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## PEDOMAN PENULISAN

Naskah hasil penelitian primer ditulis dalam bahasa Indonesia atau Inggris dengan urutan pembagian sebagai berikut:

**JUDUL & NAMA PENULIS** ditulis dengan huruf kapital pada awal setiap kata dan disertai profesi/jabatan dan nama instansi tempat penulis bekerja serta mencantumkan e-mail (bagi yang telah memiliki). judul hendaknya singkat (tidak lebih dari 15 kata) dan mampu menggambarkan isi pokok tulisan.
Contoh: Pengaruh pemupukan melalui daun pada kedelai

**ABSTRAK/ABSTRACT** ditulis dalam bahasa Indonesia dan Inggris masingmasing tidak lebih 250 kata yang dituangkan pada satu alinea, merupakan inti seluruh tulisan dan harus mampu memberikan uraian yang tepat, jelas tapi **singkat** tentang **latar belakang**, **tujuan** yang ingin dicapai, **metodologi** yang digunakan dalam pencapaian tujuan, **hasil penelitian** yang terpenting, dan **kesimpulan**.

**KATA KUNCI** terdiri dari beberapa kata atau gugus kata yang menggambarkan isi naskah

Contoh: Daun, kedelai dari contoh judul di atas.

**PENDAHULUAN** *(nama bab tidak ditulis)* mencakup latar belakang masalah, alasan pentingnya penelitian itu dilakukan, temuan terdahulu yang akan disanggah atau dikembangkan (termasuk di dalamnya telusuran pustaka terkait), hipotesis yang mendorong dilakukannya penelitian, pendekatan umum, dan tujuan penelitian, Nama jasad hidup yang menjadi topik penelitian harus disertai nama ilmiahnya.
Contoh: kedelai {*Glycine max* (L.) Merr.); Eceng lembut (*Monocharia vaginalis* L.)

**BAHAN & METODE** berisi penjelasan ringkas tentang waktu dan tempat penelitian, rancangan percobaan, dan analisis data. Nama piranti lunak komputer yang digunakan untuk menganalisis data seyogyanya disebutkan.

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**PEMBAHASAN** *(boleh ditulis di dalam satu bab dengan Hasil)* merupakan kupasan penulis tentang hasil, menerangkan arti hasil penelitian, persamaan dan perbedaan hasil penelitian ini dibandingkan dengan penelitian terdahulu (baik dari dalam maupun luar negeri), peran hasil penelitian terhadap pemecahan masalah yang disebutkan di bab pendahuluan, hubungan antara parameter yang satu dengan yang lain, dan kemungkinan pengembangannya.

**KESIMPULAN** *(apabila memungkinkan)* merupakan hasil konkrit atau keputusan yang diperoleh dari penelitian yang telah dilakukan serta saran-saran. Informasi yang *bersifat faktual*.

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# ADAPTABILITY OF VARIOUS SOMACLONES ON TOLERANT-DROUGHT SUGARCANE BASED ON PRODUCTION AND PHYSIOLOGICAL CHARACTERS

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## ABSTRACT

The occurrence of drought in sugarcane is very influential on the decrease in production, especially if there is a critical phase of growth on water demand. Plant physiological responses to drought differ among tolerant species to drought sensitivity, so that the physiological behavior can be used for the identification of tolerant plants. This study aims to identify physiological characters that can be used as a standart of drought resistance of sugarcane at the field level with a significant correlation coefficient to the production, and to get tolerant somaclone resulted from mutations of drought and have high adaptability and production stability. The experiment was conducted on saline-dry land in Takalar from March to November 2009, using a split plot design with three replications in a group. Main plot is the level of irrigation consists of two levels, namely: normal irrigation every two weeks and limited irrigation every four weeks. Secondary level plots are 18 somaclones of sugarcane which are 12 somaclones of sugarcane obtained from induced mutations and six parent somaclones. The results showed that the physiological characters which can be used as a drought resistance standart of somaclone of sugarcane with a highly significant correlation coefficient to the production of chlorophyll a, chlorophyll b, and total chlorophyll content whereas proline content has a low correlation coefficient although significant on production. Somaclone k7 has the potential resistance on drought with high production compared to other somaclones

**Keyword : Adaptation, Sugarcane, Somaclone, Drought tolerant**

## INTRODUCTION

Even the area of sugarcane plantation in Indonesia tent to decrease precisely at a rate of 1.69% from 2006 to 2008, the national production and productivity increase 16.88% and 18.89%, respectively. With a decrease of plantation area 1.72% in South Sulawesi, however, regional production and productivity decrease 18.05% and 16.61% respectively (Anonymous, 2009). That condition is caused by environmental stress such as drought and limited fertile-land for sugarcane development.

Drought is one of the factors limiting the productivity of plants such as legume, maize and sugar cane that are cultivated in dry and rain-fed land. Approximately 70% sugarcane plantation area in sub-tropic area and 65% in tropic area experience drought problems during their growth stage (Singh, 1997). The cause of drought is mostly insuficience of water and the lack of distribution as the need of plant. The occurrence of drought in sugarcane plant can decrease productivity. According to Setyo-Budi et al., (2004), lack of water in plant cell even for short term can limit the growth productivity of plant. Sugarcane plant has four growth stages which are germination, tillering, grand growth and maturity. The tillering and grand growth stages are critical phases in water availability. The insuficient of water in these stages will reduce yield 70 – 80% (Silva et al., 2007). Photosinthetic respons on water deficits during the critical phases can be used to identify tolerant genotype on drought. Accordingly, plant breeding is needed to release a new tolerant variety on drought with a high adaptibility and productivity.

Physiological activity of some somaclones grown in drought stress condition can be used as plant selection method of drought tolerance. Rong-hua et al. (2006) proposed a fast method to measure photosynthetic activity such as chlorophyll *a* fluorescence technique, particularly the maximum photochemical efficiency of photosystem II – PSII. The plant that is able surviving its physiological activities in the water limitation condition is indicated as a potential tolerant plant on drought. Findings some studies also showed that the ability of plants to maintain water potential of leaf and physiological activity of plant under drought stress conditions positively correlated with capability of plants to maintain biomass production of canopy and to contribute significantly reducing yield losses (Wu and Cosgrove 2000; Sinclair and Muchow 2001; Vadez et al., 2007).

According to Shannon (1978), the key to improve the salinity and drought resistance as well as inheritance depends on a high diversity of the population and screening selection method that can identify resistant genotypes. Improvement of plant varieties can be done through the induction of mutation (Witjaksono, 2003) to produce variations of somaclone. Somaclonal variation in vitro can cause genetic changes that affect the morphological and biochemical characteristics as screening material in the somaclone-seed selection (Farid, 2003). Somaclone derived from callus that had escaped the selection of NaCl 12 g $L^{-1}$ is the most tolerant somaclone on drought which is seeded in a hydroponic test based on the morphophysiological characters (Farid, 2008).

Farid et al. (2006; 2007) has conducted the induction of mutations on sugarcane with the chemical mutagen $NaN_3$ and has found 11 somaclones that have potential salinity tolerance and 23 salinity-tolerant somaclones at the seedling level. However, they are not yet recommended somaclones as drought-salinity tolerance prior to field and multilocation tests. This is due to the complexity of drought and salinity problems at the field level. So it is necessary conducting tests to determine the production stability multilocation every tolerant somaclone with high productivity and yield.

This research aims to identify physiological characters that can be used as a standart of drought resistance of sugarcane at the field level with a high heritability value and to find somaclone of sugarcane by mutation which is tolerance to drought with high adaptability and high production stability.

## MATERIALS AND METHODS

The experiment was conducted on saline-dry land in Takalar since March until November 2009. Selection and testing carried out on 18 genotypes (12 somaclones – the results of selection potentially tolerance to drought and salinity and the six parent somaclones as a control). The experiment was underrun in split plots design with three replications. Main plot is the level of irrigation (P) consisting of two levels, namely: normal irrigation every two weeks ($p_1$) and limited irrigation every four weeks ($p_2$). While the secondary level plots are 18 somaclone of sugarcane genotypes, namely: PS 81 362 soma from callus on NaCl concentration of 4 g $L^{-1}$ ($k_1$), somaclone bukit loe from callus on NaCl concentration of 4 g $L^{-1}$ ($k_2$), Q 81 somaclone from callus on NaCl concentration of 4 g $L^{-1}$ ($k_3$), TK 26 of the calli somaclone on PEG concentration 0 g $L^{-1}$ ($k_4$), 26 of the calli TK somaclone on PEG concentration 30 g $L^{-1}$ and 45 g $L^{-1}$. ($k_5$), R 579 somaclone from callus on PEG concentration of 0 g $L^{-1}$ ($k_6$), R 579 somaclone from callus on PEG concentration of 30 g $L^{-1}$ and 45 g $L^{-1}$ ($k_7$), PS 81 362 somaclone from callus on PEG concentrations of 0 g $L^{-1}$ ($k_8$), PS 81 362 somaclone from callus on PEG concentration of 15 g $L^{-1}$ ($k_9$), Q 81 of the calli somaclone on PEG concentration of 15 g $L^{-1}$ ($k_{10}$), Q 81 of the calli somaclone PEG at a concentration of 30 g $L^{-1}$ ($k_{11}$), somaclone bukit loe from callus on PEG concentration of 15 g $L^{-1}$ ($k_{12}$), with six parent somaclone, namely Varieties TK 26 ($k_{13}$), R-579 ($k_{14}$), BC 86 ($k_{15}$), PS 81-362 ($k_{16}$), bukit loe ($k_{17}$), and Q 81 ($k_{18}$).

Crops were planted with spacing of 30 cm x 125 cm. Each clone is planted in rows with 10 m long and three replicates. Maintenance is done by irrigating normally until age three months. After that, normal treatment and limited irrigation were applied. Weeding and making dikes were conducted two weeks after planting. It was also conducted initial fertilization with urea 300 kg $ha^{-1}$, SP36 200 kg $ha^{-1}$, and KCl 100 kg $ha^{-1}$. At the age of 3-9 months, physiological characterics and pro-duction components at harvest were observed.

The parameters used were: chlorophyll a, b and total chlorophyll concentrations following the method of Arnon (1949), and proline content (Bates, Waldren, and Teare, 1973). Measurement of sugar content or yield is done by measuring the Brix and Pol content (BSES, 1991). The heritability analysis is based on the central squares estimation in the analysis of variance (Helyanto et al., 1998).

## RESULTS AND DISCUSSION

The results showed that somaclone $k_1$ (somaclone PS 81 362 callus at a concentration of NaCl 4 g $L^{-1}$) gives the best results on chlorophyll a (0.74 mg $g^{-1}$), chlorophyll b (0.45 mg $g^{-1}$) and total chlorophyll (1.17 mg $g^{-1}$) per weight of fresh-leaves and significantly different from the others except somaclone $k_3$ on chlorophyll a; $k_7$, $k_8$, $k_{13}$ on chlorophyll b; and $k_2$, and $k_3$ on the total chlorophyll (Table 1). These conditions indicate that

Table 1. Average chlorophyll a, chlorophyll b, total chlorophyll (mg $g^{-1}$ fresh weight of leaf), the content of Brix (%), pool (%), yield (%), and total sugar content (kg $ha^{-1}$) some somaclones sugarcane.

| Somaclone n | Parameters | | | | | | |
|---|---|---|---|---|---|---|---|
| | Chlorophyll-a | Chlorophyll b | Total Chlorophyll | Brix Content | Pool Content | Yield | Total Sugar |
| $k_1$ | 0.74$^{a}$ | 0.45$^{a}$ | 1.17$^{a}$ | 19.00$^{b}$ | 15.92$^{a}$ | 8.36$^{b}$ | 8410.70$^{bc}$ |
| $k_2$ | 0.68$^{bc}$ | 0.45$^{a}$ | 1.16$^{a}$ | 18.95$^{b}$ | 15.73$^{ab}$ | 8.31$^{b}$ | 8616.35$^{bc}$ |
| $k_3$ | 0.71$^{ab}$ | 0.38$^{b}$ | 1.12$^{ab}$ | 19.90$^{a}$ | 16.05$^{a}$ | 8.97$^{a}$ | 9111.60$^{b}$ |
| $k_4$ | 0.45$^{g}$ | 0.28$^{ef}$ | 0.67$^{gh}$ | 17.10$^{fgh}$ | 13.65$^{hij}$ | 6.75$^{ef}$ | 5729.45$^{gh}$ |
| $k_5$ | 0.67$^{bcd}$ | 0.38$^{b}$ | 0.99$^{c}$ | 18.88$^{b}$ | 15.90$^{a}$ | 8.51$^{ab}$ | 10083.28$^{a}$ |
| $k_6$ | 0.45$^{g}$ | 0.27$^{f}$ | 0.64$^{h}$ | 16.60$^{h}$ | 13.90$^{ghij}$ | 6.51$^{f}$ | 6206.80$^{fg}$ |
| $k_7$ | 0.64$^{cd}$ | 0.43$^{a}$ | 1.06$^{b}$ | 18.73$^{bc}$ | 15.79$^{ab}$ | 8.33$^{b}$ | 9203.77$^{b}$ |
| $k_8$ | 0.62$^{de}$ | 0.42$^{a}$ | 1.05$^{b}$ | 18.78$^{b}$ | 15.00$^{cde}$ | 7.98$^{bc}$ | 8954.25$^{b}$ |
| $k_9$ | 0.62$^{de}$ | 0.36$^{bc}$ | 0.86$^{ef}$ | 18.15$^{cd}$ | 14.33$^{efgh}$ | 7.61$^{cd}$ | 6865.32$^{ef}$ |
| $k_{10}$ | 0.52$^{f}$ | 0.33$^{cd}$ | 0.82$^{f}$ | 17.85$^{de}$ | 14.37$^{defg}$ | 7.32$^{d}$ | 7249.28$^{de}$ |
| $k_{11}$ | 0.50$^{fg}$ | 0.32$^{d}$ | 0.82$^{f}$ | 17.60$^{def}$ | 14.30$^{fghi}$ | 7.47$^{cd}$ | 6766.50$^{ef}$ |
| $k_{12}$ | 0.45$^{gh}$ | 0.27$^{f}$ | 0.72$^{g}$ | 17.00$^{fgh}$ | 13.66$^{hij}$ | 6.64$^{f}$ | 6171.79$^{fg}$ |
| $k_{13}$ | 0.58$^{e}$ | 0.43$^{a}$ | 0.94$^{cd}$ | 17.93$^{de}$ | 15.11$^{bc}$ | 7.63$^{cd}$ | 8078.06$^{cd}$ |
| $k_{14}$ | 0.47$^{fg}$ | 0.33$^{cd}$ | 0.81$^{f}$ | 17.34$^{defg}$ | 14.70$^{cdef}$ | 7.25$^{de}$ | 7429.81$^{de}$ |
| $k_{15}$ | 0.49$^{fg}$ | 0. 31$^{de}$ | 0.89$^{de}$ | 16.98$^{gh}$ | 14.91$^{cdef}$ | 7.22$^{de}$ | 7380.67$^{de}$ |
| $k_{16}$ | 0.41$^{hi}$ | 0.25$^{f}$ | 0.69$^{gh}$ | 17.35$^{defg}$ | 13.61$^{i}$ | 6.62$^{f}$ | 5035.40$^{h}$ |
| $k_{17}$ | 0.35$^{i}$ | 0.15$^{g}$ | 0.74$^{g}$ | 15.90$^{i}$ | 13.62$^{ij}$ | 6.52$^{f}$ | 6330.20$^{fg}$ |
| $k_{18}$ | 0.58$^{e}$ | 0.33$^{cd}$ | 0.94$^{cd}$ | 18.10$^{d}$ | 15.04$^{cd}$ | 7.41$^{d}$ | 7774.09$^{cd}$ |

Note: These numbers are followed by the same letters in the same column (a, b, c ...) means that they are not significantly different at test level $BNT_{0.05}$

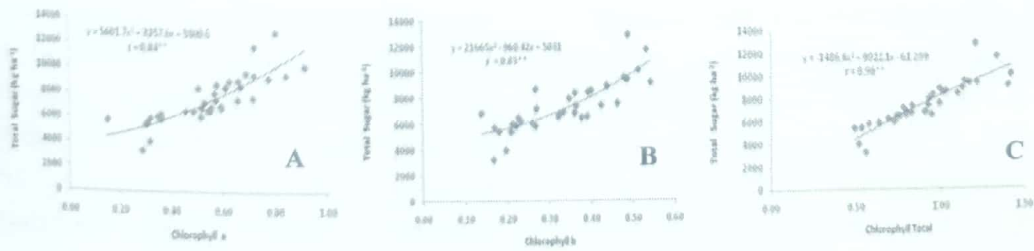


Figure 1. The relationship between chlorophyll a (A), chlorophyll b (B), and total chlorophyll (C) with a total sugar (kg $ha^{-1}$)

Table 2. Average chlorophyll-a, chlorophyll-b, total chlorophyll (mg $g^{-1}$ fresh leaf weight), brix content (%), pool content (%), yield (%), and total sugar content (kg $ha^{-1}$) from the somaclone of sugarcane at two irrigation intensities.

| No | Parameters | Irrigation Intensities | |
|---|---|---|---|
| | | $p_1$ | $p_2$ |
| 1 | Chlorophyll a | $0.68^a$ | $0.42^b$ |
| 2 | Chlorophyll b | $0.42^a$ | $0.26^b$ |
| 3 | Total Chlorophyll | $1.07^a$ | $0.72^b$ |
| 4 | Brix Content | $18.74^a$ | $17.05^b$ |
| 5 | Pool Content | $15.67^a$ | $13.84^b$ |
| 6 | Yield | $8.23^a$ | $6.81^b$ |
| 7 | Total Sugar | $8770.43^a$ | $6273.72^b$ |

Note: These numbers are followed by the same letters in the same rows (a, b) means that they are not significantly different at test level $BNT_{0.05}$

tolerant somaclone is able to maintain high turgor pressure on the leaves so that the drought level of leaves more slowly than the sensitive somaclone. This can be seen from the color of the leaves that remain green, chlorophyll a, chlorophyll b and total chlorophyll concentration is higher compared to the sensitive somaclone. However, if the drought stress increased, the chlorophyll content was also lower. This result is relevant with the findings showing in Table 2 which indicates that the intensity of irrigation treatments every two weeks ($p_1$) gives chlorophyll a (0.68 mg $g^{-1}$), chlorophyll b (0.42 mg $g^{-1}$) total chlorophyll concentration (1.07 mg $g^{-1}$) higher compared with the concentrations for intensity of irrigation every four weeks ($p_2$). The decrease in chlorophyll content is very influential to the decrease of physiological activity. As a consequence, sugar production is also low. Figure 1 shows that the chlorophyll a, chlorophyll b and total chlorophyll content was significantly correlated with increased coefficients production of 0.84**, 0.83** and 0.90** respectively. This is due to the photosynthetic activity in the production of photosynthates for growth of plants is chlorophyll. These conditions indicate that in the event of drought stress, somaclone can show different adaptation strategies to mitigate the effects of damage caused by drought stress. Adaptation is a physiological response of plants in case of drought stress. Tolerant somaclone also retain the availability of water in plant tissue and reduce canopy growth to reduce water loss from transpiration process (Wu and Cosgrove, 2000). According Hamim (2004), the effect of drought stress depends on genetic crops, where differences in morphology, anatomy and metabolism will produce a different response to drought stress.

Table 3 shows that the intensity of irrigation treatments every two weeks ($p_1$) gives the highest proline content

(135.43 µmol g$^{-1}$) at the somaclone $k_2$ and significantly different from the others except with somaclone $k_3$, $k_4$, and $k_5$. In the irrigation intensity every four weeks ($p_2$), the best proline content is at somaclone $k_{13}$ and significantly different with other treatments except the treatment $k_7$ and $k_8$. Meanwhile, the difference between the intensity of irrigation every two weeks ($p_1$) with 4 weeks ($p_2$) is only on somaclone $k_4$, $k_6$, $k_{13}$ and $k_{18}$.

Table 3. Average content of proline (µmol g$^{-1}$ weight of fresh leaves) some clones of sugarcane in the treatment of irrigation intensity

| Clones | Irrigation | | NP $BNT_{0.05}$ |
|---|---|---|---|
| | $p_1$ | $p_2$ | |
| $k_1$ | 117.60 $^{x}_{bc}$ | 114.53 $^{x}_{bc}$ | 33.86 |
| $k_2$ | 135.43 $^{x}_{a}$ | 113.00 $^{x}_{bc}$ | |
| $k_3$ | 131.64 $^{x}_{a}$ | 104.63 $^{x}_{cd}$ | |
| $k_4$ | 131.60 $^{x}_{a}$ | 63.23 $^{y}_{h}$ | |
| $k_5$ | 125.40 $^{x}_{ab}$ | 103.00 $^{x}_{cd}$ | |
| $k_6$ | 110.10 $^{x}_{bcd}$ | 71.37 $^{y}_{gh}$ | |
| $k_7$ | 108.33 $^{x}_{cde}$ | 138.30 $^{x}_{a}$ | |
| $k_8$ | 105.10 $^{x}_{def}$ | 137.27 $^{x}_{a}$ | |
| $k_9$ | 101.20 $^{x}_{defg}$ | 123.57 $^{x}_{b}$ | |
| $k_{10}$ | 96.77 $^{x}_{efg}$ | 123.43 $^{x}_{b}$ | |
| $k_{11}$ | 94.77 $^{x}_{fg}$ | 120.73 $^{x}_{b}$ | |
| $k_{12}$ | 92.28 $^{x}_{g}$ | 76.90 $^{x}_{fg}$ | |
| $k_{13}$ | 75.10 $^{x}_{hi}$ | 142.63 $^{y}_{a}$ | |
| $k_{14}$ | 74.27 $^{x}_{i}$ | 87.80 $^{x}_{def}$ | |
| $k_{15}$ | 72.20 $^{x}_{ij}$ | 93.67 $^{x}_{de}$ | |
| $k_{16}$ | 71.97 $^{x}_{ij}$ | 87.30 $^{x}_{ef}$ | |
| $k_{17}$ | 61.53 $^{x}_{jk}$ | 65.10 $^{x}_{gh}$ | |
| $k_{18}$ | 59.90 $^{x}_{k}$ | 103.60 $^{y}_{cd}$ | |
| NP $BNT_{0.05}$ | 11.84 | | |

Note: These numbers are followed by the same letters in the same column (a, b.. J) and row (x, y) means that they are not significantly different at test level $BNT_{0.05}$

Based on the proline content analysis, the interaction of irrigation treatment and various somaclones showed significant effect. In the treatment of irrigation every two weeks somaclone $k_2$ showed the best results and not significantly different from the soma $k_3$, $k_4$, $k_5$. Irrigation treatments every four weeks somaclone $k_{13}$ showed the best results and was not significantly different from the soma $k_7$ and $k_8$. Overall verietas showed an increase in proline accumulation with increasing to drought stress in the soil. Proline accumulation in plants is a response to drought stress conditions and one of the mechanisms of resistance to both drought stress tolerance. The findings of Raymond and Smirnoff (2002); Sharp et al. (2004); Ogawa and Yamauchi (2006); Mohammad Khan and Heidari (2008) showed that plant under drought stress conditions increased proline accumulation in the primary root.

Osmoregulation compound formation is a biochemical marker for drought stress tolerance. Many researchers stated that a lot of accumulated proline in response to water stress that can be observed on the leaves and roots. The results Sharp and Davies (1979) states that the compounds proline contributed more than 50% in the osmotic adjustment compared with other compounds osmoregulation. Table 3 shows that all somaclone tolerant to drought, proline content increased by 36% -123% compared with normal conditions. The higher increase in proline, the higher tolerance to drought. Proline content significantly affected the production of sugar per hectare, although the low correlation coefficient of 0.27 * (Fig. 2). Tolerant somaclones contain brix, pol, yield and sugar production higher than the moderate and sensitive clones. Statistical analysis indicated that clone $k_3$ showed the best results on the measurement of brix and total sugar content. Clone $k_3$ is not significantly different from $k_5$ on pol content and yield measurement. Brix is the solids part in the palm sugar that is potentially transformated into sugar. Therefore the higher brix content is the higher the potential production as well. This can be sen in Figure 3, which show highly significant correlation between the content of brix and sugar production with correlation coefficient of 0.78**.

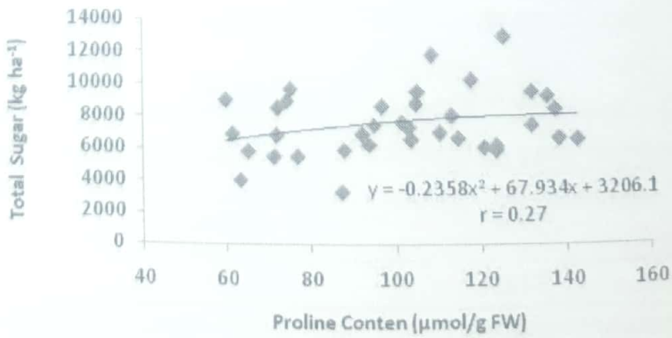


Figure 2. The relationship between prolin content (µmol $g^{-1}$ FW) with a total sugar (kg $ha^{-1}$)

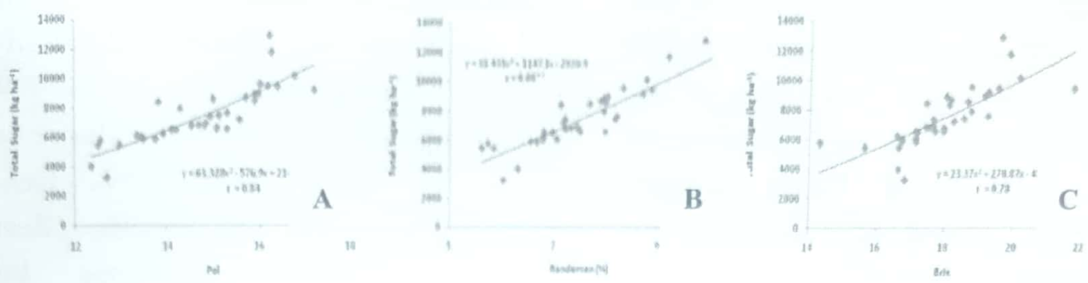


Figure 3. The relationship between brix content (A), pol (B), and yield (C) with a total sugar (kg ha$^{-1}$)

Likewise with the content of pol and the yield has also significant correlation with sugar production with correlation coefficients 0.84** and 0.88**, respectively.

Somaclone with high content of chlorophyll a, b, total height, and the proline in limited irrigation intensity every four weeks ($p_2$) tends to produce a total sugar (production) that is higher than other somaclone. This indicates that the somaclone is more tolerant to drought as indicated by physiological activity. Proline accumulation is a physiological parameters that can be used for the selection on the stress (Sankar et al., 2007). High proline content allows plants to maintain water potential in plants. The amount of water used by plants is closely related to physiological activity and production of a crop. The potential maximum photosynthesis by plants is strongly influenced by environmental factors including drought (Sairam et al., 2002). Maximum photosynthesis for tolerant plants is able to minimize tissue damage caused by drought stress through physiological adaptations to maintain leaf water content. So that the chlorophyll content in leaves can be maintained (Silva et al., 2007).

Different appearance from each tested genotype indicated that a somaclonal variation of callus cells occurs caused by addition of mutagene to the medium and induces mutations. According to Larkin and Scowcroft (1981), in vitro methods can be obtained to get genetic variety precisely. The diversity is caused by mutations that triggered by added mutagenes in the media during the culture period. The diversity of mutations in the in vitro method depends on the character of the parent plants, including in this case is the use of varieties as each variety has different characteristics.

## CONCLUSION

Physiological characters that can be used as a standart of drought resis-tance of sugarcane somaclone with a highly significant correlation coefficient at the production of chlorophyll a, chlorophyll b, total chlorophyll content whereas proline has a low correlation coefficient although significant effect on production.

Somaclones $k_7$, $k_8$, and $k_{13}$ are somaclones that have potential drought resistance with high yield and sugar production based on proline content under drought condition. The sugar production of the somaclones are 138.30, 137.27, and 142.63 μmol $g^{-1}$ of fresh leaves weight, respectively. Under normal condition, somaclone $k_5$ produces the highest yield of sugar (10083,28 kg $ha^{-1}$).

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**PUSTAKA** disusun menurut abjad tidak diberi nomor urut. Setiap pustaka hendaknya terdiri atas **nama penulis. tahun, judul, dan penerbit**. Pustaka seyogyanya dipilih 10 tahun terakhir yang masih mempunyai kaitan dengan topik penelitian dan ditulis sebagai berikut:

- **Untuk Artikel di dalam Buku**: Nama penulis, tahun penerbitan, judul artikel, halaman, nama ketua redaktur/penyunting ditulis lengkap jika kurang dari tiga orang atau dengan et al., jika lebih dari tiga orang (hanya penulis pertama yang nama marganya ditulis pertama), judul publikasi atau buku, nama dan tempat penerbit. Contoh:

  Egli, D.B., and S.T.Craft-Brander. 1996. Soybean. p.595-623. **In** El Zamski, A.A. Schaffer (ed.). Photoassimilate distribution in plants and crops. Source-sink relationships. Marcel Dekker, Inc. New York.

- **Untuk Terbitan Berkala**: Nama penulis ditulis lengkap, tahun penerbitan, judul artikel, nama terbitan (disingkat sesuai dengan konsensus), volume, nomor, dan nomor halaman. Contoh:

  Cheah, U.B., R.C. Kirkwood and K.Y. Lum. 1998. Degradation of four commonly used pesticides in Malaysian Agricultural soils. J. Agric. Chem. 46:1217-1223.

- **Untuk Buku**: Nama penulis, tahun penerbitan, judul buku, edisi dan tahun revisi (jika ada), nama dan tempat penerbit. Contoh :

  Fageria, N. K., V.C. Baligar, and C. A. Jones. 1991. Growth and mineral nutrition of fields crops. Marcel Dekker, Inc. New York.

- **Untuk Tesis atau Disertasi** : Nama penulis, tahun, judul tesis atau disertasi, nama program pendidikan, nama perguruan tinggi dan tempat. Contoh:

  Maraqa, M.A. 1995. Transport of dissolved volatile organic compounds in the unsaturated zone. Ph.D. diss. Virginia Polytechnic Onst. & State Univ. Blacksburg.

  Endies, C. 1986. Influence of production practices on yield and morphology of Amaranthus cruentus and Amaranthus hypochondriatus. M.S. tesis. Univ. of Arkansas, Fayetteville.

Penulisan dosis atau bahan aktif senyawa kimia : Misal Pemupukan dengan dosis 100 kg $ha^{-1}$ N tidak ditulis 100 kg N/ha atau 100 kg/ha N atau 100 kg N $ha^{-1}$; g 1000 $biji^{-1}$ bukan g/1000 biji.

**Persiapan Tulisan**. Naskah diketik pada piranti *Word for Windows* dicetak **dua spasi** pada kertas ukuran A4, satu muka, **tipe huruf baku (new times roman) ukuran 12 cpi** *(character per inch)* atau setara dengan 12 points dan tidak lebih dari **15 halaman** (termasuk pustaka, tabel, dan gambar). Badan naskah dicetak dengan ketentuan batas pinggir kertas masing-masing 3 cm dari atas, bawah, dan kanan, dan 4 cm dari kiri.
Judul tabel terletak. di atas tabel yang bersangkutan dan hendaknya berupa **satu kalimat** yang singkat dan jelas .
Besaran ditulis menurut **Standar Internasional** bukan besaran lokal (e.g, kuintal, are) dan mengikuti kaidah Ejaan Bahasa Indonesia Yang Disempurnakan (misalnya: g, L, kg, t $ha^{-1}$ bukan gr, ltr, Kg atau t/ha).