International Journal of Scientific & Engineering Research Volume 10, Issue 1, January-2019
ISSN 2229-5518

THE SWEET SORGHUM (*Sorghum bicolor L.*) FOR FEED AND ENERGY

M.C. Tri Atmodjo

PPIPE BPPT Jl. Inovasi no.1 Puspitek, Setu, Tangerang Selatan, 085861228809
Email : chaerudin.atmodjo@bppt.go.id

The Sweet sorghum plants (Sorghum bicolor L.) are cereal plants that are quite potential to be developed in Indonesia because they have a fairly extensive environmental adaptation, especially in marginal dry land. The Sweet Sorghum is also an alternative commodity for, feed and bioenergy that is very prospective in terms of all the biomass components that can be utilized. Sorghum is a prospective source of bioethanol raw material. The Cultivation of sweet sorghum plants for renewable energy and animal feed that is no plant waste that pollutes the environment or we can say that almost zero waste or no waste disposal to environment.

Key Words: Bioenergy, Feed, Sweet Sorghum, Cereals

1.INTRODUCTION

Sweet sorghum plants (Sorghum bicolor L.) are cereal plants that are quite potential to be developed in Indonesia because they have quite extensive environmental adaptation, especially in marginal dry land. Sorghum is also an alternative commodity for food, feed and industry which is very prospective in terms of the results of all biomass components that can be utilized. However, this plant has not been cultivated and cultivated optimally to become a commodity that can produce economic value equivalent to other crops. Some farmers in Central Java and NTT have cultivated sorghum using local varieties for the purpose of animal feed. Lately, with the launch of the Vegetable Fuel program, sorghum plants are a prospective source of bioethanol raw material because all of the plant components can be used as raw materials for energy, food and feed (Zubair 2016). Increasing domestic sorghum production needs special attention because Indonesia is very potential for the development of sorghum (Subagio and Aqil, 2014).

The rural agrarian environment in Indonesia has the potential to support food, feed and energy security. The linkages between plants and livestock in rural areas within the framework of traditional farming are optimal utilization of land resources, labor and capital to produce products such as food, forage and energy (Aprizal 2001; Priyanti et al. 2007; Soedjana 2007; Bamualim 2008)

An assessment of sweet sorghum cultivation has been carried out through the selection of varieties that are suitable or have adaptations to the conditions of Lampung Red Yellow Podsolic dry land. Likewise, the study of harvest age for varieties that have been tested for the purpose of animal feed / silage and bioethanol production processes has been carried out through analysis of Total Sugar (TS) plant stem sap.

2. MATERIALS AND METHOD

In this study was used randomized block design. The sweet sorghum varieties studied were as follows: 1) Numbu, 2) Mandau, 3) PSj (lines from Batan), 4) GHZb (lines from Batan) and 5) Kosyoka Sorgo (var. From Japan)

The assessment of sweet sorghum cultivation includes the cultivation of sweet Sorghum accompanied by the utilization of all components of the crop, leaves and stem for feed, sweet sorghum juice for energy. The stages of cultivation are in accordance with 1.Planting, 2.Fertilizing, 3 Weeding, 4.Harvesting, 5 Leaf Selection for feed, 6.Crushing of Stem, 7.Application of Biopower for sillage. 8. Sillage packing.

3. RESULTS AND DISCUSSION

The results of observation of Sweet Sorghum Plant Growth are as follows:

1. Heigh of Plant

The plant height of several varieties studied is presented in figure 1.

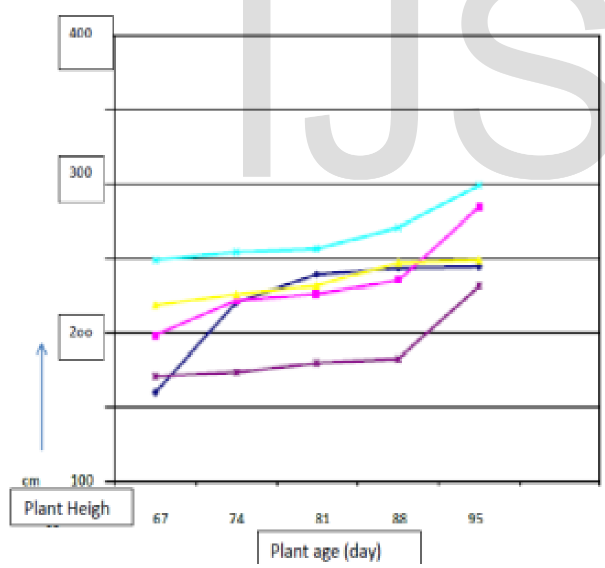

Figure 1. Graph of plant growth based on variety and age of plants

Remarks : Numbu , PSj , GHZb , Koshyoka , Mandau

From the data and graph above, we can see the increase in age of the plant, the height of the stem will increase and stop at a certain age of about 95 days. Koshyoka and PSj varieties have a height of ≥ 250 cm and Numbu varieties, GHZb, Mandau has plant height 250 cm.

2. Number of Leaf

The number of leaf from several varieties studied is presented in figure 2.

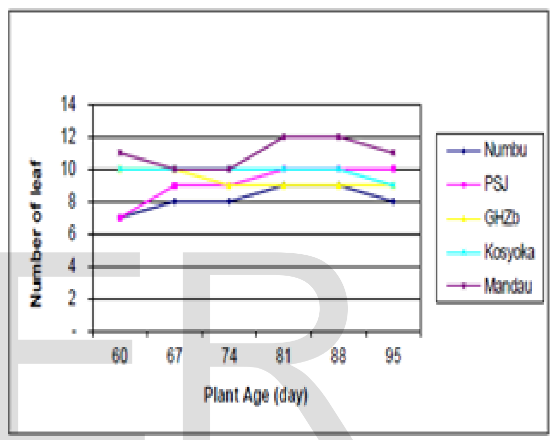

Figure 2. Graph of vegetative growth of plants based on variety and age of plants

From the data and graph above, we can see the age increase of the plants, the number of leaves will increase and decrease (dry out) at a certain age about 85 days. Koshyoka, PSj, Numbu, GHZb varieties have a number of leaves less than 10 and Mandau has more or equal to 10 leaves.

3. The Stem Circles

The Stem circle of several varieties studied is presented in figure 3.

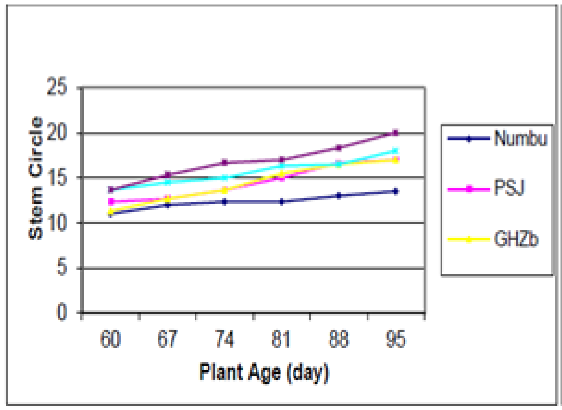

Figure 3. Graph of vegetative growth of Stem Circle based on variety and age of plants

From the data and graph above we can see that with increasing age, the stem circle increases and stops at a certain age of about 95 days. Koshyoka, PSj, GHZb, Mandau varieties have a stem circle of ≥ 15 mm and the Numbu variety has a stem circumference of ≤ 15 mm.

For the dry season cultivation mulch treatment has a significant effect on the number of leaf parameters. The treatment of organic matter has a significant effect on the parameters of plant length, number of leaves, and stem diameter (Siregar, N, Irmansyah, T and Mariati. 2016).

The results of the study by Fadriansyah (2015) suggest that administration of organic mulch such as rice straw is the right alternative because rice straw mulch can improve soil fertility

From the results of selling sorghum seeds in the form of seeds when the price of seeds reaches Rp. 25,000 per kg, a profit of Rp. 17,050,000 per hectare is obtained. If the price of seeds is only Rp 10,000 per kg, a loss of Rp 4,950,000 per hectare occurs.

Leaf development differences such as smaller canopy size, delayed plant vigor, or increased leaf display rates are believed to increase seed yield especially in dry conditions (Kholová, et al., 2014).

4. The Stem Weight

The Stem Weight per ha presented in figure 4

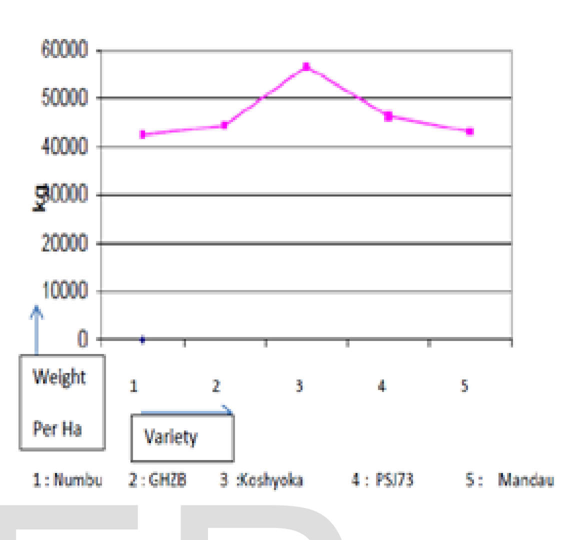

Figure 4. Graphical Stem Weight per Ha based on plant varieties

From the graph above, it can be seen that the stem potential is the most significant in the case of koshyoka, which is 56,619 kg per ha, it is estimated that the frequency of variance is superior to other varieties. Whereas the least stem weght are obtained from Numbu varieties of 42,408 kg per ha.

The potential of sorghum koshyoka plants is 56,619 kg per hectare if it is made sillage as far as meeting the needs of 1 ruminants in the dry season for 9 months each year or 1.5 cows for 6 months. The body weight of several cows fattening phase (the cow is already 2 teeth), the total is 6,000 kg. The feed ration uses a moderate benchmark of 2.5% of the weight of the body based on dry ingredients equal to 150 kg.

If the complete feed water content is 25% (75% dry matter), then the total amount of complete feed needed = 150 kg x 100/75 = 200 kg per day or 6 tons of forage per month. In addition to sweet sorghum leaves, silage straw and corn leaves can be made silage which is of quite good quality (Naibaho et al; 2017)

The average annual dry biomass and dry matter content of three sweet sorghum cultivars showed an overall upward trend with increasing plant length. The average dry biomass yield of the three groups of sorghum maturity on arable land was 48.9% higher than that of salt-alkali soil (Chao-Chen et al; 2018).

5. Total Sugar (TS)

The Total Sugar Content presented in figure 5.

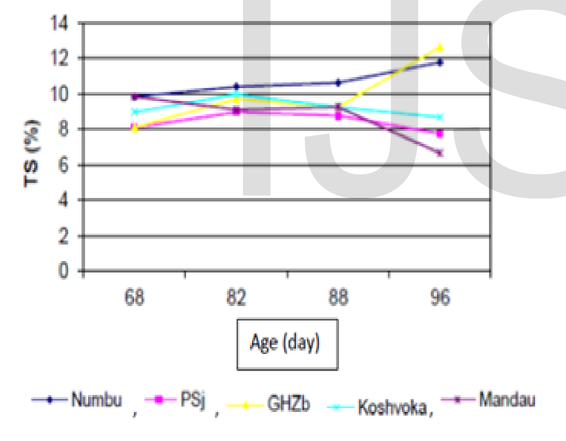

Fig 5. The total sugar (TS) of several variety

From the graph above there are two varieties increasingly increasing in age, the increasing amount of total sugar (TS) that is formed, namely the varieties of Numbu and GHZb. The GHZb are suitable for use as raw material for ethanol which is more flexible during the harvest period. Whereas the other three varieties are increasingly growing in age, the total amount of sugar (TS) decreases. The results of research by Soha and Khalila in 2015 showed that from 1 kg of SS 301 varieties obtained 60mL of ethanol from the raw material of juice and bagasse. Sorghum juice can also be fermented into saturated fat (high lipid yield) using Cryptococcus curvatus. (Yi Cui, Yanna Liang, 2015).

The study of generative properties (plant height, panicle length, and panicle) and yield components showed that the tested varieties responded well to the environment in which they were grown (Dewi, ES and Yusuf, M. 2017).

Table 6 illustrates the composition of sweet sorghum products based on mass and energy content and the net energy produced by each hectare of land.

Tabel 1. The Production of Juice and Fresh Top Yield of Sweet Sorgum per Hectar

	Production (ton/ha)	**Energy content** (Mkal/ton)	**Total Energy** (Mkal/ha)
Sugar (in juice)	8	3.940	31.500
Cellullose, Seed and Leaf	20	2.150	43.000
Total Yield	**28**	-	**74.500**
Input Energy for 1 ha			4.850
The Ratio of energi			23,23

The data above illustrates that with "capital" of energy 4,850 Mkal per hectare alone obtained 23.23 times energy yield. This multiple energy is read as sunlight energy that can be absorbed by sweet sorghum. The ability to absorb this is twice the corn and almost the same as sugar cane. With the acquisition of such energy, basically for other bioethanol production, no other fuel is needed and enough to use bagasse obtained from the process of squeezing sweet sorghum sap.

Thus, the use of improved varieties such as Numbu, PSJ etc. is very possible to be used as a sustainable energy source (Mullet et al., 2014).

4. CONCLUSION

1. The sweet sorghum plants suitable for animal feed and energy which is not pollutes the environment or zero waste.

2. Utilization of seeds for sorghum flour still needs to be studied considering the price of seeds is quite expensive between Rp 10,000 to Rp 25,000 per kg.

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