

Vegetable Cultivation in the montane zone of the Western Carpathians, Romania

Key words: vegetable cultivation , montane zone

Abstract. With increasing altitude, cultivation of vegetables becomes more and more risky due to low temperatures and a short vegetation period. Only relatively few vegetables remain to be cultivated in favourable microsites.

25 species and varieties of vegetables were tested in the montane village Ghetari, situated in the Western Carpathian Mountains (or Apuseni Mountains). Onions, winter onions, chives onions, garlic, peas, celery, cabbage, salad, garden chicory, lovage, tarragon and rhubarb can be grown successfully up to 1150 m a.s.l..

Introduction

The growth of vegetables in montane areas is impeded by lower temperatures and a shorter vegetation period. In the Romanian Western Carpathians, vegetable species tolerant of low temperatures are cultivated in family gardens, and traditionally include cabbage, onions, carrots, and parsley.

Because of increasing demand for vegetables due to the extension of agro-tourism in the Western Carpathian Mountains, it will be necessary to diversify the assortment of cultivated vegetables and to improve the cultivation techniques. The study is an integrated part of "Proiect Apuseni", which is a development research program in the Western Carpathians, initiated and coordinated by the University of Freiburg (Germany), in collaboration with Romanian partners, and financed by the German Ministry of Education and Research (BMBF).



Results and Discussions

The experimental cultivation was placed on a Terra Rosa (red soil; table 1). The average temperature of the year is 4.5° C, and of July 13° C (table 2). Ca. 210 days per year are without frost.

In the area of Glacier - Poiana Călineasa, with the aid of diagrams of correlation with altitude, the mean value of relative humidity of air was estimated to 80-81%.

In Western Carpathian Mountains, the smallest precipitations quantities that have fallen in the period of 1961-2000, have been between 600 mm and 700 mm. Exception was made by Viădeasa (1400) and Stâna de Vale stations, where the precipitations haven't fallen under 1200 mm.

In the studied area, the average temperatures are over 10° C only in May, June, July, August and September. In organization of vegetable cultures an important aspect that must be taken in consideration is the fact that the minimum temperatures are often negatively in May and low enough in June.

The species and the varieties of vegetables tested under the above-mentioned pedo-climatic conditions and an assessment of the way these have reacted are presented in the table 3.

It can be seen that out of the 25 species and varieties of vegetables, 12 have reacted very good, 9 good, 2 satisfactory and only three species have reacted unsatisfactory. Therefore results that the assortment of vegetables in this area could be diversified by growing species, which are less or not in the least known by the locals, and which have favorable conditions of growing.

Regarding the growth of vegetables in the specific conditions of Scărișoara Glacier area, it has been found that protection of plants by direct covering with special materials ensures a rhythm of growth more accelerated comparative with unprotected plants (table 4). As for example, in case of early cabbage, the protected plants have been with 125 % higher; the diameter of rosette was with 59,4% larger and the number of leaves with 48,5% higher than in case of the unprotected plants. Similar results were obtained to summer cabbage, cauliflower, kohlrabi, broccoli and lettuce.

Considering the specific conditions of the area, the setting up of growings of the first urgency could be performed from the second decade of April (15.20.IV), when there were set up the growings of: carrot, parsley, parsnip, pea, salad, radishes, red beet, cabbage, turnips. During the last decade of May there were set up more pretentious to heat growings (tomato, pepper, cucumber) and growings for the autumn production (autumnal cabbage, autumnal turnip, leek, celery).

Specific to the performance of the vegetation phases is the extension of the vegetation period with 2 - 3 weeks approximately (Graphic 1).

Material and Method

The experiment was initiated in 2001 and it consisted in studying a diversified assortment of species and varieties of vegetables, observing, in the first phase, their way of reacting in the specific conditions of the mountainous area.

The experimental growing parcels were placed in the area of Scărișoara Glacier, at 1150 m altitude. Twenty-five species and varieties of vegetables were tested in 2001 and thirty species in 2002, using, almost exclusively, Romanian sorts.

During the vegetation period, a special attention was paid to the setting up of the main phenological phases of growth in non-protected conditions.

To increase the diversity of vegetable ranges some unknown species in the mountains area such as: winter onion, chives onion, rhubarb, garden chicory and corn salad have been taken in study. With a view to cultivating some species with higher pretentious to warmth and with the purpose to obtain earlier yields it was studied the effect of temporary protection of cultures using special covering materials (such as Agryl, Covertain) that are permeable to water, so water form rainfalls can be used by plants since the water resources are limited.

As part of the project, there were also performed studies regarding the types of soil and the climatic conditions in the area.



Conclusions

1. The specific pedo-climatic conditions of Western Carpathian Mountains give possibility to diversify the assortment of grown vegetable by introducing new species and varieties, less known in the area.
2. For the species pretentious to the temperature, measures of temporary or permanent protection with various kinds of covering materials are indispensable.



Meteorological station	Monthly												Annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Viădeasa 1800	-7,3	-7,2	-4,9	-0,4	4,5	7,7	9,4	9,6	6,2	2,7	-2,2	-5,8	1
Viădeasa 1400	-4,3	-4,1	-1,7	3,4	8,2	11,3	13	13,1	9,6	5,7	0,9	-2,8	4,4
Scărișoara	-4,1	-3,8	-1,2	3,7	8,7	11,9	13,6	13,6	10,1	6	1,3	-2,5	4,8
Stâna de Vale	-5,5	-4,9	-1,7	3,1	8,4	11,8	12,9	12,4	9,1	4,7	0,3	-4,2	3,9
Câmpeni	-4	-1,7	2,4	7,6	12,6	15,5	17,1	16,6	12,7	7,8	2,5	-1,9	7,3

Table 2

Growth of vegetables in specific conditions of Scărișoara - Glacier area (18.V.2002)

Species	Type of culture	Height of plants		rosette Ø		Number of leaves	
		cm	%	cm	%	Pieces	%
Early cabbages	unprotected	8,0	100,0	18,0	100,0	13,0	100,0
	protected	18,0	225,0	28,7	159,4	19,3	148,5
Summer cabbages	unprotected	12,7	100,0	18,6	100,0	7,7	100,0
	protected	19,3	151,9	34,3	184,4	11,7	151,9
Cauliflower	unprotected	18,7	100,0	21,4	100,0	12,6	100,0
	protected	30,0	160,4	33,3	155,6	15,6	123,8
Kohlrabi	unprotected	17,7	100,0	26,3	100,0	12,4	100,0
	protected	23,0	129,9	37,6	142,9	15,3	123,4
Broccoli	unprotected	21,6	100,0	21,3	100,0	8,0	100,0
	protected	25,6	118,5	37,0	173,7	10,0	125,0
Lettuce	unprotected	7,0	100,0	12,0	100,0	9,7	100,0
	protected	13,0	185,7	23,4	195,0	13,3	137,1

Table 4

Performance of the vegetation phases for the main species of vegetable, grown in the specific conditions of the Glacier area

Culture	Month / Decade																
	IV			V			VI			VII			VIII		IX		X
	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1
Early cabbage	ooo							xxxx									
Summer cabbage				oo				x	xxxx								
Onion, garlic	ooo								xxxxxxx	x							
Leek				oo									xxxxxx				xxx
Celery				oo									xxxxxx				
Carrot	ooo								xxxx	xxxxxxx							xxx
Parsley	ooo												xxxxxx				
Parsnip	ooo																
Pea	ooo										xx	xx					
Salad	ooo				xxxx												
Early radishes	ooo					xxx											
Perennial onion	ooo				xx	xxxxxxx			xxxxxxx	xxxxxxx							

Legend: ??? - setting up culture (seeding, planting)
 - - - - - period of vegetative growth
 xxx - - - - - period of harvesting



Graphic 1



The characterization of the type of soil „Terra Rosa”

Horizons	A _p		A _o		A _B		B _{v1}		B _{v2}	
	3-0	0-15	15-24	24-43	43-60	60-78	78-100	100-120	120-140	140-160
Rough sand (2,0-0,2 mm)	3,4	4,0	4,6	3,1	2,4	2,4				
Fine sand (0,2-0,002 mm)	36,0	14,6	9,4	12,7	7,8	7,8				
Dust (0,02-0,002 mm)	26,7	41,0	44,5	40,6	28,5	28,5				
Clay (under 0,002 mm)	33,9	40,4	41,5	43,6	61,3	61,3				
Apparent density (DA g/cm ³)	-	1,08	1,22	1,19	1,18	1,18				
Total porosity (PT%)	-	59,7	54,4	55,7	56,1	56,1				
Withering coefficient (CO%)	-	14	15	15	22	22				
Field capacity (CC%)	27	26	26	31	-	-				
Water PH	5,21	5,34	5,54	5,69	6,70	6,70				
Humus (%)	15,42	6,31	2,82	2,61	-	-				
Total N (%)	0,754	0,312	0,144	0,134	-	-				
Total P (%)	10	3	2	3	-	-				
Mobile K (ppm)	109	25	23	25	-	-				

Table 1

Species and varieties of vegetables grown in the conditions of Glacier - Western Carpathian Mountains area

No.	Species (variety)	Way of reacting	No.	Species (variety)	Way of reacting
1.	Allium cepa L.	Very good	13.	Brassica oleracea, var.gongyloides L.	Good
2.	Allium schoenoprasum L.	Very good	14.	Raphanus sativus L.	Good
3.	Allium fistulosum L.	Very good	15.	Allium porrum L.	Good
4.	Allium sativum L.	Very good	16.	Beta vulgaris L., convar.conditiva L.	Good
5.	Fisum sativum L.	Very good	17.	Pastinaca sativa L., convar. hortensis, Ehrh.	Good
6.	Apium graveolens L. var. rapaceum	Very good	18.	Petroselinum crispum Mill	Good
7.	Brassica oleracea, var.capitata L.aba L.	Very good	19.	Daucus carota L.	Good
8.	Lactuca sativa L.	Very good	20.	Valeriana locusta L.	Good
9.	Chicorium endivia L.	Very good	21.	Phaseolus vulgaris L.	Satisfactory
10.	Levisticum officinale Koch	Very good	22.	Cucurbita pepo L., var.oblonga Wild	Satisfactory
11.	Athemsia diacunculus L.	Very good	23.	Solanum lycopersicum L.	Unsatisfactory
12.	Rheum rhabarbarum L.	Very good	24.	Capsicum annuum L.	Unsatisfactory
			25.	Cucumis sativus	Unsatisfactory

Table 3