IMPROVEMENT OF ESTABLISHING METHOD IN NORMAL AND DWARF VARIETIES OF ELEPHANTGRASS FORAGE FIELD

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Abstract: Improvement of Establishing Method in Normal and Dwarf Varieties of Elephantgrass Forage Field. For determining the establishment method by transplanting nodal positions of tiller bud were compared in a normal (cv. Wruk wona) and two dwarf varieties (dwarf-early type, DE and dwarf-late type, DL) of Elephantgrasses. The position of tiller bud measured was odd number from 1 to 19 in Wr and DL by dividing into two nodes, and every number from 1 to 10 in DE by dividing into a single node because of a limited number of tiller buds per tiller. The order of internode dry matter weight (DMW) was larger in dwarf DE followed by normal Wr and dwarf DL. Percentage seedling emergency (PSE) was larger in dwarf varieties than normal Wr. Regrown tiller number (RTN) was larger in dwarf varieties than normal Wr, however, the position of that node number to that RTN was negatively relationship ($P<0.05$). Both dry matter weight of tiller (DMWt) and stubble (DMWs) decreased with the increase in nodal position from the base to the upper position among varieties and the relationships were positive to that positions ($P<0.01$).

Abstrak: Peningkatan Metode Pertunasan Hijauan Rumput Gajah Varitas Normal dan Dwarf. Untuk menentukan metode pertunasan dengan penanaman bagian node stek tanaman rumput gajah, maka akan dikomparasikan varitas Normal Wrukwona (Wr) dan dua varitas Dwarf yaitu dwarf-early (DE) dan dwarf-late (DL). Bagian node stek yang diukur adalah bagian node ganjil dari node 1 sampai 19 yang masing-masing terdiri dari dua node pada varitas Wr dan DL, dan setiap bagian node dari node 1 – 10 yang terdiri masing-masing satu node karena keterbatasan node dalam setiap stek batang. Secara berurut, bahan kering (DMW) internode adalah lebih besar pada dwarf DE kemudian normal Wr dan dwarf DL. Persentase tumbuh tunas (PSE) lebih besar pada dua varitas dwarf dibanding normal Wr. Meskipun korelasi jumlah bagian node pada semua varitas adalah negative terhadap pertumbuhan tunas ($P<0.05$), pertumbuhan tunas (RTN) lebih besar pada dua varitas dwarf dibanding normal Wr. Bahan kering batang

(DMWt) maupun bahan kering stubble (DMWs) hasil pertumbuhan adalah menurun dari posisi dasar hingga bagian atas stek pada semua varitas, dan berkorelasi positif (P<0.01) terhadap seluruh bagian node.

Kata Kunci : dwarf elephantgrass, normal elephantgrass, pertumbuhan tunas, potensialitas tunas.

Elephantgrass (*Pennisetum purpureum* Schumach) can reproduce sexually, but the fertility is low and seed yield is very poor (Burton, 1986). Since the seedling is so weak, it should be started to grow in a nursery and then transplanted, even if it is grown from seed (Kipnis et al., 1987). Thus, Elephantgrass field is normally established from stem cuttings or rooted tillers taken from the stubbled crown. Generally, establishment is done by the diagonal or upright planting of short stem cuttings with one or two nodes per sets. It is assumed that the ability of tiller emergence from stem cuttings is different with the nodal position on the mother shoot (Mukhtar et al., 2002). That is, nodal position should affect the maturity of tiller bud and internode, which results in the different ability of tiller emergence depending on the nodal position.

It is also assumed that the stem cuttings may be successful after the internodes or tiller buds reach to the certain stage of maturity (Anom, 1992). Thus, in the summer season when the tillers are not so elongated, especially in the dwarf varieties, transplanting rooted tillers by dividing plants is the sole method for establishing Elephantgrass forage field. In this case, the efficiency of expanding forage field should be lower than the stem cutting method from the same number of mother plants for the establishment, but the risk for death during overwintering may be lower by rooted tillers.

Many cultivars of dwarf elephantgrass (*Pennisetum purpureum Shumach*) have recently been ground and examined for their growth characteristics in the tropical and sub-tropical regions in the world (Cuomo et al, 1996; Hanna and Monson, 1988; Kipnis and Bneimoshie, 1988). Dwarf elephantgrass fasilitates hand harvesting by farmers and is assessed to be more suitable for grazing than normal variety (Rusland et al; Williams and hanna, 1995). Dwarf varieties were different from normal varieties in tiller number, mean tiller weight and percentage of leaf blade in preliminary study using the plants (Ishii et al, 1998).

Since two dwarf varieties of elephantgrass has been introduced from Japan to Gorontalo in 2004, it should be investigated in Gorontalo agro climates to obtain their growth characteristics as well as the nodal potentialities. Two dwarf of elephantgarss varieties definitely named in Japan are Dwarf-early (early-heading variety was termed DE) and Dwarf-late (late-heading variety was termed DL). They were original by bred in Florida, USA and brought to Thailand in 1990 and introduced to Japan in 1996.

The objective of this study was to evaluate the establishment potentiality by transplanting tiller bud on each nodal position and the regrowth tiller development after transplanting among verities of normal and dwarf elephantgrass.

MATERI DAN METODE

Plant materials

The research was carried out at the experimental field from June to August, 2010. The soil structure is illustrated in Fig. 1 where the top soil was the sandy soil, and the basal soil was Kanuma soil for facilitating the water penetration. The examined of Elephantgrass varieties were normal variety of Wruk wona (Wr) and dwarf varieties of dwarf-early type (DE) and dwarf-late type (DL) introduced from Japan in 2004.

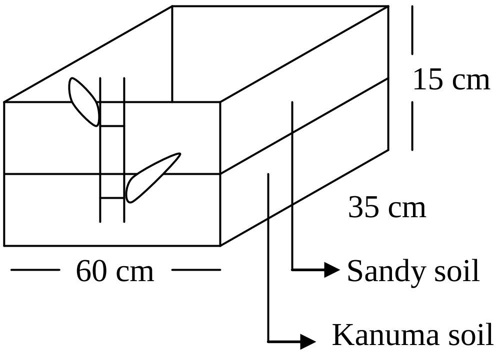


Fig. 1. Illustrasi of the soil structure and the transplanting bed. Replication: 10 sets/one nodal position

Experimental design

The size of transplanting bed was 60 cm × 35 cm × 15 cm (depth) and plant spacing density was 6 cm × 7 cm (24 nodal sets/m^2) for Wruk wona (Wr) and Dwarf-late (DL) and 12 cm × 7 cm (12 nodal sets/m^2) of Dwarf-early (DE) because of the limited number of tiller buds suitable for transplanting per tiller. The position of tiller bud measured was odd number from 1 to 19 in Wr and DL by dividing into two nodes, and every number from 1 to 10 in DE by dividing into a single node because of a limited number of tiller buds per tiller. All tiller buds of normal and dwarf varieties were planted on June 5, 2010 and there was not fertilizer performed. The data where analyzed statistically by the analysis of variance.

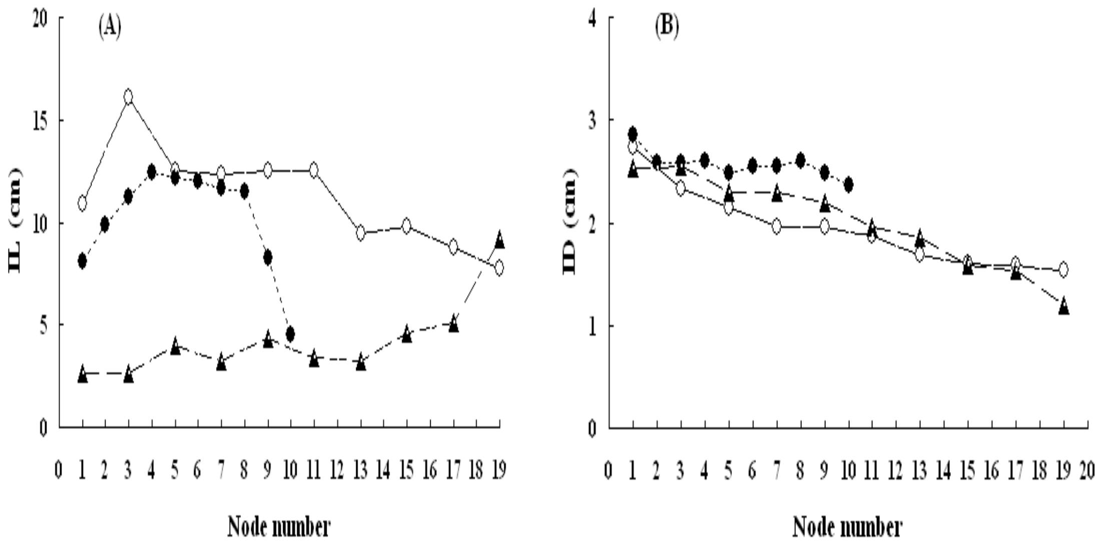
Sampling methods

Nodal positions measured were every other nodes counted from the basal to the upper nodal position, while the uppermost internode was not used because of immature internode. By four replications of every positioned tiller buds, characters were measured as follows : (a) Length, diameter of the longer side, the fresh matter weight and dry matter weight (DMW) of internode, (b) length, width, fresh matter weight and DMW of tiller buds, and (c) seedling efficiency of the tiller buds which were measured by ten replications. Every tiller bud or nodal positions were measured at pre- and post-planting on June 5 and September 5, 2004, respectively.

RESULTS AND DISCUSSION

Seedling abilities of tiller buds were compared on the nodal position at the odd number in Wr and DL, while at each number in DE because of limited nodal buds for planting.

Relationships between the nodal position and internode length (IL), internode diameter (ID), tiller bud length (TBL) and tiller bud width (TBW) are shown in Fig. 2. IL was larger in normal Wr than the dwarf varieties of DE and DL. IL in Wr and DE tended to be smaller with the increase in the nodal position from the base to the upper positions, while the IL in DL tended to be larger with the increase in the nodal position. The larger IL in Wr was reflected by the larger plant height and tall growth habit, whereas dwarf varieties had shorter IL, because of the dwarf plant type, and the degree of dwarf type was stronger in DL than in DE. ID was the largest in dwarf variety of DE, followed by DL and normal variety of Wr. Comparing IL and ID, ID was larger at the shorter IL on the basal positions. ID in a range of 2 – 3 cm decreased from the base to the upper positions.



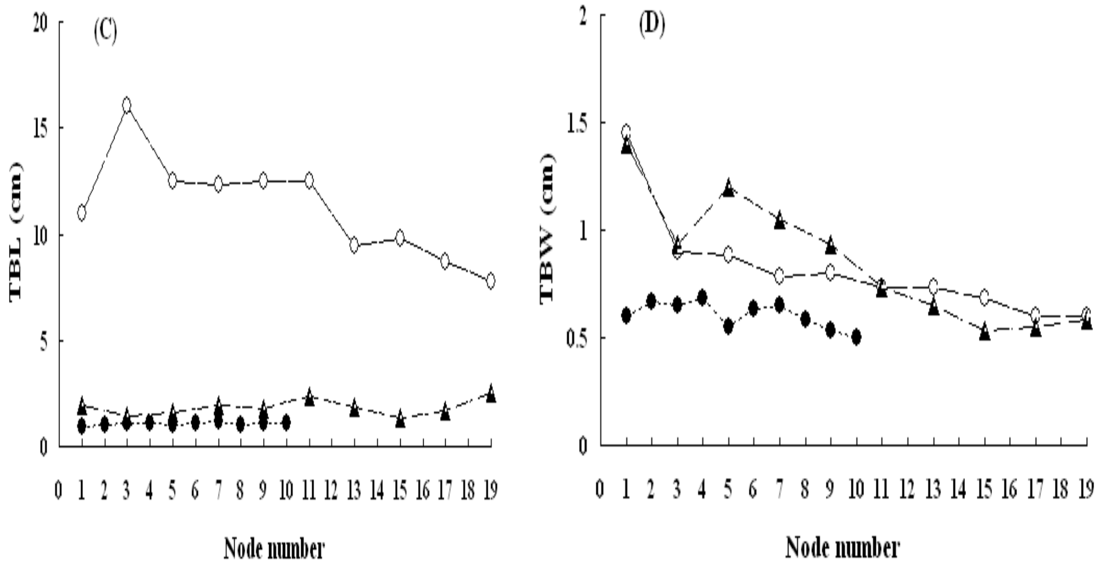


Fig. 2. Relationship between the nodal position and internode length (IL, A), internode diameter (ID, B), tiller bud length (TBL, C) and tiller bud width (TBW, D) of the stem cuttings. Nodal number was counted from the base to the upper position.

Wruk wona (Wr,●), Dwarf-early (DE, O) and Dwarf-late (DL, ▲).

The large ID of dwarf varieties was similar with the previous study by Hanna *et al.* (1993) who reported that normal napiergrass varieties had 2 – 3 cm of stem diameter at most. TBL was quite larger in normal variety of Wr, followed by dwarf variety of DL and DE, because most of tiller buds in Wr started to elongate underneath the leaf sheath. TBW was similarly larger in Wr and DL than in DE. Both TBL and TBW in all varieties decreased with the increase in node number from the base to the upper positions, except TBL in DE and DL which had a relatively stable TBL.

The relations of the nodal position with dry matter weight (DMW) and the percentage of dry matter weight (PDMW) of the internode and the tiller bud are shown in Fig. 3.

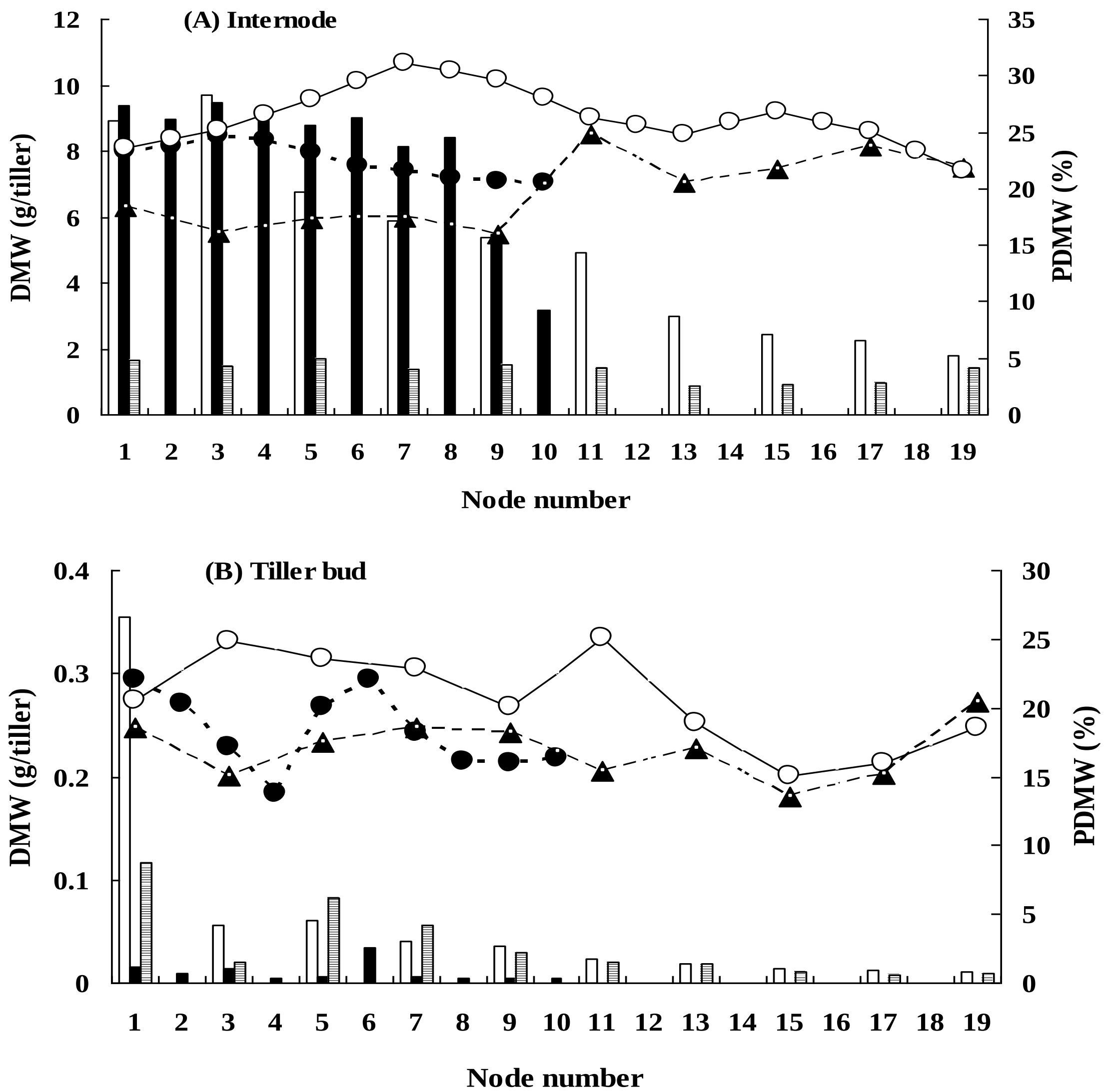


Fig. 3. Relations of the nodal position with dry matter weight (DMW), and the percentage of dry matter weight (PDMW) of the internode (A) and of the tiller bud (B) at the planting into the transplanting bed.

Bar chart (DMW) : Wruk wona (Wr, □), Dwarf-early (DE, ■) and Dwarf-late (DL, □)

Dot chart (PDMW) : Wruk wona (Wr, O), Dwarf-early (DE, ●) and Dwarf-late (DL, ▲)

In all varieties, DMW of internode decreased and PDMW of the internode tended to increase, except DE, from the base to the upper positions. Comparing Wr and DE, the DMWs of the internode were almost similar from the base to the 10^{th} nodal number with the decreasing tendency from about 9 to 3 g/tiller. The order of internode

DMW was the largest in DE, followed by Wr and the lowest in DL. DMW of tiller buds decreased in all varieties with the increase in the nodal number from the base to the upper positions, while PDMW showed some variation among nodal positions in all varieties.

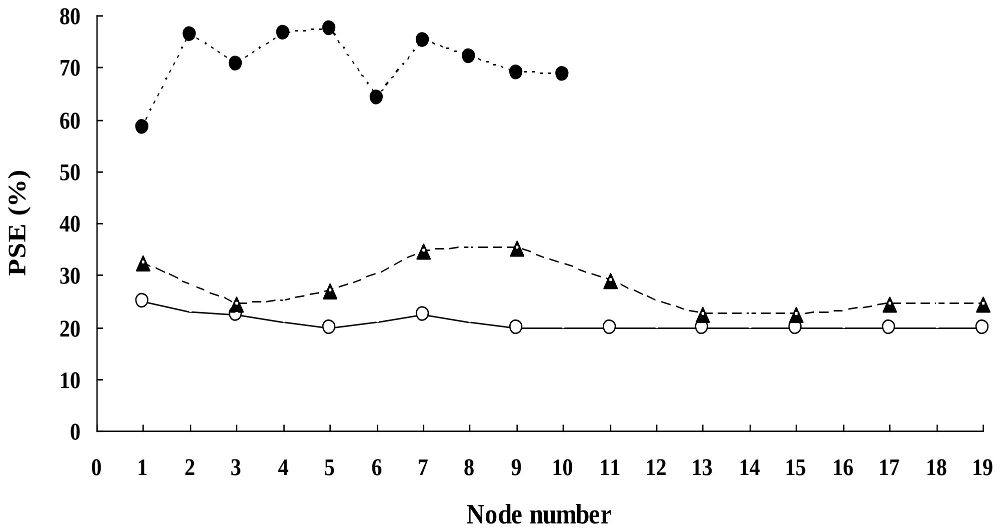


Fig. 4. Relationship between the nodal position and the percentage of seedling emergence (PSE) at 59 days after transplanting. Nodal number was counted from the base to the upper positions.
Wruk wona (Wr,●), Dwarf-early (DE, O) and Dwarf-late (DL, ▲).

Relations between the nodal position and the percentage of seedling emergence (PSE) is shown in Fig. 4. PSE tended to be inconsistent in all varieties, while nodal position of 7 in DE and of 9 in DL decreased throughout nodal position of 10 and of 19, while nodal position of 9 in Wr was stable throughout nodal position of 19. The PSE was larger in dwarf variety of DE and DL than in normal Wr. The largest PSE reached in nodal position of 2, 4 and 5. Ishii *et al*. (1998) noted that tiller number (TN) was largest in dwarf variety of DE than normal ones. The largest TN in DE was because naturally highest in PSE.

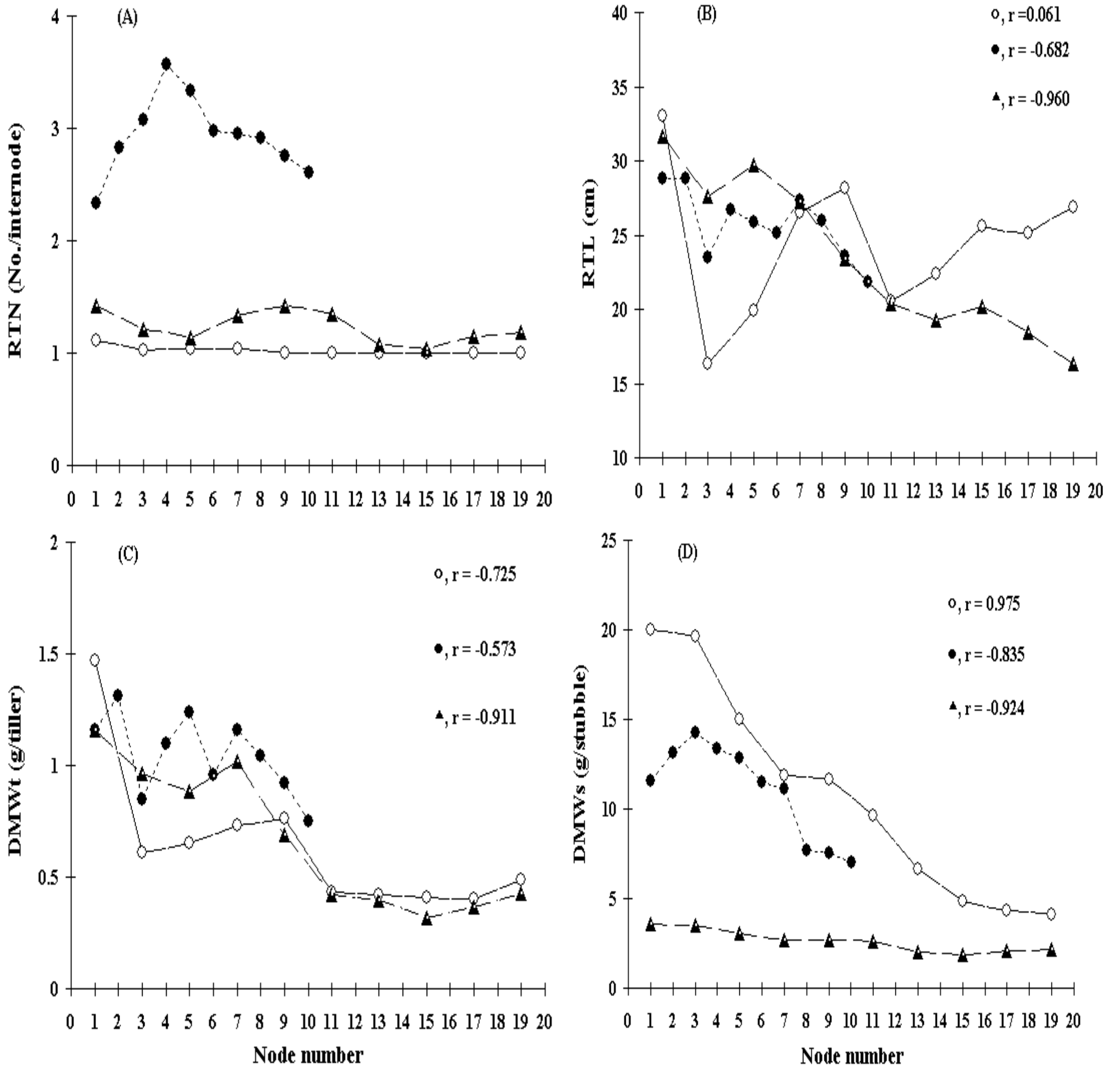


Fig. 5. Relationship between the nodal position and regrown tiller number (RTN, A), regrown tiller length (RTL, B), and dry matter weights of the tiller (DMWt, C), and of stubble (DMWs, D) at 59 days after transplanting.

Wruk wona (Wr,●), Dwarf-early (DE, O) and Dwarf-late (DL, ▲).

The relationship between the nodal position and regrown tiller number (RTN), regrown tiller length (RTL) and dry matter weight of the tiller (DMWt) and of stubble (DMWs) are shown in Fig. 5. RTN of nodal position was largest in DE followed by DL and Wr. In DE, RTN from nodal position of 1^{st} to 4^{th} increased then decreased through to nodal position 10^{th}, while it tended to be stable from nodal position 1^{st} to 10^{th} in DL and Wr with some increasing tendency from nodal position 7th to 10th in DL.

The nodal position was negatively related with RTN ($P<0.05$) in all varieties except in DE that had positive relationship ($P<0.10$). RTL of nodal position was almost similar among varieties from the base to the upper position with some fluctuation in Wr of nodal position 3rd to 5th. Both DMWt and DMWs tended to decrease with the increase in nodal position from the base to the upper position among varieties. DMWt and DMWs were negatively related with the nodal position except DMWs of Wr that had a positive relationship with the nodal position ($P<0.01$).

CONCLUSIONS

The internode length, tiller bud length and tiller bud width was larger in normal variety of Wr than the dwarf varieties of DE and DL, while the dwarf varieties had larger internode diameter than the normal Wr. The order of internode dry matter weight was larger in dwarf DE followed by normal Wr and dwarf DL. Percentage seedling emergency was larger in dwarf varieties than normal Wr. Regrown tiller number (RTN) was larger in dwarf varieties than normal Wr, however, the position of that node number to that RTN was negatively relationship ($P<0.05$). Both dry matter weight of tiller and stubble decreased with the increase in nodal position from the base to the upper position among varieties and the relationships were positive to that positions ($P<0.01$).

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