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Effects of Phosphorus Fertilizer Rates on the Growth and Yield of Cucumber (*Cucumis Sativus L.*) Varieties

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Abstract

Cucumber is a vegetable mostly consumed fresh as a snack or in salads, soups, smoothies, boats, roll-ups, dips, dressing and ice pops. Problems affecting the production of cucumber in the tropics are low soil fertility and low yielding varieties. Therefore, this research assessed the influence of phosphorus fertilizer rates on growth and yield of cucumber varieties at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo state. The treatments involved three varieties of cucumber (Amarisa Super, Oliveira Bold and Oliveira Super) subjected to five level of phosphorus fertilizer rates (0, 15, 30, 45, 60 kgP2O5/ha). The fifteen treatment combinations were laid out in a 3 x 5

factorial experiment fitted into a Randomized Complete Block Design (RCBD) with three replications. Data collected on growth and fruit yield were subjected to Analysis of Variance (ANOVA). The significance of the treatments effects was determined using Duncan's Multiple Range Test (DMRT). The result shows that phosphorus fertilizer rates significantly ($p \leq 0.05$) increased the variables assessed. The growth parameters and fruit yield increased as the applied phosphorus rates increased from 0 up to 60kgP_2O_5. The fruit yield of the cucumber varied significantly among the varieties. The combination of Oliveira Bold Variety and 60kgP_2O_5/ha recorded highest (2.07 tons/ha) yield, closely followed by Oliveira Super Variety and 60 kgP_2O_5/ha which gave (1.81tons/ha) while the least (1.71 tons/ ha) fruit yield of cucumber was obtained with combination of Amarisa super and 60kgP_2O_5/ha. In conclusion, farmers in Ogbomoso can make use of Oliveira Bold Variety and 60kgP_2O_5/ha for optimal performance in cucumber production.

Introduction

Cucumber (*Cucumis sativus* L.) is an important vegetable crop cultivated worldwide for its nutritional and economic value. It is widely grown in tropical and subtropical regions, including Africa and Asia, where it serves as a significant source of vitamins, minerals, and antioxidants (Ali et al., 2021). Cucumber is highly valued in fresh markets and food processing industries, making it a crucial crop for both subsistence and commercial farmers. Its rapid growth cycle, high yield potential, and adaptability to

different environmental conditions contribute to its widespread cultivation (Chowdhury et al., 2022).

The productivity of cucumber is influenced by several factors, including soil fertility, water availability, and agronomic practices. Among these, phosphorus (P) plays a crucial role in root development, flowering, and fruit set, making it an essential nutrient for optimal cucumber growth and yield (Sanchez & Uhart, 2020). Phosphorus is vital for energy transfer, cell division, and early root formation, which directly impact the overall plant health and productivity (Razaq et al., 2022). However, phosphorus deficiency is a common issue in many agricultural soils, particularly in tropical regions where high weathering rates lead to phosphorus fixation, rendering it unavailable for plant uptake (Singh et al., 2021).

Despite its importance, excessive phosphorus application can lead to nutrient imbalances, environmental pollution, and reduced fertilizer use efficiency (Azeem et al., 2022). Thus, determining the optimal phosphorus fertilizer rates for different cucumber varieties is essential for enhancing crop yield while minimizing negative environmental impacts. Various studies have examined the effects of phosphorus on different vegetable crops, yet limited research has focused on its specific impact on cucumber varieties, particularly Olivera Bold, Amarisa Super, and Olivera Super (Ahmed et al., 2023). Understanding the phosphorus requirements of these varieties will help develop targeted fertilization strategies that optimize productivity and sustainability.

Understanding the effects of different phosphorus fertilizer rates on cucumber growth and yield is essential for developing sustainable and efficient nutrient management strategies. Optimizing phosphorus application rates can enhance root development, improve nutrient use efficiency, and increase cucumber yield, thereby contributing to food security and economic sustainability for farmers (Ahmed et al., 2023). Furthermore, identifying the most responsive cucumber variety to phosphorus application will help breeders and agronomists recommend

suitable varieties for specific phosphorus management regimes. This study aims to bridge the knowledge gap by evaluating the response of three cucumber varieties (Olivera Bold, Amarisa Super, and Olivera Super) to different phosphorus fertilizer rates and providing recommendations for improved production practices.

MATERIALS AND METHODS.

The experiment was conducted during 2023 cropping season at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria. Ogbomoso lies on latitude 8°10 N, longitude 4°10 E in the Guinea Savanna Zone of South west Nigeria. The temperature of the site ranged from 280 - 320C with high humidity of about 74% all year round except in January when the dry wind blows from the north. Rainfall distribution is bio-modal and extends for eight to nine months of the year (Olaniyi, 2006). Three cucumber varieties namely: Amarisa Super, Oliveira Bold and Oliveira Super were sourced from Solokad Multi Ventures Limited, Ogunpa, Ibadan, Oyo State while Single Super Phosphate Fertilizer (SSP) was sourced from KAAL Farmer Shopping Centre, Ogbomoso. The experimental site was manually cleared and beds were constructed. The experimental beds consist of 45 beds which was divided into three blocks each containing 15 beds. The sizes of each bed was1.2 m by 1.2 m with the spacing 0.5 m within each bed and 1 m between blocks. The 3 x 5 factorial experiment was fitted into randomized complete block design (RCBD) and replicated three times. The treatments involved three varieties of cucumber namely: Amarisa Super, Oliveira Bold and Oliveira Super , five rates of phosphorus fertilizer (Phosphorus Rates (0kgP_2O_5/ha, 15kgP_2O_5/ha, 30kgP_2O_5/ha, 45kgP_2O_5/ha, 60kgP_2O_5/ha) and their various treatment combinations which amounts to 15 treatments. One seed of cucumber variety each was sowed per hole at a depth of 5 cm. Watering was done daily at early hours until the rain was stable. Supplying was done 7 days after sowing. Thinning was carried out 10 days after sowing. Weeds were removed

every two weeks by hoeing and hand pulling. Staking and insect control were done two weeks after sowing. Four weeks after sowing (4WAS), Single Super Phosphate Fertilizer (SSP) was applied to each bed at varying rates of 0, 15, 30, 45, and 60 kgP_2O_5/ha using drilling method. Data collection started six weeks after sowing (4WAS), and continued every two weeks until eight weeks. Data were collected on growth and yield parameters namely: vine length, number of leaves, number of flowers, Fruit length and diameter and fruit weight.

Statistical Analysis

Data collected were subjected to Analysis of Variance (ANOVA) and significance of the treatments effects was determined using Duncan's Multiple Range Test (DMRT)

RESULTS.

Table 1: Main influence of phosphorus fertilizer rate and varieties on the growth of Cucumber

Fertilizer Rate (P_2O_5/ha)	Growth Parameters	
	Vine Length (cm)	Number of Leaves
0	73.72b	17.98a
15	99.83ab	21.02a
30	100.30ab	22.99a
45	117.02a	23.94a
60	108.24ab	20.20a
Varieties		
Amarisa Super	107.33a	20.73a
Oliveira Bold	85.15a	18.53a
Oliveira Super	106.99a	24.42a

Table 2: Interaction of varieties and phosphorus fertilizer rates on the growth parameter of Cucumber

Varieties	Growth Parameters		
	Fertilizer Rate (kgP_2O_5/ha)	Vine Length (cm)	Number of Leaves
Amarisa Super	0	103.83ab	20.10ab
	15	107.27ab	20.90ab
	30	108.63ab	21.53ab
	45	112.07ab	19.77ab
	60	104.83ab	21.37ab
Oliveira Bold	0	42.13b	12.50b
	15	85.23ab	18.33ab
	30	82.60ab	20.33ab
	45	97.23ab	20.47ab
	60	118.57a	21.00ab
Oliveira Super	0	75.20ab	21.33ab
	15	107.00ab	23.83ab
	30	109.67ab	27.10ab
	45	141.77a	31.60a
	60	101.33ab	18.23ab

The main influence of phosphorus fertilizer rate and varieties on the vine length and number of leaves of cucumber is presented in table 1.

There were no significant variations among the varieties for the growth parameters, but among the Phosphorus rates, significant variations were observed. The highest vine length(117.02cm) and number of leaves (23.94) was obtained at 45kgP_2O_5/ha while the least values (73.72 and 17.98) were recorded at control.

The combined action of the varieties and P-rates had significant effects. Oliveira Super with 45kgP_2O_5/ha produced the longest vines(141.77cm) while Oliveira Bold with no phosphorus fertilizer resulted in the shortest vines(42.13cm). Oliveira Super with 45kgP_2O_5/ha produced the highest

number of leaves (31.6) while Oliveira Bold with no phosphorus fertilizer had the least number of leaves (12.50) as shown in table 2.

Fruit Yield and Yield Components

Table 3: Main influence of phosphorus fertilizer rates and varieties on the fruit yield and yield components of cucumber

	Yield and Yield Components				
Fert. Rate (kg P_2O_5/ha)	Number of Fruits	Fruit Weight (kg)	Fruit Yield (Tons/ha)	Fruit Length (cm)	Fruit Diameter (cm)
0	5.87b	0.21a	1.43e	19.34a	4.85b
15	8.34ab	0.22a	1.51d	19.99a	5.14ab
30	7.97ab	0.28a	1.71b	20.58a	5.54a
45	10.00a	0.23a	1.61c	18.41a	5.45a
60	10.10a	0.25a	1.96a	17.87a	5.65a
Varieties					
Amarisa Super	12.87a	0.23b	1.58b	19.67b	5.28ab
Oliveira Bold	5.01b	0.27a	1.85a	19.94a	5.62a
Oliveira Super	7.49b	0.22c	1.51c	18.10c	5.07b

Table 4: Interaction of varieties and phosphorus fertilizer rates on the fruit yield and yield components of cucumber

Fruit Yield and Yield Components

Varieties	Fert. Rate (kgP_2O_5/ha)	Number of Fruits	Fruit Weight (kg)	Fruit Yield (Tons/ha)	Fruit Length (cm)	Fruit Diameter (cm)
Amarisa Super	0	9.47abcd	0.20a	1.36de	20.20ab	5.05bc
	15	13.13ab	0.19a	1.33de	19.60ab	5.15bc
	30	13.13ab	0.27a	1.85b	18.83ab	5.31b
	45	13.27ab	0.20a	1.38de	18.80ab	5.23bc
	60	15.37a	0.29a	1.99ab	20.93a	5.66ab
Oliveira Bold	0	1.50e	0.23a	1.62cd	19.13ab	5.18bc
	15	5.10cde	0.25a	1.73bc	20.63a	5.35b
	30	2.67de	0.29a	2.01ab	19.60ab	5.76ab
	45	6.67bcde	0.26a	1.77bc	19.10ab	5.47ab
	60	9.10abcd	0.30a	2.09a	21.23a	6.32a
Oliveira Super	0	6.63bcde	0.19a	1.31de	18.70ab	4.33c
	15	4.57cde	0.21a	1.46d	19.13ab	4.91bc
	30	8.10bcde	0.19a	1.26e	15.17b	5.19bc
	45	10.07abc	0.24a	1.68c	17.33ab	5.31b
	60	8.67bcde	0.26a	1.81bc	20.17ab	5.63b

Main influence of phosphorus fertilizer rates and varieties on the fruit yield and yield components of cucumber.

Varietal effects brought significant variation in the yield and yield components. Oliveira Bold had the highest values for the fruit yield (1.85), weight (0.27), length(19.94cm) and diameter (5.62), while Amarisa Super produced the highest number of fruits (12.87). Oliveira Super had the least values for all the yield's parameters. The P-rates had significant effects on the yield and yield components. The highest values were obtained at $60kgP_2O_5/ha$ for fruit yield (1.96), number of fruits (10.10) and fruit diameter

(5.65) while the least values were obtained for number of fruits (5.87), fruit yield (1.43) and fruit diameter (4.85) at control.

Interaction of varieties and phosphorus fertilizer rates on the fruit yield and yield components of cucumber is shown in table 4. The combination of the different varieties and phosphorus fertilizer rates had significant effects on the fruit yield and yield components. Oliveira Bold with 60kgP_2O_5/ha produced the highest fruit yield (2.09), weight (0.23), length (21.23) and diameter (6.32) while Amarisa Super at 60kgP_2O_5 recorded the highest number of fruits (15.37).

DISCUSSIONS

Phosphorus is crucial during both the vegetative and yield stages of fruit vegetables (Hidayat et al., 2018). This study found that both fertilizer rates and varieties significantly affected the growth and yield of cucumbers. A rate of 45 kg of phosphorus per hectare increased vine length and the number of leaves across all varieties. This aligns with findings by El-Deen et al. (2011), which showed that plants receiving 45 kg of P2O5 per feddan (approximately 47.1 kg/ha) exhibited significant improvements in various vegetative growth parameters. Additionally, higher levels of phosphorus fertilizer enhanced fruit characteristics such as length, diameter, and average weight in tomatoes (Hidayat et al., 2018). The findings also indicated that Oliveira Bold and Amarisa Super exhibited the highest yield values and their components. However, this contradicts the results from Umeh et al. (2024), who found that Jorad and Darina were the top performers when assessing the yield potential of five cucumber varieties: Oliveira Bold F1, Amarisa Super F1, Gorald, CU99, and Darina, cultivated in Ifite-Ogwari, Anambra State. This discrepancy may be due to differences in ecological zones. The data showed that applying 60 kg of phosphorus per hectare to the Oliveira Bold variety resulted in the highest values for fruit yield, diameter, length, and weight, while Amarisa Super recorded the highest number of fruits. This may be attributed to the high availability of phosphorus, which is essential for fruit formation. These findings align with Kiran et al. (2018), who reported the highest seed yield per hectare of beans with the application of 60 kg of P2O5

per hectare in their study on the effects of phosphorus and zinc on the growth and yield of vegetable cowpea. The significant impact of both phosphorus fertilizer and variety on growth and yield underscores the importance of effective fertilizer management and the selection of appropriate varieties. Phosphorus aids plant growth by enhancing root development and nutrient absorption (Alhassan et al., 2018). Farmers can benefit from using high-yielding varieties such as Amarisa Super while applying phosphorus fertilizer at optimal levels.

CONCLUSION AND RECOMMENDATION

This experiment showed that 60kgP_2O_5/ha application rate of fertilizer resulted in the highest cucumber fruits yield, especially for the Oliveira Bold variety while 45kgP_2O_5/ha boosted the growth parameters the most, particularly in Oliveira Super cucumbers. Overall, the best performing combinations were Oliveira Bold with 60kgP_2O_5/ha for fruit yield and Oliveira Super with 45kgP_2O_5/ha for growth parameters. Therefore, Oliveira Bold varieties of cucumber with 60kgP_2O_5/ha can be recommended for optimum yield in Ogbomoso. Future research should explore interactions with other nutrients and long-term effects of phosphorus use.

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