Drill-seeding of soybean

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Farmers are very familiar with the conventional seed drill for sowing cereals. This practice note outlines how this standard farm equipment can be also successfully used in soybean production.

Outcome

Good crop establishment is the key to high soybean yields. Practical experience has shown that drill seeders are suitable for achieving high yields. Drill seeders sow in narrow rows which contribute to an early canopy closure which increases the competitiveness of the crop against weeds and reduces the risk of soil erosion.

Applicability

Theme: Crop management

For: All soybean growers

Where: On all farms where soy is grown

Timing: Shortly before sowing – April

Equipment: Drill for grains and soybean

Follow up: No follow-up action required

Impact: Optimum yield with narrow-row seeding

Drill-seeding in practice

Drill seeders are widely used for arable field crops, especially small-grained cereals. Drill seeders are also known as solid crop seeders because the rows are narrow. The seed is placed in the soil at the set depth in rows using hoes or disks (known as coulters) drawn through the soil. Drill seeding is a robust technology that can also be used to sow seed into minimally cultivated soils. While the seeding depth and distance between rows is set, the distance between individual seeds within the rows is not. The spacing of the plants in the row depends on the seed flow from a seed tank to the coulters. The older machines use metered gravity feed while more modern machines use compressed air to carry the seed.

Drill seeders are generally lower-cost and are more widely available than precision seeders.

Grain sowing complex Pöttinger, with pneumatic seed metering/delivering mechanism, provides row width of 125/167 mm, or 250 mm. Photograph: Mykola Bykov (Donau Soja Ukraine)

They are also operated at higher speeds resulting in faster sowing. This results in a good combination of effective crop establishment at a low cost for machinery and labour. Drill seeding has better results on small, uneven fields as the area is more evenly filled with plants.

The disadvantage of drill seeding is the lack of control over seed spacing within the row as well as greater variation in seed depth compared with precision seeders.

Basic functional components

Seed metering and seed transfer within drill seeders determine the distribution of seeds in the row and seed rate. Mechanical (gravity) or pneumatic (compressed air) mechanisms are used.

Mechanical seed meters supply and distribute seeds using gravity flow. The metering mechanism is situated directly under a seed hopper with one meter for each row. These meters are driven by a single shaft that extends to the full width of the seeder. The shaft is rotated by a land wheel that links the flow of seed to the forward speed. The fluted roller is the most widely used mechanism. This type of meter is adjusted for different sized seeds and seeding rates by regulating a flap on the fluted roller and by adjusting the velocity ratio, i.e., the speed of rotation of the fluted roller in relation to the forward speed of the drill. Most mechanical seed drills are 3–4 meters wide.

Amazon grain drill, with gravity seed metering/ delivering mechanism, provides row width of 150 mm**.** Photograph: Donau Soja Ukraine

Pneumatic seed distribution systems use compressed air to transfer seed from a central tank to the coulters. Hydraulically powered onboard fans create an active air stream which passes seeds to a distribution head. This splits the seed flow into the individual delivery tubes that open into the coulters. There are two types of pneumatic seeders: those that have a flow meter for each tube, coulter and row and those that have a single central metering mechanism before the seed flow is split between the tubes to the coulters. The main advantage of the pneumatic drills is that a wider working width and forward speed is possible because the air flow can carry seeds several meters on either side of the tractor. There is however a higher mechanical impact on the seed which can reduce the germination rate of soybean. The air flow can also remove powdery inoculants that have not been applied using adhesives.

The coulter options

Coulters open the slot in the soil and place the seed at the required depth. There are two most common types of coulters: anchor and disk (single disk or double disk) and various combinations of these. The choice depends on typical soil texture and amount of plant residues on the soil surface. Disk-anchor combinations are sometimes used where the first coulter improves the seedbed by cutting crop residues and loosening heavy soil and the second seeding coulter opens the slot for the seeds.

Covering the seeds

The seeder should place the seeds in the slot on a firm moist soil layer and cover the seeds evenly to the required depth. There should be good contact between the seed and the soil. This is achieved using press wheels or rollers. This operation improves seed contact with the soil, with the moisture of the lower soil layers and promotes uniform germination. As covering devices press wheels, rollers, chains, drags and packers are used.

Seed drills need to be calibrated to ensure the right amount of seed is released per unit area. This seed needs to be evenly distributed in the rows at a uniform depth. Careful calibration of the seeder ensures that the target seeding rate

is achieved. The forward speed needs to be limited to 6 km/hour so that the coulters have time to open the slot and place the seed evenly. Excessive speed leads to uneven seeding with gaps in parts of rows and bunching of plants in other parts. A good drill should guarantee that the seeds are placed evenly at the same depth in good contact with the soil and that the seeds are well covered with a layer of soil for better germination.

Special agronomic aspects

Drill seeders were developed for sowing cereal crops, traditionally with narrow row spacing (12-25 cm). In practice, drill seeding of soybean using narrow rows results in following benefits and limitations:

Narrow rows speed up canopy closure

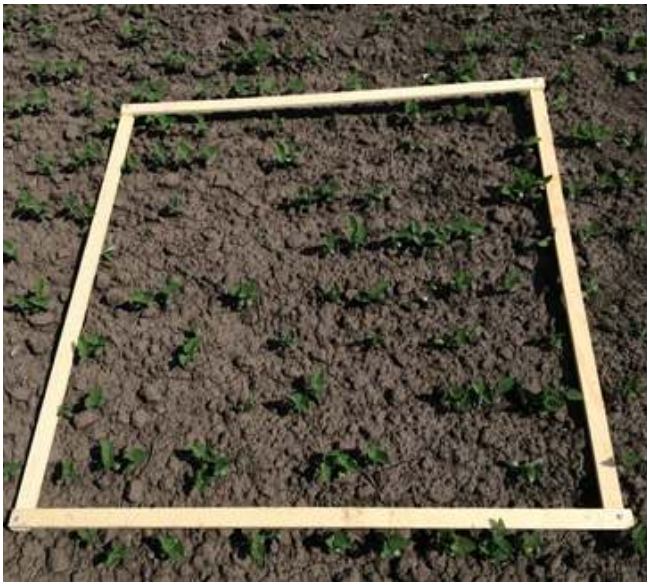
The yield potential of any crop depends on the amount of light intercepted by the green canopy from crop emergence to maturity. Narrow row spacing reduces the time to canopy closure supporting this fundamental driver of yield. Early canopy closure also reduces evaporation of water from the soil, suppresses weeds, and reduces the risk of soil erosion. The rapid canopy cover may also stimulate pods setting higher up in the plant. This makes harvesting easier and reduces losses of low pods.

Research conducted in the northern steppe zone of Ukraine (Shepilova, 2009) showed that crops sown at 15 cm row widths reached full canopy closing when the plants had 3-5 nodes. Crops with 30 cm rows reached full canopy closure at budding to flowering (Growth Stage R1-R2). Crops with 70 cm rows did not close until flowering and pod formation (Growth Stage R2-R3). A similar effect is shown in Table 1.

Table 1. Days to full canopy

Row width (cm)	Approximate days to full canopy
0	30 days
25	35 days
75	55+ days
95	70+ days

Sources: Minor et al., 1993



Seedlings of soybean, narrow-row sowed in 150 mm rows. Photograph: Mykola Bykov (Donau Soja Ukraine)

Seedlings of soybean, wide-row sowed in 350 mm rows. Photograph: Mykola Bykov (Donau Soja Ukraine)

As a robust seeding technology, drill seeding opens up the possibility to use different soil tillage systems for growing soybean:

1. Seeding in a conventional tillage system with a seedbed consisting typically of a firm lower layer at a depth of 3-4 cm, covered by a loose upper soil layer.

2. Seeding in a reduced or conservational tillage system without a specially prepared seedbed. This reduces soil disturbance, evaporation and fuel consumption. Additionally, seeding into a mulch of plant debris from the previous crop is enabled which helps to reduce the risk for soil erosion.

Unevenness of sowing depth in drill seeding. Photograph: Mykola Bykov (Donau Soja Ukraine)

Doubling of seeds in drill seeding. Photograph: Mykola Bykov (Donau Soja Ukraine)

Spatial placement of soybean seeds

Compared to precision seeders, drill seeders are susceptible to variation in the placing of the seeds in terms of depth and homogeneity within the row. This is happening especially if driven fast and where there is a large amount of crop residue. Gaps and doubling of seeds could occur also. It is not critical for soybean if it does not exceed 5% of the seeds sown. It is important to set up the drill correctly and to monitor its operation periodically.

Further information

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