NITROGEN FERTILIZATION OF ONION IN SANDY SOILS

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Abstract

This investigation was conducted at Ismailia, Agricultural Research Station, during the two growing seasons 1994/95 and 1995/96 to study the response of onion plants (*Allium cepa* L.) grown in sandy soil to nitrogenous fertilization as urea foliar spray at the rate of 2.30, 3.45 and 4.60 kg N/f alone or in combination with soil applied N (60, 90 and 120 kg N/f.) comparing with the N recommended rate (150 kg N/f) in the form of ammonium sulphate (20.6% N).

The results revealed the following:

1. Nitrogenous fertilization as soil application in combination with foliar application at high N level significantly increased plant hieght, number of leaves, fresh and dry weights of the whole onion plant, compared to foliar application of urea only. However, bulbing ratio was higher with foliar application alone followed by soil N recommended level (150 kg/f).
2. Total yield and average weight of bulb were also significantly increased with the combination of the highest N (4.6 kg N foliar as urea + 120 kg N/f.). However, the highest value of dry weight percentage was achieved with the highest level of urea as foliar application (4.45 kg N/f.) in combination with the lowest level of soil application N (60 kg N/f.)

   Foliar application of 4.6 kg N as urea with soil N application at any level gave the highest values of total soluble solids (T.S.S.).
3. Soil N application in combination with foliar spray at higher level (4.6 kg N/f.) significantly increased nitrogen percentage at harvest and N, P and K uptake of onion plant after 100 days from sowing. However, at harvest, P percentage was significantly increased only by foliar spray, but K percentage was not significantly affected.

INTRODUCTION

Onion is one of the most important Egyptian vegetable crops. Nitrogen fertilization is the important agronomic variable known to affect plant growth and yield.

Soil application of nitrogen markedly increased number of onion leaves (Pande and Mandra, 1971; Dacquel, 1986), bulbs yield (Hedge, 1988; Al Rajabi, 1987, Dacquel, 1986, Patil *et al.*, 1984; Badr *et al.*, 1996; Narang and Dastanc, 1971; and El-Keklawy *et al.*, 1985) and the dry weight of the whole plant (Moursi and Butt, 1961; El-Habbasha and Behairy 1976). On the other hand, Al-Rajabi (1987) and Daequel (1986) showed that diameter, length, and dry weight percentage of onion bulb were not markedly affected by N rates.

Soil application of nitrogen resulted in an increase in N concentration of onion bulb (AL-Rajabi, 1987 and Hedge, 1988), while a decrease in P and K concentration occurred with high rates of nitrogen application (Hedge 1988). Moreover, El-Sherif and El-Habbasha (1977) and El-Neklawy *et al.* (1985) found an increase in total uptake and content of N, P and K in different parts of onion plants by increasing the nitrogen level.

Many investigators tried to use N fertilization through foliar spraying of crop plants. El-Shafie (1996), with fodder beet, found that foliar application of nitrogen increased growth parameters and total dry matter. Negm *et al.* (1994) observed that grain and straw of wheat plants, received 25 kg N/f. as soil application followed by three sprays of 6% urea at crown, tillering and booting stages, were increased over the recommended N rate (75 kg N/f.). Also, Lamb and Moraghan (1993), using a combination of soil and foliar treatments with sugar beet, found that the use of foliar N application as urea significantly increased root yield.

This investigation aimed to study the effect of foliar application of urea as source of N alone or in combination with soil applied N on growth, yield and nutrient uptake of onion crop grown on sandy soil.

MATERIALS AND METHODS

A field experiment was carried out at Ismailia Agricultural Research Station during the two growing seasons (1994/1995) and (1995/1996) to study the effect of nitrogenous fertilization on growth, yield and nutrient uptake of onion (*Allium cepa* L.) cv. Giza 20. N fertilizer was applied as foliar application at the rate of

2.30, 3.45 and 4.60 kg N/f. as urea (46% N) alone or combined with soil N application at the rate of 60, 90 and 120 kg N/f. as ammonium sulphate (20.6% N) comparing with the recommended rate (150 kg N/f. as ammonium sulphate 20.6% N).

A rondomized complete block design with four replicates was used. The plot area was 10.5 m^2 (3x3.5 m). Plants were transplanted in raws 20 cm apart and 7 cm between plants.

One month after transplanting, plants received 5 sprays of the urea solutions with one week intervals, while soil N levels were applied in 5 equal doses every two weeks starting one month after transplanting.

All the experimental plots were fertilized with calcium superphosphate (15.0% P_2O_5) at the rate of 45 kg P_2O_5/fed. and potassium sulphate (48% K_2O) at the rate of 48kg K_2O/f.

Phosphatic and potassium fertilization were added in two equal doses at transplanting and 30 days later. Chemical and mechanical analyses of the experimental soil are shown in Table 1.

Table 1. Chemical and mechanical analysis of experimental soils.

Soil analysis	1994/95	1995/96
Coarse sand %	60.42	65.26
Fine sand %	32.04	30.90
Silt %	2.46	1.44
Clay %	4.82	3.20
Organic matter %	0.16	0.19
$CaCO_3$ %	0.13	0.17
pH (1:2.5, soil: water suspension)	7.80	7.91
EC mmhos/cm (1:5, soil: water suspension)	0.28	0.34
Available nutrients (ppm):		
Available N	15.0	10.0
Available P	1.4	2.7
Available K	54.0	45.0

Available N was extracted by 1% K_2SO_4 solution and determined using Kjeldahl Method (A.O.A.C., 1970). Available P was extracted by 0.5 N $NaHCO_3$ solution

(pH 8.5) and determined according to Olsen Method (Jackson, 1968), while available K was extracted by 1.0 N neutral ammonium acetate (Black, 1965) and determined by Flame photometer.

After 100 days from transplanting random samples of ten plants were taken from each treatment. In each sample, plant height, number of leaves and fresh and dry weight of both leaves and bulbs were recorded. Bulbing ratio was also calculated. Nitrogen, phosphorus and potassium uptake (mg/plant) were determined.

Harvest took place after 150 days from transplanting and total yield (ton/f.) and average weight (gram) of bulb was measured. Random samples of ten bulbs were also taken from every treatment to determine dry weight, total soluble solids and the contents of nitrogen, phosphorus and potassium. Estimation of nitrogen, phosphorus, and potassium was carried out as described by Jackson (1968).

The obtained data were statistically analysed according to Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

1. Growth:

Data illustrated in Table 2 indicated that nitrogen fertilization as soil application combined with foliar application significantly increased plant height, number of leaves and fresh and dry weights of both leaves and bulbs compared to that of foliar application alone at any level of N. This may be due to the increased root surface per unit of soil volume as a result of adding nitrogen fertilizers to the soil, there by increasing plant capacity to absorb more minerals, resulting in more growth. This result is in agreement with those obtained by Pande and Mundra (1971), Moursi and Butt (1961) and El-Habbasha and Benhairy (1976). Meanwhile, less growth due to foliar application only might be attributed to the small area of the plant leaves which did not allow more nitrogen absorption. In this connection, Abou-Deya (1991) showed that growth parameters and total dry matter of fodder beet were markedly affected by N fertilizer added to the soil more than that as foliar application. The result clearly showed that soil application of 120 kg N/f alone with foliar application of 4.6 kg N as urea/f. gave the highest values with no significant difference over the recommended N rate (150 kg/f.) .

On the other hand, the highest values of bulbing ratio were obtained from foliar application of urea at the three used levels followed by that gained by soil application of N at the recommended rate without significant differences.

Table 2. Effect of foliar (urea) and soil application (ammonium sulphate) of nitrogen on growth parameters and N, P and K uptake of onion plant at 100 days from sowing (Average of two growing seasons).

N application		Plant height (cm)	Number of leaves	Fresh weight (g/plant)		Dry weight (g/plant)		Bulbing ratio*	Uptake (mg/plant)		
Foliar (kg N/f.)	Soil (kg N/f.)			Leaves	Bulb	Leaves	Bulb		N	P	K
2.30	--	37.85	5.20	9.06	9.45	0.940	1.370	3.56	15.51	7.33	39.78
3.45	--	44.38	5.13	10.26	11.67	1.174	1.669	3.69	20.26	10.03	49.31
4.60	--	48.65	5.72	16.86	13.50	1.683	2.073	3.62	29.10	12.57	59.81
2.30	60	69.83*	6.43	38.18	33.23	3.180	3.670	3.39	64.38	19.58	123.20
	90	68.87	6.07	37.57	30.68	3.340	3.253	3.10	76.67	17.88	127.70
	120	71.22	6.65	40.06	33.57	3.417	4.300	3.27	93.49	21.85	135.70
3.45	60	69.47	6.50	41.89	35.17	3.342	3.752	3.27	77.95	21.50	133.20
	90	71.55	7.08	45.06	35.98	3.239	3.544	3.08	91.25	21.81	120.90
	120	70.02	6.90	39.90	36.45	3.755	3.820	3.28	88.23	24.52	140.60
4.60	60	69.85	7.08	34.25	32.50	4.333	3.630	3.41	86.56	20.49	133.70
	90	71.72	7.07	44.74	37.82	3.714	4.675	3.28	88.16	24.35	130.50
	120	78.00	7.96	45.75	42.62	4.155	4.813	3.33	111.60	26.59	159.60
--	150	75.88	7.68	48.78	42.32	4.823	4.603	3.51	107.50	24.60	145.90
L.S.D. at 5%		5.87	1.24	7.80	4.46	0.751	0.819	0.36	17.42	2.81	18.66

* Bulb/Necle diameters ratio.

2. Yield :

Data listed in Table 3 generally showed that soil application in combination with foliar application showed highly significant effect on total yield and average weight of bulb in comparison with foliar spray at any concentration. Meanwhile, the highest values of total yield and weight of bulb were obtained from soil application of N recommended rate (150 kg/f.) followed by soil application of N at the rate of 120 kg/f. along with foliar application of 4.6 kg N/f. as urea. No significant difference between the two treatments showed in the yield while it was true in case of bulb weight. These results may be attributed to the stimulating effect of nitrogen on onion growth mentioned before which was reflected on the final yield as well as the low nutrient content of the experimental soil. These findings are in accordance with those reported by El-Neklawy (1985) and Bader *et al.* (1996).

On the other hand, the foliar spray with 3.45 kg N as urea/f. along with soil application of 60 kg N/fed. gave the highest and significant value of dry weight percentage (15.91%) compared with the recommended soil application alone (14.58%).

3. Total soluble solids (T.S.S.):

The highest values of total soluble solids (T.S.S.) were obtained by the highest level of foliar application (4.6 kg N/f. as urea) along with soil N treatments (60, 90 and 120 kg N/f.) without any significant difference among treatments except foliar spray alone at 2.30 or 3.45 kg N as urea/f.

4. Nutrient status:

Data illustrated in Table 2 indicated that soil application of N along with foliar spraying of urea at any level gave significant increases in N,P and K uptake at 100 days after sowing compared with foliar spray only. At the same time, foliar spray at 4.6 kg N/f. as urea with soil application at 120 kg N/f. recorded the highest uptake of the three nutrients by onion plants, compared with other treatments, followed by soil application at 150 kg N/f. with insignificant difference.

These findings may be due to the increasing of onion dry matter by such treatments which were reflected on the increasing of nutrients uptake. These results are in agreement with those obtained by El-Sherif and El-Habbasha (1977).

At harvest, data listed in Table 3 showed that the N percentage was significantly increased by foliar spray of 4.6 kg N/f. as urea + 120 kg N/f. as soil applica-

Table 3. Effect of foliar (urea) and soil application (ammonium sulphate) of nitrogen on growth parameters and N, P and K uptake of onion plant at 100 days from sowing (Average of two growing seasons).

N application		Yield (ton/f.)	Av.weight of bulb (g)	Dry weight (%)	T.S.S.*	N (%)	P (%)	K (%)
Foliar (kg N/f.)	Soil (kg N/f.)							
2.30	--	8.02	29.72	14.72	11.01	0.47	0.350	1.272
3.45	--	8.10	29.60	15.01	11.23	0.53	0.350	1.285
4.60	--	8.79	33.652	14.95	11.56	0.52	0.348	1.275
2.30	60	18.16	67.03	13.95	11.49	0.62	0.305	1.314
	90	19.58	72.22	13.87	11.83	0.67	0.344	1.348
	120	20.51	75.67	14.89	11.88	0.68	0.330	1.280
3.45	60	19.89	70.00	15.40	11.87	0.66	0.295	1.286
	90	19.01	71.80	14.12	11.65	0.59	0.321	1.396
	120	19.10	72.63	15.77	11.73	0.59	0.293	1.258
4.60	60	19.68	72.58	15.91	12.14	0.55	0.303	1.269
	90	21.20	77.28	14.91	12.21	0.58	0.319	1.314
	120	22.23	80.25	14.87	12.16	0.79	0.302	1.269
--	150	23.20	88.77	14.58	11.79	0.76	0.295	1.273
L.S.D. at 5%		1.17	6.81	1.14	0.92	0.09	0.037	N.S.

* T.S.S. = Total soluble solids %.

tion compared with the other treatments, with no significant difference over the recommended soil N treatment (150 kg N/f.). On the contrary, foliar spray alone at any level significantly caused higher increase in phosphorus percentage than any other treatment. Also, no significant differences in potassium percentage among various treatments.

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التسميد الأزوتى للبصل فى الاراضى الرملية

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أجريت هذه الدراسة بمحطة البحوث الزراعية بالاسماعيلية خلال موسمى الزراعة ١٩٩٤ / ١٩٩٥، ١٩٩٥ / ١٩٩٦ لدراسة استجابة نبات البصل للتسميد الازوتى رشا على النباتات فى صورة يوريا (بمعدل ٢,٣٠ ، ٣,٤٥ ، ٤,٦٠ كجم ازوت /ف) فقط او مع اضافة النتروجين أرضا (بمعدل ٦٠ ، ٩٠ ، ١٢٠ كجم نيتروجين / ف) فى صوره سلفات نشادر ومقارنة ذلك بالمعدل الموصى به (١٥٠ كجم نتروجين / ف) فى صورة سلفات نشادر.

.وقد أظهرت النتائج ما يلى :

١ – أحدث التسميد النتروجينى الارضى مع الرش عند معدلات مرتفعه زيادة معنوية فى طول النبات وعدد الاوراق والوزن الطازج والجاف لكل من الاوراق والبصيلات بالمقارنة بمعاملات الرش فقط. بينما اعطى الرش منفردا أعلى نسبة تبصيل متبوعا باضافة المعدل الموصى به من التسميد الازوتى (١٥٠ كجم نيتروجين /ف).

٢ – زاد المحصول الكلى ومتوسط وزن البصلة أيضا معنويا بالاضافة الارضيه عند ١٢٠ كجم نيتروجين / ف مع الرش بمعدل ٤,٦ كجم نيتروجين فى صورة يوريا. كذلك أعطت المعاملة بالرش ٣,٤٥ كجم نيتروجين فى صورة يوريا مع اضافة ٦٠ كجم نيتروجين/ف أرضى أعلى قيم للنسبة المئوية للوزن الجاف. واعطى الرش باستخدام ٤,٦كجم نيتروجين للفدان على صورة يوريا مع الاضافة الارضيه عند أى مستوى أعلى قيم للنسبة المئوية للمواد الصلبة الكلية .

٣ – أعطى التسميد النيتروجينى الارضى مع المعدل العالى من اليوريا رشا (٤,٦ كجم نيتروجين للفدان) زيادة معنوية فى النيتروجين والفوسفور والبوتاسيوم الممتص بعد ١٠٠ يوم من الزراعة والنسبة المئوية للنيتروجين عند الحصاد. وأظهرت النتائج زيادة معنوية فى محتوى النبات من الفوسفور عند الحصاد باستخدام الرش فقط وفى نفس الوقت لم يتأثر محتوى النبات من البوتاسيوم بالمعاملات تحت الدراسة.