International Journal of Innovative Approaches in Agricultural Research
2018, Vol. 2 (4), 278-284
https://doi.org/10.29329/ijiaar.2018.174.2

Original article

Different Effects of Tomato Leaf Extract on Seed Germination

Burcu Begüm Kenanoğlu [a, *] & Aslı Kor [b]

[a] Department of Horticulture, Agriculture and Natural Science Faculty, Uşak University, Uşak, Turkey
[b] Department of Plant Protection, Agriculture and Natural Science Faculty, Uşak University, Uşak, Turkey

Abstract

Pre-germination, osmotic seed applications induce germination improvement. Although they are made with traditional and chemical methods, they have recently become alternative nature-friendly, clean, inexpensive and most importantly plant-based (essential oils, medicinal plant extracts, propolis (bee gum), seeweed) applications. By these treatments, the loss of production and yield which may be experienced in seed or seedling origins can be prevented, germination and emergence performance can be increased. In our study, three different varieties of sugar beet (Serenada, Turbata, Laila) and radish (Kara, Ufacık, Başak) were used. As a priming treatment, these seeds were germinated in the extracts of the lower, middle and upper leaves belonging to six different tomato varieties for 2 days at 25 °C. According to the results, the germination rate of the seeds of Seranada sugar beet cultivar is the best (69 %) with application of top leaf extract of Seyit tomato variety. In the seeds of the Turbata variety, Arzum germinated high (84%) in the middle leaf extract of the tomato variety. While the germination rate was generally high in the radish seeds, the location of the tomato leaves used in the extraction in the application results did not make a difference. However, tomato leaves extract was found effective in the first germination rates of Serenada sugarbeet and Kara radish seeds.

Keywords: Tomato leaf extract, Priming, Radish, Sugarbeet.

Received: 29 July 2018 * **Accepted**: 11 November 2018 * **DOI**: https://doi.org/10.29329/ijiaar.2018.174.2

* **Corresponding author:**

Burcu Begüm Kenanoğlu, Department of Horticulture, Agriculture and Natural Science Faculty, Uşak University, Uşak, Turkey
Email: burcu.kenanoglu@usak.edu.tr

INTRODUCTION

In a successful seedling production, it is expected to obtain strong seedlings from qualified seeds germinating rapidly and uniformly. Although the seed vigor is partially repaired under appropriate conditions, it declines rapidly or slowly after physiological maturity (Pollock, 1972). Nowadays, priming is widely used to accelerate germination and increase homogeneous emergence (McDonald, 2000; Halmer, 2004). Priming affects the germination rate under different ecological conditions and encourages the seed vigor and seedling development. Seed and seedling features are positively affected from the priming solutions containing water or different substances (Taylor, 1998). It is determined that the damages occurring at the end of abiotic (salt and drought) stress, to which the sunflower seeds are exposed, are repaired by hydropriming treatment and thus, the germination performance and development increase (Kaya, 2006). In priming treatments, the agents such as KNO_3, PEG, $CuSO_4$ (Patade, 2011) and GA_3 (Mavi, 2006) are widely used, and studies regarding the most economical and easy to use alternatives are being conducted. For an efficient treatment, germination is not desired at the end of the priming treatment. Thus, the treatment temperature and period have a particular importance. Deep plantation and low temperatures in seedbeds may increase the development risk of pathogens such as *Fusarium* and *Pythium*, which cause root rot. Via the priming treatments, seedlings resistant to this risk are developed. Additionally, it is reported that another advantage of priming technique in organic farming is that it allows weed control to be performed effectively due to early emergence (Groot, 2004).

The dense and uncontrolled chemical inputs used in agricultural production for many years are quite dangerous for human and environmental health. In order to prevent this danger, alternative environmentally friendly production techniques protecting the ecological balance have started to come to the forefront. For this purpose, every method applied to improve the seedling quality and performance in the solutions containing organic preparations is called “organic osmotic conditioning” (Groot, 2004). These treatments are seaweed, extracts of medicinal plants, vinegar priming, essential oils and propolis etc., respectively. The reason for treating the seeds with seaweed extract is that it can highly absorb the water due to the high mineral substance content of ocean water (Blunden, 1991). Plant extracts, which are the alternatives to osmotic conditioning treatments via herbal ways, are cheaper and more usable. Pre-germination treatment with vinegar is safer while it shows the effect of sulphuric acid treatment and can be applied to all the species that do not have testa impermeability (Evans, 1914). In this context, the use of essential oils also becomes very widespread both as herbicide against the weeds and to encourage germination. In general, vegetable oils such as thyme, cumin, lemon grass, carnation, oregano and garlic are widely used in seed treatments. In the study, tomato juice extracts were tried in order to determine whether they could be alternatives to them or not.

Tomato (*Lycopersicon esculentum* Mill) is a species that is widely worked and cultivated for organic sources especially in its branches and leaves (Taveira, 2012). Tomato especially has bioactivity

metabolism, steroidal alkaloids (Friedman, 2013) and phenols (such as hydroxycinnamic acids and flavonoids) (Slimestad, 2009). These compounds especially form a defense against the host plants. However, it has many pharmacological and nutritional functions in humans (Friedman, 2002). Flavonoids have an effective scavenging and chain breaking potential of antioxidants in the oxidation reaction of the oils (Hopia, 1999). Steroidal alkaloids in tomato have numerous biological activities and antiviral-antifungal-antibacterial effects (Khalid, 2004; Friedman, 2013). Antioxidants reduce the oxidative stress with ROS (Nordberg, 2001). The effects of radish and sugar beet seeds on the germination activity were investigated by benefiting from these features.

Material and Methods

In this study, the seeds of Seranada, Laila and Turbata sugar beet cultivars and Kara, Ufacık, and Başak radish cultivars were used. For priming treatment, the water extracts of lower, upper and middle leaves of 7806 F1, Seyit F1, Clx37 532 F1, Arzum F1, Asil F1 and 7806 F1 tomato cultivars were used. Leaves to be used for priming were kept at room temperature for 1 day in 1 l beakers and then filtered to obtain the leaf water extracts. Sugar beet and radish seeds were kept at room temperature in the leaf extract water for 2 days. Then, they (3x25 seed) were placed in a petri dish for germination at 25 ^{0}C in the incubator. As a result of the trial, the effects of the treatments on the seed germination rate (%) and the mean germination time (days) were determined.

Table 1. Sugarbeet and radish varieties and priming materials which used in the experiment

Sugarbeet varieties	**Priming materials (tomato leaves extracts)**	**Location of tomato leaves which used**	**Radish varieties**	**Priming materials (tomato leaves extracts)**	**Location of tomato leaves which used**
Seranada	7806 F1	Lower Middle Top	Ufacık	Arzum F1	Middle
	Clx37 532 F1 Seyit F1			Ilgın F1	Middle
Laila	Asil F1	Lower	Başak	Asil F1	Lower
	Ilgın F1	Middle		Seyit F1	Top
Turbata	Arzum F1	Middle	Kara	532	Middle
				7806	Lower

Results and Discussion

The germination rate of Seranada sugar beet cultivar gave the best result (69%) with treatment of extract of upper leaves of Seyit tomato cultivar, whereas, seeds of Turbata cultivar germinated at high rate (84%) with extract of middle leaves of Arzum tomato cultivar. While the germination rate was generally high in the radish seeds, the location of the tomato leaves used in the extraction in the treatment

results did not make a difference. In addition, tomato leaves extract was found to be effective in the initial germination rates of Seranada sugar beet and Kara radish seeds (Table 2).

Table 2. Germination results obtained by application of tomato leaf extract of seeds of sugar beet and radish varieties (%)

Sugarbeet varieties	**TLE**	**LTL**	**MGR (%)**	**MGT (day)**	**Radish varieties**	**TLE**	**LTL**	**MGR (%)**	**MGT (day)**
Seranada	7806 F1	Lower	57	2	Ufacık	Arzum F1	Middle	99	2
	Clx37532 F1 Seyit F1	Middle	68	1		Ilgın F1	Middle	100	3
		Top	69	2					
	Control	-	87	4		Control	-	99	3
Laila	Asil F1	Lower	13	4	Başak	Asil F1	Lower	97	3
	Ilgın F1	Middle	16	4		Seyit F1	Top	100	3
	Control	-	29	4		Control	-	99	2
Turbata	Arzum F1	Middle	84	2	Kara	532	Middle	91	4
						7806	Lower	88	4
	Control	-	96	1		Control	-	97	2

*****TLE: Tomato leaves extract, LTL: Location of tomato leaves which used, MGR: Mean germination rate, MGT: Mean germination time

Seaweed extract diluted at a specific rate increased the germination vigor in the seeds of California wonder pepper cultivars (Sivritepe, 2008). Positive effect was obtained by the treatment of seaweed on germination and seedling vigor of maize seeds (Matsiyak, 2011). Seeds of Yalova çarliston pepper cultivar treated with pre-germination for 32 hours at 15ºC in the water obtained from dry petals of marigold flower and Anatolian Rose flowers prepared with distilled water as well as control seeds were subjected to the emergence test at 25ºC and 15ºC (Teksan, 2016). The results of the study revealed that while the highest germination rate (94.5%) was obtained in the treatment of brewed tea with marigold, brewed teas also encouraged the shooting length. The pre-germination treatment applied with potassium nitrate, *Tagates* p*atula* and *Tagates* e*recta* plant extracts in bishops crown seeds harvested during their different maturity periods affected criteria such as germination rate, average germination period, germination index, emergence rate, average emergence period, fresh seedling weight and emergence index at different levels. However, good results were obtained in seeds in physiological mature period, whereas, the advantage of the treatment was observed most distinctly in immature periods (Mavi, 2016). The effects of essential oils of the plants such as dittany, thyme and rosemary on the germination of radish, pepper and lettuce seeds and dead seed rate and mean germination period were determined (Angelini, 2003). As a result, while the germination rate decreases in all the cultivars, abnormal seedling showed an increase in lettuce and radish.

In the present study, the average germination times indicated that the best results were observed in seeds of Seranada cultivars treated with the extracts of the middle leaves of Clx37 532F1 tomato cultivar; whereas, treatment did not affect germination rate in sugar beet seeds belonging to Laila cultivar (Table 2). In general, germination in radish seeds occurred faster. Among the treatments, the seeds of Ufacık radish cultivar obtained the most efficient result treated with the middle leaf extract of Arzum F1 tomato cultivar.

Sugar beet seeds were subject to pre-germination treatment for 2, 4, and 6 hours with PEG 8000, 1.5 N NaCl and 0.1 N HCl, and as a result, in 6-hour 0.1 N HCl, germination was 25% greater than control and 9% greater than NaCl treatment (Jalali, 2012). Beet seeds treated with pre-germination (24-25% moisture content at 20 ^{0}C for 5 days) in the boiler contained soluble sugar at the rate of 0.5-4% higher than the control and their amylase activities were1.9-11.5 times higher. The treated seeds showed earliness of 1.6-4 days than the control. However, there was no change in the sugar, potassium, sodium or amino nitrogen content (Mukasa, 2003).

Conclusion

As an alternative to the generally used and preferred inorganic or organic pre-germination treatments, priming treatment with the plant extract has shown that it is likely to have a positive effect on germination even at specific rates. Although the degree of this effect varies according to the cultivar and variety treated, the variety of the cultivar from which the plant extract will be received, varies according to the levels at which the leaves are taken. Starting from this point of view, further studies should be conducted regarding this matter.

REFERENCES

Angelini, L.G., G., Carpanese, P.L., Cioni, I., Morelli, M., Macchia and G., Flamini (2003). Essential Oils from Mediterranean Lamiaceae as Weed Germination Inhibitors. J. Agric. Food Chem., 51, 6158-6164.

Blunden G. (1991). Agricultural uses of seaweeds and seaweed extracts. pp.65-81. In: Guriy&Blunden.

Evans, E.X. and F.A., Blazich (1914). Overcoming Seed Dormancy: Trees and Shrubs. North

Carolina Cooperative Extension Service. 1/99 HIL-8704.

Friedman, M. (2002). Tomato glycoalkaloids: role in the plant and in the diet. J. Agric. Food Chem., 50, 5751-5780.

Friedman, M. (2013). Anticarcinogenic, cardioprotective, and other health benefits of tomato compounds lycopene, α-tomatine, and tomatidine in pure form and in fresh and processed tomatoes. J. Agric. Food Chem., 61, 9534-9550.

Groot, S.P.C., J.M. van der Wolf, H. Jalink, C.J. Langerank and R.W. van den Bulk (2004). Challenges for the production of high quality organic seeds. Seed Test. Int., 127, 12-15.

Halmer, P. (2004). Methods to improve seed performance in the field. In: Handbook of seed physiology; Application to agriculture. (Eds.): R.L. Benech-Arnold and R.A. Sanchez. The Haworth Press. New York, pp. 125- 165.

Hopia, A. and M., Heinonen (1999). Antioxidant activity of flavonol aglycones and their glycosides in methyl linoleate. J. Am. Oil Chem. Soc., 76, 139-144

Jalali, A.H. and F., Salehi (2012). Sugar beet yield as affected by seed priming and weed control. Arch. Agron. Soil Sci., 59.

Kaya, M.D., G. Okçu, M. Atak, Y. Çıkılı and Ö. Kolsarıcı (2006). Seed treatments to overcome salt and drought stress during germination in sunflower (Helianthus annuus L.). Eur. J. Agron., 24, 291-295.

Khalid A., G. M. N. Zaheer-ul-Haq, F. Feroz and A. H. Atta-urRahman Gilani (2004). Cholinesterase inhibitory and spasmolytic potential of steroidal alkaloids. J. Steroid Biochem. Mol. Biol., 92, 477-484.

Matsiyak, K., Z. Kaczmarek and R. Krawczyk (2011). Influence of seaweed extracts and mixture of humic and fulvic acids on germination and growth of *Zea mays* L. Acta Sci. Pol. Agric., 10(1), 33-45.

Mavi, K., S. Ermis and I. Demir (2006). The effect of priming on tomato rootstock seeds in relation to seedling in relation to seedling growth. Plant Sci., 5 (6), 940-947.

Mavi, K. (2016). Bio-Herbicidal effects of oregano and rosemary essential oils on germination and seedling growth of bread wheat cultivars and weeds. Rom. Biotechnol. Lett., 21, 1.

McDonald M.B. (2000). Seed priming. In: Seed Technology and Biological Basis, Black, M and Bewley JD (Eds). Sheffield Academic Press. England. Chapter 9, 287-325.

Mukasa, Y., H. Takahashi, K. Taguchi, N. Ogata, K. Okazaki and M. Tanaka (2003). Accumulation of soluble sugar in true seeds by priming of sugar beet seeds and the effects of priming on growth and yield of drilled plants. Plant Prod. Sci. 6(1), 74-82

Nordberg, J. and E.S. Arnér (2001). Reactive oxygen species, antioxidants, and the mammalian thioredoxin system. Free Radic. Biol. Med., 31, 1287-1312.

Patade, V.Y., K. Maya and A. Zakwan (2011). Seed priming mediated germination improvement and tolerance to subsequent exposure to cold and salt stress in capsicum. Res. J. Seed Sci., 4 (3), 125 -136.

Pollock, B.H. and E.E. Ross (1972). Seed and seedling vigour in seed biology, Vol I (Kozlowski, T.T., ed). Academic Press, New York and London.

Slimestad, R. and M. Verheul (2009). Review of flavonoids and other phenolics from fruits of different tomato (*Lycopersicon esculentum* Mill.) cultivars. J. Sci. Food Agri., 89, 1255-1270.

Sivritepe, N. and H.Ö. Sivritepe (2008). Organic priming with seaweed extract (*Ascophyllum*

nodosum) affects viability of pepper seeds. Asian J. Chem., 20(7), 5689-5694.

Taylor, A.G., P.S. Allen, M.A. Bennett, K.J. Bradford, J.S. Burrisand and M.K. Misra (1998). Seed enhancements. Seed Sci. Res., 8, 245-256.

Taveira, M., F. Ferreres, A. Gil-Izquierdo, L. Oliveira, P. Valentão and P.B. Andrade (2012). Fast determination of bioactive compounds from Lycopersicon esculentum Mill. leaves. Food Chem., 135, 748-755.

Teksan, B.Ö. and S. Kavak (2016). Kadife Çiçegi ve Gül Taç Yaprakları Demleme Çaylarında Ön Çimlendirme Uygulamalarının Biberde Çimlenme ve Çıkıs Üzerine Etkileri. Süleyman Demirel Üniversitesi Ziraat Fakültesi Dergisi.11 (1), 34-42.