

## Technical Notes

# A Fast and Effective Progressively Delivered In-Tree Fruit Bagging Apparatus

Yanbin Hua<sup>1,2</sup>, Baotong Yang<sup>3</sup>, Lichun Quan<sup>1</sup>, Jiangang Yang<sup>1</sup>, Yahong Tian<sup>4</sup>, Xin-Gen Zhou<sup>5</sup>,  
Juang-Horng Chong<sup>6</sup> & Liulin Li<sup>2</sup>

<sup>1</sup> Fruit Industry Service Center of Fufeng County, Fufeng, Shaanxi, China

<sup>2</sup> College of Horticulture, Shanxi Agricultural University, Taigu, Shanxi, China

<sup>3</sup> College of Engineering, Shanxi Agricultural University, Taigu, Shanxi, China

<sup>4</sup> Agricultural Technology Extension and Service Center of Fufeng County, Fufeng, Shaanxi, China

<sup>5</sup> AgriLife Research and Extension Center, Texas A&M University System, Beaumont, TX, USA

<sup>6</sup> Pee Dee Research and Education Center, Clemson University, Florence, SC, USA

Correspondence: Liulin Li, College of Horticulture, Shanxi Agricultural University, Taigu 030801, Shanxi, China.  
E-mail: tgliulin@163.com

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Fruit growers around the world envelop developing fruits in paper bags to protect them from mechanical injuries and damage from birds, insects and diseases. Fruit bagging has the added benefits of improving fruit appearance and quality, and preventing pesticide deposition. The current methods of fruit bagging involve manual, simple mechanical or hand-held heating apparatus, which are labor intensive, with limited height of reach, and require plastic film and external power source (as in the case of heating apparatus).

Our team recently developed a portable, semi-automatic fruit bagging apparatus (Figure 1) that reduces labor and improves efficiency. This apparatus employs the mechanisms of ‘over-running clutch’ and ‘self-locking between nut and bolt’. It is constructed of a platform, onto which four smooth tubes (each enveloped by a sliding pipe) were mounted on the top and corners, and an adjustable (of varying height) operation handle was mounted on the bottom. A lever at the end of the operation handle is connected through a wire to a unidirectional spiral wheel mechanism and a self-locking movable screw mechanism mounted in the center of the platform. The four sliding pipes are connected to each other and the wheel and screw mechanisms through a support holder. The apparatus utilizes paper bags and each bag is fitted with a rubber band along the rim and four plastic rings on its four corners.

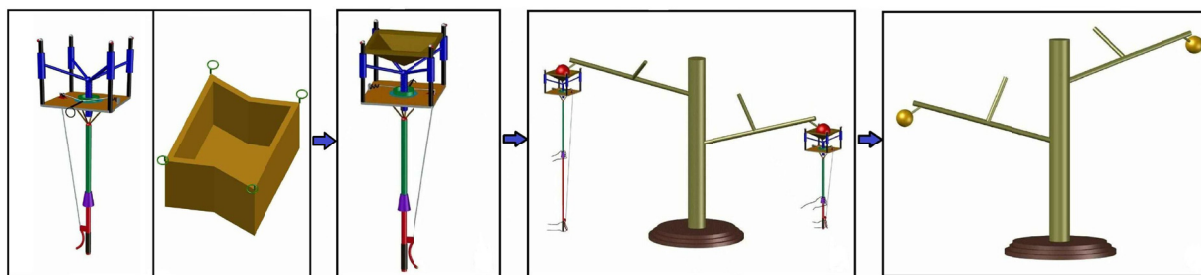


Figure 1. The operation of a new progressively delivered fruit bagging apparatus

An operator would open the paper bags, fit the plastic rings onto the four smooth tubes, and adjust the operation handle to the desired height. With one hand raising the operation handle to the target fruit, and another pressing

on the lever, the operator could trigger the wheel mechanism through the wire. The wheel mechanism, once rotated, forces the screw mechanism to move up thus pushing up the support holder. The upward movement of the support holder pushes the sliding pipes to slide up the smooth tubes, and the sliding pipes push the plastic rings fixed onto the smooth tubes to slide to the rotatable plectrum of which one end is fixed, the rings would press the plectrum downward, with this force, the spring is compressed by the plectrum. When the rings detach from the plectrum, the plectrum is bounced instantly due to the action of the spring, and the four plastic rings of paper bag would be detached from the smooth tubes entirely, the rubber band shrinks as the four plastic rings detach from the smooth tubes entirely, sealing the target fruit inside the paper bag, sequentially the paper bag is pushed out individually and entirely in the process, the first fruit bagging process is completed when the fruit is bagged successfully. Then, the apparatus could be moved down to carry out the second fruit bagging process until all paper bags are run out. To prepare for the next round of bagging work, the operator needs to pull the reset rope, rotate the reset spiral, and make the screw mechanism, support holder and sliding pipes to be moved down to the initial states. The paper bags are progressively delivered to the target fruits one at a time. Because this apparatus can hold 50 or more paper bags, the operator can limit the frequency and time needed to reload the apparatus with additional paper bags.

This new semi-automatic apparatus performed well in bagging apples and pears at any height in field demonstrations (Figure 2). It is simplistic in design, efficient in operation, and could be customized for specific operational criteria of individual orchards. Users should ensure proper operation of this apparatus by correctly placing the opened paper bags on the smooth tubes.



Figure 2. The new apparatus bagged apples (a) and pears (b) quickly and efficiently

To our knowledge, this is the first semi-automatic fruit bagging apparatus that utilizes paper bags embedded with rubber bands and plastic rings and the operating mechanisms described above. This new fruit bagging apparatus has received Chinese Invention Patent (Patent No. ZL 201510663576.0). We believe growers worldwide can use this apparatus to reduce labor costs and improve fruit production.

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