



Effects of Humic Acid on the Emergence and Seedling Growth of Safflower (*Carthamus Tinctorius L.*)

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Abstract

This research was conducted to determine the effects of different humic acid doses [control (water), 60, 120 and 180 g/100 kg seed] on seedling development and growth of safflower during 2012, under greenhouse conditions at Ankara University, Faculty of Agriculture, Department of Field Crops. The trial was designed in randomized complete block design with split-split blocks using three replications. The seeds of safflower cultivars Dinçer, Yenice, Remzibey were treated with Delta Plus 15 Humic acid^a (150 g/l HA+30 g/l potassium oxide). The results showed 100% emergence was obtained in all applications. Root length ranged 5.878 – 7.156 cm depending on humic acid doses and maximum root length was obtained on 60 g/100 kg seed application to cv. Dinçer. Significant differences among cultivars in terms of seedling length were determined and the maximum height was measured as 10.085 cm from cv. Dinçer variety. Applied humic acid doses compared to control seedling increased the seedling height and the maximum value was measured on 60 g humic acid. In the fresh weight of seedlings, cv. Dinçer (7.526 g/plant) and 120 g humic acid doses resulted in best responses. Maximum results in terms of dry root weight were obtained from cv. Remzibey (3.450 g/plant) and Yenice (3.425 g/plant) safflower cultivars with the application of 60 g humic acid. It is concluded that significant differences were determined among cultivars regarding seedling growth and treatment of seeds using 60 - 120 g humic acid /100 kg seed before sowing affected seedling growth positively in safflower.

Key Words: Safflower, *Carthamus tinctorius L.*, Humic Acid, Seedling Growth.

Özet

Bu araştırma, farklı humik asit (HA) dozlarının (kontrol (su), 60, 120 ve 180 g/100 kg tohum) aspirde fide gelişimi üzerine etkilerini belirlemek amacıyla 2012 yılında Ankara Üniversitesi Ziraat Fakültesi Tarla Bitkileri Bölümü serasında yürütülmüştür. Deneme Tesadüf Bloklarında Bölünmüş Parseller deneme desenine göre 3 tekerrürlü olarak kurulmuştur. Araştırmada materyal olarak Dinçer, Yenice, Remzibey aspir çeşitlerine ait tohumlar ile ticari ismi Delta Plus 15 (150 g/l HA + 30 g/l potasyum oksit) olan HA kullanılmıştır. Araştırmada, kök uzunluğu, fide boyu, kök ve fide yaş ağırlığı ile kök ve fide kuru ağırlıkları değerleri belirlenmiştir. Araştırma sonuçlarına göre; tüm uygulamalarda % 100 çıkış elde edilmiştir. Kök uzunluğu, HA dozlarına göre 5.878 – 7.156 cm arasında değişmiş ve en büyük kök uzunluğu 60 g dozdan ve Dinçer çeşidinden elde edilmiştir. Çeşitler arasında fide boyu bakımından önemli farklılıklar belirlenmiş ve en yüksek değer 10.085 cm ile Dinçer aspir çeşidinde ölçülmüştür. Uygulanan HA dozları fide boyunu kontrole göre artırmış ve en yüksek değer 60 g HA dozunda saptanmıştır. Kök yaş ağırlığı bakımından çeşitlerin HA dozlarına gösterdiği tepkiler birbirine yakın sonuçlar vermiştir. Fide yaş ağırlığında çeşitler arasında Dinçer çeşidi (7.526 g/bitki) ile 120 g HA dozu daha yüksek sonuçlar vermiştir. Kök kuru ağırlığı bakımından en yüksek değerler Remzibey (3.450 g/bitki) ve Yenice (3.425 g/bitki) aspir çeşitleri ile 60 g HA uygulamasından (3.467 g/bitki) elde edilmiştir. Fide kuru ağırlığı bakımından Remzibey çeşidi diğer çeşitlere, HA uygulamaları da kontrole göre üstünlük sağlamıştır. Araştırma sonucunda, çeşitler arasında fide gelişimi yönünden önemli farklılıklar belirlenirken, ekimden önce tohumların 60 g HA/100 kg tohum ile muamele edilmesinin aspirde fide gelişimini olumlu yönde etkilediği gözlemlenmiştir.

Anahtar Kelimeler: Aspir, *Carthamus tinctorius L.*, Humik Asit, fide gelişimi

Introduction

Turkey is considered as one of the gene centers of safflower (Gilbert 2008). Safflower yield is not high in other countries, and also, according to 2010 data, Safflower yield was 196 kg/da in Turkey. The most important reason for low seed yield are climate and soil characteristics

In particular, soil organic matter and moisture occurs less in our country and absence of sufficient rainfall and harsh winters negatively affect the growing of safflower.

Besides suitable culture techniques and improving soil organic matter, many chemicals like humic acid are also used to improve efficiency of the soil fertility and thus to increase plant yield. Importance of the HA sold in the markets is increasing progressively, humic acid has positive impacts on plant nutrition and metabolism and is of great importance especially in terms of modern greenhouse production. As importance of organic matter has increased in recent years, many organic substances are marketed by the name of organic fertilizers.

Organic matter problem in modern agriculture is increasing. One of the most economical and fast solutions for solving this problem is the application of humic acid directly to the soil or plants. Humic acids play an important role in the development of plant directly and indirectly. It has a direct effect on plants by affecting root development and metabolism of plants to absorb nutrients that help plant growth. The positive effects of HA on plant growth, stimulation of seed germination and soil fertility are reported. Humic acids remain in the soil for a long time and is decomposed slowly over time. Soil aeration and water retention, growth and development of soil microorganisms provided increase with humic acid application, resistance to plant stress conditions, disease and pest are also increased. Today humic acids is used by many scientists and agricultural engineers in improving soil fertility for healthy plant growth.

Icel (2005) tried different doses of humic acid on safflower. The longest roots (13.55 cm) maximum seedling fresh weight (0.22 g) and root dry weight (0.09 g) were obtained after 120 and 180 g of humic acid application.

Sözüdoğru et al. (1996) determined that effect of humic acid on dry weight of bean plants had not a significant impact; however, they increased reception of N, P, Fe, Mn and Zn.

Dursun et al. (1997) studied the effect of humic acid in greenhouse cultivation of tomatoes and eggplant seedlings. For number of leaves, width, stem and root dry wet weight and stem

length, the best results were obtained on 50 and 100 ml / l humic acid application.

Peyamlı et al (1997) treated seeds of corn with 0, 0.5, 1.0, 1.5, 2.0 g / kg humic acid. Humic acid applied to the soil increased intake of Cl, Na and Fe by plants, but had no significant impact on fresh and dry weight of plant.

Yetim (2008), treated seeds of soybean with nitrogen (0, 3, 6, 9 kg da⁻¹). They reported that an increase in nitrogen dose had positive effect on seed yield per plant, 1000 seed weight and protein ratio.

This research was conducted to determine the effects of different humic acid (HA) doses on seedling development of safflower.

Materials and Methods

Cultivars Dinçer, Yenice, Remzibey safflower registered by Eskişehir Anatolian Agricultural Research Institute were used in the study. Delta Agricultural Chemical Industry. Ltd. 'had active ingredient of 150 g / L humic acid + 30 g / L of potassium oxide, Delta Plus 15 Commercial View humic acid was used in liquid form. HA 100 kg of seed in doses of 60 g (400 ml), 120 g (800 ml) and 180 g (1200 mL) was prepared. As a control, 2.2 L of water was applied to 100 kg of seed. For this purpose, 60 g of water + 400 ml of 1.8 L = 2.2 L of HA, 120 g of water + 800 ml of 1.4 L to 2.2 L and 180 g of HA = 0.8 L = 2.2 L of water + 1200 mL HA solutions were prepared. The solution was sprayed onto the seeds with a small hand sprayer. In control applications, the seeds were just sprayed with water. After application of HA the seeds were dried for 24 hours at room temperature.

The seeds were sown to 16 cm diameter plastic pots containing ^{field} soil + sand + burned manure (2:1:1). Each pot contained 10 seeds sown 2 cm deep. After emergence of the seeds completed, five plants were selected per pot. During the experiment, all pots were irrigated with sufficient quantity. 10 days after the emergence of the seeds on the soil surface rooted seedlings are removed, the roots were washed carefully with tap water using sieves (Gençtan et al., 1994). Thereafter, seedling length, root length were measured and the seedlings were divided into roots and above-ground parts and they were placed in Petri dishes. Thereafter, fresh weights of the seedlings were determined, The seedlings were dried at 105° C for 3 hours and root seedling dry weight were also determined (Böhm, 1979).

The trial was designed in split plots in randomized block design with 3 replications. Cultivars were sown as main plots, HU applications were placed as sub plots. Analysis of variance of the data were performed using MSTAT-C statistical

program and differences between means were determined by LSD test (Duzgunes et al. 1987).

and 180 g). Root length, shoot length, root & shoot fresh weight and root and seedling dry weight were examined. Analysis of variance results are given in Table 1.

Results

Cv. Dinçer, Yenice and Remzibey were treated with four levels of humic acid (0, 60, 120

Table 1. Analysis of variance results pertaining to the effects of different humic acid doses on safflower seedling characteristics.

Source of variance	DF	Root length	Seedling length	root fresh weight	Seedling fresh weight	Root dry weight	Seedling dry weight
General	35	34.543	72.767	0.065	0.464	0.970	0.183
Replication	2	0.003	0.152	0.001	0.022	0.016	0.003
Cultivars (A)	2	11.223*	13.844*	0.018	0.100*	0.091*	0.099*
Error ₁	4	1.673	1.370	0.011	0.039	0.066	0.004
Humic asids (B)	3	8.936*	9.686*	0.009	0.116*	0.096	0.002*
A x B	6	6.813	31.443	0.004	0.077	0.463	0.051
Error ₂	18	5.894	16.272	0.022	0.111	0.238	0.024

Table 2. Effects of various doses of humic acid on seedling characteristics of some safflower cultivars.

Cultivars	Humic Acid Doses				Means
	Control	60 g	120 g	180 g	
		<i>Root Length (cm)</i>			
Remzibey	6.217	7.567	5.667	5.683	6.283 AB
Yenice	4.967	5.967	6.200	5.450	5.646 B
Dinçer	6.450	7.933	6.233	7.433	7.013 A
Means	5.878 B	7.156 A	6.033 B	6.189 B	
LSD(A): 0. 0.7328		LSD (B): 0.8462		LSD (AxB): 4.165	
		<i>Seedling length (cm)</i>			
Remzibey	9.560	10.917	11.217	8.646	10.085 A
Yenice	9.940	8.007	7.450	9.130	8.625 B
Dinçer	10.390	11.130	7.950	9.403	9.718 A
Means	9.936A	10.018A	8.872 B	9.051 B	
LSD(A): 0.6629		LSD (B): 0.7654		LSD (AxB):6.920	
		<i>Root fresh weight (g/plant)</i>			
Remzibey	5.143	5.153	5.123	5.150	5.142
Yenice	5.133	5.127	5.123	5.177	5.140
Dinçer	5.213	5.173	5.160	5.210	5.189
Means	5.163	5.151	5.136	5.179	
		<i>Seedling fresh weight (g/plant)</i>			
Remzibey	7.262	7.333	7.535	5.468	7.400 B
Yenice	7.368	7.452	7.422	5.520	7.440 AB
Dinçer	7.473	7.543	7.575	7.512	7.526 A
Means	7.368 B	7.443 AB	7.511 A	7.500 A	
LSD(A): 0.1133		LSD (B): 0.1309		LSD (AxB):0.5715	
		<i>Root dry weight (g/plant)</i>			
Remzibey	3.300	3.367	3.633	5.683	6.283 AB
Yenice	3.533	3.533	3.300	3.333	3.425 A
Dinçer	3.133	3.500	3.300	3.400	3.333 B
Means	3.322	3.467	3.411	3.411	
LSD(A): 0.1133		LSD (B): 0.1309		LSD (AxB):0.5715	
		<i>Seedling dry weight (g/plant)</i>			
Remzibey	5.323	5.267	5.303	5.320	5.303 A
Yenice	5.217	5.187	5.157	5.140	5.175 C
Dinçer	5.153	5.290	5.280	5.267	5.248 A
Means	5.231 B	5.248 A	5.247 A	5.242 A	
LSD(A): 0.1133		LSD (B): 0.1309		LSD (AxB):0.5715	

As seen in Table 1, in terms of features of seedling and root of cultivars statistical difference was found at 5% level in humic acid doses. LSD test results are given in Table 2.

Humic acid doses had statistically different effect on root length, at 5% level among cultivars and. Dinçer with maximum root length (7.013 cm) and 6.283 cm and 5.646 cm were respectively on cv. Remzibey and Yenice. The maximum root length (7.156 cm) was obtained from 60 g application of humic acid, while the minimum value was noted on control (5.878 cm). Malik and Azam (1985) reported that application of humic acid to wheat (54 mg / l) that increased root length.

In terms of seedling length, the varieties and humic acid doses were statistically different at the 5% level. The highest (10.08 cm) seedling length was taken from cv. Remzibey, with 9.718 cm and 8.625 cm on cv. Yenice and Dinçer respectively. At 60 g dose of humic acid and the highest seedling length (10.018 cm) was obtained, 9.963 cm, 9.051 cm, 8.872 cm values were found on the control, 180 g and 120 g of humic acid treatments respectively. The results obtained were similar to Lulakis and Petsas (1995) 's results which humic substances (humic acid, fulvic acid, sodium humate) had a positive effect on tomato seedlings development.

Safflower varieties and HA levels were not significant statistically in terms of fresh root weight. Among the varieties, as well as humic acid doses, the highest root weight were achieved 5189 g and 5179 g respectively, from cv. Dinçer.

There were statistically important differences among humic acid doses and the varieties at 5% level in terms of seedling fresh weight. The highest seedling fresh weight value (7526 g) was achieved in cv Dinçer using 120 g of humic acid treatment. While the lowest values (7400 g and 7368 g) were observed in cv. Remzibey and the control respectively.

There were statistically significant differences among cultivars at 5% level and were different in terms of root dry weights, and the highest values were achieved on cv Remzibey (3,450 g) on 60 g of humic acid treatment (3.467 g), while the lowest values were 3.333 g on cv Dinçer and 3332 g on control applications.

Differences among the varieties and the humic acid doses in terms of seedling dry weight were found at the level of 5%. The highest seedling dry weight (5.303 g / plant) was obtained from cv. Remzibey at 60 g of humic acid application. Yenice variety and control application gave minimum values of 5.175 g and 5.231 g respectively.

Discussion

Safflower is an oilseed crop that grows under arid conditions. Because of that it can be grown in alternative areas, rotated with other crops, importance of this crop should be emphasized for Turkey's vegetable oil and mixed feed industry.

To ensure sufficient emergence after sowing and strong seedling growth after emergence is a prerequisite for high seed yield of safflower in Central Anatolian conditions at Ankara; that receive irregular and insufficient precipitation.

Result of this research indicated that seedlings of cv. Dinçer had the best response to humic acid applications compared to other cultivars. Additionally, application of 60 g per 100 kg seed humic acid dose has positive effects on seedling growth and safflower seed germination when applied before sowing.

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