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A Study on The Agronomic Benefits Using Liquid Compound Fertilizer Plus on Maize Crops

Oviyanti Mulyani[1]*, Emma Trinurani Sofyan[1], Anne Yulina[2]
[1]Department of Soil Science and Land Resources Management, Soil Chemistry and Plant Nutrition Laboratory, Faculty of Agriculture, Padjadjaran University, West Java, Indonesia
[2] Soil Chemistry and Plant Nutrition Laboratory, Faculty of Agriculture, Padjadjaran University, West Java, Indonesia
Correspondence Author

Abstract: Liquid fertilizer in cultivation improves water efficiency while simultaneously reducing plant water requirements. This is because each form of fertiliser has its own set of advantages and disadvantages, which have an individual impact on each type of farming.The purpose of this study was to determine the effect of the combination of liquid compound fertilizer plus on the optimal growth and yield of maizecrops. This study used a Randomized Block Design (RBD) method using liquid compound fertilizer plus, with the variation of doses liquid compound fertilizer. The data collected from the parameters of plant height, number of leaves andyield parameters. The results of this study showed, there was the liquid compound fertilizer has a significant impact on the soil's variable element content (soil pH, N and P total content) and yield components (N, P, and K absorption).In general, the use of liquid compound fertilizer with the recommended doses of ¾, 1, 1 1/4, and 1¾ can significantly increase yields. The highest yields were observed at the 1¾ treatment dose, with a corn crop yield of 15,680 kg/ha. However, when considering fertilization efficiency, the one recommended dose of liquid compound fertilizer with a corn crop yield of 14,400 kg/ha is the most effective.
Keywords: Liquid fertilizer, Sorption, Compound plus, Maize, Anorganic material

1. Introduction:

In recent year, many industrial factories create inorganic fertilizer through chemical and physical engineering. Inorganic fertilizers, which can be of either mineral or synthetic origin, are chemical products that provide nutrients to promote plant growth. In contrast to organic fertilizers, inorganic fertilizers are typically quick-releasing formulas that make nutrients rapidly available to plants [1].The needs of fertilizers account approximately 50-70% of field operational costs [2]. Bassically, the production cost for cultivation activity is largely influenced by fertilizers. Many farmers have been motivated to reduce fertilizer costs by reducing the rate or frequency of application or by changing to lower-cost materials, as a result of the escalating prices of fertilizer and the reduced farm incomes. Certain producers have transitioned to proprietary fertilizers with low analysis[3]. The utilization of inorganic fertilizers as an agricultural intensification technique will present its own set of challenges.

While productivity will increase, the environment will be significantly affected[4]. With the passage of time, the variety of inorganic fertilizers has expanded. The shape, color, and application of these items are diverse. Root fertilizers are still distributed through the leaves, tucked near the roots, or built under or around the roots.Farmers will derive advantages from the various inorganic fertilizer options available to them, provided that they realize the regulations, properties, and advantages.The ecosystem's negative effects are a result of the ongoing increase in the intensity of chemical fertilizer use. Inorganic fertilizers are relatively expensive, but they are simpler to obtain. The application of inorganic fertilizers is consistently related to environmental issues, including the impact on consumers and the physical conditions of the soil, as well as biological fertility.Industrial producers produce liquid fertilizers, introducing them into the soil at a specific depth in a liquid state to prevent ammonia loss.The twentieth century saw the creation of liquid manure as a replacement for fermented manure. They are provided to plants as a supplement to nourishment to improve the quality and quantity of plant development by forming a fluid shape.Liquid manure was created in the twentieth century as a substitute for fermented manure. Nitrogen, phosphorus, and potassium are abundant in the excretions of farm animals and are derived from the food they consume. Consequently, both forms of manure are employed as nutrient-rich fertilizers for plants.Liquid fertilizers are intended to supply plants with the nutrients they need. It will function as a conduit for the delivery of nutrients to plants, either through their foliage as foliar feed or through the soil and root system. The utility of liquid fertilizers is demonstrated by their ability to have a rapid and extensive impact on crops, as well as their ability to act as catalysts, thereby increasing the accessibility of plant nutrients[5].

2. Experimental Procedure

This experiment conducted using the experimental protocol with the effects of ten treatment combinations (each consisting of 8 treatment doses of liquid compound fertilizer with content of NPK (11–8-6), one treatment with the recommended fertilizer dose, and one control treatment (without fertilizer) on maize plants using a Randomized Block Design (RBD). This experiment repeated each treatment three times, resulting in a total experimental plot of thirty polybags. The experiment used a variety of materials, including liquid compound fertilizer, urea, SP-36, KCl, soil from the Inceptisol order in Jatinangor, and sweet maize seeds. A variety of chemicals are required for soil analysis including chemistry and physics. For chemical analysis The total N was determined using the Kjeldahl method as an index for the N value [6]. Organic analysis for the C content used the Walkley and Black Method [7]. The soil pH was measured using a soil-water suspension ratio of 1:2.5 [8]. The available phosphorus was determined colorimetry using a spectrophotometer after the extraction of the soil samples, using 0.5 M sodium bicarbonate ($NaHCO_3$) at a pH value of 8.5, according to the Olsen extraction method [9]. Extracted the exchangeable basic cations (Ca, Mg, K, and Na) at a pH value of 7 using 1 N ammonium acetate [8]. Determined the exchangeable Ca and Mg from this extraction using an atomic absorption spectrophotometer, and the exchangeable K and Na from the same extract using a flame photometer. We determined the cation exchange capacity (CEC) of the soil by analyzing ammonium acetate-saturated samples. After removing excess ammonium through repeated alcohol washing, we replaced these samples with sodium from a percolated sodium chloride solution[8].The saturating the soil sample with a 1 M KCl solution and titrating it with 0.05 N NaOH to determine the exchangeable acidity. We extracted the exchangeable capacitance using an NH_4OAc (ammonium acetate) solution to achieve the maximum ex-change between NH_4 and the cations that originally occupied the exchange sites on the soil surface [8]. We determined the percentage base saturation by dividing the sum of exchangeable bases by the number of CEC. We employed the ethylene diamine tetraacetic acid (EDTA) method to extract soil micronutrient cations (Fe, Mn, Cu, and Zn) [8]. The extraction of fulvic acids (Sa-putro&Karmanto, 2020) employed a NaOH ratio of 1:10 (soil:extractor) to extract humic acids from the soil [10]. For physical analysis followed the procedure used H_2O_2 as an organic matter indicator in a pipette method to determine the soil composition. The method involved directly sampling soil particles from the suspension using a pipette at a fixed depth, h, and time, t [11]. The assessed the water content by conducting a gravimetric comparison between the mass and weight of the water in the sample before drying at 105 °C and the sample mass and weight after drying, until we achieved a consistent mass and weight [11].

3. Result and Discussion

3.1. Plant Growth

Table 1CornPlantHeight

TREATMENTS	1 WAP (cm)	3 WAP (cm)	5 WAP (cm)	7 WAP (cm)
Control	11.00 a	35.83 a	74.00 a	105.67 a
NPK Standard	12.17 a	35.00 a	68.33 a	111.33 a
1/4 Dose of LCF	12.00 a	40.33 a	62.67 a	112.00 a
1/2 Dose of LCF	12.83 a	35.67 a	84.00 a	116.00 a
3/4 Dose of LCF	13.50 a	42.67 a	92.00 a	123.67 a
1 Dose of LCF	13.50 a	42.50 a	90.50 a	123.80 a
1 1/4 Dose of LCF	13.00 a	43.33 a	88.00 a	121.00 a
1 1/2 Dose of LCF	13.17 a	37.67 a	73.67 a	109.00 a
1 3/4 Dose of LCF	13.83 a	38.83 a	81.00 a	113.00 a
2 Dose of LCF	12.17 a	39.33 a	84.00 a	114.00 a

Information : WAP (week after planting)

In general, the control treatment demonstrated the lowest plant height in comparison to the other treatments, but no significant with others treatments. The application of liquid compound fertilizer (11-8-6) and standard NPK fertilizer also gave the same plant height in statistics analysis. The impact of this influence on the height of the corn plant may not be visible during the observation period, and it will require a longer period of time to observe the difference.

3.2. The Average of Leaf Plant

In general, the leaf number parameter indicates that the number of leaves between control and treated plants is not substantially different from 1 WAP to 7 WAP. Table 2 illustrates this.

Table 2Amount of Leaf Plant

Treatments	1 WAP	3 WAP	5 WAP	7 WAP
Control	3 a	4 a	5 a	6 a
NPK Standard	3 a	5 a	6 a	7 a
1/4 Dose of LCF	3 a	5 a	6 a	6 a
1/2 Dose of LCF	3 a	5 a	6 a	7 a
3/4 Dose of LCF	3 a	6 a	6 a	8 a
1 Dose of LCF	3 a	6 a	6 a	7 a
1 1/4 Dose of LCF	3 a	5 a	6 a	7 a
1 1/2 Dose of LCF	3 a	5 a	6 a	6 a
1 3/4 Dose of LCF	3 a	5 a	6 a	7 a
2 Dose of LCF	3 a	5 a	6 a	7 a

Information: WAP (week after planting)

At 3, 5, and 7 WAP, the control plants exhibited the lowest average number of leaves in comparison to the other plants. In addition, the standard NPK fertilizer treatment and the liquid compound fertilizer treatment (11-8-6) both experienced an increase in the number of leaves per week. The nutritional content of the corn plant and the increase in the number of plant leaves as the plant matures are significant factors. Although the soil's nutrient content will decrease as the plants develop, they still require adequate energy sources during their growth period. The application of liquid fertilizer that is straightforward, consistent, and effortless and have the potential to absorb into the soil and distribute more uniformly, thereby providing an effective coating that ensures all plants received the same nutrients, no matter their location[5].

Picture 1. The Plant Growth

3.3. The Average of Stem

The maize plant's diameter is an additional growth factor. In each treatment, the average diameter of sweet corn plants at 1, 5, and 7 WAP was significantly different from the control, particularly in the treatment with a single dose of liquid NPK (11-8-6). This indicates that the fertilizer treatment had an actual effect on the diameter indicators of sweet corn plants, as illustrated in table 3.

Table 3.Stem Diameter Data

Treatments	1 WAP	3 WAP	5 WAP	7 WAP
Control	2.97 a	7.36 a	12.17 a	16.63 a
Npkstandard	3.05 ab	8.08 a	12.19 ab	19.60 b
1/4 Dose of LCF	3.12 ab	8.02 a	15.21 abc	18.88 b
1/2Dose of LCF	3.07 ab	7.85 a	15.73 bc	18.26 ab
3/4Dose of LCF	3.10 ab	7.27 a	13.15 abc	19.09 b
1Dose of LCF	3.41 b	8.09 a	17.41 c	21.33 b
1 1/4Dose of LCF	3.09 ab	7.75 a	15.10 abc	17.98 ab
1 1/2Dose of LCF	3.08 ab	7.34 a	13.72 abc	17.75 ab
1 3/4Dose of LCF	3.17 ab	8.71 a	15.12 abc	19.47 b
2Dose of LCF	3.12 ab	8.13 a	16.18 bc	21.21 b

Compared to the other measures, the control still showed the lowest stem diameter at 5 and 7 WAP. The diameters of plants treated with standard NPK and those treated with liquid compound fertilizer (11–8-6) between treatments, revealing substantial differences. The treatment dose of ¾ to 1 dose of liquid NPK (11-8-6) is observed to produce stem diameter results that are comparable to or even greater than the standard NPK.

3.4. The Average of Sorption N, P and K

Basedontheresultsofstatisticaltests thathavebeencarriedout, theaverageplantuptake (N, P and K) measuredonindicatorplantsshows a significantimpact (Table4).

Table 4The AverageofPlantSorption

Treatments	N sorption (g/plant)	P sorption (g/plant)	K sorption (g/plant)
Control	3.35 a	0.35 a	1.29 a
NPK Standard	6.30 bc	0.64 cd	3.28 bc
1/4 Dose of LCF	5.37 b	0.54 b	2.35 bc
1/2 Dose of LCF	5.91 b	0.53 bc	2.49 bc
3/4 Dose of LCF	5.75 bc	0.58 bcd	2.94 bc
1 Dose of LCF	7.25 bcd	0.65 d	3.60 c
1 1/4 Dose of LCF	5.46 bc	0.58 d	3.42 bc
1 1/2 Dose of LCF	6.62 bc	0.60 d	3.40 bc
1 3/4 Dose of LCF	5.38 d	0.77 bcd	3.06 b
2 Dose of LCF	5.84 cd	0.72 bcd	3.04 bc

The table shows a significant difference in the N, P, and K uptake parameters per plant weight compared to the control, which included standard NPK and up to two doses of liquid compound fertilizer (11-8-6) in all tested regimens. The treatment dose of liquid compound fertilizer can effectively balance the use of conventional NPK fertilizer. The highest uptake was observed in the treatment of 1 dose, which is equivalent to 1 ¾ of the recommended dose of liquid compound fertilizer (11-8-6). In general, this is evident. The analyzed nutrient uptake content can determine the plant's efficacy in utilizing the nutrients provided during its growth, as plants require these nutrients for growth. The quantity required by plants categorizes the nutrients into two categories: macronutrients and micronutrients. Plants require macronutrients, which are present in greater quantities than micronutrients. Plants rely on these nutrients to complete their life cycle. Other nutrients cannot replace the function of each nutrient, leading to the inhibition of metabolism or complete cessation of activity, known as plant deficiency.Fluid fertilizer provides a faster delivery and instantaneous nutrition, as the fluid enters the soil instantaneously. This is due to the high mobility of nutrients in the soil water solution, which enables plants to reach the roots more quickly. It yields results faster than the granular ones[5].

3.5. The Average Content of pH, N,P and K Soil.

There were big differences between the treatment and the control in terms of pH, P, and N. This can be seen in Table 5, which shows the average amounts of pH, N, P, and K in the soil. This, however, was not the case for K-dd.

Table 5. Content of pH, N,P and K Soil

Treatments	pH	Exchangeable K	P ($mg.kg^{-1}$)	N (%)
Control	6.38 ab	0.53 a	14.76 a	0.29 a
NPK Standard	6.18 ab	0.54 a	21.86 c	0.41 bc
1/4 Dose of LCF	6.51 ab	0.69 a	16.41 ab	0.43 b
1/2 Dose of LCF	6.26 ab	0.56 a	16.72 ab	0.42 bc
3/4 Dose of LCF	6.08 a	0.59 a	18.16 b	0.49 bc
1 Dose of LCF	6.23 ab	0.62 a	22.67 c	0.46 c
1 1/4 Dose of LCF	6.79 b	0.59 a	22.21 c	0.49 bc
1 1/2 Dose of LCF	6.78 b	0.65 a	29.31 d	0.43 bc
1 3/4 Dose of LCF	6.38 ab	0.66 a	34.86 e	0.45 b
2 Dose of LCF	6.62 b	0.65 a	24.62 c	0.39 bc

In general, all operations provide greater nutritional value than control. The liquid compound fertilizer (11-8-6) can also have a significant impact on the total amount of phosphorus in the soil. The application of ¼ to 2 doses of liquid compound fertilizer can increase the amount of nutrients in the soil if compared to the NPK standard. However, for several parameters, the recommended dosage is 1 to 1 ¾ doses, as shown in Figures 1 and 2.Both organic and inorganic components make up soil, a free natural organism. The chemical properties of the soil are a determining factor in the level of soil fertility, as soil diversity has a variety of properties and contents in its components. Fertility ultimately closely correlates with the development of a plant. The element content has a significant impact on the overall growth of plants, as evidenced by the graph above. One of them is nitrogen, which is the primary component of protein, hormones, chlorophyll, vitamins, and essential enzymes that are essential for plants' survival. N metabolism is the primary factor in vegetative, stem, and leaf growth; therefore, plants need a significant amount of N. Plants that receive an adequate amount of nitrogen will experience robust vegetative growth; however, an excessive amount of nitrogen can postpone fruit formation and flowering. In contrast, a deficiency of nitrogen results in crop failure, stunted growth, and the yellowing of leaves. Applying urea fertilizer can enhance the availability of nitrogen in the soil. In addition, plants require phosphorus, which is an indispensable nutrient. In plants, P is involved in root development, flower, fruit, and seed formation, as well as cell division, particularly in juvenile plants. Orthophosphate ions (HPO_4^{2-} and H_2PO^{4-}) are two forms of P that are accessible to plants. This form's mobility is restricted because it reacts readily with numerous elements, compounds, and soil mineral surfaces. All of these nutrients influence the general proliferation of plants.Improved nutrient use efficiency, increased plant yield and quality, greater tolerance to pressure (e.g., drought, cold, insect pests), and increased root growth or activity are among the general claims made for this type of liquid fertilizer. Additionally, some declare that they have advantageous impacts on the biological activity of the soil and the availability of nutrients[12].

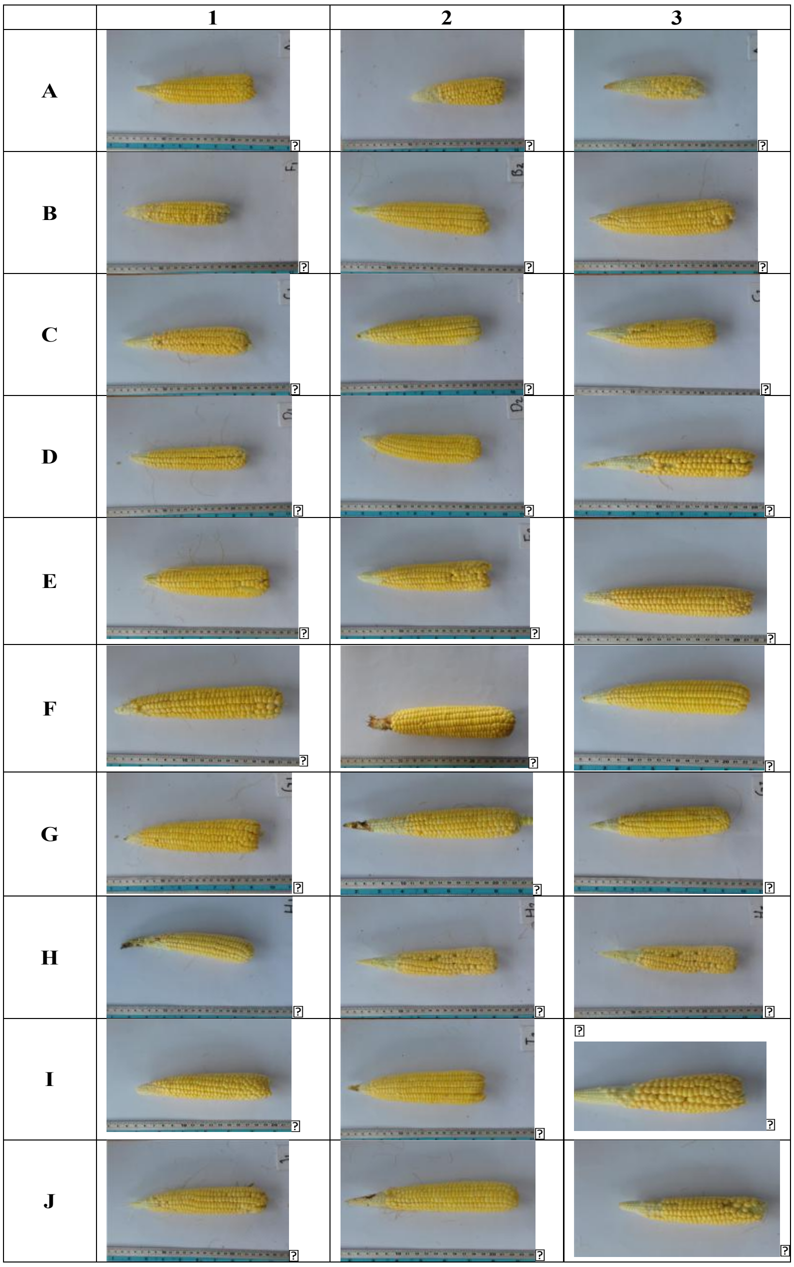
3.6. Yield Parameters

The components of corn yield, namely cob weight, cob length, cob diameter, and the effect of treatment, influence the overall yield of maize. In general, all treatments yielded significant results in comparison to the control (Table 6). One of the factors that affects corn crop yields is photosynthesis, which occurs after flowering. We harvest sweet corn crops as filthy cobs (cobs and husks), indicating that the quantity of photosynthesizing compounds in the leaves and stems determines the yield parameters. This implies that increasing the transport of photosynthesizing compounds from leaves and stems will have a general impact on plant yields, as well as increasing the seed loading phase.

Table 7The Average of Yield Parameters

Treatments	**Cob Weight (g)**	**Peeled Cob Weight (g)**	**Cob Length (cm)**	**Cob Diameter (cm)**
Control	89.00 a	68.00 a	14.00 a	3.65 a
NPK Standard	221.67 c	162.33 c	16.90 bc	4.30 b
1/4 Dose of LCF	208.00 c	126.33 b	16.83 bc	4.61 bc
1/2 Dose of LCF	215.67 c	122.67 b	15.83 b	4.44 bc
3/4 Dose of LCF	226.67 c	142.00 c	16.33 b	4.93 c
1 Dose of LCF	270.00 d	222.00 e	18.23 cd	4.58 bc
1 1/4 Dose of LCF	268.33 d	217.67 de	18.50 e	4.95 c
1 1/2 Dose of LCF	182.00 b	229.67 e	18.13 cd	4.62 bc
1 3/4 Dose of LCF	294.00 e	219.00 e	18.50 e	4.26 b
2 Dose of LCF	225.67 c	192.33 d	16.17 b	4.66 bc

These harvest components consist of the length and diameter of the cobs, the weight of the shelled cobs and the weight of the stripped cobs. In general, the liquid compond fertilizer treatment (11–8-6) can impact all components of maize crop yields. The observational data clearly shows that applying 1, 1 1/4, and 1 3/4 dosages of liquidcompound fertilizer (11-8-6) can enhance the yield components. Table 7 illustrates the conversion of the results obtained (Figure 1) into an average weight of fresh cobs tons/ha.



Picture 1. The Average of Cob weight

Table 8. The Average of Fresh Cob Weight(t.ha^{-1})

Treatments	**Cob Weight (g)**	**Cob Weight (kg.ha^{-1})**	**Cob Weight (t.ha^{-1})**
Control	89.00	4,747	5
NPK Standard	221.67	11.822	12
1/4 Dose of LCF	208.00	11.093	11
1/2 Dose of LCF	215.67	11.502	12
3/4 Dose of LCF	226.67	12.089	12
1 Dose of LCF	270.00	14.400	14
1 1/4 Dose of LCF	268.33	14.311	14
1 1/2 Dose of LCF	182.00	9.707	10
1 3/4 Dose of LCF	294.00	15.680	16
2 Dose of LCF	225.67	12.036	12

Information:Per polybag there is one corn plant with a planting distance of 75 cm x 20 cm

Picture 2. Harvesting Parameters

The average outcomes of harvest metrics, we can observe that using liquid compound fertiliser (11-8-6) can greatly improve results. Meanwhile, the 1 ½ dose and 2 dose parameters declined due to a disease assault on the plot, which reduced the predicted crop output. The illness that targets this treatment is leaf rust, which is caused by the fungus Puccinia sorghi. The early signs emerge as yellow spots that grow over time and are found on aged leaves. As a result of this disease, plants are unable to perform photosynthesis properly, disrupting the growth process and reducing agricultural yields; yet, the attack on the plot remains below the threshold.The application of liquid fertilizers positively influenced root growth parameters in their studies on the efficacy of conventional, solid soluble, and liquid fertilizers and achieved the maximum fruit yield by combining conventional fertilizers with liquid fertilizers[13].

4. Conclutions

1. The liquid compound fertiliser (11-8-6) has a substantial effect on soil variable contents (soil pH, N, and P total content) and yield components (N, P, and K absorption).
2. The application of liquid compound fertiliser (11-8-6) can increase results that are significantly different when compared to the control. In general, of all the parameters tested, the use of LCF (11-8-6) with the recommended doses of ¾, 1, 1 ¼ , and 1¾ can significantly increase yields, with the highest yields found in the 1¾ treatment dose with a corn crop yield of (15,680 kg.ha^{-1}); however, if seen from the perspective of fertilisation efficiency, it is the 1 recommended dose of LCF (11-8-6) with a corn crop yield of (14,400 kg.ha^{-1}).

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Conflict of Interest

The authors certify that they do not have any competing interest to declare.

References

[1]. Ibrahim M, Tasi'u R, Umma M, and Dangora II, "The effects of inorganic fertilizer on soil characteristics and production of Egg Plant (Solanum melongena L.) in Warawa area of Kano State 1 Phytoremediation and soil microbiology View project Water Management Practices View project," *Proc. 2001 PIPOC Int. Palm Oil Congr.*, no. June, pp. 550–556, 2001.

[2]. J. P. Caliman, B. Martha, and S. Saletes, "Dynamics of Nutrient Release from Empty Fruit Bunches in Field Ctfnditions and Soil Characteristics Changes," *Proc. 2001 PIPOC Int. Palm Oil Congr. Bangi, Malaysia Malaysian Palm Oil Board.*, pp. 550–556, 2001.

[3]. C. Feyter, D. C. Edmeades, M. O'Connor, and C. E. Smart, "Effects of Liquid and Low Analysis Fertilisers on Pasture and Animal Production," *Proc. New Zeal. Grassl. Assoc.*, vol. 144, pp. 139–144, 1989.

[4]. C. Feller, E. Blanchart, M. Bernoux, R. Lal, and R. Manlay, "Soil fertility concepts over the past two centuries: The importance attributed to soil organic matter in developed and developing countries," *Arch. Agron. Soil Sci.*, vol. 58, no. SUPPL., pp. 3–21, 2012.

[5]. S. Danu, P. Nautiyal, V. Supyal, R. Bisht, P. Bhandari, and S. Gurang, "Liquid fertilizer: Much needed boost and plant drink to nourish today's agriculture compressed," *Food Sci. Reports*, vol. 3, no. March, pp. 47–49, 2022.

[6]. J. M. Bremner, "Inorganic Forms of Nitrogen in Soil," no. 84, pp. 1179–1237, 1965.

[7]. J. C. Yeomans and J. M. Bremner, "Effects of organic solvents on denitrification in soil," *Biol. Fertil. Soils*, vol. 7, no. 4, pp. 336–340, 1989.

[8]. J. R. Okalebo, K. W. Gathua, and P. L. Woomer, *Laboratory Methods of Soil and Plant Analysis: A Working Manual The Second Edition*, vol. Second Edi. 2002.

[9]. J. L. Kovar and G. M. Pierzynski, *Methods of phosphorus analysis for soils, sediments, residuals, and waters. Southern Cooperative Series Bulletin*. 2009.

[10]. F. De Souza and S. R. Bragança, "Extraction and characterization of humic acid from coal for the application as dispersant of ceramic powders," *J. Mater. Res. Technol.*, vol. 7, no. 3, pp. 254–260, 2018.

[11]. BBLSLP, *Sifat Fisik Tanah dan MetodeAnalisisnya*. 2006.

[12]. D. C. Edmeades, "The effects of liquid fertilisers derived from natural products on crop, pasture, and animal production: A review," *Aust. J. Agric. Res.*, vol. 53, no. 8, pp. 965–976, 2002.

[13]. K. Rajan, A. Abdul Haris, L. K. Prasad, and Shivani, "Efficacy of conventional, solid soluble and liquid fertilizers applied through drip-fertigation on tomato," *Indian J. Hortic.*, vol. 71, no. 2, pp. 217–221, 2014.