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Article

Innovation for Sugarcane Planting Material in Ryland Farming

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ABSTRACT

Sugar productivity of sugarcane is dependent on stalk yield and sucrose content which both influenced by planting material. Due to the important of planting material, this study is intended to examine the influence of planting materials i.e. cutting as a control, bud set and bud chip, toward seed quality and the early growth of cane plant in the field. This study was arranged in completly randomized design, with two factors, which are six clones of sugarcane and three types of seedling materials. The results showed that there was an interactions between both factors on germination rate, vigor index, leaf numbers, internode numbers, tiller numbers, leaf area, root volume, root fresh weight, root dry weight, shoot fresh weight, and shoot dry weight. The early growth of seedling was dependent on the clone. According to shoot fresh weight, cutting was suitable for PS 881 and Bululawang. Bud set for PS 864 clone, whereas bud chip for PSJT 941 and Kidang Kencana. Three seedling materials could be fitted to Bululawang and VMC 86-550, however for dryland farming bud sett and bud chip are preferred because such planting materials can be germinated first at the nursery and then transplantted in the field when there has been enough water content in the soil.

Keywords: clone; seed material types; sugarcane.

INTRODUCTION

Sugar is one of strategic and important commodities, which used sugarcane as raw material for sugar industry at the tropical regions. High sugar productivity depends on cane stalk productivity and stalk sucrose content. Sugarcane needs enough water during the vegetative growth and dry condition during the maturation phase, therefore sugarcane will decrease the growth, when water shortage happens during the vegetative phase. The way to solve such problem is by mitigation system through the construction of irrigation system or the cultivation system innovation.

Cane plant is generally propagated by vegetative methods through stem cuttings with 2–3 lateral buds, bud sett and bud chip. Stem cutting can be stored for longer periods and yields a good quality of seedling and endurance in storage. However, it requires huge weight of planting material, because internode should be included in the implementation.

According to Hunsigi (2001), bud sett is very advantageous in economic scale because it reduces transportation cost of planting material. Devi et al. (2011) said that bud sett has a weakness in germination in direct seeding. Bud sett germination for 35 days in field is 51.9%, on the other hand, stem cutting can reach 63.1%.

The use of bud chip as seed material can decrease cane stalk utility as seed material around 80–90% cane stalk (Anonim, 2007). This method can be economics in seed material around 1–1.5 t/ha and easier in transportation and seed cultivation. According to Prasad (2007), bud chip needs to be germinated before transplanted into field.

Because the importance of three types on seedling materials, therefore in this research the effectiveness of the three types of

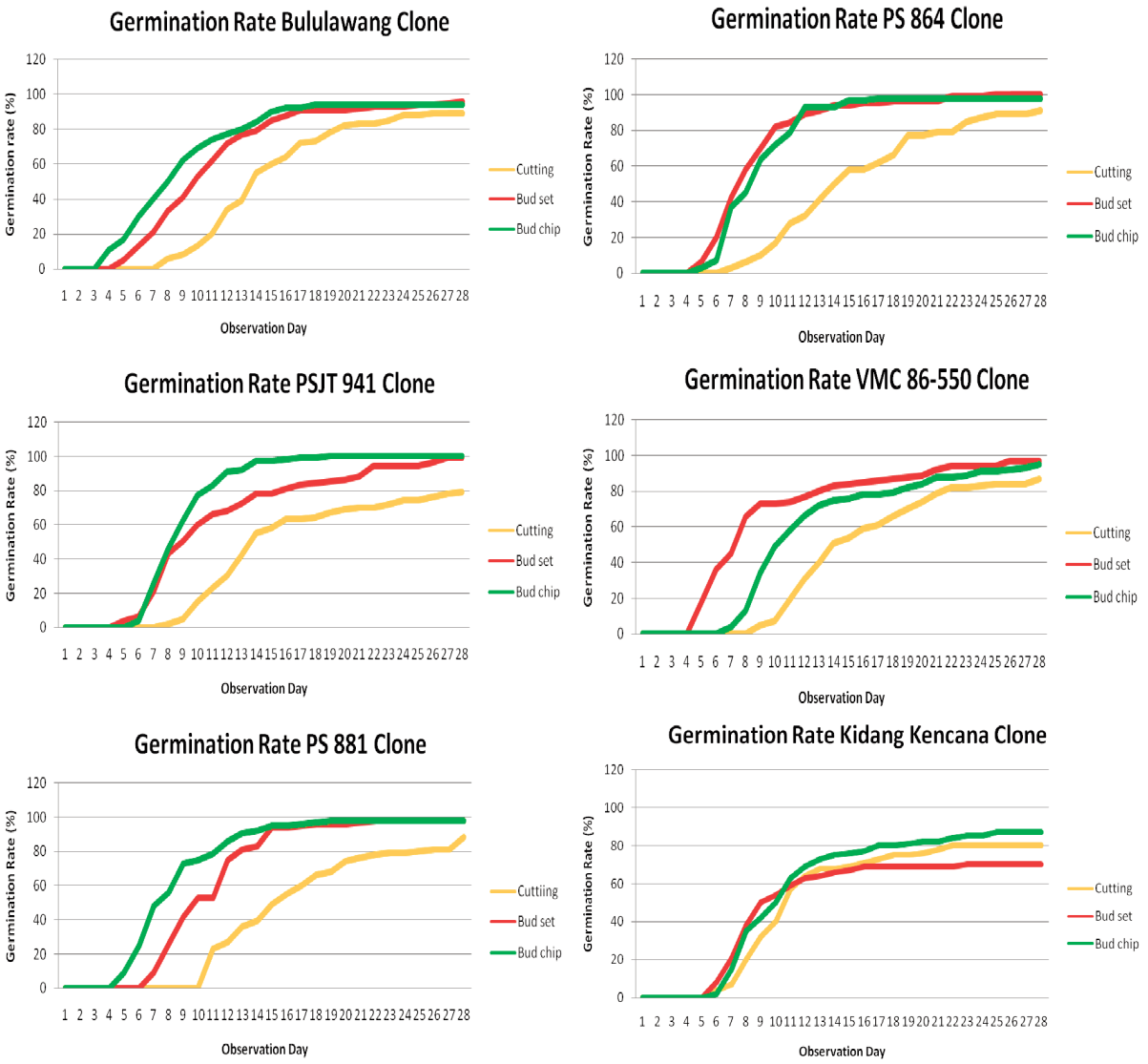

Figure 1. Germination rate of six clones in cutting, bud sett, and bud chip.

seedling materials that are cutting, bud sett, and bud chip will be investigated with 6 clones. This study is intended to inovate the cultivation system by examining the influence of conventional method (stem cutting) as a control, bud sett and bud chip, toward seed quality and the early growth of cane plant in the field, and to examine the behavior of clone from specific seedling material.

MATERIALS AND METHODS

The research Materials were six clones aged 6 months such as Bululawang, PS 864, PSJT 941, VMC 86-550, PS 881, and Kidang Kencana from Madukismo and Tasik Madu sugar factories. This study used factorial 6x3 which arranged in completely randomized design. The first factor was three types of seedling materials which were stem-cutting (T1), bud sett (T2), bud chip (T3), whereas the second factor was six sugarcane clones which were Bululawang (V1), PS 864 (V2), PSJT 941 (V3), VMC (V4), PS 881 (V5), and Kidang Kencana (V6) with 4 replicates. There were two sequential experiments. First experiment was at the nursery level. In this experiment, every experimental unit consisted of 25 polybags, therefore, the number of polybags was about 1800 polybags. When the cane plant reached two months old, the seedlings were moved from both 15x18 cm^3 and 35x35 cm^3 sized polybags to 50x50 cm^3 polybags. The number of plants that were transplanted to 50x50 cm^3 polybags as many as 72 plants. Early growth of plant in field was observed only once every two

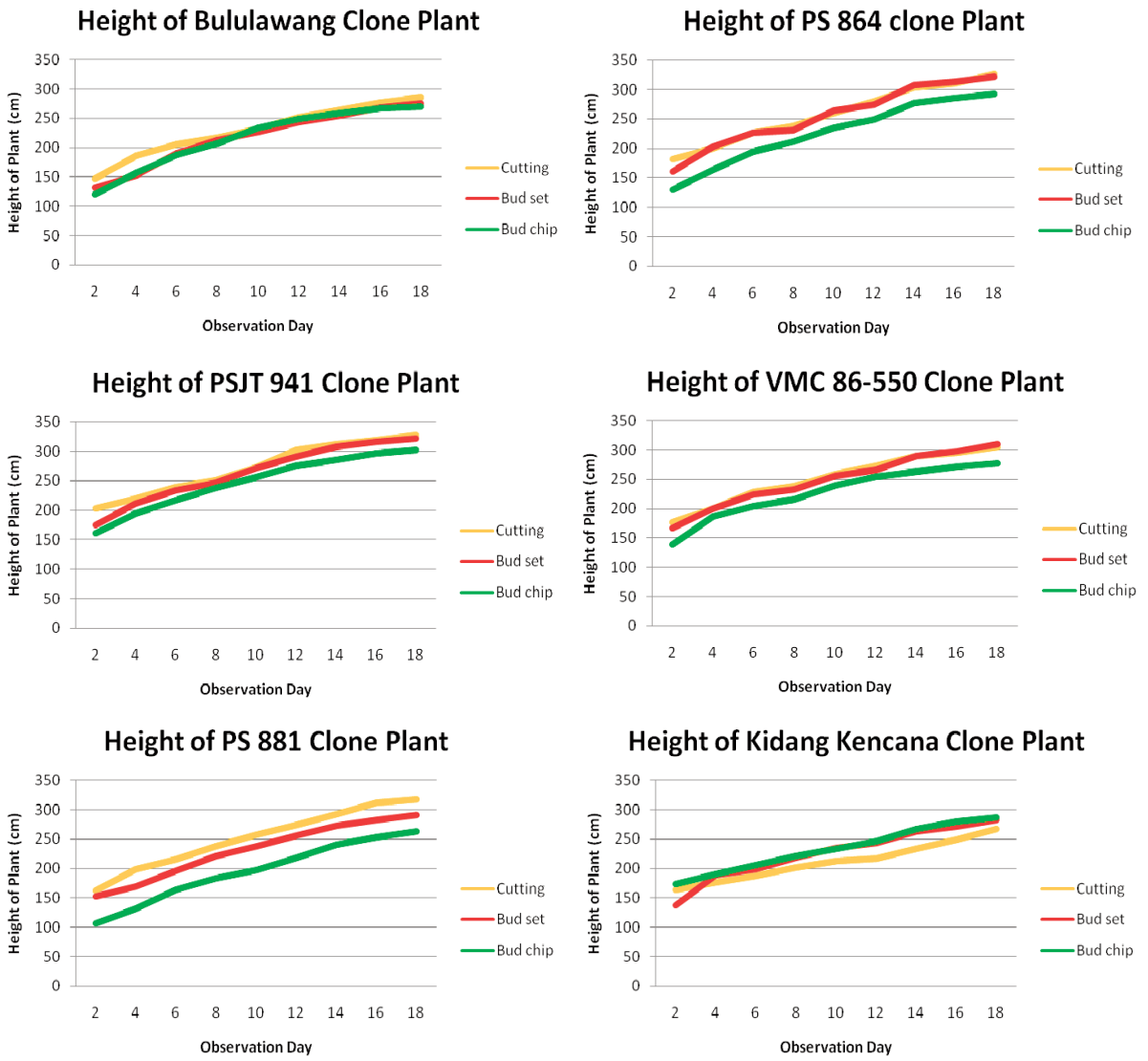

Figure 2. The increasing plant height of six clones from cutting, bud sett, and bud chip.

weeks until four months. Quantitative data was analyzed statistically using α = 5% and conducted by soft sets of equipment SAS 9.0 for windows.

RESULT AND DISCUSSION

Germination Rate (%)

Clone germination rate in different types of materials seedling showed different results. In general, every clone showed high germination rate in bud chip, whereas planting with cutting showed low germination rate. Van Dillewijn (1952) stated that a small volume of tissue and a single root primordium adhering to the bud was enough to ensure germination in sugarcane. Loganandhan (2012) also stated that bud chip germination increased to 80% after two month incubation period.

Plant height (cm)

The planting using different types of seedling would be extended to different influences in high plant that depent on sugarcane clone. Bululawang and PS 881 clones showed the highest plants in stem cutting material seed. On the other hand, PS 864, PSJT 941, and VMC 86-550 clones showed the highest plants in stem cutting and bud set planting material. Kidang Kencana clone showed the highest plant in bud sett and bud chip. Generally, types of seedling showed low sized plant in bud chip, it was probably due to slight amount of food reserves such as sucrose was left in the tissue.

Leaves number

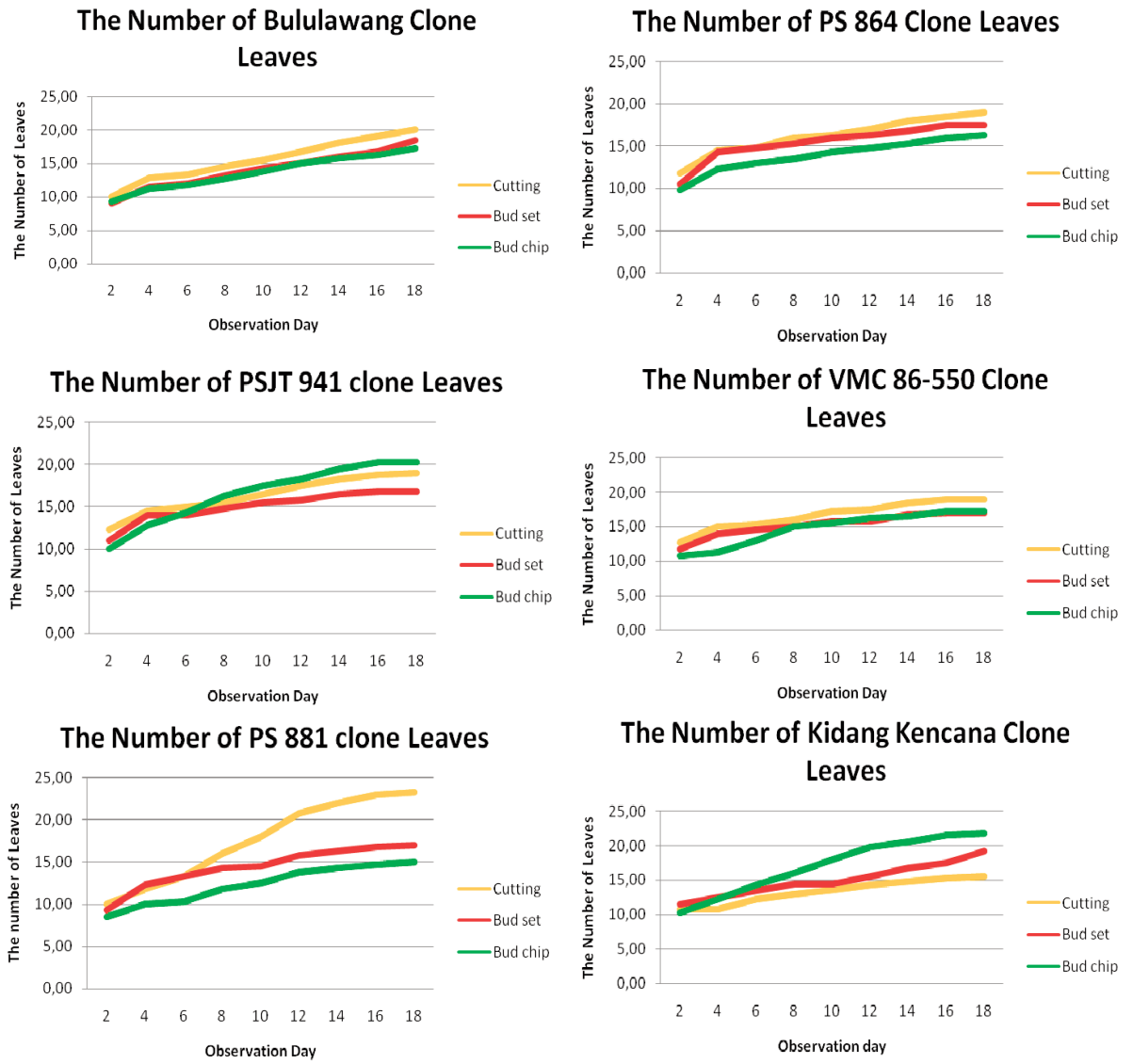

Figure 3. The increasing leaf number of six clones from cutting, bud sett, and bud chip.

Increase of the leaves number depent on the activity of cell elongation which stimulate the formation of leaves as photosynthesis organs especially in higher plants.

The graph showed the leaf number from six clones in three tyipes of seed materials. Stem cutting dominantly yielded the highest leaf number.

Stem diameter (cm)

Besides observing plant height, stem section can also be observed as diameter of the trunk. Bululawang, PS 864, and PS 881 clones showed the highest stem diameters in stem cutting planting material. PSJT 941 dan VMC 86-550 clones showed the highest stem diameter in stem-cutting and bud sett planting materials. Three seedling materials can be fitted to Kidang Kencana. Greater stem diameter showed significant linear correlation to the sugar content in stems.

Tiller numbers

Tiller numbers affected the final result in the harvest of sugarcane. The more tiller numbers were the greater the final result in the harvesting of sugarcane.

In general, clones planted using bud chip showed the highest tiller numbers while the stem cutting showed the lowest seedling tiller numbers (figure 5). Loganandhan (2012) stated that the bud chip method produced many seedlings and higher yield.

Based on the anova of each trait showed that there were an interaction between clone and seedling types on vigor index, leaf

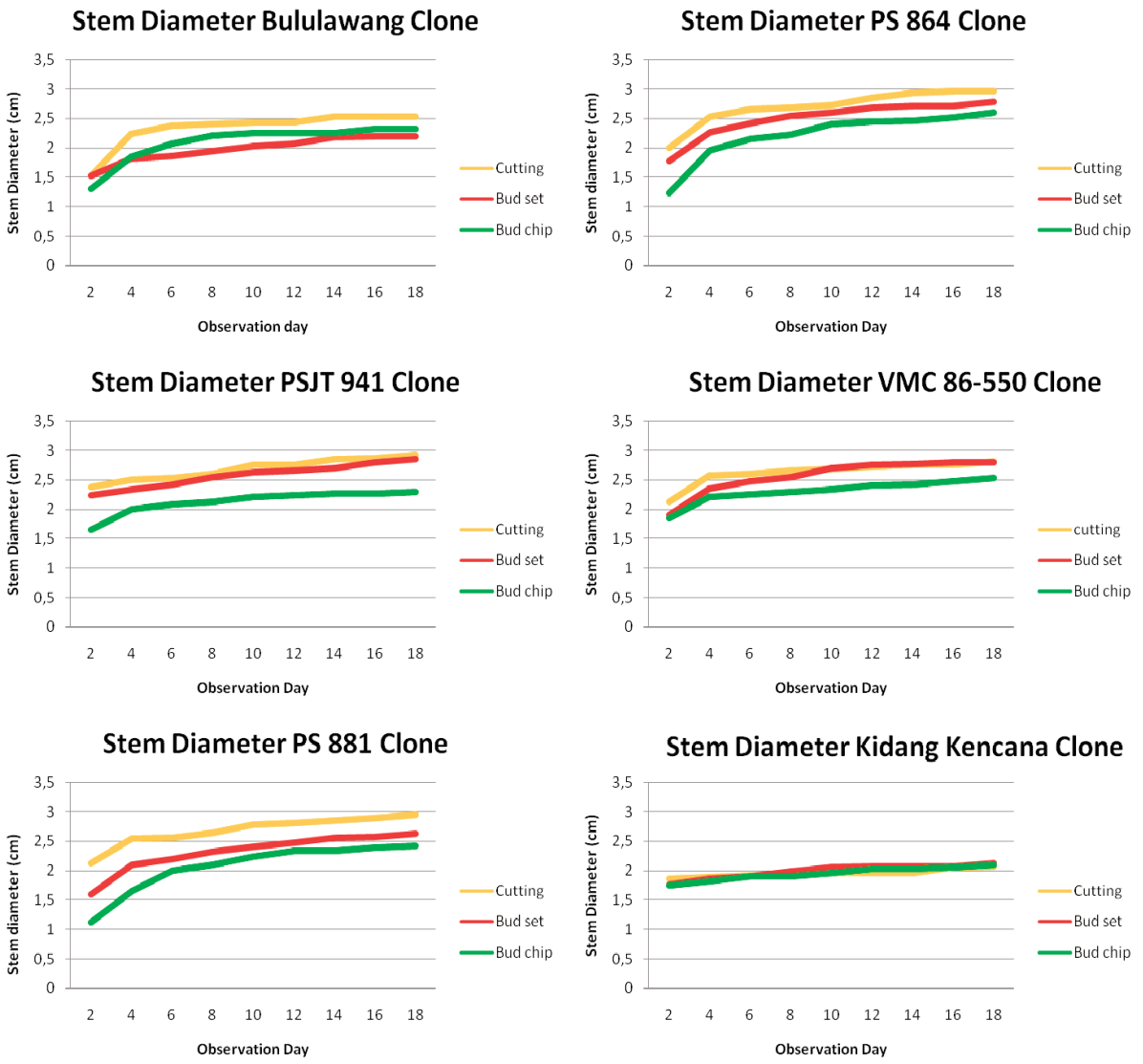

Figure 4. The increasing stem diameter of six clones from cutting, bud sett, and bud chip.

number, internode number, seedlings, leaf area, root volume, root fresh weight, root dry weight, shoot fresh weight, and shoot dry weight. However, there are only significant different among clones and types of seed material factors in plant height, diameter (table 1 and table 2).

Early growth of each clone such as germination rate and vigor index affected the next sugarcane growth. Fitter and Hay (1992) cit. Marjenah (2001) stated that leaf size became a major determinant of leaf area. Stem diameter, tiller numbers, and leaf area greatly affected the cane yield.

Root volume is influenced by the types of seedling material. Optimal rooting described an optimal conditions in canopy. Shoot fresh weight showed the level of water and nutrient uptake by the plant for metabolism (Dwijoseputro, 1980).

In this research, the characteristic that symbolized high yield of sugarcane was shoot fresh weight. Shoot fresh weight was supported by tiller numberss, stem diameter, leaf number, and leaf area. The shoot fresh weight was important because it symbolized the sugar. According to shoot fresh weight, stem cutting was suitable for PS 881 and Bululawang clones. Bud sett was for PS 864 clone, whereas bud chip originated from PSJT 941 and Kidang Kencana. Three seedling materials can be fitted with Bululawang and VMC 86-550, however for dryland farming bud sett and bud chip are preferred because such planting materials can be germinated first at the nursery and then

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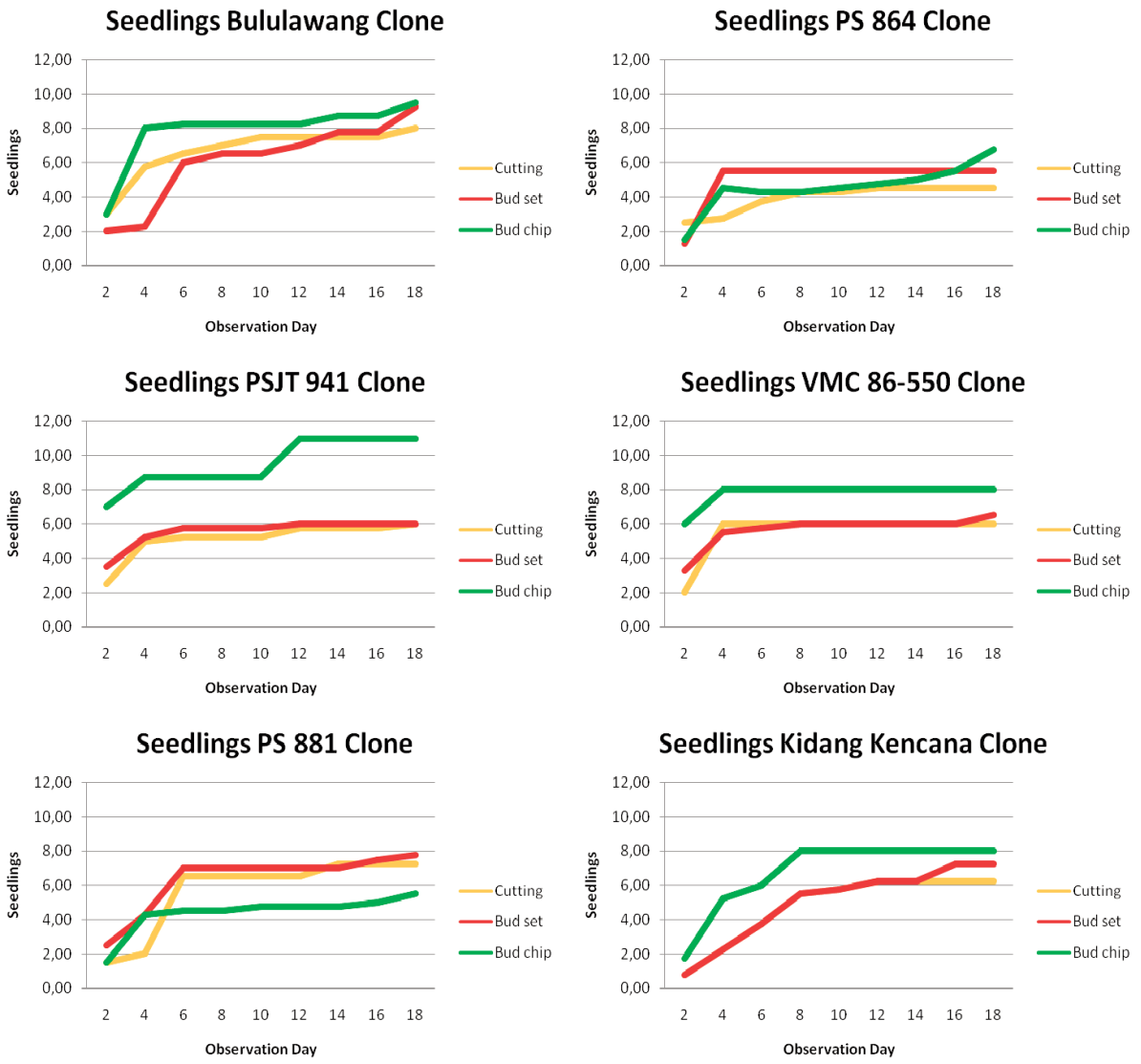

Figure 5. The increasing seedling tiller numbers of six clones from cutting, bud sett, and bud chip.

transplantted in the field when there has been enough water content in the soil.

CONCLUSIONS

The early growth of the cane plants depent on clone. There were interactions between both factors on germination rate, vigor index, leaf number, internode number, seedlings, leaf area, root volume, root fresh weight, root dry weight, shoot fresh weight, and shoot dry weight. According to shoot fresh weight, stem-cutting was suitable for PS 881 and Bululawang clones. Bud sett was for PS 864 clone, whereas bud chip came from PSJT 941 and Kidang Kencana. Three seedling materials can be fitted with Bululawang and VMC 86-550 however for dryland farming bud sett and bud chip are preferred because such planting materials can be germinated first at the nursery and then transplantted in the field when there has been enough water content in the soil.

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Table 1. Analysis of variance of germination rate (GR), vigor index (VI), plant high (PH), Leaf number (LN), diameter (D), Internode number (IN), tiller numbers (S), Leaf area (LA).

Source of variation	Mean square							
	GR	VI	PH	LN	D	IN	S	LA
Clone	557.59*	0.29*	3389.61*	3.19*	0.85*	4.12*	0.04*	0.0100*
Seedling material	1160.05*	8.81*	3748.18*	18.01*	0.64*	5.38*	0.06*	0.0639*
clone*seed material	131.98*	0.65*	734.21 ns	25.63*	0.09 ns	6.95*	0.02*	0.0861*
Error	42.888	0.05	468.94	8.39	0.04	2.25	0.01	0.0331

Remarks: *: there is significant different according to variance analysis (α = 5%); ns: there is no significant different according to variance analysis (α = 5%).

Table 2. Analysis of variance of root volume (RV), root fresh weight (RFW), root dry weight (RDW), shoot fresh weight (SFW), shoot dry weight (SDW).

Source of variation	Mean Square				
	RV	RFW	RDW	SFW	SDW
Clone	0.172*	0.119*	0.114*	0.195*	0.271*
Seedling material	0.013*	0.156*	0.259*	0.077*	0.112*
Clone*seedling material	0.107*	0.074*	0.093*	0.132*	0.136*
Error	0.025	0.027	0.033	0.031	0.035

Remarks: *: there is significant different according to variance analysis (α = 5%); ns: there is no significant different according to variance analysis (α = 5%).

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