NEW DEVELOPMENTS IN CHAFFY GRASS SEED CONDITIONING

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ABSTRACT
New developments in chaffy grass seed conditioning includes the replacement of electric motor drives with pneumatic drives to increase range of speed adjustments on mechanical components of the "Woodward Chaffy Seed Conditioning System". The aerodynamic part of the conditioning system has been improved by incorporating ring jet air flow amplifiers to entrain, accelerate and convey chaffy seed. The use of a curved surface air-seed separator has increased the efficiency of the system.

INTRODUCTION
Chaffy seed normally contain a mixture of seed and extraneous material which is difficult to separate and problematical to plant without separation. Dewald et al. (1) described a new mechanical-aerodynamic conditioner "The Woodward Chaffy Seed Conditioning System" which greatly improved the quality of certain chaffy seeds. The mechanical components (2) have been improved through the use of pneumatic drives and the aerodynamic components have been improved by incorporating ring jet air flow amplifiers and a skewed "Coanda" jet for air-seed separation. These changes involve lower initial equipment costs, reduced power requirements, greater safety and more efficient seed conditioning.

MECHANICAL CONDITIONING
Pneumatic vs Electric Power
The mechanical portion of the conditioning system consists of a variable speed tumbling basket to dispense the unprocessed seed and a high intensity scalper to remove stems, leaves and light debris. Formerly both the tumbling feed basket and the scalper were powered by individual 1/2 HP electric motors. Rotation speed of the tumbling basket was controlled by a 5 speed lawn mower transmission and scalper oscillation speed was constant at 1725 oscillations per minute by direct drive from the electric motor to an off center weight (wobble rod).

Tumbling Feed Basket
The substitution of an air-powered right angle gear motor (Rotary Vane Type) with a 15:1 gear reduction resulted in a wider range (5 to 200 RPM) of speed of tumbling compared to the electric motor and 5 speed transmission. This allows for more precise tumbling speed control which is necessary to break up the entangled, unprocessed seed for more uniform dispensing onto the scalper decks. The air motor is powered with 5-20 psi requiring a maximum of 4.5 CFM of air supplied by an air compressor. The pneumatic drive system used was less expensive to purchase than the electric motor transmission drive.

High Intensity Scalper
A single air driven rotary ball vibrator attached to the center of the support frame connecting the top and bottom of scalper decks together was used to replace the electric motor and direct drive wobble rod (off center weight) to control oscillation of the high intensity scalper. The rotary ball vibrator has a steel ball, approximately 2.0 inch in diameter which roll around inside a circular race 4.0 inch in diameter at a speed and force dictated by the amount of air pressure supplied. At 20 psi (12 CFM) 3100 oscillations per minute is generated which is the maximum required for efficient scalping to remove extraneous material from the chaffy seed. Within the range of 5-20 psi, oscillation speed and intensity can be varied as needed for different lots and kinds of chaffy seed for maximum efficiency. The pneumatic rotary ball vibrator component allows complete control over the scalper oscillation speed and intensity while being less expensive than the electric motor - wobble rod component used previously.

AERODYNAMIC CLASSIFICATION
Seed Entrainment, Acceleration and Conveyance
The original "power unit" (Fig. 1) on the "Woodward Chaffy Seed Classifier" consisted of a venturi nozzle forcing air through a venturi barrel to create a vacuum behind and a positive air flow ahead of the unit. Air entrained seed material enters the aerodynamic component through the vacuum end, is accelerated within the unit and conveyed forward by the positive air flow.

Figure 1. Venturi type power unit formerly used to entrain, accelerate and convey seed material. Presently it's use is restricted to seed dehulling.

A ring jet type air flow amplifier (Fig. 2) was substituted for the venturi type "power unit" giving

Figure 2. Ring jet type air flow amplifier. Presently used to entrain, accelerate and convey seed material when dehulling is not desired.
a quieter operation and producing a more laminar air flow. This increased the seed quality classification efficiency compared to the venturi type power unit which produced a turbulent air blast.

**Air-Seed Separation and Momentum Discrimination**

The elimination of air movement behind the accelerated seed material is necessary for effective seed quality classification by momentum discrimination. A cross air flow device (Fig. 3) was previously used to divert air from the power stream away from the direction of seed travel. This required an additional air stream and increased power requirements.

![Cross Air Flow Device](image)

Figure 3. Cross air flow device formerly used to separate air and dust from accelerated seed. It has been eliminated from the system to reduce power requirements.

The present air-seed separation component utilizes the skewed "Coanda" jet principal (Fig. 4). When air is forced through the curved tube the pressure near the extension is lower than the pressure above and the air stream follows the curve of the extension away from the direction of seed travel. The heavier seed material is forced to the upper surface of the curved tube and travels forward by momentum (Fig. 5) free of air movement. Unlike the cross air flow device, the skewed "Coanda" jet does not require additional air input and together with the ring jet air flow amplifier requires only 1.5 HP compared with the former air blast - cross air flow device combination which required a 5 HP compressor.

![Momentum Discrimination Chamber](image)

Figure 5. Momentum discrimination chamber which allows accelerated seed material to segregate into quality classes without air movement interference.

Several chaffy seed classifiers complete with mechanical and aerodynamic components have been manufactured and are being used for improving the quality of chaffy seed material.

**Aerodynamic Dehulling**

Grain can be extracted and separated from stubbending appendages (chaff) by aerodynamic dehulling (1). Air entrained chaffy seed are subjected to impinging air blasts and accelerated to super high speeds. The air blast and acceleration strip away the chaff leaving the grain free of appendages.

**Woodward Laboratory Air-Seed Shucker**

This small dehulling device (3) was designed to determine the grain content of chaffy seeds rapidly. Small samples (5 grams) of most chaffy grasses can be dehulled in less than one minute. The unit utilizes a venturi type air blast for dehulling and a cyclone separator to remove air from the system. Extracted grain exits the unit against vacuum resistance which holds the lighter trash within the unit. Several air-seed shuckers have been manufactured commercially and are in use by analytical laboratories, plant breeders, seed processors and producers.

**Woodward Commercial Air-Seed Shucker**

This large unit was designed for commercial seed dehulling. It operates on the venturi air blast-acceleration principals for dehulling. Air-seed separation using the skewed "Coanda" jet principal and momentum discrimination are similar to that of the chaffy seed classifier. Grain free of chaff exits at the far end of the unit as momentum propels it further than chaffy seed. Chaffy seed will recycle through the power unit until the grain is free and separated from the chaff. Seed dehulling rates will depend on the chaffy seed quality and the
amount of air available for dehulling. An efficient 5 HP compressor will supply adequate air to dehull 10 lbs of grain per hour of good quality WW-Spar bluestem seed. Additional power units can be added to increase the rate of dehulling in processing plants with adequate air supply.

**Improved Woodward Chaffy Seed Conditioning System**

Chaffy seed can be conditioned into a uniform high quality product to increase planting precision and stand establishment. The improved system is completely air driven and is fed by a pneumatic right angle gear motor. A single air driven rotary ball vibrator controls oscillation speed and force of the high intensity scalper decks which removes extraneous material. Seed is funneled directly from the scalper into a negative air stream created by a ring jet air flow amplifier, accelerated there in, and conveyed in a positive air stream to a skewed "Coanda" jet for air-seed separation. The seed is propelled forward to be separated into quality classes by momentum discrimination. Complete chaff removal is accomplished by funneling high quality seed directly from the classifier into a "Venturi" type air blast for acceleration until the grain is free from the chaff.

**Improved Woodward Chaffy Seed Conditioning System**

Figure 6 shows an improved unit designed to condition, classify and/or dehull chaffy seed in one operation. It has three power units which can be of the venturi or ring jet type depending on the degree of processing desired. Ring jet air flow amplifiers are used to convey dust away from operation and to convey seed from any section of the discrimination chamber to any point in the system for further conditioning or into bags of finished product as desired. Venturi air blast power units can be substituted for the ring jet air amplifiers for partial or complete seed dehulling. This model is completely pneumatic and very adjustable for adapting to different lots or kinds of chaffy seed. This one-in-all unit requires a 50 HP compressor and is designed for use in larger seed conditioning operations. Woodward Laboratory air-seed shucker is a valuable component of the system for quality control monitoring.

**REFERENCES**

