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The Effect of Tillage Methods and Types of Fertilizer on the Quality of Virginia Tobacco Yield in Central Lombok Regency

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ABSTRACT

Tobacco (*Nicotiana tabacum*) is one of the leading agricultural commodities, alongside rice, widely cultivated in West Nusa Tenggara, particularly in Central Lombok. A majority of the population is engaged in Virginia tobacco farming. However, an optimal combination of tillage practices and fertilizer formulations that can enhance yield and quality at a cost suitable for farmers has not yet been identified. This study aims to determine the most effective tillage method and fertilizer formulation that can improve the yield and quality of Virginia tobacco at an economically feasible cost. The research employed a Split-Plot Randomized Block Design (RBD) with two factors: tillage (C) as the main plot and fertilizer formulation (P) as the subplot. The fertilizer formulation consisted of four levels and was replicated three times. A total of eight treatment combinations (C × P) were tested, each applied in three replicate plots. The results showed that optimal tillage (Co) produced the best outcomes. Additionally, fertilizer formulation Pp significantly increased both the fresh leaf weight and oven-dried leaf weight per plant compared to other treatments. The combination of Co and Pp (CoPp) was found to be the most effective treatment, providing relatively high yield and quality at a comparatively low cost.

Keywords: Lombok, Tillage, Tobacco Yield and Quality, Virginia Tobacco

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1. INTRODUCTION

Tobacco (*Nicotiana tabacum*) is one of the leading plantation sub-sector commodities that plays a significant role in Indonesia's economy (Santoso, 2018). As one of the world's largest tobacco producers, Indonesia has great potential to meet both domestic and international cigarette industry demands (Ali and Hariadi, 2018). Tobacco is also a preferred crop for Indonesian farmers, particularly in Central Lombok, West Nusa Tenggara (NTB), due to its high economic value (Suprihanti *et al.,* 2018). According to BPS (2022), Central Lombok is the largest tobacco-producing region in Indonesia, with Virginia tobacco being the most widely cultivated variety. Virginia tobacco farming in Central Lombok is a primary agricultural activity after rice farming, offering higher income potential compared to rice cultivation (Hayati and Maisaroh, 2019). According to Nursan *et al.*, (2020), the average profit

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earned by Virginia tobacco farmers per hectare per growing season is IDR 42,349,763, with an R/C ratio of 1.9 and a B/C ratio of 0.9.

Despite the high-income potential of Virginia tobacco in Central Lombok, farmers face several challenges that hinder optimal production (Hidayat *et al.,* 2021). One of the main constraints is the declining productivity rate of tobacco plants, caused by both external and internal factors, such as unpredictable weather conditions and difficulties in determining the proper fertilizer formulation (Rachmat and Aldillah, 2016). Dependence on fluctuating weather conditions often results in crop losses, as unseasonal rains can cause tobacco plants to wilt or die.

Suboptimal fertilizer formulation remains a significant issue in efforts to improve the quality and quantity of tobacco. Industry partners often set standards based on leaf color, aroma, and yield, which are difficult to meet due to inappropriate fertilization practices. Most farmers in Central Lombok still rely on single-nutrient fertilizers such as urea and ZA, which primarily supply nitrogen (N) and phosphorus (P). The use of these fertilizers can increase production costs and may reduce tobacco quality if not balanced with proper formulations (Fuady and Mustagin, 2015). Efficient fertilization is crucial to improving soil fertility and fulfilling the nutrient requirements of tobacco plants. Therefore, research and development of more targeted fertilizer formulations are needed, taking into account dosage, timing, fertilizer type, and existing soil conditions.

In addition to fertilization, soil tillage also plays a crucial role in supporting tobacco plant growth. Appropriate tillage practices can improve soil structure, provide better conditions for root development, and help plants absorb nutrients more effectively (Abolla *et al.,* 2020). Both optimum tillage (intensive soil cultivation) and minimum tillage (reduced or no-till systems) have significant impacts on tobacco yield. Proper tillage can enhance soil physical properties, such as moisture retention and aeration, thus supporting better growth and development of tobacco plants.

To increase the productivity and quality of Virginia tobacco in Central Lombok, improvements are needed in two key areas: fertilization and soil tillage. Improved fertilizer formulations tailored to soil conditions and the application of optimal tillage systems will help achieve tobacco yields that meet the quality standards set by cigarette companies, such as PT. Djarum. Through these improvements, it is expected that tobacco production in Central Lombok will become more stable and sustainable, contributing positively to both regional and national economies.

2. METHODS

2.1 Location and Time Study

This research was conducted from June 2023 to June 2024 in Rembiga Village, Kopang District, Central Lombok Regency, West Nusa Tenggara Province, Indonesia.

2.2 Tools and Material Study

The tools used in this study included a hoe, mini tractor, cultivator, measuring tape, raffia rope, stationery, scissors, nails, wooden stakes, mobile phone camera (iPhone 14), scales, buckets, shovel, gloves, and masks.

The materials used in this study included Virginia tobacco seedlings, single-nutrient fertilizers such as ZA, Urea, and SP-36, as well as compound fertilizers such as NPK Fertila and NPK Petro Ningrat.

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2.3 Design Study

The study employed a Split-Plot Randomized Complete Block Design (RCBD) with two factors and three replications. The first factor was the tillage method (C) as the main plot, consisting of two levels:

Co : Optimum tillage (plowing, hilling, and bed preparation)

Cm : Minimum tillage (no plowing, no hilling, and no bed preparation)

The second factor was the type of fertilizer (P) as the subplot, consisting of four levels: :

Pz : ZA + SP-36 + ZK

Pu : Urea + SP-36 + ZK

Pf : Fertila + KNO_3

Pp : Petro Ningrat + ZA + Urea + SP-36 + ZK

2.4 Data analysis

The collected data were analyzed using ANOVA (Analysis of Variance) with SPSS software version 25 (IBM Inc.). If the interaction between factors showed significant or highly significant effects, mean comparisons were conducted using Duncan's Multiple Range Test (DMRT) at a 5% significance level. If the interaction was not significant, the main effects were tested using the Least Significant Difference (LSD) test at the 5% level to identify differences among treatments and determine the best-performing treatment (Gomez and Gomez, 2007).

3. RESULT AND DISCUSSION

3.1 Effect of Treatment on the Yield and Quality of Virginia Tobacco Products

The effects of tillage treatment (C) and fertilizer formulation (P) on yield and quality variables of Virginia tobacco grown in Central Lombok showed no significant effect on the number of leaves, fresh weight per leaf, and oven-dry weight per leaf. However, the tillage treatment (C) had a significant effect on the fresh leaf weight per plant and the oven-dry leaf weight per plant. Furthermore, the fertilizer formulation treatment (P) had a highly significant effect on both the fresh leaf weight per plant and the oven-dry leaf weight per plant. These results are presented in Table 1 below.

Table 1
Significance of the Effects of Tillage (C) and Fertilizer Formulation (P) on Yield and Quality Variables of the Crop

No.	Variables	Treatment		CxP
		C	P	
1	Amount leaf	ns	ns	ns
2	Weight per strand leaf	ns	ns	ns
3	Heavy oven dried per piece leaf	ns	ns	ns
4	Fresh weight of leaves per plant	*	**	ns
5	Heavy oven dried leaves per plant	*	**	*

Note :

ns : influential No significant ($P \leq 0.05$)

* : influential real ($P > 0.05$)

** : influential very significant ($P > 0.001$)

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3.2 Effect of Treatments on Virginia Tobacco Yield

The effect of the single factor treatments—tillage (C) with two levels and fertilizer formulation (P) with four levels—on Virginia tobacco yield variables such as the number of leaves and fresh weight per leaf grown in Central Lombok was analyzed using the Least Significant Difference (LSD) test at the 5% significance level. The results are presented in Table 2 below.

Table 2
Effects of Tillage (C) and Fertilizer Formulation (P) as Single Factors on Oven-Dry Weight per Leaf, Fresh Leaf Weight per Plant, and Oven-Dry Leaf Weight per Plant

Treatment	Amount Leaf (Sheet)	Fresh Weight per Leaf (g)
Exercise land (*Tillage*)		
C_o	18.08 a	78.83 a
C_m	17.58 a	75.58 a
BNT 5%	2.24	15.47
Formulation Fertilizer		
P_z	16.33 b	75.90 a
P_u	17.50 a	78.73 a
P_f	18.50 a	77.17 a
P_p	19.00 a	77.02 a
BNT 5%	1.58	4.52

Note : Numbers followed by the same notation in the same treatment and column indicate no significant difference based on the Least Significant Difference (LSD) test at the 5% significance level

Based on the results of the LSD test at the 5% significance level presented in Table 2, the highest number of leaves under the single factor of tillage (C) was obtained from the optimum tillage treatment (Co), with an average of 18.08 leaves, which was not significantly different from the other treatment level. The lowest number of leaves was observed in the minimum tillage treatment (Cm), with an average of 17.58 leaves, and was also not significantly different from the other treatment.

For the single factor of fertilizer formulation (P), the highest number of leaves was observed in the Pp treatment, with an average of 19.00 leaves, which was not significantly different from the Pu and Pf treatments but was significantly different from the Pz treatment. Meanwhile, the lowest number of leaves was found in the Pz treatment, with an average of 16.33 leaves, and it was significantly different from the other treatments.

The results of the LSD test at the 5% level presented in Table 2 also showed that the highest fresh weight per leaf under the tillage factor (C) was obtained from the optimum tillage (Co) treatment, with a weight of 78.83 g, which was not significantly different from the other treatment level. The lowest fresh weight per leaf was found in the minimum tillage (Cm) treatment, at 75.58 g, and was not significantly different from the other treatment.

Under the fertilizer formulation factor (P), the highest fresh weight per leaf was

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obtained from the Pu treatment, at 78.73 g, which was not significantly different from the other treatments. The lowest fresh weight per leaf was found in the Pz treatment, which also did not differ significantly from the other treatments.

3.3 Effect of Treatments on the Quality of Virginia Tobacco Yield

The effects of tillage (C) with two levels and fertilizer formulation (P) with four levels on the quality variables of Virginia tobacco grown in Central Lombok—namely oven-dry weight per leaf, fresh leaf weight per plant, and oven-dry leaf weight per plant—are presented in Table 3. Meanwhile, the leaf color variable is also shown in Table 3 below.

Table 3
Single Factor Results *Tillage* (C) and Formulation Fertilizer (P) on Dry Weight Variable Oven per Leaf, Fresh Weight of Leaves per Plant, and Dry Weight Leaf Oven per Plant

Treatment	Dry Weight Oven per Leaf (g)	Fresh Leaf Weight per Plant (g)	Dry Weight Leaf Oven per Plant (g)
Tillage			
Co	11.28 a	1,481, 22 a	230.00 a
Cm	10.63 a	1,371, 08 b	214.40 b
BNT 5%	2.28	51.22	15.29
Formulation Fertilizer			
Pz	10.74 a	1,269.60 c	207.45 c
Pu	10.97 a	1,406.02 b	226.16 b
Pf	11.27 a	1,529.99 a	211.47 c
Pp	10.85 a	1,498.99 a	243.72 a
BNT 5%	0.85	48.88	8.93

Note : Numbers followed by the same letter notation within the same treatment and column indicate no significant difference based on the Least Significant Difference (LSD) test at the 5% significance level.

Based on Table 3, the highest oven-dry weight per leaf under the single factor of tillage (C) was obtained from the optimum tillage (Co) treatment, with a value of 11.28 g, which was not significantly different from the minimum tillage (Cm) treatment. Conversely, the lowest oven-dry weight per leaf was recorded under the minimum tillage (Cm) treatment at 10.63 g, which was also not significantly different from the Co treatment.

Under the single factor of fertilizer formulation (P), the highest oven-dry weight per leaf was obtained from the Pf treatment, with a value of 11.27 g, and was not significantly different from the other treatments. The lowest oven-dry weight per leaf was found in the Pz treatment at 10.74 g, which also showed no significant difference from the other treatments.

Based on Table 3, the fresh leaf weight per plant showed a significant difference across both single factors, with notable differences among nearly all treatment levels. The highest fresh leaf weight per plant under the tillage (C) factor was

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observed in the optimum tillage (Co) treatment, at 1,481.22 g, which was significantly different from the minimum tillage (Cm) treatment. The lowest fresh leaf weight per plant was recorded under the Cm treatment, with a value of 1,371.08 g, significantly different from Co.

Under the single factor of fertilizer formulation (P), the highest fresh leaf weight per plant was observed in the Pf treatment at 1,529.99 g, which was not significantly different from the Pp treatment, but significantly higher than the Pu and Pz treatments, which yielded 1,406.02 g and 1,269.60 g respectively. The lowest value was found in the Pz treatment and was significantly different from the other treatments.

Based on Table 3, the highest oven-dry leaf weight per plant under the tillage (C) factor was obtained from the optimum tillage (Co) treatment, at 230.00 g, which was significantly different from the minimum tillage (Cm) treatment. The lowest value was observed in the Cm treatment, at 214.40 g, which was significantly different from Co.

Under the fertilizer formulation (P) factor, the highest oven-dry leaf weight per plant was obtained from the Pp treatment, at 243.72 g, which was significantly different from all other treatments. The lowest value was recorded in the Pz treatment, at 207.45 g, which was not significantly different from the Pf treatment but was significantly different from the Pp and Pu treatments.

The combined effect of tillage (C) and fertilizer formulation (P) on leaf color is shown in Table 4. The leaf color resulting from the CoPz and CoPp combinations was predominantly F (Orange), while the CoPu combination produced predominantly FR (Orange-Red) leaves, and CoPf produced predominantly L (Lemon) leaves. In the CmPz, CmPu, CmPf, and CmPp combinations, the leaf color was consistently dominated by F (Orange).

Table 4
Effect of Tillage (C) and Fertilizer Formulation (P) as Single Factors on Leaf Color of Virginia Tobacco

Treatment	P_z	P_u	P_f	P_p
C_o	F, F, F (**F**)	R, FR, FR (**FR**)	L, F, L (**L**)	F, L, F (**F**)
C_m	F, F, F (**F**)	F, FR, F (**F**)	L, F, F, (**F**)	F, F, L (**F**)

Note: Bold letters indicate the dominant leaf color in each treatment based on data from all replications.

4. CONCLUSIONS

Based on the results and discussion, the following conclusions can be drawn:

1. Cultivating Virginia tobacco using the optimum tillage method resulted in higher yield, better quality, and greater costs compared to the minimum tillage method.
2. The Pp fertilizer formulation (Petro Ningrat + Urea + ZA + SP-36 + ZK) was the most effective, as it produced the highest number of leaves (yield) and oven-dry

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weight (quality) compared to other formulations, while incurring relatively lower costs than Pf and Pz.

3. The interaction between tillage method and fertilizer formulation had a highly significant effect on fresh leaf weight per plant and oven-dry leaf weight per plant. The highest values for these variables were obtained from the combination of optimum tillage (Co) and the Pp fertilizer formulation (CoPp), with 1,523.84 g and 243.72 g, respectively.

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