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PHYSIOLOGICAL STUDIES ON GERMINATION AND GROWTH OF OCHNA SHRUB
A. GERMINATION OF THE QUICK DETERIORATED SEEDS OF MICKEY MOUSE (*Ochna serrulata* Hochst) PLANT.

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ABSTRACT

This investigation was conducted under shade at the nursery of Al- Zohriya Garden, Hort. Res. Inst., ARC, Giza, Egypt, during 2017 and 2018 seasons, to improve the germination of the quick failure seeds of Mickey Mouse plants (*Ochna serrulata* Hochst.) by sowing its depulped seeds in different times (directly after collection or after collection by 12, 24 and 48 hr.) and soaking them for 0, 12, 24 and 48 hr in 1 ml/l Lena-tonik solution (a commercial liquid plant growth regulator consisted of 1 g/l Na-5-nitroguaiacholate + 2 g/l Na-ortho-nitrophenolate + 3 g/l Na-para-nitrophenolate). The effect of the interaction between sowing time and soaking in Lena-tonik solution was also studied. The results indicated that the highest percentage of germination was obtained by sowing after 12 hr. from seed collection, as this treatment significantly increased the mean of this trait to 90 % in both seasons over all the other sowing times. Delaying sowing time to either 24 or 48 hr. significantly decreased germination percentage, while soaking the seeds in 1 ml/l Lena-tonik solution for any period raised germination percentage to 100 % regardless of the sowing time. The shortest time to either 100% germination velocity (G.V.) or 50 % mean germination rate (M.G.R.) was also achieved by planting the seeds after 12 hr. from harvest and by soaking in Lena-tonik solution. Likewise, the best results of germination rate index (G.R.I.), vigour index (V.I.), seed viability (S.V.) and plumule length were recorded as well by the previously mentioned two treatments, with the superiority of combining between them (sowing after 12 hr from seed collection + soaking in Lena-tonik solution at a concentration of 1 ml/l), as this combination gave in general the best germination results. Similarly, were those results of seedling growth characters (seedling length, No. leaves/seedling, root length and top growth and roots fresh and dry weights). Planting the seeds after 12 hr. from harvest scored also the highest concentration of chlorophyll a and b in leaves of the resulted seedlings, whereas planting at the other times gave concentrations closely near together. The opposite was right regarding the total soluble sugars content. Carotenoids concentration, however, was gradually increased with elongating sowing time. Soaking the seeds before planting in Lena-tonik solution slightly improved the previous constituents. The effect of the interaction between treatments fluctuated with few exceptions. From these results, it can be recommended to sow *Ochna serrulata* seeds after soaking them in 1 ml/l Lena-tonik solution for 12 hours in order to attain better germination and higher quality of the seedlings produced.

Key words: *Mickey Mouse (Ochna serrulata), seed germination, Lena-tonik, germination and growth activator, germination velocity and vigour.*

1. INTRODUCTION

Ochna serrulata (Hochst.) Walp. (Syn. *O. multiflora*), Mickey Mouse plant, or Bird`s Eye bush, that belongs to Fam. Ochnaceae and native to the coast of southern Africa is a slow growing semi-evergreen small shrub of 1.5-2.5 m height with a slender dark brown smooth-barked stem and elliptical glossy green leaves with fine toothed wavy margins. It has beautiful fragrant yellow flowers in spring, forming at branch tips and very attractive fruits which are shiny black and berry-like, suspended below bright-red sepals in a way that resembles the face of Mickey Mouse. The flowers are attractive to bees and butterflies. The ripe fruits are eaten by birds (Huxley *et al*., 1992). The plant tolerates wet and heavy soils, and very dry conditions when planted in shade. It also tolerates wind and

seaside conditions and takes well to regular hedging and pruning, making it an ideal candidate for a formal or informal small hedge. It can also be used as a feature plant or in the mixed border. It looks good and does well growing amongst rocks, as a container plant and has great potential as a bonsai one. It is excellent plant to grow if you want to attract birds to your garden (Hattatt, 2001).

Bandi *et al*. (2012) mentioned that Ochna has long been used in folk medicine for treatment of various ailments, such as asthma, dysentery, epilepsy, gastric disorders, lumbago menstrual complaints, ulcers, as an abortifacient and as antidote against snake bites. Up till now, about 111 constituents, including flavonoids, anthranoids, triterpens, steroids, fatty acids and some others have been identified in the oil. The information were also documented by Makhafola and Eloff (2012), Voegele (2013) and Fidelis *et al*. (2014) as they stated that seeds of *Ochna serrulata* contain about 31 % oil included many active medicinal compounds.

Ochna serrulata is propagated by seed and cuttings. Seeds must be very fresh, it can not be stored at all, not even in refrigerator. In this regard, Gosper *et al*. (2006) mentioned that persistence of *O. cerrulata* was low, particularly under field conditions, with 0.75 % seed viability after 6 months and 0 % at 12 months. However, its germination occurred under all seed-processing treatments (with and without pulp). Moreover, Ma *et al*. (2011) stated that *Ochna integerrima* as a medicinal and ornamental plant in Southeastern Asia has been listed as a rare and endangered species in china due to the quick failure of their seeds. So, an efficient mass propagation and regeneration system must be established.

On the other hand, there have been many attempts to improve germination of seeds by treating them with some commercial nitrophenolate products. Gornik and Grzesik (2002) found that Asahi SL applied 3 times during flowering of china aster "Aleksandra" at the rates of 0.2 or 0.4 % caused an increase in the seed yield, germination and metabolic activity without modifying vegetative growth of plants. Likewise, Cai-Lian *et al*. (2010) indicated that soaking soybean sseds in 10 mg/l sodium nitrophenolate or 5 mg/l sodium nitroguaiacolate significantly increased the weight of sprout, germination energy, germination rate, germination index and vigour index. Transformation of protein was accelerated from the 3^{rd} day, the fat in seed became decreased obviously and the soluble sugars were always lower than other treatments from the 5^{th} day.

The nitrophenolates had also marked effects on seed production and quality, fruit abscission, plant growth and some metabolic events in plants. These effects were documented by Sharma *et al*. (1990) on soybean, Bynum *et al*. (2007) on cotton, Chen (2008) on *Camellia oleifera*, Zhanga *et al*. (2009) on alfalfa, Genesoylu (2009) and Dianaquiraman *et al*. (2010) on cotton, and Ogorek *et al*. (2011) on fusarium.

The purpose of the present trial was to secure the best time and treatment appropriate for the best and fastest germination of Ochna seeds coupled with the best growth of the resulted seedlings.

2. MATERIALS AND METHODS

This study was carried out under shade at the nursery of Al-Zohriya Garden, Hort. Res. Inst., ARC, Giza, Egypt, during the two successive seasons of 2017 and 2018 in order to improve seed germination and seedling quality of Mickey Mouse plant (Ochnaceae).

Thus, the ripe shiny black and berry-like fruits of this shrub (*Ochna serrulata* Hochst.) were picked in time, cleaned and the fleshy exocarp was removed. These depulped seeds (mean weight of 10 depulped seeds ranged between 2.1- 2.2 g) were sown in the following different times:

1-Directly after collection without any treatment as control.

2- After collection by 12, 24 or 48 hours.

The depulped seeds sown after collection by 12, 24 or 48 hours were divided into two groups; The first group was sown without soaking in any solution or tap water, while the second group was sown after soaking for the corresponding periods (12, 24 and 48 hrs., respectively) in Lena-tonik solution (1 ml/l) to formalize 7 interaction treatments. Lena-tonik is a liquid commercial plant growth regulator (manufactured by Lena Tarim Urunleri Ur. Paz. Dis Tic., Ltd., Ankara, Turkey) composed of 1 g/l sodium 5-nitroguaiacholate + 2 g/l Sodium ortho-nitrophenolate + 3 g/l sodium Para-nitrophenolate (the 3 ingredients are aromatic compounds). The treated seeds and those of control were sown in 16 cm-diameter plastic pots filled with about 1.7 kg of an equal mixture of sand and clay (1:1, v/v). The physical and chemical properties of the used sand and clay are shown in Table (a).

Table (a): Some physical and chemical properties of the sand and clay used in 2017 and 2018 season.

Soil type	Particle size distribution (%)				S.P.	E.C. (dS/m)	pH	Cations (meq/l)				Anions (meq/l)		
	Coarse sand	Fine sand	Silt	Clay				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{--}
Sand	84.76	6.30	1.49	7.45	21.86	3.71	7.8	19.42	8.33	7.20	0.75	1.60	7.8	26.30
Clay	7.64	22.50	30.15	39.71	52.40	2.33	8.1	7.50	2.20	15.50	0.75	6.78	8.02	11.15

The pots were arranged in a complete randomized design in factorial experimental type, replicated thrice, as each pot contained 10 seeds represents one replicate (Mead *et al*., 1993). Clearly visible plumule appearance was used as a criterion for germination. All care practices needed for the seeds were done in time, while the number of germinated seeds was counted daily and plumule length (cm) was measured after a week from emergence. The other germination characteristics were recorded as follows:

1- Germination percentage (G %) from the following equation:
G. % = No. germinated seeds/ Total No. sown seeds x 100

2- Germination velocity (G.V.) in days, which equal average number of days from sowing till emergence of the final plumule.

3- Mean germination rate (M.G.R.) in days, which equal the mean number of days till 50 % germination (Odetola, 1987).

4- Germination rate index (G.R.I.), was calculated from Bartled equation indicated by Hartmann and Kester (1983);
GRI=A+(A+B)+(A+B+ C)+…/N (A+B+C …).
- Where: A, B, C, …. etc. are number of germinated seeds counted at different times, and N is number of times at which the germinated seeds were counted.

5- Vigour index (V.I.) = G % x mean length of plumule (Selvaraju and Selvaraj, 1994)

6- Seed viability (S.V) = No. survived seedlings in each treatment after excluding the deteriorated and dead ones (Odetola, 1987).

Random samples from the resulted seedlings under each treatment were gently lifted to measure: seedling length (cm), No. leaves/seedling, mean root length (cm), as well as top growth and roots fresh and dry weights (g).

In fresh leaf samples taken only from the seedlings obtained in the second season, photosynthetic pigments (chlorophyll a, b and carotenoids, mg/g f.w.) and total soluble sugars(mg/100 g f.w.) were determined according to the methods of Moran (1982) and Dubois *et al*. (1956), respectively.

Data were then tabulated and subjected to analysis of variance using program of SAS Institute (2009), followed by Duncan's New Multiple Range Test (Steel and Torrie, 1980) to reveal the significance level among treatment means.

3. RESULTS AND DISCUSSION

3.1. Effect of sowing time, soaking in Lena tonik solution and their interactions on

3.1.1. Germination characters and plumule length

It is obvious from data averaged in Table (1 a) that the highest percent of germination was achieved by sowing after 12 hr. from seed collection, as this treatment significantly raised the mean of this parameter to 90 % in both seasons over all the other sowing times, even the directly sowing after seed collection treatment. Delaying sowing time to either 24 or 48 hr. significantly decreased germination % in both seasons. This may be attributed to the quick deterioration of such seeds after collection (Ma *et al*., 2011). On the other side, soaking the seeds in Lena-tonik solution for any time elevated the percent of germination to 100 % irrespective of sowing time, indicating the great role of such commercial product in improving germination of the quick decayed seeds. In this regard, Sharma *et al*. (1984) mentioned that Asahi SL (A-tonik) contains natural products (sodium ortho- and Para-nitrophenolates, sodium 5-nitro guaiacolate), which stimulate many physiological processes and increase activity of nitrate reductase. Besides, Bynum *et al*. (2007) reported that nitrophenolates are found naturally in plants and stimulate growth by altering the activity of specific antioxidant enzymes, such as superoxide dismutase (SOD), catalase (CAT) and peroxidase (POX). On *Camellia oleifera*, Chen (2008) found that spraying 7 repeats of 1.7 % FCH (sodium ortho-nitrophenolate + sodium Para-nitrophenolate + sodium 5 nitro guaiacolate)

significantly increased diameter, weight of simple fruit, fruit quality and germination.

Data in Table (1 a) also reveal that the least number of days to score either 100 % germination (G.V.) or 50 % germination (M.G.R.) was accomplished by sowing after 12 hr. from seed harvesting with significant differences compared to the other sowing times in the two seasons, while that was true for the seeds soaked in 1 ml/l Lena tonik solution relative to those unsoaked. So, the acceleratest germination at all was attained by combining between sowing after 12 hr. treatment and soaking in Lena-tonik solution (Fig.1). Similarly, were those results of germination rate index (G.R.I.), vigour index (V.I.), seed viability (S.V.) and plumule length (cm) as shown in Tables (1 b, c), where the best results in both seasons were recorded as well by binding between sowing after 12 hr. treatment and soaking in Lena-tonik solution at the rate of 1 ml/l. This of course is owing to connection between culture the seeds at its top vitality and getting some germination activators from Lena-tonik plant growth regulator solution.

Fig. (1): The germinated seeds of *Ochna serrulata* **sown after 12 hr. from collection (1), directly after collection(2), after 24 hrs.(3) and after 48 hrs.(4) from collection.**

These results are in accordance with those explored by Gornik and Grzesik (2002) on China aster and Cai-Lian *et al*. (2010) who detected that soaking soybean seeds in Na-Nitrophenolate at 10 mg/l concentration or in Na-nitroguaiacolete at 5mg/l level greatly improved germination energy, germination rate, germination index and vigour index.

3.1.2. Seedling growth characters

As shown in Tables (2 a, b and c), it is evident that the best growth of the resulted seedlings was recorded in the two seasons by planting the seeds after 12 hr. from collection which produced the longest seedling and root length (cm), the highest No. leaves/seedling and the heaviest fresh and dry weights of top growth and roots (g) over the control and all other times of sowing in both seasons. This may indicate the importance of planting the seeds in the proper time after harvest where the embryo is in its high vitality. Soaking the seeds in Lena-tonik solution (1 ml/l) for various periods before planting gave also better growth of the seedling than un-soaked treatment with significant differences in most cases of the two seasons. This may be ascribed to the role of Lena-tonik as a powerful plant growth regulator in increasing cell juice activity, strengthing the capacity of assimilating and receiving higher water and minerals making plants resist diseases and stresses (Bynum *et al*., 2007). Przybysz *et al.(*2014) stated that nitrophenolates inhibite IAA oxidase, which ensures a higher activity of naturally synthesized asxins. The phosphorylated from of para-nitrophenolate enhances IAA activity *via* increased high-affinity binding sites of IAA.

In this respect, Genesoylu (2009) observed that the application of A-tonic positively affected plant height, average number of open bolls and yield of cotton. Furthermore, Dianaquiraman *et al*. (2010) postulated that nitrophenolate spray reduced the content of various reactive oxygen species (ROS) in cotton plants, while antioxidant enzyme activity was increased, and thus plant growth was improved, while boll abscission was reduced. The previous results were supported by those revealed by Chen (2008) on *Camellia oleifera*, Zhanga *et al*. (2009) on *Medicago sativa* and Cai-Lian *et al*. (2010) who declared that the weight of soybean sprouts significantly increased after soaking the seeds before sowing in either 10 mg/l Na-nitrophenplate or 5 mg/l Na-5-nitroguaiacolate.

The interaction treatments also had a pronounced effect on growth and quality of the produced seedling, where combining between sowing after 12 hrs. from seed collection and soaking in 1 ml/l Lena-tonik solution registered the utmost high averages of the different growth traits over all the other interactions (Fig. 2). This may be due to the synergistic effect of both sowing in the suitable time and soaking in the multipurposes Lena-tonik solution. In this connection, Zhanga *et al.* (2009) found that the combined application of CCC and Na-nitrophenolate was more effective in improving plant height, basal stem diameter, aboveground

Table (1a): Effect of sowing time, soaking in Lena-tonik solution and their interactions on some germination characteristics of *Ochna serrulata* seeds during 2017 and 2018 seasons.

Soaking in Lena tonik / Sowing time	Germination (%)			Germination velocity (day)			Mean germination rate (day)		
	Un-soaked	Soaked	Mean	Un-soaked	Soaked	Mean	Un-soaked	Soaked	Mean
	First season: 2017								
Directly after seed collection	80.00b	0.00d	**40.00d**	31.35c	0.00f	**15.68d**	28.00c	0.00f	**14.00d**
12 hr. after seed collection	80.00b	100.00a	**90.00a**	31.50c	26.33e	**28.92c**	28.75bc	21.37e	**25.06c**
24 hr. after seed collection	66.67c	100.00a	**83.34b**	33.76b	27.50de	**30.63b**	30.25b	22.00e	**26.13b**
48 hr. after seed collection	60.00c	100.00a	**80.00c**	36.00a	28.56d	**32.28a**	32.50a	24.58d	**28.54a**
Mean	**71.67b**	**75.00a**		**33.15a**	**20.60b**		**29.88a**	**16.99b**	
	Second season: 2018								
Directly after seed collection	86.67b	0.00d	**43.34d**	32.33c	0.00f	**16.17d**	28.96bc	0.00f	**14.48d**
12 hr. after seed collection	80.00b	100.00a	**90.00a**	33.00bc	27.25e	**30.13c**	30.11bc	21.15e	**25.63c**
24 hr. after seed collection	65.50c	100.00a	**82.75c**	34.58b	28.46de	**31.52b**	31.00b	22.81cd	**26.91b**
48 hr. after seed collection	60.00c	100.00a	**80.00c**	37.16a	30.33d	**33.75a**	33.55a	24.00c	**28.78a**
Mean	**73.04b**	**75.00a**		**34.27a**	**21.51b**		**30.91a**	**16.99b**	

- Means within a column or row having the same letters are not significantly different according to Duncan's New Multiple Range t-Test at 5 % level.

Table (1 b): Effect of sowing time, soaking in Lena-tonik solution and their interactions on germination rate index and vigour index of *Ochna serrulata* seeds during 2017 and 2018 seasons.

Soaking in Lena Tonik / Sowing time	Germination rate index (GRI)			Vigour index (V.I.)		
	Un-soaked	Soaked	Mean	Un-soaked	Soaked	Mean
	First season: 2017					
Directly after seed collection	0.625b	0.000c	**0.313b**	520.00d	0.000g	**260.00d**
12 hr. after seed collection	0.631b	0.688a	**0.660a**	506.40d	900.00a	**703.20a**
24 hr. after seed collection	0.633b	0.650ab	**0.642a**	351.35e	769.00b	**560.18b**
48 hr. after seed collection	0.625b	0.617bc	**0.621a**	258.60f	628.00c	**443.30c**
Mean	**0.629a**	**0.652b**		**409.09b**	**574.25a**	
	Second season: 2018					
Directly after seed collection	0.681b	0.00c	**0.341b**	593.69d	0.00g	**296.80d**
12 hr. after seed collection	0.680b	0.731a	**0.706a**	552.00d	948.00a	**750.00a**
24 hr. after seed collection	0.690b	0.710ab	**0.700a**	374.01e	831.00b	**602.51b**
48 hr. after seed collection	0.681b	0.678b	**0.680a**	281.40f	676.00c	**478.70c**
Mean	**0.683a**	**0.530b**		**450.28b**	**613.80a**	

- Means within a column or row having the same letters are not significantly different according to Duncan's New Multiple Range t-Test at 5 % level.

Table (1 c): Effect of sowing time, soaking in Lena-tonik solution and their interactions on seed viability and plumule length of *Ochna serrulata* seeds during 2017 and 2018 seasons.

Soaking in Lena Tonik / Sowing time	Seed viability (S.V.)			Plumule length (cm)		
	Un-soaked	Soaked	Mean	Un-soaked	Soaked	Mean
	First season: 2017					
Directly after seed collection	8.76b	0.00d	**4.38c**	6.50c	0.00e	**3.25d**
12 hr. after seed collection	8.18b	10.00a	**9.09a**	6.33c	9.00a	**7.67a**
24 hr. after seed collection	6.00c	10.00a	**8.00b**	5.27d	7.69b	**6.48b**
48 hr. after seed collection	6.00c	10.00a	**8.00b**	4.31d	6.28c	**5.30c**
Mean	**7.24a**	**7.50a**		**5.60a**	**5.74a**	
	Second season: 2018					
Directly after seed collection	9.00b	0.00d	**4.50c**	6.85c	0.00e	**3.43d**
12 hr. after seed collection	8.76b	10.71a	**9.74a**	6.90c	9.48a	**8.19a**
24 hr. after seed collection	6.50c	10.83a	**8.67b**	5.71d	8.31b	**7.01b**
48 hr. after seed collection	6.00c	10.00a	**8.00b**	4.68d	6.76c	**5.72c**
Mean	**7.57b**	**7.89a**		**6.04a**	**6.14a**	

-Means within a column or row having the same letters are not significantly different according to Duncan's New Multiple Range t-Test at 5 % level.

Table (2 a): Effect of sowing time, soaking in Lena-tonik solution and their interactions on some growth parameters of *Ochna serrulata* seedlings during 2017 and 2018 seasons.

Soaking in Lena Tonik / Sowing time	Seedling length (cm)			No. leaves/seedling			Root length (cm)		
	Un-soaked	Soaked	Mean	Un-soaked	Soaked	Mean	Un-soaked	Soaked	Mean
	First season: 2017								
Directly after seed collection	10.81b	0.00e	**5.41d**	6.50c	0.00d	**3.25c**	7.00a	0.00d	**3.50d**
12 hr. after seed collection	10.50b	12.78a	**11.64a**	6.50c	7.51a	**7.01a**	7.00a	7.50a	**7.25a**
24 hr. after seed collection	7.93cd	9.65bc	**8.79b**	6.00c	7.00b	**6.50b**	5.50bc	7.00a	**6.25b**
48 hr. after seed collection	6.88d	8.21c	**7.55c**	6.00c	7.00b	**6.50b**	4.26c	5.98b	**5.12c**
Mean	**9.03a**	**7.66b**		**6.25a**	**5.38b**		**5.94a**	**5.12b**	
	Second season: 2018								
Directly after seed collection	11.33b	0.00e	**5.67d**	6.50c	0.00d	**3.25c**	7.67a	0.00d	**3.84d**
12 hr. after seed collection	11.45b	13.91a	**12.68a**	6.68c	7.19a	**6.94a**	7.50a	8.20a	**7.85a**
24 hr. after seed collection	8.67cd	10.53bc	**9.60b**	6.50c	7.00b	**6.75ab**	6.00bc	7.50a	**6.75b**
48 hr. after seed collection	7.50d	8.98c	**8.24c**	6.54c	6.97b	**6.76ab**	4.69c	6.53b	**5.61c**
Mean	**9.74a**	**8.36b**		**6.56a**	**5.29b**		**6.47a**	**5.56b**	

-Means within a column or row having the same letters are not significantly different according to Duncan's New Multiple Range t-Test at 5 % leve.

Table (2b): Effect of sowing time, soaking in Lena-tonik solution and their interactions on top growth fresh and dry weights of *Ochna serrulata* seedlings during 2017 and 2018 seasons.

Soaking in Lena Tonik / Sowing time	Top growth					
	Fresh weight (g)			Dry weight (g)		
	Un-soaked	Soaked	Mean	Un-soaked	Soaked	Mean
	First season: 2017					
Directly after seed collection	0.118ab	0.00d	**0.059d**	0.043ab	0.00d	**0.022b**
12 hr. after seed collection	0.110ab	0.131a	**0.121a**	0.039ab	0.051a	**0.045a**
24 hr. after seed collection	0.086b	0.109ab	**0.098b**	0.031b	0.042ab	**0.037ab**
48 hr. after seed collection	0.055c	0.081b	**0.068c**	0.021c	0.030b	**0.026b**
Mean	**0.092a**	**0.080a**		**0.034a**	**0.031a**	
	Second season: 2018					
Directly after seed collection	0.127ab	0.00d	**0.064d**	0.046ab	0.00d	**0.023b**
12 hr. after seed collection	0.121ab	0.148a	**0.135a**	0.043ab	0.057a	**0.050a**
24 hr. after seed collection	0.091bc	0.117b	**0.104b**	0.034b	0.045ab	**0.040ab**
48 hr. after seed collection	0.060c	0.083c	**0.072c**	0.023c	0.031b	**0.027b**
Mean	**0.100a**	**0.087a**		**0.037a**	**0.033a**	

- Means within a column or row having the same letters are not significantly different according to Duncan's New Multiple Range t-Test at 5 % level.

Table (2 c): Effect of sowing time, soaking in Lena-tonik solution and their interactions on roots fresh and dry weights of *Ochna serrulata* seedlings during 2017 and 2018 seasons.

Soaking in Lena Tonik / Sowing time	Roots					
	Fresh weight (g)			Dry weight (g)		
	Un-soaked	Soaked	Mean	Un-soaked	Soaked	Mean
	First season: 2017					
Directly after seed collection	0.145a	0.00d	**0.073d**	0.045ab	0.00d	**0.023bc**
12 hr. after seed collection	0.136ab	0.156a	**0.146a**	0.041ab	0.063a	**0.052a**
24 hr. after seed collection	0.110b	0.123b	**0.117b**	0.033bc	0.049ab	**0.041b**
48 hr. after seed collection	0.083c	0.097b	**0.090c**	0.023c	0.037b	**0.030b**
Mean	**0.119a**	**0.094b**		**0.036a**	**0.037a**	
	Second season: 2018					
Directly after seed collection	0.158a	0.00d	**0.079d**	0.049b	0.00d	**0.025b**
12 hr. after seed collection	0.141ab	0.170a	**0.156a**	0.045b	0.069a	**0.057a**
24 hr. after seed collection	0.120b	0.131b	**0.126b**	0.036bc	0.051ab	**0.044ab**
48 hr. after seed collection	0.086c	0.103b	**0.095c**	0.023c	0.039b	**0.031b**
Mean	**0.126a**	**0.101b**		**0.038a**	**0.040a**	

- Means within a column or row having the same letters are not significantly different according to Duncan's New Multiple Range t-Test at 5 % level.

biomass and seed yield of alfalfa plants. On gladiolus cvs. Fortua Red, Wine and Roses and Peter Pears, Khella (2018) reported that Atonik at 1000 and 2000 ppm levels caused a marked increase in plant height and produced the earliest flowering, while applying it at 2000 ppm raised spike stem, rachis length, No. florets/spike, gave the heaviest corm F.W. and the highest cormels yield.

Fig. (2):The seedlings resulted from soaking in lena-tonik solution and sown after 12 hrs. (1), 24 hrs. (2) and 48 hrs. (3) from collection.

3.2. Chemical composition of the leaves

According to the data listed in Table (3), it could be concluded that the highest concentration of chlorophyll a and b (mg/g f. w.) was accomplished by planting the seeds after 12 hr. from collection, whereas planting at the other times gave contents closely near together. The opposite was true concerning total soluble sugars concentration (mg/100 g f. w.), as sowing after 12 hrs. from seed collection gave the least content while sowing at the other times recorded higher means which were also near together. On the other hand, carotenoids concentration (mg/g f. w.) was gradually increased with prolonging sowing time. In addition, concentrations of the aforementioned constituents were improved, to some extent in the leaves of the seedlings resulted from seeds soaked for various times in Lena-tonik solution. This may ascribed to that nitrophenolates stimulate many physiological processes in plant tissues (Sharma *et al*., 1984). In this regard, Dianaquiraman *et al*. (2010) observed that ascorbate, phenol and proline were accumulated by 245, 253 and 150 % in nitrophenolate-sprayed cotton plants compared with the control at the 9^{th} day after anthesis and that reduce fred boll abscission and increased yield. Further, Przybysz *et al.*(2014) indicated that cotton plants exposed to nitrophenolates uptake more nutrients from the medium than those of the control.

The interaction between sowing after 12 hrs. from seed harvest and soaking in 1 ml/l Lena-tonik solution scored the highest content of chlorophyll a and b in seedling leaves, whereas combining between planting after 24 hr. from seed collection and un-soaking treatment recorded the highest concentration of carotenoids. The highest level of total soluble sugars, however was acquired by combining between planting the seeds after 24 hrs.from collection and soaking in Lena-tonik solution. In general, the effect of interactions was fluctuated without a clear trend. In this concern, Kocira *et al.* (2018) found that the foliar application of Atonik markedly improve the efficiency of photosynthetic apparatus and chlorophyll content in the leaves of *Dracocephalum moldavica* plants.

Table (3): Effect of sowing time, soaking in Lena-tonik solution and their interactions on some chemical constituents in the leaves of *Ochna serrulata* seedlings during 2018 season.

Soaking in Lena Tonik / Sowing time	Chlorophyll a (mg/g. f. w.)			Chlorophyll b (mg/g. f. w.)		
	Un-soaked	Soaked	Mean	Un-soaked	Soaked	Mean
Directly after seed collection	1.276	0.00	**0.638**	0.924	0.000	**0.462**
12 hr. after seed collection	1.281	1.387	**1.334**	0.933	1.121	**1.027**
24 hr. after seed collection	1.259	1.308	**1.284**	0.984	1.093	**1.039**
48 hr. after seed collection	1.247	1.276	**1.262**	0.897	0.937	**0.917**
Mean	**1.266**	**0.993**		**0.935**	**0.788**	
Soaking in Lena Tonik / Sowing time	**Carotenoids (mg/g. f. w.)**			**Total soluble sugars (mg/100g. f.w.)**		
	Un-soaked	Soaked	Mean	Un-soaked	Soaked	Mean
Directly after seed collection	0.186	0.000	**0.093**	3.006	0.000	**1.503**
12 hr. after seed collection	0.184	0.236	**0.210**	2.609	2.710	**2.660**
24 hr. after seed collection	0.251	0.210	**0.231**	2.935	3.348	**3.142**
48 hr. after seed collection	0.239	0.243	**0.241**	2.897	3.167	**3.032**
Mean	**0.215**	**0.172**		**2.862**	**2.306**	

From the previous findings, it can be advised to sow *Ochna serrulata* seeds after soaking them for 12 hrs. in 1ml/l Lena-tonik solution for better germination and higher quality of the produced seedlings.

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دراسات فسيولوجية على إنبات ونمو شجيرة الأوكنا
أ. إنبات بذور نبات ميكى ماوس (الأوكنا) سريعة التدهور

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ملخص

أجـري هـذا البحـث تحـت الظـل بمـشتل حـديقة الزهـرية، معهد بحوث البساتين، مركز البحوث الزراعية، الجيزة، مصر، خـلال موسمي 2017، 2018 لتحسين إنبات البذور سريعة التدهور لشجيرة ميكي ماوس (*Ochna serrulata* Hochst.)، وذلك بزراعة بذورها منزوعة اللحم في أوقات مختلفة بعد جمعها (بعد الجمع مباشرة أو بعد الجمع بـ 12 ، 24 أو 48 ساعة) أو نقعها لمدة: صفر، 12، 24 أو 48 ساعة في محلول تركيزه 1 مل/لتر من الليناتونيك (منظم نمو نباتي تجاري في صورة سائلة يحتوي على: 1 جم/لترصوديوم -5-نيتروجوياكولات + 2 جم/لتر صوديوم-أورثو-نيتروفينولات + 3 جم/لتر صوديوم - بارا- نيتروفينولات). كما تم دراسة تأثير معاملات التفاعل بين مواعيد الزراعة والنقع في محلول الليناتونيك. أشارت النتائج الى أن أعلى نسبة للإنبات تم الحصول عليها بزراعة البذور بعد 12 ساعة من جمعها، حيث أدت هذه المعاملة زيادة معنوية في نسبة الإنبات بلغت 90 % في كلا موسمي الدراسة مقارنة بجميع مواعيد الزراعة الأخرى. على النقيض من ذلك، أدى تأخير زراعة البذرة إلى 24 أو 48 ساعة بعد الجمع إلى إنخفاض معنوي في هذه الصفة. أحدث نقع البذور في محلول الليناتونيك (1 مل/لتر) لأي فترة إلى زيادة نسبة الإنبات إلى 100 % بصرف النظر عن موعد الزراعة. أما أقل فترة لتحقيق 100 % إنبات (سرعة الإنبات) أو 50 % إنبات (معدل متوسط الإنبات) فقد حققتها معاملة الزراعة بعد 12 ساعة من جمع البذرة، وكذلك معاملة النقع في محلول الليناتونيك. بالمثل، فإن أفضل نتائج لدليل معدل الإنبات (G.R.I.)، دليل قوة الإنبات (V.I.)، حيوية البذرة (S.V.) وطول الريشة فقد سجلتها أيضاً نفس المعاملتين المذكورتين سابقاً، مع تفوق معاملة الجمع بينهما (الزراعة بعد 12 ساعة من جمع البذرة + النقع في محلول الليناتونيك)، حيث أعطت هذه التوليفة بصفة عامة أفضل نتائج للإنبات. وبالمثل، كانت نتائج صفات نمو الشتلات الناتجة (طول الشتلة، عدد الأوراق/شتلة، طول الجذر والوزن الطازج والجاف للنمو الخضري والجذري). ولقد حققت معاملة زراعة البذرة بعد 12 ساعة من الحصاد أعلى تركيز لكلوروفيللي أ، ب في أوراق الشتلات الناتجة، بينما أعطت توقيتات زراعة البذرة الأخرى تركيزات متقاربة جداً من بعضها. ولقد كان العكس صحيحاً فيما يتعلق بمحتوى الأوراق من السكريات الكلية الذائبة. أما محتوى الأوراق من الكاروتينويدات فقد زاد تدريجياً بإطالة موعد زراعة البذرة. ولقد أحدثت معاملة نقع البذور في محلول الليناتونيك لأي فترة تحسناً طفيفاً في تركيز المكونات سالفة الذكر. أما تأثير معاملات التفاعل على هذه المكونات فقد كان متقلباً مع بعض الإستثناءات البسيطة. من هذه النتائج، **يمكن التوصية** بزراعة بذور شجيرة ميكي ماوس (*Ochna serrulata* Hochst.) بعد نقعها في محلول الليناتونيك (1مل/ لتر) لمدة 12 ساعة للحصول على أفضل صفات إنبات وأعلى جودة للشتلات الناتجة.

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