# THE CULTIVATION OF HALF-HIGH BUSH BLUEBERRY UNDER ORGANIC FARMING CONDITION

**MARGE STARAST [1,2], KADRI KARP [2], ELE VOOL [2], ULVI MOOR [2]**

*1 University of Tartu, Institute of Botany and Ecology*

*2 Estonian Agricultural University, Institute of Agricultural and Environmental Sciences*

*Kreutzwaldi 64, 50412 Tartu, Estonia*

*E-mail: starast@eau.ee*

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***Abstract***

For century's decades, blueberries maintained popularity in the North America, with a thriving commercial business in the Northeast USA and Canada. Today, blueberries are grown commercially in South America, Australia, New Zealand, Asia, Europe and South Africa. Blueberries contain number of beneficial photochemical contributing to health. These include: antioxidants, anthocyanins, bacterial inhibitors, folic acid, vitamins A and C, carotenoids, ellagic acid, and dietary fibers. The goodness of this little fruit, they are becoming more and more popular. It is important to use methods of blueberry cultivation that don't decrease quality of this valuable fruit. The aim of the study was to find out the influence of organic farming on production and yield quality of half-high bush blueberry. In the trial two half-high bush blueberry (*Vaccinium corymbosum x Vaccinium angustifolium*) cultivars 'Northblue' and 'Northcountry' were used and 6 different cultivation technologies (mineral soil without mulch (control); mineral soil with peat mulch; mineral soil with sawdust mulch; ground mixture (mineral soil + peat) with peat mulch; ground mixture (mineral soil + peat) with plastic mulch; mineral soil with plastic mulch) were employed. The blueberry experiment was carried out in South Estonia in 6-year-old blueberry plantation. The gap between the plants was 0.7 m and the space between two rows was 1.5 m. our results showed that the half-high bush blueberry was grown best when peat was used (ground mixtures and peat mulch). Average yield of blueberry plant was 56...1136 g. Significantly higher yield was obtained from variants with peat. The berry weight of cultivar 'Northblue' was 1.2...1.7g and of 'Northcountry 0.4...0.8 g. Using plastic mulch decreased weight of berries.

**Key words:** cultivation technology, *Vaccinium corumbosum x Vaccinium angustifolium*, peat, mulch, and yield

# INTRODUCTION

Blueberries are the most widely grown fruit crop in the USA and Canada. Today, blueberries are grown commercially also in South America, Australia, New Zealand, Asia, Europe and South Africa (Strik, 2005). In North European countries such as Norway, Sweden, Finland and Estonia, the cultivation of blueberries is also being considered. The climate conditions of North Europe are suitable for the lowbush and half-high bush blueberry cultivation (Bläsing, 1989; Haffner and Vestrheim, 1994; Karp et al., 2000; Paasisalo et al., 1994; Starast et al., 2002).

Blueberries contain number of beneficial photochemical contributing to health. These include: antioxidants, anthocyanins, bacterial inhibitors, folic acid, vitamins A and C, carotenoids, ellagic acid, and dietary fibers (Kalt and Dufour, 1997; Prior et al., 1998). The most immediate, and perhaps greatest, opportunity for marketing blueberries may be in promoting blueberries as a healthy food and they are becoming more and more popular. It is important to use methods of blueberry cultivation that don't decrease quality of this fruit. Berries will be more healthy and valuable if organic agriculture as farming without synthetic pesticides and conventional fertilizers is used. Blueberries are well suited to organic culture, and good markets exist for organically grown blueberries. Organic blueberries typically sell for about 20% more than conventionally grown blueberries (Krewer, 2001).

Weed control is one of the most important problems in organic farming of blueberries. Mulching is a practice often used by organic growers to keep down weeds. In addition to prevent weed growth, there are also other objectives of applying mulch, for example conservation of moisture in the soil; cool soil surface and stabilize soil temperature; add organic matter to soil, if mulch materials are organic in nature; reduce soil erosion on slopes; keep fruits cleaner; improve aesthetics of a landscape and add to property values (Rosel and Smith, 2001).

In organic agriculture the plant productivity is best if natural environment conditions are provided. Korcak (1988) has stated that blueberries are distinct among fruit crops in their soil and fertility requirements. As members of calcifuges, blueberries require an acidic (low pH) soil, preferably in the 4.8 to 5.5-pH range. Blueberries have a relatively low nitrogen requirement and thrive on organic fertilizers. Adding peat to the soil and using peat as mulch increased acidity of substrate (Starast et al., 2003). Peat

can also increase the nature and retention of potential plant nutrient (Haynes and Swift, 1985). Mycorrhizae probably play an important role in the biology of *Vaccinium* spp. and in the development of a sustainable agriculture, because Mycorrhizae may be beneficial in reducing the utilization of agricultural chemicals. Mycorrhizae fungus increases the uptake of nitrogen (Stribley and Reade, 1974) and phosphorus (Pearson and Reade, 1973), thereby improving nutrient levels and growth rates of calcifuges, which invariable grow on acidic or peaty soils in which the natural rooting processes are slower.

The aim of the study was to find out the influence of organic farming on production and yield quality of half-high bush blueberry.

## MATERIALS AND METHODS

The blueberry experiment was carried out in Tartu County, South Estonia (58° 15′ N, 26° 43′ E). By WRB classification (1994) the soil in the experimental area was Enti-Umbric Albeluvisol, and texture was sandy. The soil was well aerated, but not drought tolerant and relatively less fertile with low organic concentration. Humification intensity was moderate; soil microbiological activity was low (Kask, 1996). After plantation the soil acidity was $pH_{KCl}$ 5.7 in the field. The plantation was established in June 1997 with one-year-old *in vitro* plants. Half-high bush blueberry (*Vaccinium corymbosum* x *Vaccinium angustifolium*) cultivars 'Northblue' and 'North country' were used. The gap between the plants was 0.7 m and the space between two rows was 1.5 m. In the same rows plants of different varieties were planted in succession so that the best pollination was guaranteed. In the trial different cultivation technologies were:

1. Mineral soil without mulch (control);
2. Mineral soil with peat mulch;
3. Mineral soil with sawdust mulch;
4. Ground mixture (mineral soil + peat) with peat mulch;
5. Ground mixture (mineral soil + peat) with plastic mulch;
6. Mineral soil with plastic mulch;

Each plant received 10 l peat into the growing substrate before plantation (the variants 4 and 5). Plastic mulch (black polyethylene) was placed before planting. Organic mulch treatments were applied at a 70-cm-wide band centered on the plant row immediately after planting. The ground was covered with a 5-cm layer of peat or

sawdust mulch. We didn't use fertiliser and pesticides on the experimental field in any years.

The half-high bush blueberry fruit ripen gradually, so the yield was picked four times during the period from 31 July to 20 August 2003. It was the third crop year of the plantation. The total yield per plant and average berry weight were calculated and statistically analyzed.

Plants were measured using the portable Hydro N-Tester chlorophyll meter (Minolta Camera Co., Ltd. Japan) on 13 August 2003. The leaves from the middle part of the one-year-old shoots (not fruit bearing) were chosen for measuring.

In the autumn (10 October 2003), the blueberry plant height and width were measured and the number of shoots (longer than 15 cm) per plant was counted.

Two-way ANOVA table analyzed data. The least significant difference (LSD) at the 95% confidence level was calculated for all variants, for average influence of cultivation technologies and for average influence of cultivars.

## RESULTS

In the trial the yield of cultivars 'Northblue' was 72...1139 g and 'Northcountry' 56...500 g per plant (Figure 1). The cultivars 'Northblue' was grain-producing in all cultivation technology variants. Comparing two cultivars, bushes of 'Nortcountry' had 56% lower yield than 'Northblue'. Significant positive influence was found in all mulched variants. In the control variant plants had very low yield – only 64 g per plant on an average. Higher yield was obtained from the variant where ground mixture (mineral soil + peat) with peat mulch was used. Good productiveness was also in variant with plastic mulch. It was nearly 10 times more than in control variant.

Average berry weight of 'Northblue' remained between 1.2...1.7 g and 'Northcountry' 0.4...0.8 g (Figure 2). Fruits of half-high bush blueberry cultivars 'Northblue' were heavier compared to 'Northcountry'. Cultivation technologies influenced berry weight. The berry weight was significantly lower in variants where plastic mulch was used.

At the harvest time N-Tester value of 'Northblue' was 353...559 and of cultivar 'Northcountry' 362...573 (Figure 3). Average N-Tester value of cultivars 'Northblue' was significantly higher than 'Northcountry' but this trend didn't appear clearly in all variants of the experiment. Average influence of cultivation technologies showed that compared to the other variants, N-Tester value was significantly lower in control variant. The highest N-Tester value was recorded in variants where peat mulch was

used. The plastic mulch (variant 6) decreased N-Tester value compared to the peat mulch and peat mixed with the ground (variants 2,4,5).

In the sixth growing year plant height of the cultivar 'Northblue' was 31...51 cm and 'Northcountry' 16...41 cm (Figure 4). The plants of 'Northblue' were 12 cm higher than 'Northcountry' on an average. The use of mulches and peat mixed with ground significantly increased plant height. The highest plants were grown in the variants where peat mulch was used.

The width of the blueberry plants were 38...62 cm of cultivar 'Northblue' and 36...61 cm of 'Northcountry' (Figure 5). Average influence of cultivar on plant width was not significant. However the effect of cultivation technologies was considerable. Plant width was significantly smaller in control variant. On an average, mulches increased plant width by 16 cm. The widest bushes were grown with peat mulch.

At the end of vegetation period 'Northblue' plants had 0.3...5.8 shoots depending on cultivation technology (Figure 6). The shoot number of cultivar 'Northcountry' ranged from 0.2 to 6.3. Significant difference between cultivars was not observed. On an average more shoots were counted in variants where peat mulch was used. Compared to the control variant, the use of plastic mulch decreased shoot number but this difference was not significant.

## DISCUSSION

Blueberries have fewer pest problems than most other fruits, offering an advantage for organic production. In some areas, most insect and disease problems can be controlled through cultural manipulation and proper cultivars selection. Weather fluctuations and geographic seasonal advantage are the major economic considerations for variety selection (Strick, 2005). Winter hardiness is very important for blueberry cultivation in North Europe (Haffner and Vesterheim, 1994; Paasisalo et al., 1994). In our experiment two half-high bush blueberry cultivars 'Northblue' and 'North country' showed good productivity. Earlier studies proved that winter hardiness of these cultivars was high in Estonian climate conditions (Starast et al., 2002). The cultivars 'Northblue' had bigger berries, higher yield and plants. 'Northblue' is characterised by higher plants and yield than the cultivars 'Northcountry' (Lehmushovi and Ylämäki, 1994; Lubi et al., 1989).

The N-Tester and SPAD chlorophyll meters are becoming as a functional portable tools for plant evaluation. Many experiments have been carried out with various species to find out the correlation between chlorophyll meter readings and N content of plant

leaves (Porro, 2001). Shaahan et al. (1999) pointed out that N-Tester could also be used to assess Mg-status for some fruit trees. Our results showed that cultivars 'Northblue' had higher N-Tester value than 'Northcountry'. The half-high bush blueberry cultivars 'Northblue' demonstrated higher productivity and plants were in better condition thereby these cultivars are more recommended for cultivation in organic agriculture conditions.

On most sites, blueberries are relatively free of disease and insect pests, but weeds are an ever-present problem of cultivation. Several selective pre emergence herbicides (terbacil and diuron) were introduced to control grasses and some broadleaved weeds, and hexazinone was approved in Canada and in USA. This soil-applied; broad-spectrum herbicide has controlled many of the common woody and herbaceous weeds. However, the almost total reliance on the repeated use of hexazinone has introduced other problems, including shifts in weed species, the development of resistance, and soil degradation on vegetation-free soils. The highly soluble nature of the herbicide has resulted in widespread detection of hexazinone in groundwater adjacent to managed blueberry fields (Gous, 1996; Ismail and Yarborough 1982). Herbicides cannot be used in organic production. The addition of mulches is an effective possibility to reduce weed growth without chemicals. Mulching is used frequently in blueberry plantations because it serves as a weed controller, improves soil conditions, and prevents extreme soil temperatures (Blatt, 1992; Haynes and Swift, 1985; Peterson, 1987; Sanderson and Cutcliffe, 1991). The influence of mulches to the experimental area was essential. Compared to the control, total yield, N-Tester value, plant height and width were significantly higher in mulched variants. The blueberry plants had the best productivity when peat mulch was used. Amendment of organic material prior to establishment of blueberry generally increases growth and fruit yield (Blatt, 1992; Peterson, 1987; Sanderson and Cutcliffe, 1991). Korcak (1988) reviewed that pH of soil can be changed depending on the mulch selected. For example, peat moss will increase acidity. In our trial the soil acidity was $pH_{KCl}$ 5.7 after planting and it was not optimum level for blueberry cultivation. Organic mulches contain both major and minor mineral elements essential for plant growth. Using of peat can also increase the nature and retention of potential plant nutrient (Haynes and Swift, 1985). The using of plastic mulch didn't give very good effect in our study. Moreover, plastic mulch decreased the berry weight significantly. Inorganic mulch is a good weed controller but it cannot improve organic matter content and nutrient

content of soil. On the basis of the obtained experimental results it could be concluded that on light texture soils, where the soil reaction is less suitable for blueberry, it is possible to obtain the higher yield from blueberry plants by the usage of peat mulch.

## ACKNOWLEDGEMENTS

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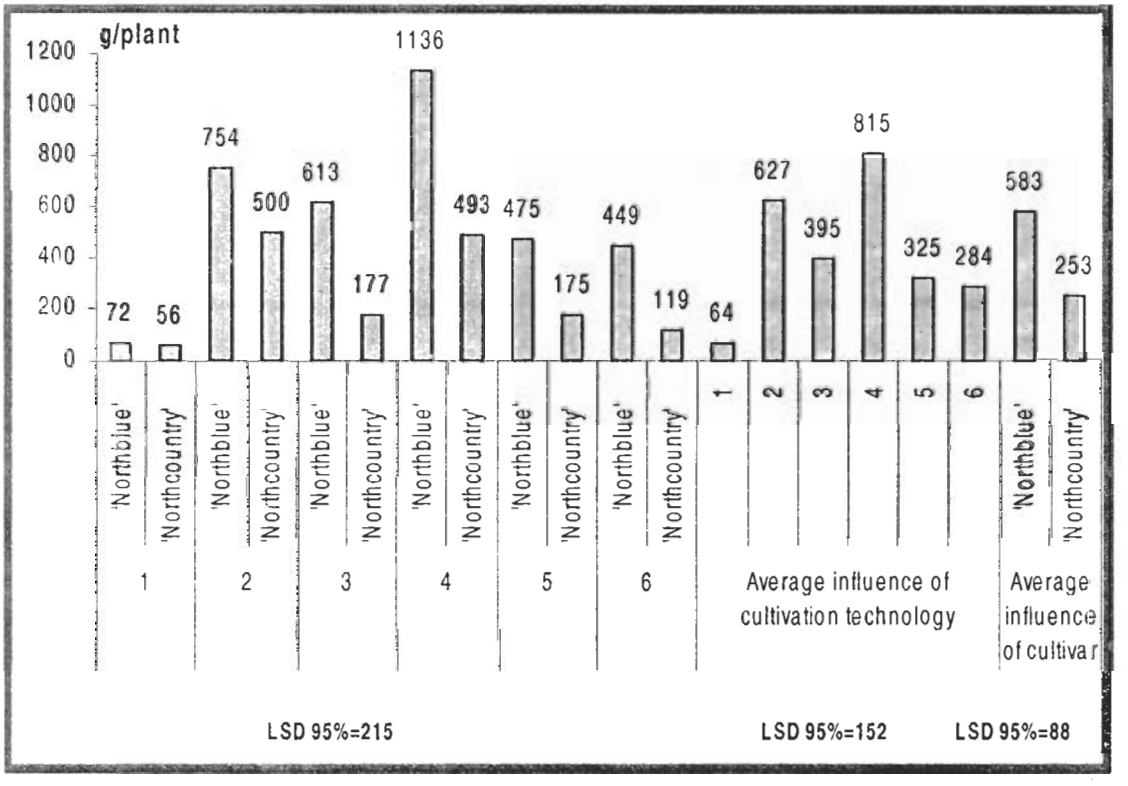



1- mineral soil without mulch (control);

2- mineral soil with peat mulch;

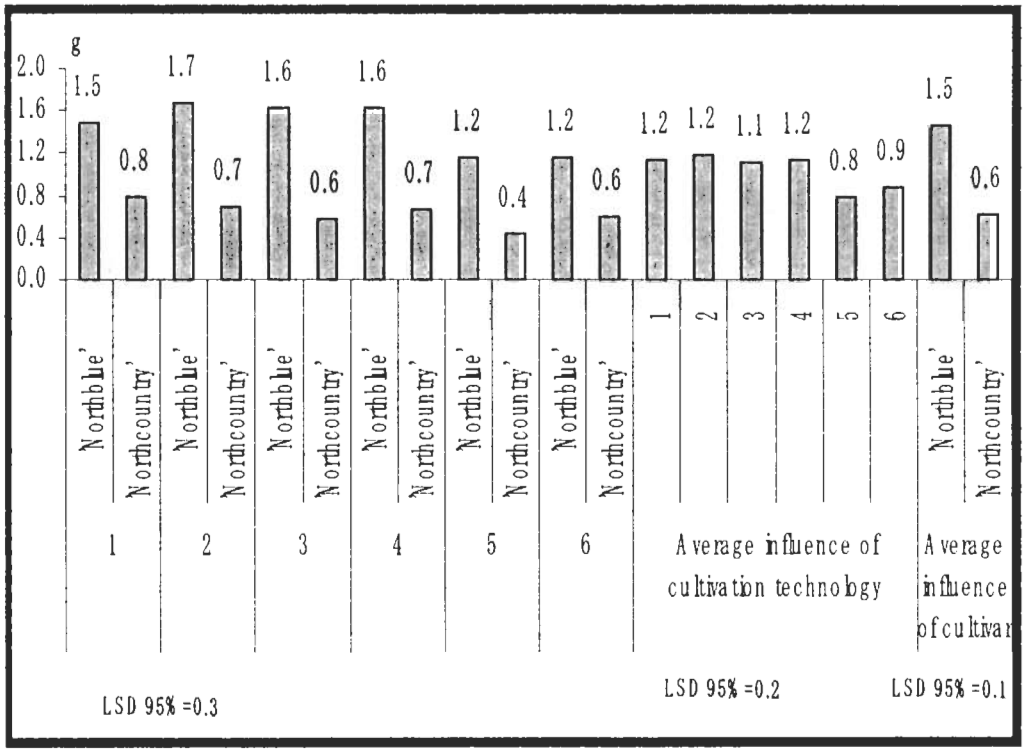
3- mineral soil with sawdust mulch;

4- ground mixture (mineral soil + peat) with peat mulch;

5- ground mixture (mineral soil + peat) with plastic mulch;

6- mineral soil with plastic mulch

Figure 1. Influence of cultivation technology on plant yield (g) of blueberry cultivars 'Northblue' and 'Northcountry'.




1- mineral soil without mulch (control);

2- mineral soil with peat mulch;

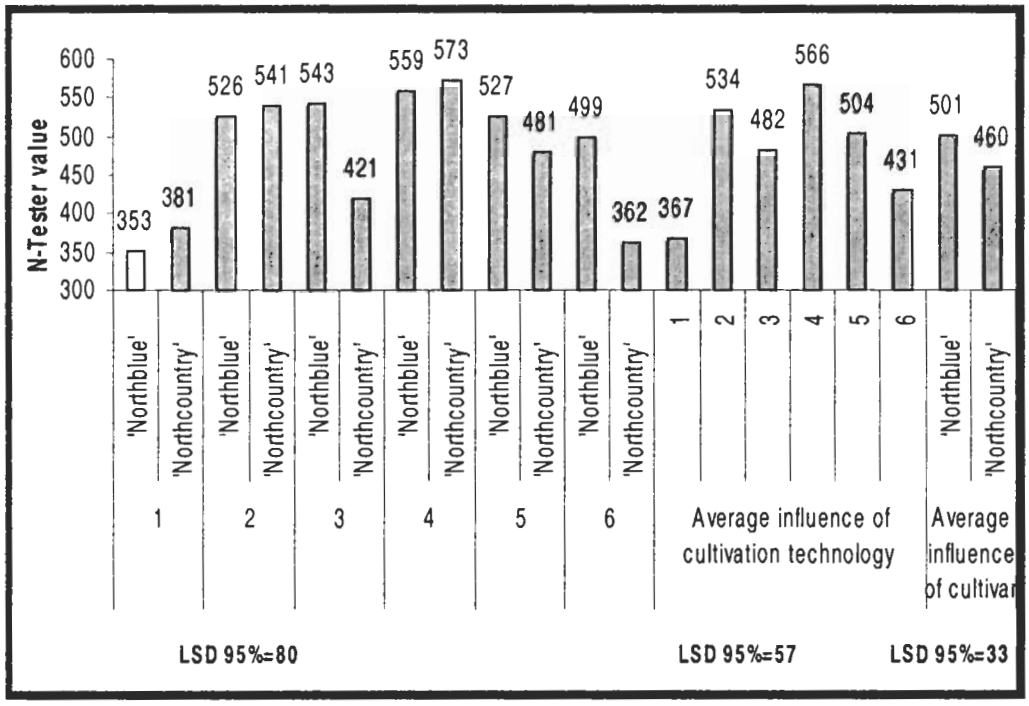
3- mineral soil with sawdust mulch;

4- ground mixture (mineral soil + peat) with peat mulch;

5- ground mixture (mineral soil + peat) with plastic mulch;

6- mineral soil with plastic mulch

Figure 2. Influence of cultivation technology on berry weight (g) of blueberry cultivars 'Northblue' and 'Northcountry'.




1- mineral soil without mulch (control);

2- mineral soil with peat mulch;

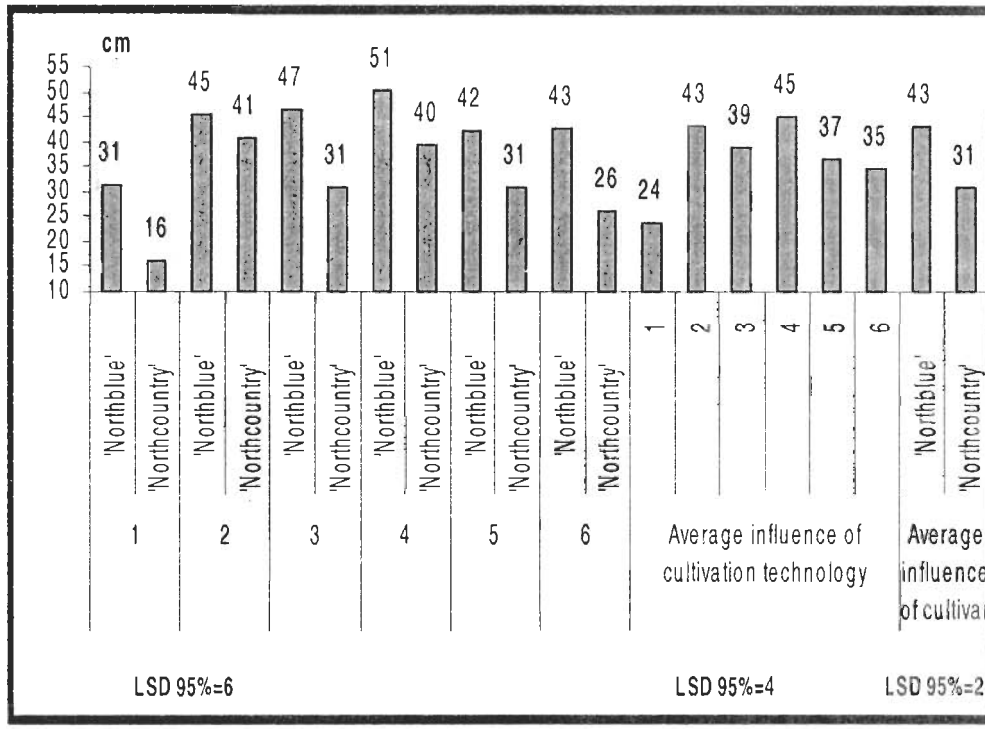
3- mineral soil with sawdust mulch;

4- ground mixture (mineral soil + peat) with peat mulch;

5- ground mixture (mineral soil + peat) with plastic mulch;

6- mineral soil with plastic mulch

Figure 3. Influence of cultivation technology on N-Tester value of blueberry cultivars 'Northblue' and 'Northcountry'.




1- mineral soil without mulch (control);

2- mineral soil with peat mulch;

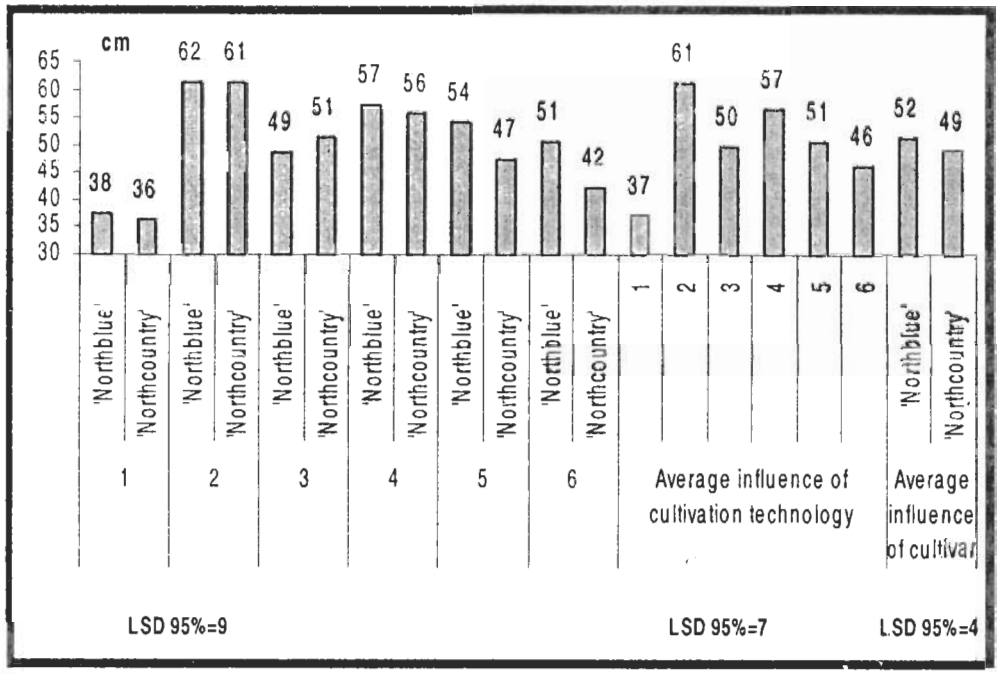
3- mineral soil with sawdust mulch;

4- ground mixture (mineral soil + peat) with peat mulch;

5- ground mixture (mineral soil + peat) with plastic mulch;

6- mineral soil with plastic mulch

Figure 4. Influence of cultivation technology on plant height (cm) of blueberry cultivars 'Northblue' and 'Northcountry'.




1- mineral soil without mulch (control);

2- mineral soil with peat mulch;

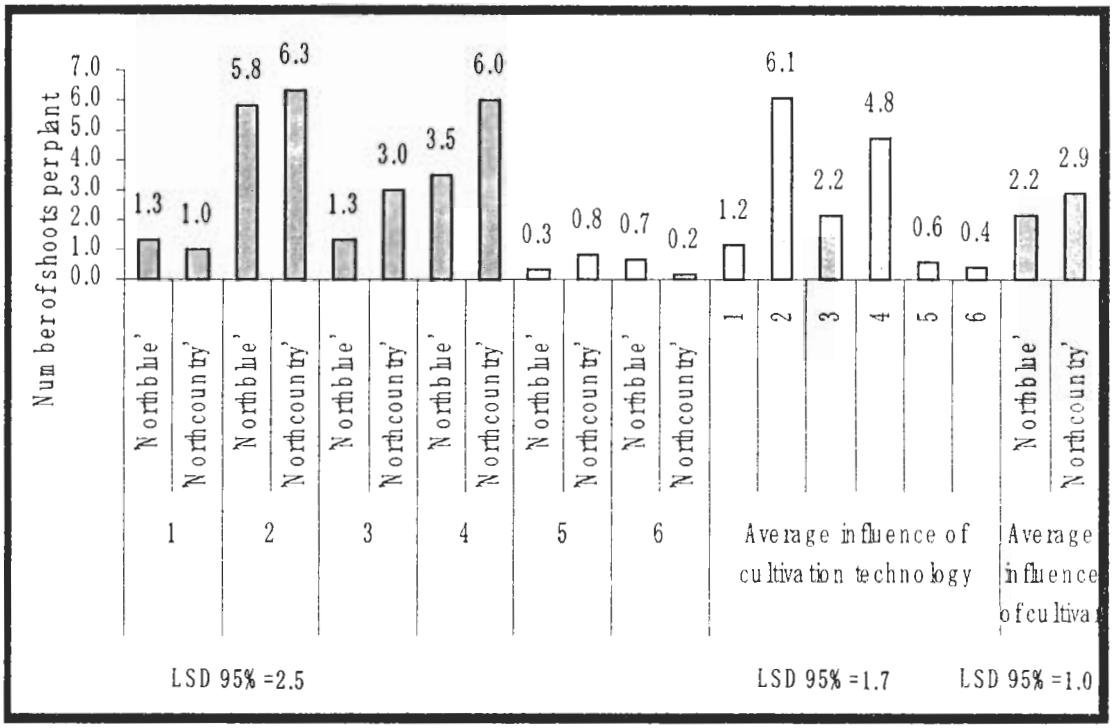
3- mineral soil with sawdust mulch;

4- ground mixture (mineral soil + peat) with peat mulch;

5- ground mixture (mineral soil + peat) with plastic mulch;

6- mineral soil with plastic mulch

**Figure 5. Influence of cultivation technology on plant width (cm) of blueberry cultivars 'Northblue' and 'Northcountry'.**




1- mineral soil without mulch (control);

2- mineral soil with peat mulch;

3- mineral soil with sawdust mulch;

4- ground mixture (mineral soil + peat) with peat mulch;

5- ground mixture (mineral soil + peat) with plastic mulch;

6- mineral soil with plastic mulch

Figure 6. Influence of cultivation technology on number of shoots per plant of blueberry cultivars 'Northblue' and 'Northcountry'.