The cowberry (*Vaccinium vitis-idaea* L.): the perspective of utilization of the aboveground biomass and preservation of its resources

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This article presents an overview of the cowberry distribution and the resources of its aboveground biomass in the pine stands of Lithuania. The possibilities and perspective of medicinal raw material (leaves of cowberry) preparation in the pine stands of *Pinetum vacciniosum*, *Pinetum vaccinioso-myrtillosum* and *Pinetum myrtillosum* types are substantiated. The collecting of cowberry leaves by clear cut off the aboveground biomass affects the development of cowberry local population essentially. The largest resources and most vigorous regrowth of the cowberry aboveground biomass are in the pine stands *of Pinetum myrtillosum* forest type. It is reasonable to harvest cowberry leaves every 7 years here.

Key words: cowberry, resources, regrowth, clear cut off, aboveground biomass, medicinal raw material, collecting

Introduction

The current economic policy of forest management and use aims at producing the largest profit from forest areas and at protecting their resources. It means use and protection not only of wood resources, but also all possible resources - mushrooms, berries, medicinal plants, etc. The value of those resources (usually called "non-wood forest resources") sometimes may have considerable influence on the economic value of forest plots.

The forest medicinal plants make up an important part of non-wood forest resources. There are over 100 species of medicinal plants represented in the forests of Lithuania (Butkus et al., 1987). Some of them are rare and protected by the law, others are common and could be gathered in forests for medicinal purposes.

The cowberry (red bilberry, lingonberry) *Vaccinium vitis-idaea* L. is a shrub plant belonging to taxonomic family *Ericaceae* DC. This species is important as a producer of tasty and valuable wild berries. However, cowberry is important also as a medicinal plant - there is 8 to 19 % of arbutin (by absolutely dry leaves mass) in its leaves. It is about 1.5 times less in comparison with the amount of arbutin in the leaves of spreng bear-berry - *Arctostaphylos uva-ursi* L. (Belonogova, 1979), however spreng bear-berry occurs relatively rare in the dry and pure pine forests of Lithuania. Therefore it could be successfully changed by the cowberry. The leaves of cowberry and bear-berry are being used in homeopathic as well as in folk medicine. The demand of cowberry leaves for medicinal purposes is estimated to 5.8 tons in 1993 with annual gathering only 1.8 tons (Budriuniene, 1994).

Cowberry is a widely distributed plant of Lithuanian forests. The cowberry populations are located mainly in the forests of *Vacciniosa*, *Vaccinioso-myrtillosa* and *Myrtillosa* forest types in Lithuania. The average cover of the plot unit by cowberry is found to be 5.2 % in the forests of *Vacciniosa* type, 2.8 % in the forests of *Vaccinioso-myrtillosa* type and 4.1 % in the *Myrtillosa* type (Karazija, 1977). The pine forests make up a major part of these forest types, so the majority of the cowberry local populations are in pine forests too.

The analysis of distribution of cowberry local populations has shown, that the main part of them (about 91%) are located in the conditions of limited illumination (high density or thick young stands), and only about 9% of them are located under good illumination conditions (the stands with density 0.3-0.5), where they produce normal yield (Daubaras, 1987).

It is mostly profitable to cut off the aboveground biomass of cowberry in the stands aged from 30 to 70 years so and on the areas of mature forest selected for clear cuttings. It is possible to collect cowberry medicinal

raw material in the forest stands with density over 0.6, where illumination is too low and cowberry does not fruit.

Expedience of cowberry local populations use for leaves collecting in the mature pine stands selected for logging was determined by the fact, that logging works affect grass cover of forest very drastically. The cowberry cover on cut forest areas reduces 2 to 3 times in comparison with that in mature stands. The remaining cowberry ramets are considerably injured mechanically. Similar injury of the cowberry populations is noted in other countries too (Kardell , 1980).

Propagation by rhizomes is the main type of cowberry propagation. It makes a possibility of fast regrowth of the aboveground biomass even after its complete cut off. The collecting of medicinal raw material by clear cutting the aboveground biomass is the most simple and perspective method.

The objective of this research was to find out the medicinal raw material collecting system for cowberry taking into account the preservation of their natural resources.

Material and methods

The results presented in this work are obtained with the aid of data analysis of the observations in the permanent and temporal research plots. These plots were located in the pine stands of South-eastern Lithuania. The plots with cowberry local population clear cut off experiment as well as the control plots were located in the pine forests of *Pinetum vacciniosum (P. vac.), Pinetum vaccinioso-myrtillosum* (*P. vac.-myrt.*) and *Pinetum myrtillosum* (*P. myrt.*) forest types. The experimental and control plots were located in the same taxonomic and environmental conditions (the stands aged 65-70 years, density - 0.67-0.74). The areas of research plots were 4 sq. meters with 4 replicas for every type of above mentioned pine stands.

The whole aboveground biomass in all investigated plots was cut completely the first year of investigation. The research was conducted for 4 years after cut off. The following indices were recorded for characterization of cowberry local population regrowth intensity: an increase in cover percentage (%), the height of ramets, the annual length increment of rhizome leafy shoots and basal shoots (cm), the average weight of the 100 air-dried leaves, mass of the regrown leaves and the whole aboveground biomass (g).

The correlation and regressive analyses were applied for evaluation of the relationship between the different indices. The essence of differences between the data on the experimental (clear cut areas) and control plots was evaluated in above mentioned pine stands of different forest types. The acceptable level of reliability was not less than 95%.

Results and discussion

The total amount of the cowberry aboveground biomass in the stands of different forest types depends on the occurrence of this species in the herbage covering, cover density (magnitude) as well as on soil fertility.

The average reserves of the fresh cowberry aboveground biomass are about 65 g/m^2 with the average cover of about 6 % in the pine stands of *Vacciniosa* forest type, 222 g/m^2 with the cover of 28 % - in the pine stands of *Vaccinioso-myrtillosa* forest type and 317 g/m^2 with the cover of 25 % in the pine forests of *Myrtillosa* forest type. The amount of the aboveground biomass was 1274 g/m^2, 1030 g/m^2 and 1317 g/m^2 in the above mentioned forest types respectively after the recalculation of cover percentage up to 100% was made. The weight percentage of dry leaves in the whole aboveground biomass is similar in the pine stands of *Vacciniosa* and *Vaccinioso-myrtillosa* forest types - 30% and 32% respectively, and by far larger in the pine stands of *Myrtillosa* forest type - 42%. This quantity is found to be 54% by some researchers (Bogdanova, 1975). The average reserves of the cowberry dry leaf mass is 210 kg/ha in the pine stands of *Vacciniosa* forest type, 660 kg/ha in the pine stands of *Vaccinioso-myrtillosa* forest types and 1350 kg/ha - in these of *Myrtillosa* forest type.

The two kinds of shoots indicate the regrowth and spreading energy of the cowberry ramets after clear cut off the aboveground biomass. The new shrubs are formed of the rhizome leafy shoots. It has been found, that the annual length increment of the rhizome leafy shoots is different in the pine stands of different forest type. The first year after cut off the increment of rhizome leafy shoots in the pine stand of *P. vaccinioosum* type was essentially different in the experimental and control plots (Fig. 1). The same tendency was noted also in the stands of *P. vaccinioso-myrillosum* and *P. myrtillosum* types. The differences between absolute sizes of the annual length increment of shoots in above mentioned stands were caused by soil fertility. However, the analysis of variance had shown, that the first year changes in the rhizome leafy shoot length

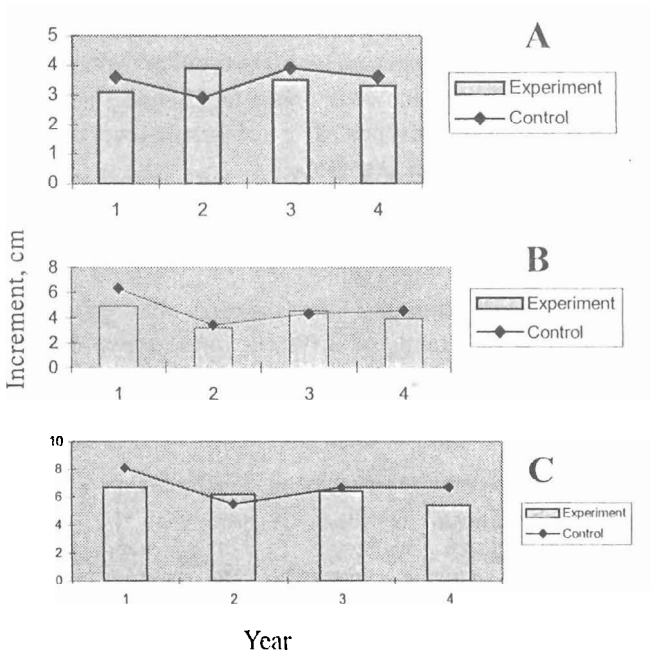

Figure 1. The average annual increment of the cowberry rhizome leafy shoot length (cm) in the stands of *Pinetum vacciniosum* (Λ), *Pinetum vaccinioso-myrillosum* (B) and *Pinetum myrtillosum* (C) forest types after clear cut off the aboveground biomass

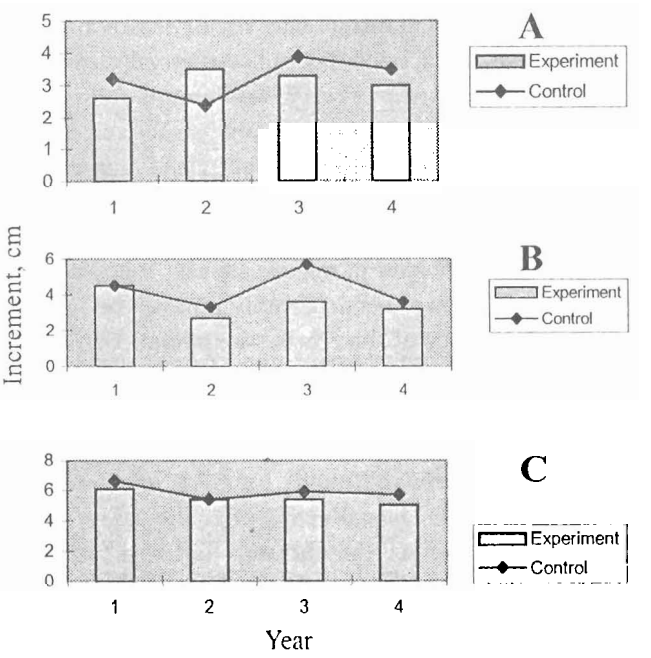

Figure 2. The average annual increment of the cowberry basal shoots length (cm) in the stands of *Pinetum vacciniosum* (Λ), *Pinetum vaccinioso-myrillosum* (B) and *Pinetum myrtillosum* (C) forest types after clear cut off the aboveground biomass.

increment were influenced by cut off the aboveground biomass on 95% in the stands of *P. vacciniosum* and on 99% in the stands of *P. vaccinioso-myrtillosum* and *P. myrtillosum* forest types. The rhizome leafy shoot length increment was essentially larger in the experimental plots in the stands of *P. vacciniosum* and *P. myrtillosum* types 2 years after cutting, and there was no difference between the experimental and control plots in the stands of *P. vaccinioso-myrtillosum* type. There was no essential difference between the experiment and control in all forest types 3 years after cutting. The increment was essentially lower in the experimental plots in the stands of *P. vaccinioso-myrtillosum* and *P. myrtillosum* types 4 years after cut off experiment.

The growth of the basal shoots represents the ramet forming energy. It depends on the age of ramets and especially on illumination conditions (Daubaras, 1987). The first year after clear cut off (Fig. 2) the annual length increment of the basal shoots was essentially lower in the experimental plot in comparison with the control in the pine stand of *P. vacciniosum* type. No essential difference was observed in the stands of *P. vaccinioso-myrtillosum* and *P. myrtillosum* types. The 2-nd and 3-d year after cut off the average annual length increment of the basal shoots was essentially lower in the experimental plot in comparison with the control plot in the stands of *P. vaccinioso-myrtillosum* type. 3 years after cut off there was no essential difference between the length increment of basal shoots in the experimental and control plots in the pine stand of *P. myrtillosum* type. The 4th year after cut off the length increment was essentially lower in the experimental plot in the stand of *P. myrtillosum* forest type.

The size of the shoot annual increment has a very strong influence on biomass production. Leaf component amounts to 79% as compared with the rest of stems in the biomass of the previous year. For old shoots this ratio is 63% and 37% (Paal , Paal , 1981). Λ decrease in the annual shoot length increment can considerably reduce regrowth intensity.

Observations of height growth of cowberry ramets had shown that 2 years after cut off it increased up to 5.5 cm in the pine stands of *Vacciniosa* forest type and it was 21 % less in comparison with the height in the control plots (7.0 cm). The analysis has shown, that the difference between these data is essential. The average height of cowberry in the pine stands of *Vaccinioso-myrtillosum* forest type was 6.2 cm or 24% less than in the control plot (8.2 cm). The difference between them was essential too. The

height of ramets in the pine stands of *Myrtillosa* forest type was 9.5 cm and here was no essential difference in comparison with the control plot, where it showed 9.6 cm. These data suggest, that the most rapid increase in the height of the ramets is in the pine stands of *Myrtillosa* forest type, and, from this point of view, the most perspective collecting of raw material should be here too.

Determination of cover percentage is the most common way to evaluate the perspective of cowberry local populations for collecting medicinal raw material. An increase in cowberry cover after clear cut off the aboveground biomass is most rapid in the stands of *P. myrtillosum* type, and slowest in the stands of *P. vacciniosum* type (Fig. 3). The average cover after 4 years reaches practically the same size as before the cut off in the stands of *P. vaccinioso-myrtillosum* and *P. myrtillosum* types. Bandzaitiene (1997) has noted, that cover in the stands of *P. vacciniosum* type in 4 years reach about 75% of previous and in the stands of *P. vaccinioso-myrtillosum* the 3d year is practically equal to the cover before clear cut of the aboveground biomass.

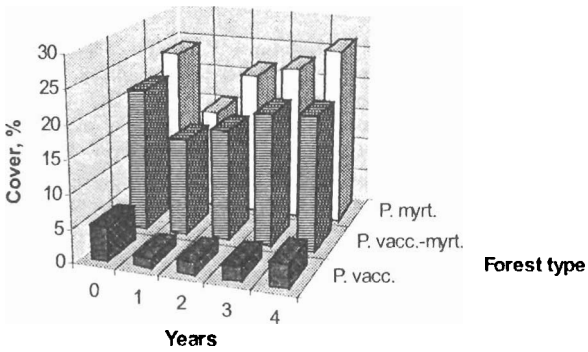

Figure 3. An increase in cowberry local populations cover in the experimental plots in the stands of *Pinetum vacciniosum, Pinetum vaccinioso-myrillosum.* and *Pinetum myrtillosum* forest types after clear cut off (0 - cover in the experimental plots before cut off)

The regrowth of the aboveground biomass is the main characteristic for evaluation of the cowberry population after clear cut off. In the stands of *P. vacciniosum* type the regrowth is so slow, that even 4 years after cut off the aboveground biomass makes up only 23% of the previous one (Fig. 4). The regrowth is faster in the stands of *P. vaccinioso-myrtillosum* type : biomass weight after 4 years is found to be 54% of the previous one. The most vigorous regrowth of the biomass was observed in the pine stands of *P. myrtillosum* type. Over 4 years it constituted 87% of the pre-cut value. In accordance with the data obtained by Mironov (1986)

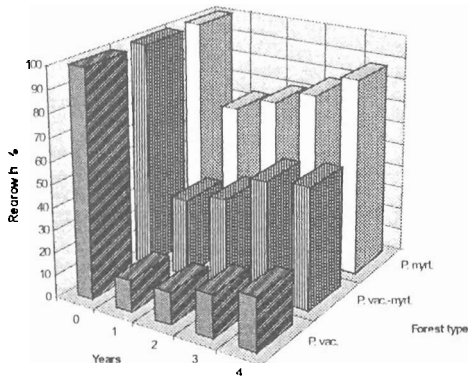

Figure 4. The regrowth of cowberry aboveground biomass (in % from the previous) in the experimental plots in the stands of *Pinetum vacciniosum, Pinetum vaccinioso-myrillosum* and *Pinetum myrtillosum*, forest types after clear cut off.

after 4 years the regrowth of the aboveground biomass in the stands of *P. vaccinioso-myrtillosum* and *P. myrtillosum* types constitutes 84%. Pihlik (1993) has noted, that complete regrowth of cowberry after clear cut of the aboveground biomass is in 5-6 years.

A negative influence of clear cut of the aboveground biomass on the weight of leaves was observed in all the types of pine stands during the first year of the investigation. The weight of 100 air-dried leaves was 44%, 13% and 22% less in comparison with that before clear cut of the aboveground biomass in the pine stands of *P. vacciniosum, P. vaccinioso-myrtillosum* and *P. myrtillosum* types, respectively.

The height of ramets and cover percentage are the two characteristics of cowberry populations that indicate possible resources of dry leaves best. It must be noted, that the amount of the aboveground biomass is determined by cover percentage at 62% and influence of the ramets height is considerably less (only about 2%). The resources of air-dried cowberry leaves depending on the average cover and height of shrubs in the forest stands of *P. vacciniosum* and *P. vaccinioso-myrtillosum* types were calculated and displayed in Table 1.

Conclusions

1. The largest resources of cowberry aboveground biomass are in the pine stands of *Pinetum myrillosum* forest type.

2. The collecting of medicinal raw material (leaves of cowberry) by cutting off the whole aboveground biomass affects the development of cowberry local populations essentially, especially via the growth energy of rhizome leafy shoots and basal shoots.

Forest type	Height of the shrubs, cm	Cover, %									
		5	10	15	20	25	30	35	40	45	50
		Air-dried leaves mass, kg/ha									
P. vac.-myrt.	8	80	170	270	360	460	550	650	750	840	940
	10	100	190	290	380	480	570	670	760	860	950
	12	120	210	300	400	500	590	690	780	880	970
	10,6 (average height)	100	200	290	390	480	580	670	770	860	960
P. myrt.	9	90	180	280	370	470	560	660	750	850	940
	11	110	200	300	390	490	580	680	770	870	960
	13	120	220	310	410	500	600	690	790	890	980
	15	140	240	330	430	520	620	710	810	900	1000
	17	160	250	350	440	540	640	730	830	920	1020
	12,3 (average height)	120	210	310	400	500	590	690	780	880	970

Table 1. Resources of air-dried leaves in the stands of *Pinetum vaccinioso-myrillosum* and *Pinetum myrtillosum* forest types depending on ramets height and cover of the cowberry local populations

3. The most vigorous regrowth of the aboveground biomass was observed in the pine stands of *Pinetum myrillosum* forest type - after 4 years it comprised 87% of the pre-cut value.

4. The clear cut of the aboveground biomass should be done in the pine stands of *Pinetum myrillosum* forest type every 7 years with the guaranty to preserve natural resources of cowberry.

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БРУСНИКА (*VACCINIUM VITIS-IDAEA* L.) – ПЕРСПЕКТИВЫ ИСПОЛЬЗОВАНИЯ НАДЗЕМНОЙ БИОМАССЫ И СОХРАНЕНИЕ ЕЕ РЕСУРСОВ

Р. Даубарас

Резюме

В статье описано распространение брусники и запасов её надземной биомассы в лесах Литвы. Обосновываются возможности и перспективность заготовок лекарственного сырья - листьев брусники (*Folium vidis-idaea*) в сосновых древостоях наиболее распространенных типов - сосняках брусничных, бруснично-черничных и черничных. Из результатов опыта по заготовке лекарственного сырья путем срезания всей надземной биомассы выяснилось, что на величину годичного прироста корневищных и базальных побегов заготовка влияет существенно. Наибольшие запасы биомассы брусники и наиболее интенсивное восстановление зарослей происходит в сосняках черничных, где заготовку лекарственного сырья целесообразно проводить не чаще чем один раз в 7 лет.

Ключевые слова: брусника, запас, восстановление, надземная биомасса, сплошная срезка, лекарственное сырье, заготовка.