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# Different rates of paclobutrazol application on Ilocos white garlic (*Allium sativum* L.) under La Union condition

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## ABSTRACT

Due to the low supply and high demand for garlic in the Philippines, sudden price spikes occur to the detriment of consumers since garlic is a major condiment used in the households. The average yield per hectare in the country is significantly lower than in other countries, hence, there is an urgent need to improve the growth and yield of garlic through the use of plant performance enhancer like paclobutrazol. The study was conducted to evaluate the effect of different concentrations of paclobutrazol (PBZ) on the growth and yield performance of garlic (*Allium sativum* L.), with the the different rates of paclobutrazol application on native garlic was conducted from February 8, 2025 to May 17, 2025 at Sinapangan, San Juan, La Union, Philippines. Results revealed that paclobutrazol significantly influenced the agronomic and economic performance of garlic. Among the treatments, the application of 10 ml paclobutrazol per liter of water produced the highest yield, gross inome, net income and return on investment. These findings indicate that paclobutrazol at this concentration was the most effective in improving both yield and economic returns in garlic production. Further studies are recommended to explore the response of other garlic varieties to PBZ application.

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**INTRODUCTION**

The domestic garlic supply chain in the Philippines is under severe strain, consistently failing to meet market demands and leading to a heavy reliance on imports. This persistent deficit is rooted in low local production yields which average far below the potential of major garlic-producing nations.

The primary culprits behind this poor performance are the widespread use of low-quality or diseased planting materials, coupled with unmitigated viral infections that compromise plant vigor and bulb development. While the country's output briefly peaked in 2015 (Elias and Camalig, 2023), production has since declined, with 2022 figures hovering around 5.88 thousand metric tons (Philippine Statistics Authority, 2022). Geographically, the Ilocos Region maintains a historical and climactic advantage, with Ilocos Norte acting as the undisputed national hub, contributing over 97% of the region's production. The combination of sustained consumer demand across food and industrial sectors, limited market supply, and the high cost of production inputs translates directly into elevated market prices, underscoring the critical need for comprehensive strategies to enhance national output and move toward self-sufficiency (Philippine Statistics Authority, 2022; Country STAT Philippines, 2019).

Efforts to bolster the struggling garlic sector are strategically divided into two main approaches: extensification and intensification. Extensification involves the physical expansion of the total area devoted to garlic cultivation, a measure that has been supported by government seed programs since 2017 (Samijan et al., 2021). However, the most sustainable path lies in intensification, which focuses on optimizing yields within existing farmlands through improved cultivation practices. This includes the fundamental components of utilizing certified quality seeds, ensuring balanced fertilization to meet crop nutritional needs, and implementing effective integrated pest management (IPM). Studies have empirically demonstrated the efficacy of these improved cultivation systems, showing the potential to increase average yields by a significant margin-up

to 19.46%- by maximizing the productivity of each unit of land. Beyond these traditional agronomic practices, innovative solutions involving Plant Growth Regulators (PGRs), such as gibberellins and paclobutrazol (PBZ), are being introduced to genetically and physiologically optimize the plants for higher yields, mirroring success seen in crops like rice where these hormones increased output by 4.5–11.9%.

Paclobutrazol (PBZ) is a highly effective synthetic triazole compound classified as a Plant Growth Retardant (PGR) (Mabvongwe et al., 2016). Its core mechanism involves acting as a powerful antagonist to the naturally occurring plant hormone gibberellin (GA) (Desta and Amare, 2021).

Specifically, PBZ inhibits the enzyme responsible for GA biosynthesis, effectively limiting the hormone necessary for cell division and elongation. This inhibition results in desirable morphological changes: stems become shorter and stouter (preventing lodging), root systems are often more vigorous, and the plant exhibits enhanced tolerance against various abiotic stresses like drought. A significant advantage of PBZ is its systemic mobility; it is slowly metabolized and preferentially transported acropetally (upward) through the plant's xylem (Sterrett, 2017), which may act as a reservoir for paclobutrazol (PBZ) taken up by roots, thus prolonging persistence (Lever, 2016). This systemic movement allows for flexible application methods—including foliar sprays, soil drenches, or incorporation into the growing medium—while ensuring a prolonged period of effectiveness as the active ingredient remains available in the plant's system over time.

Targeted research confirms the considerable potential of PBZ to directly mitigate the primary yield problem in Philippine garlic: the unsatisfactory size of the cloves and bulbs. While PBZ's anti-gibberellin action results in a typical reduction of vegetative growth e.g., shorter plant height and fewer leaves (Akta, 2024), it redirects the plant's energy toward reproductive and storage organs and decreasing acidity (Lolaei et al., 2017). In addition, it acts as a highly active systemic

fungicide and used against several economically significant fungal diseases (Ahmed and Magaji, 2017). This results in a measured increase in bulb diameter and fresh weight. This beneficial effect is believed to be facilitated by PBZ's ability to increase chlorophyll content in the leaves. Higher chlorophyll levels boost photosynthetic efficiency, leading to greater carbon accumulation-the essential building blocks and energy stores required for rapid and significant bulb formation (Flores-Lopez *et al.,* 2016; Sari *et al.,* 2015). Studies have demonstrated this positive relationship between PBZ application and increased bulb diameter and fresh weight (Desta and Amare, 2021; Barbosa *et al.,* 2024).

Offering a strong, science-backed justification for its integration into improved garlic cultivation protocols to achieve enhanced farmer yields and support the national goal of self-sufficiency.

A recent study showed that paclobutrazol increased chlorophyll content (Tesfahun, 2018). In short, paclobutrazol might contribute to the increase in bulb diameter and fresh weight by increasing chlorophyll content, leading to $GA_3$ biosynthesis (Flores-Lopez *et al.,* 2016; Sari *et al.,* 2015) which resulted in more carbon accumulation. In addition, PBZ has also been reported to promote the bulb diameter of shallots. The farmer's interest in garlic planting is low because the yield is unsatisfied. One reason is the use of small cloves. Giving paclobutrazol is expected to increase the size of garlic cloves and bulbs. Generally, this study was conducted to determine the effect of Paclobutrazol application on the growth and yield of native garlic. Specifically, it sought to: (1) determine the best rate of paclobutrazol application on native garlic; and (2) assess the economics of producing native garlic using paclobutrazol.

## MATERIALS AND METHODS
### Experimental design and treatment
The experimental area was laid out following the randomized complete block design in three blocks. Each block was divided into six equal plots where the different treatments were allocated. Each plot has a dimension of 5 m x 6 m. The planting distance was 15 cm between hills and 20 cm between rows. Alleys of 50 cm between plots and 100 cm between blocks were prepared, with the following rates, to wit: To- no spraying; $T_1$-5 ml Paclobutrazol/1 liter water; $T_2$-10 ml Paclobutrazol/1 liter water; $T_3$-15 ml Paclobutrazol/1 liter water; and $T_4$-20 ml Paclobutrazol/1 liter water.

### Site selection
A well-drained area of approximately 500m², flat, clean and formerly planted with rice and corn, located at the field of Sinapangan, San Juan, La Union was selected as the experimental site.

### Soil analysis
A composite soil sample (approximately 1 kg) was collected from the experimental site before land preparation using standard random sampling procedures with a shovel and bolo, specifically by taking a V-cut from each hole. The sample was air-dried for seven days and submitted to the Regional Soils Laboratory in Sta. Barbara, Pangasinan, for analysis. The results indicated that the soil has a low organic matter content (0.69%), very high available phosphorous (117.22 ppm), and a very low level of exchangeable potassium (0.26 cmol/kg).

### Procurement and collection
The following materials were procured and collected for the experiment: Thirty five kilograms of seed pieces of Ilocos White garlic seed pieces were purchased from the Sinait, Ilocos Sur Public Market, and the cloves were separated. The chemical treatments, Paclobutrazol and ANAA, were obtained from La Union Agro Service and Sales in San Fernando City. Finally, 40 sacks of soil compost were collected from the Municipal Nursery in San Juan, and rice straw was gathered from Calincamasan and Caculangan in San Juan, La Union.

### Land preparation
The land preparation involved first clearing the area of all agricultural wastes, including weeds, roots, and plant debris. The site was then thoroughly tilled by passing a tractor two times. Finally, the experimental beds were manually formed using a shovel, spade, and garden fork,

with the beds raised to 25 cm and the furrows spaced 50 cm apart:

| Fertilizer | 1 Hectare (kg) | 500 m²(kg) |
|---|---|---|
| Complete/Balanced fertilizer (14-14-14) | 50 | 2.54 |
| Ammonium sulfate (21-0-0) | 395.24 | 19.9 |
| Muriate of Potash (0-0-60) | 188.33 | 9.46 |

**Manure application**
During plot preparation, 72 sacks of soil compost were incorporated into the soil. The purpose of this application was to add essential nutrients and to increase the soil's water-holding capacity and cation exchange capacity (CEC).

**Seed preparation**
The seed preparation involved two main steps: first, the cloves were separated from the garlic bulbs and their tips were cut using sharp tools to encourage early sprouting. Second, the prepared cloves were soaked for five hours in a solution of 4 tbsp of ANAA per liter of water to further enhance their sprouting before planting.

**Planting**
The garlic bulblets were planted in the early morning using a spacing of 15 cm between hills and 20 cm between rows. The bulblets were placed into the dibbled holes with the growing point facing upward and then covered with a thin layer of soil.

**Mulching**
The three-centimeter layer of rice straw for mulching. This practice was implemented to prevent weed growth, conserve soil moisture, and help maintain the cleanliness and orderliness of the experimental area.

| Scale | % Crop injury |
|---|---|
| 1 | none |
| 2 | 1-10 |
| 3 | 11-20 |
| 4 | 21-30 |
| 5 | ≥30 |
| Source: (FPA, 2019) | |

**Fertilizer application**
Organic fertilizers were applied two weeks before planting 4 inches away from plant. The fertilizer

recommendation used in the experiment based on the Bureau of Soil Recommendation (BSR) were:

**Irrigation/watering**
Ten days after planting, until 80 days after planting, watering was done using the garden hose. This facilitated the early establishment of garlic.

**Weeding**
Weed management in the experimental area was performed by hand pulling while the weeds were still small. This practice was necessary because weeds compete with the garlic for vital resources like nutrients, water, light, carbon dioxide, and space, and pulling large weeds risks disturbing the garlic roots, which could cause significant stress to the crop.

**Paclobutrazol preparation and application**
Paclobutrazol at different rates was mixed in 1 liter of water and sprayed on the experimental plants using an atomizer This was applied early in the morning when the stomates are still open.The paclobutrazol used in the experiment was 25 SC with a composition of 250 g/L paclobutrazol, 114 g/L Inert Ingerdients and 636 g/L Water.

**Harvesting and drying**
Harvesting was done when the leaves are dried at maturity. It was done through hand pulling. The harvested taps were tied, hung, and air-dried for three to five consecutive days.

**Data gathered**
Crop stand: Refers to the over-all stand of plants per plot (to be taken two weeks after emergence and monthly thereafter).

| Scale | Description |
|---|---|
| 1 | Excellent, Extra vigorous |
| 2 | Good, Vigorous |
| 3 | Fair, Normal |
| 4 | Poor, Weak |
| 5 | Unacceptable, Weak |
| Source: (FPA, 2019) | |

Number of days to bulb formation: This was determined by counting the days from planting to bulb initiation.

Number of leaves: This was taken by counting the leaves of the 10 sample plants per plot at 30, 40, 50, 60 and 70 DAS.

Length of leaves (cm): This was taken by measuring the height from the base to the tip of the tallest leaf at 30, 45, 60, and 75 DAS.

Width of leaves (cm): This was taken by measuring the width at 30, 40, 50, 60 and 70 DAS.

Insect pest and disease prevalence: This was gathered by identifying, classifying and counting the total number of insect pest and disease attacking per treatment at weekly interval.

Bulb diameter (mm): This was taken using a vernier caliper at harvest and after drying.

Fresh weight of bulbs: This was determined by weighting the bulbs in kilograms per plot and converted into kg/ha at harvest.

Dry weight of bulbs: This was determined by weighting the bulbs in kilograms per plot and converted into kg/ha after drying.

Number of cloves/liter: This was determined by counting the cloves produced per bulb per liter after drying.

Chlorophyll content: This was determined by using the Chlorophyll Concentration Meter (SPAD meter) at the first and third week of every month.

% Phytotoxicity: It was based on the untreated check one week after first application and before each treatment application thereafter, showing the scale below. The type of injury can be stunting, chlorosis, tip burning, leaf curling, or retardation, etc.

Percent (%) moisture loss: This was computed by subtracting the fresh weight from the dry weight then divided by the dry weight multiplied by 100 after a week.

Cost and return analysis: This was determined by computing the following:

Gross income (Php): This was computed by getting the kilogram yield per plot and valuing it with the current market price.

Total expenses (Php): This was computed from the total expenses incurred during the study's operation.

Net income (Php): This was computed by subtracting the total expenses and gross income.

Return on Investment (%): This was computed by dividing the net income by the total expenses multiplied by 100.

Average production cost (Php): This was computed by dividing the total expenses by the yield per hectare.

Break-even yield (kg): This was computed by dividing the gross income and the total expenses.

**Analysis of data**
The gathered data was analyzed using the Analysis of Variance of Strip plot design. The differences between treatment means were detected by employing the Tukey's Honestly Significant Difference (HSD) using the Statistical Analysis for Agricultural Research (STAR) software. Further, the control was compared to the best rate using T-test.

**RESULTS AND DISCUSSION**
**Mean crop stand of garlic**
Table 1 presented the rate of application on the mean crop stand of garlic as affected by rate of paclobutrazol application. The crop stand ratings for all treatments range narrowly from 1.97 to 2.02, which fall within the good, vigorous to excellent, extra vigorous. This indicates that paclobutrazol application regardless of rate did not significantly affect the crop stand of garlic. The minimal variation among the mean values suggested that garlic plants maintained a generally vigorous and healthy stand across all paclobutrazol rates.

**Table 1.** Mean crop stand of garlic as affected by rate of paclobutrazol application

| Treatment[1] | Mean | Description |
|---|---|---|
| $T_0$- 5 ml | 1.97 | G, V |
| $T_1$- 10 ml | 2.02 | E, EV |
| $T_2$- 15 ml | 1.98 | E, EV |
| $T_1$- 10 ml | 1.98 | E, EV |
| $T_2$- 15 ml | 1.97 | GV |

[1]Paclobutrazol/1 liter water

Legend: 1- excellent (E), extra vigorous (EV), 2- good (G), vigorous (V), 3- fair (F), normal (N), 4- poor, (P) weak(W), 5- unacceptable(U)

Even at higher concentrations at 15 ml to 20 ml, there was no observable decline in plant vigor, implying that these levels of paclobutrazol did not cause any phytotoxic effects on garlic crop stand. The result in consonance with the study of Kristina *et al.* (2024) on the effect of concentration and time of giving paclobutrazol on garlic seedling bulbs which found that different concentration and timing affected yield and bulb/clove but reported no significant affect on garlic crop establishment (crop stand).

**Mean number of leaves of garlic**

The mean number of leaves of garlic subjected to the rate of paclobutrazol application at 5ml, 10ml, 15ml and 20ml is presented in Table 2. Analysis of Variance revealed no significant differences. The mean number of leaves of garlic applied with paclobutrazol shows the result among the treatment means at 30 DAS with means ranging from 3.80 to 4.27, at 40 DAS with means ranging from 4.80 to 5.00, at 50 DAS with means ranging from 7.73 to 8.00 and at 70 DAS with means ranging from 8.00 to 8.07, respectively.

**Table 2.** Mean number of leaves of  garlic as affected by  rate of paclobutrazol  application

| Treatment[1] | Days after planting | | | | |
|---|---|---|---|---|---|
| | 30 | 40 | 50 | 60 | 70 |
| $T_0$- 5 ml | 3.87 | 5.00 | 5.33 | 7.87 | 8.00 |
| $T_1$- 10 ml | 4.27 | 5.00 | 5.47 | 7.80 | 8.07 |
| $T_3$- 15 ml | 3.80 | 4.93 | 5.33 | 7.73 | 8.00 |
| $T_4$- 20 ml | 4.00 | 4.80 | 5.60 | 8.00 | 8.00 |
| | ns | ns | ns | ns | ns |

[1]Paclobutrazol/1 liter water, ns=not significant

The results implied that the mean numbers of leaves of garlic were not significantly influenced by the different rates of paclobutrazol application. It

indicates that the paclobutrazol did not significantly influence the bulb diameter applied at 30 DAS, 40 DAS, 50 DAS 60 DAS and 70 DAS.

**Mean length of leaves of garlic (cm)**

The mean length of leaves of garlic subjected to different rates (5ml, 10ml, 15ml and 20ml) of paclobutrazol application per liter of water is presented in Table 3. Results revealed no significant differences among the treatment means at 30 DAS with means ranging from 21.15 cm to 21.36cm, at 40 DAS with means ranging from 29.55 cm to 29.83 cm, at 50 DAS with means ranging from 31.46 cm to 31.95 cm, at 60 DAS with means ranging from 40.75 cm to 41.11 cm and at 70 DAS with means ranging from 41.40 cm to 41.79 cm. This implies that paclobutrazol did not significantly affect the garlic length at 5ml, 10ml, 15ml and 20ml.

**Table 3.** Mean width of leaves of garlic as affected by rate of paclobutrazol application

| Treatment[1] | Days after planting | | | | |
|---|---|---|---|---|---|
| | 30 | 40 | 50 | 60 | 70 |
| $T_0$- 5 ml | 0.78 | 0.89 | 1.07 | 1.29 | 1.50ab |
| $T_1$- 10 ml | 0.79 | 0.88 | 1.07 | 1.25 | 1.48b |
| $T_2$- 15 ml | 0.77 | 0.88 | 1.08 | 1.28 | 1.50ab |
| $T_4$- 20 ml | 0.80 | 0.88 | 1.09 | 1.25 | 1.52a |
| | ns | ns | ns | ns | * |

[1]Paclobutrazol/liter water, *=significant, ns=not significant

**Mean width of leaves of garlic (cm)**

Table 3 showed the effect of rate of application on the mean width of leaves of garlic as affected by paclobutrazol application.

**Table 4.** Mean weight of bulbs of garlic as affected by rate of paclobutrazol application

| Treatment[1] | Fresh weight (kg/plot) | Dry weight (kg/plot) | Fresh weight (kg/ha) | Dry weight (kg/ha) |
|---|---|---|---|---|
| $T_0$- 5 ml | 1.85 | 1.57 | 2044.44 | 1762.96 |
| $T_1$- 10 ml | 1.87 | 1.59 | 2074.07 | 1770.37 |
| $T_2$- 15 ml | 1.85 | 1.54 | 2051.85 | 1711.11 |
| $B_3$- 20 ml | 1.84 | 1.55 | 2044.44 | 1718.52 |
| | ns | ns | ns | ns |

[1]Paclobutrazol/liter water, ns=not significant

The results obtained no significant differences among the treatment means at 30 DAS with means ranging from 0.77 cm to 0.80 cm, at 40 DAS with mean ranging from 0.88 cm to 0.89 cm, at 50 DAS

with means ranging from 1.07 cm to 1.09 cm and 60 DAS with means ranging from 1.25 cm to 1.29 cm, respectively. The results implied that the leaves width during the early to mid-vegetative stage (30 to 60 DAS) exhibit limited sensitivity to paclobutrazol rates during initial development. However, at 70 DAS, the effect of the rate of paclobutrazol application on the mean width of leaves of garlic obtained a significant results among the treatment means wherin the application of paclobutrazol at a concentration of 20 ml/liter of water shows the widest leaf with a mean of 1.52 cm but not differ to a concentration at 5 ml and 15 ml with means of 1.50 cm. The narrow leaf was produced at a concentration of 10 ml with a mean of 1.48 cm and does not also differ to a concentration of 5 ml and 15 ml, respectively. The emergence of a significant difference in mean leaf width at 70 DAS indicates that garlic plants respond to varying paclobutrazol rates later in the growth cycle.

## Mean weight of bulbs of garlic (kg)

Results revealed no significant differences among the treatment means of fresh weight with means ranging from 1.84 to 1.87 kg/plot and 2, 044 to 2, 074.07 kg/ha while the dry weight with means ranging from 1.54 to 1.59 kg/plot and 1, 711.11 to 1, 770.37 kg/ha, respectively (Table 4). This implies that paclobutrazol did not significantly affect the weight of garlic bulb applied with a rate of 5ml. 10 ml, 15ml and 20ml.

## Mean bulb characteristics of garlic

### Days to bulb formation

Analysis of variance indicates the timing of paclobutrazol application that had no significant effect on the mean number of days to bulb formation in garlic with means ranging from 26.83 to 27.92. This implies that within the range of application time tested the developmental transition from vegetative growth to bulb initiation in garlic was not substantially influenced by the timing of paclobutrazol treatment (Table 5).

**Table 5.** Effect of rate of pacloburazol application on the mean bulb characteristics of garlic

| Treatment[1] | Days to bulb formation | Bulb diameter at harvest | Bulb diameter after harvest | Number of cloves/liter | Number of cloves/bulb | Number of bulb/liter |
|---|---|---|---|---|---|---|
| B₀- 5 ml | 27.13 | 41.20 | 37.13a | 643.07 | 26.13 | 24.67 |
| B₁- 10 ml | 27.13 | 41.20 | 37.20a | 662.80 | 26.27 | 24.93 |
| B₂- 15 ml | 26.93 | 40.33 | 36.07b | 640.27 | 25.53 | 24.93 |
| B₃- 20 ml | 26.93 | 39.80 | 36.07b | 653.20 | 26.00 | 35.67 |
| Signi-ficance | ns | ns | * | ns | ns | ns |

[1]Paclobutrazol/liter water, *=significant, ns=not significant

All means followed by the same letter are not significantly different.

### Bulb diameter (mm) at harvest and after harvest

The results revealed significant differences on the bulb diameter at harvest but does not significantly affect bulb diameter after harvest with means ranging from 39.80 mm to 36.07 mm. Garlic applied with 5 ml Paclobutrazol/1 liter water gave bigger bulb in diameter, at harvest and after harvest. However, the number of cloves/liter was highest in garlic received 20ml Paclobutrazol and number of bulb per liter, which that as the concentration of Paclobutrazol increases, there show negative effective to size of bulbs. This implies that paclobutrazol application influenced the bulb diameter at harvest subjected to 70 DAS with a mean of 43.42 mm.

### Number of cloves/liter, cloves/bulb and bulb/liter

Analysis of Variance revealed no significant differences. The mean number of cloves/liter applied with paclobutrazol at 30 DAS to 70 70 DAS were comparable with mean ranging from 551.08 to 727.08, number of cloves/bulb with mean ranges from 23.83 to 27.58 and number of bulb /liter with mean ranging from 24.00 to 26. 33, respectively. The results implied that the mean number of cloves/liter, mean number of cloves/bulb and mean number of bulb/liter were not significantly influenced by the different time of paclobutrazol application. It indicates that the PBZ did not significantly influence the bulb applied at 30 DAS, 40 DAS, 50 DAS, 60 DAS and 70 DAS.

**Chlorophyll content**

The effect of rate of application on the mean chlorophyll content of leaves of garlic is presented in Table 6. The results revealed that no significant difference in mean chlorophyll content across different application rates of paclobutrazol from first week to third week of every month. However, significant difference in mean chlorophyll content was observed during the first week of April. The results revealed that at 50 DAS application has the highest chlorophyll content with mean of 63.81 but not differ from 30 DAS and 60 DAS with means of 58.93 and 59,78 while the lowest chlorophyll content at 40 DAS and 70 DAS with mean of 57.59 and 55.41.

**Table 6.** Effect of rate of paclobutrazol application on the mean chlorophyll content of leaves of garlic

| Treatment[1] | Feb | Mar | | Apr | | May |
|---|---|---|---|---|---|---|
| | 3rd | 1st | 3rd | 1st | 3rd | 1st |
| $B_0$- 5 ml | 64.86 | 53.80 | 72.06 | 59.15 | 72.21 | 57.80 |
| $B_1$- 10 ml | 64.61 | 51.98 | 69.70 | 60.31 | 74.73 | 56.71 |
| $B_2$- 15 ml | 65.57 | 51.56 | 69.41 | 59.28 | 73.03 | 57.35 |
| $B_3$- 20 ml | 67.21 | 51.74 | 71.23 | 57.67 | 73.87 | 59.30 |
| | ns | ns | ns | ns | ns | ns |

[1]Paclobutrazol/liter water, ns=not significant

As to first week, month of March with means ranging from 51.56 to 53.80, month of April with means ranging from 57.67 to 60.31 and month of May with means ranging from 56.71 to 59. 30, While as to third week, month of February with a mean ranging from 64.61 to 65.57, month of March with a mean ranging from 69.41 to 72.06 and month of April with mean ranging from 72.21 to 74.73, respectively. This implies that varying PBZ concentrations within the tested range did not substantially influence chlorophyll synthesis or degradation in garlic plants during the early stages of growth. Therefore, Barbosa *et al.*, 2024 said that paclobutrazol application within the tested rates might be used to manipulate morphological traits without negatively or positively affecting leaf chlorophyll levels.

**Mean % phytotoxicity of garlic**

The effect of rate of application on the mean phytotoxicity of garlic is presented in Table 7. Analysis of variance revealed no significant differences among the treatment means. Results obtained comparable at one week before treatment and one week after treatment at a concentration level of 5ml to 20 ml with a mean of 3.00 % tip burning. This indicates that varying the concentration or amount of paclobutrazol applied did not lead to notable differences in the level of phytotoxic symptoms exhibited by the plants.

**Table 7.** Mean phytotoxicity of garlic as affected by rate of paclobutrazol application

| Treatment[1] | One week before treatment | One week after treatment |
|---|---|---|
| $B_0$- 5 ml | 3.00 | 3.00 |
| $B_1$- 10 ml | 3.00 | 3.00 |
| $B_2$- 15 ml | 3.00 | 3.00 |
| $B_3$- 20 ml | 3.00 | 3.00 |
| Significance | ns | ns |

[1]Paclobutrazol/liter water, ns=not significant

In other words, regardless of whether a low, medium, or high rate was used, garlic plants responded similarly showing no increased signs of stress or damage typically associated with phytotoxicity, such as chlorosis, necrosis are growth suppression. This outcome suggested that garlic has a certain level of tolerance to paclobutrazol across a range of application rates, and that the tested concentrations were within a safe threshold. It also implies that adjusting the rate of application may not compromise plant health in terms of visible toxicity symptoms, offering growers some flexibility in dosing without increasing the risk of crop injury.

**Percent moisture loss of bulbs of garlic**

Table 8 presented the effect of rate of application on the mean moisture loss of bulb of garlic as affected by time and rate of paclobutrazol application. Analysis of variance showed no significant differences among the treatment means on the fresh weight with a mean ranging from 14.98 % to 16.41 % and dry weight with a mean ranging from 18.20 % to 20.22%, respectively. This implies that the application of paclobutrazol at the tested levels (5ml to 20 ml) did not significantly affect the moisture loss of bulb of garlic. The lack of significant effect of paclobutrazol means that treatment did not alter plant water retention or transpiration; it could be due to plant species

traits, environmental factors, insufficient dosage, or the method of measurement.

**Table 8.** Effect of rate of paclobutrazol application on the mean moisture loss of bulb of garlic

| Treatment[1] | Fresh weight | Dry weight |
|---|---|---|
| $B_0$- 5 ml | 15.16 | 18.20 |
| $B_1$- 10 ml | 14.98 | 18.33 |
| $B_2$- 15 ml | 16.41 | 20.22 |
| $B_3$- 20 ml | 16.06 | 19.25 |
| Significance | ns | ns |

[1]Paclobutrazol/liter water, ns=not significant

## CONCLUSION

There were significant differences in the rate of paclobutrazol application as to the mean width of leaves of 1.52 cm subjected to 20 mL/liter of water, and mean bulb diameter after harvest of 37.20 mm subjected to 10 mL/liter of water. There were significant differences in the rate of paclobutrazol application as to the mean SPAD index of leaves at the first week of March, with a mean of 64.94 subjected to 5 mL/liter of water at 40 DAP, and at the third week of April, with a mean of 87.71 subjected to 20 mL/liter of water at 40 DAP. The plants obtained the heaviest weight of 1.90 kg/plot or 2,111.11 kg/ha, and with the highest return on investment are those plants applied with paclobutrazol with 10 mL paclobutrazol at 70 DAP.

Based on the results of the study, it is recommended to apply paclobutrazol at a rate of 10ml at 70 DAP and to further explore the use of PBZ in other garlic varieties.

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