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Test on effect of the operating speed of maize-soybean interplanting seeders on performance of seeder-metering devices

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Abstract

To improve the operating efficiency of seeders and enable the seeder-metering device to keep good metering performance at different operating speeds of seeders, in this paper a multifunctional smart test bench for STB-700 seeder-metering devices and a 2BJYM-5 maize-soybean interplanting precision seeder, were used for metering and seeding tests with two different kinds of soybean and maize seeds. Research results showed that, the rotating speed of the seeder-metering device at different operating speeds of maize-soybean interplanting precision seeders had influence on the metering performance of the seeder-metering device. Then the influence trend was explored. With the function fminbnd in MATLAB, the minimum point of acceptable re-seeding rate was determined to be at 43.05 r/min, the minimum point of miss-seeding rate at 39.96 r/min and the minimum point of interplanting distance variation coefficient at 40.25 r/min. Therefore, the optimal operating speed range of the seeder-metering device when being installed in the seeder was identified, further determining spoon-shaped metering devices and adjustable cell-wheel metering devices not suitable for seeding at high speeds.

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Keywords: Precision interplanting; Operating speed; Rotating speed of seeder-metering shaft; Metering performance

1. Introduction

In China the arable area per capita is far below that of developed countries, and in order to ensure food safety, economical and effective methods have been used to increase the crop yield per area and enlarge the seeding area through interplanting. Maize-soybean interplanting is an agriculturally effective and sustainable planting technology,

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with which the planting is conducted with alternate wide and narrow spacings of maize and soybean in order to take good advantage of land and improve the utilization of nutrient, water, sunlight and heat [1-3]. In this background the 2BJYM-5 maize-soybean interplanting precision seeder was designed and created. Such seeder provides simultaneous precision seeding of maize and soybean, reducing the number of yield operations, improving the operating efficiency of the seeder and facilitating uniform planting & management. With development of modern technologies, the operating speed of foreign seeders is kept between 10-16 km/h and specifically up to 20 km/h. Although the operating speed of domestic seeders has been increased, it still is between 4-7 km/h, reducing the seeding efficiency significantly. Now the development of domestic seeders is mainly hindered by poor performance of seeder-metering devices at high speed of seeders [4-6]. Thus, it is extremely urgent to improve the operating performance of seeder-metering devices at high speed of maize-soybean interplanting seeders.

2. Materials and methods

2.1. Maize-soybean interplanting precision seeders

The 2BJYM-5 maize-soybean interplanting precision seeder is used with a spoon-shaped metering device for maize seeding, and with an adjustable cell-wheel metering device for soybean seeding. As shown in Fig.1, there are 5 seeding rows in the seeder, which is connected to a tractor with trifilar suspension. Among these 5 seeding rows, the left and right 2 rows are used for maize and the middle 3 rows are used for soybean. Maize and soybean are sowed with different seeder-metering devices, and with optimal design of their structural parameters, etc., good seeding results are yielded. Also due to different types and application amounts of seed fertilizers in the seeding of maize and soybean, the fertilizer can is designed separately, and the positions of furrowing mechanism and metering device are adjusted to meet agricultural requirements of interplanting.

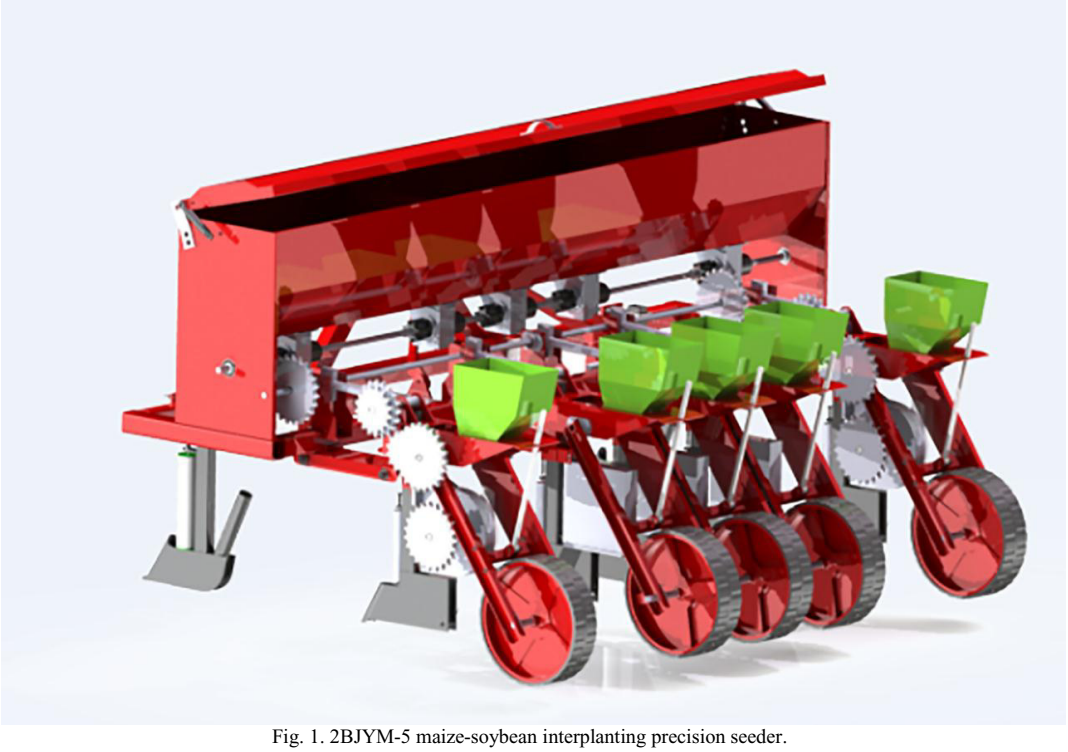

Fig. 1. 2BJYM-5 maize-soybean interplanting precision seeder.