# AUOTMATIC SECTION CONTROL (ASC) FOR PLANTERS AND SPRAYERS

**M. J. Buschermohle**
**L. A. Gibson**
**The University of Tennessee**
**Knoxville, TN**

## Abstract

Precision agriculture can be defined as the practice of managing crop production inputs on a site-specific basis to increase profits and maintain the quality of the environment. Simply stated, it is the process of dispensing or applying desired amounts of crop inputs such as seeds, pesticides, growth regulators and defoliants in specific areas of an agricultural field in order to maximize productivity. There are several technologies commercially available today to monitor and actuate these production inputs based on the location of farm equipment in the field. One example of this technology is Automatic Section Control (ASC) for row crop planters and sprayers. ASC utilizes the Global Positioning System (GPS)/Global Navigation Satellite System (GNSS) location of a planter or sprayer and as-applied maps to control planter or sprayer sections. As the planter or sprayer travels across the field, the controller continually checks to see if sections are passing over previously planted or sprayed areas or areas that have been mapped as no coverage zones. When a planter or sprayer section passes into these areas, it is turned off automatically and turned back on when it passes back into unplanted or unsprayed areas. Investing in Automatic Section Control (ASC) has shown to reduce input costs and improve profitability. However the amount of savings ASC technology is contingent upon several factors: shape and size of fields, the number of acres farmed, obstacles within fields, the number of sections the planter or sprayer is divided into, and the level of accuracy of the GPS/GNSS guidance system.

## Automatic Section Control (ASC) for Planters

Automatic Section Control (ASC) for row crop planters is a relatively new precision agriculture technology. ASC eliminates double-planting in areas of fields where planter overlap normally occurs such as end rows, point rows, and around internal field obstacles (Figure 1). By eliminating these double-planted areas, ASC has the potential to reduce seed input costs and profit losses due to increased plant competition and/or reduced harvest efficiency. Planter overlap is dependent on several factors such as field size, field shape, planter width, and equipment operator accuracy. Fields that are more irregular in shape tend to have higher incidences of planter overlap. Also, as farming operations become larger producers are purchasing wider planters to speed up planting. As planter width increases, a potential risk of increasing planter overlap, especially in end rows and point rows, can occur. Equipment operator response can also add to unavoidable planter overlap by over-planting at the beginning and/or ends of planter passes.

ASC utilizes the Global Positioning System (GPS)/Global Navigation Satellite System (GNSS) location of the planter and previously planted coverage maps to control individual planter units or sections of planter units. As the planter travels across the field, the controller continually checks to see if the planter units are passing over previously planted areas or areas that have been mapped as no plant zones. When the planter units pass into these areas, it is turned off automatically and turned back on when it passes back into areas that are unplanted.

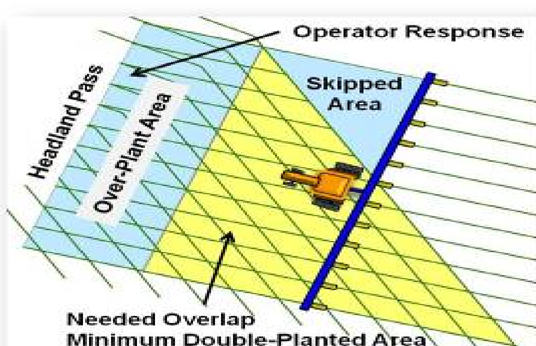


Figure 1. Examples of double-, over- and skipped planting in end and point rows.

**Benefits of Adopting ASC for Planters**

There are several economic benefits of equipping planters with ASC. Jernigan et al. (2012) showed the potential of reducing seed costs in cotton production systems with ASC. In this study, Real-Time-Kinematic (RTK) GPS position of the planter and planter status (i.e. planting or not planting) was recorded every 1/10$^{th}$ of a second in 52 cotton production fields that totaled 1725 acres. Field size ranged from 1.9 to 105.9 acres with an average of 33.2 acres. Planting maps were generated in ArcGIS to calculate the minimum double-planted area that occurred in each field. Percentages of minimum double-planted area ranged from as low as 0.1% to as high as 15.6% with an average of 4.6%. The study showed percent double-planted area was highly dependent on irregularity of field boundaries and presence of internal field obstacles such as grass waterways and terraces. The total minimum double-planted area across all fields was determined to be 54.7 acres. With seed cost of $110 per acre, planting with ASC would have reduced seed input cost by over $6000 for this 1725 acres.

Another benefit of planting with ASC is the potential to eliminate mechanical harvest losses due to high plant populations in double-planted areas. In most cotton production systems, end rows are picked first, regardless of double-planted area prevalence, and then stalks are mowed with a rotary cutter. A recent study in Tennessee showed potential cotton yield losses due to different angles of encroachment in double-planted areas can result from harvesting inefficiency. Treatments used for this experiment included single-planted and three double-planted plots at angles of 30°, 60°, and 90° in relation to the straight rows. All treatments were picked once in the direction of the straight rows and weighed to determine if yields differed statistically among treatments. As shown in Figure 2, the two year average lint yields for the first pick from the single-planted plots were statistically different from the double-planted plots. The two year average lint yield from the single-planted plots was 1389 pounds per acre compared to 917, 943, and 1033 pounds per acre for the double-planted plots with rows crossing at 30, 60, and 90 degrees, respectively.

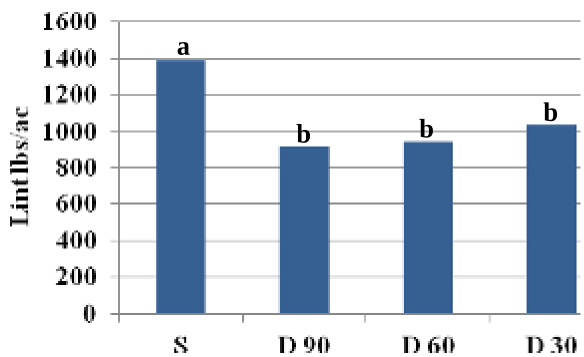


Figure 2. Two year average lint yield in lbs/ac per treatment - first pick.

These differences in yield were attributed to the fact that some plants in the crossing rows were not harvested (Figure 3a) on the first pass due to the configuration of the picker header as shown in Figure 3b. However, the angle at which the picker intersected the cross rows did not have a significant impact on the amount of cotton left behind in double-planted plots after a single harvest pass.

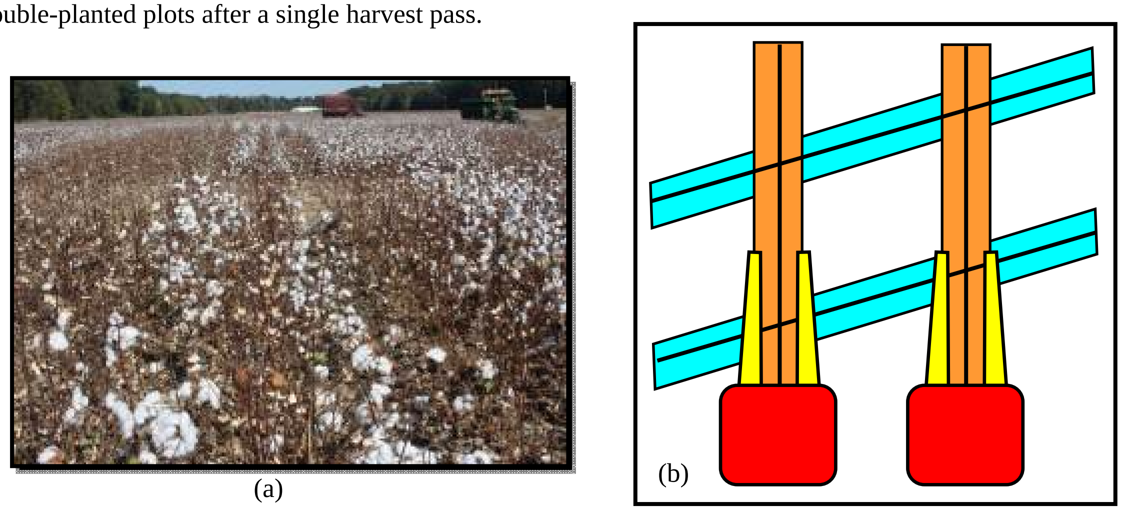


Figure 3. (a) Cotton not harvested during the first pass of double-planted plots and (b) picker header limitations when harvesting crossing rows.

Double-planted cotton plots were re-picked in the direction of the crossing rows and weights were combined with the first picking to determine if any differences existed between total yields. As shown in Figure 4, total lint yields in all double-planted plots were found to be statistically similar to the single-planted yield average. This result indicated that no significant losses in yield occurred due to increased plant competition for moisture and nutrients.

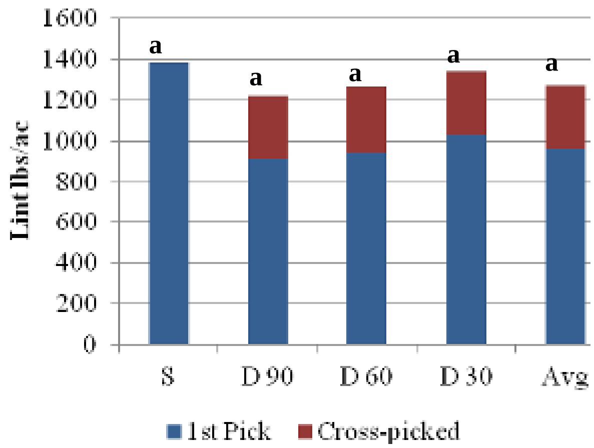


Figure 4. Two year average lint yield in lbs/ac per treatment - second picking added to first picking

Additional benefits of planter ASC technology are:

1. Improved overall planter accuracy
2. Increased operator efficiency
3. Reduced operator fatigue

## Automatic Section Control (ASC) for Sprayers

Automatic section control has become one of the most popular features on high-tech sprayers. Reducing off-target chemical application errors with ASC can improve profitability by reducing chemical costs and also, reduce chemical and nutrient losses to the environment. Off-target errors include: skipped-application, multiple-application, and unintentional-application to environmentally sensitive areas such as grass waterways and buffer strips. Systems are available from numerous manufacturers and are suitable for installation on self-propelled, pull-behind, or three-point hitch-mounted sprayers. These systems operate by mapping sprayed areas as the sprayer travels across the field. The sprayed areas are georeferenced using coordinates from a GPS/GNSS receiver, along with the knowledge of the sprayer geometry and active sprayer boom sections (Figure 5) to create as applied maps. As the sprayer continues to travel across the field, the controller continually checks to see if any boom sections are beyond a mapped field boundary or are passing over previously sprayed areas or areas that have been mapped as no spray zones. When a boom section passes into these areas, it is turned off automatically and turned back on when it passes back into unsprayed areas.

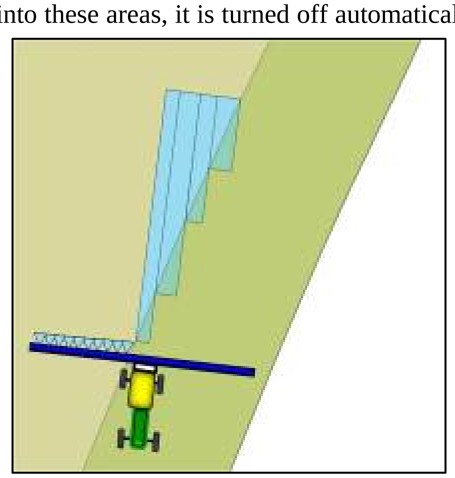

Figure 5. As applied spray map showing benefits of ASC.

**Benefits of Adopting ASC for Sprayers**

The primary economic benefit of sprayer ASC is the reduction in overall chemical costs. For example, Luck et al. (2010) conducted a study in 21 agricultural fields to determine differences in pesticide applications using a manually-controlled five section boom sprayer versus a seven section boom sprayer equipped with ASC. Results of this study showed a 6.2% average reduction in sprayer overlap was achieved by switching from a manually-controlled five boom section sprayer to an automatically-controlled seven boom section sprayer. One important point to consider is that field shape significantly impacts the potential savings from ASC equipped sprayers. Reduced input costs are generally greatest for irregularly-shaped fields, or for fields containing internal obstacles such as grass waterways, trees, terraces or buffer strips. As fields become more regular (square) in shape, chemical savings are less. These benefits not only result in economic savings on crop inputs but also improved environmental stewardship at the farm level.

Additional benefits of sprayer ASC technology are:

1. Improved overall sprayer accuracy
2. Less spray tank fill-ups
3. Reduced crop damage from over-application of chemicals
4. Improved environmental stewardship
5. Increased spraying efficiency
6. Reduced operator fatigue
7. As applied maps and records for making future management decisions

## Automatic Section Control Components

**GPS/GNSS receiver**

The GPS/GNSS receiver is an integral part of the ASC system because it monitors the location of the planter or sprayer in the field to generate the as-applied planting or spraying maps. To obtain the highest accuracy during planting or spraying, it is recommended to use RTK, Trimble's new RTX or a decimeter level (OmniStar HP or John Deere SF2) correction service.

**Controller and software capable of section control**

The controller and user interface contains the software to generate the as-applied maps and to automatically turn on or off the section control mechanisms.

**Section control mechanisms**

***Planters***

ASC on planters utilizes row clutches to stop the flow of seed by temporarily disengaging the seed meter. Planters can be controlled row-by-row, or in multiple row sections depending on the accuracy desired by the producer. There are hydraulic, electronic and pneumatic row clutches available on the market for use on planters.

***Sprayers***

Boom section valves or individual nozzle valves are required for ASC on sprayers. Boom section valves are used to control multiple nozzles and individual nozzle valves attach directly to each nozzle body to give spray control down to the individual nozzle.

**Peripheral components**

The peripheral components needed for ASC include all the necessary cabling, wiring harness, electronic control modules, or other components (e.g. air tank, air compressor, and air valve modules for the TruCount row clutch system).

## Summary

Investing in Automatic Section Control (ASC) has shown to reduce input costs and improve profitability. However the amount of savings ASC technology is contingent upon several factors: shape and size of fields, the number of acres farmed, obstacles within fields, the number of sections the planter or sprayer is divided into, and the level of accuracy of the GPS/GNSS receiver. ASC can be retrofitted to work on old equipment but is either standard or an option on most new equipment. Consult your local dealer or manufacturer to determine if ASC is compatible with your equipment.

## References

Luck, J.D., R.S. Zandonadi, B.D. Luck, and S.A. Shearer. 2010. Reducing Pesticide Over-Application with Map-Based Automatic Boom Section Control on Agricultural Sprayers. *Transactions of the ASABE* 53(3): 685-690.

Jernigan, B. M., M. J. Buschermohle, W. E. Hart, J. B. Wilkerson, and M. Velandia. 2012. Effects of Field Geometry and Operator Influence on Double-Planted Ares in Row Crop Fields. Proceedings - 2012 Beltwide Cotton Conferences. National Cotton Council of America., Orlando, FL, pp. 487-495. 3-6 Jan.