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Determination of Different Doses of Zinc on Fatty Acid Composition of Safflower (*Carthamus tinctorius* L.) in Tekirdağ, Turkey

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Abstract

This research was applied in Hayrabolu, Tekirdağ, Turkey. The one safflower variety (Yenice) was found from Eskisehir Institute of Agricultural Research. Hand planting was made on April 11, 2012 in plots of four rows 0.9 m wide and 5 m long. Harvesting was made on August 8, 2012 by handling. Nitrogen fertilizer was applied to the plots after planting and in addition four different doses of zinc fertilizer (Control, 1500, 3000 and 4500 ml ha^{-1}) were pulverized to leaves as zinc sulfate ($ZnSO_4.7H_2O$) before flowering period of safflower. In this research, oil content and fatty acid composition of oil were examined. The highest oil content (30.88%) was obtained from control dose. In fatty acid composition, the highest linoleic acid content (81.20%) and stearic acid content (2.20%) were obtained from control dose. The highest oleic acid content (13.90%) was obtained from 1500 ml ha^{-1}. The highest palmitic acid content (6.87%) was obtained from 4500 ml ha^{-1}.

Keywords: Safflower, zinc, fertilizing, oil content, fatty acids

Tekirdağ Koşullarında Aspirin (*Carthamus tinctorius* L.) Yağ Asitleri Komposizyonu Üzerinde Farklı Çinko Dozlarının Belirlenmesi

Özet

Bu araştırma, Tekirdağ ili Hayrabolu ilçesinde yürütülmüştür. Araştırmada kullanılan Yenice aspir çeşidi Eskişehir Tarımsal Araştırma Enstitüsü'nden temin edilmiştir. Ekim, elle 11 Nisan 2012 tarihinde, genişliği 0.9 m ve uzunluğu 5 m olan parsellerde, hasat ise 8 Ağustos 2012 tarihinde yine elle yapılmıştır. Ekimden sonra azot gübresi verilmiş ve aspirin çiçeklenmesinden önce 4 farklı dozda (Kontrol, 1500, 3000 and 4500 ml/ha) çinko sülfat ($ZnSO_4.7H_2O$) formunda yapraklara çinko uygulanmıştır. Araştırmada yağ içeriği ve yağ asitleri komposizyonu incelenmiştir. En yüksek linoleik asit (% 81.20) ve stearik asit (% 2.20) kontrol dozunda elde edilmiştir. En yüksek oleik asit (% 13.90) 1500 ml/ha dozda saptanmıştır. En yüksek palmitik asit ise 4500 ml/ha dozda tespit edilmiştir.

Anahtar Kelimeler: Aspir, çinko, gübreleme, yağ, yağ asitleri

Introduction

Safflower (*Carthamus tinctorius* L.) is a valuable and multipurpose oilseed; its oil has been containing high proportion of linoleic acid, high iodine value and characteristic pleasant flavor. Besides, from the oil is also widely used as the cooking and salad oil, hydrogenated fat, margarine, mayonnaise and in several types of processed foods. However the safflower oil is used in significant proportion such as industrial oil, colorless varnishes and paints in the developed world. The oil compositions of seed may be exchange with different causes as a soil structure, breeding regimes for obtaining the desired properties of the seed oil composition. Tekirdağ in northwest Turkey is one of three provinces of the Thrace peninsula region. Safflower has a high nutrient value and an alternative production of the crop is being tried. Furthermore, safflower is resistant to arid conditions. It would be adaptable to the climatic and land conditions of the Thrace Region and Tekirdağ. The mono-cultural (sunflower-wheat) management of Thrace has caused the increase of phosphorus in soil (Tok, 2002). Phosphorus fertilizer in large amounts leads to zinc deficiency (Aktaş and Ateş, 1998). In addition, zinc absorb of the plant falls when pH increases in the land. (Çelik et al., 2001).The yield and quality of

safflower has been adversely affected. In the past, producers have used zinc fertilizer especially in rice and wheat and other plants, and also found the practice necessary for safflower production. Zinc content of the land in Turkey ranges from 0.12 to 3.65 ppm and the average has been determined as 3.39 ppm zinc (Silanpaa, 1982). It has also been determined that there has been zinc deficiency in 50% of the land in Turkey (Eyüpoğlu et al., 1995). The zinc levels of the wheat leaf samples and the soils were low in Anatolia, Turkey (Elinç et al., 2000). Zinc sulfate fertilizer applied to sunflower in different doses hasn't affected yield and yield elements significantly (Çelik et al., 2001). Several studies have been shown that a small amount of nutrients particularly Zn applied by foliar spraying can significantly increase the yield of crops (Crabtree, 1999; Gadallah, 2000; Hebbern et al., 2005; Mirzapour and Khoshgoftar, 2006; Sarkar et al., 2007). Also, foliar nutrition is an option when nutrient deficiencies cannot be corrected by applications of nutrients to the soil (Crabtree, 1999; Sarkar et al.., 2007; Çakmak, 2008). Geçgel et al. (2007) revealed the effect of genotype on fatty acids was greater than that of environment. Zn application can improve the seed yield and seed quality of safflower. Linoleic acid and oleic acid comprised about 90% of the fatty acid composition and other fatty acid components in safflower seed oil were significantly unaffected (Movahhedy-Dehnavy et al., 2009). Şatana (2005) reported that the highest of oil content, oleic and linoleic acid were obtained 2000 ml ha^{-1} dose for Zn.

Materials and Methods

The field trial was conducted for one year (2012) in Hayrabolu, Tekirdağ, Turkey on soil having 0.5% total nitrogen content, 1.9 kg ha^{-1} phosphorus, 3.7 kg ha^{-1} exchangeable potassium, 0.8% organic matter, 0.25 mg Zn kg^{-1}. The soil pH was 7.0. According to the long-term average, annual total rainfall was 650 mm, average temperature was 13.4 ^{0}C and average relative humidity was 71% in Tekirdağ.

The Yenice variety obtained from Eskişehir Institute of Agricultural Research were used as plant material. In the experiment, plot size was 4.5 m² on six row, 0.9 m wide and 5 m long. In the plots, row spacing was 0.15 m and plant-plant spacing was 0.04 m. Hand planting was made on 11 April 2012. 40 kilograms of nitrogen per hectare as composite fertilizer was applied before sowing. In growing period, 120 kilograms of nitrogen per hectare as ammonium nitrate was applied. Four different doses of zinc (5.5% w/w) fertilizer (Control, 1500, 3000 and 4500 mililiters ha^{-1}) were applied to the leaves as zinc sulfate (ZnSO4.7H2O) before flowering. Hand harvesting was made on 8 August 2012. After plots were harvested, oil content and fatty acid composition (oleic, linoleic, palmitic and stearic acid) were determined. All data were subjected to analysis of variance for each character using MSTAT-C (MSTAT, 1991). This experiment was based on Complete Randomized Block design with three replications. The significance of doses was determined at the 0.05 level by the F-test. The F-protected least significant difference (LCD) was calculated at the 0.05 probability level (Steel and Torrie, 1980).

Results

In this research, zinc fertilizing applied to safflower in different doses (Control, 1500, 3000 and 4500 ml ha^{-1}) on Yenice variety. Oil content, oleic acid, linoleic acid, palmitic acid and stearic acid properties were investigated and the results were given in Table 1.

Table 1. The effects of zinc fertilizer on oil content, oleic acid, linoleic acid, palmitic acid and stearic acid of safflower in Tekirdağ, Turkey

Doses (ml ha^{-1})	Oil Content (%)	Oleic Acid (%)	Linoleic Acid (%)	Palmitic Acid (%)	Stearic Acid (%)
0 (Control)	30.88	12.40 c	81.20 a	6.74	2.20
1500	30.69	13.90 a	80.00 c	6.86	2.07
3000	30.43	13.80 ab	80.03 cd	6.82	2.08
4500	30.75	13.50 b	80.40 b	6.87	2.13
Mean	30.69	13.40	80.41	6.82	2.12
LSD (P≤0.05)		Doses: 0.400	Doses: 0.208		

In zinc fertilizing as shown in Table 1; no significant difference was found in the means of Control, 1500, 3000 and 4500 ml ha^{-1} doses on the statistical analysis in oil content. In oil content, the highest value in dose was obtained from control dose with 30.88% in Yenice variety. The lowest

value in oil content was obtained from 3000 ml ha^{-1} dose application with 30.43%.

Significant difference was found in the means of dose on the statistical analysis in oleic acid. In oleic acid, doses mean was obtained 13.4%. The highest value in oleic acid was found from 1500 ml ha^{-1} dose with 13.90% and the lowest value was found in control dose with 12.4%. Nevertheless, oleic acid was obtained from 3000 ml ha^{-1} dose application with 13.80% and 4500 ml ha^{-1} dose application with 13.50% in Yenice variety.

Significant difference was found in the means of dose on the statistical analysis in linoleic acid. In linoleic acid, doses mean was 80.41%. The highest value was obtained from control dose with 81.20%. The lowest value was found from 1500 ml ha^{-1} with 80.00%. Nevertheless, in the other linoleic acid values in Yenice variety was found from 4500 ml ha^{-1} with 80.4% and in 3000 ml ha^{-1} dose with 80.03%.

In palmitic acid and stearic acid, no significant difference was found in the means of dose on the statistical analysis. Doses mean in palmitic acid was 6.82%. The highest value in palmitic acid was found from 6.87% with 4500 ml ha^{-1} and the lowest value was found in control dose with 6.74% in Yenice variety. In stearic acid, doses mean was 2.12%. The highest value in stearic acid was found from control dose with 2.20% and the lowest value was found from 1500 ml ha^{-1} with 2.07% in Yenice variety.

Discussion

This findings show that the Yenice variety can be grown, in Tekirdağ, Turkey because of its quality. The highest oil content (30.88%) were obtained from control dose. In fatty acid composition, the highest linoleic acid content (81.20%) and stearic acid content (2.20%) were obtained from control dose. The highest oleic acid content (13.90%) was obtained from 1500 ml ha^{-1}. The highest palmitic acid content (6.87%) was obtained from 4500 ml ha^{-1}. Oleic acid and linoleic acid was increased in Zn application. Findings of current study were similar to findings of Çelik et al. (2001), Crabtree (1999), Gadallah (2000), Hebbern et al. (2005), Mirzapour and Khoshgoftar (2006), Sarkar et al. (2007), Movahhedy-Dehnavy et al., 2009) and Şatana (2005).

Conclusion

The accumulation of phosphorus fertilizer given to the land in Tekirdağ and Thrace Region for years and high pH level make difficulties in plants absorbing zinc. For this reason, the growth of safflower can be affected negatively. To remove zinc deficiency in the land rapidly and efficiently, zinc was applied to safflower for fatty acid composition.

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