Utilization of Waste Beef Cattle-corn as Formulation Material in Compost Fertilizer Manufacturing

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Abstract: The success of corn agro-industry is influenced by the availability of fertilizers, especially of artificial fertilizers whose availability continues to decrease. The solution is to increase compost production through the use of wet/ dry stover (WS/DS), commercial/ traditional cattle waste (C/T CW) in EM4 solutions (5 ml/l and 10 ml/l). The purpose of this study was to obtain the formulation of compost making materials. Composting was done by mixing C/T CW, WS and DS with formulation material (Control; 1: 0: 3; 1: 1: 2; 1: 2: 1; 1: 3: 0), putting into polybags in a bucket covered, performing an anaerobic fermentation for 40 days, and checking and stirring once in three days. Compost is ripely characterized by a distinctive fermented aroma. The treatment of compost material formulation used a nonfactorial Completely Randomized Design Model (non-factorial CRDM). Parameters observed were yield, moisture content (oven), pH (potentiometry), P_2O_5 (spectrophotometry), K_2O (AAS), organic C (Gravimetric), N-total (Volumetric), C/N ratio. The results showed that EM4 performance of 10 ml/l of water was better than 5 ml/l of water which could speed up the composting process, K_2-1: 0: 3 compost material formulation produced more compost in accordance with SNI quality standards with a yield of 30.86%, moisture content 28.92%, pH 5.97, $P_2O_5$1.12%, K_2O 2.01%, organic C 50.06%, N total 1.95% and C / N ratio 25.67.

1 INTRODUCTION

The demand for maize in the country increases. This is in line with the development of the corn processing industry and the development of animal husbandry sector (BPS, 2011; Kementan, 2016a). In addition to the procurement of food and feed, corn is also widely used in the food industry, beverages, chemicals, and pharmaceuticals which give added value to the commodity corn farming (Suarni and Widowati, 2014).

According to BPS, corn production reached 19.61 million of shelled corn in 2015. This production rose 3.17 percent if compared to 2014 (Kementan, 2016b). However, to meet the needs of livestock feed in 2016, the government of Indonesia imported corn as much as 2.4 million tons gradually by as much as 200 thousand tons per month. In 2017, it was predicted that Indonesia imported corn in 30% of the total national maize needs, which reached 8.6 million tons per year or approximately 665 thousand tonnes per month (Kemenperin, 2016).

The problems faced in the development of agro-industries, the corn are in low productivity. The price of corn is fluctuating because of extensive land and more small businesses and the risk of failed harvest due to weather changes. One of the factors of the success of industrial agriculture of maize was strongly influenced by the availability of fertilizer. Recently, most farmers have still used artificial fertilizers. In addition to its decreasing availability, the use of which is not wise. This also affects the ecological balance so that resources support neighborhood continues to decline and productivity corn which still remains low.

The alternative is the counter measures which increase the production of organic fertilizer (compost) through the management and utilization of the waste corn (waste is produced in the form of stems, leaves, cornhusk about 14.88 million tons and maize cobs as much as 34.06 million ton) (Setiawan. 2014). Corn plants produce waste whose proportions vary. The largest proportion of corn stalks is (stover) followed by leaf, fruit peels, and corn cobs. The proportion of waste from several varieties of maize was developed by maize and cereal crops research hall Maros i.e. the proportion of stems varies between 55.38-62.29%, the proportion of leaves

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between 22.57-27.38% and the proportion between cornhusk 11.88-16.41% (Anggraeny et al. 2006). The proportion of the waste corn plants percent dry ingredients consist of 50% of the stem, leaves 20%, 20% and 10% of cob, cornhusk (BPS, 2009). Cow manure has excellent potential as a provider of plant nutrients (fresh feces as much as 15-20 kg/head/day and urine 10-15 liters/head/day) (Lutojo et al. 2010; Wahyuni. 2010). The amount of waste is quite a lot and it is very potential if it can be utilized appropriately and optimally. Therefore, is it important to handle it by utilizing waste such as livestock droppings of organic fertilizer. Processing beef cattle droppings into the compost (composting) needs to consider a sustainable technology because it aims for environmental conservation, and the use of compost (organic fertilizer) can reduce the use of chemical fertilizers and the larger value breeders (Indrawaty, 2015). So far, the utilization of waste stool and urine has still been untapped with maximum livestock excrement. Many have accumulated around the enclosure and not many are utilized. Stool that was not processed can only be allowed naturally into organic fertilizer, while the urine passing from the cage can only be put into the tub without treatment. Therefore, this will produce solid organic fertilizers that are moist, not crumb, immature, easily moldy, save time and the manufacturing process (Swastike et al, 2015).

2 RESEARCH METHODS

2.1 Research Time and Location

This research was conducted from June to September 2018. The research location was in Deli Serdang regency, North Sumatra province. This location was chosen by considering the area of corn farming and beef cattle, in which transportation facilities (axle road and sub-district ring road), location plantations and beef cattle farms that are close together were available.

2.2 Research Materials and Tools

The materials used in this study were corn waste (wet stover/dry stover; WS/DS), cattle waste commercial (C) and cattle waste traditional (T), EM4, water. The equipments used in this study were tissue, label paper, polybag, plastic bucket/tube, wood stirrer, chopper machine, oven, furnace, micropipette (Socorex Calibra 832; 1-10 ml, Gilson; 1000 µl, Transferpette; 10-100 µl), analytical scales (mettler ae 100), whatmen paper, desiccator, and other analysis tools.

2.3 Research Implementation

The process of making compost was done in several steps of finely chopping WS/DS and mixing, cattle waste (C/T) mixed with EM4 solution with a concentration of 5 ml/l of water and 10 ml/l of stirred water evenly. The composting formulation was then carried out by comparing 1 part C/T: 3 parts WS/DS. Formulation of C/T : WS : DS (Control; 1: 0: 3; 1: 1: 2; 1: 2:1; 1: 3: 0). The mixture of WS/DS and cow manure was evenly mixed, then put in a polybag in a closed bucket, followed by checking and reversing once in three days. It was estimated that after forty days the compost had been ready. During the decomposition process, it did not emit a foul odor, even the fermented aroma. The parameters observed were closely related to the quality of compost, namely yield, moisture content (Oven), pH of compost (Potentiometry), P_2O_5 (Spectrophotometry), K_2O (AAS), compost organic C content (Gravimetry), N-total compost content (Volumetric), and C/N ratio (Supatma and Arthagama, 2008; Surtinah, 2013).

2.4 Statistical Analysis

The experimental design used for the treatment of compost material was a nonfactorial Completely Randomized Design Model (non-factorial CRDM). The independent variable used for the treatment of compost material is the compost material formulation, namely the C/T: WS: DS (Control; 1: 0: 3; 1: 1: 2; 1: 2: 1; 1: 3: 0). The compost produced was then tested for yield, moisture content, and pH of compost, P_2O_5 compost, K_2O compost, compost organic C content, N-total compost content, C/N compost ratio. A statistical model for complete random design is as follow:

$$\mathbf{Y_{ij} = \mu + \tau_i + \varepsilon_{ij}} \quad (1)$$

information :
i : factor (i = 1,2,3,4 .... n)
j : replication (j = 1,2,3 ... n)
Y_{ij} : the experimental response to compost material is the factor and the jth test
μ: general average
τ_i: influence of compost material factors
ε_{ij}: trial error

3 RESULTS AND DISCUSSION

Parameter test results and analysis of compost data generated with the anaerobic composting system using EM4 activator (Table 1) can be explained that in general, the compost material formulation treatment shows a very significant difference in *Duncan's test* level of 5% although there were several treatments which showed the difference that was not real. The results showed that during the composting process the performance of EM4 activator at a concentration of 10 ml/l of water was better than 5 ml/l of water because it could speed up the composting process. The results of compost chemistry analysis showed that most of the compost material formulation treatment had met the requirements of quality standards of organic fertilizer from SNI.

During the composting process, color changes occur gradually. Brownish green-yellow color changed to dark brown color. At the end of the composting process the color changed to brownish black due to the formation of humic acid. In addition to discoloration, when the process took place, the compost emited an unpleasant odor due to the decomposition of the organic material that was still running. However, at the end of composting, compost smelled of perfection.

3.1 Yield

The decomposition process depends on the content of the material used, where cellulose is more easily decomposed than lignin. The decrease in compost yield (Figure 1) is quite high. This is because the compost material, especially corn stover contains more cellulose than lignin and porous which ware easy to absorb and release water. Depreciation of compost material in the material formulation because at the time of composting takes place a process of decomposition of compost material by microorganisms that convert organic matter into carbon dioxide, water, hummus, and energy. Depreciation of final mature compost is about 50-75% of the initial weight of compost (Wahyono et al, 2011). The lowest compost was in the T_2-1: 0: 3 formulation (12.95%) and the highest was in T_2-1: 3: 0 (34.29%).

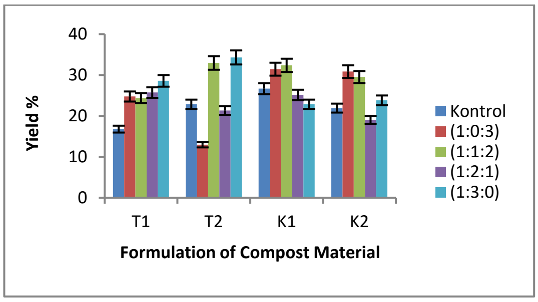

Figure 1: The relationship between Formulation of Compost Material and Yield.

3.2 Moisture Content

Compost moisture content depicts moisture during the composting process. When composting takes place, the compost water content is quite high. High water content is due to compost material consisting of cattle waste in wet conditions, wet/dry field corn stover and the addition of 1 liter EM4 solution (Table 1). Compost water content is obtained from the decomposition of organic matter into carbon dioxide, water vapor and compost (Arumsari et al, 2012). Besides being needed directly by a microorganism, water also affects the aeration system and oxygen supply in the bucket media. The compost water content produced (Figure 2) is lower than SNI quality standards. This has met SNI quality standards. The lowest compost moisture content was in C_2 Control formulation (10.07%) and the highest in C_1-1: 0: 3 (31.08%).

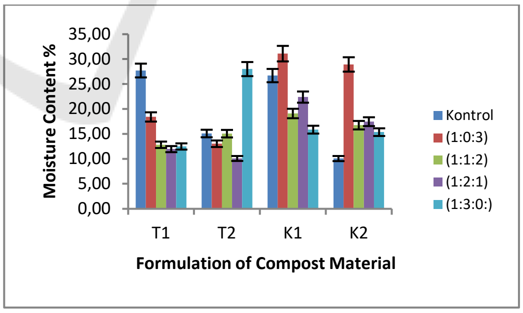

Figure 2: The Relationship between Formulation of Compost Material and Moisture Content.

3.3 pH

The level of acidity or alkalinity of a solution can be seen from the pH. When composting takes place, organic matter decomposes into organic compounds. The pH value of compost produced from compost material formulation is not in accordance with SNI quality standards (Table 1), because some pH is too high and the others are too low (Figure 3). The lowest compost pH was in T_2-1: 0: 3 formulation (4,51) and highest was in T_2 Control (9,15).

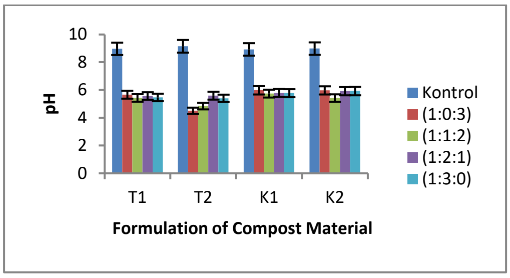

Figure 3: The relationship between Formulation of Compost Material and pH.

3.4 P_2O_5

P_2O_5 levels show high values (Figure 4). This is because the control formulation is 100% cattle waste. As stated by Miftahul (Miftahul, 2003) that the high and low content of phosphorus in compost is probably due to a large amount of phosphorus contained in the raw material used and the number of microbes involved in composting. The lowest compost P_2O_5 level was in C_1 Control formulation (0.40%) and the highest was in T_2-1:3:0 (2.12%). P_2O_5 compost from all compost material formulations has met SNI quality standards (Table 1).

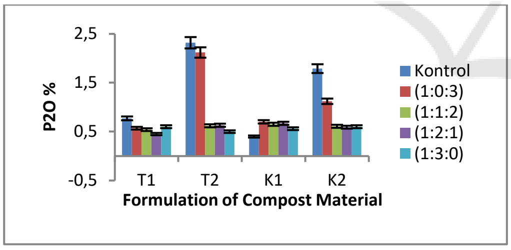

Figure 4: The relationship between Formulation of Compost Material and P_2O_5.

3.5 K_2O

The results of the analysis of compost material formulation had a higher K_2O compared to SNI quality standards (Table 1). This condition was possible because the formulation of compost material also greatly affected the content of potassium in composting for bacterial activity. This is in accordance with the statement of Agustina (Agustina, 2004), that potassium is a compound produced by microbial metabolism, in which microbes use free K^+ ions which are present in fertilizer raw materials for metabolic purposes. K_2O of all compost material formulations have met SNI quality standards (Table 1). The lowest compost K_2O was in C2-1: 3: 0 formulation (1.15%) and the highest was in T_1 Control (2.48%).

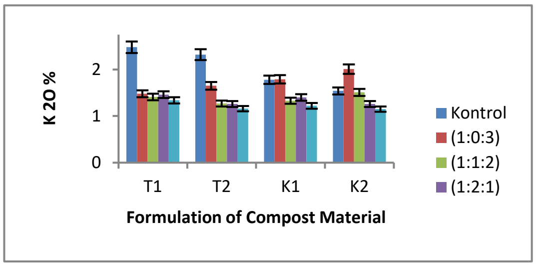

Figure 5: The relationship between Formulation of Compost Material and K_2O.

3.6 Organic C

The results of the analysis of compost organic C levels are still too high (Figure 6), because corn stover and cattle waste contain high carbon. Jannah (Jannah, 2003) has explained that during the process of decomposition of organic matter, the activity of microorganisms produces element C so that the level of organic C increases. Then when the compost is made, the decomposers will die and the C organic content will slowly drop. The lowest compost organic C was in the C_2 Control formulation (40.01%) and the highest was in T_1-1: 0: 3 (54.21%).

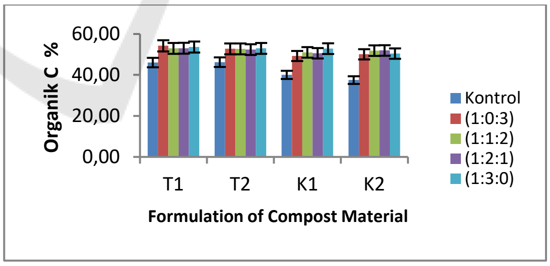

Figure 6: The relationship between Formulation of Compost Material and Organic C.

3.7 Total N

The decomposition of organic matter by microorganisms in the composting process will produce a number of nitrogen elements. This is one of the parameters in the quality standard of organic fertilizer. The greater the content of N, P, and K nutrients in compost, the better the compost used for plants because it provides enough nutrients for plants and soil (Putro et al. 2016). In general, the total N of all compost material formulations has met the requirements and this is higher than the total N SNI quality standard (Figure 7). The lowest total N was in T_1-1: 0: 3 (1.21%) and the highest was in T_1 Control (2.20%).

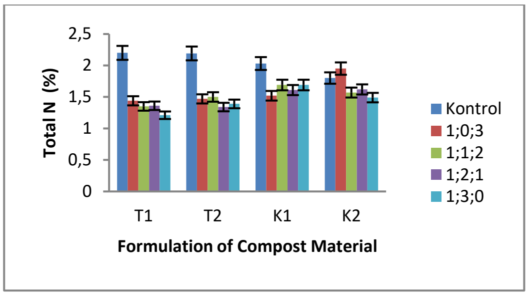

Figure 7: The relationship between Formulation of Compost Material and Total N.

3.8 C/N Ratio

The C/N ratio of the formulation of compost material is still in the range required by the quality standard although there is a C/N ratio that is too high. The lowest C/N ratio analysis results were in C_1 Control (18.27%) and the highest was in T_1-1: 3: 0 (44.32%). The high C/N ratio generated from the compost material formulation (Figure 8) is in accordance with Sulaeman (Sulaeman., 2011), that compost materials, such as husks, rice straw, corn stalks, and sawdust, have a C/N ratio between 50-100.

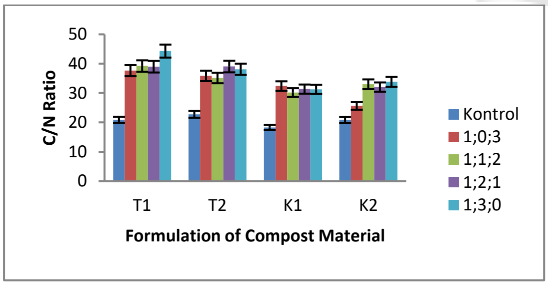

Figure 8: The relationship between Formulation of Compost Material and C/N Ratio.

4 CONCLUSION

The results showed that the EM4 performance of 10 ml/l of water was better than that of 5 ml/l of water, which could speed up the composting process of compost material formulation. Compost formulation C_2-1: 0: 3 produced compost with a yield of 30.86%, moisture content 28.92 %, pH 5.97, P_2O5 1.12%, K_2O 2.01%, organic C 50.06%, N total 1.95% and C/N ratio 25.67 more. This is in accordance with SNI quality standards.

RECOMMENDATION

1. Similar research needs to be done by increasing fermentation time to obtain more quality compost with a C/N ratio to meet quality standards.
2. To follow up and support the development of integrated corn agro-industry in Deli Serdang, North Sumatra, it is better to apply compost produced from compost material formulation.

THANK YOU NOTE

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REFERENCES

Agustina. 2004. *Book, Basic Plant Nutrition*. Jakarta : Rineka Cipta. Page 54.

Anggraeny, YN., Umiyasih, U., Krishna, NH. 2006. *The Potential for Corn Waste is Ready to be Released as a Source of Forage for Beef Cattle*. Pros. National Workshop on Corn - Cattle Integration System Development Network. Pontianak, 9-10 August 2006. Bogor: Research Center for Animal Husbandry. p. 149 - 153.

Anonymous. 2015. *Harvest and Postharvest Corn Management*. Corn Cultivation Technical Training for Agricultural Extension. Agricultural Human Resources Counseling and Development Agency. Bogor: Agricultural Training Center.

Arumsari, A., Syafrudin, Winardi. 2012. *Utilization of Sludge Resulting from Wastewater Treatment PT. Indofood Cbp. with the Addition of Domestic Waste and Effective Microorganism (EM4) and Activated Sludge as Activators Through the Composting Process*. Semarang: Diponegoro University. Faculty of Engineering. Environmental Engineering Study Program.

BPS (Statistics Center). 2009. *Agricultural Statistics*. Center for Agricultural Data and Information. Ministry of Agriculture. Jakarta.

BPS (Statistics Center). 2011. *Food Crop Production Statistics*. South Sulawesi: Directorate General of Food Crops.

SNI (Standart of National Indonesian). 2004. *SNI 19-7030-2004: Specifications for compost from domestic organic waste*. Jakarta: BSN Pr.

Indrawaty, PV. 2015. *Effect of the use of urine as a source of nitrogen on the physical form and nutrients of cow feces compost* [Thesis]. Jambi: Jambi University

Jannah, M. 2003. *Compost Quality Evaluation from Various Cities as a Basis for Composting Compilation of SOP (Standard Operating Procedure).* Bogor: Bogor Agricultural University, Faculty of Agricultural Engineering.

Kementan (Ministry of Agriculture). 2016a. *Corn Production in 2016 is Enough to Fulfill the Feed Industry. Retrieved from* http: /www.repu-blika.co.id/berita/kementan/berita-kementan/ 16/ 06/28/o9gve7383-kementan-production-maize-2016-quite-full-industry-feed.

Kementan (Ministry of Agriculture). 2016b. *Harvested Area and Productivity Increased, 2016 Corn Production is Predicted to Penetrate 23 Million Tons. Retrieved from* http: //www.agro-farm.co.id/m/pertanian/3548/ebaran-panen-dan-prod Productivity-up-production-corn-2016-pre-dicted-translucent-23-million-ton / # wgude9j97iu. Agrofarm.co.id.

Kemenperin (Ministry of Industry). 2016. *2016 RI Imports of Corn 2.4 Million Tons. Retrieved from* http://www.kemenperin.go.id/artikel/13892/2016,-ri-import-corn-2,4- million-ton.

Lutojo, Sihombing G., & Rriyanto J. 2010. *Application of Integrated Installation Design of Faecal and Urine Waste Processing for Solid and Liquid Organic Fertilizer Industry in Beef Cattle Fattening Business*. Appl. Science and Technology. Semarang: Dipa Blu UNS.

Mifathul. 2003. Evaluation of Compost Quality from Various Cities as a Basis for Making Composting SOPs. Bogor: IPB.

Putro, BP., Walidaini, RA., Samudro, G., Nugraha, WD. 2016. *Quality Improvement of Campus Organic Waste Compost Enriched with NPK and Urea Fertilizer.* Proceedings of the 7th 2016 SNTS. Semarang: Wahid Hasyim University, Faculty of Engineering. Page.17-22.ISBN 978-602-99334-5-1.

Setiawan, E. 2014. *Utilization of Corn Waste (Cob, Cornhusk, and Straw) as Animal Feed*. Retrieved from http://i1122.photobucket.com/albums/ l524/ riyosuke/tail2.gif. Tuesday, February 4, 2014. Broken HTTP://ekasetiawanfapetunja .blog spot. co.id / 2014/02 / corn-waste-use-tongkol.html.

Suarni & Widowati, S. 2014. Corn Structure, Composition and Nutrition. Bogor: Bogor Center for Agricultural Postharvest Research and Development.

Sulaiman, D. 2011. *Effect of Waste Compost Baglog White Oyster Mushroom (Pleurotus ostreatus Jacquin) on Soil Physical Properties and Growth of Yellow Passion Fruit Seeds (Passiflora edulis var. Flavicarpa Degner)* [Thesis]. Bogor: Bogor Agricultural University, Faculty of Agriculture, Department of Soil Science.

Swastika, W., Handayanta, E., Purnomo, SH. 2015. *The Application of Faecal and Urine Waste Processing Technology as an Entrepreneurial Business Establishment in Jatikuwung Sebelas Maret University Mini Farm*. Proceedings of the 2015 National Seminar on the 4th UNS SME Summit & Awards "Synergy of MSME Development in the Era of the ASEAN Economic Community (MEA)". Semarang: UNS Pr.

Wahyono, S., Sahwan, FL., Suryanto F. 2011. *Making Granule Organic Fertilizers from Various Wastes.* Jakarta: Agromedia Library.

Wahyuni. S. 2010. *Produces Biogas from Various Wastes.* Jakarta: Argromedia Pustaka.

Table 1. Compost Composition Based on SNI and Compost Formulation Test Results

Formulation	Parameter (%)							
	Yield	Moisture Content	pH	P_2O_5	K_2O	Organic C	N-total	C/N Ratio
* Minimum	-	-	6,8	0,10	0,20	9,8	0,40	10
Maximum	-	50	7,49	-	-	30	-	20
** Control T_1	16,78 b	27,70 k	8,96 j	0,77 e	2,48 i	46,00 c	2,20 g	20,91 b
T_1 (1:0:3)	24,76 fg	18,41 g	5,66 efg	0,57 abcd	1,48 bcde	54,21 m	1,44 abc	37,65 l
T_1 (1:1:2)	24,38 efg	12,81 c	5,43 cd	0,54 abc	1,41 abcde	52,96 jk	1,35 ab	39,23 m
T_1 (1:2:1)	25,71 gh	11,96 b	5,56 cde	0,45 ab	1,46 bcde	53,02 k	1,36 ab	38,99 m
T_1 (1:3:0)	28,57 i	12,50 bc	5,46 cd	0,60 bcd	1,34 abcd	53,63 l	1,21 a	44,32 n
Control T_2	22,86 de	15,09 d	9,15 k	2,12 h	2,32 i	46,23 c	2,19 g	22,77 c
T_2 (1:0:3)	12,95 a	13,03 c	4,51 a	0,62 cde	1,65 efg	52,72 j	1,47 abc	35,86 k
T_2 (1:1:2)	32,95 kl	15,04 d	4,84 b	0,63 cde	1,27 abcd	52,71 j	1,50 abcd	35,14 j
T_2 (1:2:1)	21,33 d	10,08 a	5,59 def	0,50 ab	1,26 abc	52,34 i	1,34 ab	39,06 m
T_2 (1:3:0)	34,29 l	28,00 k	5,40 c	0,40 a	1,16 a	52,96 jk	1,39 abc	38,10 l

Control C_1	26,67 h	26,69 j	8,92 j	0,70 e	1,78 fg	40,01 b	2,03 fg	18,27 a
C_1 (1:0:3)	31,43 jk	31,08 l	5,98 i	1,02 f	1,79 gh	49,23 d	1,52 abcd	32,39 g
C_1 (1:1:2)	32,38 jk	19,10 h	5,74 efgh	0,65 cde	1,33 abcd	50,99 g	1,69 cde	30,17 e
C_1 (1:2:1)	25,14 fgh	22,39 j	5,78 gh	0,67 de	1,40 abcde	50,54 f	1,61 bcd	31,39 f
C_1 (1:3:0)	22,86 de	15,86 d	5,77 fgh	0,56 abcd	1,22 ab	52,84 jk	1,69 cde	31,27 f
Control C_2	21,91 d	10,07 a	8,98 jk	1,79 g	1,54 defg	37,50 a	1,80 def	20,83 b
C_2 (1:0:3)	30,86 j	28,92 m	5,97 i	1,12 f	2,01 h	50,06 e	1,95 efg	25,67 d
C_2 (1:1:2)	29,52 i	16,75 e	5,42 cd	0,61 cd	1,51 cdef	51,83 h	1,57 bcd	33,01 h
C_2 (1:2:1)	19,05 c	17,46 f	5,91 hi	0,59 bcd	1,26 abc	51,94 h	1,62 bcd	32,06 g
C_2 (1:3:0)	23,81 ef	15,36 d	5,92 hi	0,60 bcd	1,15 a	50,39 f	1,49 abcd	33,82 i

Description: Numbers followed by the same letter in the same column showed no significant difference In Duncan's test level of 5%.

Source : * SNI (2004); ** Research Data (2018).