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Jurnal Agroteknologi

Journal homepage: https://talenta.usu.ac.id/joa

The Effect of A Combination of Solid Cigarette Factory Waste and Dolomite on Soil Chemical Properties and Yield of Sweet Corn (Zea mays saccharate Sturt) on Ultisols

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ARTICLE INFO

Article history:

Received : 26 Februari 2026

Revised : 23 Maret 2026

Accepted : 27 April 2026

Available online

https://talenta.usu.ac.id/joa

E-ISSN: 2963-2013

P-ISSN: 2337-6597

How to cite:

Siallagan, J.O.F., Kemala, S.L. (2020). The Effect of A Combination of Solid Cigarette Factory Waste and Dolomite on Soil Chemical Properties and Yield of Sweet Corn (*Zea mays saccharate Sturt*) on Ultisols. *Jurnal Agroteknologi.* 14(2), 67-71

http://doi.org/10.32734/ja.v14i2.25766

ABSTRACT

Solid cigarette factory waste not yet used optimally with amount that is large enough that 3-4% of the production capacity. Now, management is still a lot to do with how stacked in the factory location in a long time.This research was conducted to evaluate the effect of a combination of solid cigarette factory waste with dolomite on soil chemical properties, growth and yield of sweet corn (*Zea mays saccharata* Sturt) on Ultisol soil. This research was conducted by using a randomized completely design (RCD) with seven (7) treatments of the combination of the solid cigarette factory waste and dolomite, there are : W0 (control); W1 (20 ton.ha^{-1} + 7,60 ton.ha^{-1} ; W2 (20 ton.ha^{-1} + 14,12 ton.ha^{-1}); W3 (40 ton.ha^{-1} + 7,60 ton.ha^{-1}); W4 (40 ton.ha^{-1} + 14,12 ton.ha^{-1}); W5 (60 ton.ha^{-1} + 7,60 ton.ha^{-1}) and W6 (60 ton.ha^{-1} + 14,12 ton.ha^{-1} with three (3) replications. The parameters measured are soil pH, soil organic carbon, available phosphor, the weight of cob with and without husk and sweetness level of sweet corn. The results showed that the combination of solid cigarette factory waste and dolomite can increase soil pH significantly with the highest value at W4 treatment. The combination of solid cigarette factory waste and dolomite can not increase soil organic carbon and available phosphorus of Ultisols but there is tendency for the highest values in the W4 treatment. All of the treatments can not increase the weight of cob with and without husk and sweetness level but there is tendency for the highest values in the W3 treatment.

Keyword: Solid Cigarette Factory Waste, Dolomite

ABSTRAK

Limbah pabrik rokok padat belum digunakan secara optimal dengan jumlah yang cukup besar yaitu 3-4% dari kapasitas produksi. Saat ini manajemen masih banyak melakukan penanganan terkait bagaimana menumpuknya di lokasi pabrik dalam jangka waktu yang lama. Penelitian ini dilakukan untuk mengevaluasi pengaruh kombinasi limbah pabrik rokok padat dengan dolomit terhadap sifat kimia tanah, pertumbuhan, dan hasil jagung manis (*Zea mays saccharata* Sturt) pada tanah Ultisol. Percobaan dilakukan dengan menggunakan rancangan acak lengkap (RAL) dengan tujuh (7) kombinasi perlakuan limbah padat pabrik rokok dengan dolomit dengan dosis masing-masing W0 (kontrol); W1(20 ton.ha^{-1}+7,60 ton.ha^{-1}; W2 (20 ton.ha^{-1}+14,12 ton.ha^{-1}); W3(40 ton.ha^{-1} + 7,60 ton.ha^{-1}); W4(40 ton.ha+14,12 ton.ha^{-1}); W5 (60 ton.ha^{-1}+7,60 ton.ha^{-1}) and W6(60 ton.ha^{-1}+14,12 ton.ha^{-1}) dengan 3 ulangan. Parameter tanah dan tanaman yang diukur adalah pH tanah, karbon organik tanah, phosphat tersedia, bobot tongkol dengan dan tanpa kulit serta tingkat kemanisan jagung. Hasil penelitian menunjukkan bahwa kombinasi limbah padat pabrik rokok dan dolomit dapat meningkatkan pH tanah secara signifikan dengan nilai tertinggi pada perlakuan W4. Kombinasi limbah padat pabrik rokok dan dolomit tidak dapat meningkatkan C-organik tanah dan fosfor tersedia pada Ultisol, tetapi ada kecenderungan nilai tertinggi pada perlakuan W4. Semua perlakuan tidak dapat meningkatkan berat tongkol dengan

dan tanpa kulit serta tingkat kemanisan, tetapi ada kecenderungan nilai tertinggi pada perlakuan W3.
Keyword: Maximum, Five, Word, Key, Important

1. Introduction

Solid waste consists of residues from activities that are in solid form or can be defined as heterogeneous materials discarded from household, commercial, and industrial activities. The cigarette industry produces waste that comes from various processes, both production and non-production. The tobacco industry produces waste including solid, liquid, and gas waste. This solid waste comes from reject produc, wrapping paper, cardboard, and leftover raw materials which, if not allocated, will leave piles of waste (Sitogasa and Alim, 2023; Tuffahati and Rizka, 2024; Yuliastuti and Handaru, 2016). According to Lusiana, Rahadi, and Luthfiyana (2020) shows that wastewater from rivers around cigarette industries contains a high ammonia content, caused by the use of clove materials as raw materials in cigarette production. Sitogasa and Alim (2023) stated that cigarette factory waste contains essential nutrients that can support plant growth when properly managed. Abdilah et al (2018) reported that organic waste of solid cigarette factory waste can enhance soil fertility by increasing organic matter content and improving soil structure.

The company PT Sumatra Tobacco Trading Company produces solid waste reaching 2-3 tons/month from clove cigarette production and 5-6 tons/month from white cigarette production. Laboratory analysis results of the solid waste produced by this company showed an H2O pH of 4.73 (acidic), organic C 45.21% (very high), P and K content of 0.16% (meeting the minimum criteria) and 1.73% (well above the minimum standard), respectively.

Dolomite is commonly used as a liming material because it contains calcium (Ca) and magnesium (Mg), which are essential for plant growth. Syahputra et al., (2015) explained that the application of dolomite can increase soil pH and improve nutrient availability, particularly phosphorus, which is often fixed in acidic soils.

Ultisols is one of the most widely distributed soil types in Indonesia, characterized by high acidity, low organic matter content, and low nutrient availability, particularly phosphorus (P). These constraints significantly limit agricultural productivity, including the cultivation of sweet corn. According to Prasetyo and Suriadikarta (2006) Ultisols generally have low base saturation and high aluminum (Al) saturation, which can inhibit plant growth and reduce nutrient uptake. Sweet corn (*Zea mays saccharata* Sturt) is a high-value horticultural crop with increasing demand. However, its productivity is highly dependent on soil fertility conditions. Sulaiman *et al*., (2018) stated that optimal nutrient availability is required to support the growth and yield of sweet corn, particularly during the reproductive phase. Therefore, improving soil conditions through appropriate amendments is essential to achieve better crop performance.

According to the research results of Vika et al. (2017), the application of solid waste from cigarette factories can improve the chemical properties of Ultisol soil, including increasing soil pH, phosphorus availability, and exchangeable calcium. Meanwhile, according to the research results of Abdillah et al. (2018), the application of a combination of solid waste from cigarette factories with chicken manure can increase soil pH, phosphorus availability, and corn growth. Although the application of organic waste and dolomite has been widely studied, the combined using of solid cigarette factory waste and dolomite on Ultisol soils has not been extensively evaluated, particularly in relation to soil chemical properties and sweet corn yield and quality. Therefore, this research was conducted to analyze the effect of solid cigarette factory waste combined with dolomite on soil chemical properties, yield and sweetness level of sweet corn.

2. Methods

This research was conducted at the experimental field of the Faculty of Agriculture, University of North Sumatera Medan from October 2025 until March 2026. This research was designed by using a randomized completely design with combining the solid cigarette factory waste and dolomite consist of seven (7) treatments, there are : W0 (control); W1 (20 ton.ha^{-1} solid cigarette factory waste + 7,60 ton.ha^{-1} dolomite); W2 (20 ton.ha^{-1} solid cigarette factory waste + 14,12 ton.ha^{-1} dolomite); W3 (40 ton.ha^{-1} solid cigarette factory waste + 7,60 ton.ha^{-1} dolomite); W4 (40 ton.ha^{-1} solid cigarette factory waste + 14,12 ton.ha^{-1} dolomite); W5 (60 ton.ha^{-1} solid cigarette factory waste + 7,60 ton.ha^{-1} dolomite) and W6 (60 ton.ha^{-1} solid cigarette factory waste + 14,12 ton.ha^{-1} dolomite) with three (3) replications.

Soil samples were taken from Ultisols and prepared before planting. The soil parameters measured are soil pH (pH meter), organic carbon (Walkley & Black) and P-available (Bray II). The plant parameters measured are the cob weight with and without husk and sweetness level. Datas were analyzed by using analysis of variance (ANOVA), followed by Duncan's Multiple Range Test (DMRT) at 5% significance level when significant effects were found.

3. Results and Discussion

3.1 Soil Chemical Properties

From Table 1 it can be seen that the effect of the application of solid cigarette factory waste combined with dolomite on soil chemical properties, including soil pH, organic carbon and available phosphorus (P-available).

Table 1. Effect of the combination of solid cigarette factory waste with dolomite on soil chemical properties

Treatment	pH (H20)	C-Organic (%)	P-Available (ppm)
W0	4,29 c	3,13	0,68
W1	6,16 b	4,09	0,64
W2	6,11 b	3,72	0,76
W3	6,28 ab	3,44	0,89
W4	6,82 a	4,14	1,29
W5	6,60 a	3,98	1,15
W6	6,81 a	4,03	1,31

Note: Means followed by the same letter are not significantly different at 5% DMRT

The results indicated that the treatments significantly affected soil pH. The highest pH value was observed in treatment W4 (6.82), while the lowest was found in W0 (4.29). This increase in soil pH was attributed to the presence of calcium carbonate ($CaCO_3$) in both dolomite and solid cigarette factory waste, which neutralizes soil acidity by reducing H^+ ions in the soil solution. According to Prihantoro *et al*., (2023) the dolomite releases hydroxyl ions (OH^-) which neutralize soil acidity. Furthermore, the combination of organic materials and liming materials is more effective in improving soil chemical properties, especially in acidic soils such as Ultisol (Prasetyo and Suriadikarta, 2006).

These results are consistent with the findings of Vika *et al*., (2017), who reported that solid cigarette factory waste can increase the pH of Ultisols. Similarly, Abdilah *et al*., (2018) stated that solid cigarette factory waste contains high levels of calcium carbonate ($CaCO_3$), which is capable of increasing the pH of acidic soils. In contrast, the treatments did not significantly affect soil organic carbon. This condition indicates that the accumulation of stable organic carbon in thesoil requires a longer decomposition time. According to Tan (2011) organic materials undergo gradual decomposition and a portion of carbon is lost as CO_2 during microbial respiration. Therefore, the increasing in organic carbon content may not be immediately evident within a single growing season. This is also supported by Prasetyo and Suriadikarta (2006) who reported that organic matter stabilization in highly weathered soils such as Ultisol is relatively slow.

Similarly, available phosphorus (P-available) was not significantly affected by the treatments. Although an increasing trend was observed at higher treatment levels, the values remained relatively low. This is due to the high phosphorus fixation capacity of Ultisols, where phosphorus is strongly bound by aluminium (Al) and iron (Fe). According to Havlin *et al*., (2005), phosphorus availability in acidic soils is often limited due to fixation processes, making it less accessible to plants. In addition, Tan (2011) explained that phosphorus transformation from organic to available forms requires time to reach equilibrium in the soil system. Therefore, even with improved soil pH, phosphorus availability may not increase significantly in the short term. According to Abdilah *et al*., (2018) reported that solid cigarette factory waste has the potential to improve phosphorus availability in Ultisols although the effect may not always be statistically significant during short-term incubation periods. The gradual release of nutrients from organic materials requires sufficient decomposition time before phosphorus becomes fully available to plants.

3.2 Yield and Sweetness Level of Corn Sweet

From Table 2 can seen the effect of combination of solid cigarette factory waste and dolomite on yield (cob weight with and without husk) and sweetness level of sweet corn.

Table 2. Effect of the combination of solid cigarette factory waste and dolomite on plant growth and yield and sweetness level of sweet corn

Treatment	Cob weight with husk (g)	Cob weight without husk (g)	Sweetness level (%)
W0	228,00	179,00	9,00
W1	189,33	153,33	8,33
W2	252,67	199,33	9,33
W3	265,67	212,33	8,33
W4	169,33	137,33	5,33
W5	228,67	175,00	9,67
W6	122,00	94,00	11,33

The results showed that the weight of cob with husk and without husk were not significantly affected by the treatments. Nevertheless, from Table 2 it can be seen that there is a tendency for cob weight to increase in treatment W3, which is a combination of the application of 40 tons of solid tobacco factory waste and 7,60 tons of dolomite. According to Soemarah's research results, the highest yield in tomato plants was obtained at a dosage of 20 tons/ha of solid waste from cigarette factories, although it was not significant, which was 1490,33 grams/plant. This indicates that the applied oftreatments were not yet able to provide sufficient nutrients to support optimal grain filling. One possible reason is the limited availability of phosphorus, which plays an important role in energy transfer and carbohydrate translocation within the plant.

According to Prasetyo and Suriadikarta (2006), phosphorus availability in Ultisol soils remains low due to strong fixation by Al and Fe, even after liming. Furthermore, the lack of significant effect may also be related to the slow mineralization of organic materials. Asril *et al*., (2022) stated that nutrients from organic matter are released gradually through decomposition processes, and their availability depends on microbial activity and environmental conditions. Therefore, during the short experimental period, nutrient release from cigarette factory waste may not have reached optimal levels. The sweetness level of sweet corn was also not significantly affected by the treatments. However, variations were observed among treatments. These differences may be influenced by internal plant physiological processes and environmental factors rather than treatment effects alone.

4. Conclusion

The application of combination of solid cigarette factory waste and dolomite can increase soil pH significantly with the highest value at W4 treatment. The combination of solid cigarette factory waste and dolomite can not increase soil C-organic and available phosphorus of Ultisols but there is tendency for the highest values in the W4 treatment. All of the treatments can not increase the weight of corn cob with and without husk and sweetness level but there is tendency for the highest values in the W3 treatment.

5. Acknowledgements

The author would like to thank the Faculty of Agriculture, Universitas Sumatera Utara, for providing facilities and support during this research.

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