Preface

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Preface

The ICSTLM 2020, International Conference on Sustainable Tropical Land Management, is the first international conference on tropical land organized by the Indonesian Center for Agricultural Land Resources Research and Development (ICALRRD) on behalf of the Indonesian Agency for Agricultural Research and Development (IAARD). This first conference was held virtually due to COVID-19 pandemic on September 16-18, 2020, Jakarta time, put the theme of "A*dapting land management to climate change and combating land degradation to increase resilience of agricultural systems"* and invited well-known international experts as speakers in plenary. Moreover, Indonesian Ministry of Agriculture, Dr. Syahrul Yasin Limpo, was show his great attention to this event and pleased to give opening remarks. ICSTLM 2020 can be enjoyed at: https://seminarbbsdlp.id/icstlm/index.php/en/.

The conference drew widely concern where around 500 participants per day, coming from 35 research institutions, universities, and government offices based in over 15 countries, were attended in both a plenary and 5 parallel sessions regarding sub-themes: 1) land use, land suitability, and risk mappings – the relationship with agricultural sustainability (LULS), 2) soil, water, and crop management and the socio-economic dimensions (SWCM), 3) adaptation and mitigation to climate change (CC), 4) soil quality assessment: morphological, physical, biological, chemical and geological aspects to support agricultural sustainability (SQA), and 5) digital and precision agriculture (DPA).

More than 200 accepted papers, which carefully screened on the basis of their quality and their relevance to the conference theme, were presented orally in those parallel sessions during three consecutive days using Zoom Breakout Room platform. Presenters, participants, and facilitator were interacted online in each parallel class, while presentation files and Q/A session were managed carefully by Committee. High quality of internet connection, professional members of ICSTLM Committee, and the very cooperative presenters and attendees were the keys of the success of ICSTLM 2020.

All accepted papers were then peer-reviewed by scientific editorial board and reviewers who fit with their expertise. All reviewers have doctoral degree and experience on publishing scientific papers in reputable international journal. Furthermore, ICSTLM Committee took full attention to the plagiarism issue, writing format, and proper layout to guarantee the papers' quality.

I am gratefully thanked to the editorial board member and the reviewers for pouring their valuable time and advice to meet the quality of papers. Thank also to authors for presenting their work at conference, considering the reviewers' suggestion for improving their papers' quality, and for publishing in this volume. My sincere appreciation to Indonesian Ministry of Agriculture, all ICSTLM Committee, facilitators, co-organizer, and all other participants for their support in ICSTLM 2020.

December 2020

Dr. Husnain
Director of ICALRRD

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Peer review declaration

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Peer review declaration for ICSTLM 2020

All papers published in this volume of IOP Conference Series: Earth and Environmental Science have been peer reviewed through processes administered by the Editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal published by IOP Publishing.

- **Type of peer review:**
- *We used triple-blind peer review, author and reviewer identities are hidden to each other, and also from the Editor(s). Author(s)'s name in each paper was replaced with ID number. We also used ID number for each reviewer.*

- **Describe criteria used by Reviewers when accepting/declining papers. Was there the opportunity to resubmit articles after revisions?**

- *We used 12 important aspects to be considered during evaluation. Scoring was applied to each point to decide whether a submission is accepted or rejected, as follow:*

POINTS OF ATTENTION	N	YN	Y	Score
Is the title well chosen (explaining the content, yet not too long)?				
Is the abstract well written and properly structured (justification/ urgency, objectives, methods, results, conclusions) and does it summarize the most important aspects of the paper?				
Is the overall structure of the paper clear and appropriate (introduction, methods, results, discussion, conclusion)?				
Does the introduction clearly identify the underlying problem in the context of the present knowledge in this domain? Does it clearly state the aim(s) of the paper?				
Does the author acknowledge related published research by others?				
Does the author clearly explain the methodology followed for tackling this problem, and the reasons for using this specific methodology?				
If the paper is based on a statistical analysis, is this performed in the correct way? Is the sampling unbiased and sufficiently large?				
Is the table or figure independent (complete) and numbered				
Does the conclusion outline the meaning of the main findings and answer the objectives?				
Is the language used clear and correct (vocabulary, grammar, etc)?				
Is there no unnecessary repetition of data (text, figures, tables)?				
Are the references relevant and complete, up-to-date				

and correctly formatted? Are the cited items publicly accessible (although not necessarily for free)?				

- *Yes, all articles reviewed and revised by the author(s) have the opportunity to resubmit only through ICSTLM website address according to time schedule.*

- **Conference submission management system:**
- *We used ICSTLM website for all submissions managed by ICSTLM secretariat (email address: seminarbbsdlp@gmail.com). The person who managed the submission process is Dr. Adha Fatmah Siregar (adha_siregar@yahoo.com)*

- **Number of submissions received:**
- *273 submissions*

- **Number of submissions sent for review:**
- *272 submissions*

- **Number of submissions accepted:**
- *213 submissions*

- **Acceptance Rate (Number of Submissions Accepted / Number of Submissions Received X 100):**
- *78.3%*

- **Average number of reviews per paper:**
- *2 reviewers per paper (12 important aspects reviewed per paper)*

- **Total number of reviewers involved:**
- *22 reviewers*

- **Any additional info on review process (i.e. plagiarism check system):**
- *All papers are checked for plagiarism using a commercially plagiarism checker application. A paper identified 20% or more plagiarism is subjected to be modified by the author(s) or rejected.*
- *We accepted 78% of 273 submitted papers to ICSTLM 2020. We tracked the institution of all authors of accepted papers, ensuring they are researchers. Almost all of them have had experience to publish scientific articles in national and/or international publications. We ensure they deserved to publish internationally through IOP Publishing.*

- **Contact person for queries:**
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Effectiveness of the combination of organonitrofos and inorganic fertilizers on soil chemical properties and the yields of cucumber (*Cucumis sativus* L.) in Ultisols

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Effectiveness of the combination of organonitrofos and inorganic fertilizers on soil chemical properties and the yields of cucumber (*Cucumis sativus* L.) in Ultisols

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Abstract. Ultisols has constraints in low organic matter, low pH, low CEC, and low soil nutrients. This study aimed to determine the effect of applying a combination of Organonitrofos and inorganic fertilizers on soil chemical properties and yields of cucumber plants in Ultisols. The study consisted of 11 combinations of Organonitrofos and inorganic fertilizers with 3 replications arranged in a randomized block design. A recommended dose of 100% Organonitrofos fertilizer which was 10,000 kg ha^{-1} and 100% NPK inorganic fertilizer (Urea = 448 kg ha^{-1}; SP-36 = 413.5 kg ha^{-1}; KCl = 63.3 kg ha^{-1}) were applied. The treatments were various combinations of Organonitrofos and inorganic fertilizers of 0, 25, 50, 75 and 100% from each fertilizer recommendation. The application of a combined Organonitrofos and inorganic fertilizers increased pH and soil available-P, but it did not affect the total-N and organic-C of soil. All combined doses of Organonitrofos and inorganic fertilizer significantly increased all the growth and yields variables of cucumber compared to control (without fertilizer) and application of Organonitrofos fertilizer only. Application of 100% Organonitrofos + 50% NPK was the most economically effective dose because it had the highest RAE value of 101%.

1. Introduction

Cucumber is a fruit vegetable that is consumed by many Indonesians in the form of fresh or processed because it has a fairly good nutritional value. Although the need for cucumbers is continuesly increase, but the production of cucumber plants still does not meet the needs of consumers. The production of cucumber has decreased from year to year. The average productivity of cucumber in 2012 and 2013 reached 9.97 t ha^{-1}, while in 2014 it decreased to 9.84 t ha^{-1} [1]. One reason of the decreased cucumber production might be due to the decreasing harvested area because of land conversion. Cucumber plants are usually cultivated on low-fertility Ultisols. The problems of Ultisols are high soil acidity (average pH <4.50), high Al-saturation, poor macronutrient content especially N, P, K, Ca, and Mg, and low organic matter content [2]. Nutrient contents in Ultisols are generally low due to intensive leaching of alkaline bases, while the low organic matter content is because the decomposition process runs quickly and some of the organic matters are lost through erosion.

One effort to increase the productivity of Ultisols can be done through fertilization. Inorganic fertilizers are easily available and can be directly absorbed by plants, but they can cause physical and biological damage to the soil if they apply in a long term. Therefore, a combination of inorganic fertilizer

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and organic fertilizer is needed so that soil damage caused by land degradation can be prevented. The combination of NPK fertilizer 30% of the recommended dose and 2 t ha^{-1} of organic fertilizer increased the yields and NPK uptake of curly chilies [3].

One of the organic fertilizers that can be used is Organonitrofos. It is a solid organic fertilizer that can provide high level of N and P nutrients. It is made from fresh manure, MSG waste, coconut fiber, and enriched with beneficial microbes (N-fixer and P-solubilizer) [4]. To improve the quality of Organonitrofos, reformulation had to be done [5]. Continuous researches regarding Organonitrofos combined with inorganic fertilizer are still done to see its possible role as a substitute for inorganic fertilizers, especially NPK [3, 6, 7]. A partial substitution of recommended chemical fertilizers with Organonitrofos fertilizer by 40% consistently resulted in the highest plant growth performance (stover weight) and maize yields (dry shelled weight and one hundred grain weight) followed by 100% organonitrofos fertilizers only (without chemical fertilizers) [8].

This research was conducted to determine the effect of the combined Organonitrofos and inorganic fertilizers on the changes in the chemical properties of Ultisols and the yields of cucumber plants.

2. Materials and methods

A pot experiment was conducted at the Integrated Field Laboratory and the soil analysis at the Soil Science Laboratory of the Faculty of Agriculture, University of Lampung, Bandar Lampung, Indonesia from July to October 2016. The research consisted of eleven treatments with three replication arranged in a randomized block design (RBD). The treatments were a combination of Organonitrofos (OP) and inorganic fertilizer (NPK) (table 1). The recommended dosages of 100% organonitrofos fertilizer (OP) was 10 t ha^{-1}, while 100% inorganic fertilizer (NPK) was Urea= 448 kg ha^{-1}; SP-36= 413.5 kg ha^{-1}; KCl= 63.3 kg ha^{-1}. Organonitrofos is a solid organic fertilizer with the composition of pH (H_2O) 7.0, organic-C 13.89%, total-N 1.08%, total-P 4.96% and total-K 3.03% [9].

Table 1. The combination of Organonitrofos (OP) and inorganic fertilizer (NPK) used in the study.

Treatment	Fertilizer Combination
P0	0% Organonitrofos + 0% NPK
P1	0% Organonitrofos + 100% NPK
P2	100% Organonitrofos + 0% NPK
P3	100% Organonitrofos + 25% NPK
P4	100% Organonitrofos + 50% NPK
P5	100% Organonitrofos + 75% NPK
P6	100% Organonitrofos + 100% NPK
P7	25% Organonitrofos + 75% NPK
P8	50% Organonitrofos + 75% NPK
P9	75% Organonitrofos + 75% NPK
P10	50% Organonitrofos + 50% NPK

Data were analyzed by ANOVA (Analysis of Variance). Before testing of ANOVA, homogeneity of variance was tested by the Bartlet test, data additivity was tested by the Tukey test. The difference in the mean value of the treatment was tested by *Duncan's Multiple Range Test* (DMRT) at the 5% level.

The research was started by preparing a polybag with a size of 35 x 40 cm, filled with the planting media consisted of 10 kg Ultisols (oven-dry weight). The soils then mixed with husk charcoal (25 g $polybag^{-1}$), dolomite (10 g $polybag^{-1}$) and Organonitrofos (according to each treatment dose). The media then allowed to stand for two weeks before planting. Two cucumber seeds were planted in each polybag. After a week, one of the best emerged plant was selected to be grown. Application of inorganic fertilizers (NPK) was given one week after planting (WAP) by being circled around the seeds. Urea fertilizer was applied twice, namely a half dose together with SP-36 and KCl fertilizers and a half dose when the cucumber plants began flowering. Plant maintenance were carried out by irrigation, replanting, plant stakes, and controlling pests and diseases. Cucumbers were harvested from 28 to 35 days after planting (DAP). Soil samplings were carried out twice, namely in the time before planting and after harvesting in a composite manner at each replication.

3. Results and discussion

3.1. Chemical properties of ultisols before planting and after harvesting

Initial soil analysis showed that Ultisols used in this study had characteristic such as acidic pH and very low nutrient contents of total-N, available-P, organic-C, and cation exchange capacity (CEC) (table 2).

Table 2. Initial soil chemical properties of Ultisols before planting time.

Soil chemical properties	Value (Criteria)
pH	4.61 (A)
Total-N (%)	0.08 (VL)
Available-P (mg kg^{-1})	3.25 (VL)
Organic-C (%)	0.95 (VL)
CEC (cmol kg^{-1})	3.43 (VL)

Note: The number followed by the letter states A=Acid and VL =Very low.

The initial soil nutrient contents were very low so that the combination of Organonitrofos and inorganic fertilizers was applied to increase the fertility of Ultisols soil. The results of the soil analysis after harvesting of the cucumber is presented in table 3.

There was an increase of soil pH values after harvesting which ranged from 5.72 to 6.60 followed by a change in criteria from being slightly acid to neutral (table 3) compared to the initial soil pH of 4.61 with acid criteria (table 2). Soil pH values affect the nutrient availability in the soil. Cucumber plants can be grown in the soil pH ranged from 5.5 to 7.5. At soil pH less than 5.5, there will be interference with the absorption of nutrients by plant roots so that plant growth is disrupted [10]. The use of dolomite as a basalt treatment in this research was sufficient to increase soil pH and to meet good conditions for growing cucumber plants.

The soil total-N content after harvesting was not significantly increased compared to those before planting for all treatments. These could be assumed that cucumber plants have been using soil N for the growth and due to the occurrence of N evaporation. It was found that the soil total-N content decreased from 0.5% (at an initial stage, before planting) to 0.4% (at harvesting time) by the application of chicken manure enriched with husk ash and Tithonia [11]. Moreover, the decreased of nitrogen levels occurred in almost all treatments except on the treatment of goat manure enriched with natural phosphate, dolomite, and Thitonia extract. Nitrogen uptake by plants caused a reduction of nitrogen in the soil.

The soil available-P after harvesting ranged from 11.9 mg kg^{-1} to 56.7 mg kg^{-1} (high to very high criteria). It was highly increasing compared to the initial value (before planting) of 3.3 mg kg^{-1} (very low criteria). This is presumably due to the application of Organonitrofos containing phosphate solubilizing microbes and SP-36 inorganic fertilizer which can contribute to P-nutrient content in Ultisols. The application of SP-36 fertilizer and organic fertilizer as well as the interaction of both treatments have significant effects on the increasing of soil available-P [12].

Furthermore, the increase of soil available-P content might be also due to the addition of soil amendments in the form of dolomite and husk charcoal applied to all treatments including control treatment (P0: 0% Organonitrofos + 0% NPK). The soil available-P increased significantly up to 31.9% by the application of dolomite 1 t ha^{-1} and increased around 9.6% by the application of biochar 4 t ha^{-1} [13].

Dolomite contains magnesium (Mg) and calcium (Ca) as soil calcifiers. Applying dolomite in acid soils has a good effect on soil properties. If Mg levels in the soil increased, then the level of N and P in the leaves will also increased. If the soil hydrogen contents decrease, then the soil pH increases [10].

The responses of increasing soil pH because of the supply of Mg and Ca nutrients which can shift the position of H^+ on the surface of the colloid to the soil solution to neutralize the acidity of the soil. Liming could reduce aluminum toxicity, increase the availability of soil P as a result of releasing P from Al-P and Fe-P bonds, increase N fixation, N mineralization, and CEC [10].

Table 3. The soil chemical properties of Ultisols after harvesting of cucumber plant.

Treatment	Fertilizer Combination (%)		pH	Total-N (%)	Available-P (mg kg^{-1})	Organic-C (%)
	OP	NPK				
P0	0	0	6.33 (SA)	0.06 (VL)	11.9 (H)	0.96 (VL)
P1	0	100	5.72 (SA)	0.08 (VL)	48.2 (VH)	1.13 (L)
P2	100	0	6.60 (N)	0.12 (L)	50.3 (VH)	1.34 (L)
P3	100	25	6.36 (SA)	0.12 (L)	51.0 (VH)	1.35 (L)
P4	100	50	6.21 (SA)	0.13 (L)	53.9 (VH)	1.52 (L)
P5	100	75	5.98 (SA)	0.11 (L)	55.6 (VH)	1.25 (L)
P6	100	100	5.85 (SA)	0.11 (L)	56.7 (VH)	1.25 (L)
P7	25	75	5.91 (SA)	0.08 (VL)	50.3 (VH)	1.08 (L)
P8	50	75	5.93 (SA)	0.11 (L)	52.9 (VH)	1.21 (L)
P9	75	75	6.06 (SA)	0.11 (L)	55.0 (VH)	1.40 (L)
P10	50	50	6.15 (SA)	0.11 (L)	51.0 (VH)	1.21 (L)

Note: OP = Organonitrofos. The number followed by the letter states SA = Slightly Acid, N = Neutral, VH = Very High, H = High, L = Low, VL = Very Low.

The soil organic-C content after harvesting did not increase in the control treatment, while slightly increase in the other treatments. The provision of organic matter can increase soil organic-C content that can affect soil properties to be better physically, chemically, and biologically. Carbon is an energy source of soil microorganisms, so the presence of soil organic-C will spur microorganism activities thereby increasing the soil decomposition process and also soil reactions that involve microorganisms, such as P-dissolution, and N-fixation [14].

It was reported that soil chemical properties such as pH, organic-C, total-N, and available-P after harvesting were significantly ($P < 0.01$) affected by the application of the different rates of organic and inorganic fertilizers [15]. Moreover, relatively higher pH value, organic-C, and nutrient concentrations for plots were treated with manure and compost [15]. Similarly, it was also reported that the application of animal manure and compost increased soil pH [16].

3.2. Effect of application organonitrofos fertilizer and inorganic fertilizer on the growth and yields of cucumber plants

The application of combined Organonitrofos and inorganic fertilizer had no significant effect on the length of cucumber plants, which is consistent with the previous research by Wijaya *et al*. [17]. It is assumed that the macro and micronutrient content in the soil is sufficient enough for the growth of cucumber plants. Based on the analysis of soil chemical properties after harvesting, there was an increase in soil pH and nutrient content compared to before planting, including the control treatment (P0: 0% Organonitrofos + 0% NPK) because all treatments had been given by dolomite and husk charcoal as basalt soil amendments.

However, based on the results of the DMRT 5% test (table 4), the P4 treatment (100% Organonotrofos + 50% NPK) had the highest plant length and significantly different from the control treatment. The application of the combined Organonitrofos and inorganic fertilizer has a significant effect on the vegetative growth of cucumber plants from the parameters of the number of leaves, stem diameter, and number of branches of cucumber plants. The P9 treatment (75% Organonitrofos + 75% NPK) had the highest number of leaves, stem diameter, and number of branches, but relatively no different from other fertilizer combination treatments and also not different from the treatment of inorganic fertilizers only (P1). The availability of complete and balanced nutrients that can be absorbed by plants is a factor that determines plant growth and yields [18].

Table 4. Effect of a combined Organonitrofos and inorganic fertilizer on the vegetative growth of cucumber plants.

Treatment	Plant Length (cm)*	Number of Leaves (strands)*	Rod Diameter (cm)*	Number of Branches*
P0	161.0 b	28.0 d	0.7 c	3.0 c
P1	202.3 ab	78.7 ab	1.2 ab	11.3 a
P2	195.8 ab	46.7 c	1.1 b	6.0 bc
P3	196.3 ab	64.7 b	1.1 ab	8.7 ab
P4	215.0 a	75.0 ab	1.3 ab	9.7 a
P5	197.6 ab	70.7 ab	1.1 ab	9.0 ab
P6	197.9 ab	69.7 ab	1.1 ab	9.3 ab
P7	200.9 ab	72.5 ab	1.2 ab	9.7 a
P8	200.5 ab	67.5 b	1.1 ab	10.7 a
P9	201.9 ab	80.0 ab	1.3 a	12.0 a
P10	198.2 ab	88.0 a	1.1 ab	9.0 ab

*The numbers followed by the same letter are not significantly different from the DMRT test at the 5% level.

The P9 treatment (75% Organonitrofos + 75% NPK) had the highest fresh stover weight and dry crop stover weight, but it was not relatively different from the P1, P4, P6, P7, P8, and P10 treatments (table 5). Fresh stover weight is the result of the measurement of the fresh weight of plant biomass as an accumulation of material produced during growth. Giving Organonitrofos fertilizer and inorganic fertilizer with various combinations can provide enough nutrients for the growth of cucumber plants because all macro and micronutrients are provided by both kinds of fertilizers.

From Table 6, it can be seen the shortest flowering age was in the treatments of P3 (100% Organonitrofos + 25% NPK), P4 (100% Organonitrofos + 50% NPK), and P6 (100% Organonitrofos + 100% NPK), which was 25.7 DAP. While the longest flowering age was in the control treatment (P0) and NPK only treatment (P1). Organonitrofos fertilizers can provide high levels of N and P nutrients because it was enriched with beneficial microbes (N-fixer, P-solubilizer, and *Trichoderma* sp.), so it can influence the flower formation process. It was found that the application of nitrogen in the form of organic and inorganic fertilizer has a significant effect on the flowering age of cucumber plants [19]. The availability of nitrogen in a high amount in the soil affects the absorption of phosphorus which plays a role in the process of flower formation. Besides, flowers on cucumber plants appear on the armpits of leaves, so the number of flowers that appear on cucumber plants is influenced by the number of leaves and segments of the cucumber plant itself [20].

Moreover, the P9 treatment (75% Organonitrofos + 75% NPK) can produce the highest number of female and male flowers. In addition to the availability of nutrients, the number of flowers is also influenced by environmental factors, especially sunlight and sunlight intensity. It has been stated that if the length of the sun's irradiation is less than 12 hours every day with low light intensity so that more cucumber plants form female flowers [21]. On the contrary, the high intensity of sunlight makes more cucumber plants from male flowers.

The combination of Organonitrofos and inorganic fertilizers did not have a significant effect on the cucumber harvest age. This is supported by Zulyana [22] where the application of chemical fertilizers and combined by dosages and forms of cow dung did not have a significant effect on the cucumber harvest age. The faster harvest time means that the treatment has a better impact because the fast harvest age shows that the ripening of the fruit is going well, as a result of better nutrient absorptions.

Table 5. Effect of a combined Organonitrofos and inorganic fertilizer on fresh and dry stover weights.

Treatment	Fresh Stover Weight (g plant^{-1})*	Dry Stover Weight (g plant^{-1})*
P0 (0% Organonitrofos + 0% NPK)	243 d	29.2 c
P1 (0% Organonitrofos + 100% NPK)	800 ab	79.7 ab
P2 (100% Organonitrofos + 0% NPK)	297 cd	37.9 bc
P3 (100% Organonitrofos + 25% NPK)	333 cd	42.9 bc
P4 (100% Organonitrofos + 50% NPK)	623 abc	84.1 ab
P5 (100% Organonitrofos + 75% NPK)	497 bcd	57.8 bc
P6 (100% Organonitrofos + 100% NPK)	513 bcd	71.0 ab
P7 (25% Organonitrofos + 75% NPK)	747 abc	87.3 ab
P8 (50% Organonitrofos + 75% NPK)	637 abc	72.7 ab
P9 (75% Organonitrofos + 75% NPK)	1393 a	144.9 a
P9 (50% Organonitrofos + 50% NPK)	577 abc	67.5 ab

*The numbers followed by the same letter are not significantly different from the DMRT test at the 5% level.

Table 6. Effect of a combination of Organonitrofos fertilizer and inorganic fertilizer on the generative growth of cucumber plants.

Treatment	Flowering Age (days)*	Amount of Female Flowers*	Number of male flowers*	Early Harvest Age (days)*
P0	27.7 a	8.7 c	25.3 c	41.0 a
P1	27.0 ab	31.0 ab	40.7 ab	39.0 ab
P2	26.3 bc	21.0 bc	31.7 cb	39.0 ab
P3	25.7 c	25.7 ab	43.0 ab	36.3 b
P4	25.7 c	29.7 ab	46.7 a	37.0 b
P5	26.0 bc	22.7 ab	45.0 ab	36.3 b
P6	25.7 c	24.0 ab	41.7 ab	37.0 b
P7	26.3 bc	26.0 ab	48.3 a	38.7 ab
P8	26.0 bc	29.7 ab	45.3 ab	37.7 ab
P9	26.0 bc	37.0 a	57.3 a	38.0 ab
P10	26.0 bc	28.7 ab	46.0 ab	36.3 b

* The numbers followed by the same letter are not significantly different from the DMRT test at the 5% level.

The treatment of inorganic fertilizers without Organonitrofos (P1) gave the highest yields based on the number of fruits per plant (table 7). A small number of female flowers will give a little amount of fruit too, but a large number of female flowers may not necessarily produce a lot of fruit, all depends on the process or obstacles that occur during pollination and the environmental factors during the formation and ripening of fruit [22]. During the development of flowers into fruit, many factors prevent the formation of flowers into fruit, including pests and diseases, flower loss, and pollination.

The combination of Organonitrofos and inorganic fertilizer had a significant effect on the length of the cucumber but did not significantly affect the diameter of the cucumber. The treatment of inorganic fertilizers without Organonitrofos (P1) fertilizer has the highest length and diameter of cucumber but is relatively not significantly different from the treatment of Organonitrofos fertilizer and its combination with inorganic fertilizer.

The combined treatment of organonitrofos and inorganic fertilizers has a significant effect on the yields of cucumber. The P4 treatment (100% Organonitrofos + 50% NPK) was able to provide the highest cucumber production of 5,732 g plant^{-1} which was relatively different from the other combination treatments and the treatment of inorganic fertilizers only (P1). The high yields achieved with the best-combined dose namely P4 treatment (100% Organonitrofos + 50% NPK) that have given optimal results based on the description of cucumber varieties of Mercy F1, where these varieties have an average production yield of 3,500 to 5,000 g plant^{-1}.

Table 7. Effect of a combined Organonitrofos and inorganic fertilizer on cucumber yields.

Treatment	Number of Fruits per Plant	Fruit Length (cm)	Fruit Diameter (cm)	Average Fruit Weight (g)	Fruit Weight per Plant (g plant^{-1})
P0	7.3 c	20.3 c	4.4 b	198.1 d	14689 c
P1	23.7 a	25.1 a	4.9 a	287.1 a	5682 a
P2	13.0 bc	22.0 bc	4.6 ab	233.1 cd	3335 bc
P3	14.3 bc	23.0 ab	4.6 ab	236.8 bcd	3287 bc
P4	23.0 a	24.8 a	4.8 a	277.1 ab	5732 a
P5	16.0 ab	23.5 ab	4.7 a	254.5 abc	3923 ab
P6	17.0 ab	23.6 ab	4.6 ab	276.8 ab	4556 ab
P7	21.3 ab	24.9 a	4.8 a	280.5 a	5214 ab
P8	20.0 ab	25.1 a	4.6 ab	267.0 abc	4925 ab
P9	21.0 ab	25.1 a	4.7 a	278.5 ab	5468 a
P10	19.0 ab	25.2 a	4.8 a	276.5 ab	4859 ab

* The numbers followed by the same letter are not significantly different from the DMRT test at the 5% level.

Table 8. The calculation of Relative Agronomic Effectiveness (RAE) on total biomass.

Treatment	Stover Weight (t ha^{-1})	Cucumber Weight (t ha^{-1})	RAE of Biomass Total (%)
P0 (0% Organonitrofos + 0% NPK)	0.50	25.0	0
P1 (0% Organonitrofos + 100% NPK)	1.35	96.6	100
P2 (100% Organonitrofos + 0% NPK)	0.64	56.7	44
P3 (100% Organonitrofos + 25% NPK)	0.73	55.9	43
P4 (100% Organonitrofos + 50% NPK)	1.43	97.4	101
P5 (100% Organonitrofos + 75% NPK)	0.98	66.7	58
P6 (100% Organonitrofos + 100% NPK)	1.21	77.5	73
P7 (25% Organonitrofos + 75% NPK)	1.48	88.6	89
P8 (50% Organonitrofos + 75% NPK)	1.24	83.7	82
P9 (75% Organonitrofos + 75% NPK)	2.46	93.0	97
P10 (50% Organonitrofos + 50% NPK)	1.15	82.6	80

Note: If the RAE value is ≥ 100%, the fertilizer tested is effective compared to the recommended standard fertilizer treatment.

Based on RAE calculations, an agronomically effective fertilizer treatment compared to standard fertilizer treatment, which has an RAE value greater than 100% can be seen in the P4 treatment (100% Organonitrofos + 50% NPK) (table 8). Score of *Relative Agronomic Effectiveness* (RAE) was obtained from the comparison between the increase in yield due to the use of testing fertilizer and the increase in yield on standard fertilizer multiplied by 100%. The P0 treatment (0% Organonitrofos + 0% NPK) as a control and P1 (0% Organonitrofos + 100% NPK) as a standard fertilizer treatment. Based on Table 8, the P4 treatment (100% Organonitrofos + 50% NPK) is the most effective combination because it has the highest RAE value of 101%. The RAE value is relatively not different from the standard P1 fertilizer treatment (0% Organonitrofos + 100% NPK) due to the total biomass in the form of dry stover weight and the total weight of cucumber produced in P1 treatment (0% Organonitrofos + 100% NPK). It is also relatively not different from the treatment of P4 (100% Organonitrofos + 50% NPK). A single dose of 5 t ha^{-1} Organonitrofos fertilizer is recommended for cucumber farmers because it is the most effective dose agronomically (Relative Agronomic Effectiveness), economically and can create sustainable agriculture [17].

Table 9. Correlation between some soil chemical properties after harvesting and an average weight of cucumber, cucumber yields, and dry stover weight.

Variable	Equation	r
Soil pH with Average Fruit Weight	y = 0.075x + 0.720	0.71 **
Soil pH with Fruit Yields	y = 52.59x + 395.6	0.62 *
Soil pH with Dry Stover Weights	y = 1.017x + 7.402	0.50 ns
Soil Total-N with Fruit Weight	y = 0.347x + 0.224	0.27 ns
Soil Total-N with Fruit Yields	y = 339.0x + 39.73	0.32 ns
Soil Total-N with Dry Stover Weight	y = 3.625x + 0.822	0.14 ns
Soil Available- P with Average Fruit Weight	y = 0.001x + 0.180	0.75 **
Soil Available- P with Fruit Yields	y = 1.291x + 11.97	0.73 **
Soil Available- P with Dry Stover Weights	y = 0.020x + 0.199	0.48 ns
Soil Organic-C with Fruit Average Weight	y = 0.053x + 0.194	0.30 ns
Soil Organic-C with Fruit Yields	y = 57.95x + 2.699	0.41 ns
Soil Organic-C with dry stover weights	y = 1.197x – 0.293	0.35 ns

* = significantly different at the 5% level.
** = significantly different at the level of 5% and 1%.
ns = not significantly different at the 5% level.

Based on the results of the correlation analysis (table 9), there is a correlation between soil pH with the average fruit weight and fruit yields. Likewise, there is also a correlation between soil available-P with the average fruit weight and fruit yields. The pH value affects the availability of nutrients in the soil. If the soil pH is around 5.5 (the minimum limit) and 7.5 (the maximum limit), it is still tolerant for cucumber plants to have good growth and produce optimal yields [10]. The content of soil available-P after harvesting has increased from the initial value before planting, this causes the number of fruit produced and cucumber fruit yields also increased. The P element is useful for plants to stimulate growth, especially the roots so that plants can develop properly because they can get optimal nutrients. Also, the P content has functions to accelerate flowering and fruit formation [23], so that a high P content in soil can increase fruit yield of cucumber plants.

Based on the present study it can be stated that Organonitrofos fertilizer at a dose of 25% to 100% and its combination with inorganic fertilizer from 50% to 100% are the best range combination dose for the growth and yields of the cucumber plants that can reach yields as many as 3,923 g $plant^{-1}$ to 5,732 g plant^{-1}. The most effective agronomically dose is found in the treatment of P4 (100% Organonitrofos + 50% NPK) because it has an RAE value greater than 100% that is equal to 101% (table 8). It showed that the recommended dose has increased yield compare to the standard fertilizers. Besides, the highest marginal rate of return for tea production on Ultisols was obtained from the application of 50% FYM (farmyard manure) + 50% recommended nitrogen and phosphorus fertilizer [24].

4. Conclusions

The combination of organonitrofos and inorganic fertilizers increased soil pH and soil available-P of Ultisols. The improvement of soil pH and soil available-P were also affected by the application of dolomite as a basalt treatment. Moreover, there was a significant correlation between soil pH and soil available-P with average cucumber fruit weights and fruit yields. Furthermore, the combined dose of organonitrofos and inorganic fertilizer significantly increased all growth and yield variables of cucumber plants compared to control (without fertilizer) and Organonitrofos only. The treatment of 100% Organonitrofos and 50% NPK fertilizer were the most economically effective dose due to the highest RAE value of 101%. The application of Organonitrofos fertilizer could reduce the use of NPK fertilizer by 50%.

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