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Súhrn

Cieľom práce je určenie vplyvu zalesnenia uprostred poľa na úrodu pšenice ozimnej. Výskum úrody zrna sa uskutočnil na vrchole kriedového pahorka v rokoch 1997–1998. Zber úrody prebiehal dvoma spôsobmi – v prierezoch, kolmých vzhľadom na hranu zalesnenia, v rôznych vzdialenostiach, ktoré záviseli od výšky zalesnenia. Výška zalesnenia bola okolo 20 m. Meranie úrody bolo spojené s výskumom koreňového systému zalesnenia. Výsledky výskumu poukazujú na pokles úrody pestovaných rastlín, ktoré sa nachádzali v blízkosti zalesnenia. Toto zníženie sa líšilo v jednotlivých rokoch, ale len do vzdialenosti nepresahujúcej jednonásobnú výšku zalesnenia. Nie je možné určiť závislosť medzi zahustením koreňov a vzdialenosťou prenikania polí koreňovým systémom i veľkosťou úrody.

Kľúčové slová: zalesnenie stredu poľa, výnosnosť plodín, koreňový systém

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Contact address:
Dr. inż. Radomir Obrośiak, Agricultural University, Department for Land Reclamation and Agricultural Structures, ul. Leszczyńskiego 7, 20-069 Lublin, tel.: +4881/53 230 47, e-mail: rimari@poczta.onet.pl

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EFFECTIVENESS OF SPRINKLING IRRIGATION IN WIELKOPOLSKA

PRODUKČNÁ EFEKTIVITA ZAVLAŽOVANIA POSTREKOM NA ÚZEMÍ VEĽKOPOĽSKA

Czesław PRZYBYŁA, Paweł KOZACZYK

Poznanská poľnohospodárska univerzita, Poznaň, Poľsko

The work presents results of studies on the production effectiveness of sprinkling irrigation in Poznań Lakeland. Field studies were carried out in the eastern part of that area, about 30 km to the south-west from Poznań, in the farms Niepruszewo and Sapowice. In the studies carried out on the water balance in the soils, it was found that rainfall deficits occurred in each of the analysed vegetation periods and they oscillated between 30 and 165 mm. The yield increase of agricultural plants showed under the influence the applied sprinkling irrigation a significant diversity depending on the type of the grown plants and on the rainfall deficits. The yield increase ranged as follows: for perennial grassland 7.4–100%, for root plants 7.7–42.8%, for cereals 8.8–30.3%.

Key words: sprinkling irrigation, yield increase

The agriculture in Wielkopolska region is characterized by 9 high level of agrotechnics and a high effectiveness of farming. However, the meteorological conditions and the atmospheric precipitations on that area are very both in relation to time and space causing a differentiation in rainfall deficits and the need to irrigate the agricultural plants (Przybyła, 1994). Also the soil and topographic divers are playing an important pole not only in the scale of the region or catchment area, but also in reference to the irrigated field (Marcinek et al., 1994). Thus, the potential production possibilities do not depend only on the soil, agrarian culture genetic and production potential, fertilization level, but high degree they are limited by frequent rainfall deficits unfavourably distributed in time causing a strong drying of the active soil layer. In face of the above statements, the introduction of sprinkling irrigation is justified and it is limit the unfavourable water deficits and contribute to a distinct increase of yields. It is also important to decrease the yield oscillations in the particular years providing there by a competitive element in the perspective of Poland's entering into the European Union. The area of Poznań Lakeland is characterized by one of the greatest rainfall deficits with a high frequency of occurrence. According to Rojek (1987), the mean values of climatic water balances from many years calculated from rainfalls measured for the summer half-year oscillate between 120 and 150 mm,

and in dry year with a 10% probability of occurrence, the rainfall deficit may reach as many as 250 to 300 according to Drupka (1976), the area of Poznań Lowland lies the first zone where the application of irrigation is purposeful. On the average, during the year, there occur 12 to 14 periods without rainfalls and each period lasts at least 1 days, while in the vegetation season, there occur 7 to 8 rainless periods. In the vegetation period, the sequences of rainless days lasting longer than 8 days occur 3–5 times, and sequences exceeding 12 days occur on the average 1.4 to 1.7 times (Woś, 1994).

Materials and methods

Field studies were carried out in the eastern part of Poznań Lakeland about 30 km to the south-west from, Poznań in the farms Niepruszewo and Sapowice. Both objects show a similar soil structure. In the highest places of the studied areas, there are grey-brown podzolic soils frequently eroded on the surface. Grey-brown podzolic soils with brown podzolic soils cover about 85% of the total investigated area. About 15% of that area occupied by black: soils found in local depressions of the terrain or at the foot of hills.

Studios on the productivity effectiveness of sprinkling irrigation had been carried out since 1989. Both in the irrigated and in the not irrigated variants within the given object, identical fertilization levels, agrotechniques and plant protection methods were applied.

On both objects, the terms of agrotechnical treatments and the doses of mineral and organic fertilization were recorded. The production experiments with a field character were established as one-factor experiments with 3–5 replications. The size of single irrigation doses was indirectly determined on the basis of a controlled output of the sprinkling irrigation pipeline and its working time

For the control harvests, machines and technologies used in production conditions were applied. The size of the control area for the harvest depended each time on the width of the working machine used for the given plant on the length of the sprinkling irrigation pipeline. The mean monthly rainfalls from many years 1988/89 to 1994/95 were calculated on the basis own measurements in the precipitation station in Niepruszewo. Basing on own strip mining and soil drillings, the ranges of the particular soil type occurrence on the studied objects were defined.

Results

Figure1 presents the deviations of rainfall sums, mean monthly temperatures and mean ground water levels in the analysed vegetation periods.

In reference to rainfall, two vegetation periods, i. e. in 1989 and in 1992, were counted to dry ones with rainfall smaller by 150 mm than the mean value of many years. The vegetation season 1993 was counted to the wet ones when the rainfalls exceeded by 80 mm the mean value of many years: the remaining years were counted to the average ones.

The studies of the yield increase, the application of irrigation doses and their frequency in both farms were carried out from 1989 to 1995. The analysis of those experiments leads to the statement that the yield increase depends primarily on the plant species, the sum of atmospheric precipitations and their distribution in time, the size of the applied irrigation dose and on the soil.

The studies were carried out in field conditions including three plant groups: perennial grassland (pastures and lucerne), cereals (winter wheat) and root plants (sugar beet). The greatest yield increase reaching 100% was obtained in the pasture in dry years (1989 and 1992) with an effectiveness coefficient equal to 0.083 and 0.08 respectively. In the remaining years, the yield increase oscillated between 7.4% in 1994 and 90.4% in 1990 with the corresponding effectiveness coefficients 0.033 and 0.158. For root plants, the yield increase under the influence of irrigations was also the most visible in the vegetation season in 1989 counted to a dry one. It ranged from 35.7% in Sapowice to 42.8 in Niepruszewo.

In the average years, the yield ranged from 7.7% (1995, Sapowice) to 12.2% (1990, Sapowice). In the dry years, the production effectiveness of the applied water oscillated between 0.083 and 0.1, and in the average years from 0.025 to 0.05 t/1 mm.

Definitely the lowest effect of the irrigation on yielding was observed in reference to cereal plants. In dry years, the production effectiveness in the yield increase in tons per 1 mm of sprayed water ranged between 0.016 and 0.017, and in the average years it was from 0.008 to 0.009. Grassland showed the highest yield increase in reaction to irrigation, while cereals reacted in the least way.

Figure 1 Deviations in monthly precipitations sums (A), mean monthly temperature deviations from the mean values of many years (1955–1995) (B), and mean ground water levels in the vegetation seasons of the years 1989–1995 (C)

Obrázok 1 Odchýlky mesačných súhrnov zrážok (A), priemerných mesačných teplôt od dlhoročného priemeru z rokov 1955–1995 (B) a priemerné stavy podpovrchových vôd vo vegetačnom období v rokoch od 1989 do 1995 (C)

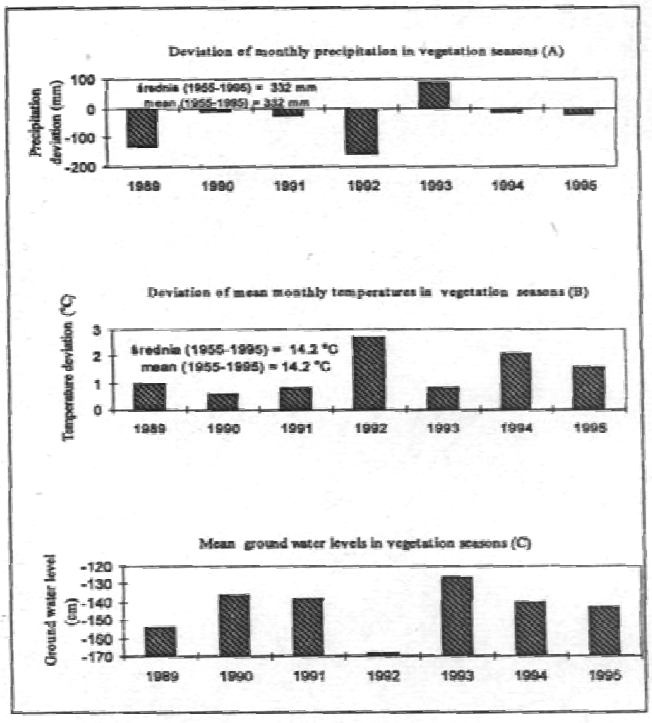

Table 1 The plant yield sizes in the not irrigated and in the irrigated conditions, the applied summary irrigation dose and the production effectiveness of 1 mm of sprinkled water in the years 1989–1995

Object	Crops or grass	Yields in t/ha		Yield increase		Irrigations		Applied fertilization in kg of pare element per hectare		
		Sprinkled	Not sprinkled	t/ha	%	Dose in mm	Production effectiveness of water (t/1 mm)	N	P	K
1989										
Niepruszewo	pasture	30.0	15.0	15.0	100.0	6 × 30	0.083	152	54	130
	winter wheat	7.1	5.9	1.2	24.0	3 × 25	0.016	144	35	123
	sugar beet	40.0	28.0	12.0	42.8	3 × 40	0.10	214	65	158
Sapowice	winter wheat	7.3	5.6	1.7	30.3	4 × 25	0.017	100	110	120
	sugar beet	38.0	28.0	10.0	35.7	4 × 30	0.083	160	130	180
	lucerne	32.0	25.0	7.0	28.0	1 × 35	0.2	0	90	120
1990										
Niepruszewo	pasture	40.0	21.0	19.0	90.4	4 × 30	0.158	119	0	130
	winter wheat	6.9	6.2	0.7	11.3	3 × 25	0.009	144	35	123
	sugar beet	38.0	35.0	3.0	8.6	2 × 30	0.05	124	70	170
Sapowice	sugar beet	37.0	33.0	4.0	12.2	2 × 40	0.05	160	140	180
1991										
Niepruszewo	sugar beet	35.0	32.0	3.0	8.6	3 × 20	0.05	120	65	180
1992										
Niepruszewo	pasture	28.0	14.0	14.0	100.0	6 × 30	0.08	150	30	140
1993										
Niepruszewo	pasture	33.0	30.0	3.0	10.0	1 × 30	0.33	120	41	130
1994										
Niepruszewo	pasture	29.0	27.0	2.0	7.4	2 × 30	0.033	125	0	135
1995										
Sapowice	sugar beet	35.0	32.5	2.5	7.7	5 × 20	0.025	140	120	150

Tabuľka 1 Výšky výnosov v závlahových podmienkach a bez závlahy, vzrast výnosov, aplikované dávky závlahy a hnojenie priemyselnými hnojivami, produkčná efektivita v tonách na 1 mm aplikovanej vody v rokoch 1989–1995

Conclusions

1. The studies carried out on the water balance of soils in selected farms of Poznań Lakeland have shown that rainfall deficits occurred in each of the analysed vegetation periods and they oscillated between 30 and 165 mm.
2. Measurement results of yield increase in agricultural plants under the influence of the applied sprinkling irrigation showed significant diversity depending on the type of plants and on the range of rainfall deficiency. For perennial grassland, it was 7.4–100%, for root plants 7.7–42.8% and for cereals 8.3–30.3%.
3. The greatest production effectiveness of 1 mm sprinkled water were observed in the vegetation periods counted to dry ones. In vegetation periods counted to average ones or medium-wet ones, the effectiveness was smaller, but also visible. The productivity of 1 mm sprinkled water for the particular crops was: for winter wheat 0.009–0.017 $t.mm^{-1}$, for sugar beet 0.25–0.10 $t.mm^{-1}$, for lucerne 0.20 $t.mm^{-1}$ and for field pastures 0.033–0.19 $t.mm^{-1}$.

Súhrn

V príspevku sú výsledky výskumu výrobnej efektivity zavlažovania postrekom na území Poznanských jazier (Pojezrzie Poznańskie). Výskum v teréne sa realizoval vo východnej časti tohto územia, 30 km juhozápadne od Poznane, v poľnohospodárskych podnikoch Nepruszewo i Sapowice. Na základe meraní, týkajúcich sa vodného režimu pôd sa zistilo, že v každom analyzovanom období sa vyskytol deficit vody vo výške od 30 do 165 mm. Zvýšenie výnosov pestovaných plodín bolo pod vplyvom aplikovaných pásových závlah značne diferencované a záviselo od druhu plodiny a výšky nedostatku vody. V prípade stálych trávnatých porastov to bolo od 7,4 do 100%, pri okopaninách od 7,7 do 42,8% a pri obilninách od 8,3 do 30,3%.

Kľúčové slová: zavlažovanie postrekom, zvýšenie výnosov

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Contact address:
Prof. Dr. hab.inż. Czesław Przybyła, ul. Piątkowska 94, 61-691 Poznań, tel.: 04801/033 618 466 422, fax: 04801/033/618 466 419, e-mail: czprzybyla@poczta.onet.pl