ПРОУЧВАНЕ НА ЕФЕКТА ОТ ЛИСТНО ПОДХРАНВАНЕ С БЪЛГАРСКИ СУСПЕНЗИОННИ ТОРОВЕ "ЛАКТОФОЛ" ПРИ ЯБЪЛКИ, ПОДЛОЖЕНИ НА ТЕМПЕРАТУРЕН СТРЕС
STUDY OF THE EFFECTS OF FOLIAR FEEDING WITH BULGARIAN *LACTOFOL* SUSPENSION FERTILIZERS IN APPLES EXPOSED TO TEMPERATURE STRESS

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Резюме

Изследването е проведено в плододаваща ябълкова градина, намираща се в УОП "Враждебна", София, през зимата на 2009 и 2010 г.

Проучен е ефектът от листно подхранване със суспензионни торове от серията "Lactofol" с цел установяване на въздействието им върху студоустойчивостта на едни от най-широко застъпените в България ябълкови сортове "Златна превъзходна" и "Старкримсон".

Получените резултати потвърждават, че листното хранене намалява щетите от ниски температури с 4–9 % при вегетативните органи на ябълковите дървета.

Abstract

The study was conducted in a four-year-old apple plantation located in RBM "Vrazhdebna", Sofia during the winter of 2009/2010. The trees were formed with a freely growing crown. The objects of the study were the apple varieties *Golden Delicious* and *Starkrimson*.

There is no sufficient data on the role of an improved leaf feeding diet for the resistance of fruit plants in overcoming various stress situations caused by extreme temperature or water regime. To give a clarification on this issue, we conducted our study in order to investigate the effects of foliar feeding with *Lactofol* bio-mineral fertilizers on the cold resistance of apple cultivars.

We confirm that leaf feeding reduces damage caused by low temperatures in the vegetative organs of apples by 4%–9%.

Improved diet with *Lactofol* contributes to better tissue maturation and differentiation of buds on the apple trees, resulting in lower annual percentages of damaged shoots and fruit buds.

Ключови думи: ябълка, листно подхранване, студоустойчивост, суспензионен тор, Лактофол.
Key words: apple, cultivar, foliar feeding, cold resistance, *Lactofol* fertilizers, stress.

INTRODUCTION

The productive potential of the fruit crops cannot be achieved, if during their development, they are exposed to adverse external influences that modern science named with the term "stressors." According to their nature they are abiotic stressors, which include violations relating to temperature, water and diet, and those relating to gas exchange and water content in plants. Abiotic stressors occur in the form of chemical substances that deplete the construction of plant cells and tissues. In such conditions, the most important place is occupied by the temperature, whose influence determines the course of all processes in plant biology.

According to Levitt (1941), under the influence of "stressors", in the plant organism changes in concentration of nutrients and state of the water content takes place. It was also found that turgidity is amended, changes pH denaturation of proteins, metabolic processes are slow.

Molich (1939) shows that freezing depends on the colloidal properties of protoplasm. Schafinit (1944) indicates the importance of protein content of the protoplasm, and Loomis (1934) and Wilhelm (1934) found that in cells of wintering plants as long as proteins accumulated sugar and other compounds that prevent protein coagulation. At the same time changes in the activity of enzymes is observed. Of large interest are the studies of Tumanov (1939), who

considers that accumulated sugars in the autumn, appeared energy materials, which protects cells from adverse environmental conditions. The process of accumulation of carbohydrates is closely related to the intensity of photosynthesis, which is directly dependent on the stuff reserves the plants with nutrients.

Particular attention should be paid to research of Dexter (1933) to clarify cold resistance of plants with unbalanced mineral nutrition. Hå found that excessive nitrogen content in the soil enhances the accumulation of soluble nitrogen compounds in plants, but does not contribute to their resistance of low temperatures.

Attempts by Duhamel (1875) have shown that cold resistance of plants is increased by potassium fertilization where phosphorus fertilization increases the energy of cells.

Studies of other authors (Apostolova, 1994; Apostolova, 1998a, Apostolova, 1998b; Pavlova, 2009) found that leaf feeding of perennial crops is extremely effective because it allows targeted intervention in particular phase of their individual development. The selected nutrients are included directly in the metabolism and the resultant metabolites increase yield and quality fruit production.

Fruit plants have a strong capacity for self-regulation and anti-stress factors, which through its own physiological systems that have tropic, hormonal, and electrophysiological nature (Vassilev, 2009).

There is no sufficient data on the role of improved leaf feeding diet on the resistance of fruit plants to overcome various stress situations caused by extremal temperature or water regime.

To clarify this issue, we conducted our study, investigating the effects of foliage feeding with biomineral fertilizers Lactofol on cold resistance of apple cultivars.

MATERIAL AND METHODS

The study was conducted in four-year-old apple plantation, located in RBM "Vrajdebna", Sofia. Winter 2009/ 2010 trees were formed with freely growing crown. Object of the study are apple varieties Golden Delicios and Starkrimson, planted on pad MM 104.

These varieties were selected to implement the second phase of their study because previous research concerns changes in the reproductive events of varieties under the influence of leaf feeding by suspension fertilizers Lactofol series.

During the experiment have not been used soil fertilizers. The following foliar feeding options at 0.5% concentration were examined. Foliar feeding was done four times: first, 20 days after flowering, and afterwards every 15 days. Plants alimentation were taken in two periods - in late December and late January, after falling temperatures below 10°C.

Observed were the damaged one-year, two-year and three-year old branches, and damage on leaves and fruit buds formed on these branches. The observations include a transverse and longitudinal cuts to assess the viability of the tissues and the extent of harm of the tree leaf and fruit buds.

RESULTS AND DISCUSSION

Table 1 represents data showing the effects of foliar feeding on the growth of in not the same age wood in cultivar Golden Delicious.

The data shows that for the Golden Delicious with all schemes of foliar feeding, the reported damage to the vegetative growth is less than for the non fertilized control tree. Older branches are more resistant to low temperatures. The lowest damage rate is achieved with

Таблица 1. Повреди по летораслите и клоните на ябълковите дървета, %
Table 1. Damage to shoots and branches of apple plants, %

Варианти/Variants	Сортове Variety	Златна превъзходна Golden Delicios			Старкримсон Starkrimson		
	Term	1-yr	2-yrs	3- yrs	1-yr	2-yrs	3- yrs
V1 - контрола V1 - Control tree	December	35	32	27	32	29	25
	January	38	35	29	34	32	27
V2 – Лактофол "О" V2 - Laktofol "O"	December	31	30	25	29	27	25
	January	35	33	27	31	34	34
V3 – Лактофол "В" V3 - Laktofol "B"	December	29	26	21	28	24	23
	January	31	29	24	32	29	30
V4 – Лактофол " Fe" V4 - Laktofol "Fe"	December	31	28	18	25	26	26
	January	33	31	21	27	28	32
V5 – Лактофол "В"+"Fe" V5 - Laktofol "B"+"Fe"	December	27	25	17	23	25	27
	January	32	29	24	26	29	34

Таблица 2. Повреди на листни и плодни пъпки на ябълковите дървета, %
Table 2. Damage to fruit and leaf buds of apple plants, %

Варианти/Variants	Дати/Terms	Златна превъзходна Golden Delicios					
		1-yr growth		2-yr growth		3-yr growth	
		листни пъпки/ leaf buds	плодни пъпки/ fruit buds	листни пъпки/ leaf buds	плодни пъпки/ fruit buds	листни пъпки/ leaf buds	плодни пъпки/ fruit buds
V1 - контрола V1 - Control	December	40	43	38	40	31	36
	January	47	46	40	45	33	39
V2 – Лактофол "О" V2 - Laktofol "O"	December	38	40	36	37	32	34
	January	45	47	39	42	35	36
V3 – Лактофол "В" V3 - Laktofol "B"	December	31	37	29	33	27	31
	January	39	43	31	39	34	37
V4 – Лактофол " Fe" V4 - Laktofol "Fe"	December	35	38	30	32	28	33
	January	37	42	35	36	36	34
V5 – Лактофол "В"+"Fe" V5 - Laktofol "B"+"Fe"	December	33	35	32	35	31	34
	January	36	37	38	37	39	38
		Старкримсон/Starkrimson					
V1 - контрола V1 - Control	December	31	34	32	34	30	32
	January	33	35	34	37	34	33
V2 – Лактофол "О" V2 - Laktofol "O"	December	28	31	26	31	29	33
	January	30	33	36	35	35	37
V3 – Лактофол "В" V3 - Laktofol "B"	December	26	29	24	37	26	29
	January	28	34	38	40	31	34
V4 – Лактофол " Fe" V4 - Laktofol "Fe"	December	26	29	24	39	27	30
	January	29	38	34	41	34	32
V5 – Лактофол "В"+"Fe" V5 - Laktofol "B"+"Fe"	December	21	24	28	32	25	27
	January	26	32	31	35	30	31

treated with Lactofol "B", followed by the high content of Fe or a combination of the two modifications. This fact is explained by the catalyst effect of the increased chlorophyll and photosynthetic activity of the leaves. They have produced more assimilations who deposited in vegetative growth, increase their cold tolerance.

Similar trend is observed in the second studied variety. It was found that by the variety Starkrimson damaged shoots and branches are 3 to 9% less.

Growth of shoots and stockpiling of nutrients correlates with differentiation and sustainability of buds to low temperatures.

Table 2 shows that the percentage of dead buds and fruit plates depends on the condition of the shoot or twig on which is formed. More sensitive to low temperatures in both varieties are fruit buds formed on the lower annual branches. Lowest percent damaged buds are achieved with treatment with boron (V2) or combination of fertilizers containing boron and iron (V3). This indicator also confirms the finding of greater cold tolerance of the variety Starkrimson. Difference untreated option to vary within 9-11% of leaf pimples on-year rate of Golden Delicious and 9-15% at variety Starkrimson. Similar observations in fruit set and fruit buds are significant variations in the model in Lactofol "B", followed by versions with combined fertilization. (V5). The data shows a low percentage of damaged buds (leaves and fruit) in a version with application Lactofol "Fe".

CONCLUSIONS

1. Leaf feeding reduces damage from low temperatures with 4-9% in vegetative organs of apples.

2. Foliar feeding with Lactofol "B" accounts for the small percentage of damaged leaves and fruit buds.

3. Improved diet, feeding tracks made by a "Lactofol" contributes to better tissue maturation and differentiation of buds on apple plant, resulting in lower annual percentage damaged shoots and damaged fruit buds.

4. Of the varieties of cold resistance Starkrimson variety is better than that of Golden delicious variety, which is explained by its genetic characteristics.

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