SCIENTIFIC WORKS OF THE LITHUANIAN INSTITUTE OF HORTICULTURE AND LITHUANIAN UNIVERSITY OF AGRICULTURE. SODININKYSTĖ IR DARŽININKYSTĖ. 2009. 28(3).

Influence of boron fertilizer and meteorological conditions on red beet infection with scab and productivity

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Investigations of the additional red beet fertilization with boron fertilizers through leaves were carried out at the Lithuanian Institute of Horticulture, on *Calc*(*ar*)*i-Epihypogleyc Luvisols – LVg-p-w-cc*) of sandy loam on light loam in 2006–2007. There was little amount of humus and nitrogen in the soil, big amount of phosphorus, calcium and magnesium, average and big amount of potassium, average and big amount of boron; it was alkaline. There was investigated the influence of various boron fertilizers and meteorological conditions on scab prevalence in root-crops of different red beet cultivars and hybrids.

In 2007 scab prevalence and disease intensity both in red beet hybrids and cultivars was 2–3 times smaller than in 2006. The increase of temperature stimulated scab prevalence (for red beet 'Boro' F_1 r = 0.88; for red beet 'Kamuoliai 2' r = 0.76) and increased intensity (correspondingly r = 0.88 and 0.85), and the increase of precipitation decreased scab prevalence and intensity (scab prevalence correspondingly r = -0.90 and -0.79, intensity r = -0.90 and -0.87).

In both years of investigation root-crops of red beet cultivar 'Kamuoliai 2' were more infected by scab than red beet 'Boro' F_1.

Boron fertilizers positively influenced the yield of red beet hybrids and cultivars and decreased scab prevalence and intensity (according to the average data of 2006–2007, on root-crops of red beet cultivar 'Boro' F_1 correspondingly 14.2 % and 15.0 %, on root-crops of red beet cultivar 'Kamuoliai 2' – 23.8 % and 6.3 %). Fertilizer Boramin Ca was the most effective to red beet. Economical efficiency of this fertilizer was correspondingly 2.6 % and 7.4 %.

The increase of scab prevalence and intensity decreased red beet standard yield. The influence on root-crops of cultivar 'Boro' F_1 was strong (correspondingly r = -0.91 and r = -0.95), and on root-crops of cultivar 'Kamuoliai 2' – average (correspondingly r = -0.44 and r = -0.43).

Key words: boron fertilizer, cultivar, hybrid, intensity, prevalence, productivity, red beet, scab, .

Introduction. The most frequent nutrient deficiency encountered in cultivated beets is boron deficiency. Boron deficiency results in stunted plants, the deformation and death of the growing point, and slow growth (Nottingham, 2004, http://ourworld.compuserve.com/). When 10 t vegetable yield is grown, 23.7 kg of boron is obtained from the soil (Анспок, 1990). Boron deficiency occur in light-textured acid soils in humid regions because of boron tendency to leach, and in heavy-textured soils with high pH because boron is readily adsorbed under these conditions (Eisler, 2000; Gupta, 2007). The decrease of soil acidity creates conditions for bigger necessity of boron fertilizers, because soil boron agility decreases and it doesn't get into the plants (Томсон, Троу, 1982). At high relative air humidity boron applied to the cotyledons was transported to hypocotyls and roots, whereas at low relative humidity no translocation of boron was detectable (Eichert, Goldback, 2006). There was no loss in yield of tops, roots or sugar from inadequate boron supply when soil boron exceeded 0.50 mg B kg of soil (Christenson, Draycott, 2006). Boron fertilizers increase sugar beet yield 20.2 %, the amount of sugar – 0.3–0.6 % and the incidence of diseases of heart roots – 12.5–75.4 % (Анспок, 1990).

Boron was found to reduce the severity of many diseases because of the function, which boron has on cell wall structure, plant membranes and plant metabolism (Dordas, 2008), and its deficiency caused some diseases (Томсон, Троу, 1982). Boron deficient beets had brown tops and roots were rough, scabby, and off colour (Gupta, Cutcliffe, 1985).

Common scabies (*Streptomyces scabies* (Thaxter) Waksman and Henrici) are most seen on mature tuber or root-crop and consist of circular or angular lesions on the surface and rarely they may appear raised or penetrate to a few millimeters. Common scab gives an overall scruffy and unmarketable yield (Parry, 1990; Poljak et al., 2009; Koike et al., 2006). Streptomycetes are abundant in soils, rather than seed-borne and are controlled through agronomic rather than regulatory means by ensuring that soil moisture is maintained at field capacity by irrigating during the critical 4–6 week infection period and following tuber initiation (Elphinstone, 2007; Loria et al., 2006). The disease is seasonal and tends to most severe in light, freely drained alkaline soils after periods of dry summer weather (air temperature above 20 °C humidity – 50–70 %) and fertilization with fresh manure (Repšienė, Mineikienė, 2006; Ražukas et al., 2003; Elphinstone, 2007; Olanya et al., 2006; Parry, 1990; Waterer, 2002). Nutrient management and time of fertilization can decrease the severity of incidence of common scabies (Lambert et al., 2005; Davies et al.; Pavlista, 2005; Klikocka, 2009).

T h e a i m o f t h e s t u d y was to investigate the influence of various boron fertilizers and meteorological conditions on scab prevalence and intensity in the root-crop of various red beet cultivars and hybrids.

Object, methods and conditions. Investigations were carried out at the Lithuanian Institute of Horticulture, on the calcaric epihypoghleyic luvisol of sandy loam on light loam (*IDg8-k* / *Calc*(*ar*)*i- Epihypogleyc Luvisols – LVg-p-w-cc*) in 2006–2007. Soil ploughing layer was 20–25 cm in thickness. There was little amount of humus (1.53–1.74 %) and nitrogen (38.2–60.5 kg ha^{-1} of soil) in the soil, very big amount of phosphorus (335–401 mg kg^{-1} of soil), calcium (6400–10850 mg kg^{-1} of soil) and

magnesium (1 280–2 880 mg kg^{-1} of soil), average and big amount of potassium (191 229 mg kg^{-1} of soil), average and big amount of boron (0.80–1.23 mg kg^{-1} of soil); it was alkaline (pH_{KCl} 7.2–7.6).

Preplant – occupied fallow. Soil was cultivated and crop supervised according to the recommendations accepted at the LIH. There were grown red beet cultivars 'Boro' F_1 and 'Kamuoliai 2' on flat surface. Sowing scheme 62 + 8 cm. seed rate – 500 thousand unit ha^{-1} of germinable seeds.

Before red beet sowing, there was scattered N90P120K180 and additionally – N_{30} when red beet had 4–6 leaves. There was fertilized with ammonium saltpetre, granulated superphosphate and potassium magnesia. Boron fertilizers were applied for thee times: 1) when red beet had 6–10 leaves; 2) after 12–14 days; 3) at root-crop formation, i. e. at the end of July (2006 – 06 21; 07 04; 07 17; 2007 06 27; 07 10; 07 19). For solution preparation 500 l ha^{-1} of water were used; its concentration was 0.2–0.3 %.

Scheme of trial / Bandymo schema:

Factor A / Veiksnys A – red beet hybrid and cultivar / burokėlių hibridas ir veislė:

1. 'Boro' F_1
2. 'Kamuoliai 2'

F actor B / veiksnys B – different boron fertilizers / įvairios boro trąšos (B / F – background fertilization / foninis tręšimas $N_{90+30}P_{120}K_{180}$):

1. Without boron / be boro.
2. Boric acid / Boro rūgštis (17.2 % B).
3. Tradebore / Tradeboras (15.4 % B).
4. Tradebore Mo / Tradeboras Mo (15.4 % B and / ir Mo).
5. Lyderis® Bor / Lyderis® Bor (10.5 % B, 0.01 % Zn, 0.007 % Cu, 0.016 % Mn, 0.05 % Fe).
6. Boramin Ca / Boramin Ca (6.5 % free amino acids / laisvųjų amino rūgščių, 10.4 % CaO, 0.27 % B).

Experiment was carried out in four replications. Fields lied out in random design. Record plot area – 4.8 m^2.

Red beet scabbiness was evaluated twice per vegetation: at the end of July and during harvest gathering. There were pulled up sex plants in each replication (24 plants per variant). After external inspection their root-crops injured by scab were evaluated in scores. The amount of injured root-crops (1), disease intensity (2) and economical efficiency of the applied means (3) was calculated in percents according to the formulas (Waller et al., 1998):

$$P = n / N \times 100, \quad (1)$$

here: P – injured root-crops (%),
n – the number of scab injured root-crops,
N – the number of inspected root-crops.

$$R = \Sigma(a \times b) \times 100 / AK, \quad (2)$$

here: R – disease intensity (%),
a – the number of root-crops injured in equal score,
b – score of injury,
A – the number of inspected root-crops,

K – the highest score of injury (0–3),

Σ – the sum of root-crops injured in equal score and multiplications of score values.

$$Y = b - a / a \times 100, \quad (3)$$

here: Y – economical efficiency of the applied means (%),

a – yield obtained without applying the means,

b – yield obtained without applying the means.

Red beet yield was gathered when they reached technical maturity.

Meteorological conditions. Thermal and irrigational conditions during red beet vegetation were characterized by monthly average air temperature, monthly precipitation sum, multiannual average and G. Selianinov hydrothermal coefficient – HTK (Table 1).

$$HTK = \Sigma p / 0.1\ \Sigma t, \quad (4)$$

here: Σt – period when the sum of active temperatures was bigger than 10° C;

Σp – the sum of precipitation during the period, which average temperature > 10° C.

When HTK ≥ 1.6 – excessive humidity, HTK 1–1.5 – optimal humidity, HTK 0.9–0.8 – slight draught, HTK 0.7–0.6 – average draught, HTK 0.5–0.4 – big draught, HTK ≤ 0.4 – very big draught (Bukantis, 2004, http://www. hkk.gf.vu.lt/).

Meteorological conditions during the year of investigation were different: in 2006 temperature of vegetation period 1.4 °C exceeded the multiannual average and was 2.6 °C higher than in 2007, and in 2007 it was 1.2 °C lower than the average multiannual parameters (Table 1). In 2006 air temperature in May was alike multiannual one, and temperature parameters of all the other months exceeded the multiannual ones. In 2007 air temperature in all the vegetation months, except August, was lower than the average multiannual parameters (Table 1).

Table 1. Meteorological conditions
1 lentelė. Meteorologinės sąlygos

The data of Kaunas meteorological station
Kauno meteorologinės stoties duomenys

Month Mėnuo	Years Metai		Long-term average Daugiamečiai vidurkiai	Years Metai		Long-term average Daugiamečiai vidurkiai	Years Metai		Long-term average Daugiamečiai vidurkiai
	2006	2007		2006	2007		2006	2007	
	average air temperature vidutinė oro temperatūra (°C)			precipitation sum kritulių suma (mm)			HTK		
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Gegužė May	12.6	11.2	12.3	74.0	104.4	50.7	1.89	2.23	1.33
Birželis June	16.3	15.1	15.9	13.8	72.2	71.2	0.33	1.59	1.49
Liepa July	19,3	15,2	17,3	30,2	173,6	75,3	0,50	3,68	1,40

Table 1 continued
1 lentelės tęsinys

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Rugpjūtis August	17.5	16.6	16.7	173.4	42.8	78.4	3.20	0.83	1.51
Rugsėjis September	14.5	10.6	12.1	83.0	57.8	58.7	1.90	1.82	1.62
Spalis October	9.7	5.4	7,1	47.0	51.2	50.5	1.69*	-	-
Average (sum) Vidutinė, suma	15.0	12.4	13.6	70.2	83.7	64.1	1.56	2.03	1.47

* *Note*: In 2006 only first decade of October
* *Pastaba*: 2006 metais tik pirmoji spalio dekada

During both years of investigation precipitation rate exceeded the multiannual average, but rainy months and the amount of precipitation were different. In 2006 June, July and October were dry, and in August, September and October of 2007 precipitation rate was smaller than the multiannual average. The evaluation of the conditions during vegetation period according to the hydrothermal coefficient showed that agrometeorological conditions for red beet growing were as follows: in May and September of both the years of investigation – the excess of humidity, in June and July 2006 and in August 2007 – draught. Excessive humidity was in August 2006 and July 2007 (Table 1).

Data significance was evaluated by the method of two-factorial dispersion analysis, using the program ANOVA, dependence – using the program STAT_ENG (Tarakanovas, Raudonius, 2003).

Results. Meteorological conditions, cultivars of the grown red beet and fertilization with boron fertilizers influenced red beet root-crop infection by scab. In 2007 scab prevalence and disease intensity in red beet hybrids and cultivars was 2–3 times smaller than these in 2006. Scab infection and disease intensity of red beet cultivar 'Kamuoliai 2' in both years of investigation in July and in autumn at harvesting time was bigger than these of red beet cultivar 'Boro' F_1 (Tables 2, 3).

In 2006 at the end of July scab prevalence from boron fertilizers on root-crops of red beet cultivar 'Boro' F_1 decreased 6.7 %, on cultivar 'Kamuoliai 2' – 32.5 %, in 2007 – correspondingly 10.8 % amd 25.9 %. Disease intensity in red beet of cultivar 'Boro' F_1 on the average slightly increased, in 'Kamuoliai 2' – 13.4 % decreased, and in 2007 in red beet of hybrids and cultivars decreased correspondingly 12.5 % and 13.4 % (Table 2). The smallest scab prevalence and disease intensity in 2006, when the year was hot and less humid than 2007, on root-crops of red beet cultivar 'Boro' F_1 was after application of Lyderis®Bor, and on root-crops of red beet cultivar 'Kamuoliai 2' – after application of boron fertilizers Boramin Ca. In cool and humid 2007, Lyderis®Bor was the most effective both to hybrids and cultivars.

Increasing temperature of June-July increased scab prevalence on red beet rootstocks (for red beet cultivar 'Boro' F_1 r = 0.96; for red beet cultivar 'Kamuoliai 2' r = 0.84) and intensity (correspondingly r = 0.95; r = 0.83). When precipitation rate increased, scab prevalence and intensity decreased (correspondingly prevalence r = -0.96 and r = -0.82, intensity r = -0.94 and r = -0.82).

Table 2. Spread of common scabies on red beet root-crop in July
2 lentelė. Paprastųjų rauplių plitimas ant burokėlių šakniavaisių liepos mėnesį

Babtai, 2006–2007

Hybrid / cultivar (factor A) Hibridas / veislė (veiksnys A)	Years Metai	Fertilization with boron (factors B)* Tręšimas boru (veiksnys B)						
		1	2	3	4	5	6	LSD_{05} B R_{05} B
		Disease prevalence Ligos išplitimas (%)						
'Boro' F_1	2006	79.2	79.2	79.2	66.7	62.5	75.0	12.1
'Kamuoliai 2'	2006	95.8	87.5	62.5	70.8	54.2	41.7	
'Boro' F_1	2007	25.0	29.25	12.5	20.8	0	8.3	8.2
'Kamuoliai 2'	2007	41.7	29.2	8.4	25.0	0	16.7	
LSD_{05} A	2006				5.4			
R_{05} A	2007				3.7			
LSD_{05} A × B	2006				18.0			
R_{05} A × B	2007				12.14			
		Disease intensity Ligos intensyvumas (%)						
'Boro' F_1	2006	60.4	70.9	66.7	60.4	54.2	75.0	10.7
'Kamuoliai 2'	2006	64.6	72.9	43.8	52.1	50.0	37.5	
'Boro' F_1	2007	25.0	29.2	8.3	16.7	0	8.3	8.5
'Kamuoliai 2'	2007	37.5	29.2	8.4	20.8	0	12.5	
LSD_{05} AB	2006				4.8			
R_{05} A	2007				3.8			
LSD_{05} A × B	2006				15.9			
R_{05} A × B	2007				12.6			

* *Note*: Variants of fertilization are shown in the methodical part
* *Pastaba*: Tręšimo variantai pateikti metodinėje dalyje

August of 2006 was hot and humid (HTK 3.2 – clear excess), and August of 2007 – cool and dry (HTK 0.83 – slight drought). After application of boron fertilizers, disease prevalence on root-crops of red beet cultivar 'Boro' F_1 in 2006 decreased 17.5 %, intensity – 19.2 %, on root-crops of red beet cultivar 'Kamuoliai 2' correspondingly – 31.5 % and 7.5 %, in 2007 correspondingly 10.8 % and 13.1 %, 15.9 % and 5.0 % (Table 3). Therefore, in the year favourable to scab prevalence boron fertilizers were more effective in red beet cultivar 'Kamuoliai 2'. The least scab prevalence and intensity on hybrid and cultivar root-crops in 2006 was observed applying fertilizer Boramin Ca, and in 2007 – on root-crops of cultivar 'Boro' F_1 fertilizing with Lyderis®Bor and on root-crops of cultivar 'Kamuoliai 2' fertilizing with Tradebor Mo.

When air temperature increased during vegetation period, scab prevalence (for red beet cultivar 'Boro' F_1 r = 0.88; for red beet cultivar 'Kamuoliai 2' r = 0.76) and intensity (correspondingly r = 0.88 and r = 0.85) increased also. The increasing amount of precipitation, on the contrary, decreased scab prevalence and intensity (scab prevalence correspondingly r = -0.90 and r = -0.79; intensity correspondingly r = -0.90 and -0.87).

Table 3. Spread of common scabies on red beet root-crop during harvesting
3 lentelė. Paprastųjų rauplių paplitimas ant burokėlių šakniavaisių derliaus nuėmimo metu

Babtai, 2006–2007

Hybrid / cultivar (factor A) Hibridas / veislė (veiksnys A)	Years Metai	Fertilization with boron (factors B)* Tręšimas boru (veiksnys B)						
		1	2	3	4	5	6	LSD_{05} B R_{05} B
Disease prevalence Ligos išplitimas (%)								
'Boro' F_1	2006	66.7	58.3	54.2	41.7	50.0	41.7	13.0
'Kamuoliai 2'	2006	87.5	58.3	45.8	62.5	70.8	41.7	
'Boro' F_1	2007	25.0	25.0	16.7	20.8	0	8.3	11.4
'Kamuoliai 2'	2007	41.7	29.2	29.2	12.5	20.8	37.5	
LSD_{05} A	2006				5.8			
R_{05} A	2007				5.1			
LSD_{05} A × B	2006				19.3			
R_{05} A × B	2007				16.9			
Disease intensity Ligos intensyvumas (%)								
'Boro' F_1	2006	66.7	45.8	54.2	45.8	50.0	41.7	11.9
'Kamuoliai 2'	2006	56.3	41.7	43.8	56.3	64.6	37.5	
'Boro' F_1	2007	25.0	25.0	16.7	20.8	0	8,3	9.1
'Kamuoliai 2'	2007	26.4	22.9	29.2	12.5	16.0	26.4	
LSD_{05} A	2006				5.3			
R_{05} A	2007				4.1			
LSD_{05} A × B	2006				17.7			
R_{05} A × B	2007				13.5			

* Note: Variants of fertilization are shown in the methodical part
* Pastaba: Tręšimo variantai pateikti metodinėje dalyje

According to the average data of 2006–2007 investigations, additional fertilization through leaves with boron more influences the yield of red beet cultivar 'Kamuoliai 2'. The standard red beet cultivar 'Kamuoliai 2' yield after fertilization increased on the average 1.1 t ha^{-1} (in 2006 – 0.3, in 2007 – 1.7 t ha^{-1}), and this one of cultivar 'Boro' F_1 increased only in 2007 (Fig.).

Root-crop yield of red beet cultivar 'Kamuoliai 2' during the both years of investigation mostly (in 2006 – 1.9 t ha^{-1}, in 2007 – 3.1 t ha^{-1}) increased after fertilization with Boramin Ca, in comparison with the yield of red beet grown without boron fertilizers. Economical efficiency of these boron fertilizers comprised correspondingly in 2006 4.9 %, in 2007 9.9 %; according to the average data of both years – 7.4 %. The yield of red beet cultivar 'Boro' F_1 in 2006 mostly (only 0.4 t ha^{-1}) increased after fertilization with Boramin Ca, and in 2007 – after fertilization with Boramin Ca and Lyderis®Bor (correspondingly 2.0 and 2.1 t ha^{-1}). Economical efficiency of these fertilizers was correspondingly in 2006 1.2 %, in 2007 – 4.0 and 4.2 %; according to the

average data of both years 2.6 % (only Boramin Ca). Probably applying Boramin Ca, the main influence did calcium and free amino acids present in the composition of the fertilizer.

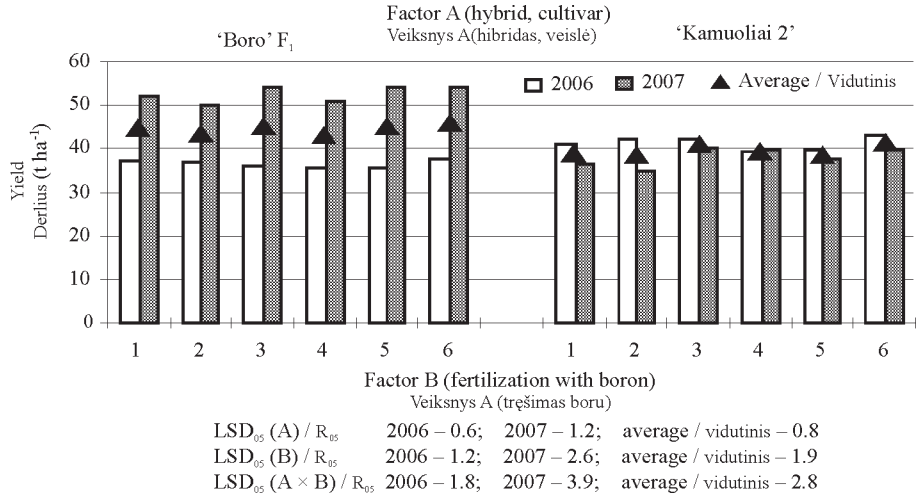

Fig. Influence of boron fertilizers on standard yield of red beet
Pav. Boro trąšų įtaka raudonųjų burokėlių standartiniam derliui

The increase of scab prevalence and intensity decreased red beet standard yield. The influence on the yield of cultivar 'Boro' F_1 was strong (correspondingly r = -0.91 and r = -0.95), and on the yield of cultivar 'Kamuoliai 2' – average (correspondingly r = -0.44 and r = -0.43).

Discussion. When it is warm (over 20 °C) and dry (humidity 50–70 %) during vegetation, the conditions for scab prevalence are very favourable (Ražukas et al., 2003; Davies et al., 1976; Schoneveld, 1974). It was established in light loamy Albeluvisol of Western Lithuania that hydrothermal coefficient slightly influenced scab prevalence (Repšienė, Mineikienė, 2006). The data of our investigations carried out at the LIH showed that the temperature increase increased and precipitation increase – decreased scab prevalence and intensity.

Potato resistance to common scab disease depends on genetic oneness and earliness of potato cultivars group (Ražukas ir kt., 2003; Klikocka, 2009). Trial results in Croatia showed that 'Desire' had significant higher percent of infected tubers with higher intensity of infection than 'Courage'. In wet season, there was no evident on scabies infection and referred that lime addition increased scab incidence (Poljak et al., 2009). Scab lesions table beet and potato can cause considerable reductions in quality, resulting in loss of marketable yield (Koike et al., 2006; Ražukas et al., 2003). 'Avon Early', 'Elsoms' 257 and 'Bikor' were the most resistant 'globe' beets, while 'New Globe' and 'Little Ball' – most susceptible. 'Boltardy' and 'Crimson Globe', the cultivars widely grown in the fen, were among the more susceptible. The significance of this noticeable effect is not yet known, but it may reflect cultivar differences in the

proportion of 'root' above and below ground (Lapwood et al., 1976). Our investigations showed that scab infection in root crops of red beet cultivar 'Kamuoliai 2' in both years of investigations was bigger than this one in red beet cultivar 'Boro' F_1.

The application of fertilizers with S, Mg and B decreased the tuber infection rate and intensity of Streptomyces scabies, increasing potato tuber yield (Klikocka, 2009). According to the average data of 2006–2007, at the end of July boron fertilizers applied in our investigations 29.2 % decreased scab prevalence on root-crops of red beet cultivar 'Kamuoliai 2', intensity – 18.3 %, in the autumn – 23.8 % and 6.3 %; on root-crops of red beet cultivar 'Boro' F_1 – at the end of July correspondingly 8.8 % and 3.7 %, in the autumn – 14.2 and 15.0 %. Fertilizer Boramin Ca was the most effective to red beet. Economical efficiency of this fertilizer was correspondingly 2.6 % and 7.4 %.

There was no effect of fertilizer material, application rate, or their interaction on the dry weight of alfalfa (Byers et al., 2001). Dried mass yield of sunflower was influenced by boron addition and dose 1.0 mg dm^{-3} provided the best yield and borax was more efficient (Marchetti et at., 2001). The data in the calcareous to a boron deficient soils of Pakistan showed that maximum sunflower biomass was produced with 1.0 mg kg^{-1} B, and application of $\geq$ 2.0 mg kg^{-1} proved toxic, resulting in drastic yield suppressions. Boron requirement can vary and depend on cultivar, plant age and plant part (Rashid, Rafique, 2005). A weekly foliar spray with boron (300 mg L^{-1} B) increased tomato marketable yield and fruit quality, reducing shoulder check incidence by 50 % compared to untreated plants (Huang, Snapp, 2009). In acid Oxisols of Brazil, boron application significantly increased common bean yield in only the first crop (Fageria et at., 2007). The foliar pulverization with boron brought benefit to the culture of beet, when boric acid or commercial product Supa bor® in concentration of 0.046 % was used (Saude et al., 2006, www.abhorticultura.com.). Boron and phosphorus did not affect yield of table beet, but boron application reduced incidence of root canker (Hemphill, 1982). Our investigations showed that boron fertilizers positively influenced red beet yield both of hybrids and cultivars.

Conclusions. 1. The increase of temperature increased scab prevalence (for red beet 'Boro' F_1 r = 0.88; for red beet 'Kamuoliai 2' r = 0.76) and intensity (correspondingly r = 0.88 and 0.85). The increase of precipitation decreased scab prevalence and intensity (scab prevalence correspondingly r = -0.90 and -0.79, intensity correspondingly r = -0.90 and -0.87).

2. Scab infection and disease intensity in root crops of red beet cultivar 'Kamuoliai 2' in both years of investigations was bigger than this one in red beet cultivar 'Boro' F_1.

3. Boron fertilizers positively influenced red beet yield both of hybrids and cultivars.

4. According to the average data of 2006–2007, at the end of July the applied boron fertilizers 23.8 % and 6.3 % decreased scab prevalence on root-crops of red beet cultivar 'Kamuoliai 2', on root-crops of red beet cultivar 'Boro' F_1 – correspondingly 14.2 and 15.0 %.

5. Scab prevalence and intensity increase decreased red beet standard yield. The influence on the yield of cultivar 'Boro' F_1 was strong (correspondingly r = -0.91 and r = -0.95), and on the yield of cultivar 'Kamuoliai 2' – average (correspondingly r = -0.44 and r = -0.43).

Gauta 2009 06 30
Parengta spausdinti 2009 08 11

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Boro trąšų ir meteorologinių sąlygų įtaka burokėlių užsikrėtimui rauplėmis ir derlingumui

O. Bundinienė

Summary

Burokėlių papildomo tręšimo boro trąšomis per lapus tyrimai atlikti Lietuvos sodininkystės ir daržininkystės institute 2006–2007 m. priesmėlio ant lengvo priemolio karbonatingajame sekliai glėjiškame išplautžemyje (*IDg8-k* / *Calc*(*ar*)*i- Epihypogleyc Luvisols – LVg-p-w-cc*). Dirvožemis buvo mažo humusingumo ir azotingumo, didelio fosforingumo, kalcingumo ir magningumo, vidutinio kalingumo ir kalingas, vidutinio ir didelio boringumo, šarmiškas. Tirta įvairių boro trąšų ir meteorologinių sąlygų įtaka rauplių išplitimui skirtingų burokėlių veislių ir hibridų šakniavaisiuose.

2007 m. rauplių paplitimas ir ligos intensyvumas tiek hibrido, tiek veislės burokėliuose buvo 2–3 kartus mažesnis negu 2006 m. Temperatūros didėjimas skatino rauplių plitimą ('Boro' F_1 burokėliams r = 0,88; 'Kamuoliai 2' veislės burokėliams r = 0,76) ir stiprino intensyvumą (atitinkamai r = 0,88 ir 0,85), o kritulių kiekio didėjimas rauplių išplitimą ir intensyvumą mažino (išplitimas atitinkamai r = -0,90 ir -0,79, intensyvumas r = -0,90 ir -0,87).

Abiem tyrimo metais 'Kamuoliai 2' veislės burokėlių šakniavaisiai buvo labiau užsikrėtę rauplėmis negu 'Boro' F_1 burokėliai.

Boro trąšos darė teigiamą įtaką tiek hibrido, tiek veislės burokėlių derliui ir mažino rauplių išplitimą bei intensyvumą (vidutiniais 2006–2007 metų duomenimis, ant 'Boro' F_1 burokėlių šakniavaisių atitinkamai 14,2 ir 15,0 %, ant 'Kamuoliai 2' veislės burokėlių šakniavaisių – 23,8 % ir 6,3 %). Efektyviausios burokėliams buvo Boramin Ca trąšos. Ūkinis šių trąšų efektyvumas buvo atitinkamai 2,6 % ir 7,4 %.

Rauplių išplitimo ir intensyvumo didėjimas mažino burokėlių standartinį derlių. 'Boro' F_1 šakniavaisių derliui įtaka buvo stipri (atitinkamai r = -0,91 ir r = -0, 95), 'Kamuoliai 2' veislės burokėliams – vidutinė (atitinkamai r = - 0,44 ir r = - 0,43).

Reikšminiai žodžiai: boro trąšos, derlingumas, hibridas, intensyvumas, išplitimas, raudonieji burokėliai, rauplės, veislė.