MORPHOLOGIC EVALUATION OF SOME OILSEED RAPE CULTIVARS IN WATER DEFICIT STRESS CONDITIONS

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Abstract

Water deficit stress is considered to be one of the most limiting factors for oilseed rape having as main effect decrease of the production. During the last few years, the water deficit stress started to be a problem for the agricultural crops also in Romania. The aim of this study was to evaluate the main morphological traits of 10 oilseed rape cultivars of different origin under three levels of water deficit stress under greenhouse conditions. The experiment was made with three irrigation levels: control (100 % FC), well watered stress (75 % FC), mild watered stress (50% FC) and severe stress (25% FC). In order to evaluate the influence of the irrigation levels upon the plants development, at the end of the vegetation stage of the studied cultivars some morphological traits were measured such as: plant height (PH), number of pods per plant (NP), number of branches per plant (NB),pod length (SL), yield per plant (YP) and 1000 grain-weight (GW). We observed that the most tolerant cultivars at water deficit stress were „Arabella", „Andol" and „Brillant" which were less influenced by the water deficit stress and the most sensible cultivars were „Perle", „Andol" and „Olimp" which obtained the smallest values in the water deficit stress conditions.

Key words: water deficit stress, oilseed rape, morphological trait.

During the past 30 years oilseed rape has become an important agricultural product and now is consider to be the world's third leading source for both vegetable and oil meal (Koike, 2007). The seeds form the newest varieties contain 40 to 45% oil which provides raw material for many industries such as food industry, production of the industrial lubricants and hydraulic oils, tensides for detergent and soap production and biodegradable plastic (Friedt et al., 2007). After the oil extraction the residual production contains up to 38-44% protein and can be used in livestock mixtures. Due to its many uses, the areas cultivated with this crop started to grow in Europe and also in our country. A limiting factor in the cultivation of oilseed rape in some countries is the water deficit stress. This has become a problem also in Romania. The water deficit stress is consider to be one of the most significant stresses of the agriculturally important crops affecting growth, development and yield (Micheletto et al., 2007). The effect of water stress on crop is a function of reduction genotype, intensity and duration of stress, weather conditions and developmental stages of rapeseed (Robertson and Holland, 2004). Water stress and high temperature can reduce crop yield by affecting both source and sink for assimilates (Mendham and Salsbury, 1995). Some previous studies reported that at oilseed rape drought reduces the biomass and seed yield, harvest index, plant height number of silique and seed, seed weight and days to maturity (Abebe and Brick, 2003; Munoz Perea et al., 2006; Padilla Ramirez et al., 2005).

The aim of this study was to evaluate the main traits of some oilseed rape cultivars for the water deficit tolerance in order to determine the

MATERIAL AND METHOD

The experiment was made in green house conditions at the University of Agricultural Sciences and Veterinary Medicine Ion Ionescu de la Brad Iassy, in the year 2014-2015. The growth conditions for the plants were a temperature regime of 22 – 24^{0}C during the day and 15-17^0 in the night with a photoperiod of 10/14 hours. The humidity was of 50-60%.

Biological material

The biological material for this study comprised 10 genotypes of rapeseed cultivars proceeded from the Centre for Genetic Resources Netherlands. Details regarding the studied genotypes can be observed in table 1.

First, the plants were cultivated in small pods of 5x5 cm a mixture of sand, peat and compost (1:1:2) for the vernalization. The vernalization was performed in a climatic chamber RUMED 4021 maintaining the plants for 2 month at 5^{0}C with the night photoperiod of 10/14h. After the vernalization, the plants were transferred in 10 kilogram vegetation pots in the same soil mixture and moved in the green house. The water deficit stress was applied to each

cultivar from the stem elongation to physiological maturity. The experiment was made with three irrigation levels: control (100 % FC), well watered stress (75 % FC), mild watered stress (50% FC) and severe stress (25% FC). In order to evaluate the influence of the irrigation levels upon the plants development, at the end of the vegetation stage of the studied cultivars some morphological traits were measured such as: plant height (PH), number of pods per plant (NP), number of branches per plant (NB), number of seeds per pods (NSS), pod length (SL), yield per plant (YP) and 1000 grain-weight (GW).

Statistical evaluation was performed using the XLSTAT and SPSS v.13 software package.

Table 1

Details about the studied oilseed rape cultivars

Nr.	Cultivar	Origin	Type
1.	Norli	Germany	Winter oilseed rape
2.	Octavia	France	Winter oilseed rape
3.	Olimpiade	France	Winter oilseed rape
4.	Olymp	-	Winter oilseed rape
5.	Panter	SUA	Winter oilseed rape
6.	Perle	Great Britain	Winter oilseed rape
7.	Andol	Germany	Winter oilseed rape
8.	Arabella	Germany	Winter oilseed rape
9.	Bienvenu	Czechoslovakia	Winter oilseed rape
10.	Brilland	France	Winter oilseed rape

RESULTS AND DISCUSSIONS

The analysis of variance showed significant difference on all of the traits between the different irrigation levels. It can be observed that different irrigation levels on the studied cultivars had different influence on the studied traits (table 2). The interaction between cultivar *irrigation level was significant only at plant height, yield per plant (table 2).

Table 2

Analysis of variance at the rapeseed traits under the water deficit stress

Source		Mean squares					
SV	f	PH	NP	NB	SL	YP	GW
Cultivars	0	30350777,88*	2422451,36*	1187,78*	34,151	82629,73*	28,498*
Irigation level		20743398,83*	2222451,36*	283,650	211,562*	7704,037 *	2,715
Cultivars*Irigation levels	3	35725145,70*	18130,081	2,333ns	0,376ns	2921,20*	0,032ns
Error	32	34373810,22	1187,781	1,444	0,008	0,566	0,123
CV		11,924	4,91	3,04	6,30	8,88	1,73

Ns and * non significant and significant at 05% level

Plants height and number of branches

Number of branches per plant and the plant height are important morphological trait of the oilseed rape. It can be observed that, the water levels had a significant influence upon the plant height and number of branches per plant. It can be seen in figure 1 (c,d) the biggest plant height values under control and stress conditions was obtained by “Arabela” , “Andol” and “Bienvenue” and the biggest number of branches under control and stress conditions was obtained by “Andol” , “Perle” and “Olimp”. It can be onserved that under the water deficit stress conditions, the plant height and number of branches per plant was smaller under the water stress (25Fc) than in the normal irrigation conditions. The smaller plant height

"Brilland", "Norli" and "Olymp" with high differences in the water stress condition than the control variant. The reduction of the plant height and number of branches per plant was also observed by Marouf et al, 2012 at the spring canola.

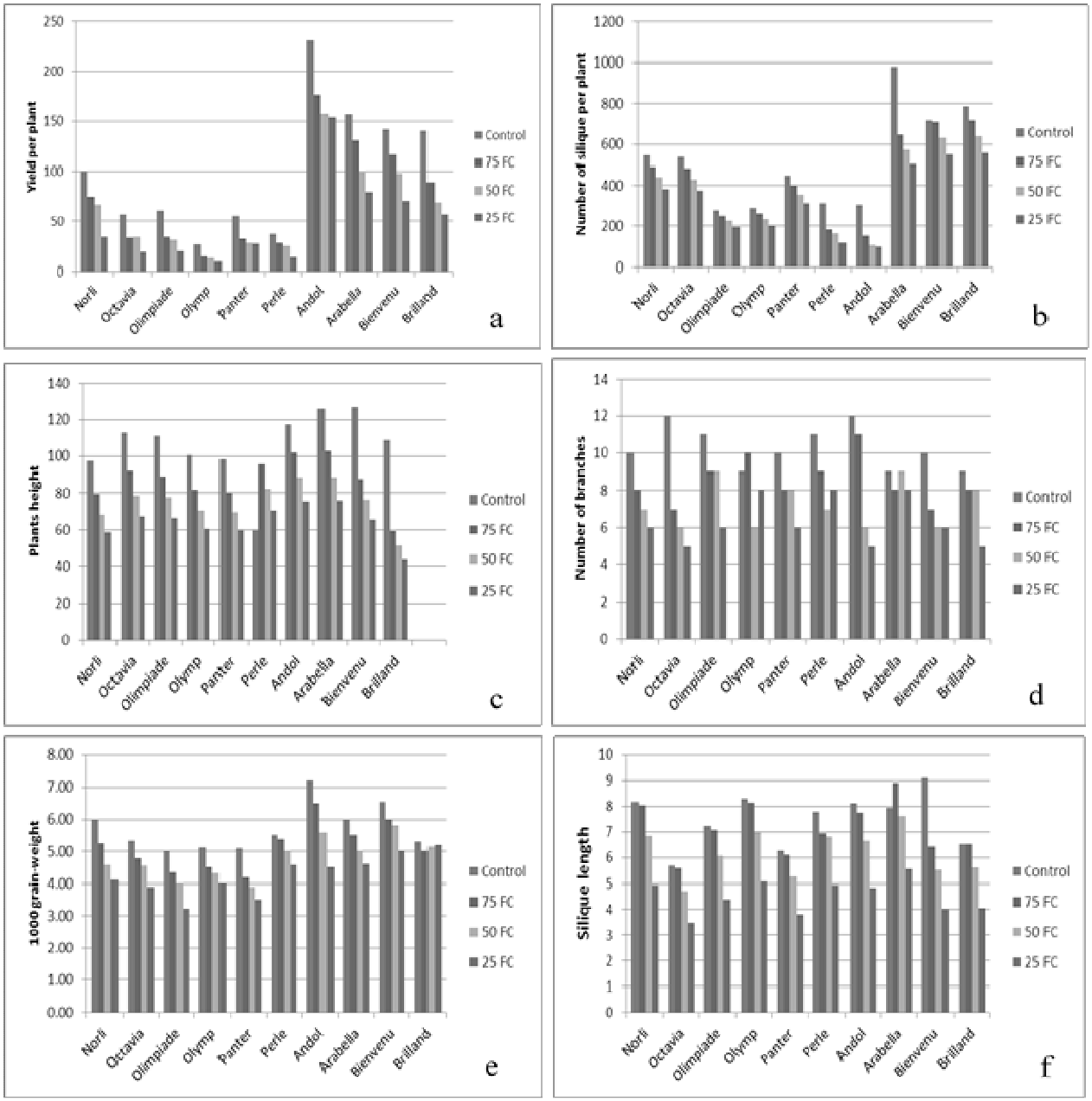

Figure1. **Interaction between the studied cultivars and water deficit stress levels: a – Yield per plant, b – number of slique, c – plant height, d – number of branches, e – 1000 grain weight, f – silique lenght**

Number of silique per plant and silique length

The number of silique per plant is consider to be an important factor for increasing the yield in rape. The three different levels of irrigation had a significant influence on the number of silique per plant. The highest number of silique per seeds was obtained by "Arabela", "Bienvenue" and "Brillant" in the water deficit stress conditions (25Fc) and control variant (figure 1, f). It can be also observed that in these cultivars the differences between the number of silique in the three irrigation variant is not so high, so we can affirm that at these cultivars, this trait is not significant influenced by the water level. The smallest values of the number of silique per plants were obtained at "Perle" and "Andol", this trait being the most influenced by the water deficit stress at these cultivars. Some similar observations were observed also by Tribuay and Reynard (1999) that showed in their studies that drought produced a significant decrease in the number of silique in canola. Regarding this trait, other authors showed that drought stress at flowering stage considerably reduced the number of silique in the bush (Shirani Rad and

Daneshian,2006). The silique lenght was has not significat differenced under the water stress deficit (Figure 1-b). The biggest values of the number of siliques was obtained by „Arabela" and „Bienvenue" both in the control and water deficit stress conditions and the smallest values were obtained by „Octavia" and „Panter".

Yield per plant and 1000 seed weight

The yield per plant and the 1000 seed weight are some important traits that can influence singnificant the production in the oilseed rape. The yield per plant showed significand differences betewwn the control variant and the water desicit stress variants. The biggest values of the seed yield was obtainded by „Andol", „Arabela" and „Bienvenue" (figure 1-a, e) in the control variant and in the water stress variants. It can be observe that the water deficit stress had a significant influence upon the yield per plant (the control variand and the 25FC variant). These results are in accordance with te studies of Tahmasebi Sarvestani et al. (2003) Further, Niknam et al. (2003) that reported also significant differences of the seed yield under different irrigations levels. The smallest values of the yield per plant was obtained at „Olimp" and „Olimpiade" both in control and water stress levels. The 1000 seed weight was aslo influenced by the water irrigation levels. The highest values of 1000 seed weight were obtained at „Andol", „Arabela" and „Bienvenue" and the smallest values at „ Olimpiade" and „Olimp" It can be observe that the water defixit stress reduces the 1000 seed weight and this can influence considerably the production.

CONCLUSIONS

As it can be observed, the water deficit stress have significand influence upon the most improtant morphological traits at oillseed rape wich can influence the production. In our study we observed that the most tolerant cultivars at water deficit stress were „Arabella", „Andol" and „Brillant" which were less influenced by the water deficit stress and the most sensible cultivars were „Perle", „Andol" and „Olimp" which obtained the smallest values in the water deficit stress conditions. This study gives some valuable informations about the behavior of this cultivars in drought conditions and in out furture studies we plann to bring this experiments in field.

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