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Full Length Research Paper

Growth, bulb yield and quality of onion (A*llium cepa* L.) as influenced by nitrogen and phosphorus fertilization on vertisol. II: Bulb quality and storability

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An experiment was conducted to study the effect of different levels of nitrogen (N) and phosphorus (P) fertilizers on bulb quality and storability of onion (*Allium cepa* L.) grown on vertisol of Shewa Robit, North-East Ethiopia. Five rates of N (0, 69, 92, 115, 138 kg ha^{-1}) and five rates of P (0, 10, 20, 30, 40 kg ha^{-1}) were arranged in a randomized complete block design, replicated three times. Regardless of the rate, N fertilization decreased bulb dry matter content by about 4% over the control. Pungency measured as pyruvate concentration improved with increase in the rate of N application and reached the highest value of 2.72 µmol ml^{-1} at a rate of 138 kg N ha^{-1}. Bulb storability study for eight weeks at ambient condition indicated that the highest level of N or P fertilizer caused the highest cumulative weight loss. It was also observed that bulb sprouting percentage of 63 and 53% were recorded from treatments that received 69 and 40 kg P ha^{-1}, respectively. Nitrogen at the rate of 115 or 138 kg ha^{-1} resulted in about 2.9% rotting of the bulbs. N fertilization improved pungency, reduced bulb dry matter content and storability by enhancing sprouting and rotting percentage. Bulb dry matter content, pungency and rotting percentage were not significantly affected by P fertilization and the lack of response may be due to the availability of adequate amount of P (16.02 ppm) in the soil.

Key words: Bulb rotting, dry matter, pungency, sprouting, weight loss.

INTRODUCTION

The average nutrient depletion in East Africa, particularly of Ethiopia is estimated to be around 47 to 88 kg/ha/year in general and 100 kg/ha/year in particular on the highlands (Henao and Baanante, 1999). Major factors contributing to such depletion are soil erosion, fixation of phosphorus (P) and leaching in respect of nitrogen (N) and potassium (K); the problem is further accelerated by deleterious land use practices resulting from high population pressure. Plants require a variety of elements for growth and development of which N, P, and K are the most important of the essential nutrients to plants because they are required in large quantities. The deficiency of these elements is manifested in the detrimental effects on the growth and development of the plants (Tisdale et al., 1995). Furthermore, high mobility of N and high affinity of P and K for chemical reactions and fixation in the soils solid phase put these plant nutrients on the priority list in soil fertility management studies (Kleinkopf et al., 1981).

Onions are most susceptible than most crop plants in extracting nutrients, especially the immobile types, because of their shallow and unbranched root system; hence they require and often respond well to addition of fertilizers (Brewester, 1994). Onion is a heavy feeder, requiring ample supplies of N. However, excess

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Abbreviations: N, Nitrogen; **P,** phosphorus; **K,** potassium; **SAS,** statistical analysis system; **LSD,** least significant difference; **GA,** gibberellic acid.

application of N causes excessive vegetative growth, delayed maturity, increase susceptibility to diseases, reduce dry matter contents and storability and ultimately reduce yield and quality bulbs (Brewster, 1994; Sørensen and Grevsen, 2001). Similarly, under sub-optimal supply of N, the growth of onions and shallots can be severely stunted, with bulb size and marketable yields reduced. Onion bulb size is related to planting density and smaller bulbs are formed at closer spacing but their size can be increased by application of N and potash during growing period (Rice et al., 1993).

The quality of onion can be affected by mineral nutrition, irrigation schedule or rainfall (Chung, 1989), cultivar differences and the use of growth regulators such as maleic hydrazide (Hussien, 1996). Cultivar, stage of bulb development, premature defoliation, skin integrity and conditions during maturation, harvesting and curing are the main factors affecting the quality of bulbs in storage (Brewster, 1994). The principal aims of onion bulb storage are to maintain the 'quality capital' present at harvest (Gubb and Tavish, 2002) and to satisfy consumer demand for extended period by ensuring the availability of onions of satisfactory quality. Appropriate pre and post harvest treatments are required so that quality factors such as dry matter content, sugars, pungency, skin integrity, skin color, and non-sprouted and unrotted bulbs can be kept at their optimum level in storage until they reach consumers or market.

Diagnostic farming system survey report of Kewet District in North-East Ethiopia (unpublished, 2002) indicated that limited fertilizer use and inappropriate use or application of artificial fertilizer are the major constraints for onion production. Farmers in the study area are conscious of the response of onion to applied nutrients but they do not know the type and rate of fertilizers to be applied to improve yield and quality. Moreover, regardless of the fertility status of the soil and the types of cultivar, the blanket national recommend-dation of 92 kg N/ha is being used for onion production in the district. One of the major problems resulting in lower onion productivity in the district is inadequate agronomic practice due to the lack of fertilizer rate recommendations based on the local conditions. To address this problem, the study was initiated with the major objective of investigating the effects of different rates of N and P fertilization on the yield, quality and storability of onion grown on vertisol, North-Eastern Ethiopia.

MATERIALS AND METHODS

Description of the study area

The experiment was conducted at Shewa Robit Research Station of Debrebrehan Agricultural Research Center which is 125 km North-East of Addis Ababa, Ethiopia. It is located at 11° 55' N latitude and 37° 20' E longitude at an altitude of 1380 m.a.s.l. The area has an average annual rainfall of 1007 mm, with short rain between March and April and long rain between June and September; and annual mean minimum and maximum temperature of 16.5 and 31°C, respectively (BoA, 2000).

The field experiment was conducted on vertisols which is clayey in texture with clay, sand and silt contents of 56, 10 and 34%, respectively; and a pH value of 8.02. It has an organic matter content of 2.18%, total N of 0.15% and available P of 16.02 ppm. Besides, the exchangeable K content was 1.89, Ca 37.60, Mg 7.20, and cation exchange capacity (CEC) 58.60, all expressed in Cmol kg^{-1} soil. Laboratory results of the soil analysis before planting indicates that the soil is heavy clay, basic in reaction with medium total nitrogen, normal available phosphorus, low organic matter, and high CEC as well as exchangeable bases (Ca^{2+}, Mg^{2+}, K^{+}).

Planting and agronomic practices

Bombay red onion (*Allium cepa* L.) variety which is dominantly produced in the area was used for the study. Seeds were sown in a nursery on well prepared seed bed. When the seedlings were at 3 to 4 leaves stage or 12 to 15 cm height, they were transplanted in the experimental field. Planting was done on ridges of about 25 cm high adopting the recommended spacing of 40 cm between water furrows, 20 cm between rows on the ridge and 10 cm between plants. The plot size was 4.2 × 3 m and a total of 30 plants were planted per row. A distance of 1 m was maintained between plots and 1 m between blocks. Each experimental plot had seven rows. All cultural practices were employed as per the regional recommendations.

Treatments and experimental design

The experiment was conducted using irrigation during 2007/2008 production period. Transplanting was done at the end of September 2007 and harvesting was carried out end of January 2008. The treatments were factorial combination of five levels of N (0, 69, 92, 115 and 138 kg ha^{-1}) and five levels of P (0, 10, 20, 30 and 40 kg ha^{-1}). The treatment combinations were arranged in a randomized complete block design with three replications.

The fertilizer sources were urea (46% N) and tripe superphosphate (20% P) for N and P, respectively. The full dose of P and half dose of N fertilizer were applied at transplanting and the remaining half dose of N was side-dressed 45 days after transplanting.

Data collection

Laboratory data

For the determination of percent dry matter, 100 g of the homogenate was taken and oven dried at a temperature of 70°C until a constant weight. It was calculated as the ratio between dry and fresh mass, and expressed as a percentage. The content of pyruvic acid developing in homogenized bulb tissue was used as measure of pungency following the procedure of Bussard and Randle (1993).

Bulb storability data

To study the effect of different rates of N and P on keeping the quality or storability of onion bulbs stored at ambient condition, the following procedure was employed. Medium (5 to 8 cm) and large (≥ 8 cm) sized bulbs weighing 6 kg from each treatment were selected. Small sized bulbs were not found in the treatments that were harvested. The fresh weight of the bulbs were recorded and stored on the shelves of a house constructed from corrugated iron

Table 1. The effect of different levels of N and P fertilizers on bulb dry matter content and pyruvate concentration at harvest and sprouting and rotting percentage of the bulbs stored for eight weeks at ambient condition

Treatment	Dry matter (%)	Pyruvate (µmole ml^{-1})	Sprouting (%)	Rotting (%)
Nitrogen (kg ha^{-1})				
0	13.56[a]	2.44[b]	1.11[b]	2.74[b]
69	13.31[b]	2.41[b]	1.81[a]	2.52[bc]
92	12.62[b]	2.64[b]	1.37[ab]	2.32[c]
115	12.99[b]	2.66[b]	1.52[ab]	2.83[a]
138	13.19[b]	2.72[a]	1.43[ab]	2.97[a]
F-test	*	*	*	*
Phosphorus (kg ha^{-1})				
0	13.29[a]	2.44[a]	1.13[b]	2.55[a]
10	13.26[a]	2.41[a]	1.53[ab]	2.54[a]
20	13.51[a]	2.64[a]	1.61[ab]	2.83[a]
30	13.41[a]	2.66[a]	1.24[ab]	2.75[a]
40	12.91[a]	2.72[a]	1.73[a]	2.70[a]
F-test	NS	NS	**	NS
SEM (±)	0.53	0.19	0.39	0.22
CV (%)	8.07	12.71	17.67	14.16

NS, Non-significant at $p < 0.05$; *, significant at $p > 0.05$; SEM, standard error of the mean. Means with the same treatment and column sharing the same letters are not significantly different at $p < 0.05$.

sheet on the roof and woods on the side walls. The treatments were arranged in three replications using randomized complete block design in the store. The three shelves were arranged vertically and each far with a distance of 1 m. Storability parameters was measured at seven days interval and the study continued for eight weeks after harvest (almost until 50% weight losses occurred).

Cumulative weight loss of bulbs (%) was determined using the methods described by Waskar et al. (1999). Percentage of sprouted bulbs is cumulative of the number of bulbs sprouted in 7 days storage period. The sprouted bulbs were labeled after 7 days interval count to avoid double counting. Bulbs that sprout and rot at the same time were classified as sprouted bulbs. The measurement of percentage of rot bulbs were cumulative and were based on the number of bulbs rot in 7 days storage period. The rot bulbs were discarded after each count to avoid double counting.

Statistical analysis

The data were subjected to analysis of variance using SAS (statistical analysis system) version 8.0 program. Mean separation was done using least significant difference (LSD) at 5% probability level. Correlations between parameters were done when deemed applicable.

RESULTS AND DISCUSSION

Bulb dry matter content

Nitrogen fertilization significantly decreased the dry matter content of bulbs (Table 1). Regardless of the rate, N fertilization decreased dry matter content by about 4% over the control. This could be attributed to the influence of N fertilization on gibberellic acid (GA) biosynthesis. The involvement of GA in regulating the pattern of assimilates partitioning was suggested by Yim et al. (1997). We noted that high GA level leads to a higher carbohydrate allocation to the shoots where as low GA level resulted in more dry matter allocation to the roots. Excessive N encourages excessive vegetative growth and reduces dry matter allocation to the bulb; and ultimately decreases yield and quality (Brewster, 1994; Sørensen and Grevsen, 2001). However, Maier et al. (1990) reported that N did not show any prominent effect on bulb dry matter content.

Bulb pungency (pyruvate content)

The pyruvate content of the bulbs increased in response to N fertilization and application of 138 kg ha^{-1} N has increased the pyruvate concentration by 10.29% over the control. This could be due to increased sulfur availability to plants in response to N fertilization according to Nasreen et al. (2007), because sulfur is the major source of pungency in onion. Randle and Ketter (1998) reported that to a large extent, the concentrations of pyruvate in onions are determined by the genetics of the cultivar. However, the growing environment can greatly influence the pungency intensity for any given cultivar. Environments which affect pungency intensity are sulfate availability, growing temperature, and water availability. The more sulfate available for uptake, the more pungent

Table 2. Effects of N and P on the cumulative weight loss of onion bulbs stored at ambient condition for eight weeks

Treatment	Cumulative weight loss (%)							
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Nitrogen (kg ha^{-1})								
0	7.61[a]	11.72[a]	15.60[a]	18.49[a]	24.31[a]	28.56[b]	32.90e	40.21c
69	6.66[a]	12.35[a]	16.03[a]	19.59[a]	24.70[a]	28.27[b]	35.63d	43.67[b]
92	7.02[a]	12.55[a]	15.57[a]	19.28[a]	23.42[a]	26.95[b]	34.72cd	44.44[b]
115	6.82[a]	11.71[a]	14.77[a]	17.98[a]	22.25[a]	27.66[b]	37.09[b]	45.89[b]
138	6.84[a]	12.26[a]	15.18[a]	19.48[a]	24.42[a]	30.23[a]	44.19[a]	52.85[a]
F-test	NS	NS	NS	NS	NS	*	*	*
Phosphorus (kg ha^{-1})								
0	6.87[a]	11.91[a]	15.18[a]	18.90[a]	23.90[a]	28.39[b]	36.96[b]	43.09c
10	6.58[a]	12.02[a]	15.45[a]	18.65[a]	23.47[a]	28.58[b]	36.44[b]	44.55[b]
20	6.82[a]	11.94[a]	15.30[a]	19.12[a]	23.23[a]	27.46[b]	36.22[b]	44.95[b]
30	7.48[a]	12.44[a]	15.64[a]	19.16[a]	24.27[a]	29.09[ab]	36.68[b]	44.92[b]
40	7.21[a]	12.29[a]	15.58[a]	19.99[a]	24.99[a]	30.13[a]	38.23[a]	46.56[a]
F-test	NS	NS	NS	NS	NS	*	*	*
SE (±)	0.35	0.29	0.38	0.44	0.58	0.54	0.58	0.58
CV (%)	17.03	14.74	10.32	12.71	11.35	13.39	9.99	10.29

NS, Non-significant at $p < 0.05$; *, significant at $p > 0.05$; SEM, standard error of the mean. Means with the same treatment and column sharing the same letters are not significantly different at $p < 0.05$.

or flavorful a cultivar will be. Higher growing temperatures and drier growing conditions both result in higher pungency. Conversely, low sulfate availability, low growing temperatures, and moist growing conditions will lower onion flavor intensity. Randle (2000) reported that when N level increased from 0.22 to 0.97 gl^{-1} in a hydrophonic solution, enzymatically produced pyruvate increased linearly but then decreased at the highest N treatments. Contrary to the present study, Abbey (2004) reported that N fertilization significantly reduced onion bulb pyruvic acid concentration or pungency (lachrymatory potency).

Cumulative weight loss

Nitrogen and P fertilization did not significantly affect cumulative weight loss of onion stored for five weeks after harvesting; however during the 6th, 7th and 8th week storage period, significant weight loss were observed in response to N and P fertilization (Table 2). Beginning from the 6th week up to the end of the storage period, the highest cumulative weight loss of onion bulb was observed from treatments that received the highest level of N or P fertilizer. This could be attributed to the development of larger sized bulbs in response to the higher fertilizer rates that have higher rate of respiration. This result is in agreement with Jilani (2004) who found that large size bulbs of onion stored for 120 days at ambient condition lost much weight as compared to small and medium size bulbs. As the storage period extends, there was an increase in cumulative weight loss that could be due to dry matter and water loss from the bulbs. Msika and Jackson (1997) reported cultivar specific weight losses between 2 and 5% per month in warm ambient storage in Zimbabwe and the loss increment occurred from second week to the end of third month storage time. They observed relatively low initial rate of water loss through the skin and low-level of respiration of the dormant bulbs. However it was followed by a change in steeper slope, indicating more rapid weight loss due to high respiration rate and senescence of older fleshy scales. In agreement with the current finding, Dankhar and Singh (1991) reported that weight loss of bulbs increased with increase in the N level. Similarly, in India, Singh and Dhankar (1995) and Pandey and Pandey (1994) found that increasing the rate of applied nitrogen from 50 to 150 kg ha^{-1} led to significant increases in storage loss of onion during 4 to 5 months under ambient conditions. On the contrary, the addition of P and K had no effect on the storage life of onions according to Rabinowitch and Brewster (1990). However, increasing applications of P fertilizer from 25 to 100 kg ha^{-1} resulted in decreased weight loss in onions stored for up to 160 days in India (Singh et al., 1998). Generally, the cumulative weight loss in the current study was found to be high in reference to the storage length that could be due to the warm storage environment that favored high rate of respiration and transpiration. The bulbs stored in bamboo platform were found in acceptable condition after 6 months of storage showing 31.40% of weight loss according to Ullah et al. (2008).

Bulb sprouting percentage

Nitrogen and P fertilization significantly increased sprouting of onion bulbs during eight weeks of storage period (Table 1). Application of 69 kg N ha^{-1} increased sprouting in stored onion by about 63% over the control although further increase had no significant effect. Similarly, application of 40 kg P ha^{-1} increased sprouting of onion bulbs by about 53% over the control. Bhalekar et al. (1987) reported that sprouting was increased with increasing N levels from 0 to 150 kg N ha^{-1}. Similar findings were also reported by Celestino (1961) where bulbs fertilized with 60 or 120 kg N ha^{-1} sprouted twice as much under common storage as compared to those which were not fertilized. The researcher further explained that the role of N in increasing the sprouting of bulbs could be attributed to increase in the concentration of growth promoters than inhibitors with high N nutrition. Dankhar and Singh (1991) also reported that high dose of N produced thick-necked bulbs that increased sprouting in storage due to greater access of oxygen and moisture to the central growing point. Contrary to the current finding, Singh et al. (1998) observed that increasing the applications of P fertilizer from 25 to 100 kg ha^{-1} resulted in decreased weight loss of sprouting and rotting in onions stored for up to 160 days in India. Similarly, Rabinowitch and Brewster (1990) reported that the addition of K and P had no effect on the storage life of onions.

Bulb rotting percentage

Rotting of bulbs was significantly influenced by N fertilization while P and their interaction did not affect it (Table 1). Nitrogen at the rate of 115 and 138 kg ha^{-1} resulted in the highest rotting of bulbs as compared to the other treatments as well as the check. The higher bulb rotting incidence in response to higher rates of N could be due to its effect in encouraging plants to produce large bulbs with soft succulent tissues which made them susceptible to the attack of diseases causing micro organisms. This result was in agreement with the report of Dankhar and Singh (1991) and Bhalekar et al. (1987) that showed that rotting of bulbs was increased with increase in N fertilization. Onion bulbs produced without N application had the lowest rotting (22%) while highest rotting (36 to 54%) was recorded in bulbs produced under high dose of N (Jones and Mann, 1963). Storage losses in 37 onion cultivars in India were also found to be positively correlated with bulb protein content and negatively correlated with ash, K, dry matter, total soluble sugar (TSS), and non reducing sugar content (Gubb and Tavish, 2002).

In this study, it was observed that the application of N beyond 69 kg ha^{-1} was disadvantageous because it reduced dry matter content and storability by enhancing sprouting and rotting. Bulb dry matter content, pungency and rotting percentage were not significantly affected by P fertilization and the lack of response may be due to the availability of adequate amount of P (16.02 ppm) in the soil and P fertilization is not advisable for commercial onion production in the study area.

REFERENCES

Abbey L (2004). Electronic nose evaluation of onion headspace volatiles and bulb quality as affected by nitrogen, sulphur and soil type. J. Veg. Crop Prod. 145(1):41-50.

Bhalekar MN, Kale PB, Kulwal LV (1987). Storage behavior of some onion varieties (Allium cepa L.) as influenced by nitrogen levels and preharvest spray of maleic hydrazide. J. Pkv. Res. 11(1): 38-46.

BoA (2000). Kewet Woreda Agriculture Development Office annual report, Bureau of Agriculture.

Brewester JL (1994). Onions and other vegetable *Alliums*. CAB International, Wallingford, UK, p.236.

Bussard ML, Randle WM (1993). Streamlining onion Pungency analysis. J. Hort. Sci. 28:60.

Celestino AF (1961). The effect of irrigation, nitrogen fertilization and maleic hydrazide on the yield, composition and storage behavior of bulbs of two onion varieties. J. Philippines Agric. 44:479-501.

Chung B (1989). Irrigation and bulb onion quality. Acta Hort. 247:233-237.

Dankhar BS, Singh J (1991). Effect of Nitrogen, Potash and Zinc on storage loss onion bulbs (*Allium cepa* L.). J. Vegetable Sci. 18:16-23.

Gubb IR, Tavis MSH (2002). Onion preharvest and postharvest considerations. *In*: Rabinowitch HD, Currah L (eds.). Allim crop science. CABI publishing, UK. pp. 237-250

Henao J, Baanante C (1999). Estimating rates of nutrient depletion in soils of agricultural lands of Africa. International Fertilizer Development Center (IFDC). Musck Shoals, Alabama USA. p. 76.

Hussien J (1996). Influence of nitrogen and maleic hydrazide on the keeping quality and subsequent establishment of shallot. M.Sc thesis, Alemeya University, Ethiopia. pp. 11-13.

Jilani MS (2004). Studies on the management strategies for bulb and seed production of different cultivars of onion (*Allium cepa* L.). PhD thesis, Gomal University, Dera Ismail Khan. pp. 1-499.

Kleinkopf GE, Westermann DT, Duelle RB (1981). Dry matter production and nitrogen utilization by six potato cultivars. Agro. J. 73:799-802.

Maier NA, Dahlenburg AP, Twigden TK (1990). Effect of nitrogen on the yield and quality of irrigated onions (*Allium cepa* L.) cv. Cream Gold grown on siliceous sands. Aust. J. Exp. Agric. 30:845-851.

Msika RL, Jackson JE (1997). Onion Production and Research in Zimbabwe: Country report. *In*: Rabinowitch HD, Currah L (ed.) Allium Crop Science. CABI Publishing, UK. pp. 241-242.

Nasreen S, Haque MM, Hossain MA, Farid, ATM (2007). Nutrient uptake and yield of onion as influenced by nitrogen and sulphur fertilization. Bangladesh J. Agric. Res. 32(3):413-420.

Pandey RP, Pandey A (1994). Storage losses of onion bulbs. Madras Agric. J. 81:603-605.

Rabinowitch HD, Brewster JL (1990). Agronomy, biotic interactions, pathology, and crop protection. Vol. II. CRC Press, Inc.; Boca Raton. Florida.

Randle WM, Ketter CA (1998). Pungency assessment in onions. Proceedings of the 19 workshop conference of the Association for Biology Laboratory Education (ABLE). pp.177-196. http://www.zoo.utoronto.ca/able/volumes/copyright.htm.

Randle WM (2000). Increasing nitrogen concentration in hydroponic solutions affects onion flavour and bulb quality. J. Am. Soc. Hort. Sci.

125:254-259.
Rice RP, Rice LW, Tindall HD (1993). Fruit and vegetable production in warm climates. The Macmillan press Ltd. London and Basingstoke.
Singh J, Dhankar BS (1995). Effect of pre-harvest chemical treatment on the storage loss of onion. Adv. Hortic. For. 4:119-126.
Singh JV, Kumar A, Singh C (1998). Studies on the storage of onion (*Allium cepa* L.) as affected by different levels of phosphorus. Indian J. Agric. Res. 32:51-56.
Sørensen JN, Grevsen K (2001). Sprouting in bulb onions (*Allium cepa* L.) as influenced by nitrogen and water stress. J. Hort. Sci. Biotech. 76:501-506.
Tisdale SL, Nelson W, Beaton L, James D, Halvin JL (1995). Soil fertility and fertilizers. 5th ed., McMillan publishing company, New York, pp. 109-229.
Ullah MH, SMI Huq, MDU Alam, MA Rahman (2008). Impacts of sulphur levels on yield, storability and economic return of onion. Bangladesh J. Agric. Res. 33(4):539-548.
Waskar DP, Khedlar RM, Garande VK (1999). Effect of postharvest treatment on shelf life and quality of pomegranate in evaporative cool chamber and ambient conditions. J. Food Sci. Tech. 2(36):114-117.
Yim KO, Kwon YW, Bayer DE (1997). Growth responses and allocation of assimilates of rice seedlings by paclobutrazol and gibberellin treatment. J. Plant Growth Regul. 16:35-41.