Design and Test of Double-pick Double-striped Wheel Tooth-type Residual Film Picker

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Abstract. For the wheel-toothed residual film picker on the more serious broken film pick-up effect is not ideal and the problem of picking up the film uneven lyzing and designed a double-pick double-striped wheel tooth-type residual film picker. The double-pick double-striped wheel tooth-type residual film picker is composed of hydraulically adjusted double-pick double-pick double-pick pick-up machine shell device, two sets of fork-type residual film picker body and two sets of “Ya” type flexible film removal roller body. The test results show that the efficiency of double-pick edgy wheel tooth-type residual film pick-up machine whole machine scrap film pick-up is 86.5%, which meets the agronomic requirements of the residual film pick-up. At the same time, the hydraulic system adjusts the pick-up machine and the distance of cultivated land, with the arable land-shaped adjustment height, so as to effectively solve the phenomenon of uneven film collecting.

1. Introduction
Since the 1970s, the film cover technology has been widely used in China, and its effect of increasing temperature and fertilizer production has also been recognized by the vast number of farmers in the course of practice. In recent years, with the increase in the amount of film, the increase of the area of mulch, the increase of the intensity of use and the expansion of the application area, the problem of residual film treatment in the process of film cover has become increasingly apparent, and the problem of film pollution has become a hot topic in current agricultural research. China put forward the standards on the thickness of the film in the 1980s set at 0.014 mm, but the current agricultural film markets in order to reduce cost to obtain greater economic profit on the quality of agricultural film is not very high. Farmers in order to reduce input production costs, in the process of purchasing the film is more inclined to use a low 0.008 mm film. If you use a standard film need 47.5 kg - 60 kg per hectare, but if 0.005 mm film is used, 30.0 kg - 37.5 kg per hectare is used, which can be seen to reduce the nearly half of the input costs. However, this reduces the cost of production while reducing the strength and toughness of the film. In order to meet the market demand, enterprises will often produce more non-compliant film in the process of production of film. The thickness standard is far lower than that of 0.02 mm in foreign countries; It is more easily broken when the machinery is in effect. The cycle of using ultra-thin films breaks into pieces, making recovery much more difficult [1-6].
In order to solve the problem of residual film recovery, since the 1990s, more than a dozen research institutions and researchers have begun to explore the research of residual film recovery machinery. Through 30 years of efforts, more than 100 types of residual film recyclers have been developed. These residual film recyclers have the advantages of high efficiency, low labor intensity and relatively low cost, which are the key to solve the problem of residual film pollution. The film-picking mechanism is the main working part of the residual film recycler, whether it can reliably pick up the film is the main index to evaluate the performance of the residual film recovery machine. The optimization and improvement of the film-picking mechanism is of great significance to the improvement of labor productivity and the smoothness of the residual film recovery machine. At present, the pre-till residual film recovery machinery is widely used. Based on the domestic film laying standards, the working principle of the Chinese film recovery machine is basically similar, which are the first surface of the film lifted through the soil device, and then by the film collection device to collect the film, and then by the film removal device will be removed, thrown into the film collection device, which closed the film collection and film removal is the most critical link affecting the effect of the film recovery [7-12].

2. Overall design
The wheel-toothed residual film picker is mainly composed of pick-up mechanism and release mechanism. When working, the wheel-toothed residual film picker moves forward with the tractor, the pick-up mechanism's steering and the turn of the ground wheel is the same; Wheel-toothed residual film picker relies on the friction between the residual film picking roller mechanism and the ground to put away the film. Wheel-toothed residual film picker has the advantages of simple structure and relatively clean residual film, which is conducive to the recycling of residual film, especially suitable for picking up sorghum, corn and other hard after-autumn harvest film. However, in the course of the actual field test, due to the shape of the pick-up roller in the wheel-toothed picking film mechanism fixed, and the depth of the film in the soil is different, resulting in the film picking is prone to the phenomenon of uneven film picking; The design of the double-pick double-off residual film picker is designed, and its structure is shown in Figure 1.

![Figure 1. Overall structure diagram.](image-url)

1. Hydraulically adjusted double-pick double-pick up pick-up machine shell device, 2. fork-type residual film pick-up roller mechanism, 3. "Ya" type flexible defilming roller mechanism, 4. fork-type residual film pick-up roller mechanism, 5. "Ya" Type flexible defilming roller mechanism

The hydraulic regulated double pick up and double release type residual film pickup machine is composed of the shell device of the hydraulic regulated double pick up and double release type residual film pickup machine, two sets of fork type residual film pickup roller mechanism and two sets...
of fork-type residual film pick-up roller mechanism. "Ya" type flexible stripping roller mechanism is installed on the inside and back of the shell device of the hydraulic adjustable double pick up and double pick up.

3. Part design

3.1 Hydraulically adjusted double-pick double-pick pick-up machine shell device

Hydraulically adjusted double-pick double-pick pick-up machine shell device is composed of the shell, the membrane outlet, after picking up the tooth, outstretched, the right hydraulic lift system, the left hydraulic lift system, the right pick-up roller shaft diameter mounting hole, the right front removal roller mounting hole, right rear pick-up roller shaft diameter adjustable installation holes, right rear defilming roller diameter adjustable installation hole, left upper hanging ear, left front pick-up roller shaft diameter mounting hole, left bottom hanging ear, left front unfiled roller shaft diameter mounting hole, left rear pick-up roller shaft adjustable mounting hole and left rear film removal roller diameter. The shell is set with a membrane outlet, the lower side of the shell is set to pick up the tooth and the front pick-up tooth outstretched, the right side of the shell is installed right hydraulic lift system, the right upper lifting ear and the right lower lifting ear, the right hydraulic lift system lower installation right lift frame; The rear of the right side of the shell is set with the right rear pick-up roller diameter adjustable mounting hole and the right rear strip roller roller diameter adjustable mounting hole; The left rear side of the housing is equipped with an adjustable mounting hole for the left rear pick-up roller diameter and an adjustable mounting hole for the left rear unfiled roller diameter. The mechanism is shown in Figure 2.

Figure 2. The structure diagram of the Hydraulically adjusted double-pick double-pick pick-up machine shell device.

3.2 Fork-type residual film pick-up roller mechanism

Fork-type residual film pick-up roller mechanism is composed of fork-type pick-up teeth, rotary roller, drive shaft neck, right rotary shaft neck and left rotary shaft diameter, fork-type pick-up teeth
according to the rule of the insertion uniform lym; The right side of the rotary roller is installed with the right rotating shaft neck; Fork-type pick-up teeth consist of fork teeth and bow-shaped tooth back, fork teeth welded under the bow tooth back. as shown in Figure 3.

![Figure 3](image3)

2-1. Fork pick-up teeth, 2-2. rotating roller, 2-3. Drive shaft neck, 2-4. Right rotating shaft neck, 2-5. Left rotary shaft diameter

Figure 3. The structure diagram of the Fork-type residual film pick-up roller mechanism

3.3 “Ya” type flexible defilming roller mechanism

“Ya” type flexible defilming roller mechanism, is composed of the “Ya” type flexible defilming teeth, rotating rollers, drive shaft neck, right rotary shaft neck and left rotary shaft diameter. “Ya” type flexible defilming teeth uniformly is installed on the rotation roller according to the rule of the insertion, and the right side of the rotating roller is installed on the right rotating shaft neck; The right rotary shaft neck end face is welded to drive the shaft neck. as shown in Figure 4.

![Figure 4](image4)

3-1. “Ya” type flexible defilmed teeth, 3-2. rotating roller, 3-3. Drive shaft neck, 3-4. Right rotating shaft neck, 3-5. Left rotary shaft diameter

Figure 4. The structure diagram of the “Ya” type flexible defilming roller mechanism

In use, through the hanging ear will be hydraulically adjusted double-pick double-pick double-off-type residual film picker using the hydraulic system hanging in the belly of the tractor, hydraulic adjustment device to adjust the front and rear fork-type residual film picking roller mechanism and "twisted" type flexible defilming roller body relative height, according to the condition to choose a different height, further increase the pick-up rate, fork-type residual film pick-up roller mechanism rotating to pick up the residual film, "Twisted" type flexible film removal roller mechanism will flexible to take off the residual film separation from the fork-type residual film pick-up roller mechanism, and through the rotation-driven wind spins will the residual film from the drain age, into the residual film collection box.
4. Test and results
In order to test the double-pick double-striped wheel tooth-type residual film picker, the whole set of experiments were carried out in the Taohai Farm, Ningcheng County, Chifeng City, Inner Mongolia Autonomous Region on October 30, 2018. The test object was 40 acres of corn field to grow the residual film.

Respectively, two sets of fork-type residual film pick-up roller mechanism pick-up rate and two sets of "Ya" type flexible defilming roller mechanism release rate was tested, the test results show that two sets of fork-type residual film pick-up roller mechanism pick-up rate of 92.67%, two sets of "ya" type flexible defilming roller mechanism release rate of 93.4%, double-pick double-off-tooth-type residual film picker machine efficiency was 86.5%, meet the agronomy requirements of residual film pick-up.

5. Conclusion
In this paper, for the wheel tooth-type residual film picker on the more serious broken film pick-up effect is not ideal, the design of double-pick double-striped wheel tooth-type residual film picker, it is composed of hydraulically adjusted double-pick double-pick-up machine shell device, two sets of fork-type residual film picking roller mechanism and two sets of "Ya" type flexible film removal roller body. The test results show that the double-pick edgy wheel tooth-type residual film pick-up machine whole machine scrap film pick-up efficiency of 86.5%, to meet the agronomic requirements of the residual film pick-up. double-pick double-striped wheel tooth-type residual film picker although the whole machine structure is complex, but the pick-up rate is slightly higher, the hydraulic system adjusts the pick-up machine and the distance of cultivated land, adjusts the height of the cultivated land-shaped adjustment, It is easy to pick up the film unevenly when it is effectively solved.

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