

INTRODUCTION

For many years at the Department of Pomology at the Agricultural University of Poznań experiments were carried out on using an organic-mineral compounds to protect fruit trees and small fruit bushes against damage caused by spring frosts during blooming (Hołubowicz 1985, Hołubowicz and Bojar 1993). The most promising results were received for the compound Cultar (known also under the name PP-333, Hołubowicz 1983). Those experiments were stopped though due to the suggested negative effects of the compound on human organism.

At the end of the last century, the results of some experiments with the compounds based on the mixture of vitamin E (α -tocopherol) with glycerol (Wölfel and Noga 1998) were published, presenting a protective effect on apple tree flowers against the spring frosts.

From the group of similar compounds the Polish company 'Agropak' (Anonymous 2001) created a new preparation HELP and in 2001 obtained an atest from the State Hygiene Institute for using it against flower damages on fruit trees caused by spring frosts. The main goal of the present experiments was to evaluate effectiveness of the HELP.

MATERIAL AND METHODS

The experiments were carried out in the years 2001 – 2002 on one year old shoots and spurs from 9-10 year old peach trees of 'Reliance' and on spurs from 26-27 year old apple trees of 'Idared' growing in the Przybroda Experiment Station near Poznań. As described by a producer, HELP is a microemulsion mixture of vitamin E (α -tocopherol) in 25 g dm^{-3} and vitamin C (ascorbic acid) in 25 g dm^{-3} and glycerol. The recommended concentration is 20 dm^3 of the product in 500 dm^3 of water per 1 ha (i.e. 4% spraying concentration).

In the area of Poznań, in those 2 years, natural frosts in the orchards were not recorded. Therefore, shoot freezing was done in the laboratory conditions. In practice, the procedure looked as follows: 24, 42 or 44 hours before the forecast of spring frosts, the trees in the orchards were sprayed with HELP. Then, because there was no frost, the shoot samples were collected and frozen in the laboratory. If a proper stage of development occurred and the weather was unfavorable for spraying, the shoots were taken from the trees to the laboratory, placed in buckets with 2-3 cm layer of water and sprayed, then, in 24, 42 or 44 hours were frozen. Sprayings in the orchard and laboratory were done with a small hand sprayer under the pressure at 2.5 atm. in 4 treatments: control (no spraying), 2%, 4%, and 6%. Then, after 24 and 42 hours in the first year and 24 and 44 hours in the second year of experiment samples were taken and brought to the lab. Before freezing, the leaves from the plants were partly removed, shoots placed in buckets with water

and frozen, always in 4 replications. The freezing was done with the automatically programmed freezer of Heraeus type. The temperature lowering was at a speed not exceeding 5°C per hour. When the temperature reached the programmed level, it lasted 2 hours and then gradually returned to the, temperature over 0°C. Twenty four hours after taking the sample out of the freezer, the results of freezing were evaluated. Flower buds, flowers and fruitlets were cut longitudinally and classified into 2 groups: undamaged or damaged. The results were given in the percentages of healthy specimen which survived freezing. Then, the results were evaluated statistically, used the Bliss's transformation. The difference evaluation was based on the Duncan's multirange test at 5% significance.

RESULTS AND CONCLUSIONS

In 2 years of the experiments, 165 tests were carried out evaluating the effectiveness of HELP applied to protect flowers and fruitlets of apple and peach trees against damages caused by early spring frosts. All tests were done in a laboratory. In 52% of the carried out tests, the protective effect was positive. Spraying with HELP increased the percentage of surviving flower buds, flowers and fruitlets from 6% to 36% in peach trees and from 2% to 31% in apple trees (some results are presented in Tables 1 and 2) in comparison with the control trees. The spraying was done 24, 42 or 44 hours before expected low temperatures. The different concentrations of HELP used in experiments had no effect on its effectiveness, therefore we suggest using 4% HELP at least 24 hours before the expected frosts.

Table 1. Percentage of freezing surviving flowers of peach 'Reliance', according to the freezing temperatures and time after HELP application at the pink stage on April 25 and 26, 2001

HELP concentration (%)	HELP application (hrs before freezing)			
	24		42	
	Freezing temperature (°C)			
	-2.5	-3.5	-2.5	-3.5
Control	32.5 h*	11.6 b	32.5 h	11.6 b
2	54.4 m	22.7 e	42.8 k	23.4 f
4	31.1 g	15.4 c	35.8 j	17.4 d
6	42.8 k	35.2 i	47.3 l	9.3 a

* means followed by the same letters are not significantly different at $p = 0.05$

The results received with HELP seem to be interesting under the described conditions but they all have to be confirmed in the orchard when natural frosts occur.

Table 2. Percentage of flower buds, flowers or fruitlets surviving freezing after 44 hrs of HELP application in 2002, second experiment season

Peach 'Reliance'				
HELP concentration (%)	Stage of development and date of sampling			
	Pink bud April 15**	Full flowering April 22	Petal drop April 29	Fruitlets diameter 10-15 mm May 14
	Freezing temperature (°C)			
	-3.5	-3.5	-3.5	-2.5
Control	67.4 a*	9.3 a	34.5 a	29.9 a
2	85.2 c	12.0 b	65.7 d	36.0 b
4	87.3 d	24.7 d	40.0 c	65.6 c
6	76.6 b	23.8 c	37.9 b	66.0 c

Apple 'Idared'				
HELP concentration (%)	Stage of development and date of sampling			
	Green bud April 15**	Pink bud April 22	Full flowering April 29	Fruitlets diameter 10-15 mm May 14
	Freezing temperatures (°C)			
	-4.5	-3.5	-3.9	-2.5
Control	58.3 b*	5.2 a	18.2 a	11.3 a
2	55.5 a	9.5 b	21.5 b	33.2 b
4	72.4 d	9.9 c	21.3 b	42.4 d
6	69.8 c	17.6 d	37.3 c	40.2 c

* means followed by the same letters are not significantly different at $p = 0.05$

** for peach and apple the data were analyzed separately for each date of sampling

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EFEKTYWNOŚĆ STOSOWANIA PREPARATU HELP W OCHRONIE KWIATÓW PRZED PRZYMROZKAMI

Streszczenie: W latach 2001 – 2002 w Katedrze Sadownictwa AR w Poznaniu prowadzono badania na 8-9 letnich drzewach brzoskwini odmiany Reliance oraz na 26-27 letnich drzewach jabłoni odmiany Idared nad skutecznością ochronnego wpływu opryskiwań preparatem HELP przeciwko powstawaniu uszkodzeń przez ujemną temperaturę kwiatów i zawiązków brzoskwini i jabłoni po opryskiwaniu na 24, 42 lub 44 godziny przed wystąpieniem wiosennych przymrozków. W latach prowadzenia badań w rejonie Poznania nie wystąpiły naturalne wiosenne przymrozki. Testy wytrzymałości na mróz przeprowadzono w warunkach laboratoryjnych. W sumie wykonano 165 testów oceniających skuteczność ochronnego działania preparatu. Stwierdzono, że w 52% wykonanych testów wyniki potwierdziły efekt ochronnego wpływu preparatu. Zastosowanie preparatu HELP na 24, 42 lub 44 godz. przed wystąpieniem ujemnej temperatury przyczyniło się do większego o 6-36% u drzew brzoskwini i od 2-31% u drzew jabłoni przeżycia przez kwiaty lub zawiązki owocowe stresu ujemnej temperatury w porównaniu z drzewami nieopryskiwanymi.

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