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Agriculture and Agricultural Science Procedia 9 (2016) 158 – 162

Agriculture and Agricultural Science Procedia

International Conference on Food, Agriculture, and Natural Resources, FANRes2015

Effects of Si-Fertilizer Application through the Leaves on Yield and Sugar Content of Sugarcane Grown in Soil Containing Abundant N

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Abstract

The research objective is to overcome the negative effects of the very high N supply for the sugar content of sugar cane. While on the other hand in order to produce high sucrose, sugarcane requires a supply provided approximately 350 kg N/ha. Experiments conducted on the sugar cane plantations containing available N higher than 2500 kg/ha. The treatments were: 1) without spraying of Si-fertilizer and 2) with spraying of Si-fertilizer began when sugarcane 3 months old (8 times spraying), with consentration of 4.3 g/L. Experiment ended at the age of 10 months for PS881 and 12 months for BL. Spraying tends to produce a yield that is different from unsprayed cane. Si-fertilizer decreased sugar content of BL, but increased harvest yield. Si-fertilizer decreased harvest yield, but increased the sugar content of PS 881.

Peer-review under responsibility of the organizing committee of IC-FANRes 2015

Keywords: Sugar cane, BL, PS881, supplay, nitrogen, sugar content.

1. Introduction

After analyzing the soil, it turns out the land used to grow sugar cane in this study had a very high nitrogen content is above 2.5 tones / ha. Soil test done at 3 months old sugarcane crop. Excess nitrogen can reduce net assimilation as a result of the many leaves that overlap, the cell walls become thin and inhibition of the formation of lignin and cellulose (network amplifier), so that the plant becomes susceptible to pests and diseases, the plant is not resistant to drought stress due to inhibition of root elongation. The above problems will lead to lower sucrose content in sugarcane crop harvested as sucrose synthesis is controlled by nitrogen (Marschner, 1995), so that the supply of N should be sought to approach the physiological needs of plants. Moreover, plants that excess N will

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Peer-review under responsibility of the organizing committee of IC-FANRes 2015
doi:10.1016/j.aaspro.2016.02.111

require more energy to convert mineral N into organic N in the body of plants, so the stored sugar will largely reduced (Bacon, 1995).

Results of research on sugar beet proved that, the plant supplied excess N forming organic N hamper the process of extracting the juice and crystallization of sucrose (Kling and Steinhauser, 1984).

Ammonium dominates N in the soil experiment, so the presence of ammonium possible will inhibit the absorption of other cations, especially K, Mg, Ca, and Mn. Cations have a physiological function associated with photosynthetic capacity and the natural resistance of plants.

As the anticipation necessary to the provision of cations K, Mg, Ca and Mn contained in Formula-Si through the spray so that the deficiency can be prevented. The Si-nutrition proved to be an effective means for the control of *Leptosphaeria sacchari* in sugarcane as well (Raid et al., 1992).

Many attempts have been made to increase the yield, but have not met expectation. The low yield of sugar per unit area is most likely caused by the supply of N that is not in accordance with the physiological needs of sugarcane to produce high sugar.

2. Material and Method

Research conducted in the field PG Jatiroto, Lumajang. Sugarcane is used as the subject of research already 3 months old. The research objective is to overcome the negative effects of the N supply is very high for the yield of sugar cane. This effort is important because the soil contains available N more than 2.5 tonnes/ha. The parameters observed are the sugar content and weight of harvested cane.

Materials used in this study are two varieties of sugarcane (BL and PS 881), Formula-Si 10,000 ppm, NPK, SP36, KCl, ZA, and other chemicals needed in the analysis of NO_3, NH_4, N total N of the soil. Spraying of Si-Formula began when sugarcane 3 months old, and then carried out every week to 5-month-old plants (8 times spraying), with Formula-Si concentration of 4.3 g/L. Experiment ended at the age of 10 months for PS881 and 12 months for BL.

Checking soil N content performed on the sugar cane that has been aged 3 months finished fostered. Fertilizer applied as directed PG namely: NPK 500 kg/ ha, SP36 100 kg/ha and KCl 100 kg/ha. The treatments being compared are two kinds of action post-fertilization, namely: 1) without the application Formula-Si and 2) with application Formula-Si through the leaves. The size of each experimental plot of 0.05 hectar, the number of rows 60 and each row there are 24 groves of sugarcane, so number of clumps 1440 in one experimental plot and the distance between rows of 100 cm.

3. Results and Discussion

Even though from a scientific point of view Si was not proven to be essential for higher plants it is well established that Si can promote plant growth especially under conditions of biotic and abiotic stress. Due to its manifold positive effects on growth Si was designated as a beneficial element for plants (Asher, 1991; Marschner, 1995). Positive Si effects cover a wide range of abiotic stress factors, such as increased tissue tolerance of manganese toxicity (Horigushi and Morita, 1987; Horst and Marschner, 1978), aluminum resistance (Wang *et al*., 2004), resistance against salt stress (Liang et al., 2003; Zhu et al., 2004), P excess (Ma and Takahashi, 1990), drought (Lux et al., 2002; Hattori et al., 2001), and temperature extremes (Agarie et al., 1998). In addition, Si nutrition prevented lodging of rice (Idris et al., 1975) and wheat (Gartner and Paris-Pireyre, 1984) by strengthening culm walls and vascular bundles, and increased photosynthesis by promotion of an upright stature, especially under conditions of high nitrogen supply (Yoshida et al., 1969).

Si application tends to increase the sugar yield cultivars PS881 from 7.79% to 8.27%, but lowered the yield cultivars BL from 7.83 to 7.39% (Figure 1). Si-Fertilizer application gave a non significan differences to sugar cotent and yield likely caused by the condition of sugarcane that has been aged 3 months was a lot of leaves damaged by virus mosaic and leaf rust disease, so Si-Fertilizer application is not a lot to contribute to the growth and metabolic processes of plants.

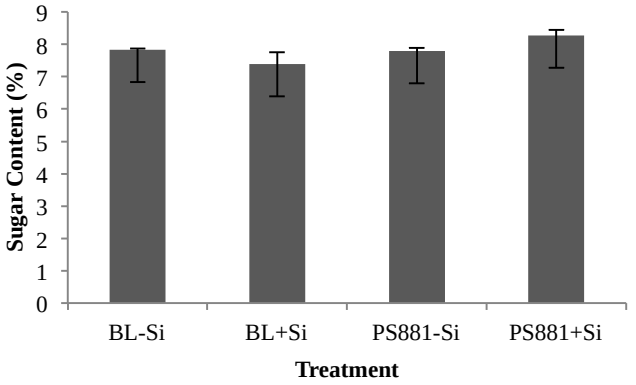

Figure 1. Sugar Content of BL and PS881 after Harvesting

There are several possibilities that reduce the effectiveness of the fertilizer-Si include: 1) absorption of Si-solution disrupted due to the many strands of leaves damaged by leaf rust, so it is possible many stomata and leaf pores are broken, 2) the process of photosynthesis disrupted because a lot of chlorophyll damaged by mosaic virus (degree of damage was not quantified), 3) the supply of N is too high so that the effect of the Si application is non significan. As proposed by Graham (1983), that the plant resistance against the disease is highly dependent on nutritional status of the plants, in this case the supply of ammonium is very high. Ammonium will stimulate cell division and cell enlargement rapidly so as to produce cells containing a high water (succulent) and thin-walled (Marschner, 1995).

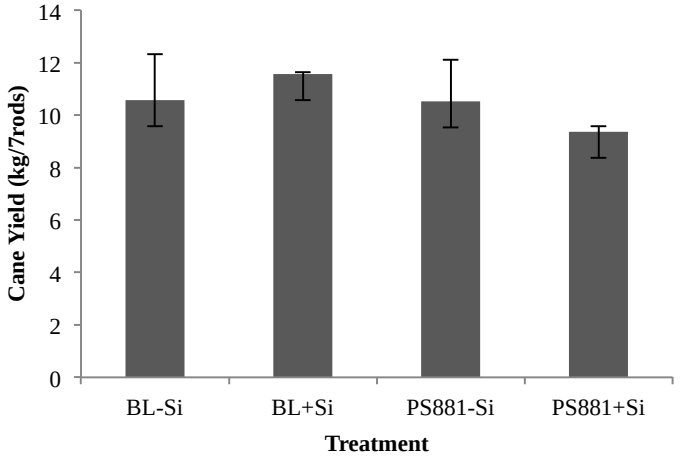

Figure 2. Cane Yield of BL and PS881 after Harvesting

High supply of ammonium (see Figure 1) also reduces the absorption of cations that play a role in the natural resistance of plants, especially calcium (Ca), potassium (K) and copper (Cu) (Conway et al., 1998), plants that are deficient in calcium will be impaired synthesis of proteins, but will accumulate amino acids that make the plants become more susceptible to disease. Cu and K-deficient plants will be more susceptible to disease because Cu and K will stimulate lignification process. Lignin inhibit pathogen infection (Graham, 1983). The resistance of plant in general will rise when the supply of Ca, Cu and K to be optimal and the response of plants is also affected by the

type of disease (Kiraly, 1976), degrees of plant resistance (Shaner and Finney, 1977), and the form of nutrients (NO_3^- or NH_4^+).

Supra optimal supply of N (Conner et al., 1992) and K (Drobny et al., 1983) often reported to increase the susceptibility of plants to diseases. The length of the cane is a parameter of growth which is also a component of production. With the same rod diameter, longer rod of sugarcane will produce higher yield. With the same sugar content and more sap will increase the yield of sugar. Figure 3 shows a different response to Si fertilization of two varieties. PS881 produce slightly better rods without Si compared with Si, but the BL produce a longer rod with- Si than BL without Si fertilization.

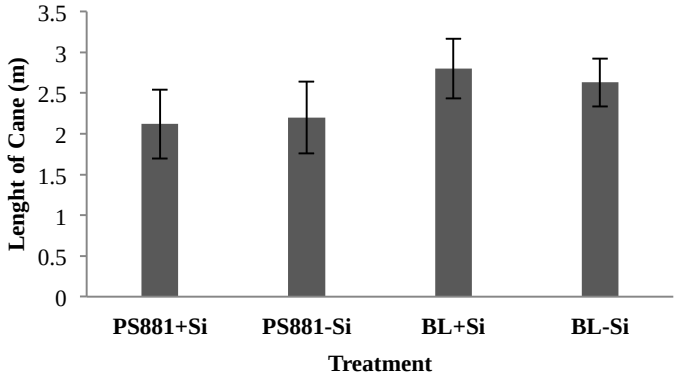

Figure 3. Cane Lenght of BL and PS881 after Harvesting

Stem diameter also one of the important parameters of growth and production as it will affect the weight of the harvest. The larger the diameter of the rod will increase the weight of the rod.

Figure 4 shows the response of two varieties on Si. PS881 and BL produces better diameter of the rod with Si fertilization.

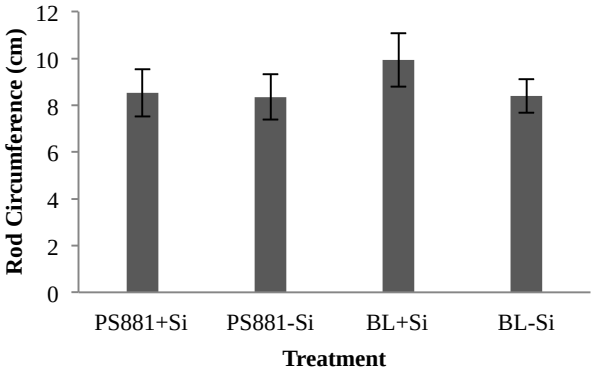

Figure 4. Cane Circumference of BL and PS881 after Harvesting

4. Conclusion

Varieties (BL and PS881) showed different response to Si-fertilizer. Si-fertilizer decreased sugar content of BL, but increased harvest yield, whereas decreased harvest yield, but increased the sugar content of PS881.

Acknowledgements

This research was carried out with the support of PG Jatiroto, PTPN XI.

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