Accepted Manuscript

Research on divider losses with high-speed photography for foxtail millet harvesting

Xinwu Du, Jiangtao Ji, Xin Jin, Can Li, Xulong Yang

PII: S0167-739X(18)30636-8
DOI: https://doi.org/10.1016/j.future.2018.05.029
Reference: FUTURE 4204

To appear in: *Future Generation Computer Systems*

Received date : 22 March 2018
Revised date : 4 May 2018
Accepted date : 11 May 2018

Please cite this article as: X. Du, J. Ji, X. Jin, C. Li, X. Yang, Research on divider losses with high-speed photography for foxtail millet harvesting, *Future Generation Computer Systems* (2018), https://doi.org/10.1016/j.future.2018.05.029

Research on Divider Losses with High-Speed Photography for Foxtail Millet Harvesting

Du Xinwu, Ji Jiangtao, Jin Xin*, Li Can, Yang Xulong
(*College of Agricultural Equipment Engineering, Henan University of Science and Technology, Luoyang, China*)

Abstract: Foxtail millet is a kind of thin and long stem and small kernel crop. Because of its high center of gravity and serious entanglement, the millet stem was hard to be divided in the mechanized harvesting. At present, there was no suitable combine harvester design method for this situation in the world, which led to the mechanization of millet harvest level far lower than the rice or wheat. To solve the foxtail millet entanglement problem, a new planar type of grain divider was designed in this paper. To study the motion law of millet stem and ear, the process of grain dividing was obtained by high speed photography. Three important parameters were selected to analyze carefully: Harvester operating speed, diffuser inlet leading edge of grain divider, the guide plank. Finally, the field test was carried out to verify the design effect. The results show that the relative motion between foxtail millet and grain divider is mainly sliding and collision. With the changing of the angle of grain divider's diffuser inlet leading edge from small to large, the contour of millet stem along the edge of the grain divider becomes weaker, then the dividing effect is worse. While the impact collision enhances with the angle increasing, the loss of millet increases. For this paper's samples, the reasonable angle of grain divider is 55 degrees. Installing the guide plank can further reduce the entanglement between millet stem and grain divider. The field test results show that the grain divider in this paper are suitable for foxtail millet combine harvester, cutting loss can be reduced to less than 4%. This study may explains that the planar grain divider can effectively accomplish the mechanization harvest of thin and long stem crops, and recommend a feasible grain divider's design scheme for foxtail millet, which provides the theoretical basis for the research and development of the new harvesting equipment.
Keywords: foxtail millet; grain divider; crop losses; thin and long stem; high-speed photography

1 Introduction

Foxtail millet is one of the most widely cultivated food crops and fodder crops in temperate and tropical regions of the world. China and India are the most important growing countries among them. For example, during the year 2016 in China, the foxtail millet's cultivation area is 599,300 hectares, accounting for the world's total planting area of 80%, and the millet's yield is 1.83 million tons, accounting for the world's total production 90%[1]. However, the harvesting of millet has not yet been mechanized in China and India, and still heavily depends on manual labor. Therefore, harvesting costs accounted for the total cost of millet cultivation 60% at present [2]. At present, the rural labor cost is increasing rapidly. It is necessary to realize mechanization of foxtail millet harvesting. In Chinese or Korean, researchers modified the cereal & wheat combines to harvest foxtail millet[3-4]. But the harming of the millet by the combine harvester was very serious,