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The Effort of Fruit Drop Reduction Coffe Robusta (*Coffea canephora)* by Pyraclostrobin

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Abstract

Robusta coffee (*Coffea canephora*) is a commodity with a high economic value among other plantation crops. Coffee is also one of the three non-alcoholic drinks (coffee, tea, chocolate) widespread. Indonesia and including a strategic country in international coffee because Indonesia is the third-largest coffee exporting country after Brazil and Vietnam. Coffee productivity in Indonesia averages 11,250 tons per year. This study aimed to study Pyraclostrobin's coffee fertilization ability to reduce the occurrence of fruit drop and determine the appropriate concentration for the treatment of spraying Pyraclostrobin in fertilization to reduce the event of Robusta coffee fruit drop. This research was conducted in January-September 2016 in the coffee plantation in Tlogosari village, Tirtoyudo sub-district, Malang district, located at an altitude of 560 m above sea level. The method used in this study was a Randomized Block Design. which consisted of 6 treatments and four replications. While the treatment is P0 (without spraying), P1 (Spraying once a week with a concentration of 150 ppm), P2 (Spraying once a week with a concentration of 300 ppm), P3 (Spraying once a week with a concentration of 450 ppm), P4 (Spraying one week earlier with a concentration of 600 ppm), P5 (Spraying once a week with a concentration of 750 ppm). Giving pyraclostrobin with a concentration of 600 ppm can increase the number of fruits compared to the treatment without pyraclostrobin.

Keywords: Robusta coffee, pyraclostrobin, spraying, fruit drop.

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Introduction

Flowering and fruiting of coffee plants is a change in the vegetative phase into the reproductive stage. At the time of flowering, the vegetative phase of the terminal or lateral will undergo various processes of physiological and histological changes and change shape directly into the reproductive stage. (Racsko and Leite, 2007) The occurrence of fruit loss is usually caused by several factors, including the failure of fertilization, physiological, and disease pests. Physiological factors occur through the influence of climate, especially humidity and drought that affect fruit loss. During fruit development, it is thought that the transfer of carbohydrates from other parts of the plant to branching has heavy fertilization. If carbohydrate is lacking,

miscarriage of leaves and fruit will occur. Moisture that is too high also causes the formation of abscissa so that the cells become damaged, resembling flour, and encourage the occurrence of leaves and coffee fruit loss. Coffee loss due to carbohydrate deficiency is less than the loss caused by hormone deficiency (Vaast et al., 2005). Thus, special handling needs to be done so that the results of the coffee plant can be maximized.

Pyraclostrobin is a compound of the strobilurin group that can inhibit mitochondrial respiration by blocking electrons' transfer in the respiratory chain (Ammermann et al., 2000). Pyraclostrobin or with the chemical name (methyl N- [2- [1- (4-chlorophenyl) -1H-pyrazole-3 yl] oxy] methyl] phenyl] methoxy-, methyl ester) is known to inhibit senescence by slowing the activity of acid synthesis 1-aminocyclopropane-1carboxylic (AAC) in plant shoot tissue (Grossmann and Retzlaff, 1997). Pyraclostrobin has the compound formula $C_{19}H_{18}CIN_3O_4$. The Cl element functions as a toxin and the N element as a nutrient enhancer in plants. Nitrogen is an essential component of amino acids, nucleic acids, and proteins.

Method

This research was conducted in January-September 2016 in the coffee plantation in Tlogosari village, Tirtoyudo sub-district, Malang district, located at an altitude of 560 m above sea level. The tools used in this research is a camera and other writing equipment. The camera is used as documentation that can support and complement data in the field. The ingredients used are a 4-year old arabica coffee plant and pyraclostrobin. This research used a Randomized Block Design Method consisting of 6 treatments and four replications. Observations made on plant growth parameters include the number of clusters, number of leaves, leaf area, and number of fruits. While the harvest observation parameters include the number of fruits, fruit weight, and yield of tons per ha-1. Destructive observations are carried to observe the number of stomata and chlorophyll content. Observational data obtained were analyzed using analysis of variance (F test) at 5% level. If the results of the examination obtained a significant difference, then proceed with a comparison test between treatments using the Least Significant Difference (LSD) at the 5% level.

Results and Discussion

Pyraclostrobin application can increase plant growth and increase yields in coffee plants. Giuliani et al. (2011) explained that the pyraclostrobin application has a positive effect on plant physiology, causing an increase in crop yield by modifying hormone balance and delaying plant aging. (Koehle et al., 2003) added that pyraclostrobin changed the status of phytohormone in shoot tissue and inhibited the ethylene hormone. Pyraclostrobin increases tolerance to environmental stress, significantly increasing tolerance to drought (dry season).

Ethylene hormone responds when plants experience stress, including drought stress due to increased air temperature (Taiz and Zeiger, 2004). Kanungo and Juhie (2014) added that pyraclostrobin application in plants could increase the rate of photosynthesis and extend the life span of flag leaves with high chlorophyll content.

Analysis of Chlorophyll Content of Coffee Plant Leaves

Pyraclostrobin application can increase chlorophyll content. The highest amount of chlorophyll was found in treatment P4 (600). The total chlorophyll content in treatment P4 (600) showed an increase in chlorophyll content of 81.50% each compared to P0 (without spraying) (Figure 1).

Pyraclostrobin can increase the activity of the nitrate reductase enzyme (Kuswanto et al., 2011). This enzyme plays a role in the formation of nitrogen in plants to increase the chlorophyll and nitrogen content in leaves (BASF, 2011). Chlorophyll is a green pigment in plants, algae, and photosynthetic bacteria. This pigment plays a role in the process of plant photosynthesis that functions by harnessing solar energy, triggering CO2 fixation to produce carbohydrates, and providing power for the ecosystem.

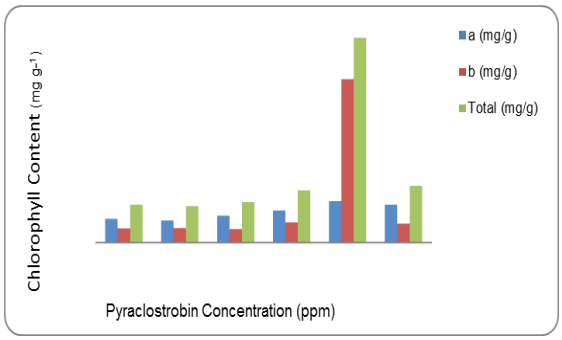

Figure 1. Histogram of Chlorophyll Content of Coffee Plant Leaves at Various Concentrations of Pytraclostrobin

Chlorophyll can accommodate the light absorbed by other pigments through photosynthesis, so chlorophyll is called the reaction center pigment. Pyraclostrobin also improves crop yield and nutrition of Conrath et al., (2004). High nitrogen content serves as a constituent component of many essential compounds for plants, for example, amino acids. These substances stimulate growth (increase plant height and number of tillers), increase leaf area, and increase protein content. The prominent role of nitrogen for plants is to stimulate overall plant growth, specifically stems, branches, and leaves (Kreiner et al., 2002).

Peduncle Network Analysis

This network observation aims to determine the difference between the peduncle attached to the fruit and the peduncle whose fruit is falling out.

This observation is carried out by cutting transversely at the linking area. Transverse appearance in the peduncle linkage area results indicates that both figures 1 and 2 show the perfectly round shape in the cortex. Furthermore, the vascular part of Figure 1 shows that the xylem secondary and phlegm are formed, and the avascular cavity is formed. Whereas Figure 2 shows, there is no forming xylem secondary and phloem surrender. This is consistent with the statement of Alberts et al. (1989), which states that phloem and xylem play a role in transferring the solution so that there is a network that opens, where this phloem plays a role in transporting organic solutions (photosynthesis results) in plants.

While the xylem parenchyma actively transfers specific solutions into and out of the vessel elements through the plasma membrane horizontally. The walls that connect in a series of vessel elements that form a tube may have small pore holes **(Fig. 2).**

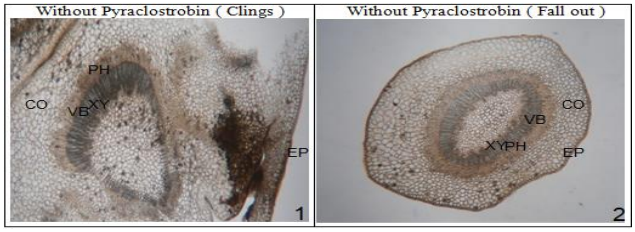

Figure 2. Peduncle tissue Transverse slices resulting from the incision of the coffee spout EP = epidermis CO = cortex; PH = phloem; XY = xylem; VB = vascular bundle; PA = Parenchyma

Amount of Coffee Fruit Plant

The various analysis results showed that the method of spraying pyraclostrobin had a significant effect on the number of coffee fruits in the upper, middle, and lower branches. In P4 (600), the number of fruits increased by 53.24%, 50.92%, and 51.63, respectively, compared to the P0 treatment (without spraying) **(Table 1).**

Table 1. Average Coffee Bean Yield at Various *Pyraclostrobin concentrations*

Pyraclostrobin (ppm)	Fruit Result			
	Top Branch (g per branch)	Middle Branch (g per branch)	Lower Branch (g per branch)	Total (g per tan)
P0 (0)	231,42 a	213,48 a	189,79 a	576,83 a
P1 (150)	409,85 abc	354,01 ab	175,47 a	939,32 ab
P2 (300)	542,34 bc	400,85 b	289,25 b	1232,44 bc
P3 (450)	484,89 bc	458,95 bc	279,32 ab	1223,16 bc
P4 (600)	579,96 c	603,52 c	399,43 c	1582,91 c
P5 (750)	322,66 ab	343,26 ab	247,63 ab	913,54 ab
BNT 5%	225,89	225,89	104,12	388,37
KK %	17,30	17,30	16,92	23,91

Note: If accompanied by the same letter at the same age and the same column shows no significant difference based on 5% LSD test; MSA = weeks after application

Fruit Weight of Coffee Plant

The total weight of coffee beans per plant showed that the fruit weight always increased in each treatment. At treatment P4 (600), seed weight increased by 81.15%. We compared to treatment P0 (without spraying). Observation of productivity level per hectare shows that the seeds' weight also always increases in each treatment. At treatment P4 (600), the number of seeds increased by 81.27% compared to treatment P0 (without spraying). In treatments P5 (750), P3 (450), P2 (300) and P1 (150) each increased by 47.77%, 76.14%, 65.69% and 36.48 compared to treatments (P0) No Spraying **(Figure 4).**

The observation of the number of fruits and fruit weight showed that the highest number of fruits and fruit weights was P4 (600). This is consistent with the statement of Anand et al. (2013), which states that fruit miscarriages occur due to physiological factors that arise through the influence of climate, especially humidity and drought that affect fruit loss. Koehle et al. (2003) added that pyraclostrobin and activity in the mitochondria plants also play a role in reducing respiration in plants.

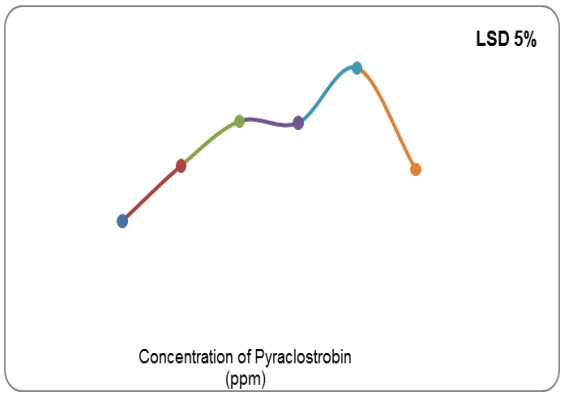

Figure 3. Histogram of Number of Coffee Plants in Upper, Middle and Lower Branch at Various Pytraclostrobin Concentrations

Respiration makes plants store more carbon compounds for growth and spur reactions from physiological changes in plants.

The positive effect of physiological changes can increase nitrate reductase

activity, which is an enzyme used for the formation of nitrogen in plants. Other benefits of growing nitrate reductase activity in plants include developing the enzyme superoxide dismutase and peroxidase movement, which removes heat. This enzyme can reduce oxidative stress to respond to chaotic environments such as ozone damage and heat stress.

Koehle et al. (2003), pyraclostrobin can increase tolerance to heat. Heat stress is associated with increased activity of the enzyme superoxide dismutase (SOD). Nitric oxide is also associated with increased tolerance to heat (Larson, 1997). Pyraclostrobin will help additional fertilizer at the time of application. Identifying sources of fertilizer that synergy increases yields with the application will help reduce disease, reduce costs and provide additional fertilizer when plant demand is in top condition (Kuswanto and Wicaksono, 2011). Besides, pyraclostrobin also acts as (ZPT). ZPT is an organic compound produced by plants and has a role in the process of metabolic regulation in these plants. Each plant can synthesize its plant growth regulator for its growth process and continuity, but to accelerate plant growth, it needs to input the plant growth regulator from outside. Giving ZPT in addition to accelerating plant growth can also improve the quality and quantity of agricultural products.

Table 2. Average Result of Coffee Fruit when Harvesting.

Pyraclostrobin (ppm)	Fruit Result				
	Top (g per branch)	Middle (g per branch)	Lower (g per branch)	Total (g per plant)	Total Seed (t. ha^{-1})
P0 (0)	168,8 a	82,0 a	45,00 A	295,8 a	0,47 a
P1 (150)	250,0 b	168,8 b	45,00 A	463,8 b	0,74 b
P2 (300)	440,0 c	278,8 c	141,3 B	860,0 d	1,37 d
P3 (450)	532,0 d	512,0 d	189,0 C	1233,0 e	1,97 e
P4 (600)	738,8 e	573,0 e	258,0 D	1569,5 f	2,51 f
P5 (750)	284,0 b	169,0 b	112,5 B	565,5 c	0,90 c
BNT 5%	60,65	48,51	36,07	85,01	0,13
KK %	10,01	10,83	18,16	6,79	6,79

Note: If accompanied by the same letter at the same age and column shows no significant difference based on the BNT test

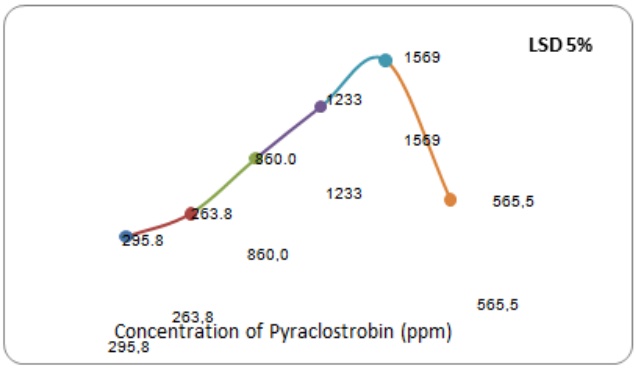

Figure 4. Histogram of the Weight of the Top, Middle, and Lower Branch of Coffee Plants.

Conclusion

Providing pyraclostrobin can increase fruit volume and yield. Providing pyraclostrobin with a concentration of 600 ppm increased the seed weight by 81.15% and reduced the incidence of fruit loss by 55.75% compared with treatment without pyraclostrobin.

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