Effect of salinity on germination and growth rapeseed (*Brassica napus* L.) cultivars seeds

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Abstract

Salinity is the most important and affect factor in Canola production and germination. In order to evaluation of salinity on germination and seedling growth of 6 canola cultivars factorial experimental which includes 5 salinity levels (0, 50, 100, 150 and 200 mM NaCl) and 6 canola cultivars (Licord, SLMO46, Okapi, Orient, Zarfam and Opera) was carried out based on complete randomized design with 3 replications. In this experiment after 7 days, germination seed (MTG[1], MDG[2], FGP[3]), length of whole plant, root and shoot, root/ shoot ratio, hard seed, normal and abnormal seedling were measured. Analysis of variance revealed significant difference ($p \leqslant 0.01$) among salinity levels. Cultivar had significant effect on FGP, hard seed, MTG ($p \leqslant 0.01$) and abnormal ($p \leqslant 0.05$) but interaction of cultivar × salinity levels had no significant differences. Mean Comparison showed that increasing of salinity levels caused to decrease MDG, FGP, total, root and shoot length and abnormal seedling but MTG, root/shoot ratio and hard seed were increased. Among cultivars, Okapi were the best for salinity situation.

Key words: Rapeseed; Germination; Seedling growth; salinity.

Introduction

Germination, seed and seedling vigor are complex issues influenced by many factors (Anonymous, 2007). The two major environmental factors that currently reduce plant productivity are drought and salinity (Serrano *et al*., 1999). Salinity in soil or water is one of the major stresses and especially in arid and semi arid regions, can severely limit crop production (Shannon, 1998). Salinity is one of the major obstacles to increasing production in crop growing areas throughout the world (Neumann, 1995). Yield reduction, over 70% has been attributed to environmental stresses such as drought, salinity, and high and low temperatures (Bray *et al*., 2000).

Successful seedling establishment depends on the frequency and the amount of precipitation as well as on the ability of the seed species to germinate and grow while soil moisture and osmotic potentials decrease (Roundy, 1987). Dry Matter Content (DMC) is a component of seedling vigor. Dry matter accumulation is an important factor in seed yield and tolerance of plants to insect, weed and disease stress (Anonymous, 2007). These salts interfere with seed germination and crop establishment (Fowler, 1991). Salinity stress can affect seed germination through osmotic effects (Welbaum *et al*., 1990).

Material and method

Seed Quality Determination

The canola seeds cultivars (SLM046, Licord, Opera, Zarfam, Orient and Okapi) were obtained from Seed and Plant Improvement Institute, Karaj, Iran. This experiment was performed on three 100 seed replications of each cultivar. This experiment was conducted to observe the influence of different NaCl concentrations on germination, root and shoot length, hard seed and abnormal seedlings. Plastic box with a tight-fitting lid were used for the experiment. The solution used for the study consisted of 0 (as control), 50, 100, 150 and 200 mM NaCl. For each cultivar 100 seeds for each of the five NaCl treatments were used. Seed were allowed to germinate in laboratory condition on blotter papers in boxes soaked in a solution of the respective salt concentration. The seed germination was investigated after every 12 hours. Seed germination was started after 12 hours (seeds were considered to be germinated with the emergence of the radical). The germinating seeds were counted at regular intervals. The lengths of root and shoot of the germinated seeds which were more than 2 mm in length were measured and recorded after 7 days of sowing. In 7 th day, thirty plants from each box were randomly chosen and tagged for subsequent sampling. Root, shoot and whole plant of seedling measured.

Daily record used to estimate as follows:

FGP is the Finally Germination Percentage. FGP is the last recorded before sampling.

MTG is the Mean Germination Time, and estimate as follow,

$$MTG = \frac{\sum(nidi)}{\sum ni}$$

where di=days after sowing, ni=number of germ in di, $\sum ni$ = total germ during 7 days.

MDG is the mean germination days and it is speed germination days index. MDG estimate as follow :

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[1] Mean Time Germination

[2] Mean Daily Germination

[3] Finally Germination Percentage

$$MDG = \frac{\text{Final germination percentage}}{\text{Germination term}}$$

Experimental Design and Statistical Analyses

All data were subjected to analysis of variance (ANOVA) appropriate to a factorial form on Complete Randomized Design for laboratory experience in 2005 with three replications factors. The studied factors were 5 salinity levels (0, 50, 100, 150 and 200 mM NaCl) and 6 winter rapeseed cultivars (SLM046, Licord, Opera, Zarfam, Orient and Okapi). All experience data were using SAS 9.1 and the treatment means were tested by Duncan Multiple Range (DMR) and drawing picture with Excel 2003.

Result and discussion

Analysis of variance revealed significant differences ($p \leqslant 0.01$) among salinity levels. Cultivar had significant effect on FGP, hard seed, MTG ($p \leqslant 0.01$) and abnormal ($p \leqslant 0.05$). Interaction of cultivar × salinity levels had no significant differences (data not shown).

Increasing of salinity levels declined Finally Germination Percentage, Mean Daily Germination and it is due to increased Mean Time for Germination (Table 1). It appears that a decrease in germination is related to salinity induced disturbance of metabolic process leading to increase in phenolic compounds (Ayaz *et al*.,2000).These results were the same as Result of JAMIL *et al.* (2006), salt stress declined the germination and also delayed the emergence of seeds. It is also assumed that in addition to toxic effects of certain ions, higher concentration of salt reduces the water potential in the medium which hinders water absorption by germinating seeds and thus reduces germination (Maas and Nieman, 1978). The result of this study showed that in high salinity levels (200 mM NaCl) hard seeds increased (Table 1). It may due to decrease of the water movement into the seeds during imbibitions (Hadas, 1977).

The root and shoot lengths are the most important parameters for salt stress because roots are in direct contact with soil and absorb water from soil and shoot supply it to the rest of the plant. For this reason, root and shoot length provides an important clue to the response of plants to salt stress (Jamil and Rha, 2004). The result showed that length of whole plant, root and shoot decreased with significant differences (Table 1), the result of JAMIL *et al.* (2006) confirmed these results. High salinity may inhibit root and shoot elongation due to slowing down the water uptake by the plant (Werner and Finkelstein, 1995) may be another reason for this decrease.

200 mM NaCl had the highest root / shoot ratio, this result showed that root length was more affected then shoots length (Table 2), this result was similar to Jamil and Rha (2004).

In salinity levels, 50 and 100 mM NaCl produced maximum abnormal seedling but 200 mM NaCl had the lowest abnormal seedling (Table 2). It may due to salinity change the normal form of seedling because most germinated seed were abnormal and in high salinity levels seeds couldn't absorb water for germination. Among cultivars, Okapi were the best cultiavr for salinity situation.

Table 1. mean traits for five Salinity Levels and six canola cultivars under standard germination test condition

SalinityLevels (mM NaCl)	Finally Germination Percentage	Mean Daily Germination	Mean Time Germination	Hard seed	Whole plant	Root length	Shoot length	Root/shoot ratio	Abnormal seedling
0	95.333 a	46.796 a	3.027 d	1.389 bc	16.900 b	10.684 a	6.216 c	1.729 b	2.167 bc
50	95.556 a	36.578 b	3.034 cd	0.889 c	18.997 a	10.157 a	8.840 a	1.153 d	5.111 a
100	94.333 a	36.531 b	3.053 c	1.722 bc	17.599 b	10.448 a	7.090 b	1.462 c	4.353 a
150	93.294 a	32.441 b	3.084 b	2.412 b	12.124 c	7.417 b	4.708 d	1.582 c	2.294 b
200	89.889 b	24.037 c	3.222 a	3.833 a	8.002 d	5.579 c	2.459 e	2.282 a	1.333 c
Canola Cultivars									
Licord	91.200 c	37.511 a	3.075 bc	3.333 a	15.021 a	8.993 a	6.028 b	1.633 ab	3.333 ab
SLMO46	92.800 c	33.827 a	3.076 bc	2.133 ab	15.044 a	9.346 a	5.721 b	1.786 a	3.500 a
Okapi	96.933 a	38.489 a	3.113 a	0.600 c	14.405 a	8.712 a	5.692 b	1.680 ab	2.533 c
Orient	91.733 c	33.200 a	3.089 ab	2.600 ab	14.659 a	8.750 a	5.909 b	1.616 b	2.733 bc
Zarfam	95.867 ab	32.947 a	3.089 ab	1.533 bc	14.659 a	8.608 a	6.050 b	1.522 b	2.933 abc
Opera	93.571 bc	35.919 a	3.051 c	2.071 ab	15.026 a	8.964 a	6.387 a	1.529 b	3.286 abc

Mean followed by the same letters in each column are not significantly different (Duncan multiple rang 5 %)

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