

## Effects of Lime combined Trichomix Fertilizer on Soil particularities and productivity of Chilli

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### Abstract

The good quality and high yield is the main target of agricultural production. Direct and indirect effects of lime, bio-organic and inorganic fertilizers have significantly been a relation with the soil fertility and crop inputs. The main objective of study finds out effects of NPK with lime and Trichomix amendment on soil chemical particularities and output of chilli. Field experiments were carried out in Cho Moi district with five treatments of organic fertilizer (processed 2.0 tons Trichomix per ha), lime (2.0 tons CaO per ha) and three different ratios of NPK fertilizer (90N-60P-60K kg/ ha) were rated on soil particularities and chilli production. As a result, the co-application of 2.0 tons CaO. ha<sup>-1</sup> + 2.0 tons Trichomix per ha +NPK increased the chemical parameters of soil and yield at all treatments. Whereas, the application of 2.0 tons CaO or 2.0 tons Trichomix only per ha exhibited a lower yield. The highest chilli production, which was obtained at the co-applied treatment of NPK with lime and Trichomix compared to the NPK treatment. Positive impacts of lime and Trichomix amendment on total N, available P, exchangeable K and organic matter were clearly proved in different application ratios. Co-application of Trichomix and lime with NPK increased the chilli yield from 14.0 % at C1 (only NPK); 53.7% C2 (only CaO) and 68.6% C3 (only Trichomix) compared to C5 (2.0 tons Trichomix/ha + 2.0 tons CaO/ha + NPK). It should be recommended for farmers to use the lime and Trichomix amendment combined with NPK fertilizers to improve the crop fertility and chilli production.

**Keywords:** Chilli; Trichomix; NPK, lime; productivity

### 1. Introduction

Chilli (*Capsicum frutescens* L.), which has really been one of popular spices in Viet Nam, has had commercial high value crops in An Giang. Chilli has cultivated widely on a commercial scale in Mekong delta. The whole area of chilli cultivation in An Giang is 1.500 per ha with an annual production of 7.46 tons (Chuong, 2019). The cultivated soil is increasingly depleted of nutrients due to abuse inorganic fertilizers and lack of technology for production. For these reasons, the chilli yield and profit have been decreasing yearly (Chuong, 2019; Khaitov et al., 2019). A long term use of inorganic fertilizers, which caused to reduce soil fertility and crop yield influenced the agricultural soil degradation and polluted environment (Adhikari et al., 2016). The lime and bio-organic fertilizers has significantly been the best solution to improve soil fertility and increase crop productivity. Therefore, the application of inorganic fertilizer combined with the different lime ratios and bio-organic fertilizers amendment were performed to understand these effects on the growth, yield and quality of chilli (Vimala et al., 2007). Among the various factors affecting the growth and productivity of chilli, the

fertility of the soil is the prime consideration for increasing the crop production. Improvement in growth and yield can be brought about by the application of different doses of essential nutrients (Khaitov et al., 2019; Kareem et al., 2007). Poultry manure application had significantly increased on yield and yield components of the maize (Kareem et al., 2007). The combined application of bat manure and lime showed positive influences on soil fertility and rice yield (Nguyen Van Chuong and Tran Van Cuong, 2021). The amendment of four tons lime (CaO) and five tons cow manure per ha had advantageous impacts of soil acidity and increased soil available nutrients (Abdissa et al., 2018). Many ways to increase the quality and quantity of chili pepper plant, one of them is by doing cultivation techniques improving. The co-application of lime and bio-organic fertilizer, which ameliorated soil texture as well as supply macro and micronutrients needed by the chili pepper, increased the yield of chilli compared to the inorganic treatment (Yuliana et al., 2018; Chuong, 2019). The paper presents the nutrient content and increases soil fertile responses of chilli by lime, bio-organic and inorganic fertilizers, with the objective of obtained results on the fertilizer requirement for conventional as well as for co-application of bio-organic production of chilli in Viet Nam.

## 2. Methodology

### Material

Chilli 04 was collected from Chanh Phong Company. Trichomix was kindly obtained from the Biofertilizers Production Unit, Dien Trang company, An Giang province, Vietnam.

### Located site and Experimental setup

The study is experimented at field in Cho Moi district, An Giang province. The study was performed with five treatments and four repeats. The experimental sites, which was located the field included all 5 treatments: C1(control): applied belong to farmers (90N-60P-60K kg per ha), C2 (2.0 tons CaO/ha + 2.0 tons Trichomix/ha), C3 (2.0 tons Trichomix/ ha), C4 (NPK+2.0 tons Trichomix/ha) and C5 (2.0 tons CaO/ ha + 2.0 tons Trichomix/ha + NPK) (Table 1).

The irrigated water used the river water and the whole area of study was to 200 m<sup>2</sup> (5 treatments x 4 repeats x 0.5m in width x 20m in length), a distance of plants is 30 cm in length (two seeds per orifice), the distance of rows was 50 cm. Application of NPK was applied for 90 kg N, 60kgP, 60kg K per ha (Chuong, 2019). The NPK fertilizers, which were NH<sub>4</sub>NO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub> and KCl. Fifteen days before planting, the whole lime and Trichomix was applied except NH<sub>4</sub>NO<sub>3</sub> for applying in two applied times. Fifty percent of NH<sub>4</sub>NO<sub>3</sub> was applied Fifteen days before seeding and the 50% for 60 days after Seeding. The fresh yield of chill that collected hectare were recorded and statistically analysed.

**Table 1.** Different fertilizers of five treatments

| Treatments   | Fertilizers          |    |    |                       |      |
|--------------|----------------------|----|----|-----------------------|------|
|              | Inorganic<br>(kg/ha) |    |    | Bio-organic<br>(t/ha) | Lime |
|              | N                    | P  | K  | Trichomix             | CaO  |
| Control (C1) | 90                   | 60 | 60 | 0                     | 0    |
| C2           | 0                    | 0  | 0  | 2.0                   | 2.0  |
| C3           | 0                    | 0  | 0  | 2.0                   | 0    |
| C4           | 90                   | 60 | 60 | 2.0                   | 0    |
| C5           | 90                   | 60 | 60 | 2.0                   | 2.0  |



Fig. 1. The map of study location

### Land preparation and soil analysis

Soil samples, which were collected at 20 cm in depth were taken twice (the first and end of the experiment). Soil samples, which was treated according to methods of central laboratory of An Giang university analysed soil particularities (OM, available P, total N and exchangeable K ) was determined the method of Walkley and Black, (1934) and the soil pH by pH meter.

Table 1. Soil particularities before the experiment

| No. | Details                              | values |
|-----|--------------------------------------|--------|
| 1   | pH <sub>H2O</sub>                    | 5.20   |
| 2   | Total N(%)                           | 0.112  |
| 3   | Available P (mg.100g <sup>-1</sup> ) | 50.1   |
| 4   | Exchangeable K(mg.kg <sup>-1</sup> ) | 240    |
| 5   | OM (%)                               | 1.08   |

### 3. Results and discussion

**pH:** soil pH (Table 2) was shown the quite suitable for the growing of chilli (pH = 5.13-5.28). The soil pH after of the experiment, which was significantly increased higher than that of pH before of the experiment, ranged from 5.67 to 6.99 and significant differences (5%). The maximum pH reached at C5 (6.99) and minimum at C3 (5.47) after of pH after of the experiment. According to (Santri et al., 2002), pH increased significantly from 5.67 (control) to 6.99 (co-application of lime, trichomix and NPK)at the end of experiment. Ten days of lime amendment, the pH value of soil increased due to Soil neutralization reaction with the lime. Amendment treatments of lime, bio-organic and NPK fertilizer had increased a pH value from 3.47 to 4.79 after 14 days of application (Mkhonza et al., 2020; Chuong, 2019).

Table 2. Impacts of Trichomix and lime on pH, OM of experiment soils

| Treatment                | pH                 |                    | %OM    |                   |
|--------------------------|--------------------|--------------------|--------|-------------------|
|                          | Before             | After              | Before | After             |
| C1                       | 5.18 <sup>b</sup>  | 5.67 <sup>c</sup>  | 1.15   | 1.34 <sup>e</sup> |
| C2                       | 5.30 <sup>a</sup>  | 6.65 <sup>b</sup>  | 1.17   | 1.54 <sup>c</sup> |
| C3                       | 5.13 <sup>b</sup>  | 5.47 <sup>c</sup>  | 1.14   | 1.43 <sup>d</sup> |
| C4                       | 5.24 <sup>ab</sup> | 6.78 <sup>ab</sup> | 1.15   | 1.63 <sup>b</sup> |
| C5                       | 5.28 <sup>a</sup>  | 6.99 <sup>a</sup>  | 1.14   | 1.90 <sup>a</sup> |
| <i>F</i> <sub>test</sub> | *                  | *                  | ns     | *                 |
| CV(%)                    | 0.86               | 2.50               | 2.75   | 3.50              |

\* ns: insignificant differences at 5 %; (\*):significant differences at 5 %

**Organic Matter (OM):** The Table 2 result, which was presented the highest soil organic matter content (1.90%) after of experiment was obtained by the limie combined Trichomix and NPK treatment when

comparing to other treatments. While the minimum content (1.34%) was reached by the C1 treatment (Table 2). The organic matter of chilli ranged from 1.14% to 1.17% before of the experiment and was insignificant differences at 5%. Furthermore, The reaction between lime and Trichomix was significant at 5% after of the experiment (Table 2). The highest OM percentage (1.90%) was reached by the C5 treatment having 2.0 tons CaO/ha + 2.0 tons Trichomix per ha + NPK followed by C4 (NPK+2.0 tons Trichomix/ha). The organic matter all the lime and Trichomix management was almost increased except control treatment (C1). Many researchers have presented that soil OM, which was a important nutrient source of agricultural soil related to soil fertility and crop yield, especially in hot and humid tropical conditions (Zao et al., 2020). Bio-organic manures increased the soil fertility and soil OM (Prasad et al., 2009).

**Total Nitrogen (N):** The crop yield has determined by nitrogen, which is a nutritional element to growth plants. Each type of N in soil depends on the organic content in soil. The soils contained the high level of humus and it also had the high N concentraion (Prasad et al., 2009). The total N values of soils after of the experiment range from 0.110% (C3) to 0.154% in C5 treatment. The highest total nitrogen (0.54%), which was produced C5 treatment at harvest was the best value of lime and Trichomix amendment for the soil N. The minimum total N content was 0.110% in the control treatment (only NPK). The effects of lime and bio-organic manures on the soil N mineralization and available P may be produced a large amount of humus in soils. The higher nitrate-N value of lime amended treatment reached than other treatments (Mkhonza et al., 2020).

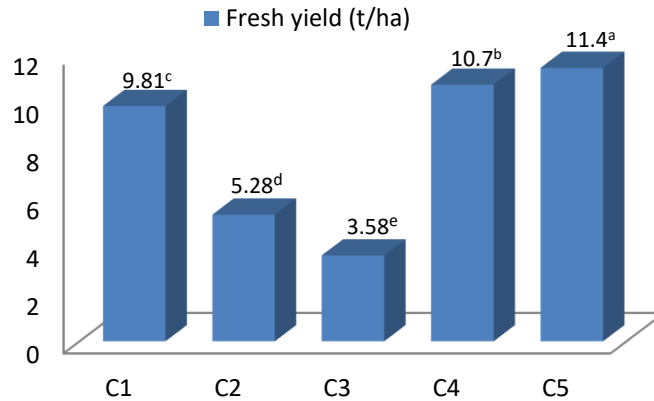
**Table 3.** Total N, available P and exchangeable K of the experimental soil

| Treatments    | Total N (%) |                    | Available P (mg/100g) |                   | exchangeable K (ppm) |                  |
|---------------|-------------|--------------------|-----------------------|-------------------|----------------------|------------------|
|               | Before      | After              | Before                | After             | Before               | After            |
| NT1 (Control) | 0.103       | 0.110 <sup>d</sup> | 37.8 <sup>c</sup>     | 52.0 <sup>d</sup> | 246 <sup>a</sup>     | 316 <sup>c</sup> |
| NT2           | 0.105       | 0.125 <sup>c</sup> | 46.7 <sup>a</sup>     | 72.7 <sup>c</sup> | 236 <sup>bc</sup>    | 341 <sup>b</sup> |
| NT3           | 0.102       | 0.129 <sup>c</sup> | 37.2 <sup>c</sup>     | 40.4 <sup>e</sup> | 245 <sup>ab</sup>    | 268 <sup>e</sup> |
| NT4           | 0.105       | 0.142 <sup>b</sup> | 41.6 <sup>b</sup>     | 87.2 <sup>b</sup> | 238 <sup>bc</sup>    | 397 <sup>a</sup> |
| NT5           | 0.104       | 0.154 <sup>a</sup> | 40.7 <sup>b</sup>     | 91.4 <sup>a</sup> | 218 <sup>d</sup>     | 292 <sup>d</sup> |
| $F_{test}$    | ns          | *                  | *                     | *                 | *                    | *                |
| CV(%)         | 2.40        | 3.60               | 4.04                  | 2.96              | 6,49                 | 1,65             |

\* ns: insignificant differences at 5 %; (\*): significant differences at 5 %

**Available Phosphorous (P):** The result in Table 3 show that available P in soil before and after of the experimental are significant differences at 5%. The soil available phosphorus increased the after of the experiment of all treatments (Table 3). Available P level ranged from 41.4 to 91.4 mg.100g<sup>-1</sup>. Available P, which had high values in all treatments were shown at co-application treatments of NPK, lime and Trichomix (C4 and C5) except for C1, C2 and C3 treatments. The available P content after of experiment in NT5 was the highest compared to other treatments. Many prior studies showed that P contents of bio-organic manures affected the soil available P after a long term of organic manure application. Because the soil OM that will be degraded by soil microorganism was clearly free the available P into soil solution, reduced P adsorption and increase available P in soil (Abdissa et al., 2018; Zhao et al., 2020).

**Exchangeable Potassium (K):** From the analysis data in Table 3 shows that exchangeable K of soil samples were significant differences at 5%. exchangeable K in all treatments ranger from 2.68 ppm (C3) to 397 ppm (C4) . After of the experiment, the C4 treatment had the highest exchangeable potassium (397 ppm). On the other hand, the lowest exchangeable potassium (268 ppm) was recorded by only using Trichomix (C3) and significant differences compared to others (Table 3). the exchangeable potassium of all treatments was significant differences at 5%. The Exchangeable K uptake of crops were related to exchangeable K in crop soils (Ullah et al., 2020). According to (Prasad et al., 2009), bio-organic and organic fertilizer is a natural source of humic for plants and soils. The humic substances have presented in almost all soils in the small form of potassium humate, potassium fulvates and humins. Naturally occurring humic substances from low grade lignites and leonardites are the best fertilizer ingredients, use or organic fertilizer leads to risk of xenobiotic compound (Ullah et al., 2020; Meena et al., 2020; Brtnicky et al., 2019). In genarally, The organic manure amendment raised exchangeable K, available P and total N values at all field and nethouse conditions. The co-application of lime, bio-organic manure improved soil nutrients and crop yield in crops (Khaitov et al., 2019; Flores et al., 2009; Ullah et al., 2020).



**Fig. 2** Fresh yield of chilli

Significant differences (Fig. 2) among the rates of lime, Trichomid and NPK were statistically significant in the average fresh yield of chilli. The C5 treatment consisting of 2.0 tons CaO/ha + 2.0 tons Trichomid/ha +NPK exhibited the highest yield of chilli (11.4 tons/ha). Whereas, the minimum yield of fresh chilli (3.58 tons/ha) was recorded at the C3 treatment, which was only applied 2.0 tons Trichomid. ha<sup>-1</sup>. The flowing low yield of chilli (5.28 tons/ha) that was the C2 treatment was applied 2.0 tons CaO/ha. The prior study of Shree et al., (2018) has proved that co-application of different organic manures and chemical fertilizers raised significant a large number of female flowers, fruits per plant, fruit weight and yield. The chilli was significantly developed under application of NPK, lime combined bio-organic fertilizer, which increased fruit weight and fruits per plant. The highest yield of fruit per plant was attained under the combined use of lime, inorganic and inorganic fertilizer (Shree et al., 2018; Jadczyk et al., 2010; Chuong, 2019).

#### 4. Conclusion

The beneficial effects of lime, bio-organic fertilizer combined with NPK were significantly shown the improvement of the soil fertility and chilli yield. The amendment of 2.0 tons CaO. ha<sup>-1</sup> + 2.0 tons Trichomix per ha combined with NPK application increased chemical parameters of soil and yield at all treatments. Whereas, the application of 2.0 tons CaO. ha<sup>-1</sup> or 2.0 tons Trichomix per ha exhibited a low yield. Therefore, co-application of lime, bio-organic and NPK is considered the optimum for the maximum total N, exchangeable K, available phosphorous and organic matter content of crop soil.

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