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Response of Onion to Application of UREA and NPS Fertilizer Rates Under Irrigation in Mareko District, Central Ethiopia

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ABSTRACT

Background and Objective: In the Central Ethiopian Region, onions are one of the most significant vegetable crops that are grown with irrigation. Applying fertilizer is a crucial input to boost vegetable yields, especially onion yields. The study aimed to determine the ideal rate of NPS and UREA fertilizer under irrigation. **Materials and Methods:** It was conducted in Mareko, Guraghe Zone in 2017 and 2018. The treatments consisted of five UREA rates (0, 50, 100, 150 and 200 kg/ha) and five NPS fertilizer rates (0, 50, 100, 150 and 200 kg/ha). Factorial combination treatments were arranged in a randomized complete block design with three replications. Data on plant height, bulb diameter and total yield were recorded and analyzed using SAS 9.3 software. **Results:** The interaction effect of NPS*UREA*Yr revealed that non-significant on plant height, bulb diameter and total yield of onion combined over two years. Based on the mean performance 100 kg NPS and 100 Kg UREA fertilizer gave the highest plant height, bulb diameter and yield was obtained while; the lowest was in the control. According to partial budget analysis, the rate of 100 kg/ha NPS and 100 kg/ha UREA fertilizer increases the profitability of onion crops for the farmers. **Conclusion:** The application of 100 kg/ha NPS increased the fruit yield by 3.4 and 7.63 ton over the control combined over theyear. Hence, the application of 100 kg/ha NPS and 100 kg/ha UREA is suitable for onion production under irrigation in the study area and similar agroecologies.

KEYWORDS

Onion production, NPS fertilizer, bulb diameter, urea fertilizer, total yield

INTRODUCTION

Smallholder farmers in Ethiopia produce a lot of onions, mostly with irrigation, as a means of subsistence[1]. Due to the high economic value of onions in Ethiopia's lowland areas where irrigation water is available, the nation's production of onions is occasionally growing[1]. The central statistical agency of Ethiopia, reports that during the 2019-2020 cropping season, onions covered 36,373.48 hectares of land, with a total production of 273,858.98 ton[1]. During the 2019/2020 cropping season, 22.53 hectares of land were used for onion production, yielding a total production of 19,286.3 ton in the Southern Nations, Nationalities and Peoples (SNNP) regional state. At the national and regional levels, the average onion bulb yield is less than 8 ton/ha, which is significantly less than the glob average onion bulb yield of 20 ton/ha[1].

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Onion *(Allium cepa* L.*)* is a popular vegetable everywhere and its bulb is used raw, sliced for seasoning salads and cooked with other vegetables and meat. Onion is considerably important in the daily Ethiopian diet. All the plant parts are edible and the bulbs and the lower section of the stem are the most popular vegetables in stews. Onions are the second most valuable vegetable in the world following tomato. Because of their shallow and unbranched root system, onions are more prone to nutrient extraction than most crop plants, especially the immobile varieties. As a result, they require fertilizer addition and frequently respond well to it. In addition to being a crucial component of the vital photosynthetic molecule chlorophyll, nitrogen is also found in proteins, enzymes and vitamins found in plants[2]. Vegetables like onions need various nutrients to sustain their growth and development. Because of its shallow root system, onion especially requires a high level of soil fertility to support high yield. Though the amount of fertilizer required depends on the type of crops produced, the fertility status of the soil and the environmental conditions of the area, onion growers in Ethiopia including those in Dembyia District have been using the blanket recommendation of 200 kg/ha DAP (diammonium sulfate) and 150 kg UREA, which may not satisfy the nutrient requirements of onion plants[3]. Showing the phenomena of determining optimum and cost-effective combined application is very interesting for better yield of onion.

Ethiopia has a potential of 15 million hectares (Mha) of land which is suitable for irrigated agriculture. However, only about 4 to 5% is irrigated, with existing equipped irrigation schemes covering about 640,000 hectares[4]. Producing almost 40% of food and agricultural commodities on 17% of agricultural land, irrigated agriculture significantly contributes to food security[5]. Even though, Mareko District is one of the potential areas identified for irrigation in Central Ethiopia especially, for onion production. However, the optimum rate of fertilizer (UREA and NPS) under irrigation has not been studied yet. Therefore, this experiment was conducted to determine the optimum UREA and NPS fertilizer levels under furrow irrigated conditions in Mareko District Central Ethiopia Region.

MATERIALS AND METHODS

Description of the study site: The experiment was conducted during 2017 and 2018 in Mareko Districts under irrigation. The experimental site is located at a Latitude of 8°07'22" N and Longitude of 38°47'23"E, with an elevation of 1800 m above sea level. The treatments consisted of five UREA rates (0, 50, 100, 150 and 200 kg/ha) and five NPS rates (0, 50, 100, 150 and 200 kg/ha). The experiments were laid out in randomized complete block design in a factorial arrangement and replicated three times.

Experimental procedure

Land preparation and sowing: A nursery site was made and seedlings were raised on seedbeds of 1 m width and 5 m length for 45-49 days. Bombay red onion variety seed was sown by hand drilling in rows after mixing them with sand. After sowing, the seeds were covered with soil about 2 cm and watering was applied two times per day during early morning and late afternoon for consecutive days of 1 week. After 1 week water was made only once per day during late afternoon. Then 2 weeks after emergence, the plants were thinned to an appropriate spacing. Before transplanting the seedling, the main field was plough three times to smooth before transplanting because the roots of onion seedlings are very small and weak.

Treatments design and management: The treatments consisted of five UREA rates (0, 50, 100, 150 and 200 kg/ha) and 5 NPS rates (0, 50, 100, 150 and 200, kg/ha). The experiment was arranged in a randomized complete block design with three replications. Plot dimensions were 2×1.2 m = 2.4 m^2, with 0.5 m separating plots and 1.5 m separating blocks. The lottery method was used to arrange the treatments for every plot. On the day of transplantation, the full rate of NPS fertilizers and half of the N fertilizers were applied; the remaining half of the N was applied 6 weeks later. The seedlings were moved to plots that had been prepared. Each plot had six rows with a 20 cm inter-row gap, a 40 cm irrigation interval and a 10 cm intra-row gap. The needs of the crop were taken into consideration when applying irrigation and other cultural practices. The rows that were ready for the seedlings to be planted, covered with fine soil and irrigated were spaced 5 cm apart uniformly with fertilizers. Throughout the growth period, all cultural practices-including weeding, irrigation, cultivation and the management of diseases and pests-were carried out consistently.

Agronomic data collected: Data on growth parameters and bulb diameter were recorded at physiological maturity and harvesting. The 5 plants were randomly selected from each plot and growth and bulb diameters were measured. Plant height was measured in centimeter from the ground level to the top of mature leaf at half physiological maturity. The central 4 rows of each plot were harvested and the bulb weight was measured immediately using analytical balance and the mean weight was calculated. The diameters of 5 onion bulbs obtained from the harvested plants of each plot were measured at the widest portion of the bulb using a measuring tape. Onion plant height, bulb diameter and total yield of onion per plot were measured.

Statistical analysis: The field collected data were subjected to SAS 9.0 (statistical analysis software) least significant difference (LSD) at $p \leq 0.05$ was employed to determine the fertilizer rates of URES and NPS.

RESULTS AND DISCUSSION

The interaction effect of NPS*UREA*Yr revealed non-significant in plant height, bulb diameter and total yield of onion combined over two years (Table 1). Even though, the statistical analysis showed that the application of NPS fertilizer did not significantly affect the plant height of onion but had a significant effect on bulb diameter and onion yield (Table 1). The effect of UREA fertilizer application was non-significant on plant height, bulb diameter and yield of onion (Table 1). Though there is no statistical difference was observed, the treatments showed relative differences for the tested factors (UREA and NPS fertilizer rate) (Table 2). Showing the response of onion to UREA and NPS fertilizer rates has been stable over years in the area. This finding was in agreement with the finding of Aweke and Diriba-Shiferaw *et al.*[6] and Kitila *et al.*[7], who reported that the highest amount of marketable yield is obtained when the rate of optimum rate fertilizers causes a significant difference in the amount of bulb yield.

With regard to the mean response for tested parameters, the highest plant was obtained with the rate of 100 kg/ha of NPS (56.63[a]) and 200 kg/ha of UREA (56.16[a]) applied (Table 2). Plants without nitrogen fertilizer (control) were generally shorter than those plants supplied with increased levels of nitrogen fertilizer. The increase in height at the increased application of nitrogen could be attributed to its involvement as building blocks in the synthesis of amino acids, as they link together and form proteins and make up metabolic processes required for plant growth. Similar results were reported by resecrchers[6-10]. The primary reason for onions' favorable reaction to phosphorus fertilization was their weak root systems, which made it difficult for them to find and use phosphorus in the soil. Additionally, phosphorus is an essential component of nuclear proteins and is part of an enzyme system that is essential to the synthesis of other compounds from carbohydrates. Again, using the rate of 100 kg/ha of NPS (39.23[a]) and 100 kg/ha of UREA (38.44) gave the highest bulb diameter (Table 2). Larger bulb diameter onion due to nitrogen application is likely because nitrogen encourages cell elongation, above ground vegetative growth and to impart dark green color of leaves which may be linked to the increase in dry matter production and allocation to the bulb. On the other hand, phosphorus plays a role in cell division, so the combined application of nitrogen and phosphorus fertilizer leads to larger bulbs of onion plants. This result was in agreement with Aweke and Diriba-Shiferaw *et al.*[6], who reported that the bulb diameter significantly increased when the rate of NPSB rate increased from 0 to 75, 75 to 150 and 150 to 300 kg/ha. Similarly, Tadesse *et al.*[10] also reported that bulb diameter significantly increased when the rate of nitrogen increased.

Table 1: Mean square values of selected onion parameters tested using two factors combined over year

Source	DF	PH (cm)	BD (cm)	TY (ton/ha)
NPS	4	49.00^{ns}	32.91*	69.85*
UREA	4	3.48^{ns}	2.82^{ns}	17.78^{ns}
Rep	2	19.19^{ns}	8.23^{ns}	0.08^{ns}
NPS*UREA	16	15.77^{ns}	8.05^{ns}	16.60^{ns}
NPS*UREA*Yr	25	28.96^{ns}	16.01^{ns}	25.62^{ns}

*Indicates significant difference and 'ns' indicates a non-significant difference, DF: Degree of freedom, PH: Plant height in centimeter, BD: Bulb diameter in centimeter and TY: Total yield in tone per hectare

Table 2: Mean values of selected growth parameter and yield of onion at Mareko District combined years

	Parameter		
Factors	PH (cm)	BD (cm)	TY (ton/ha)
NPS (kg/ha)			
0	53.26^{b}	36.50^{b}	9.55^{b}
50	54.71^{a}	37.73^{ab}	23.99^{b}
100	56.63^{a}	39.23^{a}	27.18^{a}
150	54.48^{ab}	37.48^{ab}	26.39^{a}
200	55.72^{ab}	38.58^{a}	22.75^{b}
Mean	54.96	37.9	23.97
LSD	3.39^{ns}	1.77*	2.54
CV %	8.49	9.1	9.8
UREA (kg/ha)			
0	49.29^{c}	36.57	7.93^{b}
50	52.09^{b}	36.73	25.23^{a}
100	54.40^{ab}	38.44	28.02^{a}
150	52.22^{b}	36.55	21.20^{b}
200	56.16^{a}	37.93	25.48^{a}
Mean	52.83	37.24	23.57
LSD	6.87	Ns	5.45
CV%	6.73	14.61	31.17

Where Means with similar letters in the same columns are not significantly different, PH: Plant height in centimeter, BD: Bulb diameter in centimeter, TY: Total yield in tone per hectare, LSD: Least significance difference and CV: Coefficient of variations

The maximum total yield of onion was recorded from the treatment that gets 100 kg/ha NPS (27.18^{a}) and 100 kg/ha of UREA (28.02^{a}) as indicated in Table 2. The overall rise in onion yield is undoubtedly a result of the combined actions of plant nutrients (phosphorus and nitrogen). The use of fertilizers containing nitrogen and phosphorus, such as NPS, alters the pH of the soil, enhances the relationship between the soil and water and increases the availability of plant nutrients, such as P, Fe, Mn and Zn, all of which can raise the yield of onion bulbs. Nitrogen additionally stimulates the production of chlorophyll and enzymes, both of which support plant growth and development and enhance the yielding capacity of onion plants. Thus, an adequate supply of nutrients to plants is associated with vigorous vegetative growth, resulting in higher productivity of crops including onion. The result of this finding was consistent with the findings of Aweke and Diriba-Shiferaw *et al.*[6], Kitila *et al.*[7]and Sharma *et al.*[9] who reported that total bulb yield shows a significant increase in yield when the rate of nitrogen increases.

Plant nutrient management improvement has an important role in normal plant growth and development especially for the vegetative plant parts to give optimum yields. According to Assefa *et al.*[11] findings, using the optimum amount of fertilizer nutrients substantially increases the productivity of onion bulbs besides using improved cultivars. Because onion is one of the heavy feeders' vegetable crops, it requires more mineral fertilizers than other vegetables for bulb and shot growth[12]. According to Simon *et al.*[13] reports, three onion varieties have been tested at Humbo, Wolaita Zone; Ethiopia responded to different applications of nitrogen and phosphorous fertilizer rates. The finding revealed that the size and onion bulb yield have increased as the level of nitrogen and phosphorous were increased which implies that the optimum nutrient management has a positive contribution to yield improvement of onion production and productivity, especially for those areas where a nutrient deficiency is critical. Yohannis *et al.*[12] also reported a similar finding on the effects of combined application of nitrogen and farmyard manure which has increased the onion bulb yield at Jimma environmental condition.

Moreover, the vertisoil of Shewa-Robit Northeast Ethiopia was used to study the effects of nitrogen and phosphorus on onion yield and yield components. The vertisoil responded to varying fertilizer rates and recommendations were made based on the maximum yield attained[14].

Economic analysis: A partial budget is a way of calculating the total costs that vary and the net benefits of each treatment. From the result of this study, the average yield of 16 treatments was obtained. According to the International Maize and Wheat Improvement Center (CIMMYT)[15] the average yield was adjusted downwards by 10%. This is the reason that researchers have assumed that using the same treatments the yields from the experimental plots and farmers' fields are different, thus average yields should be adjusted downward. Based on this, the recommended level of 10% was adjusted from all 25 treatments to get the net yield. In addition to this, to obtain the gross field benefits, it is essential to know the field price value of 1 kg of onion bulb during harvesting time. Then finally, the adjusted yield was multiplied by the field price to obtain the gross field benefit of the onion. For the different treatment combinations, the total costs and net benefits were calculated. The different costs of this experiment which include costs for UREA and NPS are varied among the different treatments. The purchasing prices of UREA and NPS were 13.5 and 14 birr/kg. The field price of onion during the harvesting season was 12 birr/kg. To obtain net benefit all the variable costs were subtracted from gross benefit. The partial budget analysis revealed, the highest net benefit of 248,050 birr with higher cost was recorded from the combination of 100 kg/ha UREA and 100 kg/ha NPS per hectare, which was followed by a net benefit of Birr 165,900 from the treatment combination of 0 kg/ha UREA and 150 kg/ha NPS per hectare (Table 3).

To calculate the Marginal Rate of Return (MRR), the dominance analysis was carried out by listing the treatments to increase the total variable cost. According to Getent *et al.*,[15] any treatments that have a net benefit less or equal to the previous treatment were dominated and eliminated from further analysis. Thus,

Table 3: Partial budget analysis for combined nitrogen and phosphorus fertilizer at Mareko During 2018

Treatment (NPS: UREA)	TY (ton/ha)	GB (Birr/ha)	VC (Birr)	NB (Birr/ha)	Rank
T1 (0:0)	7.10	85,200	0	85,200	23
T2 (0:50)	10.00	120,000	675	119,325	8
T3 (0:100)	10.30	123,600	1350	122,250	7
T4 (0:150)	8.70	104,400	2025	102,375	14
T5 (0:200)	8.10	97,200	2700	94,500	21
T6 (50:0)	7.80	93,600	700	92,900	22
T7 (50:50)	6.50	78,000	1375	76,625	24
T8 (50: 100)	8.40	100,800	2050	98,750	19
T9 (50:150)	9.00	108,000	2725	105,275	12
T10 (50:200)	9.60	115,200	3400	111,800	9
T11 (100:0)	9.00	108,000	1400	106,600	11
T12 (100:50)	8.70	104,400	2075	102,325	15
T13 (100:100)	20.90	250,800	2750	248,050	1
T14 (100:150)	8.7	104,400	3425	100,975	16
T15 (100:200)	11.80	141,600	4100	137,500	3
T16 (150:0)	14.00	168,000	2100	165,900	2
T17 (150:50)	10.60	127,200	2775	124,425	5
T18 (150:100)	8.70	104,400	3450	100,950	17
T19 (150:150)	8.50	102,000	4125	97,875	20
T20 (150:200)	7.50	90,000	4800	85,200	23
T21 (200:0)	10.60	127,200	2800	124,400	6
T22 (200:50)	9.30	111,600	3475	108,125	10
T23 (200:100)	11.80	141,600	4150	137,450	4
T24 (200:150)	9.00	108,000	4825	103,175	13
T25 (200:200)	8.70	104,400	5500	98,900	18

TY: Total yield, GB: Gross benefit, VC: Variable cost and NB: Net benefit

Table 4: Dominance analysis for onion influenced by nitrogen and phosphorus combined application at Mareko During 2018

Treatment (NPS: UREA)	TVC (ETB/ha)	NB (ETB/ha)	Dominance
T1 (0:0)	0	85,200	-
T2 (0:50)	675	119,325	-
T3 (0:100)	1350	122,250	-
T4 (0:150)	2025	102,375	D
T5 (0:200)	2700	94,500	-
T6 (50:0)	700	92,900	D
T7 (50:50)	1375	76,625	-
T8 (50: 100)	2050	98,750	-
T9 (50:150)	2725	105,275	-
T10 (50:200)	3400	111,800	-
T11 (100:0)	1400	106,600	D
T12 (100:50)	2075	102,325	-
T13 (100:100)	2750	248,050	-
T14 (100:150)	3425	100,975	D
T15 (100:200)	4100	137,500	-
T16 (150:0)	2100	165,900	-
T17 (150:50)	2775	124,425	D
T18 (150:100)	3450	100,950	-
T19 (150:150)	4125	97,875	D
T20 (150:200)	4800	85,200	-
T21 (200:0)	2800	124,400	-
T22 (200:50)	3475	108,125	D
T23 (200:100)	4150	137,450	-
T24 (200:150)	4825	103,175	D
T25 (200:200)	5500	98,900	-

TVC: Total variable cost, NB: Net benefit, ETB: Ethiopian birr and D: Dominant

Table 5: Marginal rate of return of onion influenced by nitrogen and phosphorus combined application at Mareko During 2018

Treatment (NPS: UREA)	TVC (ETB/ha)	NB (ETB/ha)	MRR (%)	Rank
T1 (0:0)	0	85,200	0	-
T2 (0:50)	675	119,325	5,056	3
T3 (0:100)	1350	122,250	433	14
T5 (0:200)	2700	94,500	2,056	7
T7 (50:50)	1375	76,625	1,349	10
T8 (50:100)	2050	98,750	3,278	5
T9 (50:150)	2725	105,275	967	12
T10 (50:200)	3400	111,800	967	12
T12 (100:50)	2075	102,325	715	13
T13 (100:100)	2750	248,050	21,589	1
T15 (100:200)	4100	137,500	8,189	2
T16 (150:0)	2100	165,900	1,420	9
T18 (150:100)	3450	100,950	4,811	4
T20 (150:200)	4800	85,200	1,167	11
T21 (200:0)	2800	124,400	1,960	8
T23 (200:100)	4150	137,450	967	12
T25 (200:200)	5500	98,900	2,856	6

TVC: Total variable cost, NB: Net benefit, ETB: Ethiopian birr and MRR: Marginal rate of return

treatment combination of 0:150 NPS: UREA kg/ha, 50:0 NPS: UREA kg/ha, 100:0 NPS: UREA kg/ha,150: 50 NPS: UREA kg/ha and 150:150 NPS:UREA kg/ha, 200:50 NPS:UREA kg/ha and 200:150 NPS:UREA kg/ha were dominated and eliminated for further analysis (Table 4).

The minimum acceptable Marginal Rate of Return (MAR%) should be between 50 and 100%. Thus, the current study indicated that marginal rate of return is higher than 100% (Table 5). This showed that all the treatment combinations are economically important as per the MRR is greater than 100%. Hence, the most economically attractive combinations for small-scale farmers with low cost of production and higher benefits were in response to the application of 100:100 NPS:UREA kg/ha fertilizer combination with an acceptable marginal rate of return.

Overall, the present finding highlights, the importance of determining the optimum inorganic fertilizer for maximum onion yield under irrigation in potential areas of Central Ethiopia Regions. Again, it has given information on the importance of using the optimum rate of UREA and NPS for economically attractive especially, for small-scale farmers with an acceptable marginal rate of return in the study area. The current study lacks soil data analysis and is specific to one location that should be addressed in the future. Indeed, the study has practical implications for small-scale farmers especially, those found in the study area to boost the yield of onions and get an acceptable marginal rate of return.

CONCLUSION

The study revealed different performances of onions to the effect of combined applications of NPS and UREA under irrigation. The maximum total onion yield of 28.02 ton/ha was obtained at a rate of 100:100 NPS:UREA kg/ha combination. With regard to partial budget analysis, the most economically attractive combinations for small-scale farmers were in using the rate of 100:100 NPS:UREA kg/ha combination with an acceptable marginal rate of return. Therefore, the application of 100:100 NPS:UREA kg/ha can be used for the study area and similar agroecologies under irrigation. The optimum and cost-effective organic fertilizer (NPS and UREA) combined for better onion yield should be further used for PVS and demonstration study in the future. For confirmation of the results, the trial should be repeated across different locations in the future.

SIGNIFICANCE STATEMENT

In the Central Ethiopian Region, onions are one of the most significant vegetable crops that are grown with irrigation. Applying fertilizer is a crucial input to boost vegetable yields, especially onion yields. The interaction effect of NPS, UREA and year revealed that it was not significant on plant height, bulb diameter and total yield of onion combined over two years. The present study will contribute the basic information for horticulturists and irrigation agronomy professionals for further study in onion crops for agronomic and pre-extension study in the considered areas. One of the most important thing is the optimum and cost-effective combined inorganic fertilizer for better onion production was identified for further PVS and demonstration study in the future.

REFERENCES

1. Ergicho, G.F. and T.W. Hogago, 2023. Participatory variety evaluation and selection of improved onion (*Allium cepa* L.) varieties for bulb yield under supplementary irrigation condition at Basketo Special District, Southern Ethiopia. Int. J. Sci. Res. Arch., 9: 186-193.
2. Marschner, H., 1995. Mineral Nutrition and Yield Response. In: Mineral Nutrition of Higher Plants, Marschner, H. (Ed.), Academic Press, United States, ISBN: 978-0-12-473542-2, pp: 184-200.
3. Nigatu, M., M. Alemayehu and A.H. Sellassie, 2018. Optimum rate of NPS fertilizer for economical production of irrigated onion (*Allium cepa* L) in Dembyia District of Amhara Region, Ethiopia. Ethiopian J. Sci. Technol., 11: 113-127.
4. Kassa, M. and T.G. Andualem, 2020. Review of irrigation practice in Ethiopia, lessons from Israel. Irrig. Drain. Syst. Eng., Vol. 9. 10.37421/idse.2020.9.242.
5. FAOUN, 2011. The State of the World's Land and Water Resources for Food and Agriculture: Managing Systems at Risk. Earthscan, London, United Kingdom, ISBN: 9781849713269, Pages: 285.
6. Aweke, A. and G. Diriba-Shiferaw, 2024. Growth, yield and economic advantage of onion (*Allium cepa* L.) varieties in response to NPSB fertilizer and planting pattern. Int. J. Hortic. Agric. Food Sci., 8: 1-13.
7. Kitila, C., A. Abraham and S. Shuma, 2022. Growth and bulb yield of some onion (*Allium cepa* L.) varieties as influenced by NPS fertilizer at Dambi Dollo University Research site, Western Ethiopia. Cogent Food Agric., Vol. 8. 10.1080/23311932.2022.2097606.
8. Molla, A., D. Belew and E.G. Seyum, 2020. Effect of blended (NPSB) fertilizer rate on growth and yield of onion (*Allium cepa* L.) varieties at Gubalafto District, North-Eastern Ethiopia. Agric. Biol. Res., 36: 33-38.

9. Sharma, G.P., R.S. Dhaka, U.S. Tanwar and V.S. Meena, 2022. Effect of nitrogen and sulphur levels on growth and yield of *Rabi* onion (*Allium cepa* L.). Pharma Innovation J., 11: 5697-5701.
10. Tadesse, T., P.D. Sharma and T. Ayele, 2022. Effect of the irrigation interval and nitrogen rate on yield and yield components of onion (*Allium cepa* L.) at Arba Minch, Southern Ethiopia. Adv. Agric., Vol. 2022. 10.1155/2022/4655590.
11. Assefa, A.G., S.H. Misgina and Y.W. Abrha, 2015. Effect of inorganic and organic fertilizers on the growth and yield of garlic crop (*Allium sativum* L.) in Northern Ethiopia. Int. J. Sci. Res., 7: 80-86.
12. Yohannes, K.W., D. Belew and A. Debela, 2013. Effect of farmyard manure and nitrogen fertilizer rates on growth, yield and yield components of onion (*Allium cepa* L.) at Jimma, Southwest Ethiopia. Asian J. Plant Sci., 12: 228-234.
13. Simon, T., M. Tora, A. Shumbulo and S. Urkato, 2014. The effect of variety, nitrogen and phousphorous fertilization on growth and bulb yield of onion (*Allium cepa* L.) at Wolaita, Southern Ethiopia. J. Biol. Agric. Healthcare, 4: 89-96.
14. Abdissa, Y., T. Tekalign and L.M. Pant, 2011. Growth, bulb yield and quality of onion (*Allium cepa* L.) as influenced by nitrogen and phosphorus fertilization on vertisol L. growth attributes, biomass production and bulb yield. Afr. J. Agric. Res., 6: 3252-3258.
15. Getnet, B., Y. Melkamu and K. Abebe, 2024. Yield of onion (*Allium cepa* L.) as influenced by nitrogen and phosphorus fertilizer rates at Alage, Central Rift Valley of Ethiopia. Agric. Biol. Res., 40: 1170-1177.