Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.8, No.19, 2018

Response of Onion to Rate of Nitrogen Fertilizer on Yield and Yield Componet at Gondar, North Western Ethiopia

Muhammed Sitote Daniel Tadese(Msc)
Department of plant science, University of Gondar P.O. box 196, Gondar, Ethiopia

Abstract
Onion (Allium cepa) is one of the bulb crops belonging to the family Alliaceae. It is a cool season, biennial crop, usually grown as an herb and is diploid. A field experiment was conducted at University of Gondar in Meles Zenawi campus (Tseda) to study the response of onion to rate of nitrogen fertilizer by using randomization complete block design on 2015. Six treatment such of 0,100,125,150,175, and 200Kg/ha of nitrogen fertilizer, half during transplant and the remaining half after one and half month after transplanting has been used. Plant height, leaf number, pseudo stem thickness, pseudo stem length and disease incidence data has been collected. The data has been analyzed by SAS software and means were separated by LSD. There was highly significant difference in the trait fresh bulb yield. There was significance difference in disease incidence among N- rates. There was no significance difference among treatments for the trait plant height; leaf number, pseudo stem thickness and pseudo stem height. It is recommend that 125 kg/ha to be used because it shows that generally the best performance with fresh bulb yield and relatively with leaf number, pseudo stem height and thickness and have good performance in plant height next to 0 kg N/ha in the study area. The result of this study was based one location and a single season. Therefore, the result needs conformation of the varieties for more than one location in a couple of seasons to get reliable result.
Keywords: Onion, N-fertilizer rate, yield

INTRODUCTION

Onion (*Allium cepa L*) is one of the bulb crop belongs to the family Alliaceae. It is a cool season, biennial crop, usually grown as an annual crop. The primary center of origin of onion is central Asia with secondary center in Middle East and the Mediterranean region. Onion is different from the other edible species of Allium for its single bulb and its usually propagated by the true botanical seed. It is diploid (2n=2x=16).

Globally review of major vegetable show that onion ranks second to tomatoes in area under cultivation. According to FAO(1999),over 40 million tones of onion were produced worldwide in 1998 covering about 4.5 million hectare tropical countries ,having about 45% of the world s arable land grow about 35% of the worlds onion(pathak,1993).the world average yield at present is about 17.3 ton/ha(FAO,1999).About 8%of total area was in Africa in 1995.

Onion was introduced to the agricultural community of Ethiopia in the 1970's when foreigners brought it in. It is an important bulb in Ethiopian diet. It is recently introduced crop and rapidly becoming popular among producers and consumers. It is a widely produced by small farmer and commercial growers throughout the year for local use and export market. The average annual sale of dry bulb and cut flower from Ethiopia fruit enterprise alone was estimated to be about 6.2 million birr (ETFRUIT, 1992). According to world bank report (2004), in the year 2001 the crop shard one fourth at the vegetable export quantities and stood third following green beans and peas contributing about 20% at the total vegetable export value which is about 244,000 US dollar of export earnings. Onion seed production depends on the cultivar, location, growing season and adequate plant protection measures (Lemma and Shimelis 2003).

Onion prefers well drained sandy loam with high content of organic matter. The optimum altitude range for onion production lies between 700-2200m.a.s .l and optimum growing temperature lies between 15 c^0 and 23c^0.Currently the research system made available the varieties like Adam Red, Bombey red, Red Creole, Melkam, Mermiru Brown and Nasik red to farmer. Bombey red and Adama red are widely grown in Ethiopia .Farmer living in the Amhara region produce large amount of onion bulbs every year .For instance, in 2005/06 production year the region contribution 706526 quintal onion bulb with 5338 hectare of land coverage of onion crop .According to the Fogera district office of agriculture in 2005/06 production season the district contribute 355315 quintal with 3100 hectare. This indicates that the district comprise 49.9% of the regional onion production.

Onions are more susceptible to nutrient deficiencies than most crop plant because of their shallow and unbranched root system (Brewster, 1994), also improper time of application of nitrogen fertilizer and lack of optimum rate of nitrogen fertilizer to onion is a problem for onion production. Due to lack of optimum rate of nitrogen fertilizer for onion production in Tseda, therefore this experiment was performed with the objective, to determine optimum rate of nitrogen fertilizer for onion for the locality.

MATERIAL AND METHEODOLOGY

Description of the Study area

The experiment was conducted at educational farm site of Faculty of Agriculture located at Tseda, in Gondar zuria administrative woreda, of north Gondar zone in Amhara region, in NW Ethiopia, in the year 2014/2015 cropping season under irrigation. North Gondar has an altitude of1800-2100 m.a.s.l, longitude of 37.47683E and latitude of 12.4776 N with annual rainfall700-1257 mm, black soil, and 24-25 ^{0}c of average temperature.

Experimental Design

Treatments were arranged in randomized complete block design with replication of three. Each block divide equally in to six experimental plots for each treatment and the total number of plot was 3*6=18 plot .The space between block and plot was 0.5 and 0.4 m, respectively. The space between rows and plants were 25 and 10 cm, respectively. Each plot was prepared with three rows and there was10 plants per row with the number of plant per each plot will be 30 plants .The length and width of each plot will be 1 and 0.7 m .The area of each plot was 0.7 m ^{2} .The productive area will be 12.6 m ^{2} .Therefore, the total area of experiment was the product of the sum of the length and the sum of width, mathematical 4*6.2=24.8 m ^{2}.

Experimental Materials

Six rate of N –Fertilizer level i.e.0, 100,125,150,175 and 200kg/hectare were used. The fertilizers were applied half during transplant and the remaining half after one month after transplanting. Experimental equipment such as meter, spade, hoe, rake, hammer, pesticide, sack, rope and ploughing material were used during the study.

collected data

Among the 30 plants in the three(3) rows the middle rows plants used for data collection but the other two most outer rows of 20 plant used as boarder.

Parameter of Data Collection

Plant height (cm) - This is the height measured in centimeter from the ground level to the of leaf. Five randomly selected plants per each experimental plot were tagged and used for plant height measurement and the average was analyzed.

Leaf number (no.) - This is the number of leaf per plant. Six plants were randomly selected per each plot and used for leaf number counting and the average was analyzed.

Pseudo stem thickness (mm)-This is the thickness measured in millimeter. Six plants were randomly selected per each plot and used to measure pseudo stem thickness and the average was analyzed.

Pseudo stem height (cm) - This is the measure of pseudo stem height in centimeter from the tip part of the bulb to the tip part of the pseudo stem. Four plants were randomly selected per each plot and used to measure pseudo stem height and the average was analyzed.

Insect incidence (%) - This is the measure of insect incidence in percentage. Eight plants were selected per each plot and used to know how much the plants were affected by the trips which are cause of disease incidence.

Fresh bulb Yield (Q/Ha)

This is the measure of fresh bulb yield per plot in gram. Among the ten plants two plants were used for border and six plants were used for data collection. The collected were analyzed using SAS software.

Data Analysis

The collected data was computed and analyzed using SAS soft ware & treatment means were compare using the least significant difference (LSD) test at 5% of significance level

RESULTS AND DISCUSSION

Plant height (cm)

The result of analysis of variance for the trait plant height showed that there was no significance difference among the studied nitrogen fertilizer rate ($p>0.05$) (Table 1). But relatively treatments with 0 Kg N/ha recorded the longest plant height (25.390 cm) followed by 125 Kg N/ha (24.410 cm) and relatively the shortest was observed in 200 Kg N/ha (22.827 cm) (Table 2). Even though the expected result was that the plant height increased when nitrogen rate is increased, but the result showed that it is not the case. This may be due to sufficient soil nitrogen in the soil since there was no primary soil test in the study area.

Number of leaves per plant (no.)

The result of analysis of variance for the trait leaf number showed that there was no significance difference among the studied nitrogen fertilizer rate ($p>0.05$) (Table 1). But relatively more number of leaf per plant was observed in 125 Kg N/ha (6.3267) followed by 0 Kg N/ha (6.1900) and relatively lowest number of leaf were observed in 100 Kg N/ha (6.0233) (Table 2). This result is consistent with the result of Karic *et al*. (2005) who

investigated the response of leaf to different levels of nitrogen and observed no effect on the number of leaves per plant in all N levels. It is obvious that as the number of leaf increase there may be good bulb formation because as the number of leaf increase there is more photosynthesis and more stored product.

Pseudo stem thickness (mm)

The ANOVA showed that there was no significance difference among treatment for pseudo stem thickness ($p>0.05$) (Table 1). Nevertheless, relatively thicker pseudo stem (9.82 mm) was observed for 125 kg/ha N treatment followed by 0 Kg/ha with 9.2667 mm. The smallest pseudo stem thickness per plant was observed in the 200 Kg/ha N rate (8.4467 mm). As the pseudo stem thickness increase it is estimated that there may be bulbs with greater diameter. The result showed to an extent that as the N rate increased, the thicker pseudo stem (Table2).

Pseudo stem height (cm)

The ANOVA result showed that there was no significance difference between treatments ($p>0.05$) (Table 1). However, the longest pseudo stem height was observed in 125 kg/ha N- rate (7.0000 cm) followed by 0kg/ha (6.5833 cm). The lowest pseudo stem height was observed in 200 kg/ha N- rate (5.5833 cm). This may be due to the nitrogen rate is excess to the study area .So nitrogen must applied optimum rate. The result also showed that treatments having nitrogen rate showed the longest pseudo stem height than controlled treatment (Table 2).

Insect incidence (%)

The ANOVA result showed that there was significance difference among treatments for insect incidence ($p>0.05$) (Table 1). Significantly 150 kg/ha gives the lowest disease incidence than 125 kg/ha and 175 kg/ha, but there is no significance difference between 150 kg/ha, 0 kg/ha, 100 kg/ha and 200 kg/ha. But relatively 150 kg/ha gives the highest insect resistance or (Table 2). Therefore this result indicated that using excessive as well as small amount of nitrogen rate lead to susceptibility of the plant to insect. Onion trips (*Thripstabaci*), was the most incidence insect during conducting of the experiment after second nitrogen fertilizer application. It causes tip drying and curling of leaf. With serious observation by magnified lens, it was seen that small yellow color insect with a size of 2 mm onion trips was observed. Mainly the insect prefers to feed on the newly emerged leaves in the center of onion neck. These tip drying and curling of leaf was observed firstly in treatment 125 kg/ha of replication 3.

Fresh bulb Yield per plot (gm)

The analysis of variance for the trait yield per plot showed that there were highly significant difference ($p< 0.01$) among 125 kg/ha and other N-rate. But there is no significance difference between other treatments. The highest fresh bulb yield were recorded in 125 kg/ha which was 214.2 quintal per hectare and the relatively lowest fresh bulb yield were recorded in 100 kg/ha which was 163.32 quintal per hectare. The data were recorded from the area 1500 cm^2 and the obtained data are converted into quintal per hectare. This result is inconsistent with the result which is carried out in South Ghor area, Jordan, by Ahmed H. Al-friht, Application of nitrogen fertilizer had a significant effect on the yield after the curing process.

Table 1. Mean Square values of different Nitrogen fertilizer rate on Onion

Source of variation	Plant height (cm)	Leaf no/plant	Pseudo stem thickness (mm)	Pseudo stem height (cm)	Insect yield/plot incidence (%)	fr bulb (gm)
N-fertilizer	2.97^{ns}	0.036^{ns}	0.612^{ns}	0.975^{ns}	722.22*	2556.88 **
Replication	8.67	0.336	2.098	3.135	164.93	590.94
Error	3.16	0.168	0.426	0.485	164.93	416.17

**=highly significant difference *=significant difference at 0.05, ns=non significance difference

Table 2. Mean values of Nitrogen fertilizer rate of onion

N-rate	Plant height (cm)	Leaf no	Pseudo stem thickness (mm)	Pseudo stem height (cm)	Insect incidence (%)	Yield/plot (gm)
0 kg/ha	25.390 [a]	6.1900 [a]	9.2667 [ab]	6.5833 [ab]	41.67 [b]	277.32 [b]
100 kg/ha	22.873 [a]	6.0233 [a]	9.2933 [ab]	5.7500 [ab]	37.5 [b]	244.98[b]
125 kg/ha	24.410 [a]	6.3267 [a]	9.8200 [a]	7.0000 [a]	66.67 [a]	321.32[a]
150 kg/ha	23.950 [a]	6.1033 [a]	8.9800 [ab]	5.83333 [ab]	29.17 [b]	248.66[b]
175 kg/ha	23.317 [a]	6.1033 [a]	9.2933 [ab]	5.7500 [ab]	66.67 [a]	252.32[b]
200 kg/ha	22.827 [a]	6.0500 [a]	8.4467 [b]	5.5833 [b]	50.00 [ab]	253.98[b]
CV %	7.474154	6.702181	7.111744	11.45291	23.364	7.656907
LSD	3.2354	0.7478	1.188	1.2675	26.41892	37.114

CV= Coefficient of Variation, LSD =Least Significance Difference

SUMMARY AND CONCLUSIONS

Onion (*Allium cepa L*) is one of the bulb crop belongs to the family Alliaceae. It is a cool season, biennial crop, usually grown as an annual herb. It is diploid (2n=2x=16.

In the study of response of onion to rat of nitrogen- fertilizer, it was observed that there was similar performance for the trait plant height, leaf number; pseudo stem thickness and pseudo stem height. But highly significant difference in the fresh bulb yield of 125 kg/ha and significance difference in 150 kg /ha in the trait insect incidence among the treatments in the study area. So it is recommend that 125 kg/ha to be used because it shows that generally the best performance with fresh bulb yield and relatively with the leaf number, pseudo stem height and thickness and have good performance in plant height next to 0 kg N/ha but it was relatively have high chance of insect incidence. This insect had potential protection measure. The result of this study was based on one location and a single season. Therefore, the result needs conformation of the varieties for more than one location in a couple of seasons to get reliable result

REFERENCE

Brady, N.C. and R.R. Weil, 2002. The nature and properties of soils. Thirteenth edition. Pearson Education Asia. Delhi, India. 960p.

Brewster, J.L. and H.A. Buttler, 1989. Effects of nitrogen supply on bulb development in onion (*Allium cepa* L.). *Journal of Experimental Botany 4: 1155-1162.*

Brewster J.L. and H.D. Rabinowitch (ed.), 1990. Onion and allied crops, vol. III. Biochemistry, Food science and Minor crops. CRC press. Boca Raton. FC. 298p.

Brewster, J.L., 1994. Onions and Other Vegetable Alliums. CABI Publishing. Wallingford, UK. 236p.

Currah, L. and F.J. Proctor, 1990. Onions in Tropical Regions. Natural resources institute. Chatham, Maritime, Kent, UK. 232p.

ETFRUIT.1992, Annual report for period 1987-1992 Addis Ababa .pp .46-58

FAO, 1999. Production year book, vol, 53, food and agricultural organization of the united nation ,Rome pp. 78-80

Gubb I.R and M.S.H. Tavis, 2002. Onion preharvest and postharvest considerations. pp. 237-250. In: H.D. Rabinowitch, and L. Currah (eds.). Allim Crop science. CABI publishing, UK.

Hegde, D.M., 1986. Effects of irrigation and nitrogen fertilization on water relations, canopy temperature, yield nitrogen uptake and water use of onions. *Indian Journal of Agricultural Sciences 56: 858-867.*

Hegde, D.M., 1988. Effects of irrigation and nitrogen fertilization on yield, quality, nutrient uptake and water use in onion (*Allium cepa* L.). *Singapore Journal of Primary Industries 16: 111-123.*

Henrisken, K., 1987. Effect of N-and P-fertilization on yield and harvest time in bulb onions (*Allium cepa* L.). *Acta Horticulturae 208:207-215.*

Jones H.A., and L.K. Mann, 1963. Onions and their Allies. London, Leonard Hill. 320p.

Karic, L., S. Vukasinovic and D. Znidarcic. 2005. Response of leek (Allium porrum L.) to different levels of nitrogen dose under agro-climate conditions of Bosnia and Herzegovina. Acta agriculturae Slovenica,85(2): 219-226.

Kato, T., M. Yamagata and S. Tsukahra, 1987. Nitrogen nutrition, its diagnosis and postharvest bulb rot in onion plant. *Bulletin of the Shikoku National agricultural Experiment station 48:26-49.*

Lemma Desalegn and Shemelis Aklilu, 2003. Research Experiences in Onion Production. EARO, 123p.

Marschner, H., 1995. Mineral Nutrition of Higher Plants, 2nd ed. Academic press. London. 196 p.

Nandpuri, K.S., S.P.A. Madan, A. Singh and S. Singh, 1968. Effect of various doses of nitrogen and Phosphorus on Onion seed production. Pp. 92.

Parton, W.J., D.S. Schimel, Cole, C.V. and D.S. Ojima, 1987. Analysis of factors controlling soil organic matter

levels in great plains grass lands. *Journal of the American Soil Science Society 51: 1173-1179.*

Pathak, C.S., 1994. Allium improvement for the tropics: problems AVRDC strategy. *Acta Horticultural 358: 395-400.*

Rabinowitch, H.O. and L. Currah, 2002. Allium Crop Science: Recent Advances. CABI Publishing. U.K. 585p.

Rahn, C.R., M.A. Shepherd and R.W.P. Hiron, 1996. The effect of water supply on the response of onions and calibers to starter solutions. *Acta Horticulturae 428: 141-150.*

Rubatzky, V.E and M. Yamagunchi, 1997. World Vegetables; Principles, Production, and Nutritive Value 2nd ed. International Thomson publishing. 804 p.

Sopher, C. D. and J. V. Baird, 1982. Soils and soil management. 2nd edition. Prentice hall. New Jersey. 312p.

Sørensen, J.N., 1996. Improve in N efficiency in vegetable production by fertilizer placement and irrigation. *Acta Horticulturae 428: 131-140.*

Suojala, T., T. Salo and R. Pessala, 1998. Effect of fertilization and irrigation practices on yield, maturity, and storability of onions. *Agricultural and Food Science in Finland 7: 477-489.*