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The Effect of Salicylic Acid on Rate Germination and Seedling Establishment on Rapeseed (*Brassica napus* L.)

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Abstract – **Laboratory tests were conducted in factorial form based on CRD. Treatments were combination of levels of salicylic acid (0, 500, 1000 mM) and three varieties of rapeseed (Okapi, Option 500, RGSOO3) which replicated 3 times. Results showed that salicylic acid had a significant effects on all of traits, but impacts of cultivar was significant only on percentage and rate germination, fresh seedling weight and seed vigor index. Pre-treatment with SA caused a decreasing in germination percentage but upgraded seedling dry weight simultaneously. In all of SA priming level RSOO3 had a better response compared to other cultivars, thus it could be recommend by priming with SA for achieving to emergence uniform in rape field.**

Keywords – **Germination Rate, Rapeseed, Salicylic Acid, Seedling Establishment, Seed Vigor Index.**

I. Introduction

Salicylic acid (SA), as a plant hormone-like substance has been shown to be an important signal molecule for modulating plant responses to environmental stress (Breusegem *et al*., 2001). SA may plays an important role in the seed germination (Korkmaz, 2005), stomatal closure, ion uptake and transport (Gunes et al., 2005), membrane permeability (Hayat and Ahmad, 2007). The role of SA in defense mechanisms under biotic and/or abiotic stress suggests that it could also alleviate salt stress in plants (Stevens et al.,2006). SA is known to play an important role in modulating the redox balance across membranes, thereby counteracting the negative effects of reactive oxygen species (ROS) generated by oxidative stress (Yang et al.,2004) by increasing the activity of anti-oxidant enzymes such as superoxide dismutase (Singh and Usha,2003). A major class of phenolic compounds are hydroxycinnamic acids, which are found in almost every plant. Phenolic compounds, their antioxidant properties and distribution in carrots were investigated by Zhang *et al*., (2004). Reports by khaliliaqdam and Mir-Mahmoodi (2013) indicated SA priming enhanced emergence percentage of seed barley. Rajasekaran (2002), and shakirava (2003) showed that external application of salicylic acid to induce germination. Finally in the stimulatory effect of salicylic acid on barley seed germination realized (Eltayeb.2005). Because of the role of salicylic acid on germination and seedling establishment, the effects of these factors on germination and seedling establishment in oilseed rape cultivar were studied.

II. Materials and Methods

Seeds of rapeseed (Brassica napus L.) were obtained from Agriculture laboratory, Mahabad, Iran. Experiments were conducted in the Mahabad Islamic Azad University. In this study, seed samples of Rape cultivars: RGSOO3, Option 500. Okapi as factor A and factor B as salicylic acid concentration (0), (500 mM),(1000 mM). The sub-samples were treatment by soaking the seeds in distilled water and solutions of salicylic acid for 18 hours. Three replication of 25 seeds were taken between double layered rolled germination papers. The rolled papers with seeds were put into plastic bags to avoid moisture loss. Seeds were allowed to germinate at 15±1℃ in the dark for 21days. Germinated seeds were recorded every 24 h for 21 days. Seed vigor index (SVI) was estimated as:SVI = SDW/MGT (ISTA, 2003) where MGT is mean germination time and SDW is seedling dry weight.

At the end of germination test (21 days), seedling weight dried in an oven at 80℃ for 48 h then weighed to the nearest g and the mean seedling dry weight, fresh seedling weight, root length and plumule weight and were determined.

III. Design Experimental

Laboratory tests were conducted in form of factorial based on CRD with 3 replications at seed technology laboratory of Mahabad Branch of Islamic Azad University, Iran, Analysis of Variance (ANOVA) done using SPSS software. Means were compared by applying LSD at 5% probability.

IV. Results and Discussion

The analysis of variance of the laboratory data showed that SA priming had a significant effects on all of traits but its effect were variable. Cultivar impact on root length, plumule length and seedling dry weight were no significant but interaction effects of priming and cultivar was significant only ongermination rate, fresh seedling weight and seed vigor index (Table 1). Significant effects of salicylic acid on rate, percentage and field emergence were also reported in barley (El-tayeb, 2005; khaliliaqdam and Mir-Mahmoodi, 2013). Also reported priming with the salicylic acid is the increase percentage and germination rate (Demir,Kaya et al.,2006).

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Table 1: Analysis of variation in determined characteristics

S.V	Mean of squares						
	df	Germination percentage	Germination rate	Root length	Length plumule	Seed vigor index	Seedling dry weight
Priming (P)	2	** 770.370	** 0.001	368.092 $^{n.s}$	2109.349 $^{n.s}$	** 0.0037	0.005 **
Cultivar (C)	2	** 256.593	** 0.001	6.829 **	55.488 **	** 0.001	0.00033 $^{n.s}$
P× C	4	10.370 $^{n.s}$	** 0.001	$^{n.s}$ 5.042	$^{n.s}$ 32.728	** 0.0011	0.001 $^{n.s}$
Error	18	519.6	00088.0	9.022	38.537	0.0015	0.0016
CV(%)		2.99	4.3	34.6	9.48	1.30	11.08

V. Germination Percentage

Results of analysis of variance appointed that the response of cultivar to SA priming was no similar and the RGSOO3 had the highest Germination (Fig.1). Increasing in SA concentration diminished germination (Fig. 2) and untreated seed had the more germination percentage rather than two other SA concentrations.

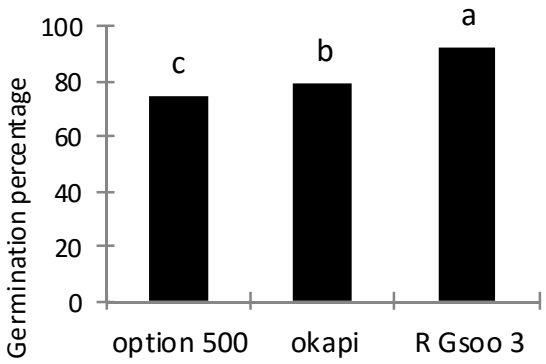

Fig.1. Effect cultivar on germination percentage

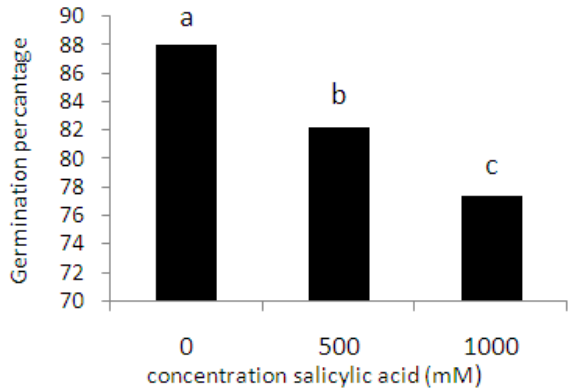

Fig.2. Effect density on germination percentage

VI. Germination Rate

SA priming had a significant effect on germination rate (Fig. 3). In no priming treatment, option500 had the highest germination rate but by increasing in SA concentration, germination rate decreased and in 500 and 1000 nM were partly alike.

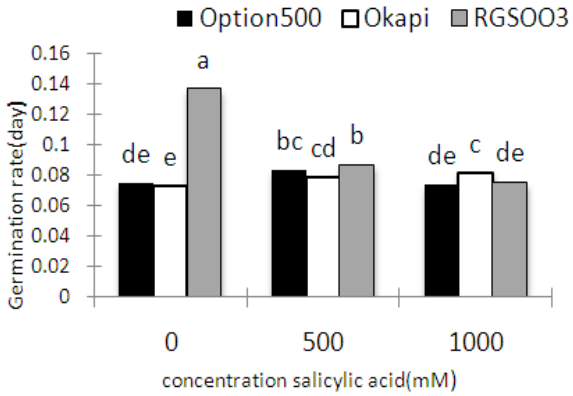

Fig.3. Effect the interaction between cultivar and density on the rate germination

VII. Root Length and Length Plumule

The analysis of variance of the laboratory data showed that the effects of SA priming on root length and plumule were no-significant whereas difference between cultivars were significant (Table1). Both of two traits (plumule length and root length) in option500 were the lowest and in RGSOO3 cultivar were the highest (Fig. 4, 5).

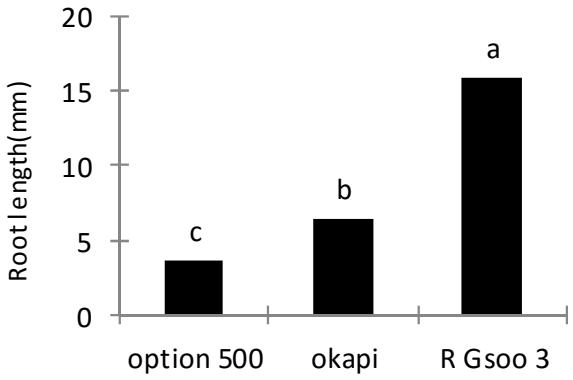

Fig.4. Effect of cultivar on root length

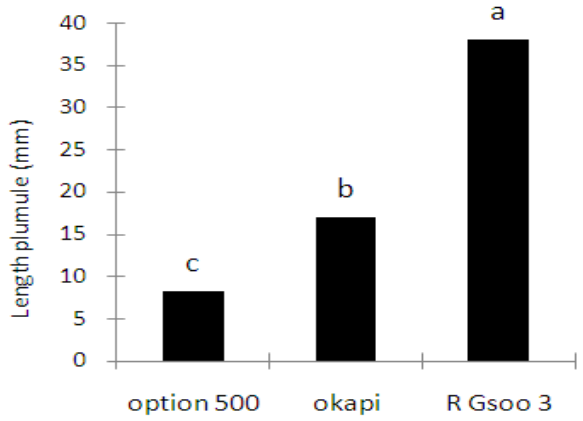

Fig.5. Effect of cultivar on length plumule

VIII. Seedling Weight

All treatments of salicylic acid had significant effects on seedling dry weight (Table1). As expected, increasing in SA concentration decreased seedling dry weight and all of the cultivars showed similar responses to SA priming but always Seedling weight was higher than two other cultivars (Fig. 6).

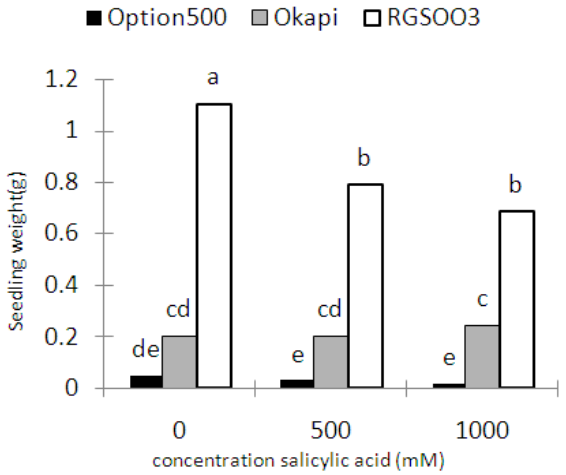

Fig.6. Effect the interaction between cultivar and SA on the seedling weight

IX. Seed Vigor Index

The effects of SA priming and cultivar alike in other traits were significant. Interaction of SA priming× cultivar was significant and SA priming decreased SVI simultaneously as seedling dry weight decreased (Fig. 6). SVI of RSOO3 in control treatment was much more than when seed primed with SA and option 500 cultivar had the lowest SVI.

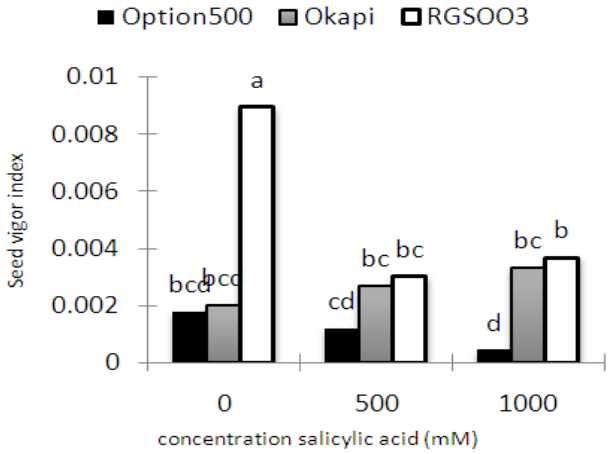

Fig.7. Effect the interaction between cultivar and density on the seed vigor index

X. Conclusion

Seed priming has been recognized as a mechanism to increase seedling establishment, especially in adverse condition but in this investigation SA priming had no positive effect of traits and generally have been decreased. Cultivars had different response to SA priming whereas all of traits by SA priming decreased in three cultivars. RGSOO3 in all of treatment had the highest value and could consider as a better cultivar than option500 and okapi.

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