THE EFFECT OF SOIL TYPE AND IRRIGATION ON THE YIELD OF CELERIAC

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Abstract

The effect of soil type and irrigation on the yield of celeriac was investigated in the years 1976-1978 in a microplot experiment. The microplots located outdoors were built as bottomless, concrete containers of 5 m^2 each. Prior to the experiment the microplots were filled up with seven following soil types: black soil, chernozem, brown soil, alluvial soil, pseudo-podzols No. I and No. II and with peat soil.

Each of the microplots was divided into two parts, of which one was irrigated according to tensiometer indications when the soil moisture dropped to 70 percent of the field capacity, whereas the other - was subject to natural precipitation only.

The water rate per single irrigation was calculated for each soil type with the aim to restore the soil moisture to the field capacity whenever water deficiency occurred.

Independently of the irrigation, highest yields of celeriac cv. Odrzanski were obtained on chernozem, alluvial and peat soil with 3 year averages of 4.44, 4.39 and 4.31 kg per m^2 respectively. The brown, black and podzolic soil No. I produced intermediate yields of 3.36, 3.30 and 3.01 kg per m^2 respectively whereas lowest yields of 2.16 kg per m^2 were produced on podzolic soil No. II. Irrigation increased significantly the yield of celeriac. The average yield from all irrigated soils was 4.0 kg as compared to 3.1 kg per m^2 of the non-irrigated ones. The effect of irrigation was related to the soil type.

The brown and pseudo-podzol soil No. I gave highest yield increase of 59 and 45 percent respectively whereas these of the peat soil averaged 10 percent only.

The amount of water required for irrigation during the vegetation period varied with the soil and lowest on peat soil with 267 and 73 millimeters respectively.

Introduction

Wide research works have shown that the effect of irrigation is closely related to soil properties. The most important factor determinating the need of irrigation is the available water capacity of the soil and water requirements for irrigation of a certain soil are related to the soil texture, organic matter content and soil structure. These soil properties affect not only the water holding capacity of the soil but also the water losses due to evaporation.

The problems of the response of different soil types to irrigation and the required water doses for different soils and crops is very important for the grower. Earlier work on this topic (Kotryń, 1975 and Sypień et al., 1979) showed that carrots and onions responded differently to irrigation and different soil types. Also the required water doses were different.

The objective of this work was to study the effect of soil type and irrigation, including water doses, on the yield of celeriac.

Acta Horticulturae 119, 1981
Watersupply and Irrigation

Material and methods

The experiments were conducted in the years 1976-1978 in microplots located on the experimental field of the Research Institute of Vegetable Crops at Skierniewice. The microplots of 5 m^2 each were made as bottomless, concrete containers, with walls reaching 20 cm above and 100 cm below the ground level.
The bottom part of the microplots was permeable, due to filling with a 20 cm layer of coarse sand and a drainage pipeline underneath.

Following 7 soil types were involved in the experiments: black soil, alluvial soil, pseudo-podzolic soil I and II, loessial chernozem, brown soil and low moor peat soil. The soils were transferred into the microplots in layers with an attempt to reproduce a natural soil deposit. Some properties of the soils used are given in table 1.

Each of the micro-plots was divided into two parts of which one was irrigated according to tensiometer readings when the soil moisture dropped to 70 percent of the field capacity.
The tensiometers were installed at the depth of 30 cm.

Irrigation rates were calculated for each soil type with the aim to bring up the water content to the field capacity (table 2).

Nitrogen fertilization in the total amount of 200 kg n/ha was performed in three dosese of which 1/3 was applied broadcast prior to planting and 2/3 in two sidedressings. The phosphorus and potassium fertilization was based on soil analyses and the doses were calculated to attain the soil fertility level of 80 mg phosphorus and 200 mg potassium per liter of soil.

Celeriac, variety Odrzanski (Oderdorfer), from transplants produced in hotbeds was planted at a distance of 40 x 30 cm.

Results and discussion

The influence of the soil type and irrigation is shown in table 3. The yields of celeriac were differentiated in the years of experiment, which was due to varied climatic conditions.
However, in all years of experiment the yields showed similar tendencies. Regardless of the irrigation, highest yields of celeriac were obtained on the chernozem, alluvial and peat soil, where the 3-year averages amounted 4.44, 4.39 and 4.31 kg per m^2 respectively. The brown soil, black soil and pseudo-podzolic soil I gave intermediate yields of 3.36, 3.30 and 3.01 kg per m^2 respectively, which were significantly lower as these obtained from the first group of soils. The lowest yields averaging 2.16 kg per m^2 were produced on pseudo-podzolic II.

The irrigation increased significantly the yield of celeriac, however, the effect was related to the climatic conditions in single years of the experiment. The average yield increase reached 11.4 percent for the years 1977 and 1978 and 60.1 percent for the year 1976. Independently of the soil type the irrigated plots produced in a 3-year period an average yield of 4.0 kg per m^2 whereas the yield from the not irrigated ones averaged only 3.13 kg per m^2, thus irrigation resulted in an increase of 27.8 percent.

The effect of irrigation was related to the soil type. The highest yield response was observed on the brown soil(59 percent) and the pseudo-podzolic soil I (45 percent), whereas the peat soil with only 10 percent yield increase showed the lowest response. The yield increase due to irrigation was not only related to the water capacity of the soils. On soil with similar water capacity e.g. chernozem and alluvial soil the latter responded with a higher yield increase.

Similar higher was the response of the brown soil in spite of its higher water capacity as compared to that of pseudo-podzolic and black soil. This allows to draw a conclusion that by determining the need for irrigation one should not only consider the water capacity of different type of soils but also other soil properties, presumable their structure, construction and soil profile and so on.

Also the seasonal water consumption was related to the soil type (figure 1). The highest quantity of water for irrigation was used on the brown soil (267 mm) and the lowest on the peat soil (73 mm).

References

Kobryń, J., 1973. Effect of soil type and irrigation on the crops and quality of three carrot varieties. Biul. Warzyw. XV: 151-172 (in Polish with English summary).

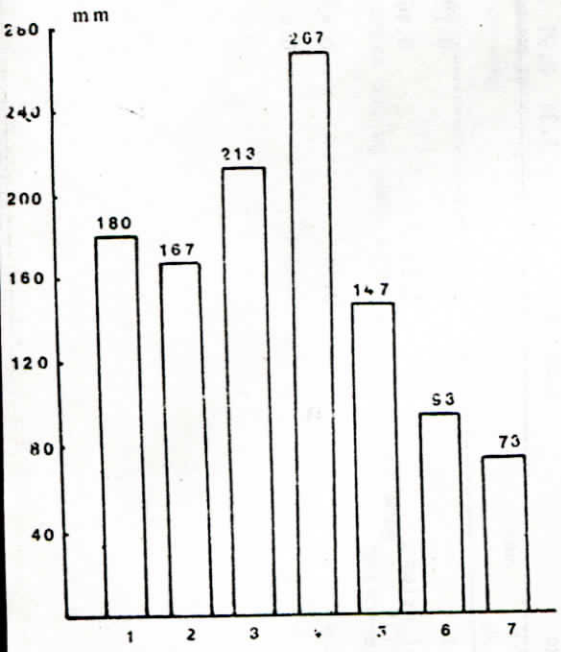
Sypień, M., Fajkowska, H. and Szwonek, E., 1979. Inlfuence of soil type and irrigation on height and structure of onion yields and on the keeping quality of this crop. Biul. Warzyw. XXIII: 331-345. (in Polish with English summary).

Table 1 - Some properties of soils used in the experiment

Type of soil	Texture	Percent of humus	Volume weight	Available water capacity mm/0.1 m
Pseudo-podzolic soil I	Sandy loam	1.16	1.63	12.5
Pseudo-podzolic soil II	Sand	3.09	1.49	10.3
Black soil	Sandy loam	3.17	1.58	16.7
Brown soil	Sandy clay loam	2.13	1.62	23.5
Alluvial soil	Silty clay loam	1.09	1.38	26.1
Chernozem	Silty clay loam	1.72	1.36	26.5
Peat soil		81.6	0.21	35.0

able 2 - The soil matric potential by which the irrigation was performed and the irrigation rates

ype of soil	Soil matric potential cm Hg	Irrigation rate mm
seudo-podzolic soil I	15	20
seudo-podzolic soil II	15	20
lack soil	18	26
rown soil	25	36
lluvial soil	37	39
hernozem	37	42
eat soil	25	25



1 Pseudo - podzolic I
2 Pseudo - podzolic II
3 Black soil
4 Brown soil
5 Alluvial soil
6 Chernozem
7 Peat

FIGURE 1 - IRRIGATION WATER REQUIREMENT
(average 1976 - 1978)

Table 1 - Effect of soil type and irrigation on the yield of celeriac kg/m^2 in irrigated (I) and non-irrigated (N) plots.

Type of soil	1976			1977			1978			Average 1976-1978		
	I	N	Average	I	N	Average	I	N	Average	I	N	Average
Pseudo-podzolic soil I	4.42	2.51	3.52	2.89	2.31	2.60	3.36	2.44	2.90	3.56	2.45	3.01
Pseudo-podzolic soil II	3.67	1.63	2.65	1.65	1.87	1.76	2.07	1.95	2.02	2.48	1.83	2.16
Black soil	4.65	3.25	3.95	3.16	2.73	2.95	3.12	2.87	3.00	3.64	2.95	3.30
Brown soil	5.36	2.28	3.82	3.40	2.51	2.96	3.59	2.95	3.27	4.12	2.59	3.36
Alluvial soil	6.00	3.49	4.75	4.33	3.95	4.14	4.35	4.24	4.30	4.89	3.89	4.39
Chernozem	5.73	3.99	4.86	4.12	4.08	4.10	4.43	4.24	4.34	4.76	4.11	4.44
Peat soil	5.95	4.38	5.23	3.64	3.37	3.51	4.35	4.05	4.20	4.53	4.09	4.31
Average	5.06	3.16		3.31	2.97		3.61	3.24		4.00	3.13	
LSD 0.05												
a) soil			0.76			0.72			0.83			0.55
b) irrigation			0.21			0.16			0.20			0.46
c) interaction												
b x a			0.56			0.43			ns			ns
a x b			0.91			0.80			ns			ns