Akta Agrosia

The Effect of Local Organic Fertilizer from Rubber Processing Waste on the Yield of Rubber Plants

Ernawati Simanjuntak, Prasetyo, Hartal
Department of Agronomy, Faculty of Agriculture, The University of Bengkulu

ARTICLE INFO

Keywords:
rubber sap, waste,
compost fertilizer

Article history:
Received: April 24, 2018
Accepted: June 26, 2018

*Corresponding author:
E-mail: nyoyok@yahoo.com

ABSTRACT

Rubber plant is an important industrial crop, as for economic community and a source of non-oil foreign exchange for the country. In Indonesia, 85% rubber planting area is community rubber plantation with its productivity is still very low (700 - 900 kg ha^{-1} $year^{-1}$), compared to its potential which can be more than 1,500 kg ha^{-1} $year^{-1}$. The low productivity of community rubber plantation is because of the lack of proper handling and maintenance of their plants. Efforts is needed to improve the quality and productivity of community rubber plantation so as to compete in international trade by improvement on planting, maintenance, latex post-harvesting from the garden to the final processing stage. This research utilizes solid waste from rubber processing factory that is local organic fertilizer (LOF) which is usually merely dumped and become source of environment contaminant. The objective of this study was to determine the optimum dosage of rubber mill waste to the yield of rubber plants. The research was carried out at farmer's plantation of Tanjung Tengah village, Sub-district of Pondok Kelapa, Central Bengkulu, from May to August 2016. The experiment was arranged in a Randomized Complete Block Design (RCBD) with four replications and 6 levels of LOF as the treatments i.e. 0, 10, 20, 30, 40 and 50 kg $tree^{-1}$ equal to 0, 5, 10, 15, 20 and 25 tons ha^{-1}, respectively. The results showed that the effect of several doses of organic fertilizer of rubber waste to rubber plants had no effect on latex volume, stem girth, latex weights, latex slab weight, and dry weight. The yield of rubber even tended to decrease as the increase of dose of LOF. This was supposedly because the rubber plant is an annual crop so takes a long time to show the response of the treatment.

INTRODUCTION

Rubber Plant (*Hevea brasiliensis* Muell Arg) is an important industrial crop, both in the economic context of society and as a source of non-oil foreign exchange earned by the country. Rubber commodities as the source of foreign exchange earning countries are recorded that in 2015 exported 2,623,471 tons (BPS, 2016). The expansion of Indonesia's rubber plantation areas continues to increase in 2012 - 2015 by 10.54% or 3.66 million hectares (BPS, 2016). However, Indonesia's rubber productivity is still less than that of neighboring countries such as Thailand with the productivity of 1.9 ton ha^{-1}, Malaysia 1.3 ton ha^{-1} and Indonesia only 1 ton ha^{-1}.

According to Siregar and Suhendry (2013), there is an imbalance of productivity between smallholders, private and state rubber plantations. This is because 85% of rubber plantations in Indonesia are smallholder plantations which have not implemented good cultivation technology, 8% in the form of state plantations and 9% in the form of private plantations that have applied good and correct cultivation technology.

One of the obstacles faced by smallholder rubber plantations is the capital, and farmers who want to take the yield without plant maintenance. Considering these conditions it is very necessary to do research efforts to improve the quality and productivity of latex rubber (latex) by utilizing rubber factory waste as an addition of chemical fertilizers or inorganic fertilizers where inorganic fertilizers are expensive and have negative impacts on environment.

One of the wastes in rubber processing factory is solid waste which has been only dumped. It can be used as fertilizer because in the waste contains high nutrients of N, P and K as an alternative fertilizer available locally called local organic fertilizer (LOF). The industrial solid waste is not necessarily only discarded. The amount of its organic matter makes it possible to be organic fertilizer or compost (Munir *et al.*, 2003). Solid rubber waste is

ISSN: 1410-3354 / e-ISSN:2615-7136

Cited this as: Simanjuntak, E., Prasetyo, Hartal . 2018. The effect of local organic fertilizer from rubber processing waste on the yield of rubber plants. Akta Agrosia 21(1):25-28.

organic waste from the disposal of industrial rubber processing into crumb rubber that contains most of the sand, rubber wood chips, rubber leaves and rubber. The availability of solid rubber waste from rubber mill processing is abundant and potentially has negative impacts on the environment.

One way to overcome the impacts of rubber processing solid waste is composting. The rubber solid waste in addition to containing organic materials, it has not been much studied as organic fertilizer. The advantages of compost fertilizer compared with chemical fertilizer are less expensive, easier to obtain around agricultural land, able to improve soil structure, increase pH, cation exchange capacity or soil anion, soil nutrient element, soil organic matter content, and soil become healthier (Riwandi *et al*., 2012). The objective of this study was to determine the optimum dosage of solid waste of rubber processing mill on rubber yields.

MATERIALS AND METHODS

This research has been carried out at farmer's plantation of Tanjung Tengah village, Sub-district of Pondok Kelapa, Regency of Central Bengkulu, from May to August 2016. The experiment was arranged in a Randomized Complete Block Design (RCBD) with four replications and 6 levels of LOF as the treatments i.e. 0, 10, 20, 30, 40 and 50 kg tree^{-1} equal to 0, 5, 10, 15, 20 and 25 tons ha^{-1}, respectively, so that there were 24 experimental unit plots with 5 plant samples each plot.

The research was started with a soil survey to determine the initial soil fertility conditions following Riwandi (2012 and 2013) and soil analysis of physical properties, chemistry, and soil biology in Soil Science Laboratory. The experimental unit comprised of five sample plants selected randomly.

The compost material was taken from rubber processing waste dumping location and selected the waste which has been of 3-4 years in the location. The compost was made by mixing the compost materials with decomposer EM4 to accelerate decomposition process. The compost was considered mature and ready to use when compost turn black color and odorless.

The selected plants of 8-year-old rubber plant clone PB-260 with a spacing of 6 x 3.1 m was fertilized in accordance with local organic fertilizer (LOF) rate tested. Fertilization was done by making a circular disk of rubber tree trunk with a distance of 1 m from the rubber tree. The disc was hoed 20 cm deep. The local organic fertilizer (LOF) was inserted into the hole, followed by iron fertilizer (Fe) and copper (Cu) at the same rate for all treatments, 18.6 grams of tree^{-1} equal to 10 kg ha^{-1}. The basic fertilizers of urea, SP36, and KCl in a rate of 186 grams of tree^{-1} (100 kg ha^{-1}), 93 grams of tree^{-1} (50 kg ha^{-1}), and 93 grams of tree^{-1} (50 kg ha^{-1}), respectively, were applied for the whole test trees (120 trees) .

Observation is done once a week by collecting rubber latex from each rubber stem sample, by tapping rubber tree at morning at 06.00 and taken the sap at 11.00, 2 weeks after application of local organic fertilizer. Observations were made for 2 months on latex volume, girth of the stem, weight of the latex slab weight of the dry rubber sheet. The data was analyze with analyses of variance (ANOVA) followed by DMRT at $\alpha = 5\%$.

RESULTS AND DISCUSSION

Rubber plant used in this study was a rubber plant from Klon PB-260 of 8 years old. In this research, in addition to local organic fertilizer as the treatment, element of Fe and Cu was also used as stimulator of plant photosynthesis to get higher quality of rubber. During the study, rainfall from June 2016 to August 2016 varied considerably.

The results of the analysis of variance showed that the treatment of local organic fertilizer did not significantly affect the rubber latex yield. Based on the results of the analysis of variance it was noticed that the various doses of organic fertilizer of rubber waste to the rubber latex did not significantly affect to all variables (Table 1). Rubber plant is a perennial crop so that the effect of the organic fertilizer takes a long time to be able to significantly be measured. On the other hand, it was also suspected that the method of circular fertilizer application which has been done in this experiment was not deep enough to bury the fertilizer so it was scattered away from the rubber tree by animals.

The compost produced was very high in carbon (C) with the average of 17.35%, nitrogen (N) 1.14%, phosphor (P) 0,53 ppm and potassium (K) 1.21 cmol$^{(+)}$ kg^{-1}(Table 2). This indicates that the compost produced was of good quality especially indicated by very high C levels, followed by K, N, and P as well as high organic waste (C) rubber waste, followed by potassium and phosphorus. In addition to this organic fertilizer, rubber plant was also given basic fertilizer urea, SP36 and KCl. It can be seen that the nutrients contained in the rubber waste was enough to be used as a nutrient addition to the rubber plant, but the duration of the experiment seem was still too short to the fertilizer to show significant effect on the yield of rubber latex.

Table 1. The result of analysis of variance on yield component of rubber plant with the application of local organic fertilizer

Variabel	F hitung
Latex volume (ml)	0.71 ns
Stem girth (cm)	1.04 ns
Latex fresh-weight (g)	1.27 ns
Slab weight (g)	1.10 ns
Dry weight (g)	0.92 ns

Note: ns = not significant based of F test at α=5% (the F table value at α=5% is 2.77).

Latex Volume. From the statistical analysis results obtained the treatment of various doses of organic fertilizer of rubber waste is not significantly different but the numbers indicate the difference in average so that made the graph as shown below.

The highest latex volume was found in the treatment of D1 = 10 kg of tree^{-1} which was 92,447 ml, followed by D4 = 40 kg tree^{-1} (88,67 ml) , D5 = 50 kg of tree^{-1} (82,625 ml), while at other treatment the latex volume tended to decrease. In D3 = 30 kg of tree^{-1} the latex volume was

Table 2. Laboratory analysis of rubber processing waste at 1.5 month composting period

Compost	C (%)	N (%)	P (ppm)	K (cmol(+) kg^{-1})
Sample 1	18,99	0,95	0,54	-
Sample 2	15,71	1,33	0,53	1,21
rubber waste	14,65	0,50	0,81	0,24

68,914 ml, and the lowest latex volume found in treatment D0 = control (65,032 ml) (Figure 1). Some factors that allegedly affected latex volumes were clones and latex flow rates. Latex volumes and latex flow rates are interconnected. This is in line with Boerhendy's (1988) assertion that the late latex flow rate during intercept has an effect on latex production. The faster and longer the latex flows, the latex results will be higher. In this study, PB-260 clone rubber treated with various doses of rubber waste organic fertilizer, its latex flow rate has not been able to show the increase in latex volume significantly although the average number was difference.

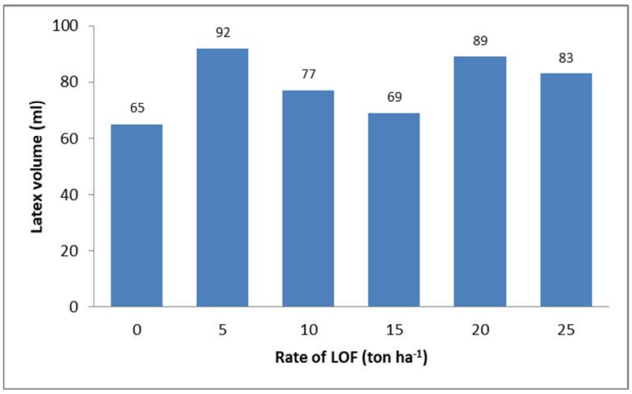

Figure 1. Effect of rate of local organic fertilizer (LOF) on latex volume

Stem Girth. During the 3 months period of research, the stem girth increased although only slightly, that was in the treatment of D0 = control, at the beginning of the girth observation 60.4 cm at the end of the observation was 60,75 cm with the amount of girth increase was equal to 0,35 cm, D1 = 10 kg tree^{-1} 1.15 cm, D2 = 20 kg of tree^{-1} 0.6 cm, D3 = 30 kg of tree^{-1} 0.25 cm, the treatment D4 = 40 kg trees^{-1} 0.37 cm, and at treatment of D5 = 50 kg of tree^{-1} of 0.75 cm (Figure 2). Stem girth has been agreed as a guide to know the growth of rubber crops, because the results of latex rubber plant obtained from the stem bark in which the latex vessels were situated. The deeper the position in the bark closer to the cambium, the more latex vessels and the higher the latex volume. However, tapping up about the cambium will obstruct the skin recovery. In this study it was noticed that the girth of the stem after being treated by various doses of organic fertilizer of rubber waste showed a slight increase. It means that the N, P and K elements contained in the organic fertilizer of rubber waste play a role in accelerating the rate of growth of the plants. Suriatna (1998) stated that the elements of N, P, K play a role in accelerating the rate and growth in plants where nitrogen is the compiler of many compounds whereas phosphorus serves to accelerate the development of rooting, increase pest and disease resistance, play a role in the process of respiration, cell division, and plant metabolism so as to encourage the growth rate of planting among other girth. The potassium element plays a role in accelerating the growth of meristematic tissue especially in the stem of the plant, strengthening the stem so it is not easy to fall, is very important in the process of photosynthesis where the increase of photosynthesis in plants will increase the size of the girth of the plant stems. In this study it can be seen that giving various doses of organic fertilizer of rubber waste did not inhibit the growth of rubber plant and enough to increase the stem girth although it was not significant.

Latex Weight. The highest weight of latex was observed in treatment D1 = 10 kg tree^{-1} which was 98.6

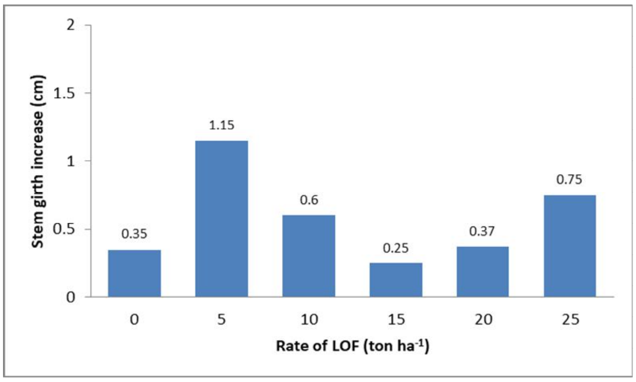

Figure 2. Effect of rate of local organic fertilizer (LOF) on the increase of stem girth

gram, followed by D4 = 40 kg of tree^{-1} 96,5 gram, D3 = 30 kg of tree^{-1} 0.94, gram, D5 = 50 kg of tree^{-1} 90.1 gram, while at other dose treatment the weight of latex tended to decrease that was in D2 = 20 kg tree^{-1} 86.7 grams, and the lowest latex weight was found in D0 = control 75.1 grams (Figure 3). It is presumed that in other weeks observations the weight of latex tended to decrease further due to the latex flow rate occurs when the tapping was delayed or stopped, so the weight of latex tended to be lower. This might be due to less-precise tapping time, the amount and flow rate of latex affected by the turgor pressure of the cells. Cell turgor pressure reaches its maximum at dawn, and then decreases during the daytime. Therefore, tapping should be done as early as possible, at 05.00-07.30 in the morning.

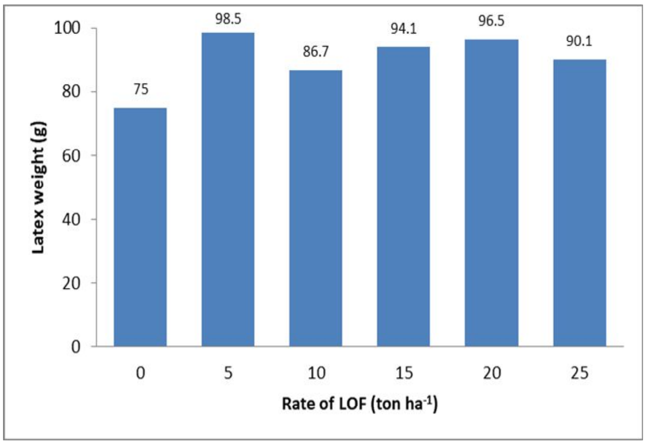

Figure 3. Effect of rate of local organic fertilizer (LOF) on latex weight

Latex Slab Weight. The highest latex slab weight is found in the treatment D5 = 50 kg of tree^{-1} which was 40.8 gram, followed by D1 = 10 kg of tree^{-1} 38.2 gram), D3 = 30 kg of tree^{-1} 38.2 gram, while the weight of the latex slab tended to decrease in D4 = 40 kg of tree^{-1} which was 37.0 grams, D2 = 20 kg trees^{-1} 36.1 grams), and the lowest latex slab weight was found in D0 = control (29.3 grams) (Figure 4). In this research the slab milling was done by magel-hand mill, the purpose of this tool was to reduce water content of rubber latex slab to accelerate the drying process. However, it was mistakes during the milling process such as lack of duration in grinding (1 sample 12 x mills) is only done 7-10 x grinding so that the amount of moisture contained in the rubber sheet slab was still quite high.

Dry weight. Treatment D1 = 10 kg tree^{-1} resulted in the highest latex dry weight which was 30.5 grams, followed by D4 = 40 kg of tree^{-1} 29.7 gram, D3 = 30 kg tree^{-1} 29.7 gram, D5 = 50 kg of tree^{-1} 28.6 gram, D2 = 20 kg of tree^{-1} 28.4 gram), and the lowest one was in D0 = control which was 23.1 grams) (Figure 5). In this research, the state of the environment such as wind, might affect the dry rubber content. The presence of wind resulted in high evaporation so it reduced the turgor pressure of cells. As a result, the water contained in the latex fluid decreased and dry rubber content increased. Dry rubber content was the content of rubber solids per unit weight (%) (Purbaya, 2011). According to Elly (2006), the higher rubber content in latex the closer the distance between molecules of rubber in latex, and the less amount of water in the latex.

CONCLUSIONS

The dosage of various organic rubber waste fertilizer doses does not significantly affect the rubber latex results in the latex volume observation variables, the girth, the latex weights, the latex weights and the dry weight we have not obtained the optimum dose. 4.2 Suggestion It is necessary to do further research on the same plant with longer period of time and in subsequent research done in rainy season.

REFERENCES

Anonim, 1999. Karet. Strategi Pemasaran Tahun 2000. Budidaya dan Pengolahan. Cetakan Keenam. Penebar Swadaya, Jakarta.

BPS. 2010. Potensi pasar ekspor karet Indonesia. http://www.bps.go.id. (10 maret 2016).

Balai Penelitian Sembawa. 2011. Sabtabina Usahatani Karet Rakyat. Balai Penelitian Sembawa Palembang. 55-62.

Badan Pusat Statistik. 2016. Statistik Karet Indonesia. http//bps.go.id/ Diakses tanggal 9 Oktober 2016.

Boerhendy, I dan K. Amypalupy. 2010. Optimalisasi produktivitas karet melalui penggunaan bahan tanam, pemeliharaan, eksploitasi, dan peremajaan tanaman. Jurnal Litbang Pertanian, 30 (1):27.

Bahri S.2013. Pemanfaatan Limbah Padat Pabrik Crumb Rubber (Tatal) Pada Pembuatan Bahan Bakar Cair.Palembang:Baristand

Cahyono, B. 2010. Cara Sukses Berkebun Karet. Cetakan Pertama. Jakarta : Pustaka Mina.

Daud D.2012. Pemanfaatan Limbah Padat Industri Karet Remah Sebagai Bahan Tambahan Pada Pembuatan Kompon Karet. (diakses pada 8 November 2016).

Departemen Pertanian. 2005. Penggunaan Pupuk Organik Bagi Lingkungan. http://database.deptan.go.id/ bdspweb/f4freeframe.Asp. diakses 15 Maret 2016.

Ditjenbun. 2013. Buku Statistik Karet (Rubber). Ditjenbun. Kementrian Pertanian. Doanload tanggal 9 Oktober 2016.

Efendri E.2013.Pemanfaatan Limbah Padat Pabrik Crumb Rubber (Tatal) Pada Pembuatan Bahan Bakar Cair.Palembang:Baristand.

Elly, N. 2006. Pengaruh pengembangan partikel karet terhadap depolimerasi lateks dengan reaksi reduksi oksidasi. Skripsi. Bogor: Fakultas Teknologi Pertanian, Institut Pertanian Bogor.

Food and Agriculture Organization of the United Nations. 1985. Manual on fertilizer distribution bulletin. FAO fertilizer and plant nutrion bulletin. 144 p

Gunawan, E. 1970. Pengolahan Karet. Lembaga Pendidikan Perkebunan. Medan.

Hadisuwito, S. 2011. Membuat Pupuk Kompos Cair. Jakarta. Indonesia: Agromedia Pustaka.

Herman dan Goenadi. 1999. Manfaat dan prospek industri hayati di Indonesia. Jurnal Penelitian dan Pengembangan Pertanian. 18.(3):7-8.

Munir, M., Moertinah, S, Sartamtama, 2003. Penelitian Pemanfaatan Limbah Padat Industri MSG untuk Pupuk Organik, Procceding Workshop Hasil Litbang Bidang Pengendalian Pencemaran, Balai Besar Kulit, Karet, Plastik, Yogyakarta.

Munthe, H. Rudite, T. Istianto. 2006. Penggunaan Pupuk Organik pada Tanaman Karet menghasilkan. Balai Penelitian Sungai Putih Pusat Penelitian Karet Indonesia.

Nazarudin, dan F.B Paiman. 1998. Karet, Strategi Pemasaran Tahun 2000, Budidaya dan Pengolahan. Penebar Swadaya. Jakarta.

Nurkhollis. 2005. Pengaruh Pemupukan Nitrogen Dan Konsentrasi Etefon Terhadap Hasil Latek Karet. Fakultas Pertanian. Universita Bengkulu.

Ompusunggu, M. 1991. Pengolahan Lateks Pekat. Sungei Putih : Balai Penelitian Perkebunan.

Prasetyo. 1990. Pengaruh Etephon dan Ukuran Lilit Batang Terhadap Hasil serta Perkembangan Anatomi/Fisiologis Kulit Batang Dua Klon Karet. Disertai Dokter pada Universitas Gadjah Mada Yogyakarta: tidak diterbitrkan.

Purbaya M., T.I. Sari., C.A. Saputri., M.T.Fajriaty. 2011. Pengaruh beberapa jenis bahan penggumpalan lateks dan dengan hubungannya dengan susut bobot kadar karet kering dan plastisitas. Prosiding Seminar Nasional AVOER ke-3, 26-27 Oktober 2011.

Rusli dan Y. Ferry. 2013. Keragaan Awal 10 Klon Karet di Kenun Percobaan Pakuwon Sukabumi. Dimuat dalam Warta Penelitian dan Pengembangan Tanaman Industri, Desember 2013.

Riwandi, M. Handayajaningsih, Hasanudin, 2012. Rekayasan Kualitas Kesuburan Tanah dengan Pupuk Kompos dan Aplikasinya terhadap Produksi Jagung Organik Laporan Hasil Penelitian Strategis Nasional Tahun ke 1, Fakultas Pertanian Universitas Bengkulu Desember 2013.

Setyamidjaja, D.1993. Karet. Yogyakarta : Kanisius

Siregar T.H.S dan I. Suhendry. 2013. Budidaya dan Teknologi Karet. Penebar Swadaya. Jakarta.

Spillane, J. 1989. Komoditi Karet. Cetakan Pertama. Yogyakarta : Kanisius.

Sutardi. 1981. Tingkat keuntungan perusahaan perkebunan karet di Jawa. Risalah Penelitian RC Getas. Rubber Research Centre, Getas. Salatiga.

Suriadikarta, D.A. dan R.D.M. Simanungkalit. 2006. Pupuk Organik dan Pupuk Hayati. Balai Besar Litbang sumberdaya Lahan Pertanian. Badan Penelitian dan Pengembangan Pertanian. Bogor.

Suriatna, S. 1988. Pupuk Pemupukan. PT. Sarana. Jakarta.

Surya, I. 2006. Teknologi Karet. Medan : Universitas Sumatera Utara.

Syamsulbahri. 1996. Bercocok Tanam Tanaman Perkebunan Tahunan. Yogyakarta : Gadjah Mada University Press