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Productivity of sugarcane plants of ratooning with fertilizing treatment

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Abstract. *Latief AS, Syarief R, Pramudya B, Muhadiono. 2010. Productivity of sugarcane plants of ratooning with various fertilizing treatments. Nusantara Bioscience 2: 43-47.* This research aims to determine the sugarcane plants of ratooning productivity with low external input of fertilization treatment towards farmers can increase profits. The method used is the Completely Randomized Block Design (CRBD) with four treatments and three repetitions (4x3). Sugarcane varieties R 579 planted in each patch experiment 5x5 m^2. Dosage of fertilizer: P0 = 3.6 kg/year plot experiment was 100% dosage usage of chemical fertilizers used by farmers. Further dosages were P1 (75%) = 2.7 kg/plot, P2 (50%) = 1.8 kg/plot and P3 (0.25%) = 0.9 kg/plot, each supplemented with fertilizer 5 mL of liquid organic/patch a year. Sugarcane crops with a variety of treatment showed no significant difference. The highest productivity was achieved at dosages of P2 (50% chemical fertilizers plus organic fertilizer) is 21.67 kg per square meter. Chemical fertilizers can be saved 7 quintals per hectare a year or Rp 997,500 per year. Additional costs of liquid organic fertilizer Rp. 100,000 per hectare year and labor Rp 100,000 per hectare, so the additional advantage of saving farmers fertilizer Rp. 797,500 per year.

Keywords: sugarcane plant, ratooning, fertilizing, profits.

Abstrak. *Latief AS, Syarief R, Pramudya B, Muhadiono. 2010. Productivity of sugarcane plants of ratooning with fertilizing treatment. Nusantara Bioscience 2: 43-47*. Penelitian ini bertujuan untuk menentukan produktivitas tebu keprasan dengan perlakuan pemupukan input eksternal rendah, sehingga petani dapat meningkatkan keuntungan. Metode yang digunakan adalah Blok Rancangan Acak Lengkap dengan empat perlakuan dan tiga ulangan (4x3). Tebu varietas R 579 ditanam pada masing-masing plot percobaan seluas 5x5 $meter^2$. Dosis pupuk: P0 = 3,6 kg/plot yaitu 100% dosis penggunaan pupuk kimia yang digunakan oleh petani. Selanjutnya dosis: P1 (75%) = 2,7 kg/plot, P2 (50%) = 1,8 kg/plot dan P3 (0,25%) = 0,9 kg/plot, masing-masing dilengkapi dengan 5 mL pupuk organik cair plot/tahun. Tanaman tebu dengan berbagai perlakuan tidak menunjukkan perbedaan yang signifikan. Produktivitas tertinggi dicapai pada dosis P2 (pupuk kimia 50% plus pupuk organik) adalah 21,67 kg/m^2. Pupuk kimia dapat dihemat 700 kg/ha/tahun atau Rp 997.500 per tahun. Tambahan biaya pupuk cair organik Rp 100.000 per tahun hektar dan tenaga kerja Rp 100.000 per hektar, sehingga keuntungan tambahan petani dari tabungan pupuk Rp. 797.500 per tahun.

Kata kunci: tanaman tebu, keprasan, pemupukan, keuntungan.

INTRODUCTION

In this time government is inciting sugarcane planting of superior variety to overcome the low sugar production in Indonesia. To be in the triumph time as sugar exporter in the year of 1930 is done by increasing sugarcane product either through quantity and quality with paying attention to the environment preservation. Indonesia sugar productivity has declined, not only because of less field, irrigation and the increasing dry field or dry farming that planted sugarcane, but also that sugarcane variety doesn't support productivity and the ratooning is done more than 10 times. Therefore the company of Plantation Nusantara XI in East Java does penetration to develop new variety of arcane plants namely R-579 (Minister of Agriculture of the Republic of Indonesia 2002). This new variety can produce average sugar of 10, 07 ton of /ha, while the average national productivity is 4 ton /ha (Anon 2002).

Development of sugarcane is quite reasonable where it is produced more than half of the world's sugar production from sugarcane (Mubyarto and Daryanti 1994). The productivity of sugarcane crop in Indonesia that has been achieved is 4.924 tons/ha (Anon 1996), but in the last 5 years it has increased from 5.7 tons/ha in 2004 to 6.8 tons/ha in 2009 (Lestari 2009); while in Papua New Guinea to reach 5.5 tons/ha (Hartemink 1996), and South Africa 11.0 tons/ha (McGlinchey and Inman-Bamber 1996).

The administrator of Sugar Factory of Rendeng, Kudus, said, most of 5,679 hectares sugarcane plants were cultivated by farmers farmer with ratooning system, with the average 10 times. Sugarcane productivity moment harvests the highest products of 70 ton/ha, and yield only 5,76%. Begin in the year 2003, farmers plant a kind of superior varieties namely PS 851 (Minister of Agriculture of the Republic of Indonesia 2004) and R 579 (BR 579) in the area of 728 hectares. The superior variety R 579 has been experimented at some amount in the Sugar Factory in East Java and has produced the minimum crops of 150 ton/ha 8% (Krismanu 2003).

The ratooning system is growing return sugarcane that felled. Anon (2005), ratooning sugarcane management has been intensively done since the issue of the President Instruction number 9 in 1975 about intensification. Since 1990, the trend of the use of ratooning system of sugarcane has continued to increase, that is around 60% from total square existing sugarcane.

Since Green Revolution was proclaimed in the 1970's farmers' dependence in inorganic fertilizer use has been there. Inorganic fertilizer used that is overdosage or more causes the depletion of the soil quality, and it leads to the decrease of sugarcane's productivity. Aryantha said that (2002) this condition causes inhibited of root absorption process towards water and nutrient that was dissolved so that the existence of nutrient in total low is not taken by the roots in maximally. Thereby certain dosage of fertilizer is needed to make the roots able to absorb the nutrient in enough number from the nutrients available in the soil.

Suprapta (2005) said that chemical fertilizer causes bad impacts as we have witnessed. He added that we should organic fertilizer and at the same time also slowly reduces the use of chemical fertilizer. While According to Darutama (2008), organic fertilizer the use organic fertilizer for sugarcane plants obviously shows good significance in comparison with the use of chemical fertilizer such as urea or NPK.

The success sugarcane farming means giving the profits to the farmers and being able to keep the environment healthy. Therefore it is necessary to conduct research aimed at decreasing the use of chemical/inorganic fertilizer and encouraging the use of organic fertilizer to do the rationing system for sugarcane farming to make the productivity stable.

MATERIALS AND METHODS

Location and time of research

The research location based on fertilizing variation treatment effort plan towards ratooning sugarcane plants is chosen to be conducted at Jurang Village, Gebog Subdistrict, Kudus District, Central Java. The place that is used to do the analysis towards the chemical element of the soil nutrient, good macro, and microelement is in the Laboratory of Department of Soil Science and Land Resources, Faculty of Agriculture, Bogor Agricultural University (IPB), Bogor. Research time is carried out to begin in July 2008 and end in June 2009, during one sugarcane harvest season.

Materials and tools

Principal material is a variety of sugarcane plants namely R 579. Other materials are fertilizers namely: (i) inorganic fertilizer ZA (ammonium sulfate), and NPK (Phonska), (ii) liquid organic fertilizer.

Method

The design of the research was Completely Randomized Block Design with 4 (four) treatments and for each treatment, there are 3 (three) repetitions. Fertilizing treatment is done towards ratooning sugarcane plants. Ratooning sugarcane plants that are analyzed is the variety of sugarcane namely R 579 that can undergo the ratooning process three times (can be four in the future) in the area in Jurang village, district Gebog, Kudus regency. The size of trial compartment each 5x5 square meters = 25 m^2 (poled to be clear the limit).

The fertilizing treatment that is: (i) P0 = the use chemical fertilizer (inorganic fertilizer/factory fertilizer) done by the farmers up to that time (100% inorganic fertilizer), without organic fertilizer. (ii) P1 = chemistry fertilizer use is reduced by 25% from the usual use (75%) then replaced by the organic fertilizer. (iii) P2 = chemistry fertilizer use is reduced by 50% from the usual use (50%) and replaced by organic fertilizer. (iv) P3 = chemistry fertilizer use is reduced by 75% from the usual use (25%) then replaced by the organic fertilizer.

The addition of organic fertilizer is done towards P1, P2, and P3 with the same dosage, that is 2 L every hectare a year, while P0 as a group control does not use organic fertilizer. Organic fertilizer kind use result of Fadiluddin (personal communication 2009).

The use dosage 2 L/ha of land, atomized twice (each time spraying 1 L/ha), before atomized in soil surround plants, liquid organic fertilizer is thinned with water first of all with comparison 100 mL to 1 (one) tank sprayer (15 L water) or 15 mL (size bottle plug) to 2 L water.

Liquid organic fertilizer use to each size compartment 25 m^2: 25/10,000x2 liters = 5 mL. Overall use from 9 trial compartments (P1, P2, and P3 with repetition 3 times) a year need: 5x9 = 45 mL then thinned with 6 clean water liters. Fertilizing with liquid organic fertilizer was done by spraying, one year did 2 times, as according to inorganic fertilizing, not concurrent but done 3-5 days before or after fertilizing with inorganic fertilizer.

Inorganic fertilizer use usually is done by farmer towards sugarcane plants each time fertilizing is 100 kilogram/sector of rice field is do twice a year (200 kilogram/year sector of rice field) consist of 50% fertilizer ZA (ammonium sulfate): nitrogen (N) = 21% and sulfur (S) = 24% and 50% fertilizer NPK (Phonska: N = 15%; P_2O_5 = 15%; K_2O = 15%; S = 10%)

One hectare there is 7 sectors of rice field, every sector of rice field approximately 1400 m^2. Inorganic fertilizer use for size of trial compartment 25 m^2 a yearlong is need: P0 = 25/1400x200 = 3.6 kg, P1 = 0.75x3.6 kg = 2.7 kg, P2 = 0.50x3.6 = 1.8 kg, and P3 = 0.25x3.6 = 0.9 kg.

Soil is taken as the sample to analyze as many as three times during research, that is: (i) before fertilizing, (ii) after fertilizing and (iii) approach harvest. Soil analysis is done in the laboratory to detect element of nutrition completely.

Sugarcane plants observation is done according to in a flash with taking when soil samples taking. The finals research is sugarcane harvest result ready mill from each trial compartment. Sugarcane observation is done towards: (i) amount of sugarcane plants every square meter or every meter makes, (ii) tall/long sugarcane stick ready mill and (iii) sugarcane stick diameter (measured 15 cm from base). Sample taking at random every square meter (meter makes

from each trial compartment). Heaviness each weighed and analyzed to detect treatment difference with statistical methods that are Analysis of Variance (ANOVA).

RESULT AND DISCUSSION

Soil evaluation criteria

Soil sample taking is done 3 times, that is: (i) before fertilizing in 9 Novembers 2008, (ii) after fertilizing on 22 February 2009 and (iii) approach harvest on 21 May 2009. Based on soil analysis result from Department of Soil Science and Land Resource, Faculty Agriculture, Bogor Agricultural University (IPB) Bogor, follow Hardjowigeno (2007) determinable the criteria as be shown in Table 1, Table 2 and Table 3.

Criteria of nutrition N before fertilizing, after fertilizing and approach harvest shows low, while P in the form of P_2O_5 there increases a little, but K does not change. Another macro element that is: Ca, Mg and Na are fair.

Sugarcane productivity

Based on observation towards sugarcane plant when taking second soil sample 22 February 2009 known that for treatment P0, green appear sugarcane leaf, while for treatment P1, P2, and P3 appear sugarcane leaf more becomes yellow. But when taking third soil sample 21 May 2009 that is approach sugarcane leaf color harvest visible has not shown difference. This matter caused by organic fertilizer has begun to react towards soil so that root absorption towards water and nutrition is better.

Table 1. Soil chemistry properties evaluation criteria before fertilizing

Soil properties	Treatment: P0 = P1 = P2 = P3	Criteria
C (%)	1.2	low
N (%)	0.13	low
C/N	9.23	low
P_2O_5 HCl (mg/100 g)	23.6	fair
P_2O_5 Bray 1 (ppm)	2.2	very low
KTK (me/100 g)	14.82	low
K (me/100 g)	0.44	fair
Na (me/100 g)	0.34	fair
Mg (me/100 g)	1.67	fair
Ca (me/100 g)	5.34	fair
Saturation of basic (%)	52.56	high
pH H_2O	4.5	acid
pH KCl	3.6	very acid

Table 2. Soil chemistry properties evaluation criteria after fertilizing

Soil properties	Treatment				Criteria
	P0	P1	P2	P3	
C-org (%)	0.96	1.36	1.2	0.96	P0 very low; P1 low; P2 low; P3 very low
N-total (%)	0.12	0.13	0.11	0.09	P0 low; P1 low; P2 low; P3 very low
C/N	8	10.46	10.90	10.66	P0 low; P1 fair; P2 fair; P3 fair
P_2O_5 HCl (mg/100 g)	25.86	30.43	49.76	48.91	P0 fair; P1 fair; P2 high; P3 high
P_2O_5 Bray 1 (ppm)	53.1	32.5	60.0	52.4	P0 very high; P1 high; P2 very high; P3 very high
KTK (me/100 g)	15.35	14.96	14.56	15.55	P0 low; P1 low; P2 low; P3 low
K (me/100 g)	0.28	0.28	0.58	0.28	P0 fair; P1 fair; P2 high; P3 high
Na (me/100 g)	0.24	0.23	0.30	0.22	P0 low; P1 low; P2 low; P3 low
Mg (me/100 g)	1.48	1.67	2.43	2.57	P0 low; P1 fair; P2 high; P3 high
Ca (me/100 g)	6.77	6.95	5.65	7.87	P0 fair; P1 fair; P2 fair; P3 fair
Saturation of basic (%)	57.13	61.03	61.54	70.35	P0 high; P1 high; P2 high; P3 very high
pH H_2O	4.00	4.30	4.40	4.40	P0 very acid; P1 very acid; P2 very acid; P3 very acid
pH KCl	3.3	3.5	3.5	3.7	P0 very acid; P1 very acid; P2 very acid; P3 very acid

Table 3. Soil chemistry properties evaluation criteria approach harvest

Soil properties	Treatment				Criteria
	P0	P1	P2	P3	
C-org (%)	1.43	1.27	0.95	0.71	P0 low; P1 low; P2 very low; P3 very low
N-total (%)	0.13	0.11	0.10	0.09	P0 low; P1 low; P2 low; P3 very low
C/N	11	11.5	9.5	7.9	P0 fair; P1 fair; P2 low; P3 low
P_2O_5 HCl (mg/100 g)	34.01	33.16	36.21	43.99	P0 fair; P1 fair; P2 fair; P3 high
P_2O_5 Bray 1 (ppm)	49.0	47.3	49.3	56.2	P0 very high; P1 very high; P2 very high; P3 very high
KTK (me/100 g)	18.62	27.75	20.35	22.2	P0 fair; P1 high; P2 fair; P3 fair
K (me/100 g)	0.35	0.08	0.10	0.29	P0 fair; P1 very low; P2 low; P3 low
Na (me/100 g)	0.40	0.19	0.21	O.90	P0 fair; P1 low; P2 low; P3 high
Mg (me/100 g)	2.70	0.20	0.18	0.31	P0 high; P1 very low; P2 very low; P3 very low
Ca (me/100 g)	8.63	4.3	2.6	3.5	P0 fair; P1 low; P2 low; P3 low
Saturation of basic (%)	64.88	32.4	36.9	83.3	P0 high; P1 low; P2 fair; P3 very high
pH H_2O	5.40	5.50	5.20	5.30	P0 acid; P1 acid; P2 acid; P3 acid
pH KCl	4.50	4.70	4.00	4.10	P0 acid; P1 acid; P2 acid; P3 acid

Sugarcane harvest is done at dry season because moment that has high yield, after cutting down sugarcane soon be processed to be sugar. The cutting down of sugarcane in this research is done after age approximately one year, that is on 16 June 2009.

Amount of sugarcane plant/stick every square meter based on observation in the harvest in the range from 16 up to 24 stick of sugarcane. Long sugarcane stick ready mill also vary that is between 1.5 meters up to 3.5 meters. Sugarcane stick diameter ranges from 2.5 cm up to 4.5 cm. The average amount stick, length stick, and sugarcane stick diameter is presented in Figure 1.

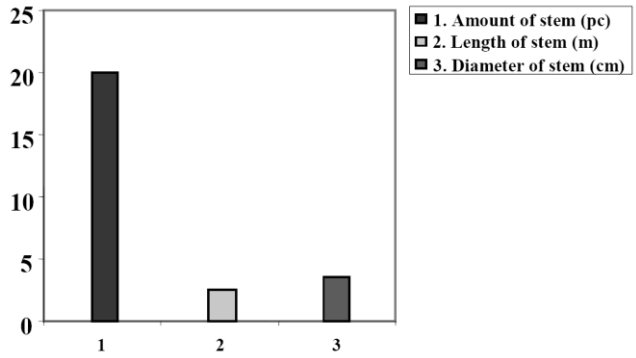

Figure 1. Amount average of stem, length, and diameter of sugarcane plant every square meter in experimental land.

The model of relation between fertilizing treatment with sugarcane productivity is shown in Figure 2.

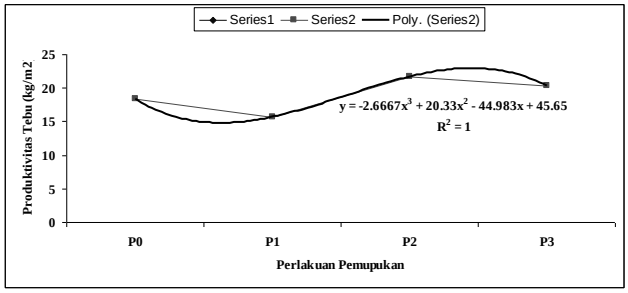

Figure 2. Relation between fertilizing treatment and sugarcane productivity.

Based on the Analysis of Varian with signification standard 1%, sugarcane productivity with variation fertilizing treatment, it doesn't show real difference. Highest productivity is achieved in treatment (P2) that is fertilizing combination with reduction of 50% chemistry fertilizer from the usual one done by farmers, added with organic fertilizer. Thereby it can save the chemistry fertilizer purchasing cost-saving as big as 50%, although the liquid organic fertilizer purchasing cost and labor cost for fertilizer spraying increase.

Farm operation analysis of sugarcane and cost-saving

Farm operation analysis of sugarcane is done to determine profit and business feasibility based on income ratio criteria towards net (B/C). Farm operation of sugarcane is said feasible when value B/C bigger than one

Based on primary data that is got and cultivated with one-hectare land square production cost: C = Rp 12,000,000. Land lease was Rp 5,000,000 per year. Labor, cultivation, fertilizer, and pesticide were Rp 7,000,000 per year. Sugarcane sales revenue: Rp 160,000 per ton, sugarcane harvest result 150 ton/ha, so that Benefit total: B = Rp. 24,000,000.

Farm operation profit of sugarcane: B-C = Rp 24,000,000-Rp 12,000,000 = Rp 12,000,000 per year.

Benefit per Cost Ratio: Net B/C = Rp 24,000,000/Rp 12,000,000 = 2.0.

Based on analysis result above (B/C = 2.0 > 1), it can be known that the farming operation of sugarcane is feasible.

Cost-saving analysis is based on fertilizer chemistry (inorganic fertilizer) use reduction 50% from habit that is as much as 7 quintals (700 kg) fertilizer that can be saved without decreasing of productivity. Chemistry fertilizer dosage that used farmers usually is 1.4 ton/ha. Despite organic fertilizer use cost and labor increasing, but still more beneficial because liquid organic fertilizer use lower than chemistry fertilizer, besides that is also cheaper the price.

The price of kind inorganic/chemical fertilizer ZA: Rp 110,000 per quintal, kind fertilizer Phonska: Rp 175,000 per quintal. Fertilizer use ZA and Phonska proportional, which is each 50%. Cost addition for liquid organic fertilizer: Rp. 50,000 per liter, as much as 2 L/ha and labor wage: Rp 25,000 per day as much as 4 persons.

Based on this research result when applied manifestly with chemistry fertilizer reduction 50% is 7 quintal/year is land square base one hectare, so cost-saving can be done by farmer:

Chemistry fertilizer cost-saving-(organic fertilizer cost + worker wage) = 7x(110,000 + 175,000/2-(2x50,000 + 100,000) = Rp. 797,500/hectare.

Cost-saving a kind of this be concept LEISA (Low External Input Sustainable Agriculture), that is a concept that promoting system and those agriculture manners by using a little chemical addition. Principle applications LEISA make possible Good Agriculture Practices (GAP) where productivity and economy profit is increased in the way of that pay attention ecological aspect. For example, livestock animal maintenance to make use in stable fertilizer maker with agriculture rubbishes utilization like foliage to be used as supplement plants.

CONCLUSIONS AND RECOMMENDATIONS

The productivity of sugarcane with fertilization treatment variations P0, P1, P2, and P3, showed no significant difference. The highest results achieved by treatment of P2, which is 21.67 kg/m² of land area.

Reduction of chemical fertilizers without the addition of organic fertilizer is not made because the experience of farmers who have tried to reduce the dosage of chemical fertilizers without the addition of organic fertilizers, the

productivity of sugarcane declined. Thus the combination of reduction in the use of chemical fertilizers and organic fertilizers can stabilize the productivity of sugarcane and input cost savings. Input cost savings made by farmers is an advantage, is Rp. 797,500/hectare during the season (year)

This study should be followed up at various locations mainly on dry land, and the land with more extensive experiments, and the use of chemical fertilizers ZA and Phonska varied to obtain optimal savings. Future research needs to be done reducing the use of chemical fertilizers or without the use of chemical fertilizers at all. The use of organic fertilizer without chemical fertilizers is conducting agricultural/organic sugarcane plantations, so that farming guidelines and good agricultural products (Good Agriculture Practices/GAP).

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