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by Raden Ajeng Diana Widyastuti

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Plant Reproductive Responses of Guava 'Crystal' Under Different Paclobutrazol and NPK Fertilizer Doses

Raden Ajeng Diana Widyastuti*[A], Hidayat Pujisiswanto[B], Hayane Adeline Warganegara[B], Eli Sabeth Sutriana[C]

[A] Department of Agrotechnology, of 3514,
[B] Agronomy and Horticulture, of
3514,
[C] Student Agrotechnology Study Program, of
3514,
*Corresponding author; email:

Abstract

preliminary study of reproductive responses of crystal guava plants under varying doses of paclobutrazol and NPK fertilizer was conducted. The research took place in a small-scale 'Crystal' orchard in Rajabasa 1, East Lampung, from Augu 2021 to March 2022. The study employed a 3x3 complete , examining : paclobutrazol NPK fertilizer. , paclobutrazol (P), had three levels: . The second fa r, NPK fertilizer, was tested at three levels: 0 (control), 250 , and . The key variables measured were the number of reproductive shoots, blooming flowers, and fruits, serving as indicators of the 'Crystal' guava plant's reproductive responses. The study findings recommended the application of 2000 ppm paclobutrazol and 500 g per plant of NP fertilizer due to their significantly positive impact on reproductive shoots, blooming . Notably, there was no significant interaction observed between paclobutrazol and NPK treatments in regulating plant reproductive growth.

Keywords: reproductive shoots, guava, nitrogen, potassium, phosphorus.

Introduction

'Crystal' guava stands out as a superior fruit in Indonesia, capable of competing with imported fruits in the domestic market. Data from the Indonesia Bureau of Statistics reveals a significant rise in guava production, escalating from 200,487 tons in 2017 to 422,491 tons in 2021. This increase of 222,004 tons over five years underscores the fruit's growing popularity (BPS 2021). The 'Crystal' variety is particularly prized for its crunchy flesh and minimal seeds, constituting less than 3% of the fruit (Widyastuti et al. 2019a).

The significance of 'Crystal' guava is further amplified by its rich nutritional content, including ssential elements like vitamin C and antioxidants (; Hartati et al. 2020). Moreover, it is a source of sugar, fiber, protein, and minerals (Adrees et al. 2010). This nutritional profile not only adds to its appeal but also contributes to its perceived health benefits. The rising demand for 'Crystal' guava in the market emphasizes the necessity of improving guava fruit production. To cater to this demand, it is important to enhance production methods and maintain the fruit's superior quality.

Cultural techniques that have been studied to crease production and fruit quality include fruit . 2022a), application (Trivedi . 20 2; Goswami . 2015), biofertilizer usage (Shukla . 2014; . 2021), bud thinning ( ), strangulation (Widyastuti . 2019b), ; Lal . 2016; the application of growth retardant (Lizawati 2008). Paclobutrazol is a growth retardant that triggers reproductive responses, particularly flowering initiation. Its mechanism involves inhibiting gibberellin biosynthesis, impeding vegetative growth, and prompting flowering, as evidenced in citrus (Darmawan et al. 2014). Soil drenched paclobutrazol at 750 ppm on the 35th day after leaf re al in mango trees led to a substantial increase in , and tree (96%, 74%, and 73% respectively)

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compared to without paclobutrazol treatment (Yuniastuti et al. 2001).

Apart from growth retardants, optimal fertilization significantly contributes to improved t production (Mahendra et al. 2017), especially with). Varied nutrient management, particularly different forms of NPK fertilizers, results in varying harvested fruit weights and fruit quality in 'Crys l' guava (Musyarofah et al. 2020). In this context, preliminarily assess reproductive responses crystal plants under varying doses of paclobutrazol and NPK fertilizers.

from to a small-scale Crystal orchard in Rajabasa 1, East Lampung, Indonesia. Two-year-old guava trees were used as the object of study, that were previously selected based on their uniformity in plant height (2 m), canopy size (2-2.5 m), stem diameter (7.5-8 cm). Five-hundred grams of manures was applied to each plant.

the present block involving of treatment, doses of paclobutrazol (P) and NPK fertilizer (N). The first factor (paclobutrazol (P) consisted of three levels, i.e., , prepared from Golstar containing 250 g.L^{-1} active ingredient in form of paclobutrazo The second factor of NPK fertilizer consists of 0 (control), 250 , and . There were nine combination treatments that were replicated three times so that 27 experimental units were obtained in total. The three main observed variables were the number of reproductive shoots, flowers, and fruits as representative of Crystal guava plant reproductive response. All variables were counted directly in the field by using a hand counter at specific days, i.e., six weeks after treatment (WAT) and 12 WAT for the number of reproductive shoots, 7 WAT for the number of flowers, and 12 WAT and 19 WAT for the number of fruits.

Data of reproductive were subjected to α= . All statistical analysis was performed using Statistix 10.

Results

revealed insignificant interaction between paclobutrazol and NPK fertilizer dose factors (Table 1). However, a single factor of paclobutrazol or NPK fertilizer significantly affected the reproductive responses of guava, as represented by the number of reproductive shoots, flowers, and fruits (Table 1).

Both paclobutrazol and NPK fertilizer significantly increased the number of reproductive shoots in guava plants at 6 and 12 weeks after treatment (WAT) (Table 2). Paclobutrazol at 2000 ppm proved to be the most efficient treatment, leading to a higher number of reproductive shoots at both 6 WAT and 12 WAT compared to paclobutrazol at 4000 ppm and the control without paclobutrazol. Specifically, it increased the number of reproductive shoots by 58% at 6 WAT and by 53% at 12 WAT compared to the control without paclobutrazol.

Similarly, in the case of NPK fertilizer, the application of 500 g per plant emerged as the most effective treatment, inducing a 58% increase in reproductive shoots at 6 WAT and a 53% increase at 12 WAT compared to the control without NPK (refer to Table 2).

e application of paclobutrazol and NPK fertilizer impact flowers (3). Paclobutrazol treatment at concentrations of 2000 ppm or 4000 ppm ulted in a 61% and 42% increase in flower count, without paclobutrazol. Additionally, use NPK fertilizer at a rate of 250 g per plant increased flower numbers by 47%, whereas a dosage of 500 g per plant led to a significant 106% increase, both compared to the absence of NPK fertilizer (Table 3).

Table 1. The result of analysis of variance of 'Crystal' guava reproductive responses to different paclobutrazol and NPK fertilizer doses.

Variables	Paclobutrazol (P)	NPK (N)	Interaction (PxN)
Number of reproductive shoots	*	*	ns
Flower number	*	*	ns
Fruit number	*	*	ns

Note: ns – not significantly different, * significantly different.

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Table 2. The number of reproductive shoots of 'Crystal' guava in response to different paclobutrazol and NPK fertilizer doses.

Treatments	Number of reproductive shoots	
	6 WAT	12 WAT
Without Paclobutrazol	2.97 b	74.33 b
Paclobutrazol 2000 ppm	3.65 a	94.33 a
Paclobutrazol 4000 ppm	3.53 ab	87.22 a
Without NPK	2.60 c	69.00 c
NPK 250 g per plant	3.45 b	81.56 b
NPK 500 g per plant	4.11 a	105.33 a
LSD	0.59	12.10

Note: WAT – Weeks after treatment. Means alphabet within

Table 3. The number of blooming flowers of 'Crystal' guava in response to different paclobutrazol and NPK fertilizer doses

Treatments	Flower number
Without Paclobutrazol	21.11 b
Paclobutrazol 2000 ppm	33.89 a
Paclobutrazol 4000 ppm	30.00 a
Without NPK	18.78 c
NPK 250 g per plant	27.56 b
NPK 500 g per plant	38.67 a
LSD	8.39

Note: Means followed by the same are not LSD α=5%.

4. in response to different paclobutrazol and NPK fertilizer doses

Treatments	Fruit number	
	12 WAT	19 WAT
Without Paclobutrazol	2.54 c	6.22 c
Paclobutrazol 2000 ppm	3.63 a	12.89 a
Paclobutrazol 4000 ppm	3.19 b	9.56 b
Without NPK	2.37 c	5.11 c
NPK 250 g per plant	3.04 b	8.33 b
NPK 500 g per plant	3.96 a	15.22 a
LSD	0.42	3.02

Note: WAT – Weeks after treatment. Means followed by the same are not LSD =5%.

Both paclobutrazol and NPK fertilizer significantly increased the number of 'Crystal' guava fruits at 6 and 12 weeks after treatment (WAT) (refer to Table 4). Paclobutrazol at 2000 ppm proved to be the most effective treatment, resulting in a 43% increase in fruit number at 12 WAT and a 107% increase at 19 WAT, surpassing both paclobutrazol at 4000 ppm and the control without paclobutrazol. Similarly, NPK 500 g per led to a 67% increase in fruit number at 12 WAT and a 198% increase at 19 WAT, compared to the control without NPK (Table 4)

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Discussion

yielded significant improvements reproductive shoots, with the highest shoot numbers recorded at 2000 ppm paclobutrazol, reaching 3.65 shoots at 6 weeks after treatment (WAT) and 94.33 shoots at 12 WAT. This finding aligns with a previous study by Prawitasari et al. (2005) that paclobutrazol increased the average number of induced, initiated, and differentiated shoots, inhibited vegetative growth, and stimulated the growth of reproductive shoots. The enhanced production of reproductive shoots significantly enhanced flower formation and, subsequently, the harvested fruits.

Similarly, the application of NPK fertilizer demonstrated a significant positive impact on generative shoots. Specifically, applying 500 g per plant of NPK resulted in a higher number of reproductive shoots compared to the 2 g per plant NPK treatment. This finding mirrors prior Listari . (2004), which highlighted positive and significant effect of NPK in increasing the guava reproductive shoot numbers.

Paclobutrazol application increased the number of flowers at 7 WAT, surpassing the control group sig ficantly. This observation aligns with the findings of Rai . (2004). Similarly, enhancement flowering was also evident with NPK fertilizer application. Adequate availability of NPK supports the reproductive growth, evident from the reduction in flower drop. 'Crystal' guava treated with NPK at 500 g per plant exhibited a higher number of flowers compared to those without NPK fertilizer application. The increase in flower numbers on 'Crystal' guava plants is promising, as it directly correlates with the fruit formation.

Under the treatment of 2000 ppm paclobutrazol, a higher number of fruits were formed. Similarly, applying 500 g per plant of NPK also resulted in a higher fruit yield compared to the other two treatments. This increase in fruit production directly correlated with the rise in the number of flowers, consistent with findings from Widyastuti et al. (2019a).

Similar to the impact of strangulation as reported by Widyastuti et al. (2019b), paclobutrazol exhibited significant stimulatory effects on reproductive growth responses. This effect was clearly observed in the sequential processes of flowering, fertilization, and fruit formation. Paclobutrazol not only promote the absorption of minerals, chlorophyll, and carbohydrate content in plant tissues but also heightened the dominance of reproductive growth over vegetative growth. Th dominance was closely linked to the C/N ratio leaves ( ). Although factors influencing this ratio were not measured in the present study, future research that delves into these aspects could prove instrumental in achieving a balanced C/N ratio. Such equilibrium could, in turn, lead to increased photosynthate accumulation and flowering.

Furthermore, the application of NPK fertilizer played an important role in supplying essential nutrients to plants, promoted flowering and fruit formation (Waskito et al., 2018). Despite its efficacy, the use of paclobutrazol for regulating guava flowering and fruiting demands careful consideration due to its potential adverse effects. While paclobutrazol has a low likelihood of contaminating surface water and groundwater, there is a significant risk associated with its accumulation in aquatic life. This accumulation poses a notable concern when aquatic organisms are consumed by humans, given the genotoxic and carcinogenic risks involved (Kishore et al., 2015).

Conclusion

The application of 2000 ppm paclobutrazol significantly increased reproductive shoots, n 'Crystal' guava. Concurrently, applying 500 g of per yielded results quantity reproductive shoots, . There was no significant interaction between the paclobutrazol and NPK treatments in regulating the reproductive growth of 'Crystal' guava.

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