



Grain Drills and Planters

Plant Materials Technical Note



Background

Grain drills and seed planters are key components in developing successful conservation plantings. They are complex machines that deliver seed at a metered rate, place it at a consistent depth in the soil, and produce light compaction to provide good seed to soil contact. Planters and drills come in many different forms with varying strength and weaknesses depending on the seed being used and condition of the planting site. Some require prepared seed beds, others require little to no seed bed preparation, and others are capable of preparing the seed bed and planting in

a single pass. Understanding the basic operation of these machines and their strengths and weaknesses is critical in determining which planter is best suited to meet the desired goals of the planting, or getting the best performance from the available planter.

Purpose

This is a continuation of a series of technical notes aimed at assisting conservation planners in developing successful conservation plantings. It complements previous tech notes on proper seed bed preparation (TX-PM-10-07), planter calibration (TX-PM-10-04), sprayer calibration (TX-PM-11-05), management of conservation plantings (TX-PM-10-03), calculating seeding rates (TX-PM-12-02), and legume seed inoculation (TX-PM-15-01). The purpose of this technical note is to provide information on the basic operations of grain drills, the types of drills currently available, and the strength and weaknesses of each design.

Basic Design and Operation of a Grain Drill and Planters

Grain drills and planters, regardless of type, operate in the same basic fashion. Seed is held in a box while a mechanism driven by the ground wheels or disks drops seed at a metered rate. Seed falls to the soil surface where some form of compaction seals it in the ground. Seed boxes come in three configurations, standard, legume, and native grass (fluffy) seed. Each box is designed to handle specific seed and can usually be calibrated independently of one another. This attribute is very helpful when planting mixes of seed to achieve the desired rate of each species.

Standard seed boxes are designed to handle large smooth seed similar to corn, soybeans, peas, wheat, oats, etc. They may or may not have agitation to keep seed moving. They generally rely on the smooth nature of the seed and gravity to feed the planting mechanism. These seed boxes will not handle light, fluffy seed. Seed will bridge on itself and not feed properly; clogging the planter. It is also difficult to calibrate with tiny seed such as clovers. Small seeded species require a smaller delivery mechanism to achieve the correct planting rates. Seed is typically delivered from the



Side view of a no-till drill with a 3 seed box configuration for legumes, native grass, and standard seed. Note the size difference of the legume seed box, first box on left.



The inside of a standard seed box showing the gravity fed mechanism that delivers seed to drop tubes. Seed is metered out via rollers with gear like teeth in the openings that control the rate seed flows to the drop tubes.

seed box through drop tubes to a set of disc shaped “V” openers where it falls into a slice in the soil left by the openers before being covered and sealed with some form of compaction device.

The legume box is designed to handle extremely small seed, and is much smaller in size than the standard seed box. Operation is generally the same and relies on gravity to feed the mechanism delivering seed to the drop tubes. The drop tubes deliver seed to the ground surface just in front of a compaction device such as press wheels or a cultipacker. Seed is planted shallower than seed from the standard seed box. Large seed can jam the smaller delivery mechanism of the legume box and should not be used.



The smaller seed delivery mechanism of a legume seed box on a no-till drill. Large seed will jam the small gears that deliver seed to the drop tubes.

The native, or fluffy seed box is similar to the standard seed box, but has some form of aggressive agitation within the box to keep seed moving so it doesn't bridge on itself. Many will have a “pick” wheel mechanism that reaches up into the seed box and pulls seed down into the machine to deliver it to the drop tubes. The drop tubes are much larger in diameter to help prevent seed from bridging. Removing the fluffy awns and appendages of native grass seed, a process called debearding, will greatly reduce seed bridging in the seed box and drop tubes. The use of a dry seed lubricant such as powdered graphite is also recommended to aid seed flow.



Close up view of the agitation auger and the pick wheel inside a native seed box. The gear like teeth on the pick wheel reaches into the seed box, grabs seed, and pull it down into the drop tubes at a steady rate rather than relying on gravity to feed the mechanism. The auger blades move seed back and forth to keep it constantly moving and prevents seed from bridging on itself.

Standard Grain Drill

Standard grain drills are typically the most common planters available. These planters place seed in narrow rows approximately 6 to 8 inches apart. They are most commonly used for seeding pastures and planting cereal grain crops such as wheat, oats, and rye. These machines most often use a pair of discs called “V” openers to slice the soil, creating a shallow furrow for the seed to be placed. Press wheels follow this action and use light compaction to seal the opening created by the “V” openers. Press wheels are spring loaded to allow



A grain drill with a standard seed box, note the V openers and press wheels with no fluted coulter.

adjustment of down pressure based on the soil conditions. They require a prepared seed bed for proper operation. This would include some form of tillage to break the ground, smoothing to break up large clods and clumps of soil, and dragging or cultipacking to create a firm seed bed. Because they require prepared seed beds, they may not meet the needs and goals of soil health and conservation plantings where minimal soil disturbance is desired.

No-Till Drills

No-till drills operate in a similar fashion to standard grain drills, and also place seed in narrow rows. Seed from the standard and native seed boxes are delivered to an opening created by “V” openers and sealed with a set of adjustable press wheels. The major difference between No-till drills and standard grain drills is they do not require a prepared seed bed. Planting sites should be mowed and or treated with a broad spectrum herbicide before planting to reduce competition. They also differ by having a fluted, straight disc or coulters that slices through the unprepared seed bed creating a cut for the “V” openers to follow and open for seed placement. These planters are typically much heavier in construction than standard grain drills. The extra weight helps them break through existing plant residue, sod, or hard soil crust. They may require a larger tractor to pull and lift. Because they create virtually no soil disturbance, they are favored for soil health and conservation plantings where minimal change to the soil structure is desired. This minimal disturbance to the soil also reduces weed competition from early successional annual species that are set free by soil disturbances during typical seed bed preparation such as disking. Planting depth can be difficult to control with some no-till drills, especially with small seeded species because of the planter’s increased weight and the opening created by the fluted cutting disc. This



Front view of a no-till drill showing the rubber drive wheel, center. This planter has an optional research plot option attached to the top; not typical of standard drills used in conservation plantings.



The front fluted coulters of a no-till drill slices an opening through hard sods for the “V” openers, seen middle, to open and deposit seed. The spring loaded press wheels then seal the opening.

problem is compounded if the planter's drive mechanism is driven by the V-openers or fluted coulters. In order for this mechanism to operate consistently, it has to have firm contact with the soil, sometimes cutting too deep for small seeded species. No-till drills that operate their drive mechanism via rubber ground wheels with adjustable height reduce, but don't eliminate this problem. Depth bands on the coulter and or "V" openers also help reduce planting depth problems.

Specialty Drills and Planters

Drop Seeders

Drop seeders are similar to standard grain drills, but do not plant in neatly spaced rows or use "V" openers. These planters drop seed along the full length of the seeding box where it then falls randomly between a set of cultipackers and is pressed into the ground. Rolling cultipackers are used to drive the planter mechanism. They work well on prepared seed beds, and are capable of smoothing, planting, and cultipacking in a single pass; reducing some of the site preparation steps associated with a standard grain drill. They are also used to over seed small seeded species such as clover in existing pasture grasses. They handle small seed such as legumes and hard seeded grasses like Bermudagrass very well, and eliminate the issue of planting small seeds too deeply. They will not plant large seeded species deep enough to insure a reliable stand. They are rarely equipped with native seed boxes, unless specifically ordered.



A typical drop seeder with two sets of cultipackers. Seed falls from the seed box between these rolling cultipackers during planting. These are typically used with small seed.

Food Plot and All in One Planters

Ever changing improvements in land management for wildlife have created new hybrid types of planters that combine attributes of the seed bed prepping implements, grain drills, and drop seeders in one machine. They typically have a tillage device in front of a seed box that drops seed on the tilled seed bed in front of a set of cultipackers. They are capable of preparing the seed bed, planting, and cultipacking in a single pass; reducing time spent in the field and fuel used. They often come with a standard and legume seed box, and some brands have native seed boxes available upon request. Some models have short drop tubes which can be moved to multiple locations to help with planting depth. Large seed can be set to fall directly behind the tillage device, while small seed can be delivered between the cultipackers for a shallower planting



An all in one planter with 3 seed box configuration. The front disks prep the seed bed. Seed falls to the ground behind the disks, and the rear cultipackers seal it. Note the paint missing on the fluted disk indicating the shallow soil disturbance of this planter. The angle of attack on the disks is adjustable via the orange handle to increase or decrease the soil disturbance.

depth. These planters are typically small 4 to 7 feet in width for use in wooded areas and small food plots. Although they do create soil disturbance to develop a seed bed; the disturbance is shallow, typically less than 3 inches. Models with disks to create the seed bed often have a mechanism to alter the angle of attack of the blades so the user can create as much or little disturbance as desired. The Brillion Till 'n Seed uses a set of counter rotating sprockets to create a very shallow seed bed, less than an inch in depth, which may meet the minimal soil disturbance required for soil health plantings. These all in one, food plot type planters make good use of soil moisture compared to other planters that require a prepared seed bed. They perform all the tasks in a single pass reducing the amount of time broken soil is exposed to the air before being resealed by the cultipackers.



The Till 'n Seed model from Brillion is an all in one planter that creates a very shallow seed bed, less than an inch. The counter rotating sprockets can be seen in the photo under the planter

Brand names pictured or referenced do not constitute an endorsement by the USDA-NRCS

Common Problems to Avoid with Planters and Grain Drills

- Planters and seed drills are complex machines that require routine maintenance such as lubrication and cleaning. Store them out of the weather if possible.
- Always clean the seed from the boxes after planting. A large shop vacuum is the easiest method to remove seed. Seed left in the box could become wet and mold or germinate in the seed box creating oxidation and corrosion of the internal mechanisms and clog the drop tubes. Seed also attracts mice and rats which will chew plastic and create potential health hazards.
- Always inspect the planter or drill before use. Spiders, insects, and mice can clog drop tubes with webs and debris when planters sit idle. Use an air compressor to blowout the drop tubes to make sure they are clear. Check to see that all the tubes are dropping seed when calibrating the planter. Check the planter often when in use to insure all seed boxes have adequate, evenly distributed seed, and that the drop tubes are putting out seed.
- Never back up with the planter down, especially planters with “V” openers. This pushes rocks and soil into the openers and drop tubes jamming them. “V” openers that cannot rotate freely will not work properly.
- Visually check the drive mechanism often while in use. This is very important with planters that are driven by disks or coulters. Debris, particularly wood, can get stuck on these and prevent them from rotating or functioning properly. If the drive disk isn't moving the planter is not planting.
- Always check the planting depth by planting a short distance and gently digging down until you find seed. Make adjustments as needed to the planter or the hydraulic setting of the tractor. This is especially critical with no-till drills. The 3rd link arm on the tractor

maybe lengthened or shortened to change the angle of the planter and help with depth adjustments or the depth at which the front coulter cuts on a no-till drill.

- On planters with “V” openers, make sure the press wheels are sealing the opening. Make adjustments as needed to insure a firm seal without excessive packing.
- Avoid planting into soft, unpacked seed beds with drill type planters. The loose soil will sluff off into the tracks left by the press wheels and bury seed too deeply after the first rain.
- When planting native or fluffy seed, always use debeared seed if possible. Add a dry seed lubricant such as powdered graphite to facilitate seed flow and reduce bridging. Check drop tubes often during plantings to insure they are putting out seed. A planter with a picker wheel mechanism will greatly increase reliability.
- Use the appropriate seed boxes. If small seed is mixed with large seed in the standard seed box, vibration from use will settle the majority of it at the bottom of the box. This will more than likely result in a higher than desired rate for the small seed, causing the user to run out of small seed, and non-uniform seed distribution.

The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers, employees, and applicants for employment on the bases of race, color, national origin, age, disability, sex, gender identity, religion, reprisal, and where applicable, political beliefs, marital status, familial or parental status, sexual orientation, or all or part of an individual's income is derived from any public assistance program, or protected genetic information in employment or in any program or activity conducted or funded by the Department. (Not all prohibited bases will apply to all programs and/or employment activities.)

If you wish to file an employment complaint, you must contact your agency's EEO Counselor (phone 301-504-2181 or fax 301-504-2175 or fax) within 45 days of the date of the alleged discriminatory act, event, or in the case of a personnel action. Additional information can be found online at http://www.ascr.usda.gov/complaint_filing_file.html.

If you wish to file a Civil Rights program complaint of discrimination, complete the USDA Program Discrimination Complaint Form (PDF), found online at http://www.ascr.usda.gov/complaint_filing_cust.html, or at any USDA office, or call (866) 632-9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter to us by mail at U.S. Department of Agriculture, Director, Office of Adjudication, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410, by fax (202) 690-7442 or email at program.intake@usda.gov.

Individuals who are deaf, hard of hearing or have speech disabilities and you wish to file either an EEO or program complaint please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

Persons with disabilities who wish to file a program complaint, please see information above on how to contact us by mail directly or by email. If you require alternative means of communication for program information (e.g., Braille, large print, audiotape, etc.) please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

For any other information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, persons should either contact the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish or call the [State Information/Hotline Numbers](#).

For any other information not pertaining to civil rights, please refer to the listing of the [USDA Agencies and Offices](#) for specific agency information.

USDA is an equal opportunity provider and employer.

Helping People Help the Land