Sustainable Development of Betel Nut Industry in Hainan Province

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Abstract In 2014, the betel nut planting area was 94000 ha, betel nut yield reached 231000 t, and the annual processing capacity of green standard betel nut drying equipments reached 677400 t in Hainan Province. The yellows in betel nut plantation have posed a serious threat to the development of betel nut industry, and the initial processing plants of betel nut are scattered, with low benefits. It is recommended to establish ecological betel nut plantations, use nutrition regulation to prevent betel nut yellows, and develop integrated betel nut processing plants to promote the sustainable development of betel nut industry.

Key words Betel nut, Industry, Sustainable development

1 Overview of betel nut cultivation in Hainan Province

The betel nut has become a cash crop second only to natural rubber in Hainan Province. In recent years, the low natural rubber prices severely affect farmers' enthusiasm for planting rubber, but it improves farmers' enthusiasm for planting betel nut. In the main producing areas of betel nut, the betel nut is planted in some regeneration rubber forests and flawed rubber plantations. The planting area is increasing and fresh fruit processing is receiving much attention, but it lacks emphasis on the sustainable development of betel nut industry.

1.1 Planting area The betel nut planting area in Hainan was 94000 ha in 2014. The betel nut planting in Hainan during 1985 - 2014 can be shown in Table 1. From Table 1, it is found that the betel nut planting area in Hainan continues to increase, and the harvested area is also increasing. The betel nut planting is rapidly developed in Hainan, mainly because the betel nut is extensively planted, the investment is not sufficient, and the economic efficiency of betel nut is high under normal management.

1.2 Yield China's betel nut yield increases year by year, and the betel nut yield was 231000 t in 2014. The betel nut yield in Hainan during 1985 - 2014 can be shown in Table 2. From Table 2, it is found that during 1985 - 2014, the total yield of betel nut continuously increased, but the betel nut yield has decreased in recent years.

1.3 Cultivation mode The continuous rise of betel nut prices during 2014 - 2015 increased farmers' enthusiasm for planting betel nut, and the planting development trend is good. However, the betel nut cultivation lacks scientific planning, and it is basically the traditional cultivation method. The betel nut is mostly planted spontaneously by farmers while few businesses plant it. When farmers plant betel nut, they often overemphasize planting, harvesting, but neglect management, and in most betel nut plantations, the soil improvement, water and fertilizer management is poor, so the betel nut plant can not get sufficient nutrients, the harvest period gets short, and the yield becomes low. The betel nut plantations with normal management can achieve 50 to 60 years of harvest, while some betel nuts in Hainan degenerate after 20 years of planting. In recent years, the betel nut yield has decreased.

Table 1 The betel nut planting in Hainan during 1985 - 2014

Year	Planting area//ha	Harvested area//ha
1985	3307	480
1986	5653	680
1987	8180	687
1988	8740	987
1989	9647	1067
1990	10120	1547
1991	11100	2107
1992	11840	3647
1993	12460	4640
1994	13160	5560
1995	15213	7373
1996	16553	7967
1997	22100	9287
1998	25953	10887
1999	26240	11333
2000	26940	12593
2001	29853	13920
2002	35047	15260
2003	42933	16600
2004	46733	18533
2005	47667	20733
2006	53067	23287
2007	59813	26900
2008	62753	31307
2009	65820	36087
2010	69227	39400
2011	79233	48187
2012	85920	54700
2013	90887	60167
2014	94067	64833

Data source: Hainan Provincial Department of Agriculture.

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Table 2 The betel nut yield in Hainan during 1985 – 2014

Year	Yield//kg/ha	Total yield//10^4 t
1985	4315.05	0.21
1986	2647.05	0.18
1987	3349.50	0.23
1988	2331.15	0.23
1989	2812.50	0.30
1990	2456.70	0.38
1991	2610.75	0.55
1992	2276.10	0.83
1993	2349.15	1.09
1994	2140.35	1.19
1995	2142.90	1.58
1996	2347.35	1.87
1997	2433.60	2.26
1998	2535.15	2.76
1999	2823.60	3.20
2000	2818.95	3.55
2001	3002.85	4.18
2002	3256.95	4.97
2003	3313.20	5.50
2004	3383.10	6.27
2005	3101.25	6.43
2006	2958.15	7.48
2007	3546.45	9.54
2008	3721.20	11.65
2009	3976.50	14.35
2010	3860.40	15.21
2011	3511.50	16.92
2012	3621.60	19.81
2013	3711.30	22.33
2014	3562.95	23.10

Data source: Hainan Provincial Department of Agriculture.

1.4 Betel nut yellows The betel nut yellows disease in Hainan was first found in Tunchang in 1981, and now it has spread to Qionghai, Wanning, Lingshui, Sanya, Wuzhishan, Qiongzhong, Baoting, Ledong and Danzhou in Hainan. The disease incidence is usually 10% to 30%, and in the severely afflicted area, the disease incidence reaches as high as 90%, resulting in production reduction of 70% to 80%, or even total loss. So far, many diseased betel nut plants have been felled in production[1]. The 2012 survey results show that in the main betel nut plantations in the eastern and western regions of Hainan, the average disease incidence is 41.38% and 37.67%, respectively. The survey results also show that the older the betel nut plantations, the severer the betel nut yellows, and the betel nut mortality increases with increasing incidence of betel nut yellows[2]. In recent years, it has been found that the betel nut yellows in the main producing areas are severe, and the yellows occur frequently especially for the betel nut planted in mountain slope.

2 Processing of betel nut

The betel nut yield in Hainan was 231000 t in 2014. Currently, Hainan has built green environmentally-friendly betel standard drying equipment production line, and the annual processing capacity has reached 677400 t (344000 t in Wanning; 214000 t in Qionghai; 55000 t in Tunchang; 38000 t in Ding'an; 15000 t in Qiongzhong; 11000 t in Lingshui; 400 t in Baoting).

2.1 Primary processing The primary processing of fresh betel nut fruit includes primary processing of black fruit and primary processing of white fruit. The primary processing of black fruit: fresh fruit→fruit selection→smoking→black betel nut fruit. The processing of black fruit is to use the dense smoke generated by burning the wet wood chips to smoke the fresh betel nut fruit, and this process can remove most of the water inside the fruit, and make the dried fruit have a special scent favored by consumers[3]. A lot of smoke produced during the black fruit processing affects the processing personnel's health and environment. The primary processing of white fruit: fresh betel nut→stewing→drying→fruit selection→re-drying→handpicking→packaging→finished product[4]. The production feature of white fruit lies in using the high-temperature steam to heat the cold air to about 60℃ hot air, and using hot air to bake the green betel nut fruit. The main problem in the processing of white fruit is that the waste water after cooking fruit is indiscriminately discharged into the environment, and the smoke from coal-fired boiler is discharged directly into the atmosphere. There is no primary processing enterprise of betel nut in Hainan effectively disposing of the exhaust gas and waste water from the production process.

2.2 Deep processing Although betel nut is a kind of commonly used traditional Chinese medicine, it is only eaten as fresh fruit or processed into dry fruit of betel nut for chewing, and it seldom goes into medicine market. The dry betel nut fruit processing is deep processing, and now there are 7 deep processing enterprises of betel nut in Hainan (4 in Wanning City; 2 in Ding'an County; 1 in Chengmai County). The 7 enterprises carry out the deep processing of betel nut, and the processing materials account for about 10% of yield. There are 3 large and medium-sized edible refined betel nut processing plants in Hainan, the designed annual processing capacity is 22000 t, and the actual processing capacity is 8000 t. For example, the betel nut deep processing enterprise in Wanning City, Hainan Kouweiwang Technology Development Co., Ltd., invests 480 million yuan in building 2 deep processing plants of betel nut in Hou'an Town and Dong'ao Town, respectively, and 17.2 million kg of betel nut raw materials are processed annually. Hainan Kouweiwang Technology Development Co., Ltd. conducts the deep processing of betel nut, and the products are divided into three categories and six grades. Products are sold to Hainan and Guangdong, and the market share is over 80%. Kouweiwang betel nut is the industry's first high-end brand, and known as "China's first brand of betel nut fruit".

3 Conclusions and recommendations

3.1 Conclusions For the development of betel nut industry, it is necessary to focus on the ecological environment for betel nut

growth, create ecological betel nut plantations, and use nutritional analysis technology for nutritional analysis of betel nut leaf. The nutrient analysis indicators are used to guide the fertilization in betel nut plantations, to ensure normal growth and production of betel nut. The integrated betel nut processing plant is the development direction of betel nut processing industry, which can promote the development of betel nut planting, increase processing efficiency of betel nut, improve product quality, and reduce environmental pollution.

3.2 Recommendations

3.2.1 Establishing ecological betel nut plantation. Currently, it is necessary to focus on the prevention based on ecological improvement, and building of ecological betel nut plantations while attaching importance to prevention and control technology for betel nut yellows. The key to building ecological disease-resistant betel nut plantations lies in maintaining and using the ecological community in betel nut plantation, to prevent the occurrence of betel nut yellows. In betel nut plantations, the weeds and dwarf plants in the periphery of trunk are regarded as covering, to form a growth environment with sufficient sunshine on upper canopy and shade on the lower part. Ecological betel nut plantations can reduce soil erosion, increase species diversity, improve the soil environment in betel nut plantation, increase the surface shade, and reduce direct sunlight onto the ground, so as to maintain moisture and fertilizer and improve soil microbial environment for betel nut growth. The herbicides should not be used during weeding in the betel nut plantation, which can avoid damage of herbicides to betel nut root system.

3.2.2 Using nutrient adjustment to prevent betel nut yellows. According to the field survey in betel nut plantation, it is believed that the main cause of betel nut yellows may be the betel nut plant malnutrition. In recent years, due to the increase in labor costs and reduction of organic fertilizer source, the organic fertilizer input in betel nut plantation decreases, and the soil fertility declines in the betel nut plantations. With the considerable application of chemical fertilizer, the soil aggregate structure is damaged, causing soil compaction. Meanwhile, the extensive use of herbicides leads to serious soil contamination. The nutrient adjustment is used to prevent yellows, and the scientific fertilization is conducted mainly based on nutrition for betel nut. Based on the analysis of nutrients in betel nut plant leaf and betel nut plantation soil, the fertilizer type and fertilizer application rate are determined, to ensure the necessary nutrients for betel nut and promote betel nut growth. Excessive use of herbicides should be avoided during weeding in betel nut plantation, high bushes are cut and dwarf plants and weeds are retained to cover the ground and keep the soil moisture and nutrients and improve soil fertility in betel nut plantations.

3.2.3 Developing the integrated betel nut processing plant. Currently, 80% of fresh betel nut fruits in Hainan are dried by farmers after primary processing, and the dried betel nut is mainly supplied to Hainan or Hunan betel nut processing enterprises for deep processing of products. Now there are nearly ten thousand processing plants of fresh betel nut fruits in Hainan, mostly concentrated in the main producing areas of betel nut such as Wanning, Qionghai, Tunchang and Ding'an. The traditional primary processing technologies and models are still widely used in Hainan. Now there are many processing plants of fresh betel nut fruits (3000 in Wanning; 2500 in Qionghai; 1000 in Tunchang; 1000 in Ding'an). The processing model is based on family workshop, and there are 2 to 3 people in small plants. There are generally 10 – 30 drying stoves, and tens of tons of fresh betel nut fruits are processed annually. There are about 200 people in large processing plants, and several thousand tons of fresh betel nut fruits can be processed annually. It is necessary to develop the integrated betel nut processing plants combining primary processing with deep processing, to continuously process betel nut. The processing plants complete the entire production process from dried betel nut fruit to edible products, and the primary processing form, dominated by family workshop or small processing plant, is gradually reduced, and the industrialized processing methods are adopted to replace the traditional processing methods. In the integrated betel nut processing plants, standard electric drying equipment is used to process dried fruits, which can save resources, reduce pollution, improve product quality and increase production efficiency. After the processing of dried fruits, it immediately enters the deep processing stage, which can reduce dried fruit marketing link, transportation costs, production and operation costs.

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