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THE IMPACT OF NITROGEN FERTILIZATION ON THE ALKALOID CONTENT AND GROWTH TRAITS OF DATURA (*DATURA STRAMONIUM* L.)

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Abstract: *D. stramonium* is a wild plant species belonging to the nightshade family *Solanaceae* and grows on the edges of cotton fields, empty lands and roadsides. The plant is one of the most important economic weed plants that contain both toxic and medicinal properties. Studies have shown that the plant contains toxic tropane alkaloids such as atropine, hyoscyamine, and scopolamine. It is known that cultivation techniques have a great influence on the quality and quantity of secondary metabolites. For this reason, it is important to determine the optimal values of the agronomic factors that influence plant growth and production. This study was conducted in the experimental area of the Agricultural Faculty of Dicle University in the 2010 and 2011 growing seasons so as to evaluate the impact of nitrogen fertilizer rates (0, 50, 100 and 200 kg ha^{-1}) on some agronomical characteristics such as fresh and dry herb yield and total alkaloid content of Datura (*Datura stramonium* L.). The results revealed that significant ($P \le 0.05$) differences were observed between nitrogen doses in the 2010 and 2011 growing seasons in terms of seed yield, fresh and dry herb yield and total alkaloid yield of seeds. However, seed yield changed between 545 kg ha^{-1} and 625 kg ha^{-1}, fresh herb yield between 8000 and 24483 kg ha^{-1}, dry herb yield between 2190 kg ha^{-1} and 5083 kg ha^{-1} and alkaloid content between 0.259% and 0.366%, respectively. The results showed that fresh and dry herb yields increased with increasing nitrogen doses.

Key words: Datura, seed yield, herb yield, total alkaloid content.

Introduction

The genus *Datura* belongs to the *Solanaceae* family, which is known for the synthesis of a number of tropane alkaloids. The main active substances are hyoscyamine and scopolamine, and this ratio for *D. stramonium* is about 2:1 (EFSA, 2008). Hyoscyamine (atropine) and scopolamine are the predominant

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tropane alkaloids in the *Datura* genus, occurring in all plant organs. These alkaloids have spasmolytic and anesthetic properties (Iranbakhsh et al*.,* 2006; Alinejad et al., 2020). Its leaves contain about 0.2–0.6% of alkaloids. There are three species spreading in Turkey such as *D. metel* L, *D. innoxia* L. and *D. stramonium* L. *D. stramonium* is a plant distributed throughout most temperate regions of the world. *D. stramonium* has been traditionally used to treat asthma, coughs and cramps (Ceylan, 1994; Cespedes-Mendez et al*.,* 2021). The plant is cultivated for medicinal purposes due to its alkaloids. *D. stramonium* grows in the wild in many zones in Turkey. In southeastern Anatolia of Turkey, *D. stramonium* is found in fields as a weed in many summer crops, particularly in maize, cotton and vegetable crops (Baytop, 1984). It is stated that the total alkaloid content of *D. stramonium* varies between 0.2 and 0.7% in plants grown in arid conditions and between 0.2 and 0.5% in plants grown in moist soils (Kulaksiz and Kan, 2002).

Nutritional elements such as nitrogen are important factors influencing alkaloid production. The excessive amount of nitrogen used in the plant causes it to get too much nitrogen and protein by blocking the conversion of certain factors, which also leads to an accumulation of nitrogen (NO_3, NO_2^{-}) (Maynard et al., 1976). Both the herbage yield and the biologically active substances are very important for the cultivation of medicinal plants. Nitrogen (N) is one of the major nutrients that support crop growth and is the most responsive nutrient required for herbage plants (Ozyigit et al., 2016; Izadi et al., 2021; Izadi et al*.,* 2022; Alinejad et al*.,* 2020). Therefore, it is very important to determine the suitable dosage. Up to date, there have been studies reporting on the effects of nitrogen doses on the secondary metabolites of many alkaloid bearing plants (Ruminska and Gamal, 1978; Ozguven et al*.,* 1986; Cakmak and Ozguven, 1987; Gupta et al*.,* 2011; Al-Humaid, 2005; Ciesiolka et al*.,* 2005; Oster et al*.,* 2014; Carrubba, 2015). Increasing nitrogen doses also causes an increase in the number of vegetative parts and total alkaloids (Nassar et al., 2015). In some agronomic studies, a nitrogen dose of 150 kg ha^{-1} has been reported to be suitable for a high proportion of vegetative parts and a nitrogen dose of 200 kg ha^{-1} for seed yield (Esendal et al., 2000). In another study, an increase in dry and fresh herb and seed yield was observed as nitrogen doses increased from 100 to 800 kg ha^{-1} (Al Humaid, 2005). The aim of this study was to investigate the effects of different nitrogen doses on *D. stramonium L.* regarding some agronomic characteristics and alkaloid content under semi-arid growing conditions in Diyarbakir, Turkey.

Material and Methods

Plant material and field experiment

Two-year field experiments were conducted in 2010 and 2011 at the experimental area of the Department of Field Crops of Dicle University (latitude

37°53′N and longitude 40°16′E, 680 m above sea level). The soil properties of the experimental plot were loamy-clayey with a pH of 7.46, 14.5 kg ha^{-1} P_2O_5, 0.48% organic matter and 11.02% lime. The soil was analyzed for total soil organic matter, total salts, lime, soil pH, and soil structure as described by Klute (1986).

D. stramonium seeds were collected from the Cinar district of Diyarbakir, Turkey. The experiments were laid out in a completely randomized block design with 3 replications. Four different nitrogen doses (0, 50, 100, 200 kg ha^{-1}) in the form of ammonium nitrate (33%) were used in the study. The seeds were scattered by hand on the prepared field at the first week of April in 2010 and 2011. Half of the nitrogen was applied at sowing and the remaining half of the nitrogen at the first irrigation. The *D. stramonium* seeds were sown into the previously prepared plots in rows 60 × 30 cm apart. The plot size was 7.2 m^2 (3 m × 2.4 m) at sowing and 2.4 m^2 (1.2 m x 2 m) at harvesting for both herbage and seed yields. Each plot consisted of four rows with a distance of 60 cm. Harvesting was done by hand when the seeds were ripe and the leaves were in full bloom.

Five plants randomly selected were taken from each plot to record growth and yield parameters. In the experiment, plant height (cm), plant stem diameter (mm), number of branches per plant, number of capsules per plant, capsule width (cm), capsule length (cm), number of seeds per capsule, thousand-seed weight (g), seed yield (kg ha^{-1}), fresh herbage yield (kg ha^{-1}), alkaloid content of seed (%) and alkaloid content of leaf (%) were investigated.

Climatic and weather conditions

The general climatic characteristics of the south-eastern Anatolia region are hot and dry in summer with temperatures above 30°C. Winter precipitation is erratic. Spring and fall are generally mild, but sudden hot and cold spells are common in both seasons in the region.

The experimental area has a long-term (70-year) average precipitation of 469.9 mm, an average temperature of 15.8 ^{0}C, and a relative humidity of 54.3%. The meteorological data for the 2010 and 2011 growing seasons showed an average temperature of 17.7 ^{0}C and 15.5 ^{0}C, and precipitation of 398 mm and 574 mm, respectively (State Meteorology Institute, Diyarbakir, Turkey).

Determination of the total alkaloid content

The determination of total alkaloids was performed according to the Harborne (1973) and EFSA (2008). According to this method, the dried plant material was crushed in a blender and soaked in 50 ml of 0.1 N HCL. Then the solution was kept at room temperature for one night and transferred to a percolation tube. After maceration, the mixture was transferred to a tube percolator and the percolation process was continued with distilled water. Then, a few drops of the percolation were dropped into Dragendorff reagent. The process was continued until the mixture was orange. The perchlorate was transferred to a 250-ml separating funnel and after decanting, the medium was made alkaline with 10% ammonia solution. Then the solution was dissolved with 4×25 ml of chloroform ($CHCl_3$) by shaking for 2 min each. The extracts were collected, and $CHCl_3$ was eluted completely from the media. The residue was dried at 105 ^{0}C for 30 min. The remaining material was dissolved in 25 ml of boiling water and 3 ml of ethanol of 95^0 was added, using methyl red as an indicator, and titrated with 0.01 N HCL. The titration, already showing a transparent yellowish color, turned pink again at the end. The calculation was made by counting 0.00289 alkaloid acid in each 1 ml of 0.01 N HCl. This value was multiplied by the acid used to determine the amount of alkaloids from 3-g samples. This value can then be converted into a percentage.

Statistical analysis

The obtained data was subjected to an analysis of variance (MSTAT-C, 1980) and the LSD test ($p<0.05$) was performed to compare the means.

Results and Discussion

The nitrogen treatments significantly affected plant height in the 2010 and 2011 growing seasons (Table 1). The highest plant height was 114.17 cm obtained with N_{100} doses, while the lowest plant height was 95.7 cm recorded in the N_0 control plot (Table 1). The plant height partially increased with an increase in applied N doses, but a decrease was observed in N_{200} doses. Al-Humaid (2005) reported that the highest dose of fertilizers resulted in a reduction in plant height, number of branches and leaves per plant, and fresh and dry weights of leaves, stems, crown flowers, and fruits of *D. stramonium* plants. Increasing nitrogen doses caused an increase in plant height in 2011. Namely, the highest value was 77.8 cm obtained with the N_{200} dose and the lowest value was 59.2 cm obtained with N_0 doses in both years (Table 1). The differences arising between the two years of the trial may be caused by changes in the amount of annual rainfall. Esendal et al. (2000) reported that nitrogen fertilization had an increasing effect on plant height, and plant height varied between 40.24 and 67.83 cm. Similar results were observed by these researchers in an experiment conducted in the second year. Kulaksiz and Kan (2002) verified that increasing N doses (ranging between 0 and 150 kg ha^{-1}) resulted in higher plant height.

Table 1 shows that the plant stem diameter was not affected significantly by the different fertilization applications. Plant stem diameter increased with increasing nitrogen dose so that the highest plant stem diameter was obtained at

N_{200} nitrogen doses with 1.87 cm, and the lowest plant stem diameter was produced at N_0 doses with 1.61 cm. The highest plant stem diameter (1.53 cm) was obtained at N_{200} nitrogen doses, while the lowest (1.19 cm) was obtained at N_0 nitrogen doses. As for plant height, the differences between the years may be due to the variations in annual rainfall. Our findings are higher than those of Esendal et al. (2000), who reported plant stem diameters between 0.72 and 0.86 cm.

The differences in the number of branches per plant between the N fertilization treatments were not significant for 2010 but were significant for 2011 (Table 1). The lowest number of branches (1.97 per plant) was obtained at N_{00} nitrogen doses, while the highest number of branches (2.3 per plant) was obtained at N_{200} nitrogen doses in 2011 (Table 1). The mean number of branches per plant was 3.84 and 2.18 in 2010 and 2011, respectively. However, the differences in the number of branches could be associated to the changes in the amount of annual rainfall between the experimental years. Our plant height results were higher than the results of Esendal et al. (2000), who reported the number of branches between 1.37 and 1.50 per plant. These variations may be due to differences in genotype, ecological conditions, and used agricultural techniques.

Table 1. The mean values of plant height, plant stem diameter, number of branches, number of capsules, capsule width, capsule length, and number of seeds per capsule of *D. stramonium* at different nitrogen doses in the 2010 and 2011 growing seasons.

Nitrogen doses (kg ha^{-1})	Plant height (cm)	Plant stem diameter (mm)	Number of branches per plant	Number of capsules per plant	Capsule width (cm)	Capsule length (cm)	Number of seeds per capsule
2010							
0	95.70c	1.61	3.63	1.53b	2.05b	2.07	293.9c
50	106.97ab	1.66	3.80	1.87a	2.18ab	2.69	314.1bc
100	114.17a	1.73	3.93	1.83a	2.36a	2.92	355.6a
200	102.45bc	1.87	4.00	1.67ab	2.13b	2.58	323.7b
Mean	104.83	1.72	3.84	1.73	2.18	2.56	321.8
LSD (0.05)	10.06	NS	NS	0.23	1.89	NS	21.48
2011							
0	59.20c	1.19	1.97b	1.20	1.88a	2.23b	239.3b
50	64.40bc	1.40	2.07b	1.53	1.89a	2.41ab	272.0a
100	73.93ab	1.48	2.33a	1.67	1.83b	2.63a	281.7a
200	77.80a	1.53	2.37a	1.80	1.91a	2.68a	281.3a
Mean	68.83	1.40	2.18	1.55	1.88	2.49	268.5
LSD (0.05)	12.19	NS	0.24	NS	0.58	2.69	31.02

*Means in the same column followed by the same letter are not significantly different according to LSD at 0.05 level, NS: Not significant.

According to the data from the 2010 growing season, the highest number of capsules per plant was 1.87 at N_{50} nitrogen doses, while the lowest was 1.53 per plant at N_0 nitrogen doses (Table 1). The increase in nitrogen doses in 2011 caused a slight increase in the number of capsules. The highest value of 1.80 per plant was achieved with the N_{200} nitrogen doses; the lowest value was 1.20 with the N_0 nitrogen doses (Table 1). Despite similar nitrogen doses and observed differences due to low rainfall during the growing season, the obtained results are in agreement with those of Esendal et al. (2000).

The width of the capsules has a great positive impact on the number of seeds they contain. The mean of the capsule width was determined to be 2.18 and 1.88 cm for the 2010 and 2011 growing seasons, respectively. In 2010, the highest capsule width (2.36 cm) was obtained with N_{100} nitrogen doses; the lowest capsule width (2.05 cm) was obtained with N_0 nitrogen doses (Table 1). In 2011, increasing nitrogen doses affected the capsule width positively. The highest value (1.91 cm) was determined for N_{200} nitrogen doses, and the lowest value (1.88 cm) was determined for the N_0 dose (Table 1). This situation might be due to precipitation differences between years. The capsule width increased with increasing nitrogen levels. Esendal et al. (2000) reported that the capsule width of the plants obtained from seeds collected from different places varied between 2.35 and 2.48, which is consistent with our results.

Theoretically, a high capsule density would produce more seeds per capsule and potentially generate a higher seed yield. The capsule length showed mean values of 2.56 cm and 2.49 cm in 2010 and 2011, respectively. The highest capsule length was 2.92 cm at N_{100}, and the lowest was 2.07 cm at N_0 nitrogen doses in 2010. The capsule length decreased with increasing nitrogen doses in the 2011 growing season. The highest capsule length was recorded at N_{200} nitrogen doses (2.68 cm) and the lowest was 2.23 cm at N_0 (Table 2). Esendal et al. (2000) reported that the nitrogen doses led to a linear increase in capsule length.

To obtain high seed yield, a high number of seeds per capsule is required. The number of capsules per plant is an important yield-contributing character for assessing the seed yield of *D. stramonium*. The maximum number of seeds per capsule was found to be 355.6 per capsule at doses of N_{100}, while the minimum value was 293.9 per capsule at N_0 nitrogen doses (Table 2). Increasing nitrogen doses enhanced the number of seeds per capsule, with the highest number of seeds per capsule at N_{100} doses (281.7 pcs), and the lowest number of seeds per capsule (239.3 pcs) at the N_0 treatment (Table 2). The determined differences between two years could be caused by the varying annual precipitation. Esendal et al. (2000) determined that the number of seeds per capsule varied in a range of 342–384 pcs. The number of seeds per capsule obtained in this study was lower than that of Esendal et al. (2000), which is probably due to the differences in the genotype, ecological conditions and agricultural practices applied.

Table 2. The effects of different nitrogen doses on thousand-seed weight, seed yield, fresh and dry herbage yield, and alkaloid content of seeds and leaves of *D. stramonium* in 2010 and 2011.

Nitrogen doses (kg ha^{-1})	Thousand-seed weight (g)	Seed yield (kg ha^{-1})	Fresh herbage yield (kg ha^{-1})	Dry herbage yield (kg ha^{-1})	Alkaloid content of seed (%)	Alkaloid content of leaf (%)
2010						
0	4.53b	546	13813b	3210b	0.312b	0.251c
50	5.09ab	657	20290ab	4317ab	0.352a	0.318a
100	5.41a	726	23356a	4500a	0.366a	0.323a
200	4.44b	569	24483a	5083a	0.323b	0.276b
Mean	4.87	625	20486	5178	0.338	0.292
LSD (0.05)	0.65	NS	741.8	124.2	0.019	0.019
2011						
0	5.55	412c	8000b	2190	0.259	0.195b
50	5.66	541b	8757b	2413	0.288	0.288a
100	5.54	675a	9713b	2522	0.320	0.304a
200	5.02	552b	12010a	2727	0.305	0.303a
Mean	5.44	545	9620	2463	0.293	0.272
LSD (0.05)	NS	10.50	191.8	NS	NS	0.063

*Means in the same column followed by the same letter are not significantly different according to LSD at 0.05 level, NS: Not significant.

The thousand-seed weight is one of the important yield components determining the quality of the seed. The maximum 1000-seed weight (5.41 g) was measured with the application of nitrogen doses at N_{100}, while the minimum 1000-seed weight (4.44 g) was recorded at N_{200} in 2010 (Table 2). The increase in nitrogen doses in 2011 caused greater seed weight. The maximum 1000-seed weight (5.66 g) was found in plants grown at N_{50} level, while the minimum thousand-seed weight (5.02 g) was measured at N_{200} level (Table 2). The 1000-seed weight results are lower than the findings of Losak and Palenicek (2005), Ceylan (1994) and Esendal et al., (2000). It is thought that these differences arise from differences in the studied material, the genotypes, and the ecological conditions.

The seed yield of *D. stramonium* is one of the latest products in the production of alkaloids. A high seed yield depends on many factors. Some of these factors are referred to as good agricultural practices, the number of plants per unit area and irrigation. In term of seed yield, the minimum seed yield (546 kg ha^{-1}) was recorded in the control, while the maximum seed yield (726 kg ha^{-1}) was obtained at the N_{100} level in 2010 (Table 2). Enhanced nitrogen doses increased seed yield in the 2011 growing season. The highest seed yield was obtained at the N_{100} level with 675 kg ha^{-1} and the lowest seed yield was obtained at the N_0 level with 412 kg ha^{-1} (Table 2). The results obtained in this study were lower than those of Esendal et al. (2000) and Kulaksiz and Kan (2002), but the findings of Losak and Palenicek (2005) and Ozguven et al. (1986) are similar to their lower values. These differences may be caused by the studied material, ecological conditions, and changes in agricultural practices. The results of this study in terms of seed yield are similar to those of Izadi et al. (2021), which were obtained by fertilizing with urea and were below the value of 180 kg ha^{-1}.

The data presented in Table 2 reveal that the different fertilization applications had a significant effect on the fresh herbage yield. The fresh herbage yield increased with an increase in nitrogen doses in the first experimental year, with the highest (24483 kg ha^{-1}) fresh herbage yield at N_{200} doses and the lowest fresh herbage yield of 13813 kg ha^{-1} at the N_0 nitrogen level. The second-year data showed that the highest fresh herbage yield was 12010 kg ha^{-1} obtained at the N_{200} level, and the lowest fresh herbage yield was 8000 kg ha^{-1} obtained at the N_0 level (Table 2). Ruminska and Gamal (1978) indicate in their study that the growth of *Datura innoxia* increased with increasing the amount of nitrogen fertilization. Ceylan (1994) also reported an increase in fresh herbage yield with an increase in nitrogen doses. However, compared with previous research data related to fresh herbage, our results showed a high value compared to the findings of Esendal et al. (2000), who reported 7038–9232 kg ha^{-1}. Similarly, it was observed by Oster et al. (2014) in *Duboisia*, another alkaloid plant, that mineral N fertilization significantly increased biomass.

The different nitrogen doses were statistically significant ($P \leq 0.05$) for dry herbage yield in 2010, but not statistically significant in the 2011 growing season. In 2010, the highest dry herbage yield (5083 kg ha^{-1}) was obtained at the N_{200} nitrogen dose, and the lowest dry yield (3210 kg ha^{-1}) was obtained at the N_0 level (Table 2). In 2011, the nitrogen doses enhanced the dry herbage yield, 2727 kg ha^{-1} was recorded as the highest value at the N_{200} nitrogen level, and 2190 kg ha^{-1} was recorded as the lowest value at the N_0 level. Our findings are higher than those of Ceylan (1994), who reported that increasing nitrogen doses increased dry herbage yield and the yield ranged from 100 to 300 kg ha^{-1}. Alaghemand et al. (2013) also reported that the dry weight of total foliage of henbane increased with increasing nitrogen fertilization.

Datura species are important for alkaloid production. Seeds, leaves, flowers and roots contain alkaloids. Leaves and seeds are used commercially for the production of alkaloids. High level of alkaloids depends on many factors, such as environmental conditions, nutrition level and different agronomical practices. The most important of these factors is fertilization. The highest alkaloid content was found to be 0.366% for N_{100} nitrogen doses, while the lowest alkaloid content was found to be 0.312% for N_0 nitrogen doses during the 2010 growing season (Table 2). The highest value (0.320%) was obtained for N_{100} nitrogen doses and the lowest value (0.259%) was obtained for N_{200} nitrogen doses in 2011. The increase in nitrogen doses in 2011 initially led to an increase in the alkaloid content of seeds, and then to a decrease. A similar tendency was observed in the study of Al-Humaid (2005). Gholamhosseinpour et al. (2011), working with periwinkle, have reported that nitrogen is a component of alkaloids that plays an important role in the synthesis of alkaloids. Therefore, increasing nitrogen nutrient leads to an increase in alkaloid content. Regarding the alkaloid content of seeds, our results are lower than those of Ceylan (1994) and Kulaksiz and Kan (2002), but higher than those of Akin and Ceylan (1986).

The effects of nitrogen doses on the alkaloid content of the leaves were significant in both years. The lowest alkaloid content of the leaf (0.251%) was obtained at the N_0 level, while the highest alkaloid content of the leaf (0.323%) was obtained at the N_{100} level in 2010. There was a trend towards an increase in the alkaloid content of the leaf with increasing nitrogen levels in the 2011 growing season. The highest value of 0.304% was obtained at N_{100} and the lowest value of 0.195% was obtained at the N_0 fertilization level. There were differences in the alkaloid content of the leaf between years, and the mean values of 2010 were higher than those of 2011. It is assumed that the higher precipitation in the second year was responsible for the high results in the first year of the experiment. As reported by Elzenga (1958), rainfall generally reduces the alkaloid content and the alkaloids are washed from the plant.

This situation shows that different ecological factors influence the secondary metabolites. Ceylan (1994) reported that the alkaloid content changed with increasing nitrogen doses, and the amount of alkaloid content increased with enhancing nitrogen doses. Al-Humaid (2005) showed that nitrogen fertilization in Datura plants caused an increase in alkaloid content at moderate fertilizer doses, while a decrease was observed at high doses. Our result is consistent with that of Ozguven et al. (1986), Tanker and Tanker (1990) and Kaya and Gurel (1997). There are also many studies showing that alkaloid content increases with increasing nitrogen doses in various alkaloid-producing plants (Ghorbanpour et al., 2014; Losak and Palenicek, 2005). Haadi-e-vincheh et al. (2013) describe this situation as follows: alkaloids contain nitrogen and are usually derived from amino acid precursors, since a higher availability of nitrogen doses would lead to higher levels of alkaloids in plants.

Conclusion

This study was carried out to determine the appropriate nitrogen dose to obtain high fresh and dry herb and seed yields. A high seed yield was obtained with 100 kg ha^{-1} nitrogen dose, and a significant decrease was observed with an application of 200 kg ha^{-1}. Fresh and dry herb yields were higher than 200 kg ha^{-1}, which corresponds to the highest nitrogen dose. The alkaloid contents of the seeds and leaves were found to be close to each other. It was determined that the alkaloid content in the seeds and dry leaves of the first year was higher than that of the second year. These results showed that *D. stramonium* can be cultivated to produce tropane alkaloids in semi-arid conditions with appropriate cultivation techniques.

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UTICAJ ĐUBRENJA AZOTOM NA SADRŽAJ ALKALOIDA I OSOBINE RASTA TATULE (*DATURA STRAMONIUM* L.)

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R e z i m e

D. stramonium je divlja biljna vrsta koja pripada porodici pomoćnica *Solanaceae* i raste na rubovima pamučnih polja, ruderalnih površina i pored puteva. Ova biljka je jedna od ekonomski najvažnijih korovskih biljaka koje sadrže i toksična i lekovita svojstva. Istraživanja su pokazala da ova biljka sadrži toksične tropanske alkaloide kao što su atropin, hiosciamin i skopolamin. Poznato je da način gajenja ima veliki uticaj na kvalitet i kvantitet sekundarnih metabolita. Iz tog razloga, važno je odrediti optimalne vrednosti agronomskih faktora koji utiču na rast i proizvodnju biljaka. Ovo istraživanje je sprovedeno u eksperimentalnoj oblasti Poljoprivrednog fakulteta Univerziteta Didžle u vegetacijskim sezonama 2010. i 2011. godine kako bi se procenio uticaj količine azotnog đubriva (0, 50, 100 i 200 kg ha^{-1}) na neke agronomske osobine kao što su kao prinos sveže i suve herbe i ukupan sadržaj alkaloida tatule (*Datura stramonium* L.). Rezultati su pokazali da su uočene značajne ($P \leq 0{,}05$) razlike između doza azota u vegetacijskim sezonama 2010. i 2011. godine u pogledu prinosa semena, prinosa sveže i suve herbe i ukupnom prinosu alkaloida semena. Međutim, prinos semena se menjao između 545 kg ha^{-1} i 625 kg ha^{-1}, prinos sveže herbe između 8000 i 24483 kg ha^{-1}, prinos suve herbe između 2190 kg ha^{-1} i 5083 kg ha^{-1} odnosno sadržaj alkaloida između 0,259% i 0,366%. Rezultati su pokazali da se prinosi sveže i suve herbe povećavaju sa povećanjem doza azota.

Ključne reči: tatula, prinos semena, prinos herbe, ukupan sadržaj alkaloida.

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