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Research Paper

Effect of liquid smoke and flower inducer (TDZ+BA) concentration on flowering of Robusta coffee (*Coffea canephora*)

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Abstract
Coffee yield could be increased in several ways, one of which is through inducing flower. The provision of liquid smoke and flower inducer can stimulate flowering of coffee trees. This research aims to determine the effect of liquid smoke and flower inducer concentrations and their interactions on coffee flowering. This research was conducted at the Agronomy Laboratory, Faculty of Agriculture, University of Lampung and in research plot of Sidomulyo Village, Air Naningan District, Tanggamus Regency from August 2024 to January 2025. This research employed a factorial Randomized Complete Block Design (RCBD) (4x3) with 3 replicators. The first factor is liquid smoke with a concentration of 0 ml/L (S0), 10 ml/L (S1), 20 ml/L (S2), and 30 ml/L (S3). The second factor is flower inducer (F) with a concentration of 0 ml/L (F0) and 20 ml/L (F1). Homogeneity of variance between treatments was tested using the Barlett Test to determine the homogeneity of variance between treatments, data additivity was tested using the Tukey Test, then the data was analyzed using analysis of variance and standard error of mean. The difference in the mean value of the treatment was tested using the Duncan Test at the 5% level. The results showed that liquid smoke treatment affected number of new branches (B0), number of flower initiation branches, number of flower initiation clusters per branch, and number of young fruits per cluster. Flower inducer treatment affected number of the first flowering branches (B1), number of flower initiation branches, and number of flower initiation clusters per branch.

Keywords
Cytokinins; Flowering; Liquid Smoke; Robusta Coffee; TDZ

1. INTRODUCTION

The Indonesian population relies heavily on the agricultural sector to meet daily needs. Robusta Coffee (*Coffea canephora* Pierre ex A.Froehner) is a plantation crop with high importance as Indonesia's sources of income. According to Direktorat Jenderal Perkebunan (2018), coffee as an export commodity contributes to foreign exchange earnings and national income, provides employment opportunities, serves as a source of income for farmers, and drives the growth of the agribusiness sector.

Indonesia ranks third in the world as a major coffee producer, after Brazil and Vietnam. It produced approximately 11,85 million bags of coffee in the 2022/2023 period(Sembiring et al., 2023). Based on data from the Direktorat Statistik Tanaman Perkebunan (2023), coffee production in Indonesia fluctuated between 2020 - 2022. In 2020, coffee production reached 762,38 thousand tons. It increased by 3,12% in 2021 to 786,19 thousand tons, but then declined by 1,43% in 2022 to 774,96 thousand tons.

Lampung is one of the largest coffee-producing provinces in Indonesia. The coffee varieties cultivated in Lampung are Arabica, Robusta, and Liberica (Evizal, 2013). According to Direktorat Statistik Tanaman Perkebunan (2023), Lampung ranks second among the top coffee-producing provinces in Indonesia. In 2022, Lampung accounted for 14,68% of Indonesia's total coffee production. Robusta coffee production in Lampung fluctuated between 2020 and 2022, indicating instability in coffee yield during this period. According to Villers et al. (2009), one factor contributing to the decline in Robusta coffee productivity is climate change.

Coffee production can be improved through several methods, one of which is by inducing flower. According to Rahardjo (2017), the development of coffee begins with the formation of flower primordia, followed by flower growth, blooming, pollination, and fruit set. Putra (2019) stated that flowering and fruiting in Robusta coffee can be enhanced by providing sufficient nutrients. Other significant factors to induce coffee flowering, fruit set and maturation include water deficit and irrigation (Miranda et al., 2020), photoperiod, air temperature, gibberellin, cytokinins, and ethylene

(Lopez et al., 2021).

Liquid smoke contains compounds including ethylene that can promote plant growth and protect plants from pests and diseases. According to Govindaraj et al. (2016), many plants flower after being exposed to smoke from fires, suggesting that smoke can stimulate flowering and root initiation. Coffee flowers can be induced by applying solutions containing plant growth regulators (PGRs). One type of PGR used is Thidiazuron (TDZ) and Benzyladenine (BA). TDZ and BA are PGRs classified as cytokinins (Puspita et al., 2024). Cytokinins can be used to increase flower production of orchid (Iryani, 2019).

2. MATERIALS AND METHODS

This research was conducted from August 2024 to January 2025. The research took place at the Agronomy Laboratory, Faculty of Agriculture, University of Lampung, and at a coffee research plot in Sidomulyo Village, Air Naningan Subdistrict, Tanggamus Regency, located at latitude -5.2653320 and longitude 104.6743060, with an elevation of 557 meters above sea level (masl). In 2023, Sidomulyo Village recorded the lowest annual rainfall over the 2015–2024 period, amounting to 1,540.8 mm. The highest rainfall occurred in 2016, with a total of 3,342.5 mm as presented in Figure 1A. Rainfall in 2024 showed a drought in May – October as presented in Figure 1B. The equipment used in this research included 1,5 liter bottles, 25 ml and 50 ml measuring glass, measuring tape, electric knapsack sprayer, and calipers digital. The materials used included Robusta coffee trees, liquid smoke, flower inducer, and distilled water (aquadest).

The research employed a Factorial Randomized Complete Block Design (RCBD) with two treatment factors. The first factor was liquid smoke (S), consisting of four levels: 0 ml/L (S0), 10 ml/L (S1), 20 ml/L (S2), and 30 ml/L (S3) of liquid smoke. The second factor was flower inducer (F), consisting of two levels: 0 ml/L (F0) and 20 ml/L (F1) of flower inducer. The trees were grouped based on land slope. Based on the two factors, there were 8 treatment combinations: liquid smoke 0 ml/L + flower inducer 0 ml/L (S0F0), liquid smoke 0 ml/L + flower inducer 20 ml/L (S0F1), liquid smoke 10 ml/L + flower inducer 0 ml/L (S1F0), liquid smoke 10 ml/L + flower inducer 20 ml/L (S1F1), liquid smoke 20 ml/L + flower inducer 0 ml/L (S2F0), liquid smoke 20 ml/L + flower inducer 20 ml/L (S2F1), liquid smoke 30 ml/L + flower inducer 0 ml/L (S3F0), and liquid smoke 30 ml/L + flower inducer 20 ml/L (S3F1).

Data analysis was carried out using Bartlett's Test to determine the homogeneity of variances among treatments, and data additivity was tested using Tukey's Test. The data were then subjected to analysis of variance (ANOVA) and standard error of the mean (SEM). Differences in treatment means were further tested using Duncan's Multiple Range Test (DMRT) at the 5% significance level.

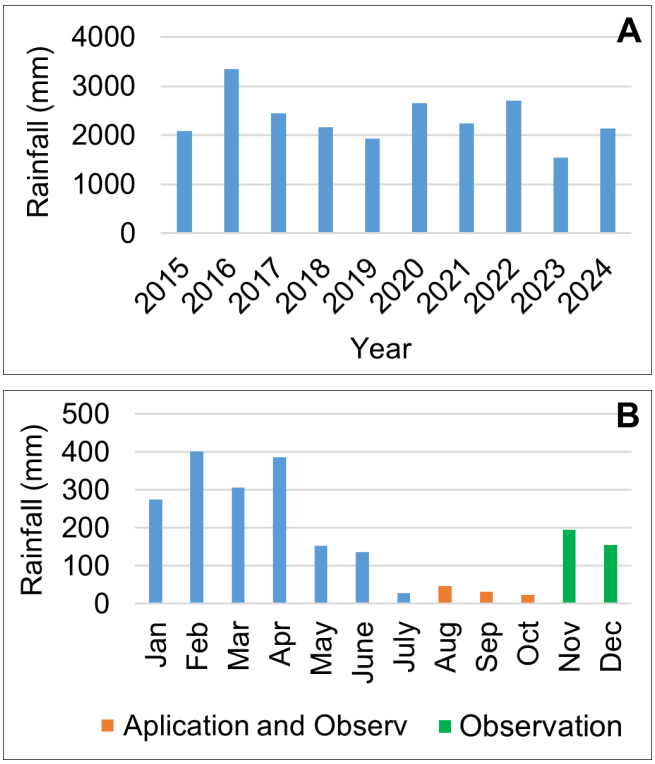

Figure 1. Annual rainfall data in 2015-2024 period (A) and monthly in 2024 (B). Source: Balai Besar Wilayah Sungai Mesuji Sekampung (BBWS-MS)

The research was conducted in several stages, including: field preparation, formulation of liquid smoke and flower inducer solution combinations, selection of sample trees, application of the treatment combinations, and observation of research variables. The experimental plot used was land cleared from old cacao plantations and then ploughed twice using handtractor. The coffee trees in the field were spaced 1,25 x 2,75 meters apart. The Robusta coffee trees were 2 years old and fertilized with 250 g of NPK (15-15-15) and 100 g of urea per tree by sown method, twice a year. Weed was controlled by hand weeding. Banana plants and silk cotton trees were used as shade trees (Evizal and Prasmatiwi, 2024).

The formulation of the treatment solutions was carried out at the Laboratory. The flower inducer solution used was produced by the Faculty of Agriculture, University of Lampung and consisted of 250 ppm BA (Benzyladenine) and 15 ppm TDZ (Thidiazuron). The liquid smoke was obtained from the condensation of vapor produced by the pyrolysis of rice husks. The liquid smoke and flower inducer for each treatment were put into a bottle and then distilled water was added until the solution volume was 1000 ml.

The sample trees were selected randomly from uniform trees that have the potential to flower. After selection, the sample trees were labeled with synthetic rubber bands marked with replicate number and treatment code. Ap-

plication of the treatment was carried out using an electric knapsack sprayer. The prepared treatment solutions were poured into the sprayer and evenly sprayed on the entire coffee trees. One liter of treatment solution was used for three coffee trees, resulting in a spray volume of 333 ml per tree. The treatments were applied four times, with a two-week interval between applications, conducted at 10:00 AM under clear weather conditions.

3. RESULTS AND DISCUSSION

The analysis of variance (ANOVA) showed that the liquid smoke treatment had a significant effect on number of new branches (B0), number of pin head per cluster, and number of young fruits per cluster. The flower inducer treatment had a significant effect on number of flowering branches (B1). The interaction between liquid smoke and the flower inducer significantly affected on number of initiated flowers per cluster, but had no significant effect on the other observed variables.

The analysis of standar error of mean showed that the liquid smoke treatment had a significant effect on number of flower initiation branches, number of flower initiation clusters per branch, and number of young fruits per cluster. The flower inducer treatment had a significant effect on number of flower initiation branches and number of flower initiation clusters per branch.

3.1 Number of B0 and B1 Branches

The results of the research indicated that the liquid smoke treatment had a significant effect. The application of liquid smoke at 10 ml/L (S1) was the most effective concentration, resulting in the highest number of new branches (B0), with an average of 7,92 branches. That effect was not significantly different from the effect of 20 ml/L treatment (S2), which produced 6,5 branches. The effect of 20 ml/L treatment (S2) was also not significantly different from the effect of 0 ml/L (S0) and 30 ml/L (S3) treatments, which resulted in 5,17 branches. These results suggested that the application of liquid smoke at 10 ml/L can increase number of new branches (B0). The effect of liquid smoke and flower inducer treatments on number of new branches (B0) is presented in Table 1.

Liquid smoke contains chemical compounds that can promote plant growth. According to Mu and Furuno (2003), liquid smoke contains major chemical components such as acetic acid, methanol, and phenols. Acetic acid originates from lignin, cellulose, and hemicellulose components and acts as an effective solvent for other substances. Tavassoli and Galavi. (2011) reported that methanol plays a role in accelerating leaf growth, acts as a carbon source, and can inhibit photorespiration, thereby enhancing plant growth.

Excessive concentrations of liquid smoke may reduce number of new branches in coffee trees. The effect of liquid smoke at 20 and 30 ml/L showed a decrease in number of new branches (B0). According to Azmi and Handriatni (2018), the application treatment at appropriate concentrations can stimulate plant growth and development, while excessively high concentrations may inhibit growth and even cause plant death.

The results also showed that flower inducer treatment had a significant effect on number of the first flowering branches (B1). The treatment of flower inducer at 20 ml/L (F1) was the most effective, producing the highest number of flowering branches (B1) at 19,67 branches, significantly higher than the 0 ml/L treatment (F0), which resulted in 13,08 branches. The treatment of liquid smoke did not have a significant effect on number of flowering branches (B1). The effect of liquid smoke and flower inducer treatments on number of flowering branches (B1) is also presented in Table 2.

An increase in flowering branches indicates the potential of more flowers set. According to Rohmandoni and Baharuddin (2024), branch development can be influenced by plant hormones such as auxin, gibberellin, and cytokinin. Cytokinin promotes cell division, which can increase branch formation. Yanto et al. (2023) stated that adequate nutrient availability is essential for optimal plant growth and development. With sufficient nutrition, the flowering process can proceed successfully.

Table 1. Effect of Liquid Smoke and Flower Inducer Treatment on Number of B0 and B1 Branches

Liquid Smoke	Number of B0 branches	Number of B1 branches
S0 (0 ml/L)	5,17 a	18,33 a
S1 (10 ml/L)	7,92 b	14,00 a
S2 (20 ml/L)	6,50 ab	15,33 a
S3 (30 ml/L)	5,17 a	17,83 a
Flower Inducer		
F0 (0 ml/L)	6,04 a	13,08 a
F1 (20 ml/L)	6,33 a	19,67 b

Note: Means followed by the same letter are not significantly diifferent based on Duncan's Multiple Range Test (DMRT) at 5% significance level.
B0=new branches, may be flowering next year. B1=branches for the first time flowering

3.2 Number of Flower Initiation Branches

The results of data analysis using the standard error of mean, as presented in Figure 2A, showed that the effect of control treatment (S0F0) differed from the effect of liquid smoke at 0 ml/L combined with flower inducer at 20 ml/L (S0F1). The S0F1 treatment tended to produce the highest number of flower initiation branches, with an average of 12 branches. In contrast, combination of liquid smoke at

20 ml/L and flower inducer at 0 ml/L (S2F0) resulted in the lowest number of flower initiation branches, with an average of 3,67 branches. These findings indicated that the application of liquid smoke showed inconsistent effect considering that liquid smoke at 10 ml/L (S1) and 20 ml/L (S2) decreased number of flower initiation branches, while the higher concentration of liquid smoke at 30 ml/L (S3) was able to increase flower initiation branch formation. Likewise, with the combination treatment of liquid smoke and flower inducer also showed inconsistent effect.

3.3 Number of Flower Initiation Clusters per Branch

The results of data analysis using the standard error of mean, as presented in Figure 2B, showed that the effect of control treatment (S0F0) differed from the treatment of liquid smoke at 0 ml/L combined with flower inducer at 20 ml/L (S0F1) and the effect of liquid smoke at 30 ml/L combined with flower inducer at 0 ml/L (S3F0). This treatment tended to produce the highest number of flower initiation clusters, with an average of 2,33 clusters. The control treatment (S0F0) resulted in the lowest number of flower initiation clusters, with an average of only 1 cluster. The application of flower inducer at 20 ml/L (F1) increased number of flower initiation clusters per branch, but when combined with liquid smoke, it reduced number of flower initiation clusters. The results showed that the increasing of the concentration of liquid smoke can increase number of flower initiation clusters per branch.

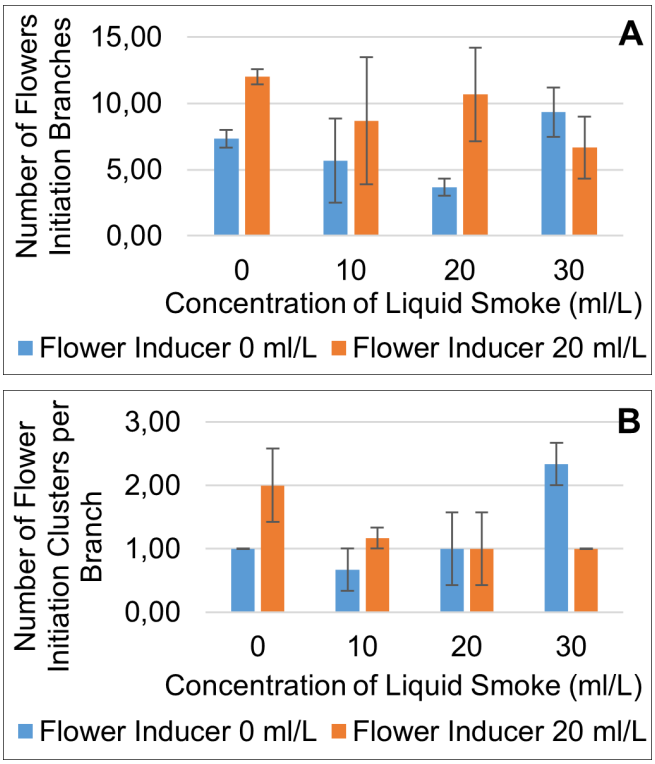

Figure 2. Effect of liquid smoke and flower inducer treatment on number of flower initiation branches (A) and initiation flower clusters per branch (B).

3.4 Number of Flower Initiation per Cluster

The results showed that the liquid smoke and flower inducer treatments individually had no significant effect on number of flower initiation clusters. However, there was a significant interaction between the two factors. The S0F1 treatment was producing the highest number of flower initiation, with an average of 4,17 flowers. This treatment differed significantly from S1F0 and S3F1, which produced 1,76 and 0,93 flowers, respectively. However, the effect of S0F1 did not differ significantly from S0F0, S1F1, S2F0, S2F1, and S3F0. The effect of liquid smoke and flower inducer treatments on number of flower initiation per cluster is presented in Table 2.

The research results indicated that the application of flower inducer at 20 ml/L could enhance flower initiation in coffee trees. This effect may be attributed to the cytokinin hormone content in the flower inducer, which functions to stimulate initiation. This aligns with the findings of Amnurrahman et al. (2018) that cytokinin is a hormone derived from adenine derivatives. It plays a role in promoting cell division, shoot initiation, and bud formation. Supporting this, research by Puspita et al. (2024) showed that the application of 20 ml/L flower inducer produced the highest number of flower primordia of coffee.

The flower inducer contains the plant growth regulator cytokinin, which can stimulate flowering in coffee trees. According to Iryani et al. (2020), one commonly used plant growth regulator (PGR) is Benzyladenine (BA), a type of cytokinin. Cytokinin application has been shown to increase flower formation in various plant species. Citra and Firmansyah (2020) also reported that cytokinins play an important role in stimulating flowering, cell division, and cell regeneration.

Liquid smoke at a concentration of 30 ml/L was also capable of inducing a high number of flower initiation in coffee trees. This suggests that higher concentrations of liquid smoke may trigger flowering in coffee. One of the components found in liquid smoke is methanol, which can promote plant growth. This is consistent with the findings of Kulkarni et al. (2011) that many plants flower after forest fires. The herbaceous plant *Watsonia borbonica* (Cape Bugle Lily) treated with liquid smoke showed an increase in flowering from 20% to 90%. Therefore, liquid smoke has potential as a flowering stimulant for various plant species.

3.5 Number of Pin Heads and Young Fruits per Cluster

The results of the research showed that the liquid smoke (S) treatment had a significant effect on number of pin heads per cluster, as presented in Table 3. The treatment of liquid smoke at 0 ml/L (S0) produced the highest number of pin heads per cluster, with an average of 25,83 pin heads, and the effect was not significantly different from the effect of

Table 2. Effect of Liquid Smoke and Flower Inducer Treatment on Number of Flower Initiation per Cluster

Treatment	Number of Flower Initiation per Cluster
Liquid Smoke 0 ml/L + Flower Inducer 0 ml/L (S0F0)	2,59 abc
Liquid Smoke 0 ml/L + Flower Inducer 20 ml/L (S0F1)	4,17 c
Liquid Smoke 10 ml/L + Flower Inducer 0 ml/L (S1F0)	1,76 ab
Liquid Smoke 10 ml/L + Flower Inducer 20 ml/L (S1F1)	2,63 abc
Liquid Smoke 20 ml/L + Flower Inducer 0 ml/L (S2F0)	2,23 abc
Liquid Smoke 20 ml/L + Flower Inducer 20 ml/L (S2F1)	2,22 abc
Liquid Smoke 30 ml/L + Flower Inducer 0 ml/L (S3F0)	3,94 bc
Liquid Smoke 30 ml/L + Flower Inducer 20 ml/L (S3F1)	0,93 a

Note: Means followed by the same letter are not significantly diifferent based on Duncan's Multiple Range Test (DMRT) at 5

20 ml/L (S2) and 30 ml/L (S3) treatments, which produced 20 and 25,08 pin heads. These findings indicated that the application of liquid smoke still inconsistent effect considering that liquid smoke at 10 ml/L (S1) and 20 ml/L (S2) decreased number of pin heads, while the higher concentration of 30 ml/L (S3) was able to increase number of pin heads per cluster.

Coffee trees treated with liquid smoke showed lower numbers of pin heads compared to the control. This could be due to the phenolic compounds present in liquid smoke, when applied at inappropriate concentrations, can disrupt plant growth and development. This is supported by Solichatun (2020) that phenolic compounds in high concentrations can adversely affect plant growth. Phenols can interfere with nutrient absorption by reducing ion uptake rates, inhibiting photosynthesis and root cell division, closing stomata, suppressing protein synthesis and enzyme activity, and affecting respiration processes.

The research also found that liquid smoke treatment had a significant effect between 10-20 ml/L with 30 ml/L concentration on number of young fruits per cluster, as shown in Table 3. The 30 ml/L treatment (S3) resulted in the highest number of young fruits, averaging 22,67 fruits per cluster, although this was not significantly different from the 0 ml/L treatment (S0), which produced 18,50 fruits. The treatments of liquid smoke at 10 ml/L (S1) and 20 ml/L (S2) resulted in fewer young fruits compared to the control. The flower inducer treatment had no significant effect on number of young fruits per cluster.

The application of liquid smoke at 30 ml/L was effective in increasing number of young fruits per cluster, as shown in Figure 3. According to Tabla and Vargas (2004), flowering is the initial stage of plant reproduction marked by the development of floral organs. After flowering, the next stage is fruit formation. Basri (2010) noted that liquid smoke has beneficial effects on both soil and plants. It can neutralize soil acidity, improve soil quality, suppress pests and pathogens, and stimulate the growth of roots, stems, tubers, leaves, flowers, and fruits. The increase in young coffee fruits may also result from the time of application of liquid smoke, which enhances the potential of flowers to develop into fruits.

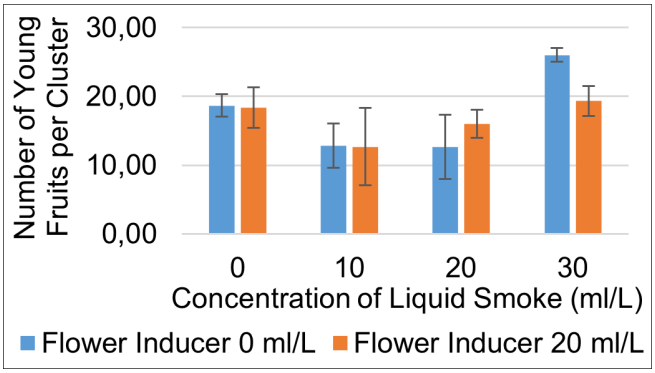

Figure 3. Effect of liquid smoke and flower inducer treatment on number of young fruits per cluster.

Fruit development in coffee trees is also influenced by rainfall. Coffee requires sufficient water for the successful development from flowering to fruit formation. In 2024, rainfall in Sidomulyo Village reached 2.137,4 mm as shown in Figure 1A. According to Djaenudin et al. (2011), Robusta coffee grows optimally in environments with temperatures ranging from 22–25°C, annual rainfall between 2.000–2.500 mm, and a dry season lasting 2–3 months. In December 2024, the recorded rainfall was 154,5 mm, as shown in Figure 1B. Rainfall during this period supports the development of flowers into fruit. This is consistent with the findings of Sakiroh et al. (2021) that young fruit formation in coffee typically occurs during wet months.

Table 3. Effect of Liquid Smoke and Flower Inducer Treatment on Number of Pin Head and Young Fruits per Cluster

Liquid Smoke	Number of Pin Heads per Cluster	Number of Young Fruits per Cluster
S0 (0 ml/L)	25,83 b	18,50 ab
S1 (10 ml/L)	16,83 a	12,75 a
S2 (20 ml/L)	20,00 ab	14,33 a
S3 (30 ml/L)	25,08 b	22,67 b
Flower Inducer		
F0 (0 ml/L)	21,25 a	17,54 a
F1 (20 ml/L)	22,63 a	16,58 a

Note: Means followed by the same letter are not significantly diifferent based on Duncan's Multiple Range Test (DMRT) at 5% significance level.

3.6 Number of Pin Head Clusters per Branch and per Tree

The results of data analysis using the standard error of mean, as shown in Figure 4A, indicated that the effect of liquid smoke at 20 ml/L combined with flower inducer at 0 ml/L (S2F0) differed significantly from the effect of liquid smoke at 20 ml/L combined with flower inducer at 20 ml/L (S2F1). The S2F1 treatment tended to produce the highest number of pin head clusters per branch, with an average of 8,5 clusters. The combination of flower inducer and liquid smoke showed inconsistent effect, but the treatment of liquid smoke without flower inducer can increase number of pin head clusters per branch.

The analysis of standard error of mean indicated that increasing the concentration of liquid smoke and combination of liquid smoke and flower inducer can increase number of pin head clusters per tree as shown in Figure 4B. The combination of liquid smoke at 20-30 ml/L and flower inducer at 20 ml/L (S2F1 and S3F1) produced the highest number of pin head clusters. The treatment of liquid smoke at 20 ml/L (S2) produced the lowest number of pin head clusters per tree.

Liquid smoke contains methanol, a compound known to influence the growth and development of coffee trees. This supports the findings of Dewi (2010) that methanol application can increase CO_2 uptake, thereby improving plant growth and development and stimulating the flowering process in plants. Meanwhile, the cytokinin contained in flower inducer plays a role in preventing fruit drop, thus contributing to an increase in fruit number. This is consistent with Koentjoro (2008) that the application of plant growth regulators can prevent the abscission of leaves, flowers, and fruits. Excessive flower and fruit drop may result in reduced yields or even total crop failure.

The development of coffee flowers from bud to full bloom is highly influenced by environmental factors. Rainfall in November 2024 was relatively high, at 195,6 mm, as presented in Figure 1. Rainfall is necessary for coffee flower blooming. Rahardjo (2012) emphasized that rainfall plays a role in breaking the dormancy of flower buds, which is a prerequisite for blooming. Dinh et al. (2022) also stated that rainfall significantly affects the productivity of Robusta coffee. Extended dry seasons can disrupt the development of flowers, pistils, and fruits, ultimately leading to decreased coffee production.

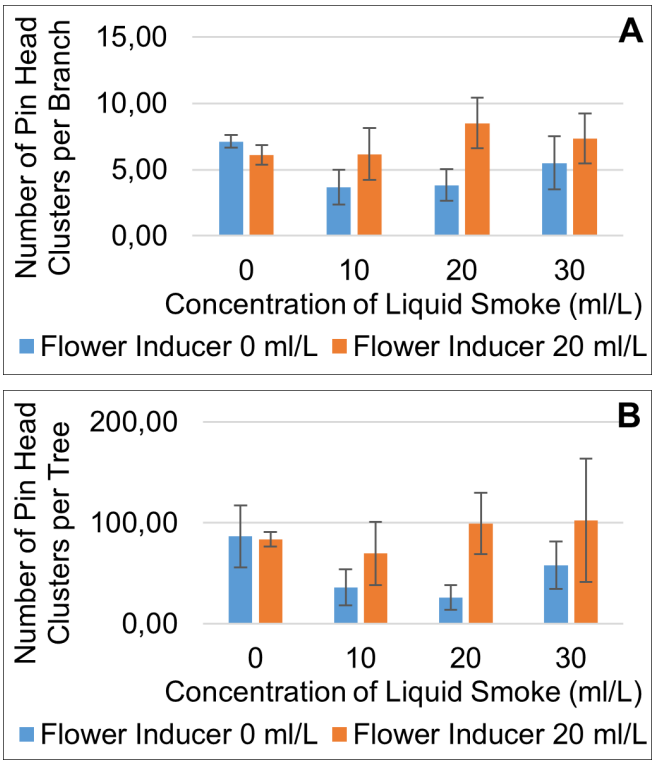

Figure 4. Effect of liquid smoke and flower inducer treatment on number of pin head clusters per branch (A) and per tree (B).

3.7 New Branch (B0) and Flowering Branch (B1) Length

The data analysis using the standard error of mean presented in Figure 4A showed that the effect of control (S0F0) differed significantly from S0F1, S1F0, S1F1, and S2F0. The treatment of liquid smoke at 10 ml/L combined with flower inducer at 0 ml/L (A1F0) produced the longest new branch (B0), with an average length of 35,80 cm. These results suggest that the application of liquid smoke at 10 ml/L (S1) can enhance the length of new branches, but increasing the concentration of liquid smoke tended to reduce branch length.

Data analysis from Figure 4B indicated that the effect of control (S0F0) differed from the effect of liquid smoke at 0 ml/L combined with flower inducer at 20 ml/L (S0F1). The S0F1 treatment resulted in the longest flowering branch

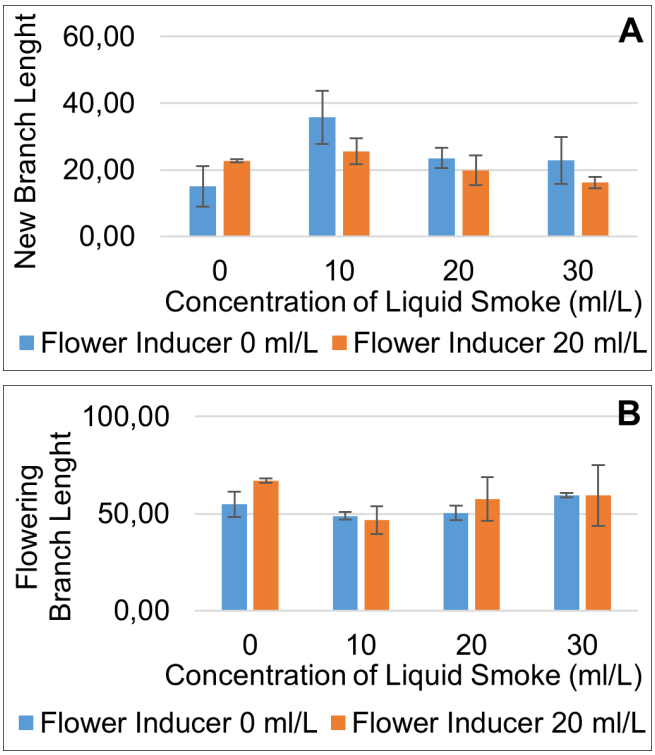

Figure 5. Effect of liquid smoke and flower inducer treatment on number of pin head clusters per branch (A) and per tree (B).

(B1), with an average length of 67 cm. This demonstrates that the application of flower inducer at 20 ml/L without the combination of liquid smoke can enhance the length of flowering branches.

Vegetative and generative growth in coffee trees require a relatively long period of time, so observable increases in branch length over a short observation period may not differ significantly from the initial measurements. This is consistent with Madusari et al. (2019) that perennial crops tend to exhibit slow growth rates, leading to limited visible differences in plant parts over short timeframes.

Observations also showed that the liquid smoke and flower inducer treatments did not significantly affect several other variables. This may be due to the timing of application at 10:00 AM, which could have reduced absorption efficiency due to evaporation. This is consistent with Solekhah (2017) that foliar fertilization is more effective when performed in the early morning or late afternoon when stomata are open. In general, foliar spraying should not be conducted under intense sunlight, just before rain, or at night. Spraying during peak heat causes rapid evaporation, leaving the fertilizer only on the leaf surface. During midday, stomata tend to close in response to high light intensity and temperature, minimizing water loss through evaporation.

4. CONCLUSIONS

The conclusions from this research are the application of liquid smoke significantly influenced in increasing number of new branches (B0), flower initiation branches, flower initiation clusters per branch, and young fruits per cluster. The effect of liquid smoke concentration was still inconsistent. Number of new branches (B0) enhanced with concentration of liquid smoke at 10 ml/L. Meanwhile, the concentration of liquid smoke for enhancing number of flower initiation branches, flower initiation clusters per branch, and young fruits per cluster was 30 ml/L. The application of flower inducer at 20 ml/L was the most effective concentration for increasing number of flowering branches (B1), flower initiation branches, and flower initiation clusters per branch.

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