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EFFECT OF SOIL TYPES AND FERTILIZERS ON THE GROWTH AND YIELD OF ONION (*ALLIUM CEPA* L.)

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ABSTRACT

Onion (Allium cepa L.) is a globally significant vegetable crop valued for its culinary, medicinal, and economic importance. Its growth and yield are influenced by various agronomic factors, among which soil type and fertilizer application play critical roles. The experiment was conducted to determine the effect of soil types and fertilizers on the growth and yield of onion (Allium cepa L.). It was laid out in a completely randomized block design and replicated three times. Growth and yield parameters were investigated. Soil treated with poultry dung had the highest plant height and it was reduced in plants treated with NPK across treatments. Number of leaves increases appreciably across all the treatments with variations in their significant level. Loamy soil treated with 20g NPK recorded the maximum leaf weight at harvest (26.89g) while the least leaf weight recorded at harvest was in sandy soil treated with 15g poultry dung (5.50g). Loamy soil treated with 20g poultry dung recorded the highest bulb weight (18.23g) at harvest while loamy soil without fertilizer (control) produced the least bulb weight (6.14g). Thus, it was concluded that both sandy and loamy soil enhances the growth and yield of onion performance, any fertilizer application regardless of the type was better than the control (no fertilizer) in the cultivation of onion.

KEY WORDS*: Allium cepa, Soil types, Fertilizer, poultry dung, NPK.*

INTRODUCTION

Onions are a widely consumed vegetable and are important source of nutrition for many people around the world (Mahmood *et al.,* 2021). The production and nutritional values are limited due to low soil fertility among many other factors, the reduction in yields of onion like other food crops has prompted farmers to amend the soils with different organic materials in order to supply the nutrients needed to enhance growth and yield of crops (Adepetu, 2017). Onion (*Allium cepa*. L.) is an important vegetable crop produced majorly in the Northern part of Nigeria. It is also known as bulb onion which are widely cultivated and used all over the world as food, it can be served

as cooked vegetable or part of a prepared savory dish, but can also be eaten raw (Fritsch and Freisen 2002; Patricia, 2006). They are pungent when chopped and contain certain chemical substances which irritate the eyes (Alkaff *et al*., 2012). It is a biennial plant but usually grown as annuals and are available in varieties of colours such as yellow, brown, white and red onions (Chris *et al*., 2013).

Onion production is determined by various factors like soil moisture, soil temperature and other soil and environmental factors, besides genetic variability (Singh, 2016). Different soil types, such as (sandy, loamy, and clay soils) exhibit varying levels of aeration, drainage, and nutrient retention, which can significantly impact onion productivity. According to Kusnarta *et al*. (2006) the soil management system regulates root spread as well as soil qualities such as porosity, compaction, water content, and organic matter concentration. Onions can be grown under a wide range of climatic conditions. However, their production is more successful under mild climate without extremes of heat or cold and excessive rainfall (Lemma, 2004). It has also a long history of medicinal importance. Compounds from onion have been reported to have a range of health benefits which include anticarcenogenic properties, antiplatelet activity, antithrombotic activity, asthmatic and antibiotic effects and effective against the common cold, heart disease, diabetes, osteoporosis, and other diseases (Griffiths *et al*., 2002).

Effective soil fertility management is a critical determinant of crop growth and yield. Nutrients management play an important role in increasing the yield and quality of vegetable crops. However, the choice of fertilizer, whether organic (such as poultry manure), inorganic (like NPK fertilizers), or a combination of both can differentially influence plant performance and long-term soil health (Yusuf *et al*., 2023). Fertilizers provide necessary plant nutrients; however, use of synthetic chemical fertilizers are no more considered as ecologically suitable. The alternative nutrient sources e.g., organic fertilizers have been applied to reduce the load of chemical fertilizers. In recent years, organic manures and biofertilizers are used as an important component of nutrient supply system and to improve crop yield (Shah *et al*., 2019).

The reasonable use of organic fertilizers can improve fruit quality, soil fertility and also showed positive effect on soil microbial population resulting in enhanced soil biomass, carbon and nitrogen contents, and dehydrogenase activity (Xu, *et al*., 2002). Organic material, such as farmyard manure improves soil physico-chemical properties that are important for plant growth (Snyman *et al*., 1998). In contrast to organic, continuous use of inorganic fertilizers and inappropriate soil fertility management practices are among the major factors limiting productivity of onion. Application of inorganic fertilizers without supplementation with organic manure has often resulted in

micronutrient deficiencies, imbalance soil physical and chemical properties and unsustainable crop production (Yohannes *et al*., 2017). Decomposition of organic materials would provide additional nutrients to the growing medium, which may lead to higher uptake of nutrients by the crop and subsequently high yield (Shaheen *et al*., 2007; Datcu *et al*, 2020; Găinaru and Ianovici, 2025).

Despite extensive research on onion agronomy, the interactive effects of soil types and fertilizer application on onion growth remain a critical area of study, particularly in regions with diverse soil compositions. This study therefore aims to evaluate how different soil types and fertilizers influence onion growth.

MATERIALS AND METHODS

The experiment was conducted at the University of Ilorin Botanical Garden, Nigeria (N 08^0 28' 53.3", E04^0 40' 28.9"), during the 2023/2024 growing season. The site experiences a tropical climate with annual rainfall of 1000–1500 mm (peaking in September–October) and high mean monthly temperatures. The soil types in the area vary between sandy, loamy, and clay.

The onion bulbs used were sourced from a local market, along Tipper Garage, Ilorin, Kwara State. Both Poultry dung (PD) and NPK fertilizer were gotten from Lower Niger River Basin farm. The Poultry dung was sun dried and grounded into powder before use. NPK (15: 15:15) and poultry dung were incorporated to appropriate labeled polyethylene bags in different concentrations and mixed thoroughly with the soil two weeks before sowing using drilling method. The onion bulbs were planted in each polyethylene bags and the bulb were covered with soil and placed in the greenhouse. Watering was done at four days interval, so as to prevent them from water logging and to keep them from getting too dry. Hand pulling was used to control weeds.

The experiment was laid down in a completely randomized block design and each treatment combination was replicated three times, totaling 30 experimental units. The treatment consisted of two different soil types (Loamy and Sandy soil) and two different fertilizers (NPK and Poultry dung). Two levels of each fertilizer were used, and these includes; NPK 15:15:15 (15g and 20g), poultry dung (15g and 20g) and soil without fertilizer (Control).

Data were collected on the growth and bulb yield of Onion at harvest and the parameter measured were: number of Leaves per plant, Plant Height (cm), the leaves and bulb weight at harvest. Data measured were statistically analyzed using analysis of variance (ANOVA) and the means were separated using Duncan multiple Range Test (DMRT) at 5% probability level.

RESULTS AND DISCUSSIONS

TABLE 1. Effects of soil types and fertilizer on the number of Leaf of onion (*Allium cepa* L.).

Soil types	Treatment	2WAP	4WAP	6WAP	8WAP	10WAP
Sandy soil	Control	0.00[a]	1.67[a]	9.00 [a]	13.33 [a]	16.00[a]
	20g pd	0.33 [a]	6.00 [a]	11.00[a]	14.00 [a]	16.00[a]
	15g pd	0.67 [a]	3.00 [a]	5.67 [a]	9.00 [a]	10.00[a]
	20g NPK	0.33 [a]	2.67 [a]	4.67 [a]	6.00 [a]	12.333[a]
	15g NPK	0.00 [a]	3.00 [a]	7.67 [a]	8.00[a]	13.67[a]
Loamy soil	Control	2.33[b]	8.67[b]	18.00[b]	21.00[b]	25.00[a]
	20g pd	0.00[a]	1.33[a]	5.33[a]	9.00 [a]	15.33[a]
	15g pd	0.67[ab]	3.00[ab]	5.67[a]	8.00[a]	9.67[a]
	20g NPK	0.33[ab]	4.67 [ab]	19.67[b]	25.67[b]	26.00[a]
	15g NPK	0.67[ab]	2.67 [ab]	4.33[a]	5.67[a]	10.00[a]

Values bearing the same letters along the same column are not statistically different at ($P \leq 0.05$)

Result from the analysis of variance showed that the effects of soil types and fertilizer application significantly influenced the number of leaves of onion at ($P \leq 0.05$). Number of leaves increases appreciably across all the treatments. Loamy soil with 20g NPK had the highest number of leaves at 6 to 10 weeks after planting with values ranging from (19.67, 25.67, 26.00), however it is not statistically different from the control with values (18.00, 21.00, 25.00) respectively, there were variations in the significant level between and among the treatments. The increase in number of leaves of onion could be attributed to the soil properties and nutrient availability of the soil. Loamy soil has a good drainage and aeration status, better nutrient retention ability which helps to hold NPK fertilizer effectively without rapid leaching. NPK provides immediate nutrient availability which are quickly absorbed by the onion plants hence promote rapid vegetative growth of the leaves. Seran *et al.*, 2011 reported that inorganic fertilizer treated plants exhibited quick growth of leaves at the early stage than compost treated plants. This also aligns with the findings of Vachhani and Patel (1993) who observed that higher number of leaves per plant was produced with the application of NPK fertilizer. It is also in agreement with the earlier reports of Adeyeye *et al*. (2017) who reported higher growth parameters of onions when applied with NPK. It can be assumed that chemical fertilizers have higher availability of nutrients to the plant roots than other organic fertilizers.

TABLE 2. Effects of soil types and fertilizers on Plant Height (cm) of onion (*Allium cepa* L.)

Soil types	Treatment	2WAP	4WAP	6WAP	8WAP	10WAP
Sandy soil	Control	0.00^{a}	2.33^{a}	12.67^{a}	20.00^{a}	27.00^{ab}
	20g pd	0.33 ^{a}	14.33^{c}	31.33^{b}	38.33^{a}	41.33^{b}
	15g pd	0.33^{a}	14.33^{c}	28.67^{ab}	36.00 ^{a}	37.00^{ab}
	20g NPK	0.67 ^{a}	6.17^{ab}	19.33^{ab}	24.67^{a}	34.33^{ab}
	15g NPK	0.00 ^{a}	14.00^{c}	26.00^{ab}	25.67^{a}	23.67^{ab}
Loamy soil	Control	3.67^{b}	19.67^{b}	24.33^{a}	26.00^{a}	34.00^{a}
	20g pd	0.00^{a}	7.50^{a}	24.00^{a}	35.67 ^{a}	43.00^{a}
	15g pd	0.67^{a}	15.83^{a}	22.50^{a}	26.67^{a}	33.33^{a}
	20g NPK	0.67^{a}	13.33^{a}	23.67^{a}	28.33 ^{a}	35.67^{a}
	15g NPK	0.50^{a}	12.67^{a}	24.00^{a}	20.67^{a}	27.00^{a}

Values bearing the same letters along the same column are not statistically different at (P≤0.05)

The effects of soil types and fertilizer application on the plant height of onion (*Allium cepa*) is as presented in table 2. There were variations in the Plant height (P≤0.05) between and among the treatments. Plant height was highest in loamy soil with 20g PD (43.00 cm) while the lowest was recorded at 15g NPK (23.67 cm) in sandy soil. Regardless of the soil types, soil treated with poultry dung had the highest plant height and it was reduced in plants treated with NPK. The obtained result may be due to the fact that soil treated with Poultry dung had more consistent N supply, by slowly releasing N into the plant thus leading to sustained stem elongation. The results of the findings corroborate with the work of Ajari *et al.* (2003) who discovered that nutrients contained in poultry manure and other organic sources are released more slowly and are stored for longer period in the soil, thereby ensuring longer residual effects. This is also in line with the work of Bello *et al*., (2019) who reported that organic amendments had a long-term residual effect compared with NPK fertilizer in terms of sustainability of the yield and soil fertility restoration. The result further confirmed the observation by (Messele, 2016) who reported a significant increase in plant height and number of leaves at only 50 kg N/ha.

Leaf fresh weight at harvest was highest in loamy soil treated with 20g NPK with value (26.89 g), while it was lowest in sandy soil treated with 15g PD, regardless of the soil types there were no significant differences in all the plants that received fertilizers. The bulb weight at harvest were higher in soil types treated with 20g PD (14.77 and18.23 g) while the lowest was recorded for soil types with no fertilizer (9.58 and 6.14 g). It was further noticed that there were no significant differences between different treatments. Higher leaf fresh weight in loamy soil treated with 20g NPK could be traced to the soil physical properties and the nutrient retention ability. Loamy soil has better water holding capacity and nutrient retention than sandy soil, promoting sustained nutrient availability (especially N from the inorganic fertilizer (NPK) for vegetative

growth(leaves). The balanced supply of nitrogen (N), Phosphorus (P), and Potassium (K) in NPK directly supports rapid leaf development. The result corroborates with the findings of Islam *et al*. (2007) who reported that onion yield is higher with the application of NPK fertilizers. Similarly, Yohannes *et al*. (2013) reported that N fertilization increased bulb length and other yield parameters of onions.

TABLE 3. Effects of soil types and fertilizer on the leaves and bulb weight at harvest (g) of Onion (*Allium cepa*).

Soil types	Treatments	LFWTAH	BWTAH
Sandy soil	Control	7.14[a]	9.58[a]
	20g pd	16.83[a]	14.77[a]
	15g pd	5.50[a]	9.59[a]
	20g NPK	11.09 [a]	10.02[a]
	15g NPK	16.48 [a]	9.91[a]
Loamy soil	Control	15.27[a]	6.14 [a]
	20g pd	14.01[a]	18.23[a]
	15g pd	19.93 [a]	8.66[a]
	20g NPK	26.89 [a]	14.33[a]
	15g NPK	16.81[a]	6.55[a]

Values bearing the same letters along the same column are not statistically different at ($P \leq 0.05$)
LFWTAH: leaf weight at harvest, **BWTAH:** bulb weight at harvest

Higher bulb weight in soil treated with 20g PD could be as a result of the positive effect of the organic matter content of the soil, microbial activity and hormonal effects of the soil. Organic manures activate many species of living organisms which release phytohormones and may stimulate the plant growth and absorption of nutrients (Arisha *et al*., 2003) and such organisms need nitrogen for multiplication (Ouda and Mahadeen, 2008). The beneficial effect of organic manures on yield might be due to additional supply of plant nutrients and improved chemical, physical and biological properties of soil (Datt *et al*., 2003). Poultry dung improves soil structure (especially in sandy soil) and provides a steady supply of potassium (K) over time, which is crucial for bulb enlargement and carbohydrate translocation. This is in line with the work of Yoldas *et al*., 2011 who reported that the application of organic fertilizers at a dose of 20 t/ha affected the yield. The application increased yield by 24% compared to the control plots. Similar result was also reported by Rumpel (1998) and Sharma *et al*. (2003) where they found that animal manure applications increased onion yield.

CONCLUSIONS

Any fertilizer application, regardless of the type used was better than no fertilizer (control), but the choice of fertilizer alone did not drastically alter the results, the soil types decide how well they work. i.e the soil types modulate the plant responses. It can therefore be concluded that different soil types have different effects on onion growth,

and optimum soil type for onion growth may depend on local conditions such as soil texture, drainage and nutrient content.

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