The assessment of morphological for seed aging in 6 rapeseed (*Brassica napus* L.) cultivars

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Abstract:

To investigate hardness of less irrigation stress applying at different growth stage (normal irrigation, irrigation until flowering, padding and seed filling stages) on germination and seedling growth of Canola (*Brassica napus* L.) namely SLM046, Licord, Opera, Zarfam, Orient, Okapi an experiment was laid out on factorial arrangement in completely randomized design with 4 replications. The accelerated aging test was conducted by aging seeds at 42°C for 48 h. Following incubation, the seeds were germinated at 22°C and after 7 day the root length, root/shoot ratio, seedling dry weight, hard seeds and abnormal seedling, MTG[1], MDG[2], FGP[3]and DGS[4] were measured. The effect of Less irrigation stages on Root length, Root/shoot ratio, FGP, Hard seed and abnormal seedling were significant ($p \leqslant 0.01$). Cultivar had significant effect on FGP ($p \leqslant 0.01$) and root/shoot ratio ($p \leqslant 0.05$). Generally less irrigation caused to decreased root/shoot ratio. Less irrigation after flowering increased abnormal seedling; less irrigation after padding increased MTG and Hard seed but declined FGP. Among cultivars, Zarfam and Orient were the best in less irrigation under accelerate aging test.

Key words: rapeseed, accelerate aging test and less irrigation

Introduction:

Environmental factors regulating germination include temperature, water, and Oxygen for seeds (Bewley and Black, 1994; Baskin and Baskin, 2001). Seed germination is an important stage in the life history of plant, affecting seedling development, survival, and population dynamics. Germination begins with seed water uptake and terminates with the elongation of the embryonic axis from the seed coat (Bewley and Black, 1994). Germination events and subsequent establishment are controlled by nuclear and maternal genetics, and current and maternal environments (King and Bridgen, 1990; Platenkamp and Shaw, 1993; Cabin *et al*., 1997; Foley and Fennimore, 1998; Meyer and Pendleton, 2000; Baskin and Baskin, 2001). Limited water supplies may make it impossible to grow traditional annual crops, such as canola and beans (Gilliland and Hang, 2003). Seed quality factors are very important, because other than purchasing decisions, the grower has no control over a poor quality seed lot (Anonymous, 2007). Dry matter content is a component of seedling vigor. Dry matter accumulation is an important factor in seed yield and tolerance of plants to stress (Anonymous, 2007). 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 (Roundy, 1987). The two species of canola *B. napus* and *B. campestris* are classified as tolerant to drought stress reported by Maas and Hoffman (Mass and Hoffman, 1977).

Materials and methods

Seed Quality Determination

The canola seeds cultivars (SLM046, Licord, Opera, Zarfam, Orient and Okapi) were obtained from Seed and Plant Improvement Institute, Karaj, Iran. The accelerated aging test was conducted by aging seeds at 40±2ºc for 48 h (Elias and Copeland, 1997) using the wire-mesh tray method (McDonald and Phaneendranath, 1978). A single layer of seeds from each sampling date of each cultivar was placed on 10×10×3 cm copper wire mesh tray inside a 11×11×3.5 cm plastic box containing 2 cm water (about 100 mL) above the bottom of the box. Following incubation, the seeds were planted on moistened blotter papers in box. Boxes were placed on growth chamber at 20±2ºc for 7 days. The percent of normal seedlings was recorded and in 7th day thirty plants from each box were randomly chosen and tagged for subsequent sampling. Then samples dried in oven 70ºc for 24 h for measuring seedling dry weight. Daily record used to estimate as follows:

FGP means finally germination percentage that recorded from seeds germinated at 7th day.

[1]Mean Germination Time
[2]Mean Daily Germination
[3]Finally Germination Percentage
[4]Daily Germination Speed

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

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

$MDG = \frac{\text{Final germination percentage}}{\text{Germination term}}$, MDG is mean germination days and it is speed germination days index. DGS (Day Germination Speed) is time to need for germination a seed when ever reduce it, increase germination speed. This index is contrast MDG.

Experimental Design and Statistical Analyses

All data were subjected to analysis of variance (ANOVA) appropriate to a factorial form on Complete Randomized Design with four replications in 2005. The studied factors were less irrigation at 4 levels (normal irrigation, irrigation until flowering, irrigation until padding and irrigation until seed filing stages) and 6 winter rapeseed cultivars (Orient, Okapi, Licord, SLMO46, Opera and used Zarfam). 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:

The analysis variance of data showed that cultivar effects were responsible for FGP ($p \leqslant 0.01$), root/shoot ratio ($p \leqslant 0.05$). Less irrigation had significant effect ($p \leqslant 0.01$) on root length, root/shoot ratio, FGP, hard seed and abnormal seedling (Table 1). The interaction of less irrigation stages×cultivar weren't significant. Analysis of variance 9 traits for different less irrigation stages and canola cultivars under standard germination test condition presented in Table 1.

Root length: Less irrigation after padding and less irrigation after seed filling had the maximum root length (Fig. 1). Among cultivars, SLMO46 and Orient had the longest root (Fig. 4). Result of this study showed that less irrigation cause to increasing root length but length of whole plant decreased. Result of Machado *et al*. (2001) and Bishnoi and Santos (1996) weren't similar to this study. **Root/shoot ratio:** Normal irrigation and less irrigation after flowering had the maximum and minimum Root/shoot ratio, respectively (Fig. 2). Among cultivars, Orient and Licord had the most root/shoot ratio (Fig. 5). Less irrigation after flowering increased shoot length and due to decrease root/shoot ratio. **Seedling dry weight:** Seedling dry weight in less irrigation after flowering was the maximum (Fig. 3). Zarfam, among cultivars produced the most seedling dry weight (Fig. 6). Deceasing dry weight after stress could be related to change contain of nuclear (Verma *et al*., 1999). Verma *et al*. (2001) declared that accelerate aging test cause to decline germination speed, seed vigor and protein content but soluble carbohydrate increased. **Mean Time Germination (MTG):** Less irrigation after padding and less irrigation after flowering had the highest and lowest MTG, respectively (Table 2). Less irrigation after padding increased MTG of seeds (Johnston *et al*., 2002). **Mean Daily germination (MDG):** Less irrigation after flowering had the most MDG (Table 2) and among cultivars, Zarfam had the maximum MDG (Table 3). **Daily Germination Speed (DGS):** Less irrigation after padding had the most DGS but they had no significant differences (Table 2). Less irrigation after padding caused to increased germination speed may due to test condition. **Finally Germination Percentage (FGP):** In accelerate aging test, the seeds that produced under less irrigation after flowering had the most FGP (Table 2) and Zarfam, among cultivars had the maximum FGP (Table 3). **Abnormal seedling:** Less irrigation after flowering in accelerate aging test had the most abnormal seedling (Table 2). This result was the same results of Machado and Takaki (2001). The most abnormal seedling produced by Zarfam cultivar (Table 3). **Hard seed:** Hard seed in accelerate aging test affected by less irrigation and less irrigation after padding had the maximum hard seed (Table 2). Among cultivars, SLMO46, Okapi and Zarfam had the lowest hard seed (Table 3).

Conclusion

Generally less irrigation caused to decreased root/shoot ratio. Root/shoot ratio is the most important trait for competition among plants. Less irrigation after flowering increased abnormal seedling; less irrigation after padding increased MTG and Hard seed but declined FGP. Among cultivars, Zarfam and Orient were the best in less irrigation under accelerate aging test.

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Table 1. Source of variance of traits affected by Less irrigation stages and canola cultivars under accelerate aging test condition

S.O.V		Root length	Root/ shoot ratio	Seedling dry weight	MTG	DGS	MDG	FGP	Hard seed	Abnormal seedling
	DF					MS				
Less irrigation stages (A)	3	5.70 **	3.41 **	0.009 ns	0.002 ns	6.25 ns	0.039 ns	40.59 **	0.17 **	0.46 **
Cultivar (B)	5	2.06 ns	0.04 *	0.010 ns	0.0006 ns	3.66 ns	0.013 ns	12.58 **	0.05 ns	0.004 ns
A× B	15	0.74 ns	0.01 ns	0.008 ns	0.0008 ns	3.86 ns	0.019 ns	3.19 ns	0.02 ns	0.01 ns
Error	72	0.93	0.016	0.006	0.001	6.91	0.031	2.65	0.03	0.0086
CV		12	9.9	10.53	1.11	1.13	11.66	1.67	53.12	7.97

×× significant at the 0.01 level of probably, × significant at the 0.05 level of probably, ns no significant

Table 2. mean traits for four Less irrigation stages under standard germination test condition

Less irrigation stages	MTG	DGS	MDG	FGP	Hard seed	Abnormal seedling
Normal irrigation	3.0301 ab	0.033 a	34 a	96.30 c	0.71 b	8.33 d
Less irrigation after flowering	3.0158 b	0.031 a	41.55 a	98.91 a	0.54 b	19.73 a
Less irrigation after padding	3.0427 a	0.036 a	30.33 a	96.04 c	1.75 a	15.5 b
Less irrigation after seed filling	3.0272 ab	0.035 a	32.66 a	97.37 b	0.47 b	11.95 c

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

Table 3. mean traits for six canola cultivars under standard germination test condition

Cultivar	MTG	DGS	MDG	FGP	Hard seed	Abnormal seedling
Licord	3.02a	0.035 a	30.59 a	96.375 bc	0.81 ab	14.69 a
SLMO46	3.02 a	0.034 a	35.57 a	97.375 ab	0.62 b	13.31 a
Okapi	3.03 a	0.034 a	37.29 a	97.6 ab	0.64 b	14.37 a
Orient	3.029 a	0.035 a	32.61 a	95.937 c	1.5 a	12.81 a
Zarfam	3.02 a	0.029 a	38.61 a	98.437 a	0.57 b	15.07 a
Opera	3.03 a	0.034 a	33.35 a	97.312 ab	1.06 ab	14.12 a

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

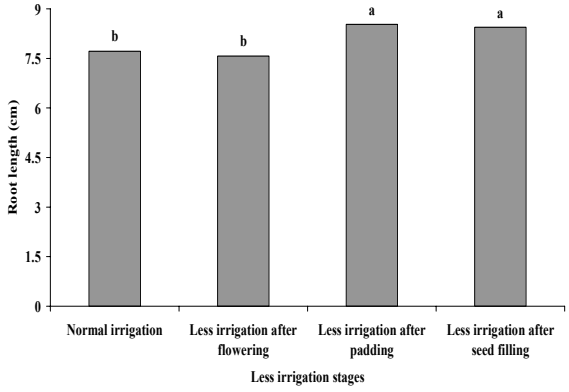

Fig 1. Multiple comparison of root length affected by Less irrigation stages under accelerates aging test condition. Mean followed by the same letters in each column are not significantly different (Duncan multiple rang 5 %

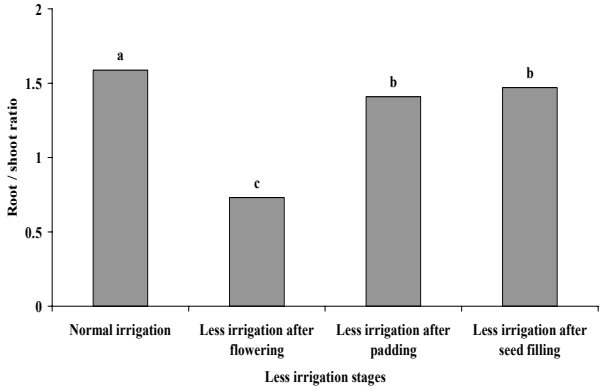

Fig 2. Multiple comparison of root/shoot ratio affected by Less irrigation stages under accelerates aging test condition. Mean followed by the same letters in each column are not significantly different (Duncan multiple rang 5 %)

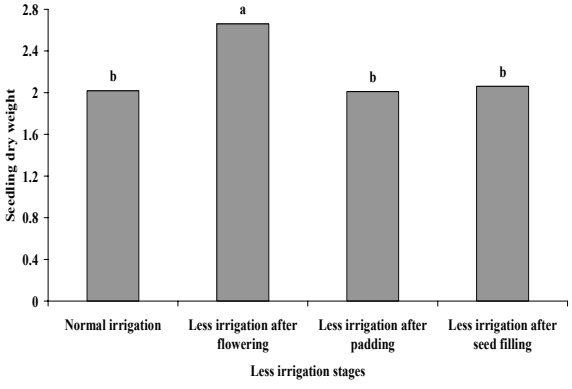

Fig 3. Multiple comparison of seedling dry weight affected by Less irrigation stages under accelerates aging test condition. Mean followed by the same letters in each column are not significantly different (Duncan multiple rang 5 %)

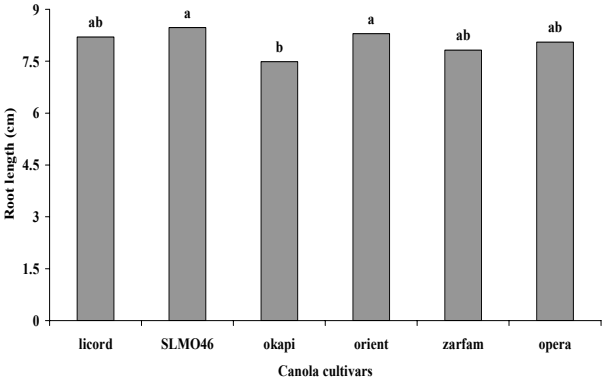

Fig 4. Multiple comparison of root length affected by canola cultivars under accelerates aging test condition. Mean followed by the same letters in each column are not significantly different (Duncan multiple rang 5 %)

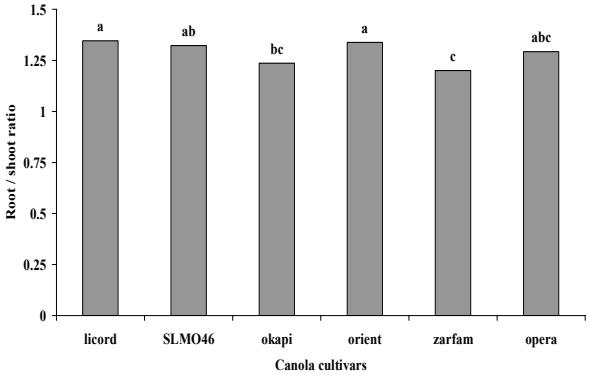

Fig 5. Multiple comparison of root/shoot ratio affected by canola cultivars under accelerates aging test condition. Mean followed by the same letters in each column are not significantly different (Duncan multiple rang 5 %)

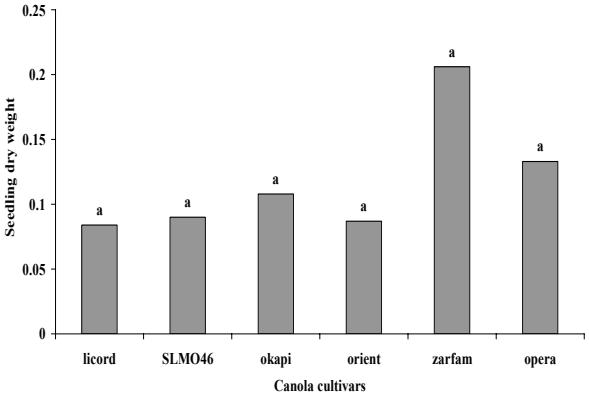

Fig 6. Multiple comparison of seedling dry weight affected by canola cultivars under accelerates aging test condition. Mean followed by the same letters in each column are not significantly different (Duncan multiple rang 5 %)