Growth Analysis Of Transplanted Sugarcane Bud Chips Seedling In The Dry Land

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Abstract: Growth of sugarcane transplanted bud chips seedlings in the dry land was assessed during 2014-2015 under different levels of interrow spacing i.e. 30 x 100, 45 x 100, 60 x 100, and 75 x 100 cm. The interrow spacing of 60 and 75 cm resulted in an increase in leaf area significantly compared with 30 and 45 cm interrow spacing. Widening the space of up to 75cm did not significantly decrease the leaf area index (LAI) compared with the row space of 30 cm in the grand growth phase and the maturity phase. Planting at interrow spacing of 60 to 75 cm in rainfed dryland produced the highest the crops growth rate (CGR) and net assimilation rate (NAR) in the clones of PS864, KK, BL, and VMC during the early phase of maturity, i.e. 8-9 months after planting.

Key Words: Sugarcane, bud chips, dry land, growth; CGR, NAR.

INTRODUCTION

Growth is a vital function of plants. Growth produces changes in shape, physiological activity, biochemical composition and structure [1]. Along with other favorable environmental conditions, cultivation practices increase the growth. Sugarcane cultivation with different spacing on the rows in single bud chips transplanting is among the important factors affecting increases in the growth in dry land. In the dry land without irrigation, ground water is limited and fertility is low, which determine the growth of plants [2],[3],[4]; therefore drought is a primary factor limiting growth and crop yield [5]. Crop growth rate and net assimilation rate of sugarcane decreased in the field with limited irrigation [6]. Declining growth in conditions of drought stress is caused by a decrease in physiological activity [7], [8], [9]. Growth parameters such as leaf area, leaf area index, crop growth rate and net assimilation rate are very important in assessing the sugarcane's growth that is affected by spaced rows planting on dry land. Islam et al. [10] reported that the wider spacing of sugarcane (150 cm between rows) produces more light and is absorbed in the bottom of the canopy. More light is absorbed causing an increase in photosynthesis and growth [11]. Maintaining the optimum growth of sugarcane on dry land become essential. This is because the tillering phase and the grand growth phase are identified as critical periods of sugarcane growth against water [12].

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Approximately 70-80% of the sugar is produced during those phases [13]. Zhao et al. [14] reported that the effect of drought during the grand growing phase caused a decrease of 53% in millable cane on sandy soils. Therefore, it is necessary to grow sugarcane in the field with the system of transplanting seedlings when soil moisture is sufficient to avoid the limitations of the water on dry land, and set the optimum plant spacing to increase the growth. Tianco [15] reported that the system of transplanting seedlings increased the weight of cane by 34%. Transplanting seedling of bud chips can be arranged by row spacing to increase growth and high yield of 117.8-120.8 tons/ha [16]. Gill [17] and Ghaffar et al. [18] stated that a significant effect was observed on crop growth rate under various planting systems. Khan et al. [19] also stated that a significant effect was observed on crop growth rate and net assimilation rate under differences row spaced planting of sugarcane. There is a an imperative need to optimize the growth of sugarcane with row spacing application with the system of transplanting seedlings in the dry land. The present study was initiated to analyze the growth of sugarcane under various row spaces in dry land conditions.

MATERIAL AND METHOD

The study was conducted in the agronomic research area, Agriculture Faculty of Universitas Gadjah Mada in cooperation with Madukismo Sugar factory, in the village of Piyaman, distric of Gunung Kidul, Special Region of Yogyakarta during 2014-2015 on dusty loam dry land area without irrigation. The altitude of research area was at 150-200 meters above sea level with red Mediterranean soil type. The soil physico-chemical and rainfall characteristics of experimental sites are detailed in Table 1 and Fig. 1. The proposed study was laid out in Factorial Randomized Complete Block Design. The first factor was the types of clone, consisting of (1) PS864, (2) Kidangkencana (KK), (3) PS881, (4) Bululawang (BL), and (5) VMC. The second factor was transplanting bud chips seedlings with spacing single row planting pattern comprised of (1) 30 x 100 cm, (2) 45 x 100 cm, (3) 60 x 100 cm, and (4) 75 x 100 cm spacing of seedlings in rows and between rows. There were twenty combined treatments. The net plot size was 70 m^2. The control was direct setts planting system in the field with 3-4 budded setts per seed. The plot of controls measured 240 m^2 for each of the clones. The plot treatments were arranged to completely randomized block design with four replications. The plot of control placed was outside of the completely randomized block design. The bud chips seeds of each sugarcane clone was planted in the nursery in polybags of size 8 x12 cm in the first week of November and transplanting in the dry land in the second of December (The 40 day-old-seedlings in the nursery) 2014 according to plant spacing treatment. The control crops were planted simultaneously with the bud chips transplanting seedlings treatment. The fertilizers applied were @ 72-40 ZA-NPK Phonska g/plant. The basal dose of ZA at 36 g/plant and NPK Phonska at 20 g/ plant was applied at the time of transplanting seedlings in the field. The remaining ZA and NPK Phonska were applied on the tillering phase. All others agronomic practices were followed normally during the whole season. After one month-old plants in the field, data on growth was taken. The growth attributes of different clones that were examined under varied spaced of seedlings levels were described as:

Leaf area per plant: Leaf area per plant was calculated by formula suggested by Yoshida et al. [20]. Functional leaf i.e. green leaves were counted on the primary tillers of clump sampled by uprooting the plants, and then measuring the total number the leaf area with leaf area meter. Leaf area per tillers obtained was multiplied by the total number of stems on a clump samples for leaf area per plant. The measurement of randomly selected 3 stalks from 3 clumps and was converted to the average.

Leaf area index (LAI): Leaf area of three randomly selected stalks from each treatment plot at 30 days intervals was measured. LAI was computed by using the following formula as:

LAI = Leaf area (cm)/Ground area (cm)

Relative growth rate (CGR) ($g/m^2/day$)**:** CGR of three randomly selected stalks from each treatment plot at 30 days intervals was measured. To record CGR of the plant were cleaned and oven dried at 70^0C for 48 h. CGR was determined by using the following formula proposed by Gardner et al. [21]:

CGR = (W2-WI)/(T2-T1)

Where:
WI & W2 are Shoot dry weight m^{-2} at time T1 & T2 respectively.
T1& T2 are Time interval between two harvests.

Net assimilation rate (NAR) ($g/m^2/day$) : NAR of three randomly selected stalks from each treatment plot at 30 days intervals was measured. To record NAR of the plant were cleaned and oven dried at 70^0C for 48 h. The mean NAR was determined by following the method proposed by Gardner et al. [21]:

NAR = ((W2-W1)/(T2-T1)) x ((lnL2-lnL1)/(L2-L1))

Where:
W1 = Dry weight of first harvest
W2 = Dry weight of second harvest
In = Natural logarithm
LAI1 = Leaf area index at second harvest and
T2-T1 = Time interval between two harvests.

RESULTS AND DISCUSSION

Leaf area was significantly affected by the row spacing as well as the clones. Interaction between clones and row spacing of determining leaf area occurred only in the tillering phase, aged 3 months after planting. At the tillering phase, VMC clone with the 75 cm inter row spacing produced higher leaf area. The wider row spacing (60-75 cm) produced the highest leaf area and was significant on PS881 clones than 45 cm of interrow spacing. Meanwhile, the other clones did not show a significant change in leaf area at different levels of row spacing in the tillering phase. Leaf area was maximum in 6 months after planting. Maximum leaf area was recorded in 60 and 75 interrow spacing, increased significantly by 33.06-70.94 % over than 45 and 30 cm interrow spacing. These results suggest that a spacing of 60 and 75 cm promote growth and development of leaves. This is associated with the ability of canopy to capture sunlight. Islam et al.[10] reported that a spacing in the row width of 150 cm produces more interception of light to be absorbed in the bottom leaves of sugarcane. More interception and distribution of light in the canopy of sugarcane cause an increase in photosynthesis and vegetative growth through increased tillers, leaf area, and stem biomass accumulation [11]. There is a significantly genetic factor among clones in producing leaf area. Maximum leaf area was recorded in clone KK followed by PS881, BL, PS864, and VMC. All clones reached the maximum leaf area at the age of 6 months after planting in the grand growth phase. Leaf area was decreased in 8 month after planting at the maturity phase. These results are in line with those of Kumar et al. [22] that leaf area differend signicantly among clones. Similar finding were also reported by Aboagye et al. [23] and Silva et al. [24] that components of the leaves and stems of sugarcane are more determined by the genetic factors of varieties. Leaf area index (LAI) was determined by the interaction of clones and interrow spacing on the tillering and maturity phases. In addition to these phases, LAI was ditermined by the clones and interrow space. KK clones produced the highest LAI. Meanwhile, the 30 cm interrow spacing produced the highest LAI. Similar finding were also reported by Aboagye et al. [23] that the optimum of LAI was more quickly achieved in high-density plantings. The value of LAI was maximum in 6 months after planting. Widening the interrow spacing up to 75 cm significantly reduced LAI by 46.46 % compared to 30 cm interrow spacing. Meanwhile interrow spacing of 45-60 cm did not produce differences of LAI. At the tillering phase, various levels of interrow spacing did not significantly produce differences of LAI for clones BL and VMC. These results indicate that BL and VMC clones have higher growth and development of leaf and those clones can be applied in the a wider interrow spacing. The characteristic of LAI surviving until the maturation phase, ages of 9 months after planting (MAP), is in VMC clones. LAI of PS864, KK, and PS881 clones decreased significantly interrow spacing of 75 cm compared to 30 cm. The decline of LAI was sharper during the ripening phase. The highest decrease in LAI was on PS864 clones in all levels of a interrow spacing so that the clones PS864 has the lowest ILD. This shows that PS864 clones were lowest in the growth and development of the leaves.

Table 1.
Soil chemical and physical properties. The soil was collected at a depth of 0–200 mm from the agronomic research area, localized in the village of Piyaman, district of Gunung Kidul, Special Region of Yogyakarta, Indonesia.

Analysis	Soil depth (0-200 mm)
	Chemical
pH	5.78
C	2.98 %
Organic matter	5.1 %
N (total)	0.27 %
P (available)	333.99 ppm
K (available)	1.5 me/100g
C/N ratio	10.95
	Physical
Sand	16.51 %
Silt	18.24 %
Clay	65.25 %
Textural classification	Clay silty

Source: *Analysis by the soil laboratory, Agricultural Faculty of Universitas Gadjah Mada, Yogyakarta, Indonesia.*

Tureal el al. [25] reported that LAI of sugarcane reached 6-7 in the first sugarcane planting and decreased in the first ratoon to 4.5. The highest LAI of sugarcane on the grand growth phase reaches 3.4 at the ages of 297 days after sugar cane harvesting [26]. Meanwhile, from this study, LAI differed among clones and interrow spacing. LAI reaches its maximum at the age of 6 MAP. The highest LAI was found in KK clone, i.e. 5.66, and at 30 cm interrow spacing, the highest LAI reached 3.94. The clones capable of sustaining LAI to remain high until the ripening phase is PS881 (9 MAP), i.e. 3.9. Value of crop growth rate (Table.3) was maximum in between 6-7 MAP but it declined abruptly in 8 MAP. Level of 30 cm interrow spacing showed a significant reduction by 62.60 % at the maximum CGR (6 MAP). Genotype BL produced a significant maximum value of CGR, while genotype PS864 gives the lowest value of CGR at the maximun CGR phase. After a phase of maximum CGR at the age of 6-7 months after planting, there were no significant differences between clones. In the maturity phase (9 MAP), the level of 75 cm interrow spacing produced the highest CGR in all clones except PS864. PS864 Clones has the highest CGR at the level of 60 cm interrow spacing. CGR of sugarcane was decreased by the short row spacing (30 cm interrow spacing) which may be due to the unavailability of certain nutrients to plant roots and many of the middle and lower leaves are shaded. Less interception of light caused a decrease in photosynthetic efficiency and hence decreases in photosynthetic efficiency resulting in the decreased crop growth rate [27], [28]. The altered/reduced supply of certain plant nutrients and decrease in photosynthetic efficiency might be due to cause of low CGR.

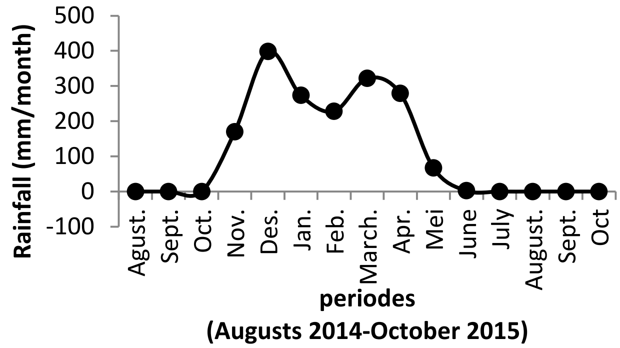

Fig 1. *Rainfall data (mm) of experimental sites of 2014-2015 of Piyaman village, district of Wonosari, Gunung Kidul, Special Region of Yogyakarta.*

The net assimilation rate (Table 3) was maximum in 6 months after planting. At the age of maximum of NAR, 60 cm interrow spacing significantly increased the NAR value up to 30.34 % compared with the level of 30 cm interrow spacing. The minimum values of NAR were found in PS864 clones. Over time the growth, the maturity phase, NAR was determined by the interaction of clones and spacing in the row. The PS864 clones significantly generate the highest NAR value with interrow spacing of 60 cm. The interrow space of 75 cm significantly produced the highest NAR value on the BL and VMC clones. These results are in line with those of Chattha [29] and Khan et al. [19] who reported that planting patterns had a significant impact on NAR. 70 cm spaced single row planting pattern of sugarcane significantly increased the NAR compared with 60 cm [19]. NAR of VMC and BL clones with interrow spacing of 75 cm increased by 35.0 % and 8.72 % at the age of 8 MAP compared with 30 cm interrow spacing. At the age of 9 MAP in VMC, BL, and PS864 clones with interrow spacing of 75 cm increased NAR and reached 70.92, 77.35, and 25.53 % respectively. According Chattha [29] the increase in NAR of sugarcane is due to an increase in leaf area and CGR, while the results of this study generally indicate that a wider row spacing (60-75 cm interrow spacing) produced leaf area and higher CGR. The maximum NAR was recorded at the age of 5-6 MAP. These results are in line with those of Patil [30] that NAR of sugarcane achieve the optimum at the age of 160-200 days after planting. The higher NAR value might be due to availability of certain nutrients to plant roots and increase the efficiency of photosynthesis [26], and more availabe space for air circulation and light interception which increased photosynthetic effeciency and improved CGR, LAI, and ultimately NAR [31], [19].

CONCLUSION

The arrangement of interrow space in the planting pattern in sugarcane clones showed changes of leaf area, LAI, CGR, and NAR. At the 60 and 75 cm spaced interrow planting pattern of dry land sugarcane had the highest CGR and NAR in PS864, KK, BL, and VMC clones during the early phase of maturity.

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Table 2. *leaf area and leaf area index of diverse sugarcane clones at different row spacing planting response of bud chips transplanting seedlings system on dry land.*

Parameter	Leaf area (dm^2)						Leaf area index					
Treatments	Ages: month after planting						Ages: month after planting					
	2	4	6	8	9	10	2	4	6	8	9	10
(A) Clones (C)												
PS864	155.74ab	206.02	217.78b	142.10b	83.57b	71.48b	3.51a	4.38a	4.30b	2.67c	1.61c	1.41c
Kidang Kencana (KK)	117.76b	183.68	281.27a	212.88a	124.02a	116.98a	2.62b	3.79ab	5.66a	4.12a	2.43a	2.31a
PS881	172.63a	194.78	240.71b	174.99ab	119.90a	106.40a	3.46a	3.98ab	4.69b	3.66ab	2.50a	2.03ab
Bululawang (BL)	118.23b	165.59	225.26b	162.84b	109.05a	104.11a	2.33b	3.48	4.52b	3.23bc	2.23ab	2.15ab
VMC	179.88 a	210.34	203.93b	149.95b	106.26a	96.03a	3.57a	4.35a	4.06b	2.99bc	2.00b	1.88b
DMRT	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**
(B) Inter row spacing (S)												
30/100 cm (S1)	150.76a	156.23c	165.89c	117.24b	80.35b	68.46b	4.90a	5.52a	5.58a	3.94a	2.76a	2.33a
45/100 cm (S2)	108.04b	176.25bc	213.12b	143.39b	85.85b	83.90b	2.35b	3.75b	4.61b	3.18b	1.91bc	1.88b
60/100 cm (S3)	176.40a	212.36ab	272.58a	196.22a	130.86a	119.19a	3.06b	3.64bc	4.60b	3.30b	2.14b	1.97b
75/100 cm (S4)	160.20a	223.48a	283.58a	217.35a	137.18a	124.44a	2.09c	3.08c	3.81c	2.92b	1.81c	1.65b
DMRT	**2.76**	**2.76**	**2.76**	**2.76**	**2.76**	**2.76**	**2.76**	**2.76**	**2.76**	**2.76**	**2.76**	**2.76**
(C) C x S												
PS864 S1	189.73a-d	167.70	152.03	95.40	59.90	53.15	6.27a	6.50	5.32	2.90	1.90e-h	1.72
PS864 S2	149.33a-f	174.15	180.00	117.00	60.40	59.55	3.32c-g	3.85	3.97	2.57	1.35gh	1.35
PS864 S3	180.06a-e	227.79	219.60	151.20	115.70	82.00	3.00c-h	3.77	3.67	2.57	1.90e-h	1.35
PS864 S4	103.84d-f	254.43	319.50	204.79	98.29	91.20	1.45h	3.40	4.25	2.72	1.32h	1.22
KK S1	163.52a-d	163.69	208.20	138.30	80.00	79.10	4.85ab	5.45	6.95	4.60	2.67b-d	2.62
KK S2	128.25b-f	170.94	257.40	179.10	111.10	107.00	2.02e-h	3.82	5.75	3.95	2.45b-e	2.37
KK S3	68.54f	179.85	359.10	253.80	161.95	146.65	2.17d-h	2.97	5.97	4.22	2.72bc	2.47
KK S4	110.75d-f	220.25	300.38	280.30	143.05	135.15	1.45h	2.92	4.00	3.72	1.87e-h	1.80
PS881 S1	181.92a-d	167.61	176.10	145.80	111.60	61.60	6.07a	5.72	5.67	5.27	3.87a	2.05
PS881 S2	86.52ef	164.10	193.95	133.12	79.05	78.10	1.87f-h	3.50	4.32	3.12	1.87e-f	1.85
PS881 S3	216.91ab	226.81	262.80	193.80	134.83	132.20	3.60b-d	3.77	4.40	3.22	2.25c-f	2.20
PS881 S4	205.20ab	220.60	330.00	227.25	154.16	153.70	2.32d-h	2.95	4.37	3.02	2.02d-g	2.05
BL S1	112.69c-f	128.33	145.20	110.40	80.95	80.05	3.77b-d	4.80	5.02	3.70	3.02b	3.00
BL S2	67.11f	160.97	231.30	156.52	89.65	87.60	1.50h	3.60	5.15	3.50	1.97e-h	1.95
BL S3	138.42a-f	179.74	277.80	186.00	108.16	102.10	2.32d-h	2.97	4.62	3.10	1.82e-h	1.70
BL S4	154.72a-f	193.35	246.75	198.42	157.45	146.70	1.72gh	2.57	3.30	2.65	2.10c-f	1.95
VMC S1	105.93d-f	153.85	147.90	96.30	69.33	68.40	3.52b-f	5.12	4.92	3.47	2.32c-f	2.27
VMC S2	168.70a-e	211.10	202.95	131.20	89.05	87.25	3.02c-h	4.00	3.87	2.77	1.92e-h	1.90
VMC S3	218.39ab	247.63	243.60	196.31	133.70	133.00	4.22bc	4.72	4.32	3.47	2.02d-g	2.12
VMC S4	226.50a	228.76	221.25	175.98	132.96	95.45	3.52b-f	3.57	3.12	2.50	1.72f-h	1.22
DMRT	**1.92**	**1.92**	**1.92**	**1.92**	**1.92**	**1.92**	**1.92**	**1.92**	**1.92**	**1.92**	**1.92**	**1.92**

Means followed the same letter in a column do not differ significantly at 5 % level of probability

Table 3. *CGR and NAR of diverse sugarcane clones at different row spacing planting of bud chips transplanting seedlings system on dry land.*

Parameter	Crop growth rate (g/m^2/day)							Net assimilation rate (g/m^2/day)						
Treatments	Ages: month after planting							Ages: month after transplanting						
	3	4	5	6	7	8	9	3	4	5	6	7	8	9
(A) Clones (C)														
PS864	3.96	3.96	5.70	5.51b	4.72c	3.74	3.67	1.88	1.73	2.25	2.19b	1.94c	1.77a	1.99
Kidang Kencana (KK)	3.90	3.57	6.29	6.97a	6.04b	3.56	3.38	2.09	1.67	2.60	2.54ab	2.14bc	1.44ab	1.57
PS881	4.12	4.12	6.19	7.40a	6.46b	3.45	3.31	1.91	1.79	2.46	2.80a	2.42b	1.50ab	1.61
Bululawang (BL)	3.93	3.93	5.18	7.54a	7.75a	2.68	3.01	2.11	1.88	2.21	2.98a	2.92a	1.29b	1.51
VMC	4.05	4.05	5.78	6.59a	5.95b	3.58	3.74	1.80	1.72	2.28	2.57ab	2.42b	1.65a	1.90
DMRT	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**
(B) Inter row spacing (S)														
30/100 cm (S1)	3.61	3.61	5.59	5.16c	3.88c	3.16b	2.82b	1.85	1.76	2.51	2.30b	1.86c	1.62ab	1.64b
45/100 cm (S2)	3.96	3.96	5.41	6.55b	5.88b	2.74b	2.52b	2.11	1.86	2.23	2.59b	2.33b	1.34b	1.42b
60/100 cm (S3)	4.10	4.10	5.71	8.39a	7.75a	3.18b	3.21b	1.85	1.72	2.22	3.00a	2.73a	1.38b	1.53b
75/100 cm (S4)	4.30	4.04	6.60	7.10b	7.22a	4.54a	5.14a	2.02	1.71	2.49	2.56b	2.56ab	1.77a	2.27a
DMRT	**2.76**	**2.76**	**2.76**	**2.76**	**2.76**	**2.76**	**2.76**	**2.76**	**2.76**	**2.76**	**2.76**	**2.76**	**2.76**	**2.76**
(C) C x S														
PS864 S1	3.50	3.50	5.54	4.50	3.26	2.89b-g	2.89c-f	1.78	1.71	2.58	2.00	1.70	1.70a-c	1.88b-e
PS864 S2	4.18	4.18	4.24	5.05	4.01	2.82c-h	2.09ef	1.96	1.89	1.80	2.22	1.76	1.40b-e	1.29d-g
PS864 S3	3.81	3.81	6.69	5.77	5.77	4.90a	4.90ab	1.67	1.56	2.45	2.16	2.28	2.21a	2.43ab
PS864 S4	4.36	4.36	6.31	6.74	5.86	4.35a-d	4.82a-c	2.10	1.76	2.17	2.37	2.02	1.78ab	2.36a-c
KK S1	3.04	3.04	6.34	5.16	3.96	3.13a-g	2.38ef	1.54	1.50	2.80	2.14	1.69	1.43b-e	1.35d-g
KK S2	3.74	3.74	5.86	7.15	6.67	2.76e-h	2.76ef	2.24	1.87	2.46	2.63	2.41	1.28b-e	1.45c-g
KK S3	3.74	3.74	6.92	8.38	7.41	3.86a-f	3.86b-e	2.03	1.73	2.77	2.83	2.29	1.41b-e	1.60b-g

KK S4	5.07	3.77	6.05	7.19	6.12	4.49a-d	4.51b-d	2.53	1.60	2.40	2.55	2.19	1.63a-c	1.88b-e
PS881 S1	3.82	3.82	5.61	6.20	4.08	4.07a-e	3.98b-e	1.76	1.72	2.42	2.66	1.90	1.86ab	2.00a-d
PS881 S2	3.88	3.88	5.45	6.46	5.93	3.15a-g	2.81ef	2.11	1.85	2.29	2.68	2.43	1.46b-e	1.55b-g
PS881 S3	4.50	4.50	6.20	8.79	8.79	2.06f-h	2.06ef	1.85	1.79	2.34	3.13	3.06	0.97c-e	1.03e-g
PS881 S4	4.28	4.28	7.51	8.14	7.03	4.51a-d	4.41b-d	1.92	1.81	2.81	2.73	2.27	1.71a-c	1.87b-e
BL S1	3.60	3.60	4.83	5.68	4.32	3.36a-f	2.72d-f	2.03	1.89	2.28	2.75	2.09	1.72ab	1.59b-g
BL S2	4.12	4.12	5.21	8.46	8.45	1.12h	1.12f	2.50	2.03	2.16	3.23	3.14	0.73e	0.75g
BL S3	4.50	4.50	3.78	9.09	9.01	1.55gh	1.55f	2.12	1.99	1.67	3.36	3.12	0.83d-e	0.90fg
BL S4	3.51	3.51	6.90	6.95	9.22	4.71ab	6.65a	1.82	1.63	2.71	2.58	3.33	1.87ab	2.82a
VMC S1	4.10	4.10	5.65	4.26	3.80	2.36f-h	2.15ef	2.15	1.98	2.47	1.95	1.91	1.40b-e	1.41d-g
VMC S2	3.87	3.87	6.29	5.65	4.34	3.83a-f	3.83b-e	1.74	1.65	2.44	2.20	1.89	1.82ab	2.08a-d
VMC S3	3.93	3.93	4.98	9.95	7.78	3.52a-f	3.66b-e	1.58	1.53	1.85	3.55	2.89	1.48a-d	1.69b-f
VMC S4	4.31	4.31	6.22	6.49	7.87	4.63a-c	5.33ab	1.74	1.74	2.38	2.59	2.98	1.89ab	2.41ab
DMRT	**1,92**	**1,92**	**1,92**	**1,92**	**1,92**	**1,92**	**1,92**	**1,92**	**1,92**	**1,92**	**1,92**	**1,92**	**1,92**	**1,92**

Means followed the same letter in a column do not differ significantly at 5 % level of probability