Acceleration adaption for integrated sugarcane cultivation technology through field laboratory practices

M Cholid* and M Machfud
Indonesian Sweeteners and Fiber Crops Research Institute, Jln Raya Karangploso Km 4, Malang-East Java-Indonesia

*Email: cholid.mohammad@gmail.com

Abstract. The use of superior varieties must involve cultivation aspects. The use of superior varieties supported by good cultivation techniques will provide higher sugarcane yields and productivity compared to conventional cultivation systems. Problems in sugarcane cultivation by farmers were identified and then those are used for assembling the suitable cultivation technology. The acceleration activity was carried out in Sukobendu village, Mantup District, Lamongan Regency, in January - December 2015 using an area of around 10 ha. The 10 ha land consists of 9 ha of farmer's land, with providing qualified sugar cane seeds, while 1 ha is used for Field Laboratory media. In field laboratory plot, cultivation technique applied consted of budchip seeds, introduction of double planting systems, addition of organic fertilizers, optimal plant maintenance and proper leaf detrashing. The use of bud chip seeds resulted in a highest sugarcane production and farmers' income. Implementation of integrated sugarcane cultivation technology in field laboratory could be an inspiration for the farmers to adopt the cultivation technology. These include unloading ratoon, the use of early mature and drought resistant varieties, bud chip seeds, double planting system, addition of organic fertilizer, and an optimal plant maintenance.

Keywords: budchips, dynamic approach, integrated, participatory.

1. Introduction
Sugarcane Integrated Crop Management (ICM) is an innovative and dynamic approach in an effort to increase sugarcane yield and production as well as increase farmer income through assembling participatory technology components with farmers. The main principles in implementing ICM are, (1) participatory, (2) location-specific, (3) integrated, (4) synergy and harmony, and (5) dynamic.

Participatory means that farmers play an active role in selecting and testing technological components, which are in accordance with local conditions and improve their abilities through the learning process in the field laboratory. Location-specific means paying attention to the suitability of technology with the physical, socio-cultural and economic environment of local farmers. Integrated means that plant, land and water resources are well managed in an integrated manner. Synergy and harmony, meaning the use of the best technology, by paying attention to interrelationships between technological components, which support each other. Dynamic means that the application of technology, always adapted to the development and progress of science and technology, as well as socio-economic conditions (Balitkabi, 2009a; 2009b).
ICM has been applied to rice, soybeans, peanuts and green beans, where the implementation of rice ICM has been proven to increase rice production nationally. But ICM in legumes has not given significant results. Sugarcane development should refer to the success of ICM in rice commodities. Like rice, sugar cane is a strategic commodity that produces sugar and is needed in daily basic needs.

The increase of population will increase sugar needs. Sugar needs in Indonesia are around 5.7 million tons, while domestic sugar production is around 2.6 million tons, and the rest is imported. In 2013 Indonesia was the largest importer of sugar after European Union. In 2010, sugar imports reached 2,197 million tons, and in 2013 the import of sugar increased to 3,2 million tons (Oktaviani and Siregar, 2013). The decline in sugar production in Indonesia is due to sugar cane yield and productivity tends to decrease (P3GI, 2008).

The unpleasant history of Indonesian sugar industry, making the development of the Indonesian sugar industry in the future difficult to predict. However, the government still proclaiming sugar self-sufficiency in 2014 with sugar production reaching 5.7 million tons. The assumption used is that there must be an additional area of 350 thousand hectares, revitalization of state-owned sugar factory and the construction of 10-15 new sugar factory with an average capacity of 10 thousand TCD (Ditjenbun, 2013). But the fact shows that until 2013 there was no significant expansion of sugarcane area, sugar factory revitalization was under 10%, and construction of 10-15 new factories was not achieved. Indonesia is certain to fail in achieving sugar self-sufficiency in 2014, and is even more likely to become the world's second largest sugar importer in the next 5 years, if national sugar factory capacity is not increased (Haerani et al., 2014).

The strategy needed to increase sugar production can be done by expanding the area, increasing productivity, and sugarcane yield. However, the most suitable increase in sugar production is to increase yield, because it does not require an increase in sugar factory capacity (P3GI, 2008). Increased production and yield of sugar cane can be done, among others, by improving on farm.

Increasing the yield and productivity of sugarcane can be done by improving the cultivation system, including the use of high quality and labeled location-specific varieties. So that the use of superior varieties is successful, good cultivation aspects and post-harvest handling must be involved. The use of location-specific superior varieties supported by good cultivation techniques will provide higher sugarcane yield and productivity, compared to conventional cultivation systems. This research activity aims to (1) accelerate adoption of cultivation technology, by using qualified and labeled sugarcane superior varieties at farm level, and (2) obtaining technological feedback needed by farmers for cultivation technology improvement, especially the suitable sugarcane type or variety. With the adoption of high quality and labeled sugarcane varieties, and supported by dry land sugar cane cultivation techniques that are applied optimally, it is expected to increase farmers income by around 20%. The impact of this activity is expected to be able to support the achievement of a sugar self-sufficiency program.

2. Material and methods
Research activity was carried out from January to December 2015 in Sukobendu Village, Mantup Subdistrict, Lamongan Regency, where the program's target was to increase farmers income through field laboratory practices.

2.1. Implementation Method
This activity was carried out on farmers land in sugar cane development area, covering an area of 10 ha, consisting of 1 ha area adjacent to a 9 ha area managed by 10-15 farmers. The technology adoption component is applied to a 1 hectare plot which is used as a pilot laboratory and learning media for farmers. This field laboratory is also a feedback medium, to improve and perfect technological innovation, so that it is more in line with user needs. The existence of the field laboratory is expected to further accelerate technology transfer. The materials used are superior quality and labeled sugarcane seeds that will be assisted to farmers, fertilizers, pesticides, herbicides, and some auxiliary tools.
The technological components applied are mainly high quality and labeled sugarcane varieties (Bululawang varieties), soil processing, creating drainage, and regulating plant populations. Observation parameters included the number of clumps, number of tillers per row, growth, production, and yield. As a comparison, sugar cane lands around the IPM location, which are not given the help of high quality and labeled superior seeds.

The material presented in the Acceleration of Adoption of Integrated Sugar Cane Technology through Field Laboratory is planting sugarcane farming, with assistance activities in Sukobendu Village which consists of several technological components namely:

- Location-specific superior varieties usages
- Improved planting system:
  - a. Double row
  - b. Single row
  - c. Double planting
- Organic fertilizer
- Plant materials: sugarcane bud chip and bud set seeds
- Inorganic fertilizer according to the package
- Plants maintenance and leaf detrashing at least 4 times
- Farmer groups assistance and guidance

Sugarcane cultivation technology application, which has been agreed with farmers for a field laboratory with an area of 1.5 ha. The applied farming technology is divided into three different treatment packages for each 0.5 ha including: 1. Budchip seeds, planted with double row systems, 6 tons/ha of organic fertilizer, and inorganic fertilizers consisting of 600 kg Za and 600 kg Phonska/ha; 2. Budchip seeds are planted with a single row system, 6 tons/ha of organic fertilizer, and inorganic fertilizer consisting of 600 kg Za and 600 kg Phonska/ha; and 3. Budsett seeds planted with a double planting system, 6 tons/ha of organic fertilizer, and inorganic fertilizer consisting of 600 kg Za and 600 kg Phonska/ha. The three technology packages are applied as a field laboratory for farmers' guidance and learning facilities. In addition to the technology package application, it is also equipped with the use of location-specific superior seeds, tillage with tractors, maintenance of weed-free plants plus the use of herbicides to suppress weed growth, and at least 4 times leaf detrashing (Table 1).

**Table 1.** The sugarcane farming technology component applied by Cooperative Farmers in Field Laboratory activities on 1.5 ha of land in Sukobendu Village.

| No. | Component of Technology | Treatment | Area (ha) | Planting Date |
|-----|-------------------------|-----------|-----------|---------------|
| 1.  | BL Seed Varieties       | Budchip seed | 1.0       |               |
|     |                         | Budsett seedlings | 0.50     |               |
| 2.  | Planting Distance      | Budchip : a. double row 120/60 cm | 0.50 | January |
|     |                         | b. single row 135 x 30 cm | 0.50 | 20 |
|     |                         | Budsett : double planting 135 cm/30 cm | 0.50 | |
| 3.  | Tillage                | Tractor |           |               |
| 4.  | Inorganic Fertilizer   | Plant Cane (PC) : Compound fertilizer (N:P₂O₅:K₂O:S= 15:15:15:10) 600 kg ha⁻¹, Amonium Sulfat (N:S=21:24) 600 kg ha⁻¹ |   |               |

Ratoon Cane (RC) :
Compound fertilizer (N:P₂O₅:K₂O:S=15:15:15:10) 600 kg ha⁻¹, Amonium Sulfat (N:S=21: 24) 600 kg ha⁻¹

5. Organic fertilizer
   Plant Cane (PC) : Biokompost PTPN X, 6 ton ha⁻¹

6. Herbicide
   Herbicide application twice, with Ametrin and 2,4-D Dimetil Amina, 5 liters

7. Weeding
   Performed free of weeds, until the sugarcane plant is 3 months old (the canopy has closed each other)

8. Leaf detrashing
   Performed 4 times

The use of budchip seeds on cooperative farmers cannot be applied at the beginning of year, so planting sugarcane with budchip seeds at an area of 10 ha was done at the end of the activity, after the farmers' learning process through a field laboratory. Being involved at the field laboratory activities, the farmers were convinced that the use of budchip seeds could increase sugarcane production and farmers starting to change from the conventional planting system, by applying a proper ratoon maintenance.

**Table 2.** The sugarcane farming technology components applied by Cooperative Farmers, the activity was carried out on an area of 9.0 ha which was not suitable, in Sukobendu village.

| No.  | Component of Technology | Treatment | Area (ha) | Planting Date |
|------|-------------------------|-----------|-----------|---------------|
| 1.   | BL and CD 148 variety seeds | Budsett seeds | 4.00      | November 2014 |
|      |                         | Ratoon seeds | 5.00      | October 2014  |
| 2.   | Planting Distance | Budsett: double planting 135 cm/30 cm | 4.00 | November 2014 |
|      |                         | Ratoon: double planting 135 cm/30 cm | 5.00 | October 2014 |
| 3.   | Soil Processing | Cow Plow |           |              |
| 4.   | Inorganic Fertilizer | PC : Compound fertilizer (N:P₂O₅:K₂O:S=15:15:15:10) 500 kg ha⁻¹, Amonium Sulfat (N:S=21: 24) 500 kg ha⁻¹ | 4.00 | November 2014 |
|      |                      | RC : Compound fertilizer (N:P₂O₅:K₂O:S=15:15:15:10) 500 kg ha⁻¹, Amonium Sulfat (N:S=21: 24) 500 kg ha⁻¹ | 5.00 | October 2014 |
| 5.   | Organic fertilizer | PC : - | 4.00 | November 2014 |
|      |                      | RC : - | 5.00 | October 2014 |
| 6.   | Herbicide | Herbicide application once, with Amigres | 4.00 | November 2014 |
| 7.   | Weeding | Weed control is not optimal, weeding only once | 5.00 | October 2014 |
| 8.   | Leaf detrashing | Done 3 times | 4.00 | November 2014 |

Observations include plant growth and yields, as well as economic analysis, namely by farming analysis using the Revenue Cost Ratio (R / C) test proposed by Soekartawi (1995) as follows:

\[
R/C = \frac{\text{Total Revenue (TR)}}{\text{Total Cost (TC)}}
\]
a. Plants observation were carried out before the harvest, including: stem diameter, plant height, number of tillers, yield and production.

b. Socio-economic observations were carried out twice: First when the plants are nearing harvest, to record responses/feedback, problems, and expectations. And, Second, after harvest, to assess sugarcane farming.

3. Results and discussion

3.1. Farmer Groups Assistance
Determination of location and farmers were based on location surveys, then coordinating the formation of farmer groups. The purpose of forming farmer groups was to facilitate coordination, assistance, guidance and discussion of learning through regular group meetings at least once every 10 days. Group meetings as a medium for disseminating activities, explaining applied technology, plant maintenance, problems solving during sugarcane farming. Mentoring and guidance was for the cooperative farmers and surrounding farmers (non-cooperative farmers) in the location of the dissemination of integrated sugarcane technology. Farmer groups mentoring and guidance involves the Village Head officer and staff, local sugar cane farmer association board and the field officer of Gempol Kerep Sugar Factory. The acceleration activities received considerable attention from farmers, village officials, community leaders and field officers in charge of sugarcane farming. Farmers feel that during sugarcane farming, there has never been assistance and guidance for sugarcane farming from the government element. During the learning process, farmers were eager to try and got benefits from the implementation of sugarcane farming technology, including planting using budchip seeds, planting double row systems, using organic fertilizers, maintaining weed-free plants at the beginning of growth, and leaf detrashing technique.

![Figure 1](image_url)

**Figure 1.** Coordination meeting involving the Village Head Officer, Sugar Factory field staff, Sugar Cane Farmers Association, cooperative and non-cooperative farmers.

3.2. Sugar Cane Growth and Production
From the application results of the technology package, it was shown that the initial growth of sugarcane plants originating from budchip seeds was very evenly distributed, the number of tillers was 4-5, and the growth are uniform (figure 3). Conversely, the plant growth originating from budsets, was uneven, the number of tillers was more than 6 or less than 4, besides, the diameter and height of tillers were not uniform (figure 4). At the beginning of sugarcane growth, the response of all farmers in the farmer group to the use of budchip seeds was very positive, farmers had decided to accept budchip seeds and do ratoon unloading in the next planting season. Even farmers also expect the transfer of technology in making budchip seeds themselves, without depending on the seeds from the provider. During the discussion, farmers proposed, to make budchip seeds by making beds around the farmer's house and not using trays.
The nursery system was inspired by rice plants nursery system using beds. The creative ideas of farmers should be studied to assess their strengths and weaknesses.

![Budchip seeds and Budsett](image)

**Figure 2.** Differences in sugarcane seedlings growth from budchip and budsets.

The implementation of technology packages transfer for other field laboratory learning facilities is the arrangement of optimum population using double row, single row and double plants system; fertilizer according to dosage; weeding and herbicide use; use of location-specific superior varieties that heat resistant; addition of organic fertilizer; and old leaves striping frequency.

The farmers responded positively to the planting system introduced, namely double row panting system. This because the double row planting system has more plant population than that of single row and double plant, which were previously adopted by the farmers. This was indicated by the number of stems as showed on Table 3.

| Table 3. Observation of 8 months old sugar cane for cooperative farmers |
|-----------------------------------------------------------------------------------------------|
| Stems | Plant Height | Stem Diameter | Varieties | Planting Date | Seeds   |
|-------|--------------|---------------|-----------|---------------|---------|
| SINGLE ROW | 111,00       | 249,15        | 26,31 BL  | 20/1/2015     | BUDCHIPS |
| DOUBLE ROW | 159,75       | 260,33        | 24,91 BL  | 20/1/2015     | BUDCHIPS |
| DOUBLE PLANT | 108,00       | 252,53        | 27,23 BL  | 20/1/2015     | BUDSETTS |
| COOPERATIVE FARMER | 74,33       | 226,22        | 27,62 BL  | 11/2012       | BUDSETTS |
| COOPERATIVE FARMER | 81,33       | 256,13        | 29,87 BL  | 7/2013        | BUDSETTS |
| COOPERATIVE FARMER | 95,00       | 241,39        | 25,57 BL  | 11/2012       | BUDSETTS |
| COOPERATIVE FARMER | 97,67       | 292,54        | 27,52 BL  | 7/2014        | BUDSETTS |
| COOPERATIVE FARMER | 74,33       | 233,17        | 26,07 PS.862 | 7/2011  | BUDSETTS |
| COOPERATIVE FARMER | 79,00       | 268,07        | 27,61 PS.862 | 11/2014  | BUDSETTS |
| COOPERATIVE FARMER | 112,00      | 292,50        | 29,11 BL  | 11/2014       | BUDSETTS |
| COOPERATIVE FARMER | 82,33       | 196,73        | 26,77 PS.862 | 7/2014  | BUDSETTS |
| COOPERATIVE FARMER | 82,33       | 196,73        | 26,77 PS.862 | 11/2014  | BUDSETTS |
| COOPERATIVE FARMER | 88,00       | 288,93        | 27,01 PS.862 | 11/2014  | BUDSETTS |
| COOPERATIVE FARMER AVERAGE | 86,63       | 249,24        | 27,39     |               |         |

Overall, the implementation of sugarcane cultivation technology packages in field laboratory activities received a positive response from farmer groups and farmers around, including the addition of organic materials which had never been done. Farmers realized that there will be a decrease in soil fertility if the land is used continuously without organic fertilizer added. The results of routine learning meetings turned out that farmers responded positively in terms of adding organic fertilizer, and the plan to add organic fertilizer will be applied in the following year's planting season.
Figure 3. Discussion with farmers on site after old leaves striping activities, aged 6 months.

Figure 4. Budchip seeds sugarcane planting after old leaves striping activities, aged 6 months

3.3 Farming Analysis

The activities implementation as learning facilities has been carried out through mentoring and discussion in every routine meeting with farmer groups. During the learning process, it is expected to encourage the technology adoption process with a learning by doing approach. The final results of these activities were studied economically, to determine the economic feasibility and to convince farmers that the applied technology package is feasible and profitable. The sugarcane cultivation farming cost analysis is presented in Table 4.

Farming analysis of sugarcane cultivation technology application is calculated based on the costs incurred and cane production, then compared to the costs and production of non-cooperative farmers sugar cane to determine differences in income advantages and economic feasibility of field laboratory activities. The farming analysis results showed that the arrangement of planting system in double-row planting increased farmers income. The increase in income occurs because the production of sugar cane was higher than that of single row, double planting and non-cooperative farmers cultivation practices. The increase of sugar cane production per ha of cooperative farmers compared to non-cooperative ones reached 1.44 with RC ratio 3.02. The increase in sugar cane production using double row systems also has an effect on increasing income and profits compared to non-cooperative farmers.

The economic analysis results turned out that the use of budchip seeds was more profitable than budsett seeds and ratoon cane from cooperative farmers and non-cooperative farmers. Sugarcane production is higher in double row and single row system using budchip seeds, reaching 94 tons and 86 tons ha\(^{-1}\) respectively. Furthermore, sugarcane production was lower in the treatment using budsets seeds with double planting system than that of the main cooperative farmers applied technologies. Sugar
cane production in field laboratory area during the activity is not optimal, because of drought and late planting. Even though, the production of sugar cane produced was much higher than that produced by the surrounding farmers. The less optimality of sugarcane production in this trial mainly due to the low average of precipitation on June, when the plant was 6 months until the time of harvesting. Sucrose content of field laboratory area was 8.7%, which was 0.2% higher than non-cooperative farmers. During the learning process in farmer groups, farmers were convinced that the sugarcane cultivation technology package that had been designed together in field laboratory provided profit and benefits.

| No | Technology application | Double row | Single row | Double plant | Cooperative farmer | Non-cooperative farmer |
|----|------------------------|------------|------------|--------------|--------------------|-----------------------|
| 1  | Cultivation cost        | 18,300,000 | 18,300,000 | 14,533,333   | 17,531,242         | 17,266,458            |
| 2  | Productivity            | 94,000     | 86,000     | 56,667       | 80,134             | 65,300                |
| 3  | Income                  | 55,263,540 | 50,560,260 | 32,130,000   | 49,403,072         | 40,159,500            |
| 4  | Advantage               | 36,963,540 | 32,260,260 | 17,596,667   | 31,871,829         | 22,893,042            |
| 5  | Yield                   | 8.7        | 8.7        | 9            | 8.8                | 8.5                   |
| 6  | R/C                     | 3.02       | 2.76       | 2.21         | 2.82               | 2.33                  |
| 7  | Increased productivity  | 1.44       | 1.32       | 0.87         | 1.23               | 1.00                  |
|    | compared to Non         |            |            |              |                    |                       |
|    | Cooperative Farmer      |            |            |              |                    |                       |
| 8  | Increased productivity  | 1.61       | 1.41       | 0.77         | 1.39               | 1.00                  |
|    | compared to Non         |            |            |              |                    |                       |
|    | Cooperative Farmer      |            |            |              |                    |                       |
| 9  | Increased productivity  | 1.38       | 1.26       | 0.80         | 1.23               | 1.00                  |
|    | compared to Non         |            |            |              |                    |                       |
|    | Cooperative Farmer      |            |            |              |                    |                       |

Table 4. Sugarcane farming analysis of 3 technology packages for main cooperative farmers, cooperative farmers and non-cooperative farmers.

3.4. Farmer Feedback

Acceleration adoption activities through field laboratories, among others, aim to obtain technological feedback needed by farmers to improve sugarcane cultivation technology, especially suitable sugarcane types or varieties. After the cultivation technology package was introduced during mentoring and learning activities, finally the farmers compared the new sugarcane cultivation technology to conventional cultivation systems that had been adopted by farmers for generations. Farmers provide a positive response and gave feedback to improve the introduced cultivation technique. The feedbacks include the spacing distance of double row system that was believed by the farmers as a caused of the not optimum size of the stem. However, through a discussion it was revealed that the cause was the occurrence of drought experienced by the plants as a consequence of delayed planting.
Figure 5. Sugar cane planting and use of organic fertilizer preparation on 10 ha of land.

Figure 6. Sugarcane optimum planting population using double curing system adopted by farmers on a 10 ha area.

Figure 7. Uniform cane budchip seedling growth, in a 2-month-old plant using double row system.

4. Conclusion

The use of budchip seeds provided the highest sugarcane production and income of farmers compared to the cultivation techniques applied by cooperative and non-cooperative farmers. The increase in sugar cane yield of 0.2% was not significant compared to that of non-cooperative farmers. The positive response of farmers to the implementation of field laboratory activities inspired the farmers to agree applying the introduced sugarcane cultivation techniques.
References

[1] Balitkabi 2009a *Pedoman Umum PTT Kacang Tanah. Badan Litbang Pertanian* (Malang: Puslitbang Tanaman Pangan. Balai Penelitian Tanaman Kacang-kacangan dan Umbi-umbian) p 23

[2] Balitkabi 2009b *Pedoman Umum PTT Kacang Hijau. Badan Litbang Pertanian* (Malang: Puslitbang Tanaman Pangan. Balai Penelitian Tanaman Kacang-kacangan dan Umbi-umbian) p 19

[3] Budhi santoso, H., E. Sugiyarta, Mirzawan and S. Purnomo. 2007. PSJT 941: Varietas unggul untuk lahan tegalan Majalah Penelitian Gula (MPG) 43 85-96.

[4] Ditjenbun 2013. Kebijakan, desain, dan upaya dalam pencapaian swasembada gula nasional Workshop Padu Serasi dan Peran Stakeholder dalam Mewujudkan Pembangunan Perkebunan Berkelanjutan dan Swasembada Gula Nasional. (Semarang: Balittas)

[5] Haerani R I, Aji J M M and Januar J 2014 Analisis trend produksi dan impor gula serta faktor-faktor yang mempengaruhi impor gula indonesia Berkala Ilmiah Pertanian 1 77-85.

[6] Hardjasudjana D S 1993a. Hasil Uji adaptasi tahap terakhir kelompok varietas tebu ps 84 di wilayah PT Perkebunan IX Buletin Perkebunan 7 33-41.

[7] Hardjasudjana DS 1993b Keunggulan varietas tebu PS 87 di Wilayah PT Perkebunan IX Buletin Perkebunan 7 11-9

[8] Marjayanti S 2003 keragaaan produksi dan nilai ekonomi varietas tebu PS 851 di lahan sawah alivial berdaarinase kurang baik Jurnal Littan 11 186-200.

[9] Nahdodin 1993 Penyediaan bibit tebu berkualitas, permasalah dan penaggulangannya Gula Indonesia 18 39-41.

[10] Oktaviani R dan Siregar H 2013 Industri gula indonesia: struktur pasar dan perbenturan kepentingan Seminar Sehari Arah Baru Kebijakan Pergulaan Nasional (Yogyakarta: Balittas)

[11] Pembengo W and Suwarto 2008 *Konsep Peningkatan Rendemen untuk Mendukung Progam Akselerasi Industri Gula Nasional* (Pasuruan: Pusat Penelitian Perkebunan Gula Indonesia) p 26

[12] PT. Perkebunan Nusantara X 2014 Strategi PT PN X dalam meningkatkan rendemen dan produktivitas tebu Prosiding Semiloka Nasional Tanaman Pemanis, Serat, Tembakau, dan Minyak Industri. Balittas (Malang: Balittas)

[13] Sugiyarta E dan Budhisantosa H 2009a Perakitan dan Adaptasi Varietas Unggul Tebu Rendemen di Atas 12% dan Produksi Keprasan di Atas 80% PC (Plant Cane). (Pasuruan: Pusat Penelitian Perkebunan Gula Indonesia - Balai Pengkajian Teknologi Pertanian Jawa Timur)

[14] Sugiyarta E dan Budhisantosa H 2009b PS 881 Sebagai varietas tebu unggul baru untuk masak awal MPG 5 214-23.