
Test of double cut alternative (DCA) tapping system under on-farm trials in southern Thailand

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To avoid adverse impact of high tapping frequencies, double cut alternative (DCA) tapping system has been introduced to optimize tapping frequencies by alternate tapping of two cuts. Test of DCA on-station trial used to be done in southern Thailand, it showed positive result. Therefore, it was also tested under smallholders' rubber plantation in two districts of Songkhla province: Hat Yai district (lowland area, sandy loam soil) and Namom district (hilly area, loamy sand soil) Comparative study of double cut alternative (DCA) tapping systems and conventional tapping systems was done in rubber clone RRIM 600. The on-farm trails were started in 2008 with 3 replicates (one plot per replicate) in each district. Results showed that DCA tapping system in Hat Yai district: 2X 1/3S d/2 (t,t) (low frequency) and Namom district: 2X 1/3S d/2.d/3 (t,t) (high frequency) provided significantly higher rubber production than those of the conventional tapping systems (25-28 and 20-22 % for production parameters of g/t and g/t/tapping, respectively). Bark consumption, girth expansion rate and tapping panel dryness were not significant difference between the treatments of DCA and conventional tapping system. It was suggested that the DCA tapping systems also provided the positive result with an increase of rubber productivity under on-farm trials. This study was the first test under on-farm trial in southern Thailand. Therefore, it would be interested to investigate further under different conditions of planting areas and tapping systems.

Key words: *Hevea brasiliensis*, double cut alternative tapping system, Songkhla province

Introduction

According to continuous decrease of the size of Thai rubber smallholdings, this led to general farmers' adoption of high tapping frequency, such as 1/3S 4d/5 and 1/3S 3d/4 tapping systems. Consequently, the rubber trees provided lower yields while farmers themselves got lesser income. It also resulted in overexploitation, high tapping panel dryness rates and the short life

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cycle of plantations (Gohet and Chantuma, 2003). Therefore, double cut alternative (DCA) tapping system has been introduced to overcome the adverse impact of high tapping frequency. Principle of DCA tapping system is to optimize high tapping frequencies by alternate tapping of two cuts. The two cuts are opened on opposite panels at different levels (low cut at 0.80 m and high cut at 1.50 m from the surface ground) and maintained vertically distant by at least 0.75 - 0.80 m, in order to minimize competition between their respective latex regeneration areas. Normally, rubber trees will be left to recuperate around 48-72 hrs or 2-3 days in order to resume a latex production process (Jacob *et al.* 1988, 1995; d'Auzac *et al.* 1997). In eastern Thailand, testing of DCA tapping system showed positive result by on-station trials at the Chachoengsao Rubber Research Centre (Gohet and Chantuma, 2003a, 2003b; Chantuma and Gohet, 2007; Chantuma *et al.*, 2011), on-farm trial at Chantaburi (Vaysse *et al.*, 2006; Kruprasert *et al.*, 2007; Leconte *et al.*, 2007). On station-trial of DCA was also tested at Songkhla province, southern Thailand, it confirmed positive result of DCA tapping system (Sdoodee *et al.*, 2012).

Therefore, the objective of this study was to test under on-farm trials of smallholders' rubber plantation in Songkhla province.

Materials and methods

The study on the response of the rubber tree to DCA tapping system was conducted under the smallholders' rubber plantation in two districts of Songkhla province, southern Thailand: 1) Hat Yai district (lowland area, sandy loam soil) and 2) Namom district (hilly area, loamy sand soil) (Figure 1).

RRIM 600 clone (spacing 7x3 m) grown in 2001 were used for the investigation in both districts. The comparison of conventional tapping system and DCA tapping system in Hat Yai district were 1/3S 2d/3 and DCA 2 x 1/3s d/2 (t,t) and in Namom district were 1/3S 3d/4 and DCA 2 x 1/3s d/2.d/3 (t,t). On-farm trails were started in May 2008 (opened tapping at 7 years after planting). There were 3 replicates (one plot of rubber plantation per replicate) in each district.

The conventional tapping system opening was implemented at 1.50 m from the ground. The tapped panel was named panel A, and the untapped one was panel B and C. In DCA tapping system was opened simultaneously on panel A was the low cut at 0.80 m from the ground and panel B was the high cut at 1.50 m from the ground (Figure 2).

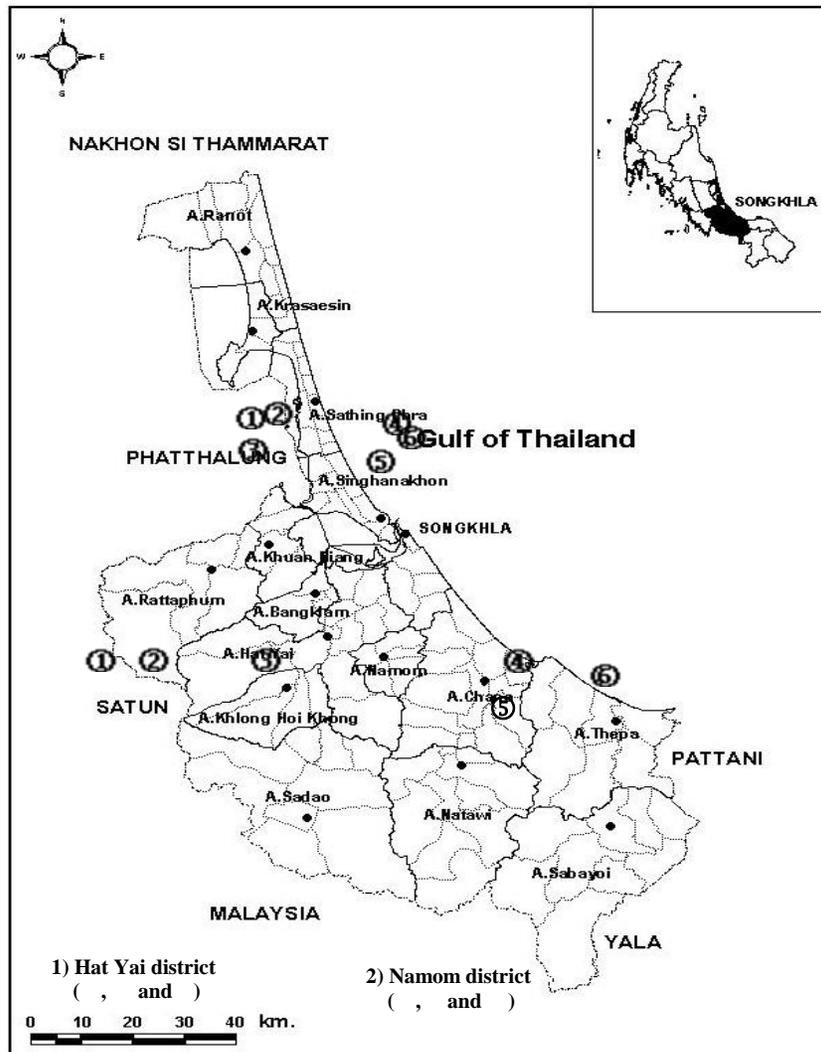


Fig. 1. The smallholders' rubber plantation in the two districts of Songkhla province, southern Thailand: 1) Hat Yai district and 2) Namom district.

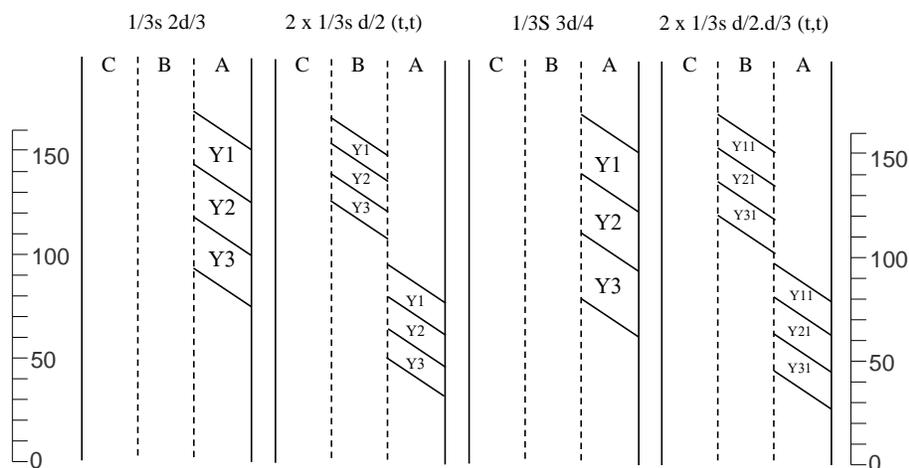


Fig. 2. Panels diagram at opening and management of tapping panels (A, B, C) after opened tapping of first three years. ($1/3s\ 2d/3$, $2\ x\ 1/3s\ d/2\ (t,t)$, $1/3S\ 3d/4$, $2\ x\ 1/3s\ d/2.d/3(t,t)$, where, S, d and t describe tapping patterns commonly used among rubber researchers.)

The on farm trial at Hat Yai district

The tapping system used (Table 1) were $1/3S\ 2d/3$ (three half spiral cut tapped every three days) was the conventional tapping system. DCA $2\ x\ 1/3s\ d/2\ (t,t)$ (three half spiral cuts, each cut tapped alternately every three days) was the double cut alternative tapping system. The plot 1 of rubber plantation was two rows of trees per treatments, in each treatment, $1/3S\ 2d/3$ used 124 sampled trees per treatment and DCA $2\ x\ 1/3s\ d/2\ (t,t)$ used 123 sampled trees per treatment. The plot 2 of rubber plantation was three rows of trees per treatments, in each treatment, $1/3S\ 2d/3$ used 267 sampled trees per treatment and DCA $2\ x\ 1/3s\ d/2\ (t,t)$ used 244 sampled trees per treatment. The plot 3 of rubber plantation was six rows of trees per treatments, in each treatment, $1/3S\ 2d/3$ used 116 sampled trees per treatment and DCA $2\ x\ 1/3s\ d/2\ (t,t)$ used 99 sampled trees per treatment.

The on farm trial at Namom district

The tapping system used (Table 1) were $1/3S\ 3d/4$ (three half spiral cut tapped every four days) was the conventional tapping system. DCA $2\ x\ 1/3s\ d/2.d/3\ (t,t)$ (three half spiral cuts, each cut tapped alternately every four days) was the double cut alternative tapping system. The plot 4 of rubber plantation was two rows of trees per treatments, in each treatment, $1/3S\ 3d/4$ used 120 sampled trees per treatment and DCA $2\ x\ 1/3s\ d/2.d/3\ (t,t)$ used 124 sampled

trees per treatment. The plot 5 of rubber plantation was three rows of trees per treatments, in each treatment, 1/3S 3d/4 used 68 sampled trees per treatment and DCA 2 x 1/3s d/2.d/3 (t,t) used 68 sampled trees per treatment. The plot 6 of rubber plantation was six rows of trees per treatments, in each treatment, 1/3S 3d/4 used 78 sampled trees per treatment and DCA 2 x 1/3s d/2.d/3 (t,t) used 71 sampled trees per treatment.

Table 1. Tapping sequences of Hat Yai on-farm trial (1/3S 2d/3 and DCA 2 x 1/3s d/2 (t,t)) and Namom on-farm trial (1/3S 3d/4 and DCA 2 x 1/3s d/2.d/3 (t,t))

Tapping frequency	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Hat Yai on-farm trial							
1/3S 2d/3	T	T	stop	T	T	stop	T
DCA 2 x 1/3s d/2 (t,t)	T _{high}	T _{low}	stop	T _{high}	T _{low}	stop	T _{high}
Namom on-farm trial							
1/3S 3d/4	T	T	T	stop	T	T	T
DCA 2 x 1/3s d/2.d/3 (t,t)	T _{high}	T _{low}	T _{high}	stop	T _{low}	T _{high}	T _{low}

The studied parameters are: recording data every tapping day of fresh weight per day per treatment. They were done dry rubber production by the method as follows:- Dry rubber production (g) = fresh weight (g) x % DRC

Then, the average yield (g/tree and g/tree/tapping) in each rubber plantation was calculated. Circumference expansion rate was measured at 1.70 m from the ground every 3 months from the beginning of the trials. Average bark consumption was determined every 3 months. Tapping panel dryness (TPD) were done twice in May and February. Trees that exude latex on the whole length of panel after tapping were considered as " healthy " trees and noted zero (0). The others were considered as trees affected by tapping panel dryness and noted from 1 to 6 according to the latex non-producing panel length. Thus, the following classes of percentages of latex non-producing panel length were classify as follows:- Level 1= 1 to 20% trees affected by TPD of very weak level; level 2 = 21 to 40% trees affected by TPD of weak level; level 3 = 41 to 60% trees affected by TPD of middle level; level 4 = 61 to 80% trees affected by TPD of enough high level; level 5 = 81 to 99% trees affected by TPD of high level and level 6 = 100% trees affected by total TPD or dry trees.

The data of TPD was determined by the rate of dry cut length (LDC) according to the following equation (Anonymous 1, 1993 refer by Okoma *et al.*, 2011): $LDC = (0.1 n_1 + 0.3 n_2 + 0.5 n_3 + 0.7 n_4 + 0.9 n_5 + n_6) / N$. In this equation, N represents the number of tapped trees per treatments, the

coefficients 0.1; 0.3; 0.5; 0.7; 0.9 and 1 correspond to averages of percentage classes of latex non-producing panel length and the numbers n_1 ; n_2 ; n_3 ; n_4 ; n_5 et n_6 represent the numbers of trees were observed by class of percentage of latex non-producing panel length. Statistical analysis to compare between the treatment of DCA and conventional treatment were assessed by T-test.

Results and discussions

Rubber production (g/tree and g/tree/tapping)

The rubber production obtained after 3 years of tapping and the cumulative rubber production expressed by gram per tree (g/tree) and gram per tree per tapping (g/tree/tapping) as shown in Table 2. Hat Yai on-farm trial, DCA comparing to the control treatment (1/3S 2d/3), DCA 2 x 1/3s d/2 (t,t) led to a 25% (g/tree) and 28% (g/tree/tapping) increased in rubber production. Namom on-farm trial, compared with its control treatment (1/3S 3d/4), DCA 2 x 1/3s d/2.d/3 (t,t) led to a 20% (g/tree) and 22% (g/tree/tapping), respectively. Condition for success of DCA tapping strategy also lies on appropriate respective positions of the two tapping cuts. In order to limit their possible competition regarding carbohydrate, water and mineral nutriment supply, and according to previous studies on spatial extension of latex regeneration area (Gohet and Chantuma, 2003a). In clone RRIM 600, DCA system is efficient without any external input such as ethephon stimulation. It would not modify the tapping work organization on farms, as tapping frequencies would remain unchanged at tree scale. The tapping intensity is just shared on two cuts tapped alternately instead of one single cut with conventional tapping systems (Vaysse *et al.*, 2006). This result indicated that the promising result was similar to the previous DCA tapping system experiments under the on-farm trial in Songkhla province (Sdoodee *et al.*, 2012).

Table 2. Cumulated rubber production (g/tree and g/tree/tapping) during the 3-year experimental period

Treatment	g/t	%	g/t/t	%
Hat Yai on-farm trial				
1/3S 2d/3	5,985.35b	100	19.57 b	100
DCA 2 x 1/3s d/2 (t,t)	7,526.72a	125	25.11a	128
Namom on-farm trial				
1/3S 3d/4	11,426.48b	100	35.05 b	100
DCA 2 x 1/3s d/2.d/3 (t,t)	13,799.95a	120	42.97a	122

*Means with the different letters in each column of the same district are significantly different ($P \leq 0.05$) by T-test.

Bark consumption

The bark consumption of DCA tapping system tended to be slightly higher than that of the control, however, there was no significant difference as shown in Figure 2. This might be due to more bark being consumed during tapping, especially with low cuts under the DCA tapping system, because the tapper in southern Thailand normally bends down and presses the tapping knife or “jebong” harder into the low cut (Huaynui, 2009). Gohet and Chantuma (2003a) also reported that total bark consumption might be slightly increased due to the reduction of tapping frequency of each DCA cut, in comparison with the equivalent single cut intensive tapping system.

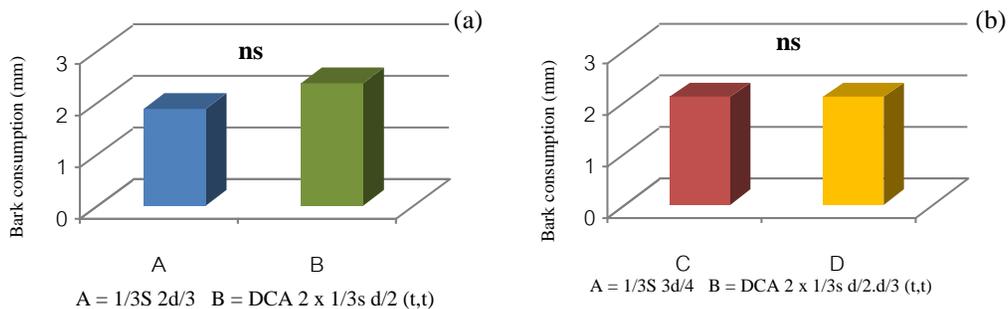


Fig. 2. Bark consumption (mm/tapping) compared between Hat Yai on-farm trial (1/3S 2d/3 and DCA 2 x 1/3s d/2 (t,t) (a) and Namom on-farm trial (1/3S 3d/4 and DCA 2 x 1/3s d/2.d/3 (t,t) (b). (ns = no significant difference)

Girth expansion rate

There was no significant difference in girth expansion rate from the beginning of the trial until the termination of experimentation as shown in Figure 3. Besides, Lacote *et al.*, 2004 suggested that relationship between yield and girth expansion rate increment of the trunk physiology of the latex cell was influenced by the panel management strategies for each period of tapping. However, this results was a short period study, it would be investigated further in long period period.

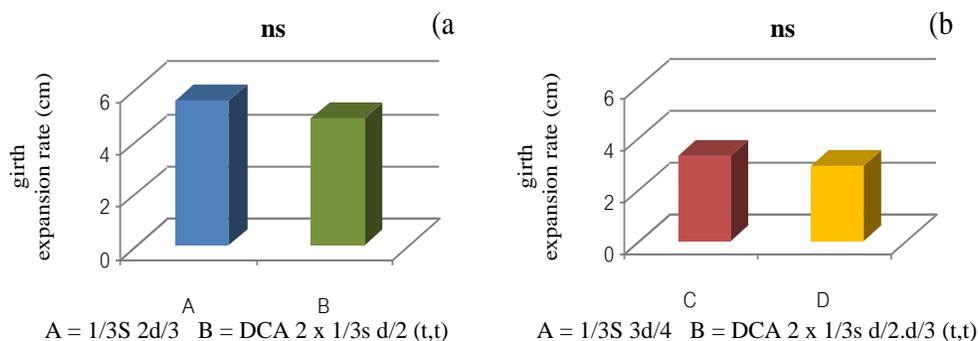


Fig. 3. Girth expansion rate compared between Hat Yai on-farm trial (1/3S 2d/3 and DCA 2 x 1/3s d/2(t,t)) (a) and Namom on-farm trial (1/3S 3d/4 and DCA 2 x 1/3s d/2.d/3 (t,t)) (b). (ns = no significant difference)

Tapping panel dryness

The sensitivity to tapping panel dryness (TPD) study of RRIM 600 clones was investigated. There was no significant difference in TPD among the on-farm trials as shown in Figure 4. Rubber tree is more oriented toward the primary metabolism (vegetative biomass production) than toward the secondary metabolism (rubber production) (Obouayeba *et al.*, 2000). However, in the current experiment with DCA tapping system, TPD tended to be slightly lower. The principle of system, especially insisting on the necessity to tap the two cuts alternately and not at the same time as this would result in serious overexploitation fast wasting of bark and total collapse of laticiferous tissues physiological parameters.

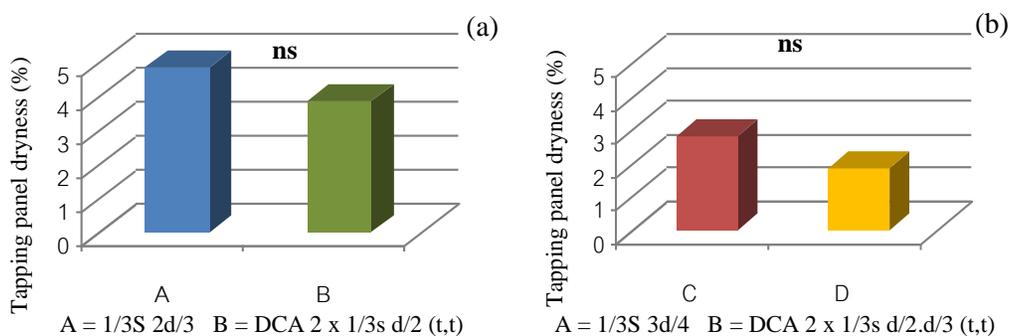


Fig. 4. Tapping panel dryness (%) compared between Hat Yai on-farm trial (1/3S 2d/3 and DCA 2 x 1/3s d/2 (t,t)) (a) and Namom on-farm trial (1/3S 3d/4 and DCA 2 x 1/3s d/2.d/3 (t,t)) (b). (ns = no significant difference)

Conclusion

After three years of the DCA tapping system testing under on-farm trials, it provided the positive result with an increase the rubber productivity comparing with the conventional tapping system. There was no significant difference of bark consumption, girth expansion rate and tapping panel dryness. Although, DCA tapping system provided promising result under on-farm trial, it needs a longer period of investigation before the recommendation.

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