e-ISSN: 2986-559X, p-ISSN: 2986-6103
DOI: https://doi.org/10.38035/gijtm.v1i4
Received: 14 December 2023, Revised: 20 January 2024, Publish: 31 January 2024

Productivity Of Arabica Coffee Varieties Under Pine Trees

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Abstract: The Community Forest Management (PHBM) program has attempted to increase soil productivity in forest areas by planting coffee under trees. The planting system used by Perhutani under PHBM is intercropping. This planting pattern aims to optimize the potential of land use for community welfare. This study aims to determine the Arabica coffee variety (*Coffea arabica* L.) with the highest productivity among pine stands at LMDH Campaka Bentang, Bandung Regency. The method used was experimental, with a completely randomized design (CRD) of five treatments with eight repetitions. The study was limited to five varieties of coffee plants grown by farmers with uniform coffee care or maintenance at the same planting date and in one plot. The results showed that the Ateng super variety had the highest average fruit weight per 100 seeds, the highest number of fruits, and the highest number of productive branches per tree, while the Ateng variety had the lowest value. The longest productive branch length per tree parameter was found in the Typica variety and the lowest in the Ateng variety. Further test results using Duncan's test with a 5% confidence level showed that the Ateng super variety had the highest value in the tested parameters compared to the other four varieties, while the lowest value was found in the Ateng variety.

Keywords: Arabica Coffee Variety, Productivity, Intercropping

INTRODUCTION

Arabica coffee (*Coffea arabica* L.) is a variety of coffee native to the mountain forests of Ethiopia and Africa and is also widely grown in Indonesia. In Indonesia, it is most common in South Sumatra, Lampung, Bali, South Sulawesi, Aceh, and North Sumatra, as it is located between 200° north and 200° south latitude (Rahardjo 2012; Bote 2011). Arabica coffee cultivation in Indonesia has a relatively low productivity value of 779,89 kg/ha compared to other coffee-producing countries such as Vietnam, which has a productivity of 1,47 tons/ha (Ferry *et al.* 2015). Arabica coffee productivity is affected by light intensity. Arabica coffee is a plant that requires low light intensity for the photosynthesis process. Therefore, Arabica coffee plants need the shade of shade trees when growing. This is because the enzyme activity

of coffee plants is sensitive to excessive sunlight, so if left unchecked, it will disrupt metabolic processes and affect coffee productivity (Sobari *et al.* 2012).

Shade tree species for Arabica coffee plants are diverse, including mahogany, lamtoro, sengon, ceremai, starfruit, cinnamon, gliricidia, and others (Utomo 2011; Sobari *et al*. 2012; Freitas *et al*. 2020). However, each of these species provides specific data that cannot be generalized as the best protection for coffee when applied to different growing environments and locations. Therefore, in this study, we sought to investigate the use of pine (*Pinus merkusii* J.) as shade trees for Arabica coffee plants. Pine is the most commonly used woody plant in agroforestry systems because it is ecologically considered a ground cover plant and has great competitive ability with other plants in its environment, allowing it to persist even when it competes with other plants in its plantation (Marisa 1990). This study used an agroforestry area at Cempaka Bentang Forest Village Community Institute (LMDH) under the Collaborative Forest Management (PHBM) program with coffee cultivation under tree cover.

LMDH Cempaka Bentang is located in Loa village, Paseh sub-district, Bandung district, one of the Perhutani supported areas with an area of 1,273.575 hectares in Mandalawangi BKPH Ciparay KPH South Bandung RPH. LMDH Cempaka Bentang supports 28 forest farmer groups in coffee cultivation with an agroforestry system in protected forest areas under pine stands. Coffee cultivation by farmers has not previously included Arabica coffee varieties, which are best suited for cultivation in pine stands. However, due to the increasing demand for coffee, forest farmer groups in LMDH Campaka Bentang have tried different varieties such as Sigarar Untang, Ateng Super, Typica, Ateng, and Tim-tim. Therefore, the purpose of this study is to provide an overview that can be considered by coffee growers when selecting the most suitable Arabica coffee varieties that are most suitable for growing under the shade of pine trees.

METHODS

The method used was experimental with a completely randomized design (CRD) factorial pattern with five treatments with eight repetitions. The number of trees prepared in the study was 40 trees. This research was limited to five varieties of coffee plants that were grown by farmers with uniform coffee care or maintenance, the same planting time, and were in one plot.

Parameters of Arabica coffee plant productivity

a. Number of productive branches per tree: calculated using all fruit-bearing branches.
b. Length of productive branches per tree: calculated from the sum of the lengths of all fruit-bearing branches per tree, calculated from the base of the branch to the tip.
c. Number of fruits per tree: calculated from the average of three harvests of ripe coffee cherries per tree.
d. Weight of fruit per 100: calculated from the average of three harvests of coffee cherries per 100 per tree.

Statistical analysis

The ANOVA model used was:

$Y_{ij} = \mu + \beta_j + r_i + €ij$

Where Yij is the corresponding variable or observation value of the i-th treatment in the in j-th group, μ is the total mean, β_j is the main effect of j-th group, r_i is the main effect of i-th treatment, €ij is the error data.

In ANOVA data analysis using SPSS version 26, an F test was performed at 5% and 1% significance levels to estimate the effect of treatment, followed by a Duncan multiple test at a 5% level.

RESULT AND DISCUSSION

The research plot is an intercropping consisting of a pine tree planted in 2001 and five Arabica coffee varieties, namely Tim-Tim, Sigarar Untang, Ateng Super, Typica, and Ateng Arabica coffee varieties. The observed effect of four parameters, namely the number of productive branches per tree, length of productive branches per tree, weight of fruits per 100, and the number of fruits per tree can be tested by ANOVA test in Table 1.

Table 1 The results of the ANOVA test on the effect of shading by pines on different parameters were observed in Arabica coffee trees

Nomor	Parameters	Result	Description
1	the number of productive branches per tree	0,031	< 0,05 : significantly different
2	length of productive branches per tree	0,000	< 0,05 : significantly different
3	weight of fruits per 100	0,005	< 0,05 : significantly different
4	the number of fruits per tree	0,777	> 0,05 : do not differ significantly

The results of the ANOVA test for the number of productive branches per tree, the length of productive branches per tree, and the fruit weight per 100 show that these three parameters have a significant influence on the presence of pine stands. According to Widiastuti *et al.* (2004), the phenotypic character of the number and length of branches is strongly influenced by the intensity of sunlight, as it is related to auxin activity. Auxin is active at low light intensity. The auxin action system plays a role in stimulating cell division and enlargement, resulting in high values for the number and length of productive branches of Arabica coffee in each cultivar. This statement is consistent with Sobari *et al.* (2012) that high light intensity for the Arabica coffee plant leads to an increase in air temperature, potentially causing water deficiency in the coffee plant. If this situation persists over the long term, the coffee plant may experience increased leaf loss and reduce the plant's ability to produce assimilates for growth in the number and length of productive branches of the coffee plant.

Then the parameter fruit weight per 100 is directly proportional to the length and number of branches. The greater the number and length of productive branches of the coffee plant, the higher the fruit weight per 100. According to Hapsari *et al.* (2017), the relationship between these parameters is because if the number and branches are large, they will produce a high number of leaves, and the presence of this number of leaves will produce a lot of food reserves from the photosynthesis process, which is then used to increase fruit weight.

The results of the ANOVA test on the number of fruits per tree showed no significant effect on the presence of pine stands. According to Hapsari et al. (2012), this is because the relationship between the number and length of branches is very different from the number of fruits. In general, the number and length of branches increase the weight and size of fruits, so there is not enough space for new fruits to grow. Therefore, it is necessary to implement silvicultural measures by thinning fruits to reduce competition between fruits for assimilation and applying potassium chloride fertilizer to increase the number of fruits (Nurrochman *et al.* 2013). In addition, data analysis continued with the Duncan multiple tests at the 5% level to determine the best variety (Table 2).

Table 2 The results of Duncan's test of the effect of shading by pines on the productivity of arabica coffee in the five varieties

Varieties	the number of productive branches per tree	length of productive branches per tree	weight of fruits per 100	the number of fruits per tree
Sigarar Utang	8.37 bc	7.56 ab	142.11 a	136.08 a
Tim-Tim	6.75 ab	9.65 ab	169.47 bc	155.37 a
Typica	7.37 abc	10.26 b	168.99 bc	152.37 a
Ateng	6.00 a	6.35 a	154.72 ab	142.58 a
Ateng Super	8.83 c	9.65 ab	177.40 c	159.55 a

Note: the same letter in the same column is not significant at 5% DMRT

Based on the results of the Duncan test, it can be seen that the varieties Ateng Super, Typica, and Tim-tim, Sigarar Utang and Ateng, had the highest values in the three parameters tested (the number of productive branches per tree, length of productive branches per tree and weight of fruits per 100). The formation of this ranking is because the growth of coffee plants is influenced by environmental factors and genetic factors. Based on the environmental factors, the intensity of sunlight received by the five arabica coffee varieties is relatively the same, namely the intensity of the sun, which is not full of regular irradiation under the pine stands. The shade pines in the study area are 21 years old. According to Firdaus and Ariffin (2018), the age of these pines is an old plant that has a percent sunlight intensity value under their canopy of 35.89%. This percentage value perfectly matches the best light intensity required to increase the productivity of Arabica coffee plants, which is 34%-46.50% (Utomo 2011; Sobari *et al.* 2012). Therefore, the difference in ranking of the five Arabica coffee cultivars is due to genetic factors, as Ateng super is genetically very resistant to disease attacks such as leaf rust (Budiman 2012).

CONCLUSION

Pines used as shade for Arabica coffee plants of Ateng Super, Typica, and Tim-tim, Sigarar Utang and Ateng cultivars were able to influence coffee plant phenotypes such as number of productive branches per tree, length of productive branches per tree, and fruit weight per 100. The amount of fruit per tree is not affected by pine shade because it depends on coffee plant management, such as fruit thinning and fertilization with potassium chloride. Arabica coffee varieties that are most suitable for growing under the shade of pine trees is the variety Ateng Super.

BIBLIOGRAPHY

Bote 2011. Effects Of Shade On Growth, Production And Quality Of Coffee (*Coffea Arabica*) In Ethiopia. *Journal Of Horticulture And forestry* 3 (11): 336 – 341.

Budiman H. 2012. Prospek Tinggi Bertanam Kopi. Yogyakarta: Pustaka Baru Press.

Ferry Y, Supriadi H, Ibrahim MSD. 2015. Teknologi budi daya tanaman kopi aplikasi pada perkebunan rakyat. Jakarta: IAARD Press

Firdaus MF, Ariffin. 2019. Karakteristik unsur lingkungan mikro pada tegakan hutan pinus (*Pinus Merkusii* Jungh) dan mahoni (*Sweietenia Macrophylla* King) di kawasan UB Forest. *Jurnal Produksi Tanaman* 7(3): 495 – 504.

Freitas AF, Nadaleti DHS, Silveira HRO, Carvalho GR, Venturin RP, Silva VA. 2020. Productivity and beverage sensory quality of arabica coffee intercropped with timber

species. *Pesq. agropec. bras., Brasília* 55: e02240. DOI: 10.1590/S1678-3921.pab2020.v55.02240

Hapsari R, Indradewa D, Ambarwati D. 2017. Pengaruh pengurangan jumlah cabang pertumbuhan dan hasil tomat (*Solanum lycopersicum* L.). *Vegetalika* 6(3): 37 – 49.

Marisa H. 1990. Pengaruh Ekstrak Daun Pinus (Pinus merkusii Jungh. et de Vriese) terhadap Perkecambahan dan Pertumbuhan Vegetatif Tanaman Kedelai (Glycine max (L.) Merr.) [Tesis]. Institut Teknologi Bandung. Bandung.

Nurrochman, Trisnowati S, Muhartini S. 2013. Pengaruh pupuk kalium klorida dan umur penjarangan buah terhadap hasil dan mutu salak (*Salacca zalacca* (Gaertn.) Voss) 'Pondoh Super'. *Vegetalika* 2(1): 3 – 12.

Rahardjo P. 2012. Kopi Panduan Budidaya dan Pengolahan Kopi Arabika dan Robusta. Penebar Swadaya. Jakarta.

Sobari L, Sakiroh, Purwanto EH. 2012. Pengaruh jenis tanaman penaung terhadap pertumbuhan dan persentase tanaman berbuah pada kopi arabika varietas kartika 1. *Buletin RISTRI* 3 (3): 217 – 222.

Utomo SB. 2011. Dinamika Suhu Udara Siang-Malam terhadap Fotorespirasi Fase Generatif Kopi Robusta di Bawah Naungan yang Berbeda pada Sistem Agroforestry [Tesis]. Universitas Jember. Jember.

Widiastuti L, Tohari, Sulistyaningsih E. 2004. Pengaruh intensitas cahaya dan kadar daminosida terhadap iklim mikro dan pertumbuhan tanaman krisan dalam pot. *Ilmu Pertanian* 11(2): 35 – 42.