# The effectiveness of compost and manure on hot chili production in North Sulawesi

*Ibrahim* Erik Malia[1,*], *Janne* H.W. Rembang[2], and *Herlina* Nanny Salamba[1]

[1] Research Center for Horticultural and Estate Crops, National Research, and Innovation Agency, 10250 Jakarta, Indonesia
[2] Research Center for Food Crops, National Research, and Innovation Agency, 10250 Jakarta Indonesia

**Abstract.** North Sulawesi is Famous as spicy culinary in Indonesia, therefore hot chili become the most important vegetable commodity in this region. An experiment to observe the influence of compost and manure on hot chili production has been conducted at Pandu Experimental Station in January to September 2018. The treatments were designed into RCBD proceeded to the Least Significant Difference Test (LSD test). Six treatments were applied, Control, without fertilizer; Inorganic fertilizer; Compost; Manure; Compost +inorganic fertilizer and Manure + inorganic fertilizer. The main parameter tested is the fresh fruit weight shown that the best treatment obtained is the treatment compost+ inorganic fertilizer, the total fresh weight gotten within 8 months productive age is 742 gr per plant, followed by the Manure + inorganic 696 gr per plant, these significantly higher than other treatments. The compost treatments are relatively better than the commercial manure due to its well decomposition of compost compared to the commercial manure. Financially, the farming also is feasible where R/C Ratio were above 1.2. The R/C Ratio were 2.83; 2.42 and 1.41 respectively for treatment E, B and A.

## 1 Introduction

Hot chili (*Capsicum annum*, L) is one of the important seasonal fruit crops and is known as a complementary food for warming and complementing the taste of typical food in Indonesia, besides having high levels of vitamins C and A [1]. People in North Sulawesi are generally more interested in hot chili than the common bigger size consuming by another place in Indonesia. This vegetable commodity is always associated with the life of the people in this area. Almost every household dish in North Sulawesi, especially from the Minahasa ethnic group, uses hot chili in their daily menu. The main problems faced by chili farmers are low productivity, short productive life, and high price fluctuations.

*Rawit* chili harvested area in North Sulawesi is 1198 ha, productivity is 3.45 tons/ha, total production is 4,132 tons/year [2]. This area is an accumulation of the area of chili land ownership per family of farmers, most of which are small scale or in addition to the plantations of the main commodities cultivated such as coconut, cloves, corn and so on.

* Corresponding author: erikmalia08@gmail.com

This causes farmers to rarely use chili as the main commodity that their families cultivate, even though the potential is available.

One of the main problems in hot chili development in North Sulawesi is the less application of appropriate fertilizing. The farmers don't have enough knowledge to apply balancing fertilizer. It is also supported by the expensive of inorganic fertilizers and sometimes difficult to find in local market. The problem may solve by optimalization of local sources such as organic fertilizer. Farmers usually use commercial manure taken from the poultry in the country. They buy and directly use in their farming system. There is possibility of contaminating manure used in their application, therefore, it is needed to examine the good formula of the organic fertilizer. Therefore, this research was conducted to study the effect of compost and manure on hot chili production and its financial feasibilities.

## 2 Methods

The research was carried out in January to October 2019 in Pandu Experimental Station, Manado North Sulawesi. Altitude of 50 m above sea level, where in the soil classified as Latosol.

The design used was a Randomized Completely Block Design (RCBD). Then the Least Significant Difference Test (LSD) was used for mean separations. Significantly, was determined at the $p$=0.05 probability level. The experiment consists of 6 treatments and 6 replications. The treatments were:

A = Control, without fertilizer
B = Inorganic fertilizer
C = Compost
D = Manure
E = Compost + inorganic fertilizers
F = Manure + inorganic fertilizer

The seed used was commercial seed, called Sret. It's grown in nursery 3 weeks before planted in experimental plots. Each plot was designed in 5 x 5 $m^2$ square, divided into 3 planting beds. The beds area 0.5 m x 5 m and distance between the bed 100 cm, and 50 cm in height.

All inorganic fertilizer used recommendation from Research Institute for Vegetables (Balitsa), namely, 180 kg N, 92 kg $P_2O_5$ and 150 $K_2O$ [3]. Organic treatments use 1.8 kg / plant, equal to 20 ton/ha.

The agronomic parameters examined are plant height, percentage of plant stay life in certain age, and productivity. Financial analysis was used to determine the financial feasibility of using organic fertilizer of chili-based farming systemin North Sulawesi. The financial analysis used were Return Cost Ratio Analysis (RC/Ratio), Break Even Point and the Sensitivity Analysis.

### 2.1 Return Cost Ratio Analysis (RC/Ratio)

Cost ratios were calculated with following formulae suggested by Mahajan, G., 2017) Gross return = Monetary value of crop produced Net return = Gross return – Cost of cultivation

R/C Ratio is a ratio of revenue and production cost formulated as follows:

$$R/C\ Ratio = TR/TC \quad (1)$$

Furthermore, Siregar dan sumaryanto [4], stated that agribusiness of a commodity is concluded feasible if net income at least 20% of total cost. Therefore, feasibility categories by using RC/Ratio analysis as follows notifications:

1. R/C Ratio >1,2: meaning the agribusiness efficient as well as giving a feasible benefit.
2. 1<R/C Ratio<1,2: meaning the agribusiness is not efficient yet, or this profitable but the profit is not feasible yet
3. R/C Ratio <1: meaning the agribusiness is not feasible
4. R/C Ratio = 1: meaning the agribusiness is getting break event point

### 2.2 Break Even Point

Break Even Point, consist of break even in production and break even in price. The analysis is used to determine the tolerance of production or product price decreasing where the business is still profitable. The break evens are calculated as follows [5]:

$$BEP\ in\ production = Cp/Pc \quad (2)$$

$$BEP\ in\ price = Cp/Pt \quad (3)$$

Where, *Pc* was product price; *Pt* was production; *Cp* was production cost (fixed cost and variable cost)

### 2.3 Sensitivity Analysis

In Agribusiness, the profitability is usually determined by two factors, such as total gain and price. The factors are sensitive to change due to environmental factors like climate, pest and disease. Moreover, total outputs are generally sensitive in changing due to environment factors, such as climate, pest and disease. Meanwhile, price is sensitive due to availability stock, fruit seasons or its competitiveness to other fruits. Therefore, sensitivity analysis was conducted in two methods: (a) changing the important variables, (b) determining, how deep the changing until the project be infeasible [1].

## 3 Results and discussions

The results of physical treatments are shown in Table 1 and Table 2, while the financial analysis was shown in Table 3. Plant height was observed in the age 3 month after planting (map) due to its alteration phase from vegetative to the generative growing. The fertilizer effects of both inorganic and organic fertilizer as well as their combination were significant on plant height, where the unfertilized treatment was shorter than other treatments. That is showing the fertilizers need in agricultural production [4,6,7].

Since the plant starting harvested in 90-100 dap, the measurement of products accumulated in 120dap as well as determining the survival productive plants. The productive plants number in that time of the unfertilized treatment A is only 78% compared with all treatments of fertilizing plants, namely above 90%. The treatments B until F, all fertilizing treatments were not significantly different among the treatments, meaning in the certain age, kind or specification of fertilizers were still not different in influencing the vigor and the growth of hot chili in this area. The trend was continued to the age 150 dap, but in the age 180 dap, there were different effects among the fertilized treatments (B, C, D, E and F). The treatment B, inorganic fertilizer only shown that in this age, the survival plant decreases in percentage became 68%, while the other four fertilized treatment still high, 78% and above.

**Table 1.** Plant height and Percentage of plant stay life in certain age, in days after planting (Dap).

| Treatments | Plant height at 90d ap (cm) | Percentage of plant stay life in certain age (dap) | | | | |
|---|---|---|---|---|---|---|
| | | 120 | 150 | 180 | 210 | 240 |
| Control | 51.33 a | 78 a | 68 a | 58 a | 36 a | 0 a |
| Inorganic fertilizers | 66.67 b | 92 b | 91 b | 65 b | 52 b | 5 b |
| Compost | 63.23 b | 90 b | 90 b | 78 c | 66 d | 38 d |
| Manure | 59.67 b | 93 b | 92 b | 80 c | 60 c | 32 c |
| Compost + inorganic. Fert | 61.60 b | 93 b | 91 b | 88 d | 86 f | 73 f |
| Manure + inorganic fertilizer | 64.03 b | 94 b | 90 b | 78 c | 80 e | 64 e |

Means followed by different letters are significantly different (LSD test=0.005)

The treatment E, the applied compost combined with inorganic fertilizer shown its advantage, where the survival plant 88% is higher even with other fertilized treatments.

In this result also can be seen that the composting organic fertilizer is better affecting chili growth than usual manure. In may be related to the manure usually used by farmers is not perfect fermented yet, compared to the better composting one. Beside containing macro and micro-nutrients, organic matter in compost pay role in absorption of main nutrients, such as N, P, K and micro-nutrients [8].

**Table 2.** Productivity of hot chili influenced by inorganic and organic fertilized.

| Treatments | Hot pepper productivity (gram/plant)/periods (dap) | | | | | |
|---|---|---|---|---|---|---|
| | 120 | 150 | 180 | 210 | 240 | Total |
| Control | 59 a | 122 a | 99 a | 40 a | 0 a | 320 a |
| inorganic fertilizers | 99 c | 126 ab | 144 c | 121 c | 28 b | 618 d |
| Compost | 88 b | 128 b | 125 b | 130 d | 93 c | 564 c |
| Manure | 90 b | 118 a | 119 b | 107 b | 86 c | 520 b |
| Compost + in. Fertilizers | 108 c | 156 c | 152 c | 177 f | 149 f | 742 f |
| Manure + in. fertilizer | 101 c | 163 c | 150 c | 145 e | 138 d | 697 e |

Means followed by different letters are significantly different (LSD Test, $\alpha = 0.05$)

Furthermore, in Table 2 were shown that the harvest started from the age 75 DAP, and it was accumulated in the first period 75 – 120dap. The role of inorganic fertilizer was still dominant both with or without compost and manure combination. In the next duration 150-180, the accumulation of chili production was more various affected by the treatments observed. The unfertilized was remained lowest, but the advantages of inorganic fertilizer were important until this certain age. Application of both compost and commercial manure produced lower hot chili than the application of inorganic even on single dosage (without combination with manure or compost). Moreover, the treatment B (inorganic fertilized) shown that there was not significantly different in chili productivity with the treatments E (compost+ inorganic fertilizer) and F (Manure+ inorganic fertilizer), meaning the importance of organic fertilizer was not identified yet in this certain age. On the other hand, the advances of the organic fertilizer were shown in the periods of 180-210 dap and 210-240 dap, where the treatments produced hot chili higher than inorganic fertilizer, compost, and manure single dosage. Whereas the combination of organic and inorganic formulations was the best treatment. Furthermore, the compost was better than commercial manure even in combination with inorganic fertilizer. It is related to the source of the organic matters which is used, the compost is prepared perfectly while the commercial is usually taken directly from the poultry site.

Based on the production of hot chili gotten by compost treatment composted by rice straw, it is also relevant or supported by former research. Supplying husk compost with dosage $\geq$ 2.7 t/ha increased soil organic content 1.40-2.29% in the first week; 1.65-2.37% in the second week and 1.51-1.69% in the third week [9]. Rice straw is a good raw material to

produce compost [10,11]. Rice straw is containing high macro nutrient Potassium (K) and micronutrient Silicon (Si), approximately 80% K absorbed by plant is available in rice straw [12]. Furthermore, Indriyati, et al. [13] stated that composition of rice straw compost consists of N-total 1.08%; P-total 0.17%; K-total 2.70%. The roles of K in a plant are to activate enzyme, opening stomata, physiological process, cell metabolic, influencing other nutrient such a Phosphorus and enhance plant resistance to pest and disease [14]. Soil organic content also affecting efficiency and availability of soil water. In increasing 1% of C-organic can increase 2% water content availability [15].

## Financial Analysis

Financial analysis of hot chili in Manado North Sulawesi is necessary to observe due to the people in this area are famous by their spacy food in many kinds of their menu. Therefore, the price fluctuation always being constraint in its agribusiness especially in farmer level. In this research was analyzed three treatments conducted, representing the control treatment, without fertilizer, then the second is the treatment B, fully inorganic fertilized and treatment E, combination of inorganic fertilizer and compost better than another combination between inorganic and the manure.

The total cost (fixed cost and variable cost). The cost is different due to the material used, especially fertilizer. The unfertilized treatment has the lowest cost needed IDR 56,520,000, followed by treatment B, inorganic fertilizer (IDR 64,020,000), and the highest is treatment E (IDR 56,520,000). In spite of, the costliest treatment is the treatment E, but the income gained is the highest related to its higher productivity.

**Table 3.** Financial analysis of several fertilizer treatments of hot chili farming in North Sulawesi….x IDR 000

| **Subjects** | **Vol** | **Unit** | **Unit Cost** | | **Income** | **R/C ratio** |
|---|---|---|---|---|---|---|
| A. Fixed Cost | | | | | | |
| Hoe, knife, shovel, pipe | 1 | Pack | 4,000,000 | 4,000,000 | | |
| B. Variable Cost | | | | | | |
| *Labor* | 400 | Man | 100,000 | 40,000,000 | | |
| *Materials* | | | | | | |
| Seedling | 8 | sachets | 65,000 | 520,000 | | |
| Fertilizer | | | | | | |
| A = Control | 1 | season | 0 | - | | |
| B = in. fertilizers | 1 | season | 7,500,000 | 7,500,000 | | |
| E = Com.+ in. Fertilizers | 1 | Season | 9,000,000 | 9,000,000 | | |
| Mulching, etc. | 15 | Roll | 800,000 | 12,000,000 | | |
| C. Total Cost Revenue | | | | | | |
| A = Control | 3,200 | kg | 25,000 | 80,000,000 | 23,480,000 | 1.42 |
| B = in. fertilizers | 6,180 | kg | 25,000 | 154,500,000 | 90,480,000 | 2.41 |
| E = Com.+ in. Fertilizers | 7,420 | kg | 25,000 | 185,500,000 | 119,980,000 | 2.83 |

The farming system is feasible based on the financial analysis. The R/C Ratio is very good and feasible in all treatment despite of there is not fertilized by one treatment. The treatment E, the combination of compost and inorganic treatment is again showing the best performance with R/C Ratio 2.83, compared treatment A (control) 1.42 and the treatment B (inorganic).

Break Even Point in production respectively 2,261 kg; 2,561 kg and 2,621 kg for treatment A, B and E. Those mean that this business will still profitable as far as the decrease in production are not reach 2,261 kg; 2,561 kg and 2,621 kg for treatment A, B

and E respectively. Then, Break Even Point in price are IDR 17,663/kg; IDR 10,359/kg and IDR 8,830/kg, respectively for treatment A, B and E. Those mean that this business will still profitable as far as the decrease in price are not reach IDR 17,663/kg; IDR 10,359/kg and IDR 8,830/kg, respectively for treatment A, B and E.

## 4 Conclusion

The compost combined inorganic fertilizer is the best treatment in this growth phase of hot chili. The effects were continued showing in productivity where the advances of the organic fertilizer were shown in the periods of 180-210 dap and 210-240 dap, where the treatments produced hot chili higher than inorganic fertilizer, compost, and manure single dosage. Whereas the compost was better than commercial manure even in combination with inorganic fertilizer. Indeed, the compost perfectly decomposed was better effect on chili growth than commercial manure caused by the manure usually sold in this region may be not decomposed appropriately. It is usually taken directly from poultry site

Financial analysis conducted was relevant to the agronomical treatments above, where the magnitude of the using compost, especially if it is combined with inorganic fertilizer giving good feasibility indicators. The R/C Ratio of treatment E (compost+ inorganic); treatment B(inorganic) and treatment A (without fertilizer) are 2.81; 2.41 and 1.41 respectively. Break Even Point in production respectively 2,261 kg: 2,561 kg and 2,621 kg for treatment A, B and E. Those mean that this business will still profitable as far as the decrease in production are not reach 2,261 kg: 2,561 kg and 2,621 kg for treatment A, B and E respectively. Then, Break Even Point in price are IDR 17,663/kg; IDR 10,359/kg and IDR 8,830/kg, respectively for treatment A, B and E. Those mean that this business will still profitable as far as the decrease in price are not reach IDR 17,663/kg; IDR 10,359/kg and IDR 8,830/kg.

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