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Research Article

COMPARATIVE STUDY OF THE EFFECTS OF ORGANIC AND INORGANIC FERTILIZERS ON THE GROWTH AND YIELD OF ONION (*ALLIUM CEPA* L.) IN SOMALIA

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ABSTRACT. This field study examined the effects of organic and inorganic fertilizers on the growth and yield of onions (*Allium cepa* L.), specifically the Yemen (Hadramout) Red Onion Variety, at the Agriculture Faculty of Zamzam University of Science and Technology in Somalia during the beginning of the winter season in 2021. The experiment followed a Randomized Complete Block Design (RCBD) with three replications and three treatments: organic fertilizer (Chicken dung and Compost) at 100kg/ha, inorganic fertilizer (NPK and DAP) at 100kg/ha, and zero control (no fertilizer). The study aimed to identify the effects of these fertilizers on onion growth and yield production, as well as to determine their efficiency. Various parameters were measured, including plant height, number of leaves, leaf length, days to maturity, average bulb weight with leaves, average bulb weight without leaves, and yield (Kg/ha). The data were analyzed using MSTATC. Results showed significant differences among treatments, particularly in bulb weight with leaves (g), bulb weight without leaves (g), and yield (kg/ha). The second treatment (inorganic fertilizer at 100kg/ha) recorded the highest yield (5,624.667 kg/ha), while the lowest yield (2,416.167 kg/ha) was observed in the first treatment (Zero control). The third treatment (Organic control at 100kg/ha) recorded the highest number of leaves (4.943). In conclusion, applying 100kg/ha of inorganic fertilizer (NPK and DAP) to the Yemen (Hadramout) Red Onion Variety in Somalia significantly increased both growth and yield.

Keywords: *Onion, Organic fertilizer, Inorganic fertilizer, Growth, yield*

INTRODUCTION

Onion (*Allium cepa* L.), a crop in the family of Amaryllidaceae, is the most important cultivated bulb crop of the *Allium* genus, which comprises over 850 species [1, 2, 3, 4]. The Near East and the Mediterranean area are secondary centers of origin for onions, with Central Asia as the primary source. Subsequently, they have extensively spread to numerous countries across the globe from these origin centers [5]. This crop is widely used as a vegetable; the bulb can be eaten raw, sliced to flavor salads, or cooked along with other vegetables and meat. Globally, onion is a product that can be influenced by speculations all over the world [6, 7]. Onions rank as the second most-produced vegetable in the world, surpassed only by tomatoes [8]. Currently, onion cultivation is widespread, spanning across over 140 countries. India and China are the primary global producers of onions, with Egypt, the USA, Turkey, Pakistan, Bangladesh, Sudan, Indonesia, and Iran following closely in onion production (Table 1), While the world's top onion-importing countries are Saudi Arabia, Japan, the UK, Malaysia, the Russian Federation, and

Bangladesh [9]. The top exporters of onions were China ($2.58B), Netherlands ($914M), Spain ($697M), Mexico ($473M), and India ($471M) [10].

Table 1. *Top 10 countries of Onion production in the world [9].*

Ranks	Country	Production in (000) MT
1	India	26,641.00
2	China	24,163.90
3	Egypt	3,312.47
4	USA	3,102.28
5	Turkey	2,500.00
6	Pakistan	2,305.70
7	Bangladesh	2,268.75
8	Sudan	2,050.77
9	Indonesia	2,004.59
10	Iran	1,925.40

Onions are difficult to grow in Africa because they produce small green plants with no bulbs. When it is compared to its original environment of Iran and Central Asia, this is entirely due to a harsh climate and shorter day lengths [11, 12, 13]. In terms of both domestic consumption and exports, Onions rank third in importance among Egypt's agricultural exports, after potatoes and oranges [14, 15]. Onions thrive in a broad spectrum of climatic conditions, ranging from mildly hot and dry to moderately cool and humid environments [16]. It is a short-season crop grown at low latitudes in horticulture [17]. Indeed, genetic factors play a crucial role in influencing the variability of various traits, marking differences among cultivars. Variations in morphophysiological traits, photoperiod needs, and bulb size, shape, colour, and quality are all influenced by these genetic factors [18, 19, 20]. The primary factor influencing the yield and quality of onions is mineral nutrition. Since plants are more likely to have deficits in nitrogen, phosphorus, and potassium than in other necessary nutrients, and because they are more heavily absorbed from the soil than other nutrients, these elements are referred to as primary macronutrients [21, 22, 23, 24]. Although, A staple of many African sauces and relishes are onion bulbs [25]. Because of its highly prized aroma, scent, and unique taste—as well as the therapeutic properties of its flavouring ingredients—It is termed as the "Queen of the kitchen" [26, 27, 28]. Onion is used throughout the year, for different uses, which are helpful to the Mankind. Since ancient times, people have valued onions (*Allium cepa* L.) as food and medicinal plants. [29]. Moreover, Onions have a distinct flavor, aroma, and taste that can be attributed to sulphur compounds and essential oils. Iron, manganese, calcium, magnesium, phosphorus, and carbohydrates are rich in onion bulbs. Antioxidants, protein, and vitamins C and B6 are also present [30, 31, 32]. Sliced raw onions, with their antibacterial qualities, can help prevent the contamination of salads by bacteria, protozoa, and helminths [33, 34]. Onion has been linked to numerous health benefits, including the treatment of renal failure [35, 36], antidiabetic, hypotensive, and hypolipidemic effects [37, 38, 39], as well as a reduction in blood uric acid [40]. Furthermore, a various studies have demonstrated the protective effects of onions and their primary constituents in a range of organs and tissues, such as blood [41], bone marrow [42], heart [43], liver [44, 45, 46] testis [47], kidney [48], gut [49], and brain [50], while some researchers highlighted that onion can be against aging, and cancer prevention [51, 52]. It’s also one of the most consumed vegetable crops in our country (Somalia),

with that in mind the onion crop is grown in some parts of the country and Somali farmers use different varieties of Onion with expensive inorganic fertilizers to meet the people's needs of onion, so there are more problems with using mineral fertilizers which leads to degradation of soil structure and decrease in soil aggregation results in nutrients are easily lost from soils through fixation, leaching, gas emission and also can lead to diminishing fertilizer efficiency. Additionally, Somali farmers tend to apply excessive amounts of mineral fertilizers, which can harm decomposers and other beneficial soil organisms, posing a hazard to soil ecology. When soil degradation occurs over time, the productivity of the soil will ultimately cease. Furthermore, excessive use of mineral fertilizer harms not only the physical environment and human health but also the health of the soil. After observing these issues, the researchers decided to conduct a comparative study of the effects of organic and inorganic fertilizers on onion (*Allium Cepa* L.) growth and yield, to advise Somali farmers to use the most effective fertilizer (organic or inorganic) with the highest productivity to meet their onion needs, thus, this study seeks the appropriate fertilizer (organic or inorganic) for the highest maximum yield.

MATERIALS AND METHODS

Study Area and Duration

This study was carried out at the Agricultural Experimental and Research Center, part of the Faculty of Agriculture at Zamzam University of Science and Technology, from December 2021 to May 2022, during the beginning of the winter season. The center is located in the Garasbaalley area, which falls administratively under Benadir Region. Garasbaalley is situated at longitude of 45.16°E and a latitude 2.04°N, to the west of Mogadishu, Somalia. The findings of the soil test carried out by SATG in 2021 showed that there was 1.39 mg/kg of organic matter, 2.50 mg/kg of sulphur, 59 mg/kg of nitrogen, 27 mg/kg of potassium, and 0.27 mg/kg of phosphorus. The pH was measured at 7.71, and the soil was characterized as shallow with a high clay content.

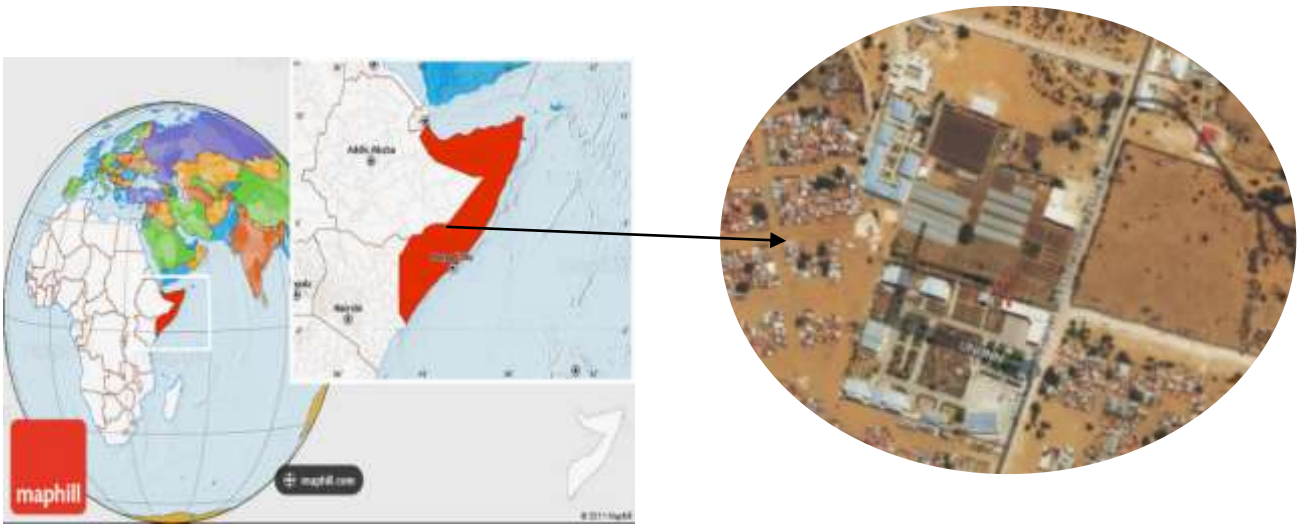

Figure 1. The Garasballey Area [53].

Research Design and Treatment

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications and three treatments. The overall size of the experimental field was 13 m Long and 12.5 m wide, bringing the total area of 162.5 m², with spacing of 70 cm between replications. Each replication consisted of 3 plots, making a total of 9 plots across all replications. Each plot comprised 9 rows, with a row length of 4 m and width of 3.6 m, resulting in a plot area of 14.4 m² and spacing of 33.3cm between Plots. The experiment evaluated the Yemen Red Onion variety with a spacing of 30 cm x 30 cm between rows and plants.

Experimental Procedure

Land clearing, utilizing hoes, rakes and other small equipment was carried out on 13 October 2021. Field measurement began on October 28, 2021, using tape. On the same day, land preparation including land levelling and Plot Formation was done by hand using hoes, to eliminate any debris, weeds, and residue from the previous crop. Subsequently, the field was ploughed using hand hoes, shovels, rakes, and spade. Soil sampling and testing occurred from 28 December 2021 to 4 January 2022. The installation of drip irrigation system in the main plots took place on 20 January 2022. The germination test and sowing date occurred on 1 December 2021, in the Nursery, where 70.5% of the total seeds germinated within 6 to 7 days. Following germination, the onion seedlings in the nursery were divided into three groups: organic, inorganic, and zero control. The first rate of organic fertilizer was conducted on 22 January 2022 during the transplanting period, the second rate was done on 3 March 2022, after one month of transplanting, and on 10 April 2022, before the Bulb Formation stage, as top and side dressing on the organic plots, using 100 kg/ha of chicken dung and compost as a source of organic fertilizer. For the inorganic plots, the first application of fertilizer occurred on 2 February 2022, after 10 days of transplanting. Additional applications were made 3 March 2022, after one Month of transplanting, and the last rate was done 10 April 2022, before the bulb Formation Stage, as Side dressing on the inorganic plots with the amount of 100 kg/ha, NPK (46-0-13) and DAP (18-46-0) were used as the source of inorganic Fertilizer and the control onion group received zero fertilizer. Intercultural operations were performed according to the assigned treatments, and various intercultural practices were implemented to ensure and maintain the normal growth and production of the Onion. when 70% of the plants showed the symptom of maturity, such as yellowing and Collapse of leaves, 18 plants were independently harvested from each plot, and they were appropriately tagged to prevent any mixture among the treatments.

Data Collection Method

Data were recorded for various parameters, including plant height, number of leaves, leaf length, days to maturity, average bulb weight with leaves, average bulb weight without leaves and yield (Kg/ha) from these harvested plants. The data collected for various parameters were tabulated. The Master of Statistics software, MSTATC, was used to perform the analysis of variance (ANOVA) with Standard Error (Se ±) and comparison by least significant difference (LSD).

RESULTS AND DISCUSSION

Treatments have not shown a significant effect on plant height (Table 1). The tallest plant height (40.387 cm) was recorded in treatment 2 (inorganic control) at the rate of 100 kg/ha, followed insignificantly by treatment 3 (organic control) at the same rate (38.187 cm), while lowest plant height (30.650 cm) was founded in treatment 1 (zero Control). The population mean of the treatments in plant height was 36.408 cm. Among the three treatments studied, two of them (inorganic control and organic control) showed heights higher than population mean. The results indicate that both organic and inorganic control affect the height of the onion plants. Similar results were suggested by different researchers, including [54] who found that the plant height in the control plot was significantly ($P < 0.01$) shorter by 37–41 cm from onion. Additionally, [55] highlighted plant height in different treatments ranging from 22.17 to 40.25 cm, and [56] reported heights from 44.15 to 59.05 cm. Our result, [57], falls within close range of 36.7-43.6.

Table 1: *Morphological Parameters*

Treatments	Plant height(cm)	No of Leaves	Leaf length(cm)	Days to maturity
Zero Control (T1)	30.650 A	4.480 A	25.093 A	87.867 A
Inorganic Control (T2)	40.387 A	4.350 A	30.223 A	86.037 A
Organic Control (T3)	38.187 A	4.943 A	28.850 A	86.200 A
Se±	4.0369	0.4534	1.7550	1.0967
Lsd	11.21	1.258	4.87	3.045
Sig.Level	**NS**	**NS**	**NS**	**NS**
Cv%	13.58%	12.10%	7.66%	1.55%

Values having same letters do not significantly different, * = significant at 5% level, NS = non significance, Se±= Standard Error of a Mean, CV= coefficient variation.

The number of leaves per plant showed insignificantly difference across treatments (Table 1). The treatment with the greatest number of leaves (4.943) was treatment 3 (organic control) at the rate 100 kg/ha, while the lowest number of leaves per plant (4.350) was found in treatment 2 (inorganic control) at the same rate. The results indicate that organic control has an affects on the number of leaves in onion plants, consistent with findings reported by [58]. As [59] also highlighted that organic treatments result in a higher number of leaves in onion plants compared to inorganic and zero treatments.

In terms of leaf length, there was no significant difference among treatments. The longest leaf length among the treatments (30.223 cm) was recorded in the treatment 2 (inorganic control) at the rate of 100 kg/ha, followed by treatment 3 (organic control) at the same rate (28.850 cm), while the shortest leaf length (25.093 cm) was found in treatment 1 (Zero Control). The population mean of the treatments in leaf length for onion was 28.055cm. Two of the three treatments studied (inorganic control and organic control) showed lengths higher than population mean. This aligns with findings from [60], documenting that inorganic control affects Leaf length of the onion plants more than organic Control, in line with our results showing that organic control affects Leaf length of the onion plants less than inorganic control. Moreover, [61] reported leaf length ranging from 21.16 to 32.00 which is similar to our findings.

Days to maturity also showed no significant difference among treatments (Table 1). The longest days to maturity (87.867) was recorded from treatment 1 (zero control), followed by treatment 3 (organic control) (86.200) and the shortest period of days to maturity was observed from treatment 2 (inorganic control) (86.037). [58, 62, 63] declared that organic and inorganic treatments significantly (P <0.01) influenced days to maturity of onions.

Table 2: *Yield Parameters*

Treatments	**Bulb weight with leaves (g)**	**Bulb weight without leaves(g)**	**Yield kg/ha)**
Zero Control (T1)	24.403 B	17.457 B	2,416.167 B
Inorganic Control (T2)	47.867 A	40.533 A	5,624.667 A
Organic Control (T3)	38.013 A	29.903 A	4,147.933 A
Se±	3.9117	4.1304	575.67
Lsd	10.86	11.46	1598.30
Sig.Level	*	*	*
Cv%	13.03%	17.27%	17.35%

Values having same letters do not significantly different, * = significant at 5% level, NS = non significance, Se±= Standard Error of a Mean, CV= coefficient variation.

The analysis of variance indicated significant differences in bulb weight with leaves (g) among the different treatments in onion production (Table 2). The highest mean value of bulb weight with leaves was observed in treatment 2 (inorganic control) at 47.867 g, followed by organic control at 38.013 g, with the lowest mean value recorded in zero control at 24.403 g. The bulb weight with leaves(g) across the treatments ranged from 47.867 g to 24.403g. The population mean of the treatments in bulb weight with leaves(g) was 36.761g, with two treatments (inorganic Control and organic Control) surpassing this mean. [59] reported a bulb weight range of 19.94 to 50.60g in different treatments, while [64] found a range 10.53-26.26.

Similarly, significant variations were observed in bulb weight without leaves (g) among the treatments (Table 2). Treatment 2 (inorganic control) yielded the highest weight of bulb without leaves at 40.533 g, followed by treatment 3 (organic control) at 29.903 g, while the smallest mean value was recorded in treatment 1 (zero control) at 17.457 g. The bulb weight without leaves (g) across treatments ranged from 40.533 g to 17.457 g. The population mean of the treatments in bulb weight without leaves (g) was 29.29 g, with two treatments (inorganic control and organic control) exceeding this mean. The effect of inorganic treatments on onion bulb weight were documented by [65, 66].

Finally, there were significant differences between yield under the different treatments of onion production (Table 2). Treatment 2 (inorganic control) had the greatest mean yield value at 5,624.667 kg/ha, followed by treatment 3 (organic control) at 4,147.933 Kg/ha, and the lowest mean value was obtained by treatment 1 (zero control) at 2,416.167 kg/ha. The yield (Kg/ha) of the treatments ranged from 5,624.667 kg/ha to 2,416.167 kg/ha. The population mean of the treatments in yield (Kg/ha) was 4,082.922 kg/ha. Among the three treatments studies two of them (inorganic control and organic control) obtained higher than population mean. Some treatments in [54, 64, 67] found results which is so close our findings when compared to [55, 68]. The variation in yield observed across the different studies may be related to the climatic or genotypic factors.

CONCLUSION

The study aimed to examine the growth and yield of onions (*Allium cepa* L.) using organic and inorganic fertilizers. The onion crops investigated in the current study showed significantly in various growth and yield parameters, such as bulb weight with leaves, bulb weight without leaves, and yield per hectare (kg/ha), While, the parameters, including plant height, number of leaves, leaf length, and days to maturity, showed statistically insignificant differences.

In terms of bulb weight with leaves, bulb weight without leaves and yield per hectare (kg /ha), the highest Mean levels were exhibited by treatments 2 (inorganic Control), followed by treatment 3, while the lowest Mean level was recorded in the treatment 1 (zero Control). Regarding the number of leaves, treatment 3 (organic control) recorded the highest and longest among the treatments, with treatment 1(zero Control) showing the lowest number of leaves. Days to Maturity were the longest in treatment 1, followed by treatment 2, while the lowest mean duration was documented in treatment 2. In terms of Plant height and leaf length, treatment 2 showed the best and longest measurements, followed by treatment 3, whereas the lowest Mean levels of plant height and leaf length were observed treatment.

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REFERENCES

[1] Fu, J., et al. (2019). Identification and characterization of abundant repetitive sequences in *Allium cepa*. Scientific reports, 9(1), 16756.

[2] Huo, Y., et al. (2019). Complete chloroplast genome sequences of four *Allium* species: comparative and phylogenetic analyses. Scientific reports, 9(1), 12250.

[3] Mehta, I. (2017). Origin and History of Onions. IOSR Journal of Humanities and Social Science (IOSR-JHSS, 22(9). https://doi.org/10.9790/0837-2209130710.

[4] Dorrigiv, M., Zareiyan, A., &, Hosseinzadeh, H. (2021). Onion (*Allium cepa*) and its Main Constituents as Antidotes or Protective Agents against Natural or Chemical Toxicities: A Comprehensive Review. Iranian Journal of Pharmaceutical Research: IJPR, 20(1), 3–26. https://doi.org/10.22037/ijpr.2020.112773.13940.

[5] Astley D. Innes NL, & QP., V. d. M. (1982). Genetic resources of *Allium* species: A global report. International Board for Plant Genetic Resources, Rome. .

[6] Hanci, F. (2018). A Comprehensive Overview of Onion Production: Worldwide and Turkey. Journal of Agriculture and Veterinary Science, 11(9), 17–27. https://doi.org/10.9790/2380-1109011727.

[7] Hossain, M. M., et al. (2017). Quality Seed of Onion: Effect of Micro and Macronutrients. Annual Research & Review in Biology, 20(6), 1-11. https://doi.org/10.9734/ARRB/2017/38172.

[8] Yusupov, Z., et al. (2021). Phylogenomics of *Allium* section *Cepa* (Amaryllidaceae) provides new insights on domestication of onion. Plant Diversity, 43(2), 102-110.

[9] FAO. (2021). World onion production, Food and Agriculture Organization of the United Nations.). Rome, Italy.

[10] OEC. (2021). Onions (HS: Onions,) Product Trade, Exporters and Importers. The Observatory of Economic Complexity. https://oec.world/en/profile/hs/onions.

[11] Etana, M., Aga, M., & Fufa, B. (2019). Major Onion (*Allium cepa* L.) Production Challenges in Ethiopia: A Review.
[12] Baudoin, W., Ba, M. L. a., & Jeangille, P. (1994). Onion production and constraints in the sahlian countries of Africa. Acta Hortic. 358, 37-42. https://doi.org/10.17660/ActaHortic.1994.358.4.
[13] R.k. Birithia, S. S. a., & Kuria, D. k. (2021). Farmers' preference for onion varieties and implications of knowledge of Iris yellow spot disease in Kenya. African Crop Science Journal, Vol. 29, No. 2, pp. 229 - 239.
[14] Guesh, T. (2015). Growth, Yield, and Quality of Onion (*Allium Cepa* L.) As Influenced by Intra-Row Spacing and Nitrogen Fertilizer Levels in Central Zone of Tigray, Northern Ethiopia.
[15] El-Fakhrany, W., & Fathalla, F. H. (2020). Utilization of the Two-Wheel Tractor in Onion Digging Operation. Journal of Soil Sciences and Agricultural Engineering, 11(11), 609–615. https://doi.org/10.21608/jssae.2020.135648.
[16] Kariuki, & Kimani. (1994). Yield and storage potential of onion cultivars in Kenya. In Proceedings of the 1st Eastern African Regional Alliums Workshop. (H. D Rabinowitch, P. M. Kimani and R. Peters, ed.), pp.50–56. Nairobi, Kenya, 21–22 Sept. 1994. .
[17] Brewster, J. (1994). Onion and Other Vegetable Alliums, Crop Production Sciense Horticulture 3. Cambridge: CAB International.
[18] Yang, J., Meyers, K. J., van der Heide, J., & Liu, R. H. (2004). Varietal differences in phenolic content and antioxidant and antiproliferative activities of onions. Journal of Agricultural and Food Chemistry, 52(22), 6787–6793. https://doi.org/10.1021/jf0307144.
[19] Schwinn, K. E., et al. (2016). The Onion (*Allium cepa* L.) R2R3-MYB Gene MYB1 Regulates Anthocyanin Biosynthesis. Frontiers in Plant Science, 7. https://doi.org/10.3389/fpls.2016.01865.
[20] El-Shafie, M., & Davis, G. (1967). Inheritance of bulb color in the onion (*Allium cepa* L.). Hilgardia, 38(17), 607–622.
[21] Amare, G. (2020). Review on Mineral Nutrition of Onion. The Open Biotechnology Journal, 14(1). https://doi.org/10.2174/1874070702014010134.
[22] Greenwood DJ, et al. (1980). Comparison of the effects of nitrogen fertilizer on the yield, nitrogen content and quality of 21 different vegetable and agricultural crops. The Journal of Agricultural Science. 1980;95(2):471-485. https://doi.org/10.1017/S0021859600039514
[23] Batista, F., et al. (2021). Split fertilization of phosphate in onion as strategy to improve the phopsphorus use efficiency. Scientia Horticulturae, 290, 110494–110494. https://doi.org/10.1016/j.scienta.2021.110494.
[24] Marrocos, S. D. T., Grangeiro, L. C., Sousa, V. D. F. L. D., Ribeiro, R. M. P., & Cordeiro, C. J. (2018). Potassium fertilization for optimization of onion production. Revista Caatinga, 31(2), 379–384. https://doi.org/10.1590/1983-21252018v31n214rc.
[25] Belay, S., Mideksa, D., Gebrezgiabher, S., & Seifu, W. (2015). Effect of Intra-row spacing on Growth and Yield Components of Adama Red onion (*Allium cepa* L.) Cultivar under Irrigation in Fiche, North shoa Ethiopia J. Harmoniz. Res. Appl. Sci. 2015, 3(4), 231-240.
[26] Greeshma KP, S Muthulingam, R Thamizselvi, & Venkatamani., G. P. (2020). Phytochemical analysis and a review on biological importance of *Allium cepa.* L. GSC Advanced Research and Reviews, 2(2), 018–024. https://doi.org/10.30574/gscarr.2020.2.2.0004.
[27] Griffiths, G., Trueman, L., Crowther, T., Thomas, B., & Smith, B. (2002). Onions? A global benefit to health. Phytotherapy Research, 16(7), 603–615. https://doi.org/10.1002/ptr.1222.
[28] Selvaraj, S. (1976). Onion: queen of the kitchen. Kisan World, 3(12):32-34.
[29] Pareek, S., Sagar, N. A., Sharma, S., & Kumar, V. (2018). Onion (*Allium cepa* L .) 58 2 Nutritional Composition and Major Phytochemicals, II, 1145–1161.

[30] Liguori, L., et al. (2017). Chemical Composition and Antioxidant Properties of Five White Onion (*Allium cepa* L.) Landraces. Journal of Food Quality, 2017, 1–9. https://doi.org/10.1155/2017/6873651.

[31] Yoldas, F. (2019). Effect of chicken manure on manure on yield and yield criteria of onion (*Allium Cepa* L.) as second crop. Applied Ecology and Environmental Research, 17(5). https://doi.org/10.15666/aeer/1705_1263912647.

[32] Sidhu, J. S., Ali, M., Al-Rashdan, A., & Ahmed, N. (2019). Onion (*Allium cepa* L.) is potentially a good source of important antioxidants. Journal of Food Science and Technology, 56(4), 1811–1819. https://doi.org/10.1007/s13197-019-03625-9.

[33] Grubben, J. H. a., & Denton, D. A. (2004). Plant resources of tropical Africa. PROTA Foundation, Wageningen; Back huys, Leiden; CTA, Wageningen.

[34] Sagar, N. A., & Pareek, S. (2020). Antimicrobial assessment of polyphenolic extracts from onion (*Allium cepa* L.) skin of fifteen cultivars by sonication-assisted extraction method. Heliyon, 6(11), e05478. https://doi.org/10.1016/j.heliyon.2020.e05478.

[35] Salawu, E., et al. (2009). Onion (*Allium cepa*) extract prevents cadmium induced renal dysfunction. Indian Journal of Nephrology, 19(4), 140. https://doi.org/10.4103/0971-4065.59334.

[36] Mohammadi S, et al. (2016). Protective effects of hydro-alcoholic extract of *Allium cepa* on biochemical and morphometric parameters of mice kidneys exposed to formaldehyde. Sci. J. Kurdestan Med. Sci. (2016) 21: 41-9.

[37] SM., Z. (2018). Evaluation of antioxidant and anti-lipid peroxidation potentials of Nigella sativa and onion extract on nicotine-induced lung damage. Folia Morphol. (Warsz).

[38] Kook, S., Kim, G.-H., & Choi, K. (2009). The Antidiabetic Effect of Onion and Garlic in Experimental Diabetic Rats: Meta-Analysis. Journal of Medicinal Food, 12(3), 552–560. https://doi.org/10.1089/jmf.2008.1071.

[39] Galavi, A., Hosseinzadeh, H., & Razavi, B. M. (2021). The effects of *Allium cepa* L. (onion) and its active constituents on metabolic syndrome: A review. Iranian Journal of Basic Medical Sciences, 24(1), 3–16. https://doi.org/10.22038/ijbms.2020.46956.10843.

[40] Rahmat, A., Yen Leng, C., Abu Bakar, F. I., & Abu Bakar, M. F. (2018). Effect of red onion (*Allium cepa* var. Aggregatum g. Don) on serum uric acid level and total antioxidant status in normal and induced hyperuricemic rats. Asian Journal of Pharmaceutical and Clinical Research, 11(3), 178. https://doi.org/10.22159/ajpcr.2018.v11i3.21790.

[41] Cho YH, et al. (2016). Protective effect of onion extract on bleomycin-induced cytotoxicity and genotoxicity in human lymphocytes. Int. J. Environ. Res. Public Health (2016) 13: 227. https://doi.org/10.1016/j.ijbiomac.2022.11.055.

[42] Guo, C., Yang, R.-J., Jang, K., Zhou, X., & Liu, Y. (2017). Protective Effects of Pretreatment with Quercetin Against Lipopolysaccharide-Induced Apoptosis and the Inhibition of Osteoblast Differentiation via the MAPK and Wnt/β-Catenin Pathways in MC3T3-E1 Cells. Cellular Physiology and Biochemistry, 43(4), 1547–1561. https://doi.org/10.1159/000481978.

[43] Kim, J.-M., & Park, E.-J. (2010). Effect of Onion Consumption on Cardiovascular Disease in Human Intervention Studies: A Literature Review. Journal of the Korean Society of Food Science and Nutrition, 39(10), 1565–1572. https://doi.org/10.3746/jkfn.2010.39.10.1565.

[44] Elhassaneen, Y., & Elhady, Y. A. A. (2014). Onion Peel Powder Alleviate Acrylamide-Induced Cytotoxicity and Immunotoxicity in Liver Cell Culture. Semantic Scholar. Life Sci. (2014) 11: 381-8.

[45] Kim, J., Seo, Y., Park, J.-H., & Noh., S. K. (2016). Protective Effect of Onion Wine on Alcoholic Fatty Liver in Rats. Journal of the Korean Society of Food Science and Nutrition, 45(4), 467–473. https://doi.org/10.3746/jkfn.2016.45.4.467.

[46] Takada, N., et al. (1994). Enhancing Effects of Organosulfur Compounds from Garlic and Onions on Hepatocarcinogenesis in Rats: Association with Increased Cell Proliferation and Elevated Ornithine Decarboxylase Activity. Japanese Journal of Cancer Research, 85(11), 1067–1072. https://doi.org/10.1111/j.1349-7006.1994.tb02908.x.

[47] Ola-Mudathir, K. F., Suru, S. M., Fafunso, M. A., Obioha, U. E., & Faremi, T. Y. (2008). Protective roles of onion and garlic extracts on cadmium-induced changes in sperm characteristics and testicular oxidative damage in rats. Food and Chemical Toxicology, 46(12), 3604–3611. https://doi.org/10.1016/j.fct.2008.09.004.

[48] KF Ola-Mudathir, & Maduagwu., E. (2014). Antioxidant Effects of Methanol Extract of *Allium cepa* linn on Cyanide-induced Renal Toxicity in Male Wistar Rats. PubMed, 29(2), 147–151.

[49] Sparnins, V. L., Barany, G., & Wattenberg, L. W. (1988). Effects of organosulfur compounds from garlic and onions on benzo[a]pyrene-induced neoplasia and glutathione S-transferase activity in the mouse. Carcinogenesis, 9(1), 131–134. https://doi.org/10.1093/carcin/9.1.131.

[50] Hyun, S.-W., Jang, M., Park, S. W., Kim, E. J., & Jung, Y.-S. (2013). Onion (*Allium cepa*) extract attenuates brain edema. Nutrition, 29(1), 244–249. https://doi.org/10.1016/j.nut.2012.02.017.

[51] Nicastro, H. L., Ross, S. A., & Milner, J. A. (2015). Garlic and Onions: Their Cancer Prevention Properties. Cancer Prevention Research, 8(3), 181–189. https://doi.org/10.1158/1940-6207.capr-14-0172.

[52] Abdel-reheim, E. S., & Abdel-Hafee, H.-H. (2014). Onion and its active constituents against aging. Egyptian Journal of Biochemistry and Molecular Biology, 32(2), 206–219.

[53] Maphill. (2011). Political Location Map of Somalia highlighted continent. Www.maphill.com.

[54] R. Sarker, Ratna, M., Ray, S., Fahim, A. H. F. a., & Tithi, M. J. (2017). Effect of planting method on onion (*Allium cepa* L.) bulb production in Faridpur region of Bangladesh. Archives of Agriculture and Environmental Science, 2(2): 63-67.

[55] Andishmand, A. B., & Noori, M. S. (2012). Growth and yield of onion (*Allium cepa* L.) as influenced by application of organic and inorganic fertilizers. Journal of Scientific Agriculture, 55–59. https://doi.org/10.25081/jsa.2021.v5.7270.

[56] Mandloi, K., Bose, U., & Deshmukh, K. (2008). Effect of organic manures and inorganic fertilizers on growth and yield of onion (*Allium cepa* L.). The Asian Journal of Horticulture, 3(2), 238–240.

[57] Zewde, A., Mulatu, A., & Astatkie, T. (2018). Inorganic and Organic Liquid Fertilizer Effects on Growth and Yield of Onion. International Journal of Vegetable Science, 24(6), 567–573. https://doi.org/10.1080/19315260.2018.1453572.

[58] Gererufael, L. A., Abraham, N. T., &, & Reda, T. B. (2020). Growth and yield of onion (Allium cepa L.) as affected by farmyard manure and nitrogen fertilizer application in Tahtay Koraro District, Northwestern Zone of Tigray, Ethiopia. Vegetos, 33(4), 617–627. https://doi.org/10.1007/s42535-020-00132-7.

[59] As, A., Ma, I., Ho, G., Kk, O., & Wa, L. (2017). Comparative Effect of Organic and Inorganic Fertilizer Treatments on the Growth and Yield of Onion (*Allium cepa* L). Research & Reviews: Journal of Botanical Sciences, 6(2), 8–11.

[60] Ali, M. (2018). Organic manures effect on the bulb production of onion cultivars under semiarid condition. Pure and Applied Biology, 7(3). https://doi.org/10.19045/bspab.2018.700135.

[61] Aftab, S., et al. (2017). Impact of Potassium on the Growth and Yield Contributing Attributes of Onion (*Allium cepa* L.). Asian Research Journal of Agriculture, 7(3), 1–4. https://doi.org/10.9734/arja/2017/38322.

[62] Negasi T, Nigussie D, Kebede W, Lemma D, & T, A. (2017). Effect of Integrated Nitrogen, Phosphorus, and Farmyard manure onpost-harvest quality and storability of onion (*Allium Cepa* L.). JPostharvest Technol 5(4):25–37.

[63] Z, G. (2011). Response of onion (*Allium cepa* L. Var. Cepa) to organic and inorganic fertilizers at gode, South-Eastern Ethio-pia. Doctoral dissertation, School of Graduate Studies, HaramayaUniversity, Ethiopia.

[64] Khan, M., Rahman, M., Sarker, R., Haque, M., &, Mazumdar, S. (2020). Effects of transplanting time on the yield and quality of onion (*Allium cepa* L.). Archives of Agriculture and Environmental Science, 5(3), 247-253. https://doi.org/10.26832/24566632.2020.050303.

[65] Naik, M. R. (2014). Effect of inorganic fertilizers, PSB and VAM on growth and yield of onion. Mysore Journal of Agricultural Sciences, 48(3), 460–463.

[66] Yoldas, F., Ceylan, S., Mordogan, N., & Esetlili, B. C. (2011). Effect of organic and inorganic fertilizers on yield and mineral content of onion (*Allium cepa* L.). African Journal of Biotechnology, 10(55), 114488–111482.

[67] Salami, A. E., &, Omotoso, S. O. (2018). Performance of Onion (*Allium Cepa* L.) Enhanced by Organic Fertilizer in a Forest Agroecology, Nigeria. Journal of Biology, Agriculture and Healthcare, 8(10), 42–48.

[68] Falodun, E., Ehigiator, J., &, Egharevba, R. (2015). Growth and yield of onion as influenced by organic and inorganic fertilizer in Edo rainforest of Nigeria. Agro-Science, 12(3), 15. https://doi.org/10.4314/as.v12i3.3.