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EFFECT OF ESSENTIAL OILS ON DORMANCY BREAKING, GERMINATION AND SEEDLING GROWTH OF CAROB SEEDS

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ABSTRACT

This work was conducted during two successive seasons of 2006 and 2007 to compare the effect of some natural and chemical pre soaking treatments on germination of strongly hard coated carob seed and seedling subsequent growth performance. Natural treatments included : soaking seeds into hot water, soaking scarified seeds into emulsion of essential oils, soaking seeds into emulsion of essential oils in hot water. Whereas, chemical treatments included : soaking seeds into sulfuric acid, formic acid, sulfuric + formic acids, hydrogen peroxide, naphthalene acetic acid (NAA) and scarified seeds into NAA solution. All treatments in comparison with soaking into water at ambient temperature (control) and mechanical scarification the common pre sowing traditional method for hard coat seeds. In all cases, soaking period was 24 hrs.

All treatments were significantly varied in their effect on germination %, germination rate and velocity as well as subsequent seedling growth characters (seedling length, root length, number of leaves and dry weight). All treatments except formic acid were significantly superior than the control, also, most treatments were superior than the traditional scarification in both seasons.

The most effective natural treatments of the highest significant value for germination and growth parameters were soaking scarified seeds into sage oil emulsion, soaking non scarified seeds into emulsion of mint oil in hot water, soaking non scarified seeds into emulsion of sage oil in hot water. These treatments increased the germination % and the seedling dry weight. The germination % were 100 %, 98 % and 95 % respectively and 42.5 % and 0.0 % for the traditional and control ones respectively, the same treatments greatly enhanced the subsequent growth, caused increments of 62.3 %, 48.1 % and 12.7 % (mean of the two seasons) for seedling dry weight respectively relative to the traditional one. Whilst the most superior chemical treatment was soaking the scarified seeds into NAA solution that caused increments of (93.6 % and 44.8 %) for germination % and seedling dry weight respectively with 82 % germination percentage.

Therefore, it is recommended to soak carob seed before sowing for 24 hrs into mint oil (2.5 %), emulsified in hot water of 80 ^{o}C initial temperature without scarification as a natural, safe and practical method for the pest germination and subsequent growth performance.

INTRODUCTION

The carob (*Ceratonia siliqua* L.) is an important component of the Mediterrane vegetation, specially in marginal and prevailing calcareous soils of this region. It is important ecologically and economically (Batlle and Tous, 1997).

The main interest of this tree is seed production for gum extraction, that widely used in industry as a stabilizer (Catarins, 1995) and the traditional use of its pods as human and/or animal food (Merwin, 1981). Also, carob has an important health value as astringent, antidiarrhea, antiacids and diuretic (Imam, 1983).

Although, it is not commonly cultivated in Egypt, it can grow successfully in the northern costal desert areas (Wally *et al*., 1975). Carob tree can also, grow in many non favorite environmental conditions, tolerant to drought and air pollution (Nunes *et al*., 1989); it is a valuable resources in reforestation for prevention of erosion in marginal lands. World production of carob is about 310000 ton/year; Spain, Italy, Portugal and Morocco are the main carob producers (MAPA, 1994). Egypt mainly imported carob fruits from these Mediterranean countries.

Now considerable attention for carob cultivation and production in Egypt must be paid, propagation is the key practice for any tree cultivation, herein this must be in the center of that attention.

Vegetative propagation by cuttings is not yet commercially available (Fadl *et al*., 1979). Carob rootstocks are still obtainable from seeds of cultivated or wild trees. The seedling stocks should be budded one year after seed germination in nursery or two years from germination in the permanent orchard.

Carob seed testa is very hard, impermeable to water and O_2 with minute hllum, very difficult to germinate normally, require certain procedure to facilitate water imbibition and O_2 uptake, induce the onset of the internal biochemical events of germination.

The embryo becomes active after water penetration, synthesis of mRNA begins, gebberelic acid is discharged induces the synthesis of hydrolases which mobilized the reserve materials, α-amylase degrades starch, proteases act on proteins librate amino acids includes tryptophan from which IAA formed, nucleases which attack nucleic acids produces cytokinins, those now act on the embryo induce it to grow (Hess, 1981).

To accelerate germination processes and to maximize germination percentage and velocity, different mechanical and chemical methods involving either abrasive or activator action known to be applied.

Those such as mechanical scarification, hot water, sulfuric acid, acetone, H_2O_2, growth regulators and others were being reported by (Hess, 1981; Hussein *et al*., 1993 and EL-Baz, 2003).

Recently, natural alternatives such as essential oils and/or their basic components (monoterpenoids) were assessed and proved promising effects (An *et al*., 1993 and Vokou *et al*., 2003).

Einhelling and Rasmussen (1978) stated that, essential oils due to their major components evolved certain stimulatory or inhibitory effects.

This depending on their concentration and allelochemicals and their interactions (An *et al*., 1993).

The present work designed to establish new effective, safe and easy to practice procedures includes essential oils and other treatments for improving germination characteristics of carob seeds.

MATERIALS AND METHODS

The present work was conducted during 2006 and 2007 seasons to study the effect of different pre soaking treatments on seed germination and subsequent seedling growth of carob.

Carob seeds were obtained from mature pods, washed with tap water, sterilized using 5 % sodium hybochlorite solution for 10 seconds, washed again with distilled water and air dried for 2 hrs.

After that some seeds were scarified physically before their stepping in solutions of the treatments. Scarification of hard coat was done using file on both sides of seeds.

Seeds were soaked into emulsion of different natural essential oils, spearmint oil, sage oil and cinnamon oil, 50 ml for each one in 100 ml conc. flask tightly closed for 24 hrs. Other seeds were soaked into hot water at 80 ^{o}C initial temperature and into water of ambient temperature for 24 hrs too.

Essential oils were extracted from the dried herb of spearmint, sage and cinnamon using hydro-distillation for 2 hr then, emulsified using tween 80 1.5 ml/L in hot or ambient temperature water. The applied concentration of all oils was 2.5 %.

This procedure designed for the first experiment, which includes Laboratory germination test and pot plantation for subsequent growth evaluations.

The natural presoaking treatments (Exp.1) :

1- Soaking seeds into water/ambient temp. (control).
2- Physically scarified seeds, traditional method.
3- Soaking seeds into hot water 80 ^{o}C initial temp.
4- Soaking seeds into spearmint oil, emulsified with ambient temp. water.
5- Soaking seeds into sage oil, emulsified with ambient temp. water.
6- Soaking seeds into cinnamon oil, emulsified with ambient temp. water.
7- Soaking seeds into spearmint oil, emulsified with hot water 80 ^{o}C.
8- Soaking seeds into sage oil emulsified with hot water 80 ^{o}C.
9- Soaking seeds into cinnamon oil emulsified with hot water 80 ^{o}C.
10- Soaking scarified seeds into spearmint oil, emulsified with ambient temp. water.
11- Soaking scarified seeds into sage oil, emulsified with ambient temp. water.
12- Soaking scarified seeds into cinnamon oil, emulsified with ambient temp. water.

The previously treated carob seeds were transferred into Petri dishes containing filter pepper (50 seeds/dish). All dishes were kept on room temperature, regularly watered in equal volume and closed with their covers. The dishes were arranged in a randomized complete design including 12 treatments and 4 replications. Three days after the beginning of the exp. until the end of germination (25 day), the number of the germinated seeds (radical emerges) were recorded every day, then the following germination parameters were determined :

- Germination percentage (G %) :

$$\frac{\text{Total No. of the germinated seeds}}{\text{Initial No. of seeds}} \times 100$$

- Germination rate index (GRI) :

$$\frac{\Sigma \text{ Ti Ni}}{S} \times 100$$

Where Ti : is the number of days from the beginning to the day of count, Ni : is the number of seeds germinated on day i, S : is the total number of the tested seeds, according to Scott *et al*., (1984).

- Germination velocity coefficient (GVC) :

$$GVC = 100 \left[\frac{\Sigma \text{ Ti Ni}}{S}\right]$$

According to Scott *et al*., (1984).

Also, the relative value (RV) for all parameters calculated as % of the traditional treatments (scarification). Since, it known as a common pre sowing practice for hard coat seed.

$$RV\ (\%\ of\ trad.) = \frac{\text{Value of germination parameter of treatments (mean of the two seasons)} \times 100}{\text{Corresponding value of traditional treatment}}$$

Other treated seeds were sown in 8 x 10 cm plastic pots filled with a mixture medium sand + peat + clay (1:1:1 v/v). The pots were placed under nursery conditions, arranged in randomized complete experiment includes 12 treatments in 3 replications each one 3 pots of one plant. The pots were regularly feed and watered.

Three months after emergence, the seedlings were taken out, and seedling length, root length, number of leaves and dry weight (gm)/ seedling were determined.

In exp.2, the same procedure, design and parameters were as in exp.1, the applied pre soaking chemical treatments were as follows :

1- Soaking seeds into water at ambient temp. (control).
2- Scarifying seeds (traditional method).
3- Soaking seeds into hot water.
4- Soaking seeds into sulfuric acid 5 % solution.
5- Soaking seeds into formic acid 5 % solution.
6- Soaking seeds into sulfuric acid and formic acid 5 % of each one.
7- Soaking seeds into 10 % H_2O_2 solution.
8- Soaking seeds into 10 ppm NAA solution.
9- Soaking scarified seeds into 10 ppm NAA solution.

All the collected data were statistically analyzed based on ANOVA and L.S.D. test.

RESULTS AND DISCUSSION

Exp. I (Natural treatments) :

1- Germination characters :

Data in Table (1) markedly show that, soaking seeds into water-ambient temperature was not effective for inducing on germination activities during the two seasons; during the laboratory germination test it was

observed that seeds of this treatment showed no swelling and remained in its hard dormant state. Among all the individual treatments only soaking seeds into hot water caused significant increase in germination percentage in comparison with that of the control and scarification in the two seasons. The other individual treatments of sage, mint and cinnamon essential oils which applied alone slightly improved germination percentage over the control but not over scarification in both seasons of study. Whereas, combinations of essential oils either with hot water or scarification significantly differed in their effect and highly increased germination % of seeds in the two seasons of study.

Table (1) : Effect of natural pre soaking treatments on germination characters of carob seed during 2006 and 2007 seasons.

Pre soaking treatments	Germination % (G %)		Relative G % of scarification	Germination rate index (GRI)		Relative GRI % of scarification	Germination velocity coefficient (GVC)		Relative GVC % of scarification
	2006	2007		2006	2007		2006	2007	
Water/ambient temp. (control)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scarification (traditional)	40.00	45.0	100	4.20	5.83	100	9.52	8.33	100
Hot water (80 ^{o}C) initial temp.	46.20	48.0	110.82	4.80	5.64	103.98	9.72	8.5	102.01
Mint oil	33.27	35.0	80.32	5.20	5.70	108.57	6.41	6.48	72.17
Sage oil	39.00	40.0	92.94	6.40	7.00	133.47	5.20	5.39	59.29
Cinnamon oil	26.00	27.30	62.71	4.03	5.30	92.93	7.50	7.48	83.87
Mint oil + hot water	96.0	100.0	230.59	13.40	12.40	256.97	9.96	9.48	108.96
Sage oil + hot water	93.30	96.90	223.76	12.47	12.58	248.8	7.48	7.38	83.20
Cinnamon oil + hot water	87.30	89.30	207.76	11.87	11.65	234.26	8.43	7.48	89.08
Mint oil + Scar.	85.0	86.30	201.53	5.20	5.80	109.56	10.38	9.30	110.19
Sage oil + Scar.	100.0	100.0	235.29	9.20	9.38	185.06	10.87	9.55	114.33
Cinnamon oil + Scar.	70.0	78.60	174.82	5.40	5.41	107.67	7.65	7.36	91.30
L.S.D at 5 %	0.05	0.07	--	0.21	0.14	--	0.75	0.69	--

Among all treatments the most effective ones were sage oil + scarification, mint oil + hot water and sage oil + hot water those increased germination percentage of their seeds by 135.3 %, 130.6 % and 123.76% (mean of the two seasons) respectively compare with traditional scarification treatment.

Regarding germination rate index (GRI), the obtained data reveal that sage oil followed by mint oil and hot water respectively increased GRI by 33.40 %, 8.57 % and 3.98 % relative to the traditional treatment. Meanwhile, most of the applied combinations greatly increased GRI in the two seasons. The most effective ones were mint oil + hot water, sage oil + hot water, cinnamon oil + hot water and sage oil + scarification, that gave increments of 156.9 %, 148.8 %, 134.2 % and 85.0 % respectively over scarification (trad. treatment).

Germination velocity coefficient also increased followed seed pre soaking treatments of sage oil + scarification (14.3 %), mint oil + scarification (10.2 %), mint oil + hot water (8.9 %) and hot water alone (2.0 %) over the value of trad. treatment. The reminder treatments only superiored the control at both seasons.

Once again, the data of Table (1) proved that the most effective pre sowing treatments on the whole germination behavior of the hard coat carob seed were soaking scarified seeds into sage oil, soaking seeds into mint oil + hot water and soaking seeds into sage oil + hot water respectively.

For essential oils the results were in line with those obtained by Asplund (1968); Trayer *et al*. (1995); Vokou *et al*. (2003) and EL-Baroty (1997), and for the other treatments Hussein *et al*. (1993) and EL-Baz (2003).

Obviously the mentioned results evidented that, either pre sowing physical scarification or hot water are effective to certain extent but not completely improve germination activities of carob seed since, the two treatments known to be physically brading or softening the solid impermeable testa, ulter it more permeable, facilitate the uptake of water and oxygen (Nagao *et al*., 1980). Meanwhile, the application of mint, sage and cinnamon oils also displayed slight enhancable effect.

In comparison of this effect with their superior stimulatory and acceleratory ones when applied in combination with hot water or scarification. This suggest that, such procedure may facilitate penetration of these oils, diffused into the internal active sites within seed wherever they evolve their effects.

Generally essential oils are frequently known to induce stimulatory or inhibitory effects on germination of seeds and other physiological processes depending on their basic components, concentration, allelochemicals interaction, selectivity due to the site of application and plant species...(Fischer *et al*., 1988; An *et al*., 1993 and Vokou *et al*., 2003). Furthermore, the resulted stimulatory and acceleratory effects of essential oils especially when the procedure allows it to act internally within seed may also explain their useful effects.

Considering the normal biochemical events occurred during germination (Hess, 1981), the involvement and effects of the applied essential oils become more elucidated, their monoterpenoids activate α-amylase (germination key enzyme), (EL-Baroty, 1997), proteases, nucleases (Marambe *et al*., 1992) also oxidases and peroxidase (EL-Awady, 2006). Thereby, degradation of the reserve materials into usable form for respiration and new biosynthesis (Mayer and Poljakoff, 1980). Moreover, this case may be also involved an hormonal rise and responses (Hess, 1981).

The findings of EL-Baz (2003) for maximization of carob seed germination followed pre soaking scarified seeds into cytokinin and GA_3 also into auxin (NAA) (the present data Table, 2).

All confirmed the prior suggestion and interpretation, at the same time drive some evidence about that maximization of carob seed germination activities not only require external procedure for overcoming the mechanical barrier but may also need stimulant agents for the internal (hormonal and enzymatic) activation and acceleration of germination process.

2- Subsequent seedling growth :

The presented data in Table (2) illustrate that, all the applied pre sowing treatments were in similar trend considerably influenced the subsequent growth performance of their seedlings as they did during the germination stage.

All combinations of essential oils either with hot water or scarification as well as hot water alone significantly increased seedling length, root length, number of leaves and dry weight of their seedlings in comparison with the control and the traditional ones in both seasons. Whereas, the essential oils alone were not considerably effective.

It was also noticeable that, hot water more than scarification ulter the effect of mint and cinnamon oils on growth of the emerged seedling to be more effective, the reverse was true for sage oil.

These differences in the combined effect of the applied combinations may be attributed with lipophilicty and volatility nature, allelochemicals and their interaction that varied among different oils (Fisher *et al*., 1988 and Vokou *et al*., 2003).

Also, from the data of Table (2) it is clear that pre soaking of the scarified seed into sage oil and non scarified seed into mint oil in hot water were respectively of the highest significant values for their seedlings growth parameters (tip length, root length, number of leaves and dry weight) during the two seasons. Those increased the dry weight of their seedlings by 62.3 % and 48.1 % respectively (relative values).

Table (2): Effect of natural pre soaking treatments on subsequent growth parameters of carob seedlings during 2006 and 2007 seasons.

Pre soaking treatments	Seedling length (cm)		Relative values % of scarification	Root length (cm)		Relative values % of scarification	No. of leaves / seedling		Relative values % of scarification	Dry weight (gm)/seedling		Relative values % of scarification
	2006	2007		2006	2007		2006	2007		2006	2007	
Water/ambient temp. (control)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scarification (traditional)	14.97	15.80	100.0	20.85	21.77	100.0	6.0	7.0	100.0	1.22	2.23	100.0
Hot water (80 ºC) initial temp.	16.25	17.0	108.02	23.52	24.23	112.04	7.0	8.0	115.38	1.30	2.30	104.05
Mint oil	8.50	9.70	59.13	13.14	14.20	64.15	3.0	4.0	53.85	0.71	0.84	44.79
Sage oil	11.27	11.50	73.98	15.65	16.55	75.55	4.0	5.0	69.23	1.0	2.0	86.71
Cinnamon oil	9.80	10.40	65.63	13.86	14.90	67.48	4.0	5.0	69.23	0.80	0.90	49.13
Mint oil + hot water	27.0	30.20	185.83	35.55	36.56	169.19	11.0	12.0	176.92	2.25	7.86	148.1
Sage oil + hot water	26.25	28.0	176.25	33.83	34.90	159.51	11.0	12.0	176.92	1.90	2.0	112.72
Cinnamon oil + hot water	20.0	20.50	131.58	28.45	29.58	136.16	8.0	9.0	130.77	1.45	2.44	112.42
Mint oil + Scar.	18.75	19.60	124.59	24.90	25.80	118.96	7.0	8.0	115.38	1.60	2.30	112.72
Sage oil + Scar.	30.50	32.0	203.05	40.95	42.08	194.81	12.0	13.0	192.31	2.40	3.2	162.3
Cinnamon oil + Scar.	16.25	16.90	107.69	22.87	24.56	111.28	7.0	8.0	115.38	1.25	2.26	101.44
L.S.D at 5 %	0.26	0.14	--	0.29	0.38	--	0.56	0.57	--	0.16	0.04	--

This subsequent growth vigorousty of carob seedling followed the mentioned pre sowing treatments is logically corresponding with their similar

stimulatory and acceleratory effects on seed germination and seedling emergence (Table, 1). Also, these results are in line with the findings of EL-Baz *et al*. (2003); Vokou *et al*. (2003) and EL-Awady (2006).

Exp. II (chemical treatments) :

1- Germination characters :

The data in Table (3) indicate that, soaking carob seeds into different chemical solutions includes sulfuric acid, sulfuric + Formic acids, H_2O_2 and NAA and scarified seed into NAA solution as well as hot water and scarification (traditional treatment) all highly increased germination parameters over the control (soaking into water/ambient temperature) of (0.0 value) for all parameters in both seasons. Also formic acid (5 %) alone gave no effect in the two seasons. In comparison with scarification the common traditional method, NAA + scarification followed by sulfuric + formic acids, hot water and sulfuric acid alone all respectively induced pronounced stimulatory effect on all germination parameters during the two seasons.

Table (3) : Effect of chemical pre soaking treatments on germination characters of carob seed during 2006 and 2007 seasons.

Pre soaking treatments	Germination % (G %)		Relative G% of scarification	Germination rate index (GRI)		Relative GRI% of scarification	Germination velocity coefficient (GVC)		Relative GVC% of scarification
	2006	2007		2006	2007		2006	2007	
Water/ambient temp. (control)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scarification (traditional)	39.80	44.90	100	4.10	5.70	100	9.50	8.40	100
Hot water (80 °C) initial temp.	46.20	48.00	112.21	4.8	5.90	109.18	9.00	9.72	101.22
Sulfuric acid	40.0	46.00	101.5	5.20	5.4	108.16	11.11	10.30	119.61
Formic acid	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sulfuric + Formic acids	46.20	47.20	110.27	5.10	6.0	113.26	9.93	9.98	111.23
H_2O_2	20.0	26.0	54.31	1.87	2.8	47.63	10.71	9.89	115.10
NAA	32.0	38.0	82.64	4.07	5.2	94.59	6.45	5.43	66.37
NAA + Scar.	80.0	84.0	193.62	5.20	6.0	114.28	15.38	11.30	149.05
L.S.D at 5 %	0.07	0.05	--	0.23	0.17	--	0.31	0.43	--

The same data show that, the highest values were of NAA + scarification treatment, its germination %, germination rate index and germination velocity coefficient increased by 93.6 %, 14.28 % and 49.0 % respectively relative to those of the traditional one.

Many workers pointed out that, using sulfuric acid (80.0 %) dipping for 20 to 30 min. resulted in high carob seed germination %. In comparison with the present results the use of more concentrated sulfuric acid in short soaking period is more effective than the less concentrated in long soaking period (Hussein *et al*., 1993). Sulfuric acid alone or combined with formic acid known to be chemically abrading the solid testa, in turn may be facilitate water diffusion and O_2 uptake through the chemically weakened testa for the high respiratory activity of the embryo.

On the other hand the fully ineffectiveness of formic acid alone and the slightly effect of H_2O_2 far from the expected may be due to the weak abrading action of the applied concentration.

The superiority of NAA + scarification treatment may be explained based on the effect of its individuals. NAA alone exert weak promotional effect may be due to its ineffectivity to penetrate into the embryo. Whilst the combined application may allow NAA to reach the embryo through the weakened scarified coat. Within the seed NAA evolved its known stimulatory effects (Hess, 1981) on germination activities and the subsequent seedling growth.

2- The subsequent seedling growth :

As shown in Table (4) the applied chemical treatments in similar trend extended their beneficial effects upon germination activities into growth case of their emerged seedlings. Also, the most superior ones of the significant highest seedling length, root length, number of leaves and dry weight of its seedlings was NAA + scarification followed equally by sulfuric + Formic acids and hot water treatments. Those increased dry weight of the seedlings by 44.8 %, 24.5 % and 24.2 % respectively relative to the traditional treatment. These results were in agreement with those obtained by (Hussein *et al*., 1993; Moustafa & AL-Zidgali, 1995 and EL-Baz, 2003).

Table (4): Effect of chemical pre soaking treatments on subsequent growth parameters of carob seedlings during 2006 and 2007 seasons.

Pre soaking treatments	Seedling length (cm)		Relative values % of scarification	Root length (cm)		Relative values % of scarification	No. of leaves / seedling		Relative values % of scarification	Dry weight (gm)/seedling		Relative values % of scarification
	2006	2007		2006	2007		2006	2007		2006	2007	
Water/ambient temp. (control)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scarification (traditional)	14.90	15.60	100	26.80	21.70	100	6.0	7.0	100	1.21	2.10	100
Hot water (80 ^{o}C) initial temp.	16.23	17.0	108.95	22.2	23.8	108.23	7.0	8.0	115.38	2.00	2.10	124.0
Sulfuric acid	15.80	16.0	104.26	21.62	22.66	104.19	6.0	7.0	100	1.27	2.10	102.12
Formic acid	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
Sulfuric + Formic acids	16.30	16.80	108.52	23.0	24.0	110.59	7.0	8.0	115.40	2.00	2.11	124.54
H_2O_2	5.0	7.20	40.00	7.40	8.50	37.41	2.0	3.0	38.46	1.23	1.00	67.57
NAA	8.70	9.30	59.01	11.40	12.42	56.04	4.0	5.0	69.23	1.30	1.7	90.90
NAA + Scar.	16.70	18.8	116.39	23.5	24.60	113.17	8.0	9.0	130.76	2.20	2.28	144.85
L.S.D at 5 %	0.18	0.15	--	0.22	0.45	--	0.59	0.48	--	0.08	0.19	--

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تأثير الزيوت العطرية على كسر السكون وإنبات بذور الخروب ونمو البادرات

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أجرى هذا البحث خلال موسمين متتاليين ٢٠٠٦ ، ٢٠٠٧ لمقارنة تأثير بعض المعاملات الطبيعية والكيماوية على إنبات بذور الخروب ذات القصرة شديدة الصلابة وصعبة الإنبات وكذلك على النمو الخضري اللاحق للبادرات الناتجة وشملت المعاملات الطبيعية : نقع البذور فى الماء الساخن – نقع بذور مخدوشة في مستحلب الزيوت العطرية – نقع بذور غير مخدوشة فى مستحلب الزيوت العطرية بالماء الساخن (مدة النقع ٢٤ ساعة) ، إضافة إلى المقارنة (نقع فى الماء على درجة الحرارة العادية) ومعاملة التخديش التقليدية.

وإشتملت المعاملات الكيماوية على نقع البذور لمدة ٢٤ ساعة فى محاليل حمض الكبريتيك (٥ %) – حمض فورميك (٥ %) – حمض كبريتيك + حمض فورميك (٥ % لكل منهما) فوق أكسيد هيدروجين (١٠ %) – نفثالين حمض الخليك ١٠ جزء فى المليون – بذور مخدوشة فى نفثالين حمض الخليك ١٠ جزء فى المليون إضافة إلى المقارنة ومعاملة التخديش التقليدية.

إختلفت جميع المعاملات فى تأثيراتها على النسبة المئوية للإنبات ومعدل الإنبات وسرعته وعلى صفات النمو الخضرى اللاحق للنباتات الناتجة (طول البادرة – طول الجذر – عدد الأوراق – الوزن الجاف) وتفوقت كل المعاملات بإستثناء معاملة حمض الفورميك على المقارنة ومعظم المعاملات على معاملة التخديش التقليدية فى موسمى الدراسة.

وكانت أفضل المعاملات الطبيعية والتى أعطت أعلى قيم معنوية لقياسات الإنبات والنمو اللاحق هى نقع البذور المخدوشة فى مستحلب زيت المريمية ونقع البذور غير المخدوشة فى مستحلب زيت النعناع بالماء الساخن ونقع البذور غير المخدوشة فى مستحلب زيت المريمية فى الماء الساخن وأعطت تلك المعاملات على التوالى زيادة فى النسبة المئوية للإنبات وفى الوزن الجاف للنباتات مقارنة بمعاملة التخديش التقليدية مقدارها (١٣٥,٣ % ، ٦٢,٣ %) ، (١٣٠,٦ % ، ٤٨,١ %) و (١٢٣,٨ % ، ١٢,٧ %). والنسبة المئوية للإنبات فى تلك المعاملات كانت ١٠٠ % ، ٩٨ % ، ٩٥ % (متوسط الموسمين) على التوالى.

وأفضل المعاملات الكيماوية هى نقع البذور المخدوشة فى نفثالين حمض الخليك والتى أعطت زيادات مماثلة مقدارها (٩٣,٦ % ، ٤٤,٨ %) والنسبة المئوية للإنبات لتلك المعاملة كانت (٨٢ %).

وتوصى الدراسة بنقع بذور الخروب قبل الزراعة لمدة ٢٤ ساعة فى زيت النعناع العطرى بتركيز (٢,٥ %) مستحلباً فى ماء ساخن (درجة حرارته الأولية ٨٠ °م) (دون الحاجة للتخديش الميكانيكي للبذور) كوسيلة طبيعية آمنة وسهلة التطبيق للحصول على أفضل إنبات ونمو لاحق للنباتات.