International Journal of Environment, Agriculture and Biotechnology
Vol-7, Issue-4; Jul-Aug, 2022

Journal Home Page Available: https://ijeab.com/
Journal DOI: 10.22161/ijeab

Peer Reviewed

Effects of cut back at different leaf phenology stages on the growth of scion of rubber seedlings

Qing Chen, Xinlong Wang, Jian Chen, Jun Wang*

Rubber Research Institute, Chinese Academy of Tropical Agricultural Sciences, Danzhou, Hainan 571737, China
*Corresponding author: wangjuncatas@163.com

Received: 28 Jun 2022; Received in revised form: 18 Jul 2022; Accepted: 22 Jul 2022; Available online: 28 Jul 2022

Abstract— *Phenology can directly reflect the characteristics of rubber seedling, people can determine the agricultural time arrangements of seedling germination, cut back, tending management and nursery operation. In this study, the phenological period of the top leaf of hevea tree seedlings was divided into four treatments, and cut back was carried out in sprout period, bronze stage, light green stage and stable stage, respectively. The effects of sawing stock in different phenological periods on the budding rate and growth potential of scion 1-2 were observed. The results showed that the budding rate and nursery rate of scion were significantly higher than those of other stages when the leaf phenology stage was sawed in sprout stage and stable stage, and the budding rate and nursery rate were the lowest in the light green stage. In the first leaf whorl, the plant height of stock leaf phenology stage was significantly higher in sprout stage and bronze stage than in light green stage, but there was no significant difference with stable stage; The stem diameter of stable phenological stage was significantly larger than that of bronze and light green phenological stage, but there was no significant difference with that of sprout stage; The leaf whorl distance in the paleobronze period was significantly higher than that in the light green period, but there was no significant difference with other periods; The number of leaves in phenological stage was significantly more in sprout stage than in light green stage, and there was no significant difference from other stages. In the second leaf whorl, The plant height, stem diameter, leaf distance and leaf number of scion of stock seedlings in phenology stage were significantly higher than those in other stages, and the growth of stock seedlings in light green stage was lowest. In conclusion, the leaf phenology stage of the rootstock seedlings of rubber tree is in the sprout stage, and the scion growth is the best, followed by the stable stage and bronze stage. Cut back in the light green stage is not recommended.*

Keywords— ***Hevea brasiliensis, Leaf phenology, rootstock seedling, Growth.***

I. INTRODUCTION

Plant phenology refers to the habit of ecological and physiological functions with regular changes due to long-term adaptation to natural changes in the evolutionary process of organisms, that is, biological activities can change with climate change.People can understand the climate change through the dynamic changes of its life activities, including the germination of plants, leaf

development, flowering, leaf discoloration, defoliation and other phenomena(Ge Quansheng et al,2010;Lu Peiling et al,2006).In the second edition of Rubber Cultivation in 1979,Rubber tree according to the leaf conditions of the top of the leaf is divided into budding stage, bronze stage, light green stage and stable stage(Huang Zongdao,1979).Each leaf whorl of a rubber tree passes through these seven phases before the next leaf begins to grow.

It has been reported that the phenological period of rubber tree is related to stress resistance, physiology, biochemistry and nutrition. Liu Suqing (1996) used powdery mildew agent to study powdery mildew fungus in different phenological stages of rubber trees and showed that powdery mildew on leaves of rubber leaves in bronzing and discoloration stages had obvious inhibitory effect.Tao Zhonghua et al. (2009) studied the leaf mass element content in different phenological stages of high-yielding new varieties of rubber trees.In general, nitrogen and phosphorus were similar, and gradually decreased from germinating stage to light green stage, while gradually increased from light green stage to aging stage. Potassium decreased gradually from germinating stage to light green stage, increased gradually from light green stage to stable stage, and decreased gradually from stable stage to aging stage. The trend of calcium is opposite to that of potassium. There is no regular change of magnesium, The contents of elements are nitrogen > potassium > Calcium > magnesium and phosphorus. Zheng Jie (2007) compared the ethylene injury sensitivity of seedlings at different phenological stages of rubber trees and found that there was no significant difference in ethylene injury degree between seedlings at different phenological stages.Chen Haijian et al. (2006) showed that there were significant differences in light compensation point and light saturation point in different phenological stages of the photosynthetic characteristics of rubber seed seedlings during bud grafting. Therefore, phenology period is an important direct index for the cultivation of hevea tree seedlings, and it has obvious influence on the seedling germination, sawing, caressing and nursery.

At present, bud grafting is the main planting material of rubber tree.Cut back is an important link of rubber tree bud grafting.In this study, the phenological stage of the top leaf of rubber tree seedlings was divided into four treatments, and the sawing was carried out in the bud setting stage, bronze stage, light green stage and stable stage respectively, to observe the effect of sawing on the bud setting rate and growth potential of scion in different phenological stages.Therefore, this study has important guiding significance to improve the utilization rate of rubber seedlings, reduce the production cost of seedlings, shorten the cultivation time of seedlings, and better manage the seedlings.

II. MATERIAL AND METHODS

The experiment was carried from September 2020 to February 2022 in the protective cultivation base of natural rubber of Rubber Research Institute of Chinese Academy of Tropical Agricultural Sciences, Danzhou City, Hainan Province,China. The polybag-raised buddings of rubber tree were used as experimental materials. The GT1 seeds of rubber tree were sown in the sand bed about 20 days lather were transplanted in seedling bag (the bag caliber is 18cm, high is 35cm). The seedlings of rubber tree were incubated about one year in the bag, and then budded with scion CATAS 7-20-59, After budding successfully, they were cut back at the different leaf phenology (sprout period, leaf-unfold stage, light green leaf stage, stable leaf stage), and then transfer to greenhouse unified management. Four treatments were designed in this study, the treatment A was cut back at the leaf phenology was sprout period, the treatment B was cut back at the leaf phenology was leaf-unfold stage,the treatment C was cut back at the leaf phenology was light green leaf stage,the treatment D was cut back at the leaf phenology was stable leaf stage. Each treatment was performed with 40 polybag-raised buddings for 3 replicates. Routine water and fertilizer management and pest control were carried out during the experiment. To investigate the budding rate and nursery rate of rubber bag seedlings under different treatments. The plant height, stem diameter, leaf whorl distance and leaf number of seedling scion 1-2 of each treatment were measured. The tape measure was used to measure the plant height and leaf whorl distance of scion, and the vernier caliper was used to measure the stem diameter of scion. The experimental data were statistically analyzed by Excel2010 and DPS6.5.

III. RESULT AND DISCUSSION

Effect of cut back at the different leaf phenology on germination rate and nursery rate

There are factors that affect the budding rate and nursery rate of rubber tree. The table 1 showed that the C (97.33%) was the largest and the C(94.00%) was smallest in the budding rate, A was significantly higher than C, and there was no significance among other treatments. A (97.80%) was the largest and the C(90.00%) was smallest in the nursery rate, there was no significant difference between A and D, both of which were significantly higher than B and C, while there was no significant difference between B and C.The budding rate and nursery rate of rubber bag seedlings under different treatments have up to 90%, and the cut back in the sprout period and stable leaf stage of phenology was the most conducive to the budding and nursery of seedlings. Yu Jingjuan's (2021)study showed that when the old and young buds of reken 525, RRII105 and Yunyan 73-477 were budded, there was a significant difference in the budding rate of the scion, and the budding rate of the young buds was 10.44-17.04% higher than that of the old ones.Gui mingchun et al (2021) Showed that different cut back mode significant or extremely significant influence on the budding rate of rubber tree, it is consistent with this study. Whether the seedlings can reach the state of nursery is closely related to seedling management.

Table 1 The germination rate and nursery rate of rubber bag seedlings under different treatments

Treatment	budding rate(%)	Nursery rate(%)
A	97.33aA	97.80aA
B	94.53abA	90.20bB
C	94.00bA	90.00bB
D	96.67abA	96.60aA

Note: The lowercase letters and uppercase letters indicate significant difference at 0.05 and 0.01 levels, respectively. The same below.

Effect of cut back at the different leaf phenology on growth in the first leaf whorl

Chen et al (2018) used rootstocks of different sizes (0.5-1.2cm) to study the small tube seedlings of rubber trees, and showed that rootstocks grew better with the increase of rootstocks within a certain size range.Hu et al (2018) study also showed that scion growth of large stock was significantly or extremely significantly greater than that of medium stock and small stock.Zhou et al (2012) study showed that the rootstock variety affected the germination survival rate and scion diameter growth.The results showed that the scion growth was affected by the variety, size and quality of rubber stock.The table 2 showed that there were no significant difference in scion plant height between A, B and D, and then there were significant difference higher than C, A (37.07cm) was the highest, C (33.00cm) was the shortest. There were no significant difference in scion stem diameter between A and B, there were significant difference thicker than B and C, B and C were the smallest. The A was significant difference C on the leaf whorl distance higher than C, the C was the shortest. In this study, in the first leaf of the young seedlings, except for the weak growth of the scion at the light green stage, the good growth of the scion at the budding stage, bronze stage and stable stage was observed.The results showed that the stock cutting at different phenological stages resulted in different endogenous hormone and nutrient storage, which affected the scion growth.

Effect of cut back at the different leaf phenology on growth in the second leaf whorl

The table 3 The treatment A showed the best plant height, stem diameter, leaf whorl distance and the leaf number, while treatment C had the worst in the second leaf whorl. Plant height of A, B and D were significantly higher than that of C, A was significantly higher than that of B and D , D was significantly higher than that of C, and there was no significant difference between B and D; Stem diameter of A was significantly higher than that of B, and there was no significant difference among A and C and D; Leaf whorl

distance of A, B and D were significantly higher than that of C, A was significantly higher than that of B and D, and there was no significant difference between B and D; Leaf number of A and B were significantly higher than that of C and D, A was significantly higher than that of B, and there was no significant difference between C and D.

In the first leaf, there was no significant difference in the scion growth of the stem cut at budding stage, bronzing stage and stable stage, but in the second leaf, the scion growth of the stem cut at budding stage was more and more obvious, and the growth was significantly better than that of the stem cut at light green stage, and also significantly better than that of the seedlings cut at bronzing stage and stable stage.From the beginning of budding scion, scion growth and growth to the nursery, its performance is the best, indicating that cutting back in the sprout stage is the best.Only when the rubber tree grows to the stable stage of the second leaf can it reach the standard nursery (GB/T 17822.2-2009). The growth of the second leaf directly affects the nursery quality of the seedlings and the recovery growth rate of the seedlings when they are planted in the nursery.

Table 2 Effect of cut back at the different leaf phenology on growth in the first leaf whorl

Treatment	The first leaf whorl			
	Plant height(cm)	stem diameter(mm)	leaf whorl distance(cm)	leaf number(pieces)
A	37.04aA	6.02abA	21.53abA	9.66aA
B	36.91aA	5.91bA	22.42aA	8.95abA
C	33.00bA	5.91bA	19.38bA	8.81bA
D	35.77abA	6.17aA	21.42abA	9.48abA

Note: The lowercase letters and uppercase letters indicate significant difference at 0.05 and 0.01 levels, respectively. The same below.

Table 3 Effect of cut back at the different leaf phenology on growth in second leaf whorl

Treatment	The second leaf whorl			
	Plant height(cm)	stem diameter(mm)	Leaf whorl distance(cm)	Leaf number(pieces)
A	59.30aA	6.96aA	18.71aA	7.12aA
B	55.50bAB	6.46bA	15.57bB	6.85bB
C	50.03cC	6.59abA	12.89cC	6.56cC
D	54.57bB	6.78abA	14.96bB	6.62cC

Utilization rate of rubber tree seedlings after bud grafting

According to the phenological period of the top leaf, the production of rubber tree seedlings was directed. Under normal circumstances, rubber tree seedling seedling is in the top of the phenology stable period before cut back. In this study, sawing seedlings at the budding stage had the best growth, while there was no significant difference between the sawing seedlings at the bronze stage and the stable stage, indicating that sawing seedlings at the budding stage, bronze stage and stable stage could be carried out. This not only convenient seedling management, reduce seedling time, but also improve the utilization rate of seedlings. In the Dictionary of Rubber Tree Agriculture, Lin Weifu (2014) divided the phenological period of the top canopy of rubber tree seedlings into germinating period,

budding period, bronze period, discoloration period, light green period, stable period and old ripening period, which were more than the germinating period, discoloration period and old ripening period.Subsequent studies will analyze the nutrient composition and physiological index contents of stocks in different phenological stages, which will have guiding significance for later seedling management.

IV. CONCLUSION

In conclusion, it is most beneficial for scion growth to cut the stem during the phenological period of rubber tree at the sprout period, the budding rate, nursery rate, plant height, stem diameter, leaf whorl distance and leaf number were all the best, the second was that scion growth relatively good in the stable period of phenology, and the seedling growth was weakest in the light green period. Therefor, the rootstock of rubber tree should be cut in the sprout period and stable period, and the seedling growth is the best. It is not recommended to cut in the light green stage.

ACKNOWLEDGEMENTS

This work was supported by the earmarked fund for China Agriculture Research System (CARS-34-YZ4).

REFERENCES

[1] GE Q S, WANG S W, FANG X Q (2010). An uncertainty analysis of understanding on climate change[J]. Geographical Research,29(02):191-203.

[2] LU P L, YU Q, HE Q T (2006). Responses of plant phenology to climatic change[J]. Acta Ecologica Sinica,(03):923-929.

[3] HUANG Z D (1979). South china tropical crop college .Rubber Cultivation[M].2nd edition. Beijing: Agriculture Press.

[4] LIU S Q(1996).The difference of inhibitory effect of fenfangning smoke agent on Powdery mildew in different phenological stages of rubber tree. Yunnan tropical crops Science and technology,19(2):21-22.

[5] TAO Z H, LUO W, LIN Z M, HE J J, WEI H Q(2009). Study on macro-element contents of leaves in new high-yield varieties of hevea brasilensis at different phenophases, Chinese Journal of Soil Science,40(5),1127-1130.

[6] ZHENG J(2007). Studies on Sensitivity of ethrel injury to rubber seedlings in different growth stages, South China University of Tropical Agriculture.

[7] CHEN H J, XIE G S, YAO Q Q(2006). Study of photosynthesis characteristics of grafted mini-seedling of hevea brasiliensis at different phenophases, Chinese Journal of Tropical Crops,27(3):30-35.

[8] YU J J, TIAN H, TANG M, LIANG G P(2021). The difference analysis of survival rate and sprouting between the mature and juvenile bud stick of grafted hevea brasiliensis seedling. Tropical Agricultural Science & Technology,44(1):1-4.

[9] GUI M C, QIU Y F, TANG M, TIAN H, GUAN Y, LI L, SUN X L, LIANG G P (2021). Effects of various nursery measures on the growth performance of green budlings of *Hevea brasiliensis*[J]. Chinese Journal of Tropical Crops,42(5):1387-1393.

[10] CHEN Q, ZHOU J, WANG J, LIN W F(2018). The effect of rootstock size on the growth of root-trainer raised green budded plants of rubber tree, Chinese Journal of Tropical Agriculture,38(5):1-3,13.

[11] HU Y H, ZHANG F L, LI X Q, KUANG Z J, ZHAO Q, WU Y(2018). Influences of rootstock on the growth and leaf traits of budding clones of rubber tree seedlings, Tropical Agricultural Science & Technology,2018,41(3).

[12] ZHOU L J, LIN W F(2012). Interaction between scion and rootstock in rubber tree (*Hevea Brasiliensis*). Chinese Journal of Tropical Crops,33(8):1337-1341.

[13] GB/T 17822.2-2009, Rubber budling and seedling[S]. Beijing: Standards press of china,2009.

[14] LIN W F(2014). Dictionary of rubber tree agriculture, China Agriculture Press.