

EFFECT OF PERIODIC DROUGHT, NITROGEN RATES AND pH OF SOIL ON SEED YIELD, FAT AND PROTEIN CONTENTS OF WINTER OILSEED RAPE

T. BARSZCZAK (1), Z. BARSZCZAK (2)

(1) *Białystok University of Technology, Institut of Ecological Production in Agriculture, Zambrowska 16, 15-601 Białystok 6, Poland*

(2) *Warsaw Agricultural University, Department of Agricultural Chemistry, Rakowiecka 26/30, 02-528 Warsaw, Poland*

ABSTRACT

In ground pots on surface of 0,126 m², according to the methods described in earlier papers [Barszczak et al. 1991, 1993] the effect of periodic drought stress on seeds yield, fat and protein contents of winter oilseed rape cultivars were investigated. The influence of nitrogen rates and soil acidity was also observed. It was noted that soil moisture has influenced the change in the optimum pH range for winter oilseed rape cultivars, and that the optimum pH value tempered the negative effects caused by periodic drought. In the experimental conditions the highest yields were obtained of the Panter cultivar and the lowest yields of the Liporta cultivar. The decrease of soil moisture and increase of nitrogen fertilization rates reduced the contents of fat in seeds.

INTRODUCTION

The rainfall amount in Central Poland is approximately 20% lower than the optimal level for cultivation of oilseed rape [Klatt 1970]. Precipitation during the vegetation period fluctuate and this causes the phenomenon of "periodic drought".

The experiments were carried out to investigate various methods of reducing the influence of periodic drought on yielding oilseed rape. It was assumed, that different soil pH, nitrogen rates and biological progress - new cultivars reduce the effect of periodic drought. This hypothesis has been verified in the present paper.

MATERIALS AND METHODS

The three-year experiments (1992-1994) were carried out in accordance to the following scheme: **Factors:** **A** - two rainfall levels; **B** - five double low quality "OO" cultivars: Mar, Panter, Bolko, Ceres, Liporta; **C** - three different soil pH values; **D** - two nitrogen rates.

The experiments were carried out in four replications, according to the methods described in detail in earlier papers [Barszczak et al. 1991, 1993].

The research were established on the soil in pots with surface of 0,126 m², the height of pots was 150 cm and the diameter of 40 cm. All soils used in the study were gray brown podzolic; the texture of surface layer was medium sand and of deeper layer medium loam.

Soil acidity in the upper soil layer was pH_{KCl} 6.4-5.9, 5.0-4.6, 4.1-4.0. The nitrogen fertilization was applied at the start of vegetation period in spring at the doses of 1,77 g N and 3,54 g N per pot (140 and 280 kg N per ha) in the form of NH_4NO_3 . "Periodic drought" or so-called water stress treatments lasted from early budding until the end of flowering.

RESULTS

The results of experiments showed that the repaseed cultivars yields were significantly reduced due to periodic drought (Table 1). The increase of seed yield caused by nitrogen rate was very high (Table 1). Nitrogen fertilization resulted differences in the rapeseed yield between cultivars. At higher nitrogen rate the Panther cultivars has given significantly higher yield than the Liporta cultivar (Table 1).

Table 1. Effect of Periodic Drought and Nitrogen Rate on Seed Yield, Fat and Protein Contents of Winter Oilseed Rape cultivars (mean within different pH of soil and 1992-1994)

Traits	Cultivars (B)					Mean
	Mar	Panther	Bolko	Ceres	Liporta	
Seed yield in g per pot with a surface of 0,126 m ²						
A ₁	46.4	46.9	46.1	44.2	43.7	45.5
A ₂	34.7	35.4	33.5	33.6	32.2	33.9
D ₁	33.5	34.0	32.6	33.0	31.4	32.7
D ₂	47.6	48.3	46.9	45.7	44.5	46.6
Mean	40.6	41.1	39.8	38.9	38.0	
Fat content in % of dry seed wt.						
A ₁	49.8	49.2	49.7	50.0	49.7	49.7
A ₂	48.3	47.7	47.6	48.3	48.0	48.0
D ₁	47.7	49.0	48.9	49.7	49.2	49.3
D ₂	48.4	47.9	48.3	48.5	48.5	48.3
Mean	49.0	48.4	48.6	49.1	48.9	
Protein content in % of dry seed wt.						
A ₁	18.4	17.7	18.6	18.0	18.6	18.3
A ₂	17.7	17.3	18.6	17.8	18.2	17.9
D ₁	17.4	17.0	18.0	17.4	17.8	17.5
D ₂	18.7	18.0	19.1	18.4	19.0	18.6
Mean	18.0	17.5	18.6	17.9	18.4	

Lsd 5% for comparing of differences in seed yields

A - 1.41, B - 2.23,

D - 1.41, D/B - 3.14, B/D - 3.49

A₁ minus A₂ = differences in water treatments. These were 135 mm in 1992, 151 mm in 1993 and 144 mm in 1994.

D₁ = 140 kg N per ha, D₂ = 280 kg N per ha.

Nitrogen fertilization distinctly increased protein content and decreased fat content in rapeseeds under investigation (Table 1).

The periodic drought stress caused a change in the optimal pH value of the soil for planting oilseed rape (Table 2). At higher level of rainfall (A_1 , Table 2) the seed yield was the highest in the soil object at pH 6.4-5.9, and declined with the increase in acidity (Table 2). However, at lower level of rainfall (A_2 , Table 2) the seed yield was the highest on soil of pH 5.0-4.6. As decrease so increase of soil pH value in relation to this level reduced rapeseed yields.

Table 2. Effect of Periodic Drought and Nitrogen Rate on Seed Yield, Fat and Protein contents of Winter Oilseed Rape in Relation to pH of Soil. Mean within cultivars and 1992-1994

Traits	Soil acidity pH _{KCl} (C)		
	6.4-5.9	5.0-4.6	4.1-4.0
Seed yield in g per pot with a surface of 0,126 m ²			
A_1	46.9	45.9	43.8
A_2	34.1	36.2	31.5
D_1	33.2	33.5	31.6
D_2	47.8	48.6	43.7
Mean	40.5	41.0	37.7
Fat content in % of dry seed wt.			
A_1	49.8	49.9	49.2
A_2	47.9	48.0	47.7
D_1	49.4	49.6	43.9
D_2	48.4	48.5	47.9
Mean	48.9	49.0	48.4
Protein content in % of dry seed wt.			
A_1	18.2	18.1	18.5
A_2	17.9	17.8	18.1
D_1	17.5	17.4	17.7
D_2	18.5	18.4	19.9
Mean	18.0	17.9	18.3

Lsd 5% for assessment of differences in rapeseed yields

C - 1.73, A/C - 2.45, C/A - 2.58

D/C - 2.45, C/D - 2.58.

A_1 , A_2 and D_1 , D_2 - see in Table 1.

The effect of interaction between periodic drought and soil acidity was proved statistically. On soil of pH 5.0-4.6 the drop of rapeseed yield resulted by periodic drought was the lowest (Table 2).

The nitrogen fertilization increased the differences in seed yields caused by soil acidity. At lower nitrogen rate the change in the soil pH value did not cause significantly differences in rapeseed yields (Table 2). At higher nitrogen rate the seed yields were significantly lower on the soil at pH 4.1-4.0 compared to the soil of pH 6.4-5.9 and pH 5.0-4.6.

The increase of pH value of soil tended towards higher fat content and lower protein content in rapeseeds.

CONCLUSIONS

1. Periodic drought resulted in change the optimum pH value of soil for planting of winter rapeseed.
2. Optimum pH values of soil reduced the negative effects caused by periodic drought.
3. The drop of soil moisture decreased the fat contents in rapeseed.
4. In the experimental conditions the Panter cultivar gives higher yield than the Liporta cultivar.

REFERENCES:

- Barszczak Z., Barszczak T., Górczyński J., Kot. A. (1991). Effect of Moisture, Nitrogen Doses and Soil Acidity on Seed Yield, Chemical Composition and Thousand Seed Weight of Some Winter Oilseed Rape Cultivars. *Rapeseed in a Changing World, Proceedings 8 th International Rapeseed Congress, Saskatoon*. T. 4: 1181-1185.
- Barszczak Z., Barszczak T., Foy C.D. (1993). Effect of Moisture Nitrogen Rates and Soil Acidity on Seed Yield and Chemical Composition of Winter Oilseed Rape Cultivars. *J. Plant Nutr.* 16(1): 85-96.
- Klatt P. (1970). *Technik und Technologie der Beregnung*. 320-326. Berlin. Germany.