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Impact of sheep manure, urea and triple superphosphate on onions morphological properties

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ABSTRACT: Onion (Allium cepa L.) is a vegetable that is widely consumed due to its flaouring and health-promoting properties. A randomized complete block factorial experiment was carried out in Payame Noor University, Marivan center, in order to study the effects of rates of nitrogen, phosphorus and sheep manure on the yield and quality of onion. The first factor consisted of two sheep manure levels (0 and 5 ton/ha), the second factor consisted of three triple superphosphate levels (0, 100 and 150 kg/ha) and the third factor consisted of three urea levels (0, 150 and 300 kg/ha). The results indicated that the morphological properties significantly improved in sheep manure treatment. Phosphorus treatment significantly improved the morphological properties of onion. Urea treatments increased the fresh and dry weight, volume and bulb diameter of onion. The highest nitrate concentrations resulting from urea rate of 300 kg/ha.

***Keywords*:** Morphological Properties, Nitrogen, Onion, Phosphorus, Sheep Manure

INTRODUCTION

Onion (Allium cepa L.) is a vegetable that is widely consumed due to its flavouring and health promoting properties**.** It has been reported that onion extract can be a potent cardiovascular and anticancer agent with hypocholesterolemic**,** thrombolitic and antioxidant effects (Block, 1985). Several antioxidant compounds, mainly polyphenols such as flavonoids and sulphur-containing compounds have been described in onion (Nuutila , 2003). Proper fertility is important in onion production. Onions require fertile, well drained, non crusting soils, and are often produced in muck soils. A slightly acid pH in the 6-6.8 range is optimum. Onions require substantial amounts of nutrients**.** Based on a yield of 36 ton of bulbs, the plants remove about 124, 22.5 and 135.5 kg, respectively, of nitrogen, phosphorus**,** and potassium per hectare (Peirce, 1987). Nutrient requirements vary with production location, variety, and soil type, soil test recommendations should be used to determine specific application rates for individual fields, since it is important to avoid over fertilization with nitrogen or phosphorus, as this will contribute to increased pest problems. Excess nitrogen also causes onions to be more susceptible to storage pathogens. Adequate potassium levels are especially important in improving bulb quality and storage life. Organic matter in the form of either barnyard or green manure should be added to the soil (Ware and McCollum, 1980). Hornok (1980) indicated that NPK fertilization was not only effective on the quantity of vegetative and generation mass, but on the essential oil content of Anethumgraveolens L. (dill). Also Hussien (1995) reported that nitrogen fertilization had a strong effect on the dill essential oil constituents**.** NPK fertilization and micronutrients increased the vegetative growth and essential oil content of some medicinal Apiaceae plants (Khalid, 1996).

Pollution with chemical fertilizers arose as an aim of health care, thus attempts were made for solving problems of chemical fertilization**,** and the organic farming technique represents a move towards an alternative system of agriculture (Abd-Allah , 2001). Organic material, such as sheep and chicken manure**,** improves soil physical properties (structure and aggregation) and soil chemical properties (decrease soil pH, increase cation exchange

capacity and enhance most nutrients) that are important for plant growth (Snyman , 1998). Application of organic fertilizer increased the biomass yield of the main crop and total essential oil yields of davana plant (Parakasa Rao , 1997). Marculescu (2002) revealed that the soil, with its content in macro and microelements enhanced by the use of organic fertilizers, plays an essential role in the plants growing and development, in the biosynthesis of organic substances, also it can be noted that the vegetative mass is rich and the amount of essential oil is high in Chrysanthemum balsamita L. plant when using organic fertilizer. Khalid and Shafei (2005) indicated that treatment of plants with different combinations of organic fertilizers and its rates resulted in a significant increase in growth, yield characters, essential oil and main components of essential oil extracted from dill (Anethum graveolens L.) Khalid (2006b) reported that organic farming increased the vegetative growth, essential oil and mineral content of Calendula officinalis L. (marigold) plants. Hussein , (2006) revealed that organic fertilizers had a promoting influence on most of vegetative growth parameters and accelerated essential oil accumulation of Dracocephalum moldavica L. (dragonhead). Applying organic fertilizers improved vegetative growth characters, essential oil, some chemical composition of essential oil, and phosphorous content of Ocimum basilicum L. (sweet basil) plants (Khalid , 2006a).

The objective of research was to evaluate the effect of sheep manure, urea and triple superphosphate on morphological properties of onions (Allium cepa L.).

MATERIALS AND METHODS

The experiment was carried out to evaluate the effects of different sheep manure, urea and triple superphosphate on onions morphological properties at the University of payame noor University, Marivan, Iran. Located in 46 longitude and 34 latitude and, 1365m Altitude from sea level. The soil is slightly alkalin and has a sandy loam texture. Selected soil chemical and physical characteristics for the soil are presented in Table 1. Soil texture was determined by hydrometer method. Soil pH and ECe were measured at a 1:2.5 soil/water ratio and saturated extract, respectively, organic matter (OM) content was determined by Walkley and Black. Soil available K was determined by 1M NH OAc extraction and K assessment 4 in the extract by flame photometer. Soil available P was measured by Olsen method. Available Fe, Zn, Mn and Cu in the soil were first extracted by DTPA and then were read by atomic absorption. A factorial experiment was including two levels sheep manure (0 and 5 ton/ha), three triple superphosphate levels (0, 100 and 150 kg/ha) and three urea levels (0, 150 and 300 kg/ha). The seed sown in the spring season. Only well-filled, healthy-looking seeds were used. The plot area was 1m2. Morphological characteristics were including plant height and volume, bulb diameter and height, fresh and dry weight and nitrate concentration. The data were statistically processed by analysis of variance according to a randomized complete block design and means with standard errors were calculated using the program Statistical Analysis System, version 9.1 (SAS Institute, Cary, NC, USA). Differences between the treatments were determined using Duncan's test.

Table1. Some physical and chemical characteristics of the soil used

Characteristic	Value	Characteristic	Value
Sand (%)	60	Total N (%)	0.16
Silt (%)	22.3	Available K (mg kg^{-1})	187
Clay (%)	17.7	Available P (Olsen, mg kg^{-1})	7.5
ECe (ds m^{-1})	0.41	Fe (DTPA, mg kg^{-1})	5.1
pH	7.8	Mn (DTPA, mg kg^{-1})	3.2
Organic carbon (%)	0.54	Zn (DTPA, mg kg^{-1})	0.26
Organic matter (%)	0.93	Cu (DTPA, mg kg^{-1})	1.4

RESULTS AND DISCUSSION

Result of ANOVA showed that the sheep manure and triple superphosphate had significant effects on plant height and volume, bulb diameter and height, fresh and dry weight of onion and the effect of urea was significant on plant volume, bulb diameter, fresh and dry weight and nitrate concentration. Sheep manure treatments increased the all measured morphological properties of onion significantly compared to control (Table2).

Table 2. Morphological properties of onion in sheep manure treatments. (LSD5%)

Sheep manure (ton.ha^{-1})	Fresh weight (gr)	Dry weight (gr)	Volume (cm^3)	Bulb diameter (cm)	Bulb height (cm)	Plant height (cm)
0	27.037^{b*}	2.45^{b}	26.12^{b}	6.43^{b}	2.97^{b}	43.81^{b}
5	53.007^{a}	5.01^{a}	51.16^{a}	8.84^{a}	3.77^{a}	51.44^{a}

*

Values followed by the same small or capital letter are not significantly different within rows or columns at Duncan test P≤0.05.

Application of sheep manure increased fresh weight, dry weight, plant volume, bulb diameter, bulb height and plant height by 96.05, 104.48, 95.86, 37.48, 26.93 and 17.41% compared to control, respectively.

It could be concluded from the data that application of sheep manure improved the measurement of growth characters. Obtained results agreed with those of Borin , 1987 and Brwaldh (1992) who reported that organic manure is a rich and a slow release fertilizer, the usage of which leads to a clean product of plants. They added that using organic fertilizer improves the soil texture. The structural improvement can encourage the plant to have a good root development by improving the aeration in the soil, which leads to a higher plant growth**.** Also the obtained results indicated the favourable effect of sheep manure on onion plant productivity; this result might be due to the role of organic manure for continues supply of nutrients which improve some physical properties of soil and increase water retention than that for chemical fertilizers (Abd-Elmoez , 1995; Fliessbach **,** 2000).

Triple superphosphate treatments increased the all measured morphological properties of onion significantly compared to control (Table3).

Table 3. Morphological properties of onion in triple superphosphate treatments. (LSD5%)

Triple superphosphate (kg.ha^{-1})	Fresh weight (gr)	Dry weight (gr)	Volume (cm^3)	Bulb diameter (cm)	Bulb height (cm)	Plant height (cm)
0	26.06^{c*}	2.25^{c}	22.23^{c}	5.73^{c}	2.79^{b}	44.65^{b}
100	40.94^{b}	3.8^{b}	39.21^{b}	6.99^{b}	3.59^{a}	48.8^{a}
150	55.06^{a}	5.13^{a}	54.49^{a}	10.18^{a}	3.74^{a}	49.43^{a}

*

Values followed by the same small or capital letter are not significantly different within rows or columns at Duncan test P≤0.05.

Application of 150 kg.ha^{-1} triple superphosphate increased fresh weight, dry weight, plant volume, bulb diameter, bulb height and plant height by 111.28, 128, 145.11, 77.66, 34.05 and 10.7% compared to control, respectively. Application of 100 kg.ha^{-1} triple superphosphate increased fresh weight, dry weight, plant volume, bulb diameter, bulb height and plant height by 57.09, 68.88, 76.38, 21.98, 28.67 and 9.29% compared to control, respectively. Application of 150 kg.ha^{-1} triple superphosphate increased fresh weight, dry weight, plant volume and bulb diameter by 34.48, 35, 38.96, and 45.63% compared to 100 kg.ha^{-1} triple superphosphate, respectively. The difference between 150 and 100 kg.ha^{-1} triple superphosphate in bulb and plant height was not significant. The positive response of onion to P fertilization was mainly due to the fact that the plants have too weak root system to effectively explore and utilize soil P. Amans (1996) reported significant effect of phosphorus on the number of leaves of onion. Nandi (2002) reported that growth and yield of onion were positively influenced by applying different doses of fertilizers. Mathuramalingam (2002) had the same observation in growth and yield of onion. These results are in agreement with the findings of Malkouti (2002).

Urea treatments increased the fresh and weight, plant volume, bulb diameter and nitrate concentration in dry matter of onion significantly compared to control (Table4).

Table 4. Morphological properties of onion in urea treatments. (LSD5%)

Urea (kg.ha^{-1})	Fresh weight (gr)	Dry weight (gr)	Volume (cm^3)	Bulb diameter (cm)	Nitrate in dry matter (mg.kg^{-1})
0	35.03^{b*}	3.1^{b}	34.36^{b}	6.38^{b}	47.41^{c}
150	41.32^{a}	4.01^{a}	39.49^{ab}	8.06^{a}	68.53^{b}
300	43.71^{a}	4.07^{a}	42.07^{a}	8.46^{a}	89.95^{a}

*

Values followed by the same small or capital letter are not significantly different within rows or columns at Duncan test P≤0.05.

Application of 300 kg.ha^{-1} urea increased fresh weight, dry weight, plant volume, bulb diameter, and nitrate concentration in dry matter by 24.77, 31.29, 22.43, 32.6 and 89.72% compared to control, respectively. Application of 150 kg.ha^{-1} urea increased fresh weight, dry weight, plant volume, bulb diameter, and nitrate concentration in dry matter by 17.95, 29.35, 14.93, 26.33 and 44.54% compared to control, respectively. Application of 300 kg.ha^{-1} urea

increased plant volume and nitrate concentration in dry matter by 6.53, and 31.25% compared to 150 kg.ha^{-1} urea, respectively. The difference between 300 and 150 kg.ha^{-1} urea in fresh weight, dry weight and bulb height was not significant. This showed that the N available in the soil was not adequate for onion production and additional N was required for the growth of the plant.

The increment of onion plant vegetative parameters with the addition of higher level of N + P may be attributed to more availability of nutrients, especially N, which enhances the number of leaves by its simulative effect on cell division and cell enlargement that in turn may increase number of leaves and leaf dimensions**.** Also enhances protein synthesis leading to an increase in building up carbohydrates and this in turn resulted in increases in plant growth characters. Phosphorus plays a pivotal role in metabolic processes and it is a main constituent of energy compounds, nucleic acids**,** phospholipids and co-enzymes. Also it may be attributed to favorable effects of phosphorus on root development and formation of carbohydrates. Bungard (1999) stated that N is a constituent of many fundamental cell components and it plays a vital role in all living tissues of the plant. No other element has such an effect on promoting vigorous plant growth. Also the improvement of fresh and dry weight of whole onion plant could be attributed to an increased photosynthetic area in response to N + P fertilization that enhanced assimilates production and partitioning to the plants.

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