Design of Roller Seeder Based on Solidworks

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Abstract. The Dibbling machine is the core part of the seeder, which plays an important role in precision and semi-precision seeding. In this paper, the suction precision seeder has strict requirements on seeds. The high speed seeding adaptability of disc precision seeder is poor and the seeds need to be graded. Because of the limitation of the landform land parcel, these large equipment can not complete the seeding operation of the relatively complex land parcel such as the small parcel or even the hilly area. The seeder overcomes the shortcomings of suction precision seeder and disc precision seeder, it can realize precise seeding of seeds of different specifications. The design has the advantages of simple structure, stable work, easy operation and low cost. It can realize fixed distance seeding, which significantly improves the uniformity and efficiency and meets the requirements of practical application. Finally, SolidWorks 3D modeling software is used to carry out solid modeling design for each part of the parts and complete the overall assembly of the hand-pushed roller seeder.

Keywords: Dibblingmachine; Precisionseeding; Efficient; Solidworks

1. Introduction

In 2019, China's soybean sown area was 132.75 million mu of land. The soybean planting area in Heilongjiang Province is 57.3 million mu of land. The sown area of corn is 41,284.06 thousand hectares. Sowing as the most important link in agricultural production, the level of its sowing technology directly affects the yield of crops. The distribution of seed grains in the row is not even, and the number of seedlings left and the spacing of seedlings are controlled by pulling seedlings by people. Moreover, the uneven spacing of plants, coupled with the inconsistency of sowing depth, produces large and small seedlings, which affects the increase of yield [1,2]. Accurate sowing [3-5] means that the seeds placed in the seed arranging box are planted into the seed hole according to the designed row spacing and plant spacing, and the wet soil around the seed hole is covered to the seeds, so that the seeds have an appropriate growth environment, so as to save seeds, reduce labor and increase output.

Experts at home and abroad have put forward a lot of planting and sowing methods for a variety of crops. Zhang Shun and the others [6] designed a rice internal pneumatic precision hill-drop seed platter to meet the planting requirements of precision hole direct seeding for hybrid rice, and described the working principle of the platter. Li Gang and the others [7] developed a 2BYF-4 type corn fertilization and precision seeder, which integrates deep soiling, fertilization, no-tillage, precision sowing and
suppression. Shi Decai and the others[8]corn membrane in Hexi District, Gansu Province irrigation area under drip irrigation sowing the present situation of the low level of mechanization, corn membrane was developed under the drip irrigation machine, mainly introduces the whole structure, working principle, main parameters and the design of the main working parts, and through the test conclusions. 1970 years later, pneumatic type precision seeder started, developed and widely used by many developed countries a cascade flow distribution set rows, such as the United States 600, Canada Motrism620. Esent and John Deere in the United States have started to use the two-level allocation system to improve the efficiency of each production line [9]. There are also some problems in these devices: the suction precision seeder has strict requirements for seeds, the disc precision seeder has poor adaptability for high-speed sowing, and the seeds also need to be graded.

This design through the shaft seed device, duck bill, ditching device, cone spring, seed scraping, seed introduction pipe, suppression plate and other parts of the reasonable layout, finally using SolidWorks 3D modeling software for each part of the entity modeling design and complete the overall assembly of the hand push roller seeder. The seeder overcomes the shortcomings of suction precision seeder and disc precision seeder, it can realize precise seeding of seeds of different specifications. The design has the advantages of simple structure, stable operation, easy operation and low cost. It can realize fixed distance seeding, so that the uniformity has been significantly improved, in line with the practical application requirements. Due to the limitation of geomorphic unit, these large equipment cannot complete the seeding operation of relatively complex plots such as small plots or even hilly areas[10-13].

2. The overall design of the roller seeder

2.1. Design Principles

- To improve the existing seeding process of uncertain distance and uneven depth of the situation, so that the seeding process of the uniformity and the success rate of seeding improved.
- Strictly control the number of seeds when sowing, saving seeds, can effectively save time and effort, improve sowing efficiency.
- In the design and manufacture of related devices that can improve the seeding uniformity, the cost should be reduced as far as possible on the premise of ensuring the structural stability of the whole machine.

2.2. Working Principle of Sowing

The hand-pushed roller seeder relies on human push, and the hill seeder controls the same amount of seeds to fall into the seed hole in the continuous rotation process. The soil is covered to the seeds through the elastic action of the spring piece, and the seeding is completed through the compaction of the suppression wheel. Put the seeds that need to be sown into the seed box before sowing. When starting work, manually push the seeder forward, and the seeds and the belt in the seeder rotate at the same time. Under the action of gravity and inertia of seeds, the same amount of seeds are picked up, and the seeds are filled into the filling chamber in a state of arrangement. Collector movement, movement to the peak of the seed to slide, from the conveying chamber to the duck bill device, complete sowing. The duck bill device pulls out the spring piece on the ground and plants holes in the front soil under the action of elastic force. As compensation, the ground wheel plays a compaction role after passing through.
2.3. **Main Technical Parameters**

| The Parameter          | Name Parameter |
|------------------------|----------------|
| Implement quality (kg) | 8–10           |
| Seed spacing (cm)      | 10–15          |
| Sowing dept (cm)       | 5–8            |
| Sowing quantity (grain)| 3–5            |

2.4. **Overall Structural Composition**

The planter is composed of armrest, seed box, duck beak, conical spring, introduction tube, pressing wheel and other parts. The overall structure diagram is shown in Fig.1.

![Fig.1 Schematic diagram of overall structure of seeder](image)

1. Suppression of wheel 2. armrest 3. Seed box 4. Introduction tube 5. Dibbling machine

3. **Design of main parts of seeder**

3.1. **Design and Working Principle of Dibbler**

The design of the Dibbling machine is shown in Fig.2. During the drill operation, the seed and the belt in the drill rotate simultaneously. In the process of work, the seeds are picked up under the action of gravity and inertia of the seeds, so as to achieve the purpose of precision sowing. The seed concentrator enters the seed group, and the seeds are filled into the filling chamber. When the seed collector passes through the rubber brush, remove the remaining seeds. The tail of the brush and the filling chamber form a small space that can only form the next row of seeds. In this case, the seeds are lined up in the filling chamber; The lever above the chassis drives the lever of the seed harvester. The lever rotates and leaves the lever to complete the seed harvesting work. The rubber brush card is in the fixed hole to prevent the next seed from entering. The seed harvester continues to move as the seed harvester moves to the top. When the seeds pass through the fixed hole, the roller's redundant seeds slide, most of the seeds have entered the seed bearing room, will not slide; As the collector reaches its apex, it begins to slide. As the seeds slide down, they are transferred from the conveyor chamber to the duck-bill hole maker, ready to come out.
3.2. The Design of Seed Extractor

Seed picker is the key part of small mechanical soybean seeder, which makes soybean precise seeding. Its performance will be an important prerequisite for sowing quality and emergence rate. The new seed extractor consists of a side by side seed filling chamber and seed carrying chamber. Its structure is shown in the Fig.3.

The seed filling chamber is separated from the seed carrying chamber by a fixed plate. The bottom of the seed collector is an O-shaped groove, and the bottom of the seed collector is located on one side of the seed carrying chamber. The lower part of the rear end of the fixing plate is provided with a fixing hole for precise seed collection. The size of the O-groove of the seed harvester is 2cm in length, 0.5cm in width and 0.5cm in depth. According to the size of the soybean seed, it can be known that the O-groove can hold about 4-6 seeds. Overcomes the suction type precision seeder to the seed requirements are more strict; The high speed seeding adaptability of disc precision seeder is poor and the seeds need to be graded.

3.3. The Design of The Rack

This part is mainly composed of seed box, pressing wheel and handrail. A seed box with a certain capacity was designed to ensure the continuity of supply in the process of sowing. The compaction wheel can compact the soil, reduce the evaporation of water and ensure the germination rate. The frame structure is shown in Fig.4.
4. The whole virtual assembly of the seeder

4.1. Overall Assembly Drawing
Design process to achieve the optimal design of key parts, each part of the function, the rationality of analysis completed dibbling machine, frame, the design of the seed box and so on all parts, parts to save, summary of each part of the assembly, complete the key part of the assembly, the final finish each part of the whole assembly, get the whole virtual assembly, is shown in Fig.5.

4.2. The Explosion Figure
After disassembling each part model of the assembly, it is placed in the specified position to form the explosion diagram as shown in the following figure. This explosion diagram can clearly show us the internal structure and assembly relationship of the model, and provide a reference for the future construction of the real object. The explosion diagram is shown in Fig.6.
5. Conclusion
This design according to the actual needs of the design of a single operation of the hand push roller seeder, can achieve efficient, accurate seeding, to lay a foundation for the healthy growth of crops. This design is mainly studied from the following two aspects:
   a) Reasonable design of the cylinder part to optimize the seed taking process. Overcomes the suction type precision seeder to the seed requirements are more strict. The high speed seeding adaptability of disc precision seeder is poor and the seeds need to be graded.
   b) According to the basic design principles and mechanical requirements of the precision seeder. The duckbill, seed box, seed tube, dibbling machine and pressing wheel of the planter were designed. Finally, the solid modeling design of each part of the parts was carried out with SolidWorks 3D modeling software and the overall assembly of the hand-pushed roller seeder was completed. The assembly drawing and explosion diagram visually show the combination of all parts of the planter, which provides a reference for the future construction of the object.

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