Ecological farming using liquid organic fertilizer for improving rubber productivity in South Sumatra

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Abstract. Liquid organic fertilizer (LOF) gains great attention recently for its practical preparation, use and environmental value. Many agricultural waste may be used as raw material, thus in turn may contribute to cleaner and safer agriculture practice. This research aims to compare various sources of agricultural waste applied with two dosages for improving rubber latex production. A field experiment was conducted in Payaramen Timur of Ogan Ilir Regency in South Sumatra using a split design comprising five LOF as main plot (P1 pineapple and watermelon; P2 watermelon; P3 pineapple peel; P4 lemon fruit; P5 cabbage and brassica) and two dosages of application weekly (40 and 50 ml/L). Thirty treeas were used as samples. Latex was collected weekly. Initial results before LOF application indicate a great variation in weekly latex production (12 to 260 gram per tree). After one week average latex production remains low or high being consistent with the initial values. Several tress indicate a sharp increase in latex production being the best by fruit waste compared with vegetable source. The final production may reach 100 to 200 gram per tree weekly. With this limited time of measurement, LOF demonstrates a potential use as provisional source of fertilizer for rubber plantation.

1. Introduction

Rubber plants are plantation commodities that make a major contribution to the Indonesian people's economy, especially farmers in South Sumatra. Based on the report of the Central Statistics Agency (BPS), rubber production in Indonesia reached 3.14 million tons in 2022. Of that number, South Sumatra recorded the largest rubber production, namely 913,400 tons. Rubber production in Ogan Ilir reached 33520 tons or equivalent to 2.78 percent of the total province production with a rubber planting area of around 36616 hectares. This is possible because the area of rubber production is smaller compared to Ogan Komering Ilir Regency, Muara Enim, Musi Banyuasin and Musi Rawas Utara.

In 2017 the productivity of rubber plants on average 1.33 tons/ha/year is targeted to increase to 1.36 tons/ha/year by the end of 2023. However, the productivity of people's rubber or natural rubber is still relatively low. Many studies that show low rubber productivity are influenced by the attack of leaf fall by Colletotrichum or Corynespora cassiicola [1]–[4] and fertilizer nutrients that are less [5]–[8]. Therefore, the strategy to increase the productivity of rubber plants should accommodate the two issues.

Fertilizer still plays important roles in tree crop productivity [9]. One source of fertilizer that is potential to be utilized in increasing plant productivity is liquid organic fertilizer. This fertilizer can be made by utilizing various attention and household or market waste. Many researchers have examined various waste materials including biological waste [5], animal manures, slaughterhouse byproducts, vegetable byproducts, green manure, algae, composts, anaerobic digestates etc [10], biochar [11]–[13], entomocomposting [14], [15]. Liquid organic fertilizer can be used as a fertilizer supplement so as to reduce the cost of plant maintenance.

Liquid organic fertilizer has been widely used in the cultivation of vegetables or horticulture [10], [16]. Its use is still rare in annual plants or industrial plants such as rubber plants [8], [17], [18]. Fertilization is still needed to increase the productivity of rubber plants [9] but farmers still have to get adequate economic benefits for family welfare. Research aims to explore the ability of five kinds of agricultural waste materials to increase the productivity of rubber plants by local farmers.

2. Research methodology

2.1 Liquid organic fertilizer preparation

This research was conducted in Payaraman Timur of Ogan Ilir Regency in South Sumatra. Field experiment was carried in 2022. Thirty trees were selected for trial. The rubber trees were divided into three blocks. The experimental design folllows a split plot treatment. Main plot is fertilizer dosage at two levels (40 dan 50 ml/litre solution) which is applied weekly for four weeks. Subplot is types of liquid organic fertilizer (LOF) made from a mixture of pineapple peel and watermelon (P1), watermelon only (P2), pineapple peel only (P3), lemon fruit (P4), and a mixture of vegetable cabbage and brassica (P5). Figure 1 describes POC preparation, demonstration to local farmers and application to rubber trees.

Figure 1. Liquid organic fertilizer preparation by chopping and weighing agricultural waste and put into digester bucket. After four weeks in process liquid is produced nearly 5 litres as demonstrated to farmers. Fertilizer application to rubber tree weekly.

2.2 Data collection and analysis

POC was applied for individual trees according to treatment codes. For baseline, the first latex was collected for the previous week. Subsequently POC was added in perforated plastic bottles, knotted to trunk and left for one week before next latex collection. There were six times latex collection following the common practice by local farmers. Latex was weighted for individual trees. The collected data were analysed using split plot design where POC was assigned as subplot.

3. Results and discussion

The initial latex production for individual trees (n=30) indicates a great variation with the same rubber species or clones (mean 78.6 and standar deviation 70.7 gram/tree) with a minimum value of 12 and maximum 260 while median of 47 gram/tree. This is a common figure under farmer practice (NR native rubber) in which fertilizer may be under optimum dosage for maintenance due to fertilizer price. Figure 2 shows a wide variation of latex productivity with POC application. A wide-scale study

of NR in Vietnam by [19] concludes that elevation determined latex productivity declines ranging between 117-127 kg with GT1 clone most widely planted.

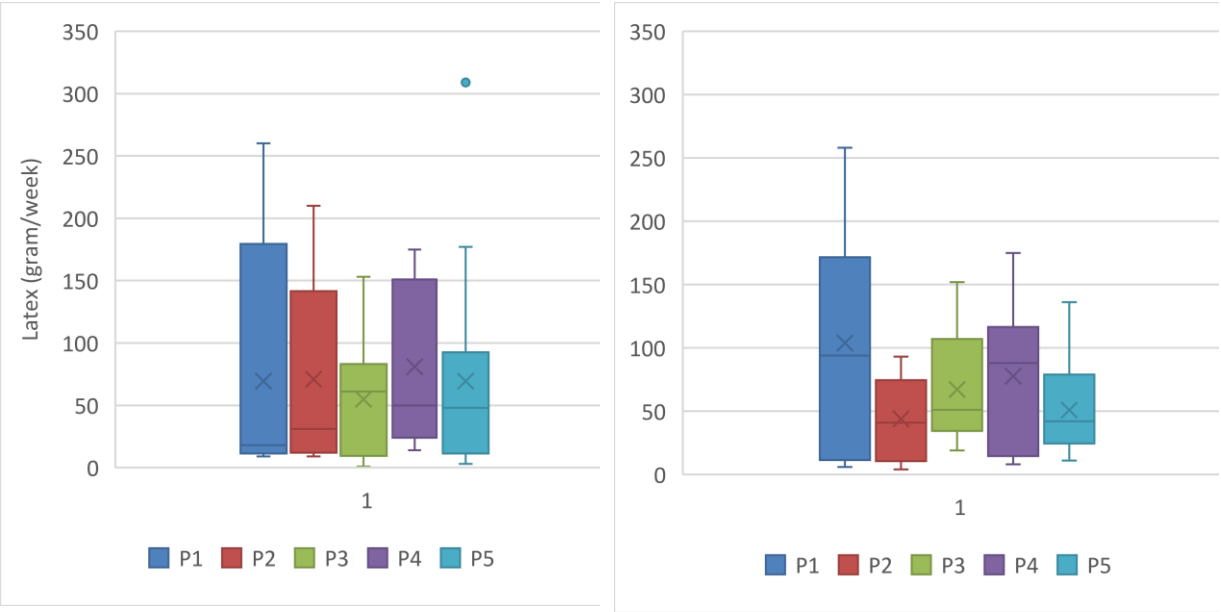

Figure 2. Box plot of latex productivity after POC application at 40 ml/L (left) or 50 ml/L (right) for six weeks. Note a mixture of pineapple peel and watermelon (P1), watermelon only (P2), pineapple peel only (P3), lemon fruit (P4), and a mixture of vegetable cabbage and brassica (P5).

The POC made from pineapple skins (or peel) is likely potential given in the higher dosage (50 ml/L) while as a mixture with watermelon remains similar but widely spread. Likewise, POC of watermelon is better given at lower dosage. Despite local condition latex productivity of NR is commonly lower than estate plantation. An example is provided by [20] with latex productivity reached 1,805; 1,364 and 1,242 kg/ha/year base on production in 2017. The current productivity of local farmers in Payaraman (studied location) is under 1 ton/ha annually.

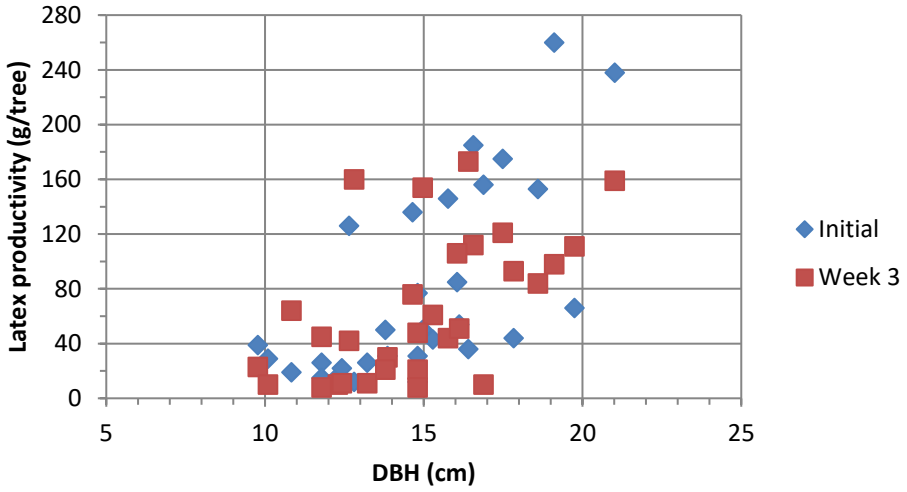

Figure 3. Relation between latex productivity and trunk diameter

It is also interesting to relate latex productivity and trunk diameter. For this research we found a linear trend between two variables (Figure 3). To increase rubber productivity, it is difficult to reduce tapping frequencies, even with ethylene or other stimulation. Local farmers tend to tap everyday. A recently study was conducted to characterize the behaviour of the Hevea latex yield under the double cut alternative tapping system (DCA) which in turn ensure the long-term sustainability [21].

Conclusion

From this study we conclude that POC made from various agricultural wastes including pineapple peels, fruit and vegetables are potential for improving latex productivity. Two benefits fro this work are minimizing waste and reducing fertilizer cost. In turn this work may improve field health and plant sustainability.

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