DESIGN AND EXPERIMENTAL OPTIMIZATION OF CLEANING SYSTEM FOR PEANUT HARVESTER
/
捡拾花生收获机清选系统的设计与试验优化

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ABSTRACT

The new cleaning system, mainly composed of light impurities cleaning device and stems separating device was designed. The former used cross-flow fan to clean light impurities, and the latter used the differences of radial geometry size between peanut pods and stems to separate stems from peanut pods. By means of theoretical calculation and graphic analysis, the structure motion parameters of the main working parts were determined and the performance experiments were carried out. According to the experimental results, the influence law of the structure motion parameters of peanut cleaning system on cleaning performance was analyzed and optimal combination of parameters was obtained. When the rotation speed of cross-flow fan was 920 r/min, the distance between sliding screen and fan impeller was 100mm, and the width of discharging exit was 50 mm, the clearance of separation rollers was 2mm, the rotation speed of separation roller was 300 r/min, and the angle between separating device and horizontal plane was 35°, the impurity content was 0.89%, and the cleaning loss rate was 0.62%, which met the requirement of peanut harvester.

摘要

设计了一种主要由轻杂物清理装置和断杆分离装置组成的花生清选系统，前者采用横流风机以吸气方式清理待清选物料中的轻杂物，后者根据荚果与断杆的径向几何尺寸差异将断杆分离出去。利用解析作图法对断杆分离装置进行受力和运动分析，得出了断杆顺利分离满足的力学关系，并通过理论计算得出了分离辊的结构参数。进行室内参数清选试验，研究了各结构运动参数对花生清选损失率和含杂率的影响，结果表明：当横流风机转速为 920r/min、滑板到风机叶轮的距离为 100mm、落料口宽度为 50mm、分离辊间隙为 2mm、分离辊转速为 300 r/min、分离装置与水平面呈 35°倾角时，清选系统的性能指标：含杂率为 0.89%，清选损失率为 0.62%。

INTRODUCTION

Peanut is one of the important oil and economic crops which has a long cultivation history in China, accounting for about 20% of the total planting areas of the world. Peanut harvesting machinery in foreign countries starts earlier and its technology is relatively mature, while the domestic mechanical harvesting technology level is relatively low *(Colvin B.C. et al,2018; Reddy K.M. et al, 2013; Lim J. et al, 2016; Zhou Dehuan et al, 2017; Shang Shuqi et al, 2005; Ortiz B V et al, 2013)*. As an important part of peanut harvesting machinery, the working performance of cleaning system directly affects the quality of the whole machine. The existing peanut harvesters generally adopt simple air separation or air-screen combination, which has the problems of high impurity rate and high loss rate, seriously restricting the further development of peanut industry *(Tang Bei et al, 2016; Wang Dongwei et al, 2013; Guan Meng et al, 2014; Liang Zhenwei et al, 2018)*. Lots of researches have been done by scholars at home and abroad. Wang Bo and others have designed a new experimental platform of cleaning device for peanut combine harvester *(Wang Bo et al, 2015)*. Zhang Rihong and others have used SolidWoks to simulate and analyse the structure and motion parameters of the vibrating screen and obtained the main factors affecting the screening rate *(Zhang Rihong et al, 2010)*. Tang Bei and others have optimized the fan-vibration sieve cleaning device of 4HBL-2 type peanut combine harvester based on the cleaning characteristics of peanut trashed materials and carried out experiments in the field *(Tang Bei et al, 2015)*.

Based on the differences of radial geometry size between peanuts pods and stems, this study designed a new peanut harvester cleaning system. While the influence law of the structure motion parameters of peanut cleaning system on cleaning performance was studied through test in the laboratory and the optimal combination of parameters was obtained. It could solve the difficulties of cleaning problem in the working process of peanut harvesting mechanization preliminarily.

MATERIALS AND METHODS

- **Structure and principle of peanut cleaning system**

The structure diagram of peanut harvester cleaning system test-bed is shown in Fig.1. It was mainly composed of conveyor belt, cleaning device and collection device and the cleaning device was composed of the light impurities cleaning device and stems separating device. The former consisted of feeding hopper, sliding screen and cross-flow fan, etc.; and the later consisted of a number of separation rollers that rotated oppositely, guide plates, gear transmission mechanism and thread adjusting rod, etc.

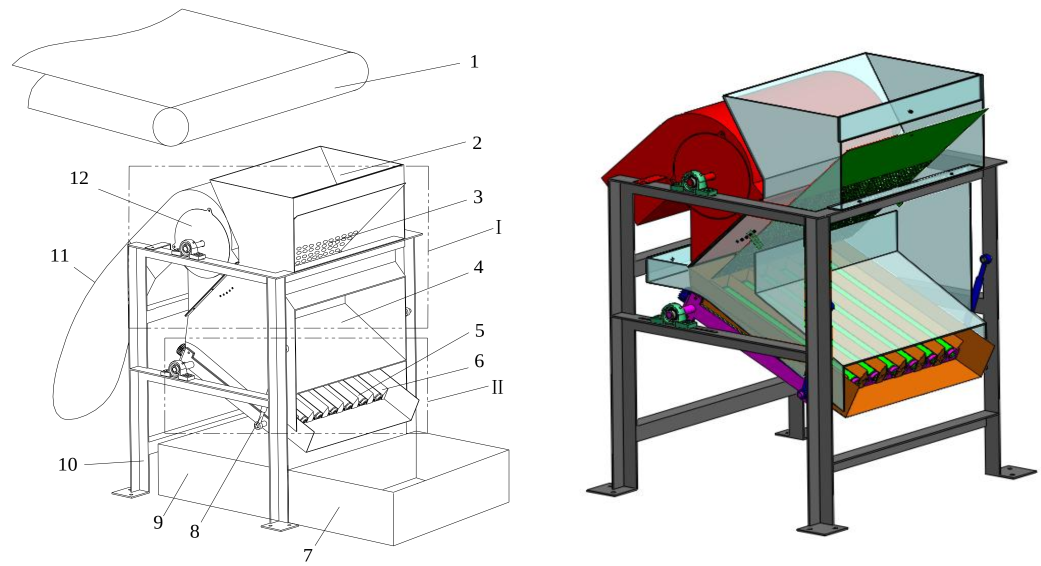

Fig. 1 - Structure diagram of peanut harvester cleaning system test-bed
Ⅰ-Light impurities cleaning device Ⅱ-Stems separating device
1-Conveyor belt; 2-Feeding hopper; 3-Sliding screen; 4-Housing;5-Separation roller; 6- Guide plates; 7-Pods box; 8-Thread adjusting rod; 9-Stems box; 10-Rack; 11-Mesh bag;12-Cross-flow fan

Peanut harvester cleaning device adopted the working principle of air-suction and separation double rollers. Peanut trashed materials were fed stably by conveyor belt to the cleaning device feeding hopper and then slid down along slant sliding screen. Because the sliding screen was full of vents, impurities and short stems were inhaled into cross-flow fan by high speed air through the vents of sliding screen and fan inlet in the slipping process of trashed materials; they were discharged into the mesh bag from the outlet of cross-flow fan. Thus, impurities and short stalks separation from peanut pods was realized. The rest of trashed materials were falling to stems separating device through the discharging exit at sliding screen bottom, and stems were took by opposite rotating separation rollers and sent into stems box. Peanut pods cleaned over stems separating device were falling to pods box. Finally, it completed cleaning work of peanut trashed materials.

- **Design of main working parts of clearing system**

Design of sliding screen

Sliding screen was composed of two different screens, one large, the other small, and the size (length×width) of two different screens were respectively 600mm×580mm, 600mm×200mm. There were many vents in the two screens and cross-flow fan could be provided with air by virtue of vents. In addition, according to the experimental need, the length, position and inclined angle of sliding screen all could be adjusted, changing the width of discharging exit, the distance between sliding screen and fan impeller, the speed of materials sliding along sliding screen and other related parameters.

According to the friction and movement characteristics of peanut pods, we determined the angle of sliding screen as 40° based on experiment of test-bed under the condition that material is not congested during the decline of materials.

Design of cross-flow fan

Due to the unique structure and working principle, the cross-flow fan has many advantages which are lacking in the other kinds of fans, such as high characteristic coefficient, distributing the wind evenly along the fan shaft, self-cleaning ability and so on. All of these advantages of cross-flow fan make the suction part possible *(Marian and Pawel, 2012; Liu Shiduo et al, 1998)*.

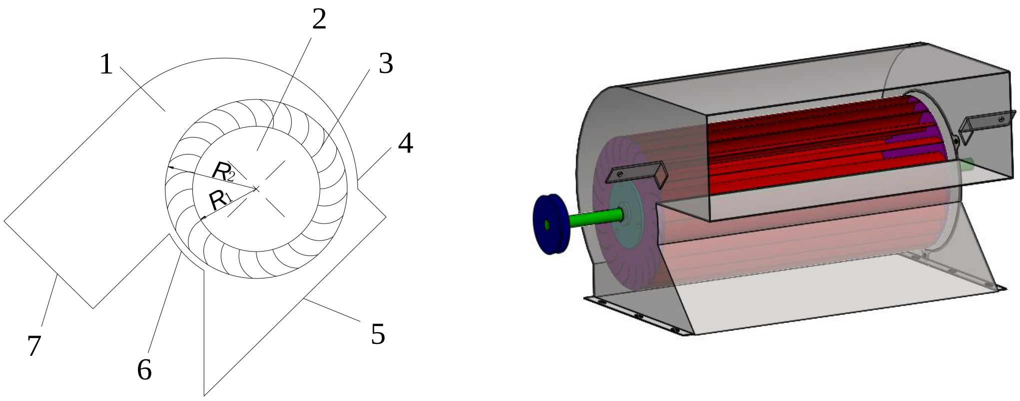

Fig. 2- Structure diagram of cross-flow fan

1-Fan shell; 2- Impeller; 3-Blade; 4-Back shell; 5-Air inlet; 6-Volute tongue; 7-Air outlet

The cross-flow fan designed is shown in Fig. 2; it was mainly composed of fan shell and impeller. The impeller blade is tilted forward and the fan shell adopted eccentric circular approximation scheme design. The main design parameters of cross-flow fan are presented in Table 1.

Table 1

Main design parameters of cross-flow fan

Parameters	Values
Impeller internal diameter [mm]	182
Impeller outer diameter [mm]	260
Blade number	24
Installation angle of blade inlet [°]	90
Installation angle of blade outlet [°]	25
Clearance of impeller outer diameter & volute [mm]	15
Clearance of impeller outer diameter & volute tongue [mm]	10

We imputed the above data in Table 1 into calculating formula (1) and calculated blade curvature radius of 36.58mm.

$$R = \frac{R_2^2 - R_1^2}{2(R_2 \cos\beta_2 - R_1 \cos\beta_1)} \tag{1}$$

where, R is mean curvature radius of blade, mm; R_1 is impeller internal diameter, mm; R_2 is impeller outer diameter, mm; β_1 is installation angle of blade inlet, °; β_2 is installation angle of blade outlet, °.

Design of stems separating device

Stems separating device was one of the core parts of peanut cleaning system, which had direct influence on the working performance of the system. If the separation of stems and pods is achieved, the clearance and diameter of separation rollers must also be considered.

Stems separation device were installed on the rack in a certain angle with the horizontal surface, and the angle could be adjusted in a certain range through the screw adjusting lever to change the speed of the material's decline. Each pair of separation rollers rotated in double opposite directions and adopted the method of gear meshing to transmit power. When stems and pods fell to separating device from sliding screen, they were going down along the axis of the separation roller under the gravity action; meanwhile they were led into the grooves which are formed by each pair of separation rollers rotating oppositely by guide plates. In order to facilitate the analysis, it was assumed that both stem and pod were cylindrical in the rule. When stem and pod were captured by separation rollers, they were respectively subjected to the reacting force of N , Ng and the grasping force of T , Tg of separation rollers. Force analysis is shown in Fig. 3.

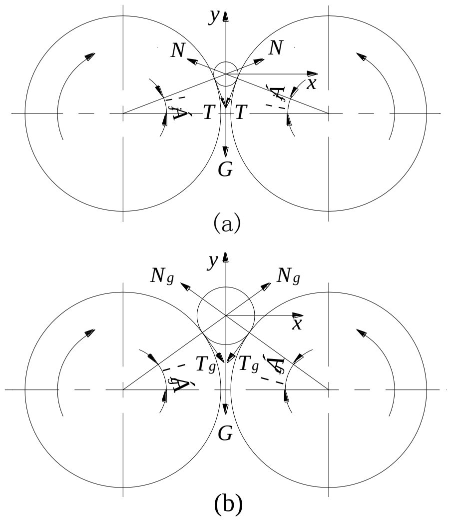

Fig. 3 - Diagram of force analysis
(a) - Stem force analysis; (b) - Peanut pod force analysis

The requirement of separation roller working normally should be that it can grasp stems but not grasp peanut pods. In the case of ignoring the influence of gravity, the requirement of separation rollers grabbing stems was that the resultant force on the Y -axis should be in the negative direction.

$$T\cos\alpha_{j} - N\sin\alpha_{j} > 0 \tag{2}$$

Due to $T = N\mu_{j}$, plugging it into the equation (2), we could get the equation as follows:

$$\tan\alpha_{j} < \mu_{j}$$

where, μ_{j} is friction coefficient of stems and nylon; α_{j} is the starting angle of separation rollers grasping stems, °.

Similarly, the following conditions must be satisfied for the pods not to be crushed by the separation roller:

$$\tan\alpha_{g} > \mu_{g}$$

where, μ_{g} is friction coefficient of pods and nylon; α_{g} is the starting angle of separation rollers grasping pods, °.

Given all that, the conditions are as follows: the tangent value of starting angle of separation rollers grasping stems should be less than the friction coefficient of stems and nylon; the tangent value of starting angle of separation rollers grasping peanut pods should be greater than the friction coefficient of pods and nylon.

Design of separation roller

The parameters of separation roller mainly include the material of separation roller, diameter, length, clearance, rotational speed, etc. All of the parameters above decide the separation performance of stems separating device directly; meanwhile the separation roller should have less energy consumption and long service life under the condition of ensuring the separation performance.

The separation rollers were made of nylon rod and both two ends of separation roller were inlaid with steel shaft. According to the normal working conditions of the separation roller mentioned above, that is the tangent value of starting angle of separation rollers grasping stems should be less than the friction coefficient of stems and nylon and the tangent value of starting angle of separation rollers grasping peanut pods should be greater than the friction coefficient of pods and nylon, we could deduce the range of separation roller diameter as follow.

$$\frac{d_g - h\sqrt{1+\mu_g^2}}{\sqrt{1+\mu_g^2}-1} \geq D \geq \frac{d_j - h\sqrt{1+\mu_j^2}}{\sqrt{1+\mu_j^2}-1} \tag{3}$$

where, D is the diameter of separation roller, mm; d_g is the diameter of peanut pod, mm; d_j is the diameter of stem, mm; h is the gap of double separation rollers, mm.

The clearance of separation rollers had a direct impact on separation performance. When the clearance was too small, separation roller could not grab stems or separation performance was poorer; when it was too large, it could damage peanut pods and even cause loss of pods. Therefore, the clearance of separation rollers was designed as 2mm~4mm.

We found that the width and thickness of peanut pods were extremely similar by measuring multiple groups of samples. The pods can be regarded as a cylinder approximately. The diameter of pod was 8.6~17.5 mm, the diameter of stems was 1.3~5.2 mm and the friction coefficients of pods and stems with separation roller were 0.42 and 0.45 respectively. By substituting data into inequation (3), the range of separation roller diameter was 34~60mm. In consideration of the logarithm, structural strength and service life of separation roller, the diameter of separation roller was determined as 40mm by the experiment.

The peanut variety "Yuhua 15" was used in the experiment, and the trashed materials separated by peanut picking device were selected as experimental materials. The main components of experimental materials were peanut pods, stems and stalks, light impurities etc., and the materials had an impurity content of 35%. The proportion of stems and stalks was 14%, while the proportion of light impurities was 11%. The moisture content of peanut pod was 18%~20% and the moisture content of stem was 15%~16%. Experimental equipment is homemade peanut cleaning device, as shown in Fig. 4, and the auxiliary equipment included laser velocimeter, moisture meter, electronic balance, computer, frequency conversion motor, converter and so on.

Fig. 4 - Experimental field of peanut cleaning

In order to ensure the stability of the components of the experimental materials, the mixed materials separated from peanut picking device were divided into peanut pods, stems, stalks and light impurities. First of all, according to the length of conveyor belt and feeding time, we could determine the speed of conveyor belt. Then, we could calculate the material quality put on the conveyor belt in each experiment based on feed quantity and length of laying material. Finally, peanut pods, stems and light impurities were mixed evenly and laid on the conveyor belt based on the proportion of trashed materials. Until all parameters of the cleaning system test-bed were adjusted to the requirements of experiment, controlled converter didn't start the cross-flow fan and stems separation device, and the conveyor belt didn't start until the test-bed reached a stable working condition. When the materials on the conveyor belt were fed into cleaning device through feeding hopper, light impurities and short stems were sucked into cross-flow fan and discharged into the mesh bag through the fan air outlet, long stems were pulled into stems box by separation roller and clean peanuts fell into pods box through the pods outlet.

Dealing with the materials in the box and mesh bags and weighing and recording the data in the experimental form, the parameters of experimental performance of cleaning system can be obtained by using the following formula.

$$Y_1 = \frac{w_1 - w_2}{w_1} \times 100\% \tag{4}$$

$$Y_2 = \frac{w_3}{w_2 + w_3} \times 100\% \tag{5}$$

Where, Y_1 is the impurities content, %; Y_2 is the cleaning loss rate, %; w_1 is the total quality of material in the pods box, g; w_2 is the quality of pods in the pods box, g; w_3 is the quality of pods in the stems box and mesh bag, g.

RESULTS

The performance experiment of peanut harvester cleaning system could be divided into light impurities cleaning experiment and stems separating experiment. The former aimed to study the influence of the width of discharging exit, the distance between sliding screen and fan impeller and the rotation speed of cross-flow fan on cleaning performance, and obtain the optimal parameters of sliding screen and cross-flow fan. The later mainly studied the influence of the rotation speed of separation roller and the angle between separating device and horizontal plane on the separation performance and the optimal parameters of stems separating device were obtained.

The main factors affecting performance of light impurities cleaning device include feed quantity, the inclined angle of sliding screen, the size of sliding screen vent, the width of discharging exit, the distance between sliding screen and fan impeller and cross-flow fan speed, etc. The width of discharging exit, the distance between sliding screen and fan impeller and the rotation speed of cross-flow fan were selected as experimental factors in orthogonal experiment, while impurities content and loss rate were selected as experimental indexes. The paper carried out orthogonal experiment based on four factors and three levels orthogonal table. Through analyzing the experimental results, the influence laws of three experimental factors on the experimental indexes were obtained and the influence factor sequences and optimal combination of various factors on impurities content and loss rate were ascertained. Theoretical basis for the selection of regression experimental factors was provided. The scheme and results of orthogonal experiment are shown in Table 2.

Table 2

Scheme and results of orthogonal experiment

Test number	A	B	C	Impurities content	Loss rate
	[mm]	[mm]	[r·min-1]	[%]	[%]
1	40	70	550	13.15	0.94
2	40	80	700	8.41	0.44
3	40	90	850	8.08	0.80
4	50	70	850	4.85	0.89
5	50	80	550	14.63	0.47
6	50	90	700	15.9	0.66
7	60	70	700	10.62	0.82
8	60	80	850	5.82	0.78
9	60	90	550	19.18	0.68

A means the width of discharging exit; B means the distance between sliding screen and fan impeller; C means the rotation speed of cross-flow fan. Based on the range analysis of the orthogonal experimental results, the influence factor sequence of three factors on impurities content was C>B>A, and the optimal combination was $A_1B_1C_3$; the influence factor sequence of three factors on loss rate was B>C>A, and the optimal combination was $A_2B_2C_2$. The influence factor sequences and optimal combination of three factors on the experimental indexes was different, so the comprehensive scoring method was used to analyse the orthogonal experimental results. When the weight factors of impurity rate and loss rate factor were 0.4 and 0.6 respectively, the influence factor sequence of three experimental factors on the comprehensive index was C>B>A and the optimal parameter combination is as follows: the width of discharging exit was 50mm, the distance between sliding screen and fan impeller was 80mm, the rotation speed of cross-flow fan was 850 r/min.

The purpose of regression experiment was to establish the relational model of impurities content, loss rate and experimental parameters, and obtain the optimal parameter combination. On the basis of orthogonal experiment, the width of discharging exit was fixed as 50mm in the regression experiment, and the experiment selected the rotation speed of cross-flow fan and the distance between sliding screen and fan impeller as experimental factors, and selected impurities content and loss rate as experimental indexes. The experimental factors and levels are shown in Table 3, and the experimental results are shown in Table 4.

Table 3

Coding of factors and levels

Coding value	Rotation speed of cross-flow fan [r·min-1]	Distance between sliding screen and fan impeller [mm]
-1.414	700	60
-1	744	65.9
0	850	80
1	956	94.1
1.414	1000	100

Table 4

Scheme and results of regression experiment

Test number	X_1	X_2	Impurities content [%]	Loss rate [%]
1	1	1	4.18	0.41
2	1	-1	4.23	1.00
3	-1	1	7.37	0.21
4	-1	-1	4.74	0.65
5	-1.414	0	12.70	0.57
6	1.414	0	4.10	0.95
7	0	-1.414	3.90	0.85
8	0	1.414	10.17	0.36
9	0	0	5.52	0.64
10	0	0	5.37	0.62
11	0	0	5.46	0.67
12	0	0	5.96	0.70
13	0	0	5.33	0.64

Note: X_1 means coding values of the rotation speed of cross-flow fan; X_2 means coding values of the distance between sliding screen and fan impeller

The regression models of impurities content and loss rate were accomplished by MATLAB statistical analysis software based on regression experimental results. The correlation coefficient of regression models of impurities content was 0.8136 and the residual standard deviation was 1.9837. The correlation coefficient of regression models of loss rate was 0.9619 and the residual standard deviation was 0.0798. The variance analysis of two regression models was carried out and it was found that both the regression models of impurities content and loss rate had good significant level and high fitting degree.

$$Y_1 = 5.52831 - 1.98285X_1 + 1.43094X_2 + 0.78904X_1^2 + 0.10634X_2^2 + 0.67000X_1X_2 \quad (6)$$

$$Y_2 = 0.65401 + 0.13594X_1 - 0.21539X_2 + 0.02425X_1^2 - 0.05328X_2^2 - 0.03750X_1X_2 \quad (7)$$

In order to analyse the effects of the two factors on impurities content and loss rate intuitively and clearly, the response surface of two regression models was drawn by MATLAB, as shown in Fig. 5 and Fig.6.

Fig. 5 shows that both the rotation speed of cross-flow fan and the distance between sliding screen and fan impeller have more significant effect on impurities content.

In the test range, with the increase of the rotation speed of Cross-flow fan, the downtrend of impurities content slow down gradually. Because the rotation speed of cross-flow fan determines the airflow velocity at the fan inlet, and when the air-flow velocity at the fan inlet increases gradually, light impurities and short stalks in the trashed materials would be got away continuously by high-speed airflow. Until the end, only the peanut pods and long stalks with high floating velocity are left. While the rotation speed of cross-flow fan is fixed at a certain level, with the increase of the distance between sliding screen and fan impeller, the impurities content shows an upward trend. The reason is that the distance between sliding screen and fan impeller becomes larger and it makes the airflow distribution area below fan inlet enlarge and the suction pressure of sliding screen decrease. So, some flat pods and short stalks could not be sucked away by airflow, which leads to the increase of impurities content.

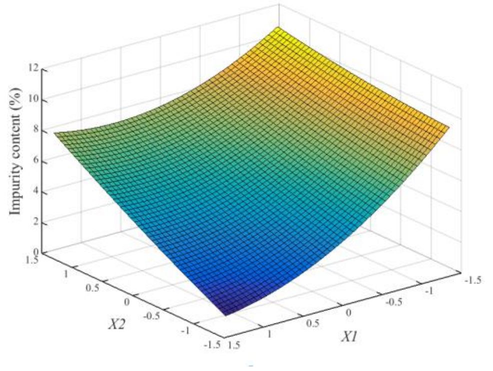

Fig. 5 - Impact of X_1 and X_2 on impurity content

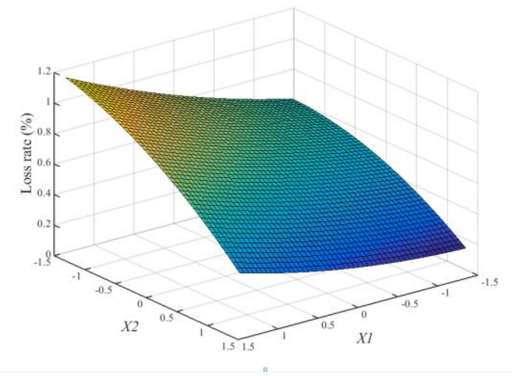

Fig. 6 - Impact of X_1 and X_2 on loss rate

Fig.6 shows that both the rotation speed of cross-flow fan and the distance between sliding screen and fan impeller have more significant effect on loss rate. In the test range, with the increase of the rotation speed of cross-flow fan, the loss rate is increasing. The reason is that the increase of the rotation speed of cross-flow fan causes the airflow velocity of fan inlet to enlarge and some small pods could be sucked away together with impurities. When the rotation speed of cross-flow fan is fixed at a certain level, with the increase of the distance between sliding screen and fan impeller, the downtrend of loss rate accelerates gradually. When the distance between sliding screen and fan impeller is smaller, the airflow distribution area below fan inlet is smaller and the suction pressure of sliding screen is stronger, some pods are sucked away together with impurities by airflow, which causes loss rate to enlarge. When the distance between sliding screen and fan impeller becomes larger, loss rate would decrease gradually.

According to the regression experimental results, it was known that the influence law of two experimental factors on impurity content and loss rate was not consistent. Therefore, the regression equations of impurity content and loss rate were weighted optimization; when the weights of both indexes were 0.4 and 0.6 respectively, we could set up the following objective function:

Objective function: $$\min Y(X_1, X_2) = 0.4Y_1 + 0.6Y_2$$

Variable constraint: $$G_1(X) = -X_1 - 1.414 \le 0$$

$$G_2(X) = X_1 - 1.414 \le 0$$

$$G_3(X) = -X_2 - 1.414 \le 0$$

$$G_4(X) = X_2 - 1.414 \le 0$$

By calculating the minimum value of the objective function, we could obtain the optimal combination of parameters that the rotation speed of cross flow fan was 920r/min and the distance between sliding screen and fan impeller was 100mm. The impurity content was 7.42%, and the loss rate was 0.31%. The optimal combination of parameters obtained by optimization was not present in the regression test, so it was necessary to verify the feasibility of optimal parameters. It was indicated that the difference between the theoretical value predicted by regression models and the verification value of the optimal parameters was very small and negligible.

Stems separating experiment was carried out at the end of light impurities cleaning experiment, so we fixed the rotation speed cross-flow fan of 920 r/min, the width of discharging exit of 50mm and the distance between sliding screen and fan impeller of 100mm based on the results of light impurities cleaning experiment. Separation performance of stems separating device was mainly affected by the rotation speed and clearance of separation rollers and the angle between separating device and horizontal plane. So, stems separating experiment mainly studied the influence of three parameters on the separation performance, with impurities content and loss rate as experimental indexes. The scheme and results of orthogonal experiment are shown in Table 5.

By analyzing the orthogonal experimental results, the influence factor sequence of three factors on impurities content was A>C>B and the optimal combination was $A_2B_3C_3$; the influence factor sequence of three factors on loss rate was A>C>B and the optimal combination was $A_1B_3C_2$. The impurities content and loss rate are both two important performance indexes of peanut harvester, so the weights of impurities content and loss rate were selected as 0.5 and 0.5 respectively, and then, analyzing the experimental data by using comprehensive evaluation method the optimal combination was determined. The analyzed results shown that the influence of three experimental factors on the comprehensive index was B>A>C and the optimal parameter combination was $A_2B_3C_1$.

Table 5

Scheme and results of orthogonal experiment

Test number	A	B	C	Impurities content	Loss rate
	[r·min-1]	[°]	[mm]	[%]	[%]
1	200	25	2	3.10	0.51
2	200	30	3	2.28	0.57
3	200	35	4	1.14	0.70
4	300	25	3	1.75	0.69
5	300	30	4	0.91	0.73
6	300	35	2	0.89	0.62
7	400	25	4	0.70	0.79
8	400	30	2	1.34	0.78
9	400	35	3	1.61	0.64

Note: A means the rotation speed of separation rollers; B means the angle between separating device and horizontal plane; C means the clearance of separation rollers.

As it can be seen from Table 5, the optimal parameter combination was exactly the sixth group of the orthogonal experimental scheme; the impurities content was 0.89% and the loss rate was 0.62%. Compared with other peanut harvester cleaning devices, the performance of peanut harvester cleaning system was good, which met the national requirement of peanut harvester.

CONCLUSIONS

A new type of peanut pod cleaning device was designed based on the difference of the clearance characteristics between the different parts of peanut mixture and the structure characteristics and working mechanism of the device were analyzed. In this paper, the indoor bench test was carried out by a self-designed test bed, the influence law of structure motion parameters of the device on cleaning performance was analyzed, the mathematic models between the parameters and the performance indexes were established and the optimal parameter combination of cleaning device was optimized. The conclusions are as follows:

1. On the basis of analyzing the cleaning characteristic parameters of peanut mixture fully, it can be seen that it is an effective method for peanut to remove the light impurities from the selected materials by cross-flow fan and to remove fruit stalks and short stems from the materials by separation rollers.

2. Under the test conditions, the optimal structure motion parameters of light impurities cleaning device are as follows: the width of discharging exit is 50mm, the distance between sliding screen and fan impeller is 100mm and the rotational speed of Cross-flow fan is 920r/min.

3. Under the test conditions, the optimal structure motion parameters of stems separating device are as follows: the angle between separating device and horizontal plane is 35°, the rotation speed of separation roller is 300r/min and the clearance of separation rollers is 2mm.

4. When the structure motion parameters of peanut pod cleaning device are at the above optimal level, the impurity content and the cleaning loss rate of are 0.89% and 0.62% respectively, which satisfies the performance requirement of peanut combine harvester.

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