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Research Article

Assessment of Residual Impacts of Poultry Manure on Nutrient, Sucrose, Fructose and Glucose Content of Second Crop Onion (*Allium cepa* L.)

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Abstract: This study, conducted at Ege University, Odemis Vocational School, aimed to investigate the influence of poultry manure applications on the nutrient, sucrose, fructose, and glucose content of second crop onions. In this research, three onion varieties (Burgaz, Snow White, Champion), three different doses of poultry manure (20, 40, 60 t ha^{-1}), and mineral fertilizer were employed. An unfertilized plot was employed as the control. The experiment was designed using a split-split plot arrangement and replicated three times. The analysis comprised the assessment of nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), zinc (Zn), manganese (Mn), and copper (Cu) contents in samples collected from both onion leaves and bulbs. In addition, sucrose, fructose, and glucose levels in the bulb were determined. The Snow White variety contains the highest level of fructose, sucrose, and glucose compared to other varieties. In the exploration of the impact of macro-micro element contents in bulbs, the Champion variety exhibited significantly higher levels of N, Ca, Fe, and Cu compared to other varieties. Additionally, P, K, and Na contents were significantly higher in Champion and Snow White varieties compared to Burgaz bulbs. The difference between the applications of these nutrients was insignificant except for N, P, Na, and Fe. The Nitrogen, Potassium, Sodium, and Iron contents of soils were the lowest control, while the highest dose application had the highest value at 60 t ha^{-1} dose. The difference among the applications in these nutrients was significant except for Mg and Cu. It may be recommended to use 40 t ha^{-1} dose in onion cultivation.

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1. Introduction

Currently, onion is produced as one of the most important crops in the world (Kumar et al., 2003 and 2007; Sharma, 2003; Yoldas et al., 2011; Sekara et al., 2015; Yoldas et al., 2020). Onion is one of our special foods, with great importance in human nutrition and its place in Turkish cuisine and a special nutritious unit.

In Türkiye, fresh onion production is 126 185 tons, and dry onion production is 2 500 000 tons (Anonymous, 2022). The cultivated area is 87 393 ha for spring onions (Anonymous, 2018) and 69 897 ha for dry onions (Anonymous, 2022). The best onion cultivation is done in sandy-clay or clay-sandy, organic-rich soils. Heavy clay or sandy soils and excess moisture are unsuitable for growing onions (Ekinci, 1971; Günay, 1983; Vural et al., 1987 and 2000).

Soils are generally poor in organic matter in Türkiye. Animal fertilizers with high organic matter content regulate and also improve soil properties (physical, chemical and biological, etc.). These materials are also storage for plant nutrients. High fertilizer doses used in onion cultivation harm human health and the environment; therefore, it is important to create conscious fertilization programs for sustainable production and sustainable living according to plant varieties. Crop production has increased with the increasing world population, and increasing inputs.

The studies discussed various aspects of onion production and fertilization methods. Yoldas et al. (2019) highlighted the positive impact of poultry manure, indicating a significant increase in yield, especially with a 60 t/ha application. Mallanagouda et al. (1995) found that the highest onion yield resulted from combining the recommended NPK amount with animal manure. Vural et al. (1987) observed that the combination of animal manure with NPK yielded the highest marketable yield under favorable moisture conditions, while low manure alone produced better results than NPK alone. In another study, different animal manure applications, mineral fertilizers (NPK), and their combinations were examined, with NPK showing effectiveness primarily in low humidity conditions. Akoun (2004) emphasized the impact of animal fertilizers on onion production.

Combining mineral and organic fertilizers significantly increased crop yields, as demonstrated by Kuldkepp (1997), Ellmer et al. (2000), Saleh et al. (2000), and Sady et al. (2008). Blay et al. (2002) investigated the effects of poultry manure and inorganic fertilizers on onion production, noting increased product yield but reduced dry matter.

High yield and quality in onion production depend on nutrient content, soil fertility enhancement, pollution prevention, and the conscious use of organic materials (Syed et al., 2000). These findings collectively underscore the importance of proper fertilization practices for optimizing onion production.

The study aimed to achieve three objectives: (i) to investigate the effects of poultry manure doses on nutrient content in onion bulbs, (ii) to explore the impact of organic manure doses on nutrient content in onion leaves, and (iii) to assess the residual effect of poultry manure applications on sucrose, fructose, and glucose content in second crop onions.

2. Material and Methods

This research was performed to expose the effects of poultry manure on content of nutrient content of second crop onion grown after lettuce. This study was done in the research and application field of Ege University, Ödemiş Vocational School. Three onion varieties - Burgaz, Snow White, and Champion (*Allium cepa* L.) - were utilized in the study.

Control (0), 20, 40, 60 t ha^{-1} poultry manure applications were made to the plots for lettuce production in the previous production period. In addition, mineral fertilizer NPK (120:100:150 kg ha^{-1}), 15:15:15, K_2SO_4, and Ammonium Nitrate were applied to the lettuce plant. The lettuce was harvested on 04.04.2017, and then the planting of onion seedlings was conducted on the same trial plan.

Seeds were cultivated on January 23 to produce seedlings of onion varieties used in the experiment. Onion seedlings were planted in their places on April 05 and harvested on August 02. In the study, after harvesting lettuce and before planting onion seedlings, each plot's soil samples were taken for analysis. The planting distance was 30×15 cm in the experiment, and the distance between the parcel and the block was 1 m. The study was established with three replications according to the split-split plot design.

The composition of poultry manure was analyzed following the method outlined by Kacar (1995) and El-Sheref et al., (2023), and the results are presented in Table 1.

Table 1. Poultry manure's properties

pH	8.55	**C/N**	12.1
Total Salt (ms/cm)	2.47	**P (%)**	0.70
Ash 550^{o}C (%)	79	**K (%)**	1.02
Organic Matter (%)	19.8	**Ca (%)**	1.37
Organic Carbon (%)	11.51	**Mg (ppm)**	3729
Total N (%)	0.95	**Na (ppm)**	1248

Soil samples were taken from 0-20 cm depth in each plot (15 samples) at the beginning of onion vegetation. They were dried, grounded, and then passed through a 2 mm sieve to determine chemical properties. The soil analysis involved the determination of pH following the method outlined by Jackson (1967), total soluble salt content based on the procedure by Anonymous (1951), $CaCO_3$ content analyzed using the method by Kacar (1995), and organic matter content determined according to Reuterberg and Kremkurs (1951). Additionally, total nitrogen (N) was analyzed (Bremner, 1965), available potassium was determined by extracting with 1 N NH_4OAc using a flame photometer (Atalay et al., 1986), and available phosphorus was measured using a colorimeter, following the method by Olsen et al. (1954).

Leaf samples were taken as the youngest leaves for chemical analyses (Jones et al., 1991). Before the onion bulbs reached maturity. The leaf and bulb samples were dried at 70°C for analyses using the method by Kacar, 1972. In the study, manure, bulbs, and leaf samples underwent wet digestion (nitric acid (HNO_3): perchloric acid ($HClO_4$); 4:1) for P, K, Ca, Mg, Na, Fe, Cu, Zn, and Mn analyses. Phosphorus was quantified using the colorimetric method, while K, Ca, and Na were analyzed by flame photometer. Mg, Fe, Cu, Zn, and Mn were determined by AAS (Atomic Absorption Spectroscopy) following the methods outlined by Moore (1992) and Campbell and Plank (1992). Total nitrogen in plant samples was analyzed using the modified Kjeldahl method as described by Baker and Thompson (1992).

2.1. Sugar analysis methods

Extraction of samples and HPLC analysis conditions were done according to Camara et al. (1996). First, fruit samples (10 g per each) were taken. The samples were mixed with 50 ml of distilled water and homogenized by crushing in a homogenizer. Subsequently, the homogenized samples underwent centrifugation at 6000 rpm and were filtered through the Whatman No. 42 filter paper. The final volume was adjusted to be acetonitrile: filtrate (6:2, v/v). Samples were kept at −18°C. A Refractive index detector (RID) was used for sugar analysis. Conditions for HPLC analysis were adjusted as follows. The method was modified as needed.

The chromatographic analysis was conducted using a Supelco column (300mmx4.1mm ID) at room temperature (18-22°C). The mobile phase consisted of acetonitrile and distilled water (75:25), with a flow rate of 1.8 m/min. Detection was performed by a refractive index (RI) detector at 30°C, and the injection amount was 20 µL.

2.1.1. Evaluation of data or statistical analyses

The data were subjected to statistical analysis using the TARIST software package, as described by Açıkgöz et al. (1993).

3. Results and Discussion

3.1. The effect of poultry manure applications on physical and chemical properties of the soil

At the onset of onion vegetation, pH, organic matter, and lime contents of field soils at 0-20 cm depth were determined and are presented in Table 2. According to this, soil pH is 6.98-7.08; organic matter is between 0.66% to 0.89%, and lime is between 0.63% to 0.84%. Thus, field soils are neutral (6.6-7.3), humus ($p<0.01$), and $CaCO_3$ (0-2.5) poor (Table 2).

Table 2. The chemical properties of the soils at the onset of onion production

Treatments ha^{-1}	pH	Organic Matter (%)	$CaCO_3$ (%)
0	7.06	0.66	0.63
NPK	7.00	0.89	0.84
20 t	7.08	0.83	0.69
40 t	6.98	0.72	0.72
60 t	7.02	0.79	0.66
LSD	Ns	Ns	Ns

**: p < 0.01, *: p < 0.05, Ns: not significant.

Onion vegetation and field soils' element contents at 0-20 cm depth were determined and are given in Table 3. Total N: 0.056% - 0.110%, available P: 24.16%-35.50%, K: 97.4%-106.7%, Ca: 891%-1089%, Mg: 210%-224%, Na: 16.26 mg kg^{-1}-42.90 mg kg^{-1} was found. The micro elements are Fe: 3.49 mg kg^{-1}-3.75 mg kg^{-1}, Zn: 1.03 mg kg^{-1}-3.03 mg kg^{-1}, Mn: 3.68 mg kg^{-1}-4.15 mg kg^{-1}, Cu: 0.63 mg kg^{-1}-0.67 mg kg^{-1} (Table 3).

Table 3. Contents of macro and micro elements of experiment soils (initiation of production)

Treatments ha^{-1}	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Na (mg kg^{-1})
0	0.056 c	24.16 b	100.6	1056	224	16.26 d
NPK	0.090 b	34.56 a	98.0	1023	215	27.96 bc
20 t	0.076 b	27.59 b	97.4	986	210	23.90 cd
40 t	0.081 b	24.72 b	80.9	891	220	32.13 b
60 t	0.110 a	35.50 a	106.7	1089	218	42.90 a
LSD	0.018**	5.92**	Ns	Ns	Ns	8.15 **

Treatment ha^{-1}	Fe (mg kg^{-1})	Zn (mg kg^{-1})	Mn (mg kg^{-1})	Cu (mg kg^{-1})
0	3.38 b	1.06	3.68	0.64
NPK	3.75 a	1.19	4.03	0.63
20 t	3.49 ab	1.16	4.13	0.67
40 t	3.49 ab	3.03	4.04	0.65
60 t	3.75 a	1.09	4.15	0.63
LSD	0.368*	Ns	Ns	Ns

**: p < 0.01; *p < 0.05; ns: not significant.

The difference between applications in these nutrients was insignificant except for N, P, Na, and Fe. In control plots, N, P, Na, and Fe contents of the soils were determined as low values. At the application dose of 60 tons, the highest value was observed for poultry manure. 60 t treatment and mineral application gave statistically the same results for the Fe content of soils. Poultry manure had a positive impact on enhancing the nutritional status of the soil, generally up to organic matter mineralization. Similarly, Ceylan et al. (2020) stated that the application of poultry manure under greenhouse conditions significantly positive effect on soil nitrogen content. Mordoğan et al. (2013) found that organic manure applications on olive-growing soils at 0-20 depths N, K, Ca, Mg, Cu, and Na content. P, K, Ca, Mn, Cu, and Na contents were affected. Dikinya and Mufwanzala (2010) observed a significant increase in nitrogen and phosphorus with poultry manure.

When the fertility of the trial soils was evaluated, N was found to be moderate (0.05–0.1 %); P rich (greater than 3.26 ppm); K -<150 mg kg^{-1}- and Ca -715-1430 ppm- poor; Mg (>114 ppm) well; Fe (2.5-4.5 ppm) deficiency possible; Zn ->1 ppm-, Mn ->1 ppm-, Cu ->0.2 mg kg^{-1}- appears to be adequate (Bergmann, 1993).

3.2. The residual effect of applications on the nutrients of second crop onion leaves

The residual effects of manure applications on the leaf nutrient content of second crop onion are given in Table 4.

Table 4. The effect of poultry manure on onion’s leaf macro and microelement content.

Treatment	N	P	K	Ca	Mg	Na
ha^{-1}	(%)	(%)	(%)	(%)	(%)	(mg kg^{-1})
0	2.09 d	0.14 c	1.89 c	0.93 c	0.51 b	922.9 b
NPK	2.69 a	0.19 ab	2.48 ab	1.25 ab	0.63 a	948.8 b
20 t	2.29 c	0.18 b	2.19 b	1.11 b	0.59 ab	1071.2 ab
40 t	2.39 bc	0.19 ab	2.53 a	1.34 a	0.67 a	1155.0 a
60 t	2.47 b	0.22 a	2.64 a	1.29 a	0.61 a	1193.7 a
LSD	0.126**	0.028**	0.337**	0.124**	0.099**	199.4**

Treatment	Fe	Zn	Mn	Cu
ha^{-1}	(mg kg^{-1})	(mg kg^{-1})	(mg kg^{-1})	(mg kg^{-1})
0	86.36 b	16.78 b	23.20	5.58
NPK	102.36 a	19.07 a	24.51	5.99
20 t	97.72ab	19.92 a	20.99	7.02
40 t	100.51ab	19.75 a	25.06	6.22
60 t	93.57ab	19.89 a	20.40	6.10
LSD	14.89*	1.25**	Ns	Ns

**: $p < 0.01$, *: $p < 0.05$; Ns: not significant.

N content in leaf is between 2.09%-2.69%, P is between 0.14%-0.22%; K is between 1.89%-2.64%; Ca is between 0.93%-1.34%; Mg is between 0.51%-0.67% Na is between 922.9 mg kg^{-1}-1193.7 mg kg^{-1}; Fe is between 86.36 mg kg^{-1}-102.36 mg kg^{-1}; Zn is between 16.78 mg kg^{-1}-19.92 mg kg^{-1}; Mn is between 20.4 mg kg^{-1}-25.06 mg kg^{-1}; Cu is between 5.58 mg kg^{-1}-7.02 mg kg^{-1} (Table 4).

The difference among the applications in these nutrients was significant except for K, Na, Mn, and amounts. The quantities of nutrients analyzed include nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sodium (Na), iron (Fe), zinc (Zn), manganese (Mn), and copper (Cu) of the leaves were at the lowest level in the control plots, while the highest doses (40 and 60 t ha^{-1}) of application had the best value. However, Nitrogen and Mn contents of the leaves were statistically at the same level with the highest applications of poultry manure and NPK ($p < 0.01$).

When the sufficiency levels of the nutrient content of onion leaves are investigated, it is seen that P, Zn, Mn, and Cu values are at the deficiency level, although N, Ca, and Mg amounts are sufficient. K values in leaves were determined at a sufficient level only in plots where 40 and 60 t ha^{-1} poultry manure doses were applied (Bergmann, 1993).

In the research, it is noteworthy that the P, Zn, Mn, and Cu nutrient contents of onion leaves are insufficient, while the P content of the soils is high before planting. This may be due to converting available phosphorus in the soil into a fixed form that plants cannot take up during vegetation. On the subject, Kırmızı (1990) reported that the phosphorus fixation capacity in alluvial soils of the Aegean region was between 36-89%. It is thought that the important positive correlation that the researchers determined between soil organic matter and exchangeable Mg X phosphorus fixation explains this situation (Kırmızı, 1990; Ceylan et al., 2003).

The soil Ca content is poor, but it is seen that the Ca amount in the leaves is sufficient (Table 3, 4). The outcome could be associated with the gradual release of organic manure and its impact on subsequent yields. Although P, Zn, Mn, and Cu sufficient in the soil, these elements are found in insufficient amounts in the leaves. This situation can be explained by the antagonistic effects between P and Zn, P and Mn, and P and Cu (Kılınç et al., 1991). Thus, Lee and Lee (2014) stated that the excess nutrient content in the soil does not benefit plants or may even depress the uptake of nutrients and crop growth and yield.

The study showed that the nutrient content of the leaf varies significantly according to onion varieties except for Fe, Mn, and Cu amounts (Table 5).

Table 5 shows that the contents of N, P, and Zn of the Burgaz variety are significantly higher than other varieties. In addition, Burgaz and Snow White varieties had significantly higher K content than Champion varieties; Snow White and Champion varieties had significantly higher level Ca than Burgaz varieties; the Mg content of the Champion variety was higher than others.

The differences weren't significant between the Champion and Snow White in terms of Mg content; in terms of Fe, Mn, and Cu content. There were no significant differences between the varieties based on the applications, as indicated in Table 5.

Table 5. Effect of varieties on the onion leaves macro-micro element content

Varieties	N (%)	P (%)	K (%)	Ca (%)	Mg (%)
Burgaz	2.56 a	0.20 a	2.45a	1.08b	0.55 b
Snow White	2.48 b	0.19 ab	2.40a	1.19a	0.61 ab
Champion	2.12 c	0.17b	2.19b	1.29a	0.65 a
LSD	0.049**	0.026**	0.185**	0.118**	0.096**

Varieties	Fe ($mg\ kg^{-1}$)	Zn ($mg\ kg^{-1}$)	Mn ($mg\ kg^{-1}$)	Cu ($mg\ kg^{-1}$)
Burgaz	92.37	20.37 a	21.50	6.48
Snow White	94.55	18.68 b	23.74	6.01
Champion	101.39	18.21 b	23.25	6.06
LSD	Ns	1.227**	Ns	Ns

**: $p < 0.01$,*: $p < 0.05$, Ns: not significant.

3.3. The residual effect of applications on the nutrients of second crop onion bulbs

Macro and micronutrient contents of onion bulbs are given in Table 6. According to Table 6, N is 2.10% to 2.93%, P is between 0.16% to 0.23%; K is between 1.37% to 1.73%; Ca is between 0.10% to 0.15%; Mg is between 0.156% to 0.183%; Na is between 283.9 mg kg^{-1} to 477.7 mg kg^{-1}; Fe is between 26.97 mg kg^{-1} to 43.19 mg kg^{-1}; Zn is between 20.19 mg kg^{-1} to 25.65 mg kg^{-1}; Mn is between 12.37- mg kg^{-1} to 14.89 mg kg^{-1}; Cu is between 4.64 mg kg^{-1} to 5.96 mg kg^{-1}. The order of nutrient elements, determined by their measured quantities in the analyzed onion bulbs, was N > K > P > Mg > Ca > Na > Fe > Zn > Mn > Zn.

Difference among applications, these nutrients were significant except for Mg and Cu. The contents of N, P, K, Ca, Na, Zn, and Mn in the bulbs were lowest in the control plots given in Table 6. Conversely, K, Ca, Na, and Fe's highest contents in bulbs were confident by the residual effect of 40 t ha^{-1}.

Yoldas et al. (2011) found that similar result in the first year. The potassium content in bulbs exhibited a significant increase with the application of cattle manure. Nevertheless, manure applications did not significantly affect N, P, Ca, Mg, Fe, Zn, Cu, Mn, and Na contents in bulbs. Coolong et al. (2004) explained that N and P content in bulbs was increased by the application of N. Although Mn, Fe, and Zn contents increased, K, Cu, and Mn contents were not affected. Abdelrazzag (2002) revealed a noteworthy correlation: elevating the rate of sheep and poultry manure led to a significant increase in the nitrogen content of onions, whereas phosphorus and potassium levels remained relatively low. Mahmoud et al. (2013) noted a significant improvement in the chemical components, including nitrogen (N), phosphorus (P), potassium (K), and total protein, as compost application levels increased. This enhancement was particularly notable, reaching significance at levels up to 180 kg N ha^{-1} in sandy soil. These findings suggest that the influence of soil organic matter could contribute to various functional soil properties, encompassing physical, chemical, and biological aspects, and play a pivotal role in nutrient cycling, as highlighted by Murphy (2014).

Table 6. Effect of poultry manure on bulbs macro-micro element content

Treatments	**N**	**P**	**K**	**Ca**	**Mg**	**Na**
ha^{-1}	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**	**(mg kg^{-1})**
0	2.10 e	0.16 b	1.37 c	0.10c	0.156	283.9 d
NPK	2.93 a	0.23 a	1.59 ab	0.12b	0.183	448.4 ab
20 t	2.32 d	0.20 a	1.49 bc	0.1bc	0.182	402.9 bc
40 t	2.54 c	0.22 a	1.73 a	0.14a	0.178	477.7 a
60 t	2.68 b	0.21 a	1.52 bc	0.15a	0.178	390.8 c
LSD	0.128**	0.033**	0.174**	0.014**	Ns	57.038**

Treatments	**Fe**	**Zn**	**Mn**	**Cu**
ha^{-1}	**(mg kg^{-1})**	**(mg kg^{-1})**	**(mg kg^{-1})**	**(mg kg^{-1})**
0	32.29 c	20.19 b	12.37 b	5.25
NPK	41.94 ab	25.65 a	14.89 a	5.78
20 t	26.97 abc	22.49 ab	13.71 ab	5.42
40 t	43.19 a	23.99 ab	13.56 ab	5.96
60 t	36.11 bc	21.86 ab	13.33 ab	4.64
LSD	6.823**	5.024*	1.863*	Ns

**: $p < 0.01$; *: $p < 0.05$; Ns: not significant.

Onion varieties cultivated in the same environment, sharing similar soil and climatic conditions, display notable differences in the mineral composition of their bulbs. This variance is attributed to genotypic factors, as emphasized by Chope and Terry (2009).

Upon investigating the impact of varieties on the nutrient content of onion bulbs, it was evident that the Champion variety exhibited significantly higher levels of nitrogen (N), calcium (Ca), iron (Fe), and copper (Cu) compared to other varieties ($p < 0.01$) (Table 7). Furthermore, Champion and Snow white bulbs demonstrated elevated phosphorus (P), potassium (K), and sodium (Na) content.

Table 7. Effect of variety on the nutrient content of bulb

Varieties	**N**	**P**	**K**	**Ca**	**Mg**	**Na**
	(%)	**(%)**	**(%)**	**(%)**	**(%)**	**(mg kg^{-1})**
Burgaz	2.37 c	0.17 b	1.34 b	0.12 b	0. 171	325.2 a
Snow White	2.47 b	0.22 a	1.61 a	0.12 b	0.175	501.2 b
Champion	2.71 a	0.23 a	1.67 a	0.13 a	0.179	375.9 b
LSD	0.065**	0.029**	0.099**	0.008**	Ns	69.055**

Varieties	**Fe**	**Zn**	**Mn**	**Cu**
	(mg kg^{-1})	**(mg kg^{-1})**	**(mg kg^{-1})**	**(mg kg^{-1})**
Burgaz	26.94 c	21.19 b	11.61 b	4.78 b
Snow White	39.19 b	22.69 ab	16.83 a	4.73 b
Champion	48.18 a	24.61 a	12.28 b	6.73 a
LSD	3.721**	2.09**	0.845**	0.825**

**: $p < 0.01$, *: $p < 0.05$, Ns: not significant.

Furthermore, there were no significant differences between the varieties depending on the applications in terms of Mg content.

3.4. The residual impact of applications on the sucrose, fructose, and glucose content of second crop onions.

The residual effects of poultry manure applications on the sucrose, fructose, and glucose content in bulbs as the second crop are presented (Table 8).

Table 8. Effect of poultry manure on sucrose, fructose, and glucose contents in bulbs

Treatment ha^{-1}	**Sucrose (g 100 ml^{-1})**	**Fructose (g 100 ml^{-1})**	**Glucose (g 100 ml^{-1})**
0	3.33 a	17.71 a	22.13 a
NPK	2.29 b	12.09 b	11.70 c
20 t	2.56 b	16.89 a	19.68 a
40 t	2.69 ab	12.16 b	13.93 bc
60 t	2.12 b	13.03 b	15.55 b
LSD	0.715**	1.752**	2.670**

**: p < 0.01, *: p < 0.05, Ns: not significant.

3.4.1. Sucrose

Bulbs sucrose contents changed significantly depending on the applications (p<0.01). The highest sucrose content in the control plots, with no application, was 3.33 g 100 ml^{-1} (Table 8). Sucrose content in the bulbs decreased with applications. Also, Dehkordi et al. (2019), reported that treatment of sheep manure had the lowest sucrose amount in sugar beet compared to the control. Nitrogen causes sugar percentage reduction, influencing sucrose percentage. Therefore, the negative impact of manure on sucrose is due to its increasing impact on N content.

3.4.2. Fructose

Residual effects of poultry and mineral fertilizer applications significantly affected the fructose content of second crop onion bulbs grown after lettuce (p<0.01) (Table 8). Fructose values were determined in onion bulbs from the control plots (17.71 g 100 ml^{-1}) and 20 t ha^{-1} poultry manure applications as highest (16.89 g 100 ml^{-1}).

3.4.3. Glucose

The glucose contents of onion bulb samples changed significantly depending on the applications (p<0.01). Similar to fructose contents, the highest glucose content was analyzed in the control plots, where no treatment was performed (Table 8). This was followed by onion bulb samples taken from the parcels with a 20 t ha^{-1} poultry manure residual effect. The lowest glucose values were determined in the parcels where the residual effect of mineral fertilizer was applied. Likewise, high nitrogen (N) application resulted in a reduction of glucose and fructose in cabbage leaves, as reported by Yano et al. (1981). Conversely, a decrease in nitrogen application led to an increase in sugar content, as observed in the study by Takebe et al. (1995). This situation can be considered the amount of nitrogen applied to the plant to increase the vegetative part and product and the dilution of glucose, sucrose, and fructose amounts.

When the effect of varieties on sucrose, fructose, and glucose content of onion bulbs was investigated, it was determined that the highest sucrose content was in Burgaz (3.53 g 100 ml^{-1}). Conversely, the highest fructose (18.95 g 100 ml^{-1}) and glucose (20.35 g 100 ml^{-1}) content were in the Snow White variety (Table 9).

Table 9. Variety effect on sucrose, fructose, and glucose content of onion bulbs as the second crop

Variety	**Sucrose** (g 100 ml^{-1})	**Fructose** (g 100 ml^{-1})	**Glucose** (g 100 ml^{-1})
Burgaz	3.53 a	14.61 b	18.30 b
Snow White	2.37 b	18.95 a	20.35 a
Champion	1.89 b	9.57 c	10.55 c
LSD	0.472**	0.774**	1.373**

**: p < 0.01; *: p < 0.05; Ns: not significant.

Conclusion

As a result, poultry manures' residual effect and varieties on nutrient content in leaves, bulbs, sucrose, fructose, and glucose levels in the bulb of second crop onion grown after the lettuce were significantly affected.

In general, the highest nutrient contents in both leaves and bulbs were observed with the residual effect of 40 tha^{-1} poultry manure applications. Notably, the Burgaz onion variety exhibited a more pronounced response to organic manure in leaves, while The Champion variety exhibited elevated nutrient values in its bulbs.

Organic fertilizers, renowned for their slow-release attributes, influence soil fertility over successive years and crops. Our study emphasizes the importance of embracing an environmentally conscious approach, considering the observed long-term effects of organic fertilizers.

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