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Full Length Research Paper

Effect of organic and inorganic fertilizers on yield and mineral content of onion (*Allium cepa* L.)

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This experiment was conducted to find the influence of both organic and mineral fertilizer on the quality and yield of onion (*Allium cepa* L.) and also on the macro and micro element contents of onion bulb. Cattle manure was applied at 0, 20, 40 and 60 t/ha. Nitrogen:phosphorus:potassium was applied at the recommended dose of 120:100:150 with half of the recommended rate of NPK. Yield, yield components and macro-micro element contents were measured. In the first year, bulb width and number of storage leaf were influenced significantly by the treatments. In the second year, applications affected onion yield significantly but bulb number, fleshy thickness, bulb weight, bulb height, number of storage leaf, number of shoot tip and number of dried leaves were not influenced statistically. In the first year, treatments influenced K content, but did not influence N, P, Ca, Na, Mg, Fe, Zn, Cu and Mn contents of the onion bulb. In the second year, the treatments influenced Na content, but did not influence the others.

Key words: Onion, organic fertilizer, mineral fertilizer, yield, macro elements, micro elements.

INTRODUCTION

In Turkey, due to over population, the high rates of using chemicals disrupt the natural balance of the environment and human health. In this sense, natural resources, such as water, soil conservation and productivity by natural sustainability are important. In this regard, organic fertilezers are considered important.

Organic material such as farmyard manure improves soil physical chemical properties that are important for plant growth (Synman et al., 1998). Organic fertilizers has positive effect on root growth by improving the root rizosfer conditions (structure, humidity, etc.) and also plant growth is encouraged by increasing the population of microorganisms (Shaheen et al., 2007). Organic fertilezers contain plant nutrients. Organic acids which occur in decomposition increases the benefits of nutrients (Anonymous, 2010).

In several studies, the effects of fertilization on yield and quality of onion were investigated. Kumar et al. (2001) found that application of 120 kg N/ha increased onion yield to 30%. Rumpel (1998) researched the effect of 20, 40, 60 t/ha animal manure doses, NPK (75: 50: 100 kg / ha) inorganic fertilizer and combination of these. Researchers have found that addition of animal manure resulted in higher onion yield compared to NPK fertilizer. 0, 50 and 150% of the recommended amounts of NPK fertilizers (125:33:50 kg/ha) with 0. 10, 20 t/ha manure combination increased onion yield and nutrient uptake (Sharma et al., 2003).

Mixture of chicken manure and biofertilizer increases the yield of onion and enriched nutrient content in tuber was reported by Shaheen et al. (2007).

Onions are produced in our country as widely as possible. According to the data of Turkey Statistics Institute (tuik), the production of fresh onion was 168223 tons, and 2007118 tons for dried onion (Anonymous, 2009).

The main objective of this investigation was to study the effect of different levels of organic fertilizers on the yield, quality and macro-micro element content of onion

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Abbreviations: NPK, Nitrogen : phosphorus : potassium; **N,** nitrogen; **P,** phosphorus; **K,** potassium; **Ca,** calcium; **Na,** sodium; **Mg,** magnesium; **Fe,** iron; **Zn,** zink; **Cu,** copper; **Mn,** manganese; **O.M.,** organic matter; **AAS,** atomic absorption spectrometers.

Table 1. Physical and chemical properties of soil in the experimental field.

Property	1st Year		2nd Year	
	(0-30 cm)	(30-60 cm)	(0-30 cm)	(30-60 cm)
pH	7.15	6.86	7.29	8.07
Salt (%)	0.03	0.03	0.03	0.03
O.M. (%)	0.57	0.77	0.46	0.05
$CaCO_3$ (%)	0.56	0.64	0.63	0.63
Sand (%)	84.92	76.92	81.12	83.12
Lime (%)	2.72	2.72	4.88	4.88
Silt (%)	12.36	20.36	14.00	12.00
Structure	Loamy-sand	Loamy-sand	Loamy-sand	Loamy-sand
Total N (%)	0.12	0.13	0.05	0.028
Available P (ppm)	0.22	0.25	18.4	19.3
Available K (ppm)	71	70	70	35
Available Ca (ppm)	1500	1486	691	543
Available Mg (ppm)	485	480	132	72
Available Fe (ppm)	4.92	4.80	17.36	14.12
Available Mn (ppm)	2.81	2.15	5.26	30.60
Available Zn (ppm)	3.22	2.85	2.13	0.51
Available Cu (ppm)	0.49	0.52	1.70	0.87
Available Na (ppm)	9	9	16	16

(*Allium cepa* L.) plants. In addition, the results are compared with mineral fertilizer applications.

MATERIALS AND METHODS

The research was conducted at the experimental field of Ege University, Odemis Technical Training College (38° 16'N, 27° 59'W). Valencia variety was used. The experiment was arranged in randomized block design with three replications. In the experiment, the cattle manure of 0, 20, 40, 60 t/ha, and also recommended dose of NPK (120:100:150 kg / ha) and half dose (60:50:75 kg/ha) were used (Vural et al., 2000). Six different treatments with control and three replications were conducted in 18 plots. The plot area was $3m^2$ and consisted of ten rows, 0.3 m apart, with 0.02 m spacing in rows. Nitrogen fertilizer was applied in ammonium nitrate form (33 %); 1/3 at planting, 1/3 for full leaf expansion and 1/3 at the beginning of the bulb, making three divisions. Phosphorus and potassium were applied at the planting in the forms of triple super phosphate and potassium sulphate.

The research was conducted over two years; seeds were sown in March 2nd in the first year and March 21st for the second year. Seedlings were planted in April 29th and May 18th, in the first and second years, respectively. In every two year, the harvest was carried out in the first week of November. The soil characteristics of the field are given in Table 1. The soil is in neutral reaction except in the second year where it is 0 to 30 cm in depth (alkaline medium).

There is no problem of total salt. The texture is loamy-sand. Lime and organic matter was poor. In the first year, total N content was good, but poor in the second year. Available K content of soil was low. Available P content was poor in the first year, but rich in the second year. In the first year, calcium content was medium, but in the second year, it was poor. The content of Mg in 0 to 30 cm depth was good. Fe, Cu, Mn and Zn were found to be sufficient. However, in the 2nd year, the experiment soil at a depth of 30-60 cm was the critical level for Zn (Günes et al., 2000). The cattle manure characteristics are given in Table 2. In this study, during the growth period, weeds were removed by hand hoeing and irrigation was done on a regular basis. At the end of the experiment, yield components (average bulb width, bulb height, and flesh thickness, number of storage leaf, number of shoot tip, and number of dried leaf) were determined.

For chemical analysis of the bulb, samples were taken from plots after they were dried in 70°C, ready for analysis (Kacar, 1972). Onion samples were chosen from each parcel. In the study, total nitrogen was analyzed according to the modified method of Kjeldahl (Bremner, 1965). After wet digestion of samples, the phosphorus content was determined by colorimetric method (Lott et al., 1956). Potassium, calcium and sodium contents were analyzed by flamefotometer; magnesium was measured by the AAS (Kacar, 1972). Fe, Zn, Mn and Cu amount was determined by AAS (Munoz, 1968).

Trial statistical evaluation result of data was done using software package TARIST (Açikgöz et al., 1993).

RESULTS AND DISCUSSION

Data about effects of organic and mineral fertilization on onion yield and some quality criteria in the 1st and 2nd years are given in Tables 3 and 4. In the first year, onion yields were found to be between 31.65 to 41.50 t/ha; number of bulb to be 26.7 to 33.0; bulb width to be 5.49 to 7.9 cm; bulb height to be 6.31 to 8.66 cm; number of storage leaf to be 7.80 to 11.27; fleshy thickness to be 0.17 to 0.26 cm; the number of shoot tips to be 1.27 to 2.07 and the number of dried leaf to be 2.00 to 2.40 (Table 3). According to statistical analysis, bulb width and the number of storage leaves were affected by applications.

Bulb width and the number of storage leaves were at

Table 2. Some properties of manure (1st and 2nd year).

Property	1st Year	2nd Year
Total N (%)	1.36	1.6
Available P (%)	0.32	0.92
Available K (%)	1.11	1.21
Available Ca (%)	0.38	0.60
Available Mg (%)	0.60	0.58
Available Fe (%)	1.35	0.06
Available Mn (ppm)	213.2	101
Available Zn (ppm)	92.1	46
Available Cu (ppm)	25.0	12

Table 3. Effects of organic and mineral fertilization on yield and some quality criteria (1st year).

Treatment	Yield (t/ha)	Number of bulb (no/m^2)	Bulb width (cm)	Bulb height (cm)	Fleshy thickness (cm)	Number of storage Leaf (no)	Number of shoot tip (no)	Number of dried leaf (no)
0	31.65	26.7	5.49^{b}	6.31	0.18	8.13^{b}	1.27	2.40
20 t / ha	34.65	33.0	6.13^{b}	7.43	0.26	8.33^{b}	1.47	2.40
40 t / ha	35.40	32.5	7.42^{a}	7.21	0.22	8.73^{b}	1.40	2.20
60 t / ha	36.70	28.5	7.89^{a}	8.66	0.20	11.27^{a}	2.07	2.00
NPK	39.20	31.7	7.45^{a}	8.03	0.19	10.20^{a}	1.73	2.33
NPK/2	41.50	31.3	6.65^{ab}	7.37	0.17	7.80^{b}	1.40	2.20
LSD	ns	ns	1.281*	ns	Ns	1.162**	ns	ns

a, b, c and d; Average which is shown with different letters in the same column are significantly different; * significantly different at the $P < 0.05$ level; ** significantly different at the $P < 0.01$ level; ns, no significant difference.

the maxmium at 60 t/ha application of organic fertilizer. However, for bulb width, 40 t/ha and 60 t/ha of organic fertilizer application, NPK and NPK/2 mineral fertilizers applications were in the same statistical group. In the number of storage leaves between 60 t/ha organic fertilizer and the NPK application, statistically significant difference was not found. The highest yield was obtained with the application of mineral NPK/2 but this was not significant. This application increased yield by 24% compared to the control plots. Similar result was found also by Rather et al. (2003), Sharma et al. (2003), Kumar et al. (2001), Dixit (1997) and Mallanagouda et al. (1995) but Akoun (2005), Agudelo and Casierra (2004), Blay et al. (2002), Rumpel (1998), Singh et al. (1997), Singh at al. (1997) and Vural et al. (1987) reported the opposite of the others. They found the best result from organic manure. The number of bulb, bulb height, fleshy thickness, the number of shoot tip and number of dried leaf were not affected statistically by fertilization in the first year (Table 3).

In the second year, it was found that yields were changed from 15.38 to 27;80 t/ha; number of bulb, from 48.98 to 68.62 no/m^2; bulb width, from 3.81 to 5.38 cm; bulb height, from 5.43 to 6.69 cm; fleshy leaves thickness, from 0.17 to 0:28 cm; number of storage leaves, from 6.87 to 7.82; the number of shoot tips, from 1.07 to 1.47 and number of dried leaf from 1.80 to 2.53 (Table 4). The applications affected yield. The highest yield was obtained with the application of organic fertilizers at a dose of 20 t/ha. This application increased yield by 24% compared to the control plots; but there was no important difference between the 20 t/ha of organic fertilizer application and the control, statistically (Table 4).

Organic manures activate many species of living organisms which release phytohormones and may stimulate the plant growth and absorption of nutrients (Arisha et al., 2003) and such organisms need nitrogen for multiplication (Ouda and Mahadeen, 2008). Similar result was also reported by Rumpel (1998) and Sharma et al. (2003). They found that animal manure applications increased onion yield. Vural et al. (1987) also reported that it was a converse relationship between delay in sowing time and bulb sizes. In addition, they noticed that the size of bulb reduced because of delay of sowing and planting to February. However, the use of organic fertilizer increases the height of the bulb, as reported by Jayathilake et al. (2003) and Akoun (2005). Organic and mineral fertilizer applications did not affect number of bulb, bulb width, bulb height, fleshy thickness, number of storage leaf, number of shoot tip, and number of dried

Table 4. Effect of organic and mineral fertilization on yield and some quality criteria (2nd).

Treatment	Yield (t/ha)	Number of bulb (no/m^2)	Bulb width (cm)	Bulb height (cm)	Fleshy thickness (cm)	Number of storage leaf (no)	Number of shoot tip (no)	Number of dried leaf (no)
0	25.98^{ab}	55.352	3.81	5.59	0.18	6.87	1.13	2.00
20 t / ha	27.80^{a}	67.045	5.38	6.69	0.28	7.43	1.47	1.80
40 t / ha	15.38^{c}	68.623	3.94	5.43	0.21	7.07	1.07	1.93
60 t / ha	19.77^{bc}	55.544	4.30	6.07	0.19	6.87	1.20	1.87
NPK	18.97^{c}	53.644	4.40	5.50	0.20	7.73	1.47	2.53
NPK/2	17.78^{c}	48.982	4.34	5.96	0.17	7.82	1.27	2.07
LSD	6.417**	Ns	ns	ns	Ns	ns	ns	ns

a, b, c and d; Average which is shown with different letters in the same column are significantly different; * significantly different at the P < 0.05 level; ** significantly different at the P < 0.01 level; ns, no significant difference.

Table 5. Effects of organic and mineral fertilization on the contents of the macro and micro elements in onion (1st year).

Treatment	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Fe (ppm)	Cu (ppm)	Zn (ppm)	Mn (ppm)	Na (%)
0	4.93	0.44	3.41^{c}	1.82	0.47	185.0	9.70	14.53	45.23	0.27
20 t / ha	5.10	0.44	3.91^{ab}	1.93	0.53	184.0	11.50	12.70	44.23	0.33
40 t / ha	5.40	0.45	3.92^{ab}	1.70	0.49	173.3	10.60	14.93	39.90	0.32
60 t / ha	4.93	0.48	4.09^{a}	1.93	0.51	172.3	10.97	16.40	42.53	0.38
NPK	4.97	0.48	3.78^{ab}	2.07	0.57	182.0	10.67	16.00	44.50	0.29
NPK/2	5.13	0.48	3.60^{bc}	1.99	0.59	175.7	10.83	17.17	54.40	0.24
$LSD_{(\%5)}$	ns	ns	0.35*	ns	Ns	Ns	ns	ns	ns	Ns

a, b, c and d; Average which is shown with different letters in the same column are significantly different; * significantly different at the P < 0.05 level; ** significantly different at the P < 0.01 level; ns, no significant difference.

leaf significantly in the second year.

The results of the macro and microelements for the first year (N: 4.93 to 5.40%; P: 0.44 to 0.48%; K: 3.41 to 4.09; Ca: 1.70 to 2.07; Mg: 0.47 to 0.59%; Fe: 172.33 to 185.00 ppm; Cu: 9.70 to 11.50 ppm; Zn: 2.70 to 17.7; Mn: 39.90 to 54.40 ppm and Na: 0.24 to 0.38%) in onion bulb are given in Table 5.

Applications affected K content of bulb significantly. Minimum K value of onion bulbs were analyzed at the control plots (3.41 %). The rise of K content in bulb depends on increasing cattle manure doses and it was maximum at 60 t/ha dose (4.09%). But 20 and 40 t/ha doses of organic manure and mineral NPK application were in the same statistical group. In the first year, N, P, Ca, Mg, Fe, Zn, Cu, Mn and Na amounts of onions were not significantly affected by manure applications. Coolong et al. (2004) reported that N, P, Mn, Fe and Zn content of bulb were increased by N treatments but the content of N was decreased by N doses. K, Cu and Mo contents were not affected by the treatments.

In the 2nd year, macro and microelements content of bulb were also determined (Table 6). Effects of the applications were significant in Na content of the bulb. The highest Na content was determined at the 40 t/ha doses of cattle manure as 0.13%. But 20 t/ha and 40 t/ha cattle manure applications were in the same statistical group. Fertilizer application did not have significant effect on N, P, K, Ca, Mg, Fe, Zn, Cu and Mn amount of onion bulbs. Then, it was considered that the decrease in the elements content of bulbs by applying manure would be due to the element which causes enlargement of bulb, and increasing yield consequently reduces the unit amount of these elements (dilution effect).

Coolong et al. (2004) stated that in onion bulbs N and P content was increased by N application. Mn, Fe and Zn contents have the tendency to increase; K, Cu and Mo contents were not affected. Abdelrazzag (2002) found that increasing the rate of the sheep and chicken manure increased N content of onion significantly, while P and K contents had low level.

As a conclusion, it was found that organic manure increased onion yield and 20 t/ha application could be

Table 6. Effects of organic and mineral fertilization on the contents of the macro and micro elements in onion (2nd year).

Treatment	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Fe (ppm)	Cu (ppm)	Zn (ppm)	Mn (ppm)	Na (%)
0	4.28	0.34	3.90	1.71	0.297	88.00	1.30	32.67	11.97	0.077^{c}
20 t / ha	4.09	0.34	3.54	1.79	0.273	74.33	1.73	28.67	11.3	0.117^{ab}
40 t / ha	4.63	0.34	3.98	1.62	0.257	66.00	1.37	31.33	11.3	0.130^{a}
60 t / ha	4.43	0.36	3.96	1.49	0.287	62.00	1.37	22.33	9.63	0.097^{bc}
NPK	4.60	0.37	3.89	2.02	0.307	73.33	1.37	28.67	10.73	0.100^{bc}
NPK/2	4.23	0.34	3.82	1.74	0.343	66.67	1.47	30.00	12.63	0.077^{c}
$LSD_{(\%5)}$	ns	ns	ns	ns	ns	ns	Ns	Ns	ns	0.028**

a, b, c and d; Average which is shown with different letters in the same column are significantly different; * significantly different at the $P < 0.05$ level; ** significantly different at the $P < 0.01$ level; ns, no significant difference.

suggested for onion cultivation.

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REFERENCES

Abdelrazzag A (2002). Effect of Chicken Manure, Sheep Manure and Inorganic Fertilizer on Yield and Nutrients Uptake by Onion. Pakistan J Biol Sci. 5(3):266-268.

Açıkgöz N, Akkaş ME, Maghaddam A, Özcan K (1993). Database Dependent. Congress of International Practice of Computer, p: 133.

Agudelo Becerra MY, Casierra-Posada F (2004). Effect of Mycorrhizae and Manure Fertilization and Yield and Quality of Onion. Revista-Facultad Nacional de Agronomia Medellin. 57:1; 2189-2202.

Akoun J (2005). Effect plant density and manure on the yield and yield components the common onion (*Allium cepa* L.) var. Nsukka red. Hort Sci. 9: 43-48.

Anonymous (2009). http://www.tuik.gov.tr.

Anonymous (2010). http://www. slidefinder. net/t/life_ your_soil/ introduction soil _microbiology/1116901. Environmental soils. cas. psu. edu.

Arisha HME, Gad AA, Younes SE (2003). Response of some pepper cultivars to organic and mineral nitrogen fertilizer under sandy soil conditions. Zagazig J. Agr. Res., 30: 1875-1899.

Blay ET, Danquahe Y, Ofosu-Anim J, Ntumy JK (2002). Effect of Poultry Manure and/or Inorganic Fertilizer on the Yield of Shallot (Allium cepa var. aggregatum). Adv. in Hort. Sci. 1: 13-16

Bremner JM (1965). Total Nitrogen. Ed. (Black, C.A). American Society of Agronomy. 1149-1178.

Coolong W, Kopsell T, Kopsell DA, Randle DAWM (2004). Nitrogen and sulfur influence nutrient usage and accumulation in onion (*Allium cepa* L.). J. of Plant Nutr. 27(9): 1667-1686.

Dixit SP (1997). Response of onion (*Allium cepa* L.) to nitrogen and farmyard manure in dry temperate high hills of Himachal Pradesh. Indian J. Agric. Sci. 67(5): 222-223.

Günes A, Alpaslan M, İnal A (2000). Plant nutrition and fertilization. Ankara Univ. Fac. Agric, Pub. No: 1514. s.199.

Jayathilake PKS, Reddy IP, Srihary D, Reddy KR, Neeraja G (2003). Integrated nutrient management in onion (*Allium cepa* L.). Tropical Agric. Res., 15: 19.

Kacar B (1972). Chemical Analysis of Plant and Soil II. Plant Analysis. Ankara University, fac. Agric. No:453, Ankara.

Kumar A, Singh R, Chhillar RK (2001). Influence of nitrogen and potassium application on growth, yield and nutrient uptake by onion (*Allium cepa* L.). Indian J. Agron., 46 (4): 742-746.

Lott WL, Nery JP, Gall JR, Medcoff JC (1956). Leaf Analysis Techniques in Coffee Research. IBEC Res. Inst. Pub. No: 9.

Mallanagouda B, Sulikeri GS, Hulamani NC, Murthy BG, Madalgeri BB (1995). Effect of NPK and FYM on growth parameters of onion, garlic and coriander. Univ. Agric. Sci. (Bangalore) 24 (11): 212-213.

Munoz J (1968). Atomic Absorption Spectroscopy and Analysis by Atomic Absorption Flame Photometry. Elsevier Pub. Company Amsterdam, London, New York.

Ouda BA, Mahadeen AY (2008). Effect of fertilizers on growth, yield, yield components, quality and certain nutrient contents in broccoli (*Brassica oleracea*). Int. J. Agr. Biol., 10 (6): 627-632.

Rather SA, Ahmed N, Chattoo MA (2003). Response of Onion to Microbial Inoculation and Chemical Nitrogen. Haryana J. Hort. Sci. 32:3/4. 270-271.

Rumpel J (1998). Effect of long-term organic, mineral, and combined organic-mineral fertilization on yield of onions (*Allium cepa* L.) grown from seeds. Biuletyn Warzywniczy, 48 : 5-15.

Shaheen A, Fatma M, Rizk A, Singer SM (2007). Growing Onion Plants without Chemical Fertilization. Res. J. Agr. Biol. Sci., 3(2): 95-104.

Sharma RP, Datt N, Sharma PK (2003). Combined Application of Nitrogen, Phosphorus, Potassium and Farmyard Manure in Onion Under High Hills, Dry Temperate Conditions Of North-Western Himalayas. Indian J. Agr. Sci., 73:4: 225-227.

Singh L, Bhonde SR, Mishra VK (1997). Effect of different organic manures and inorganic fertilizers on yield and quality of rabi onion. News Let. – Natl. Hort. Res. Dev. Foundation 17 (3): 1-3 1997.

Snyman HG, Jong DE, Aveling TAS (1998). The stabilization of sewage sludge applied to agricultural land and the effects on maize seedlings. Water Sci.Technol. 38 (2): 87-95.

Vural H, Eser B, Özzambak E, Eşiyok D, Tüzel Y, Yoltaş T (1987). A Study on Determining Degrees of Conformity of Planting the seed to be produced directly with Native Onion Varieties. Ege. Res. Fund, Res. Report, no: 051.

Vural H, Esiyok D, Duman I (2000). Vegetable Growing. Depart. Hort., Fac. Agric., Ege Univ. Bornova, Izmir, Turkey. 440 pages.

Ware GW, McCollum JP (1980). Producing Vegetables Crops, Interstate Press, Danville, IL, USA.