Tarım Bilimleri Araştırma Dergisi 6 (2): 35-39, 2013
ISSN: 1308-3945, E-ISSN: 1308-027X, www.nobel.gen.tr

Farklı Sıcaklık Değerlerinde NaCl Konsantrasyonlarının Çemen (*Trigonella foenum-graecum* L.)'nin Çimlenmesi Üzerine Etkileri

Erman BEYZİ[1*] Gökhan İPEK[2] Ali İrfan İLBAŞ[1] Bilal GÜRBÜZ[3]

[1]Erciyes Üniversitesi, Seyrani Ziraat Fakültesi, Tarla Bitkileri Bölümü, Kayseri
[2]Çankırı Karatekin Üniversitesi, Yapraklı Meslek Yüksekokulu, Çankırı
[3]Ankara Üniversitesi, Ziraat Fakültesi, Tarla Bitkileri Bölümü, Ankara

*Sorumlu yazar
e-mail: ermanbeyzi@gmail.com

Geliş Tarihi: 01 Kasım 2013
Kabul Tarihi: 15 Aralık 2013

Özet

Bu çalışma, farklı sıcaklık değerlerinde (10, 15, 20 ˚C), çemen (*Trigonella foenum graecum* L.)'nin çimlenmesi üzerine NaCl konsantrasyonlarının etkilerini belirlemek amacıyla 2009 yılında yürütülmüştür. Araştırmada materyal olarak Gürarslan çemen çeşidi ile 0 (saf su), 5, 10, 15 ve 20 dS m^{-1} NaCl konsantrasyonları kullanılmıştır. Tohumdaki çimlenme sayımlarının bittiği 15. günde, ortalama çimlenme zamanı, sürgün boyu, kök boyu, sürgün yaş ağırlığı, sürgün kuru ağırlığı, kök yaş ağırlığı ve kök kuru ağırlığına ilişkin ölçümler yapılmıştır. Araştırma sonucunda, incelenen tüm sıcaklık değerlerinde, artan NaCl konsantrasyonlarıyla ortalama çimlenme zamanının arttığı, 20 ˚C sıcaklıkta uygulanan tuz konsantrasyonlarına çemenin, incelenen diğer sıcaklıktaki NaCl konsantrasyonlarına göre daha toleranslı olduğu belirlenmiştir.

Anahtar kelimeler: Çemen, çimlenme, NaCl, *Trigonella foenum graecum* L.

Effects of various NaCl concentrations on germination of fenugreek (*Trigonella foenum-graecum* L.) seeds at different temperatures

Abstract

In this study, effects of various NaCl concentration were investigated on the germination of fenugreek (*Trigonella foenum-graecum* L.) seeds at different temperatures (10, 15, 20 ˚C), at the laboratory of Department of Field Crops, Faculty of Agriculture, University of Erciyes, in the year 2009. Different concentrations of NaCl (5, 10, 15, 20 dS m^{-1}) were applied to Gurarslan fenugreek variety. Mean germination time; shoot length, root length, fresh shoot weight, dry shoot weight, fresh root weight and dry root weight measurements were assessed out at 15th day of germination counts for the seeds. It was evident that mean germination time extended with increasing NaCl concentrations at all temperatures. Seeds were more tolerant against NaCl concentrations at 20 ˚C compared with other temperatures.

Key Words: Fenugreek, germination, NaCl, *Trigonella foenum-graecum* L.

INTRODUCTION

Fenugreek is an annual crop in legume family. *Trigonella* variety includes about 50 species commonly grown around the Mediterranean region. 45 of these species including *Trigonella foenum-graecum* L. [1] are cultured in Turkey. The growth of Fenugreek in Turkey is carried out in Konya, Kayseri, Cankırı, Ankara, Gaziantep, Kahramanmaras, Afyon, Sanliurfa, Hatay and Tokat provinces. It is grown in winter or in early spring at warm regions of Turkey. About 1000 tons of total 2000 tons annual production is exported [2, 3, 4]. Fenugreek is also cultured in India, Egypt, Morocco, Algeria, Italy, Spain, France and Greece. Fenugreek is used as fenugreek paste or as cover material over pastrami. It is also used in sausage production and directly utilized as a food source [5,6]. It is sometimes used in medicine and spice industry. Depending on the purpose of utilization, entire crop, fresh shoots, peels and seeds are used for various purposes. Seeds are mainly used in medicine and spice industry. Fenugreek seeds contain oil, mucilage, phosphorous organic compounds, choline, trigonelline, nicotinic acid and coumarone. It has chest relaxing, expectorant and mushily effects in treatments. It is also used in patients with diabetes to reduce the blood sugar level. It has nitrogen fixing property from atmosphere into soil in agriculture and is used as fertilizer for soil [3,7,8].

A winter sown fenugreek species (Gurarslan) is developed by the researchers of Field Crops Department of Agricultural Faculty, Ankara University, Turkey. Fenugreek production is usually carried out by using fenugreek seeds gathered from certain regions as a population and sown in spring [9].

It is known that salinity has significant impacts on crop yield in agricultural lands. Salinity problem exists over 2-2.5 million hectare land areas in Turkey [10]. Plants have various tolerance mechanisms to cope with salinity problem. Species of the same variety have also variations in their response to salinity. Some plants are more tolerant against salinity. Plant responses against salinity also vary with the growth stages.

Germination and seedling development stages are the most sensitive stages against salinity [11]. Salinity is a natural problem in arid and semi-arid regions with deficit precipitation. Excessive irrigations and consecutive evaporations also drive the salts in groundwater toward the root zones of plants [10]. This study was carried out to determine the resistance of fenugreek seeds against various salt concentrations at different temperatures.

MATERIAL and METHOD

This study was carried out in field crops laboratories of Agricultural Faculty, Erciyes University. Seeds of registered Gurarslan cultivar were used as the material of the study. Different salt concentrations (0, 5, 10, 15, 20 dS m^{-1}) were applied to fenugreek seeds at 10, 15, and 20 ˚C temperatures.

Germination tests were carried out in dark germination cabins. Germinations were performed in between three drying papers with 20×20 cm dimensions at different temperatures. Experimental setup was randomized block design with 4 replications and 50 seeds in each replication. 8 ml test solution was added for each germination paper in each replication and they were put into air tight plastic bags to prevent evaporation. Germination counts were made every day during the initial 15 days and seed with 1 mm rootlet were assumed as germinated. Mean germination time was calculated according to Ellis and Roberts (1980) to determine rate of germination [12].

$$MGT = \frac{\sum(f\,x)}{\sum f}$$

Where, if is the number of germinated seed at day of count and χ is number of count days. Where, f and χ specifies the number of germinating seeds and the number of considered days, respectively. In terms of root length, shoot length and plant fresh weight, the measurements were accomplished at 15^{th} day. Randomly selected 10 seedlings were used for average root length, shoot
length, shoot fresh weight, and root fresh weight and dry weight measurements. Samples were dried at 70˚C temperature for 2 days to determine dry weights. Variance analyses were performed by using MSTAT-C software and also significance tests ($P<0.01$) were carried out to determine the differences between the treatments [13].

RESULT

The relationships with temperature, salt concentration and temperature versus salt concentrations were found to be significant in terms of shoot length, root length, shoot fresh weight, root dry weight and mean germination time. Relationship with temperature and salt concentrations were found to be significant with regard to shoot dry weight and root fresh weight.

Mean Germination Time (MGT)

The mean germination day was observed as 2.926, and 1.539 days at 10 and 20 ^{o}C, respectively. However, mean germination time increased from 1.692 to 2.790 days with increasing salt concentrations (Table 1).

Shoot Length and Root length

A decrease was observed in shoot length with increasing salt concentrations at all experimental temperatures. The maximum shoot length observed to be 79.979 mm at 5 dS m^{-1}concentration at 20 ˚C. The highest resistance against salinity was observed at 20 ˚C. The highest (64.306 mm) and the lowest (28.970 mm) average shoot length were reached at 20 and 15˚C, respectively. The highest root length was observed at 5 dS $m^{-1}$with 68.758 mm and the lowest value was observed at 20 dS m^{-1} with 29.880 mm. While the root lengths at 10 ˚C have decreased regularly, they reached to the highest values around 5 dS m^{-1} levels at 15 and 20 ˚C and started to decrease at 10 dS m^{-1} levels. The highest root length was observed at 20 ˚C with 59.514 mm and the lowest was at 10 ˚C with 40.884 mm (Table 1).

Table 1. Effects of NaCl at Different Temperatures on Germination of Fenugreek (Trigonella foenum graecum L.) Seed

Salt concentrations (dS m^{-1})	Temperature (˚C)	Mean germination time (MGT) (day)	Shoot length (mm)	Root length (mm)	Fresh shoot weight (mg plant^{-1})	Dry shoot weight (mg plant^{-1})	Fresh root weight (mg plant^{-1})	Dry root weight (mg plant^{-1})
0	10	2.230 ± 0,08^{ef}	60.84 ± 2,07^{bc}	56.74 ± 1,31^{bcd}	124.2 ± 5,27^{bc}	8.600 ± 0,37	31.525 ± 1,15	1.550 ± 0,05^{ef}
	15	1.715 ± 0,02^{ı}	50.96 ± 1,60^{d}	52.78 ± 1,95^{cde}	104.7 ± 6,17^{de}	8.625 ± 0,31	43.600 ± 1,61	3.350 ± 0,10^{ab}
	20	1.130 ± 0,05^{k}	76.15 ± 0,60^{a}	64.86 ± 2,54^{b}	137.0 ± 1,68^{b}	6.425 ± 0,18	42.775 ± 2,05	1.650 ± 0,10^{def}
5	10	2.430 ± 0,06^{d}	40.10 ± 1,23^{e}	50.88 ± 1,87^{def}	81.25 ± 3,36^{fg}	8.325 ± 0,30	28.925 ± 4,50	1.775 ± 0,18^{de}
	15	1.930 ± 0,03^{h}	39.21 ± 1,32^{e}	79.36 ± 3,34^{a}	94.35 ± 4,44^{ef}	7.125 ± 0,34	43.450 ± 1,65	3.550 ± 0,09^{a}
	20	1.130 ± 0,02^{k}	79.98 ± 0,53^{a}	76.04 ± 1,52^{a}	157.8 ± 2,58^{a}	7.375 ± 0,13	50.800 ± 1,77	2.050 ± 0,13^{d}
10	10	2.795 ± 0,02^{c}	36.83 ± 2,41^{e}	43.36 ± 1,77^{efg}	72.75 ± 3,61^{gh}	9.450 ± 0,47	26.225 ± 2,45	1.550 ± 0,18^{ef}
	15	2.000 ± 0,03^{gh}	25.00 ± 1,13^{fg}	58.53 ± 3,64^{bcd}	66.47 ± 2,54^{hı}	10.000 ± 0,37	33.725 ± 2,51	3.200 ± 0,04^{abc}
	20	1.390 ± 0,05^{j}	66.02 ± 2,71^{b}	61.11 ± 3,77^{bc}	128.6 ± 6,12^{b}	7.975 ± 0,35	38.500 ± 1,82	1.750 ± 0,19^{de}
15	10	3.205 ± 0,05^{b}	29.01 ± 0,51^{f}	31.48 ± 1,81^{hı}	55.03 ± 1,30^{ij}	9.900 ± 0,26	16.450 ± 0,98	1.275 ± 0,05^{fg}
	15	2.040 ± 0,03^{gh}	17.61 ± 0,83^{h}	40.88 ± 2,48^{gh}	51.63 ± 2,49^{jk}	10.400 ± 0,58	29.450 ± 2,16	3.000 ± 0,13^{bc}
	20	1.950 ± 0,01^{gh}	58.44 ± 1,10^{c}	54.35 ± 4,53^{cd}	111.9 ± 1,80^{cd}	8.100 ± 0,19	35.650 ± 0,92	1.975 ± 0,19^{de}
20	10	3.970 ± 0,03^{a}	21.79 ± 0,17^{gh}	21.95 ± 0,36^{ı}	40.08 ± 0,66^{kl}	9.550 ± 0,10	13.450 ± 0,19	1.025 ± 0,11^{g}
	15	2.305 ± 0,04^{de}	12.07 ± 0,33^{ı}	26.47 ± 1,46^{ı}	36.58 ± 1,89^{l}	10.675 ± 0,18	20.225 ± 0,93	2.800 ± 0,11^{c}
	20	2.090 ± 0,02^{fg}	40.93 ± 1,45^{e}	41.21 ± 2,53^{fgh}	90.27 ± 0,95^{f}	8.825 ± 0,29	27.225 ± 0,94	2.025 ± 0,06^{d}
Main Effects								
0		1.692^{e}	62.65^{a}	58.13^{b}	121.9^{a}	7.883^{bc}	39.30^{a}	2.183^{b}
5		1.830^{d}	53.10^{b}	68.76^{a}	111.1^{b}	7.608^{c}	41.06^{a}	2.458^{a}
10		2.062^{c}	42.62^{c}	54.33^{b}	89.28^{c}	9.142^{ab}	32.82^{b}	2.167^{b}
15		2.398^{b}	35.02^{d}	42.24^{c}	72.84^{d}	9.467^{a}	27.18^{c}	2.083^{b}
20		2.788^{a}	24.93^{e}	29.88^{d}	55.64^{e}	9.683^{a}	20.30^{d}	1.950^{b}
	10	2.926^{a}	37.72^{b}	40.88^{c}	74.65^{b}	9.165^{a}	23.32^{c}	1.435^{c}
	15	1.998^{b}	28.97^{c}	51.60^{b}	70.74^{b}	9.365^{a}	34.09^{b}	3.180^{a}
	20	1.538^{c}	64.31^{a}	59.52^{a}	125.1^{a}	7.740^{b}	38.99^{a}	1.890^{b}
P values								
Salt conct. (S)		*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0001*	*0.0000*	*0.0000*
Temperature (T)		*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0001*	*0.0000*	*0.0002*
S x T		*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.4165*	*0.0907*	*0.0064*

a-l: Different letters indicate differences at $p < 0.01$

Fresh and Dry Shoot Weights

Parallel to shoot lengths, shoot fresh weights showed a general increase with increasing salt concentrations at each experimental temperature. However, the highest value was observed at 20 ˚C and 5 dS m^{-1} with 157.775 mg $plant^{-1}$ and exhibited an increase compared to control and started to decrease at 10 dS m^{-1} level with increasing salt concentrations. Dry shoot weights exhibited a regular increase with increasing salt concentrations at 15 and 20 ˚C and exhibited a fluctuation at 10 ˚C with different salt concentrations (Table 1).

Fresh and Dry Root Weights

Root fresh and dry weights have reached to highest values at 5 dS m^{-1} levels and started to decrease at 10 dS m^{-1} levels. The highest fresh root weight was observed at 20 ˚C and 5 dS m^{-1} with 50.800 mg $plant^{-1}$ and the lowest value was observed at 10 ˚C and 20 dS m^{-1} with 13.450 mg $plant^{-1}$. Root dry weights reached to highest value at 15 ˚C with 3.180 mg $plant^{-1}$ and the lowest value at 10 ˚C with 1.435 mg $plant^{-1}$. Following conclusion were drawn when the results of experiments carried out to determine the effects of various salt concentrations at different temperatures on germination of fenugreek seeds were evaluated (Table 1).

DISCUSSION

Considering the effects of various salt concentrations at different temperatures on germination of fenugreek seeds, it can be concluded that germination time prolonged with increasing salt concentrations at all temperatures. In a similar study Kaya et al. (2005) determined that germination time of rapeseed, cabbage and oil turnip extended with increasing salt levels (0, 5, 10 and 20 dS m^{-1}) [10].

Likewise, Day et al. (2008) concluded that germination times of some sunflower genotypes extended with increasing NaCl concentrations (0, 5, 10 and 20 dS m^{-1}) [11].

Kolsarici et al. (2005) also found increased germination times with increasing salt concentrations (0, 3, 6, 9 and 12 dS m^{-1}) [14]. The results above mentioned were in accordance with our findings. Although root and shoot lengths, measured in all experimental temperatures, were negatively affected from 20 dS m^{-1}, shoot and root lengths at 20 ˚C and root length at 10 ˚C were highly tolerant against 5 dS m^{-1}. NaCl concentration and they showed a decrease at 10 dS m^{-1} levels. Likewise, in a study carried out by Kaya et al. (2005) it was shown that *Brassica* species were negatively affected from 20 dS m^{-1}. However, an increases in root and shoot lengths was evident at 5 dS m^{-1} level [10].

In this study, it was evident that the best germination rate was achieved at 20 ˚C compared to other temperatures. Accordingly, fenugreek seeds, germinated at 20 ˚C, displayed high shoot and root lengths and suffered less from negative effects of NaCl concentrations. Therefore, fenugreek seed were found to be more tolerant against salinity at 20 ˚C.

REFERENCES

Akgul A (1993). Baharat Bilim ve Teknolojisi. Gida Teknolojisi Derneği Yayinlari, No: 15, Ankara.

Calik E (1996). Determination of quality criteria of fenugreek (*Trigonella foenum-graecum* L.). Ankara University, Institute of Science, Ankara.

Day S, Kaya M.D, Kolsarici O (2008). Effects of NaCI Levels on Germination of

Duzgunes O, Kesici T, Kavuncu O, Gurbuz F (1987). Research and trial methods. A.U. Agricultural Fac. Pub. No: 1021, Practice Guide: 295, p. 381.

Ellis R.H, Roberts E.H (1980). Towards a rational basis for testing seed quality. In Seed Production (ed: P.D. Hebblethwaite), pp. 605-635. Butterworths, London.

Gurbuz B, Arslan N, Gumuscu A (2000). The correlation and path analysis of yield components on selected fenugreek (*Trigonella foenum-graecum* L.) lines. Journal of Agricultural Sciences, 6: 7-10, .

Ipek A, Kaya M, D, Gurbuz B (2008). Effects of Seed Age and GA_3 Application on Germination of Fenugreek (*Trigonella foenum-graecum* L.) and Cumin (*Cuminum cyminum* L.) Seeds. Journal of Agricultural Sciences, 14: 57-61.

Kan Y, Mülayim M (2006). Organik ve İnorganik Gübrelerin Çemen (*Trigonella foenum-graecum* L.)'in Bazı Tarımsal Karakterleri Üzerine Etkileri, Bitkisel Araştırma Dergisi, 1: 6-15.

Kaya M.D, Kaya G, Kolsarici O (2005). Effects of NaCl Concentration on Germination and Emergence of Some Brassica Species. Journal of Agricultural Sciences, 11: 448-452.

Kizil S, Arslan N (2003). Investigation of the effects on yield and yield components of different sowing rates in some fenugreek (*Trigonella foenum-graecum* L.) lines. Journal of Agricultural Sciences, 9: 395-401.

Kolsarici O, Kaya M.D, Ustuner N.D, Sarihan E.O (2005). Farkli NaCl konsantrasyonlarinin bazi yağ bitkileri tohumlarinin cimlenmesi uzerine etkileri. Turkey VI. Field Crops Congress, I: 553-556.

Some Confectionary Sunflower (*Helianthus annuus* L.) Genotypes. Journal of Agricultural Sciences, 14: 230-236.

Yilmaz G, Akdag C (1994). Effects of Sowing Denisty and Fertilizing on Seed Yield and Some Traits of Fenugreek (*Trigonella foenum-graecum* L.) in Tokat Ecological Conditions. Journal of the Agricultural Faculty of Gaziosmanpasa University, 11: 112-124.

Yilmaz G, Telci I (1999). An Investigation on Fenugreek (Trigonella foenum-graecum L.) Production for Spice in Tokat Ecological Conditions. Turkey III. Field Crops Congress, II: 227-232.