

Crushing Machine and Double Roll Balancing Test in Pineapple Stems and Leaves

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Abstract: This paper describes the pineapple leaf crushing machine in detail, including two-roll structure, structural characteristics, working principle, two-roll processing requirements and dynamic balance testing methods, Knife sharpener and after knife edge knife straight knife with the composition. After fully considering the radial and axial positioning and balancing, the machine can effectively increase the number of hitting, cutting and secondary crushing of the pineapple blades after entering the crushing chamber, achieving the goal of meeting the agronomic requirements of a crushing operation. The testing results showed that the passing rate of pineapple leaf was 98.9% after the crushing and returning machine calibrated by dynamic balance test. The passing rate of pineapple head was 92.4% and the working stability was 89.4%. The unevenness of throwing and The average time to failure was 0.59 and 3.4h, the whole machine showed high reliability, to meet the actual operational needs.

1 INTRODUCTION

Pineapple is one of the famous tropical fruit, which is mainly distributed between the 30 degrees of the north and the south. China's planting area is about 70 thousand hectares, mainly in Guangdong, Hainan, Guangxi, Yunnan, Fujian and other provinces. Pineapple leaves are rich in fructose, glucose, amino acids, protein, organic acids, crude fiber, calcium, iron, phosphorus, vitamins, enzymes and other nutrients. Therefore, the comprehensive utilization of abandoned Pineapple leaves has certain economic benefits and important environmental benefits (Zhang Guo, 2017). In recent years, the comprehensive utilization of waste in the pineapple leaf also a lot of research, such as the use of pineapple leaf residues by anaerobic fermentation biogas production, production of bio organic fertilizer, silage, in the main planting area in our country most of the pineapple, Pineapple leaves by returning the way into the line by this way, the speed and efficiency high promotion and easier application.

Pineapple leaf returning first adopted the way that post-harvested pineapple stubble will be

transported to the fields through artificial or bulldozers and other equipment, dry incineration or compost into fertilizer, caused by a certain degree of pollution to the environment, in order to solve this problem, at the end of 80s, China began the study of crushed pineapple leaf returning machinery and technology, and experienced a multi-stage harrow flail chopped, stems and leaves of pineapple cut and crushing stage, the existing models mainly include: hoe shaped flail of pineapple leaf shattering and returning machine (Figure 1) and improved L shaped flail pineapple leaf shattering and returning machine (Figure 2).



Figure 1: The structure of returning hoe shaped grinding knife.



Figure 2: Returning L shaped flail crushing structure.

Pineapple leaf shattering and returning machinery in general operation mainly due to low efficiency, high operation energy consumption is due to its unique biological characteristics and mechanical properties of the pineapple stem leaf shattering and returning machine into the pineapple, tend to be the 2-3 smash, in order to make the crushing effect and meet the requirements of the proportion (pineapple stem and leaf length is less than 15cm is not less than 90%), but in second times, third times in the process of grinding, pineapple stem leaf and ground surface close to earth mixed together, to crush it, must reduce the crushing knife stick of pineapple leaf and soil mixture crushing operations, so that the energy consumption increases, at the same time. 2-3 means crushing tractor repeated rolling land, resulting in land compaction, is not conducive to subsequent tillage operations (Ou Zhongqing, 2017; Zhang Yurong, 2017). Therefore, the most direct way to reduce the problem of low efficiency, high energy consumption and soil compaction of pineapple stem and leaf is to reduce the operation times of pineapple stem and leaf crushing and returning machine under the premise of ensuring the grinding rate.

In view of the existing pineapple stem leaf shattering and returning machine operation efficiency is low, operation difficulty and operation of high energy consumption, soil compaction and other issues, combined with reduced pineapple stem leaf crushing returning machine number, according to the technical thought and the overall scheme of stable performance, simple structure, the design and development of double roller supporting large and medium-sized tractor pineapple stem the leaf shattering and returning machine, also carried out a lot of research work on dynamic balance test on twin roll.

2 THE OVERALL STRUCTURE AND CHARACTERISTICS OF A DOUBLE ROLL PINEAPPLE LEAF PULVERIZING MACHINE

2.1 Structural characteristics

Double knife roller pineapple stem and leaf shattering and returning machine, which comprises a frame, a supporting rod, a transmission mechanism, the knife roller assembly, the knife, the knife roll assembly, fixed knife, wheel, which is characterized in that a frame is arranged at the tail part of the front plate, a support rod arranged inside the rack and the gear box, the middle part. With a knife before and after the knife roller assembly and assembly; the knife roller assembly and the knife roller assembly is assembled above the fixed knife before and after the fixed knife, the knife roller assembly via a front seat with the knife edged knife mouth and pin hinge, the front end is provided with a a belt wheel, and is fixed on the power output shaft of the gear box at one end of the driving pulley is connected through the V belt, the other end is provided with a front pulley and fixed on the rear end of the knife roller assembly after the belt wheel is connected through the V belt, after the knife roller assembly through after the knife holder and is fixed to the bolt group straight knife (Xie Yanmin, 2017; Cui Zhende, 2013). The whole machine structure is shown in Figure 3.



Figure 3: Structure diagram of a double knife roll pineapple pulverizing machine.

The main features of the machine are as follows: the structure of one big, one small and two knives and rollers can work together to significantly improve the crushing effect, reduce the number of pineapple leaf crushing from 2-3 times to 1 times, avoid multiple operations, increase productivity, reduce energy consumption and avoid excessive compaction of soil.

2.2 Working principle

The machine is equipped with 120-140 horsepower tractors, the use of rear suspension as a working power, the tractor in the forward process, the output power through the output shaft, through the universal transmission assembly to the bevel gear gear shaft, through a pair of cones Gear growth and change direction, and then through the transmission shaft connected to the front roller pulley, drive the front shredding roller high-speed rotation, driven by the pulley connection after the shredding roller rotation. Before driving the grinding knife roller rotating speed, and grinding knife roller is connected with a belt wheel, the knife roller to rotate in the process through a belt pulley and a belt drive after high speed rotary knife roller. Double roller crushing returning machine into the stems and leaves of pineapple pineapple, pineapple leaf machine hand to slow down shattering and returning machine, with the wheel, adjusting front knife roller clearance tractor, walking forward, before driving a knife roller rotating speed, the knife roller and the cutting, with the fixed knife pick up, crushed pineapple leaf, and crushed Pineapple leaves thrown after the knife roll, after the knife roller with the fixed knife is installed on the frame, again on the pineapple stem and leaf is crushed, Pineapple leaves and stems along the baffle is spread evenly on the surface, complete the grinding operation of pineapple stem and leaf of the final.

3 DOUBLE ROLL STRUCTURE TEST

Roll in installation tool, by the environmental impact crushing object and surface uneven will jump a wide range, in addition to the design of double roller to test the instability caused by the operation object, also need to take into account the dynamic balance roll itself, otherwise it will directly affect the normal use of the equipment or service life.

3.1 Processing and assembling of double knives

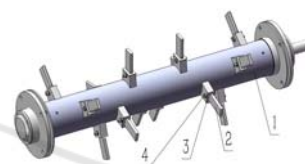
Double roll pineapple stem leaf shattering and returning machine has before and after the installation of knife knife knife knife stick installation, processing and assembly process to consider the radial and axial double precision, and

ensure that the static and dynamic balance of the single roll.

Roll design before considering the cutters and stick the assembly simulation test calibration, modal analysis shows that the knife roller of the first 5 natural frequencies in the range of 0.0018 ~ 0.0163Hz can effectively avoid the inherent frequency of the knife roller, so far, to ensure that the high-speed operation of the knife roller is reliable, then processing and installation. Simulation results are shown in Figure 4 (a, b, c).

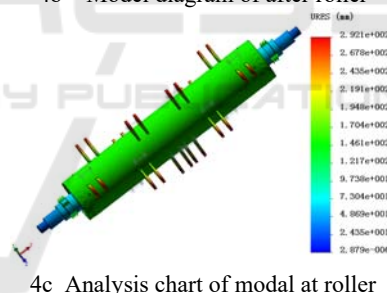


4a Model diagram of front roller



1.After roller 2.Straight Knife 3.Straight Knife base 4.Bolt group

4b Model diagram of after roller



4c Analysis chart of modal at roller

Figure 4: Model and modal analysis diagram of knife stick.

At the same time, the installation of the stick is balanced by the balance of the shaft, and the processing and installation are shown in Figure 5 (a, b, c) (Zhang Yuan, 2017; Ou Zhongqing, 2017; Li Ling, 2014).



5a Machining chart of knife stick + cutter seat



5b Tool bar + knife seat + blade machining map



5c Installation diagram

Figure 5: Tool roll processing and installation drawing.

3.2 Dynamic balance test of double knives

Double roll pineapple stem leaf shattering and returning machine balancing using HSC type China Guangdong Foshan Shunde electric machinery industry limited company to test the dynamic balancing machine, the 75g standard balance principle, the detection process marked with standard magnet after welding of metal materials by way of balance. The detection process is shown in Figure 6 (a, b).



6a Machine effect



6b Detection page

Figure 6: Tool roll test process diagram.

3.3 Test result of whole machine index

The whole machine test of two roller pineapple stem and leaf crushing and returning machine is carried out in Xuwen County, Zhanjiang City, Guangdong province (Tang Ningning, 2017; You Jiahan, 2017). The demonstration base of the 100 mu demonstration area of continuous pineapple mechanization and crushing is returned, and the relevant test results are shown in Table 1.

Table 1: Detection index and results.

index	result
Productivity(hm ² /h)	0.25
Fuel consumption (kg/hm ²)	16.12
Sprinkle evenness(%)	0.59
stability(%)	89.4
Pineapple Leak out of the ground pass rate(%)	92.4
Pineapple leaf smash pass rate(%)	98.9
Broken broken rate(%)	0
Mean time to failure(h)	3.4
Visual vibration situation	normal

From table 1 shows: pineapple leaf crushing pass rate stable at 98.9%, pineapple head leakage height pass rate stable at 92.4%, stability is 89.4%; throwing non-uniformity and the average time was 0.59 and 3.4h, high working reliability of the whole machine, meet the actual operation requirements and design requirements.

4 CONCLUSIONS

A. double roller type structure of pineapple leaf shattering and returning machine, using Daogun double L thickening and flail Daogun after opening with the knife edged, together with fixed cutters in full consideration and dynamic balance of radial and axial positioning, can effectively increase the pineapple leaves into the crushing cavity after being hit, cutting and two times the number of pieces, achieved a crushing to the agronomic requirements, effectively solved by repeated operation of soil compaction and low production efficiency and energy consumption of higher multiple tasks (Wang Ruili, 2017).

B. test showed that after crushing and returning machine dynamic balance detection after calibration, pineapple leaf crushing pass rate stable at 98.9%, pineapple head leakage height pass rate stable at 92.4%, stability is 89.4%; throwing non-uniformity and the average time was 0.59 and 3.4h, the work showed high reliability, meet the actual operation needs.

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