Scientific Papers. Series A. Agronomy, Vol. LVI, 2013
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

EFFECTS OF DIFFERENT NITROGEN FORMS ON SOME AGRONOMICAL CHARACTERISTICS OF *Echinacea purpurea* IN SEMI-ARID CONDITIONS OF TURKEY

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Abstract

Echinacea, commonly known as coneflower, is a member of the Asteraceae family. The plant is one of the most commonly medicinal plant, is herbaceous perennials with large daisy-like flowers. The roots and aerial parts of Echinacea purpurea is used commercially as herbal plant for enhancing the immune system and treating common cold. This research was conducted to determine the effects of different nitrogen forms on some agronomical characteristics on purple coneflower. In terms of agronomical parameters, plant height, number of branches, stem diameter, number of head, fresh root weight, fresh flower weight, whole plant fresh weight, dry root weight, dry flower weight, whole plant dry weight per plant were examined. According to the results, the nitrogen forms had no statistically significant effects on yield parameters except fresh & dry root weight. Dry root, dry flower weight and dry whole plant weight were determined as 24.6-31.3 g/plant, 9.3-15.4 g/plant and 76.2-106.6 g/plant, respectively.

Key words: *Echinacea, coneflower, nitrogen forms, agronomical characters.*

INTRODUCTION

Echinacea are herbaceous perennials belonging to the Asteraceae family natural lands of North America, with wild populations spreading from the Eastern and Central United States to Southern Canada. They are widely used for wild flower as ornamental plants in gardens (Chen et. al., 2008). Echinacea also called "pembe koni cicegi" in Turkish (Kucukali, 2012).

Three species of Echinacea are used medicinally: *E. purpurea* (L.) Moench, *E. pallida* (Nutt.) Nutt., and *E. angustifolia* DC because of their antiviral, antibacterial and immunostimulatory benefit to human health (Chen, 2008). All three species show pharmacological activity, which appears to result from the combined effects of caffeoylphenols, alkamides, and polysaccharides. However, *E. purpurea* is the most cultivated and widely used of the three species, due to ease of cultivation and total use of the whole plant (Chen, 2009). The most widespread use of Echinaceae drugs is aerial parts of *E. purpurea* and *E. pallida*'s roots (Mat, 2002).

Medicinal and aromatic plants are strongly affected by environmental factors. These factors influence the fresh and dry weight, as well as active substances of herbs. In this respect, the use of chemical fertilizers and their different forms can increase the yield of active substances and main components of medicinal plants. For example, there is evidence that there is an increase in biomass with N fertilization but not fertilization phosphorus and potassium (Shalaby et al., 1997). Meanwhile, utilization of chemical fertilizers and nutrients increase the yield and yield components in a positive way. Nitrogen is an important nutrient for

MATERIALS AND METHODS

E. purpurea was cultivated at the Department of Field Crops, Faculty of Agriculture, University of Dicle, Turkey located at 20°45'S, 42°51'W and at 670 m above the sea. Seeds of *E. purpurea* were sown in a seedbed nursery, from where at 10-15 cm plant height, they were transplanted to field (April 2009). Field trial was conducted under different fertilization forms of 10 kg/da named control, ammonium sulphate, ammonium nitrate and **diammonium phosphate,** according to randomised block design with three replications. Each plot was arranged as 4 rows each of 45x20 cm. Fertilizer was applied as two times; ½ applied during

transplanting and ½ applied at first irrigation. Weeds were controlled by manually. Plants were irrigated three times.

Plants in the trial were harvested by each plant separately on 13 September 2010 at full blooming stage. All the harvested plants were separated into leaves, flowers and roots for evaluated characters. Plant height, number of branches, stem diameter, number of head, fresh root weight, fresh flower yield, whole plant fresh weight, dry root weight, dry flower yield and whole plant dry weight per plant were investigated for each fertilization form. The experimental design was a randomised complete block with three replications. Plot size was 5.1 m^2. Data on all parameters were assessed by analysis of variance and treatment means separated by DUNCAN test (SPSS 18:00).

RESULTS AND DISCUSSIONS

The differences between treatments with respect to the plant height, number of branches, stem diameter, number of head, fresh root weight per plant, fresh flower yield per plant, whole plant fresh weight, dry root weight per plant, dry flower yield per plant, whole plant dry weight per plant were given for each fertilization form in Table 2 and Table 3.

Table 1. The mean values of some agronomical characteristics in *E. purpurea*

Fertilization Forms	Plant height (cm)	Number of branch	Stem diameter (cm)	Number of flower head	Fresh root weight (g/plant)
Control	79.9 b*	5.8	7.33b	14.2ab	51.8
Diamonium Phosphate	85.5ab	8.1	8.28ab	12.8b	61.1
Amonium Nitrate	79.8b	6.9	8.07ab	14.8ab	71.0
Amonium Sulphate	91.6a	6.3	9.18a	17.7a	57.6
Duncan (0.05)	*	ns	*	*	ns

Means followed by the same letter are not different according to Duncan Range Test (P=0.05)

Plant Height

The mean values of the trial were given in Table 2. According to the results of research, different nitrogen doses had significant effect on plant height. The maximum plant height obtained from ammonium sulphate as 91.6 cm, while the minimum plant height from control as 79.8 cm. The plant height of *E. purpurea* reported as 82.5 cm by Yaldiz et al. (2012), as from 46.21 to 50.01 cm by Chen et al. (2008), as from 36.13 to 46.21 cm by Chen (2009), as from 78.0 to 100.4 cm by Kan (2010), as from 38.6 to 41.6 cm in first year while from 74.6 to 91.6 cm in second year by Sati (2012). Kucukali (2012) determined plant height of *E. purpurea* as 63.3 cm. Morphological characteristics are affected from different ecological factors such as light, temperature, irrigation etc., so some plants growing different ecological conditions could create their ecotype. Therefore, differences in literature relating with Echinaceae could be arose this cause.

Number of Branch

There was no significant difference among the nitrogen forms for the number of branch per plant. However, the highest number of branch was obtained from diammonium phosphate with 8.1 per plant, while the lowest number of branch was obtained from ammonium sulphate as 5.8 per plant. Yaldiz et al. (2012) found that number of branch per plant was 13 per plant, Kan (2012) reported that number of branches of *E. purpurea* ranged from 9.5 to 26.6 per plant, Yarnia et al. (2012) determined number of branches values as 13.4 per plant. Kucukali (2012) also reported that the average of number of branch of *E. purpurea* was 9.20 per plant. Our data was found lower than literature, this may cause from ecological conditions, especially from semi-arid climatic.

Stem Diameter

Table 2 shows that there were significant differences among nitrogen doses for the stem diameter. The high stem diameter found in ammonium sulphate fertilization form as 9.18 cm, while the lowest stem diameter was obtained from control as 7.33 cm. Differences among nitrogen sources relation with stem diameter might be caused from ammonium sulphate nitrogen forms which is resists loss

from leaching and its efficiency is long-lasting (Anonymous, 2012).

Number of Flower Head

Significant differences were determined between fertilization forms for number of flower head.

Fresh Root Weight

There were no significant differences between the different fertilization forms for fresh root weight. The highest fresh root weight was obtained from ammonium nitrate (71.0 g/plant) and lower fresh root weight (51.8 g/plant) from control plots. Kucukali (2012) reported that fresh root yield per plant varied due to different plant densities and harvest number, and reported mean fresh root yield as 109.16 g/plant. Results of Seidler and Dabrowska (2003) indicate that fresh root yield per plant is 100.5 g/plant in rosette stage, 377.5 g/plant in rosette stage of second year and 1270 g/plant flowering stage.

Fresh Flower Weight

Data in Table 3 revealed that fresh flower weight gave the maximum result in Ammonium sulphate form (66.0 g/plant), while, control was ranked in the lowest position (35.9 g/plant). Kucukali (2012) reported that fresh flower yield of *E. purpurea* was 214.82 g/plant. Chen et al. (2008) determined that flower yield per plant ranged from 25.61 to 51.19 g. In their study, all the morphological, agronomic and biochemical traits in harvested plants were highly variable, this variability could be explained by environmental and cultural conditions, with the inter-individual differences being the main source of variability. *E. purpurea* is a cross-pollinated plant and tends to be self-incompatible. Therefore, the large variability in its morphological and agronomic traits is not unexpected. Differences in our results seem to verify it.

Whole Plant Fresh Weight

There were no statistical differences in fresh herbage weight. However, higher fresh herbage weight (264.3 g/plant) was recorded at forms of diammonium phosphate and lower fresh herbage weight (187.6 g/plant) was recorded on control plots. Fresh herbage yield per plant were reported as 664.4 g/plant by Kucukali, 2012), and as between 61.52 and 112.89 g/plant by Chen (2008). The reason of variable yield parameters in Echinacea is better able to grow efficiency; neutral, efficient, light, well-drained and alkaline pH of soils (Douglas, 1993).

Dry Root Weight

In this experiment, dry root weight was not affected by fertilization forms, however the maximum value obtained from ammonium nitrat as 31.3 g/plant. The lowest value also was obtained from control plots with 24.6 g/plant. Parmenter and LittleJohn (2002) found the maximum root yield after two season of growth as 30 g/plant in different plant densities. Powell et. al. (2001) stated that dry root yield of *E. angustifolia* is variable due to soil type and depth and reported that root weight ranged from 6.9 to 55.6 g/plant. Chen (2009) also reported that dry root yield of *E. purpurea* lines varied from 8.89 to 16.77 g/plant. The results are compatible with the findings of the mentioned authors.

Dry Flower Weight

In connection with fresh flower weight, ammonium sulphate gave the maximum yield for dry flower weight with 15.4 g/plant. The lowest dry flower weight was obtained from control with 9.3 g/plant. Kucukali (2012) reported that average of dry flower yield was 54.3 g/plant, Shalby et al. (1997) indicated that dry flower yield was 45 g/plant. In the words of Chen et al. (2008), *E. purpurea* is a cross-pollinated plant and tends to be self-incompatible. Therefore, the large variability in its morphological and agronomic traits is not unexpected. According to Chen et al. (2009), dry flower head yield per plant varied from 26.08 to 31.60 g/plant.

Whole Plant Dry Weight

No significant differences were observed among nitrogen forms in whole plant dry weight. However, the high value obtained from diamonium phosphate as 106.6 g/plant, while the low one (76.2 g/plant) achieved in the control treatment. Kucukali (2012) indicated that dry herbage yield per plant was 164.81 g/plant, Shalbay et al. (1997) also reported dry herbage yield as 53 g/plant. Yarnai (2012) found 41.41 g/plant for above ground dry yield. Chen (2009) indicated that aerial part of *E. purpurea* varied between 50.80 to 92.93 g/plant depending on different Echinecea lines. Differences between these studies might cause from different ecological conditions, different harvest stages or applications.

Table 2. The mean values of some agronomical characteristics in *E. purpurea*

Fertilization Forms	Fresh flower weight (g/plant)	Whole plant fresh weight*	Dry root weight (g/plant)	Dry flower weight (g/plant)	Whole plant dry weight (g/plant)
Control	35.9b**	187.6	24.6	9.3b	76.2
Diamonium Phosphate	44.9b	264.3	29.6	12.8ab	106.6
Amonium Nitrate	51.1ab	237.5	31.3	12.6ab	95.9
Amonium Sulphate	66.0a	212.2	25.6	15.4a	84.2
Duncan (0.05)	*	ns	ns	*	ns

Leaves stem and flower

* Means followed by the same letter are not different according to Duncan Range Test (P=0.05)

CONCLUSIONS

Purple coneflower is an important medicinal plant that has the potential for future consumption in our country. It was determined that the nitrogen forms had significant effects on dry flower weights and the other some plant growth parameters. Further studies should be planned for this purpose, but efficiency of the diammonium sulphate was better than the ammonium sulphate, DAP and control for investigated characters.

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