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Influence of peat substrate composition on indicators of physiological vitality of cloudberry (*Rubus chamaemorus* L.) during the rooting period

Laura Āboliņa*, Andis Karlsons

University of Latvia, Institute of Biology, Laboratory of Plant Mineral Nutrition, O. Vācieša street 4, Riga, Latvia

* Corresponding author: abolina.la@gmail.com

Abstract: The growing of cloudberry *Rubus chamaemorus* in Latvia and globally is still done in rather small areas and harvests are mainly obtained in wild stands, thus making cloudberry cultivation in Latvia a promising research field. The aim of the study was to determine the most suitable substrate composition for successful rooting of cloudberry in greenhouse conditions. Results indicated that unfertilized peat (K) was the most suitable for cloudberry rooting, as it ensured the highest survival and vitality of plants in the first year.

Key words: cloudberry, rooting, peat, shoot physiological status, chlorophyll fluorescence

Introduction

The growing of cloudberry *Rubus chamaemorus* in Latvia and globally is still done in rather small areas and harvests are mainly obtained in wild stands, thus making cloudberry cultivation in Latvia a promising research field. Planting different berries in cutover peat bogs is a method successfully developed over the last 20–30 years. For example, in Latvia, the highbush blueberry *Vaccinium corymbosum* or the American cranberry *Vaccinium macrocarpon* are both widely commercially grown in extracted peatlands. Berry plantations are known to protect the upper peat layer from wind erosion and water loss, as well as to reduce GHG emissions. Production of high-quality berry yields and their highly demanded processed products also contribute to the local economic development. Determining the conditions for successful propagation of seedlings is an important aspect in the development of cloudberry cultivation technology. Therefore, the aim of the study was to determine the most suitable substrate composition for successful rooting of cloudberry in greenhouse conditions.

Material and methods

In 2020, hermaphroditic cloudberry variety *Nyby* (originating in Finland) was vegetatively propagated by dividing rhizomes and then planting them in 3 variations of peat substrate with different levels of acidity and nutrient supply. Variations were formed by mixing bare peat (K-without added lime or fertilizer), with limed and fertilized peat substrate (M1) in the following proportions: 1) K, 2) 1K:1M1, 3) M1. Rhizomes were divided into 10–15 cm long parts and planted in pots (11 × 11 × 15 cm in size). Only living parts of the rhizomes with a visible bud at the tip were planted (Fig. 1). A total of 300 new cloudberry seedlings were planted, 100 pots in each substrate variation.

The survival and vitality of plants were recorded in a non-destructive way. In 2020, in the middle of the growing season (July), when all the surviving buds had developed leaves, morphological parameters as number of young shoots, leaf amount and size were recorded to determine survival rates among substrates. In the second half of the growing season (August), when most of the leaves had fully developed, leaf plate size was measured for each variant (Fig. 2). In 2021, leaf measurements and survival recordings were carried out in May.

Figure 1. Cloudberry rhizome with a visible bud

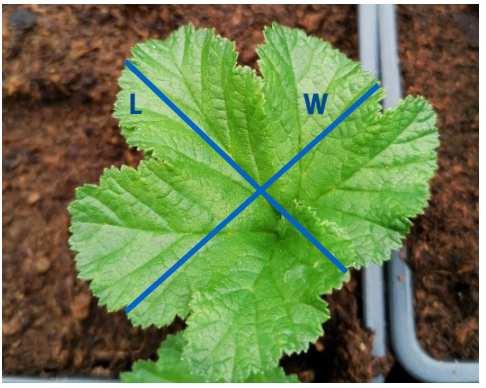

Figure 2. Leaf blade measurements. Leaf size = (L + W)/2

In 2020, chlorophyll fluorescence activity (Fv/Fm) and the complex fluorescence parameter Performance Index (PI) were measured using a chlorophyll fluorimeter *Handy PEA*, which indicate the overall physiological status of plants. The concentration of total *a* and *b* chlorophyll in SPAD units was measured with a chlorophyll meter, by which it is possible to detect changes in leaf chlorophyll as a reaction to various stressors, the parameter also indicates the general condition of the plant (Neufield et al., 2006, Yuan et al., 2016). Measurements were taken 3 times during the growing season (n = 30).

Results and discussion

First year results marked higher rooted cloudberry vitality and photosynthetic productivity in the bare peat variant (K), which held the highest values of all three chlorophyll-related parameters ($p < 0.05$). The optimal value of Fv/Fm is considered to be a result above 0.800, indicating good vitality of the plant (Öquist et al., 1992; Andersone et al., 2011). Only the leaves from cloudberries grown in substrate K reached this value. Meanwhile, the lowest values for these indicators were characteristics for cloudberries in substrate M1. The highest survival rates (number of shoots and leaves) were also observed in variant K – 78 young shoots with a total number of 218 leaves; the lowest rates – in variant M1: 24 young shoots with a total number of 51 leaves.

In the second year of development, describing the productivity of rooted cloudberry rhizomes, the highest results corresponded to M1 – on average 4.1 shoots per pot. It should be noted that in the first year, the rooting of cloudberry in substrate M1 was the least successful. For variant K, an average of 3.4 seedlings per pot were found.

There were no significant differences between the variants regarding the size of leaf blades in the first year: in substrate K the average leaf size was 4.47 cm, in 1K1M1 – 4.56 cm, in M1 – 4.52 cm (Fig. 3).

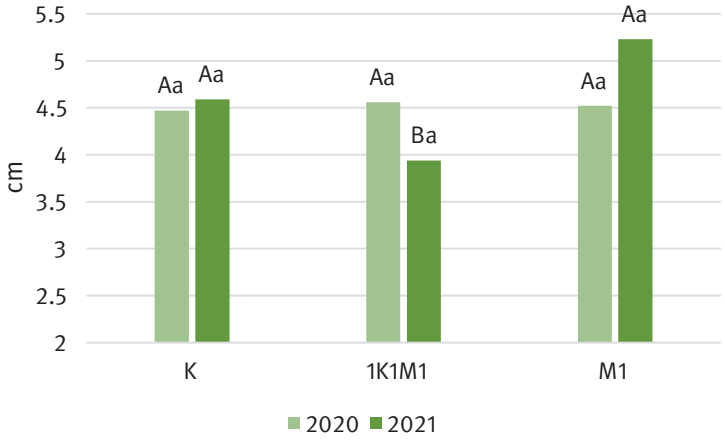

Figure. 3. Average cloudberry leaf blade size by substrate in study years 2020 and 2021. Values with different letters differ significantly ($p < 0.05$), according to Student's t-test
[1] Uppercase letters compare variants within a year.
[2] Lowercase letters compare two study years for each variant.

In the second year, the largest average leaf size was obtained for cloudberry seedlings grown in the nutrient-richest substrate M1 – 5.23 cm. However, differences between K and M1 were not significant (t-test), leaf size in substrate K on average was 4.59 cm. Only the 1K1M1 variant (3.94 cm) differed significantly (t-test, $p < 0.05$). Overall, there were no significant differences in either variant between study years regarding leaf size.

When propagating cloudberry, successful rooting is essential for high survival rates of rhizomes and their ability to form young shoots and vital leaves. According to these criteria, results indicated that unfertilized peat (K) was the most suitable for cloudberry rooting, as it ensured the highest survival and vitality of plants in the first year. Unfertilized or slightly fertilized peat substrate could be considered as most suitable for propagated cloudberry rooting.

In contrast, the heavily fertilized M1 substrate is not considered suitable for rooting, since the high concentrations of most nutrients, as well as too high pH and electric conductivity levels can suppress the development of seedlings in the first year. However, in the second year, higher green mass production in M1 indicated the positive effect of fertilizer on the rooted cloudberry to form shoots and leaves in further development. After rooting, cloudberry seedlings should be fertilized with low doses of fertilizer as it enhances growth of leaves and shoots. Further research including fertilizer and moisture effects on cloudberry production must be done to understand the preconditions of the first steps of cloudberry propagation and commercial growing.

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