IMPROVED DRILL TECHNOLOGY FOR NO-TILL/INTERSEEDING APPLICATIONS

C.E. Hood[1], A. Khalilian[2], J.H. Palmer[1], and W.B. Smith[3]

INTRODUCTION

Conservation compliance has stimulated interest by southern producers in new drilling and planting systems for double-cropping soybeans and cotton with winter wheat. Researchers are investigating new methods for double-cropping peanuts (Khalilian, 1992) with wheat and soybeans following canola (Porter, 1992).

Interseeding or relay intercropping soybeans into standing wheat has been investigated extensively in Illinois by Wendte (1975), in Mississippi by Buehring et al. (1990), and in South Carolina by Khalilian et al. (1991). In general, soybean yields have been increased over conventional double-cropping methods and, in some cases, without reduction in wheat yields. Successful interseeding of cotton into standing wheat has also been reported (Garner, et al., 1992).

At Clemson University, three systems have been developed that allow interseeding of soybeans, cotton, and peanuts into standing wheat using a controlled-traffic production pattern (See Figures 1, 2, and 3). Scheme #1 uses a 76-inch tractor wheel spacing with 11 rows of wheat that permits interseeding of 8 rows of soybeans or 4 rows of cotton or peanuts. Schemes #2 and #3 use a 96-inch tractor wheel spacing. With Scheme #3, eight rows of soybeans are interseeded into 11 rows of wheat, while in Scheme #2, five rows of soybeans or cotton are interseeded into 14 rows of wheat. For the cotton application, this configuration fits the new narrow-row cotton pickers that accommodate 5-row harvesting. A summary of the crop performance and production guidelines for these interseeding systems is being presented in two additional papers presented at this conference.

Additional machinery development studies have been undertaken at Clemson University beginning in 1991 to design, assemble, and test a versatile no-till drill that would satisfy both the requirements of conventional no-till and interseeding applications. Other objectives included 1) the seed metering unit should desirably accommodate small grains, soybeans, cotton, and small seeds like canola; 2) the seed delivery/furrow openers should be toolbar-mounted to allow adjustable row spacings; 3) the drill should function both for no-till and conventional-till applications; 4) the components selected should maximize the use of commercially available parts; and 5) the drill should be readily convertible between a three-point hitch and tow version.

The purpose of this paper is to describe the Clemson no-till/interseeding drill and the field performance of the system, both in research plot studies and on-farm evaluations.

NO-DRILL COMPONENT SELECTION

An excellent coverage of most commercially available drills with their respective components is presented in Conservation Tillage Management (1992). This publication describes the various no-till coulters, seed furrow openers, and press-wheel configurations being utilized. Air seeders are also discussed in their traditional application for dry land small grain seeding in conjunction with soil-opening devices, such as disks, hoes, spikes, and seeps. Growers, mainly in the Midwest, are developing their own air systems for drilling soybeans using sweep, chisel, or double-disk furrow openers (Soybean Digest, 1993).

Based on an evaluation of available components in 1991, it was determined that an air applicator offered the most versatility for metering and transport of seed to adjustable seed furrow openers mounted at any selected distance along a toolbar. Another advantage of the air applicator is that it could be used for granular fertilizer and herbicide handing applications. A Model No. 6216C Gandy Orbit-Air application system equipped with an 18-bushel hopper with 16 metering wheels and air venturies was selected for dispensing seed. Different metering wheels that accommodate a wide range of seed sizes and types are color coded. In this study, the wheels selected were: red -wheat, white - soybeans, and yellow - cotton. Individual metering wheels can be inactivated by closing gates. Seed are delivered by air supplied by a hydraulically powered fan

[1]Agri. & Bio. Engr. Dept. and Agron. & Soils Dept., respectively, Clemson University, Clemson, SC.
[2]Edisto Res. & Ed. Ctr., Clemson University, Blackville, SC.
[3]Coop. Extn. Serv., Clemson University, Newberry, SC.

from individual venturies through hoses to seed furrow openers. Seeding rate is regulated by powering the metering wheels with a ground-wheel drive through an infinitely variable transmission.

Yetter, model no. 2977, no-till seeder coulters were selected for seed furrow openers. These units have a narrow 6.5-inch wide profile that assists with interseeding applications in standing small grain. A harrow 17-inch diameter ripple coulter is used to cut crop residue and slice a soil opening ahead of a seed slot opener that contains an internal seed tube. Seed exit through a hole at the rear of the seed slot opener at 90 degrees to the direction of travel. Soil generally flows behind the opener back into the furrow ahead of a narrow (1-inch wide, 12-inch diameter) press wheel that firms the soil and seed in the furrow. Depth and seed placement are controlled by a plastic gage wheel (two sizes available) that mounts on the side of the coulter. Press wheels have individual depth control and spring tension adjustments.

DESCRIPTION OF CLEMSON NO-TILL/INTERSEEDING DRILL

Figures 4, 5, and 6 illustrate the drill features. A three-point hitch fork assembly with mounted Gandy Orbit-Air unit couples to dual (4-inch square) toolbars to which the Yetter seeder coulters are mounted. This design feature allows the Gandy Orbit-Air unit to be retained on the tractor's three-point hitch to permit shining to another toolbar arrangement for other applications such as herbicide banding in combination with cultivation or incorporation. Several features of the Orbit-Air unit were modified slightly for this drill application. The location of the loading platform was moved to the fan side of the unit and to the rear of the machine. The hopper lid mounting was reversed to provide rear loading of the seed. These changes provided several advantages: 1) the operator could observe the seed metered into the venturi tubes and, thus, detect if a seed opener was plugged and 2) the operator was exposed to less fan noise.

The toolbars are equipped with two adjustable gage wheels that serve to regulate the overall height of the toolbars. As a three-point hitch drill, mechanical screw elements are used for wheel adjustment. For the tow version, hydraulic cylinders with stroke limiting devices are used to raise and lower the drill. One of the gage wheels drives the Gandy Orbit-Air unit through a spring compressed wheel-on-wheel drive. The drive gage wheel has a floating feature that insures continuous rotation and power to the seed hopper should the toolbars be elevated due to coulters engaging hard soil or uneven terrain.

The tongue attachment is shown in Figure 4. This attachment couples to the drill three-point hitch, and in conjunction with wheel lift cylinders, permits conversion to the towing configuration.

In Figure 6, the plastic depth gage wheel that mounts on the disk coulter is shown. An additional attachment was fabricated and added to provide scraping of the press wheel plus allow attachment of conventional drag chains that assist with seed covering for certain field conditions.

DRILL PERFORMANCE

It was determined that drill calibration was easily accomplished and provided very good repeatable accuracy based either on the number of seed/ft for the particular row spacing or lb/A In a stationary mode with the fan running and through rotation of the toolbar wheel (12 times equal 100 ft) that powers the drill, calibration was accomplished by collecting seeds in a 1-gal size plastic bag left unsealed to allow air escape. The stationary calibration correlated well when compared with plot and field size evaluations.

The drill has been evaluated for planting directly into prepared seedbeds, minimum-till, and no-till, for conventional, as well as interseeding, applications on research plots and grower fields. Crop-yield response for the interseeding applications is presented in other papers at this Conference. Coastal Plain, as well as Lower Piedmont, soil conditions in South Carolina were evaluated in the study.

Prepared seedbed Applications

Successful stands of wheat, oats, and canola were established with the drill in prepared seedbeds. One grower in Dillon County, South Carolina, obtained a very good stand on 150 acres of wheat and 40 acres of oats planted with the drill using the interseeding scheme #1 in the fall of 1992. Satisfactory stands of wheat planted in plots and small fields for later interseeding were established in Newberry, Florence, and Barnwell Counties. An acceptable stand of canola was established in Barnwell County in October 1992 in plots where soybeans will be no-till drilled with the unit following canola harvest.

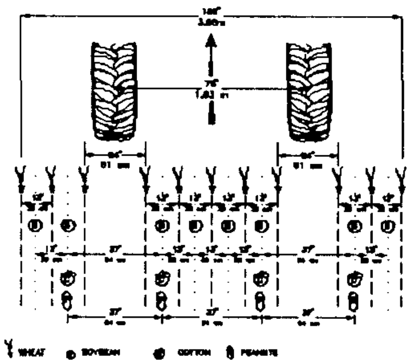


Figure 1. Interseeding scheme with 76" tractor wheel spacing - 8 rows soybeans, 4 rows cotton or peanuts (Scheme#1).

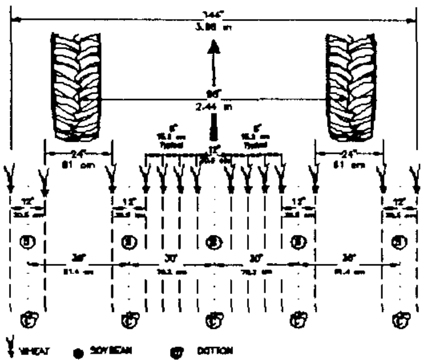
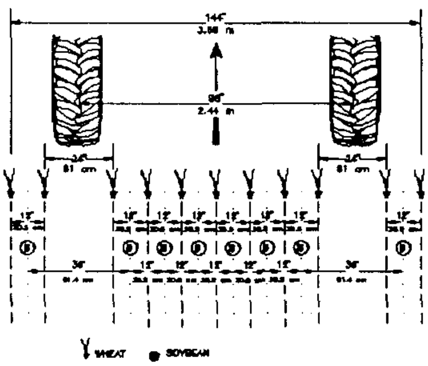


Figure 2. Interseeding scheme with 96" tractor wheel spacing - 5 rows soybeans or cotton (Scheme #2).



Fqure 3. Interseeding scheme with 96" tractor wheel spacing - 8 rows soybeans (Scheme #3).

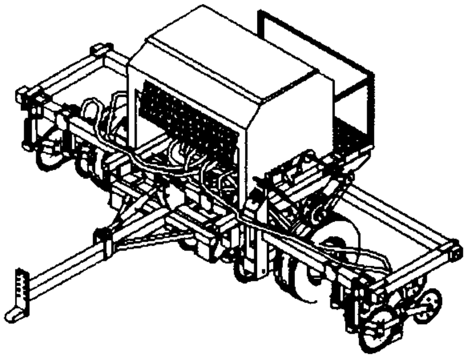


Figure 4. Overallview of Clemson no-till/interseeding drill with tongue attachment.

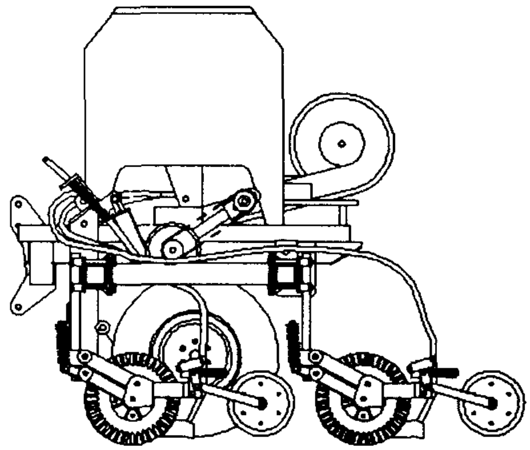


Figure 5. Side view of drill showing attachment of seeder coulters to either toolbar.

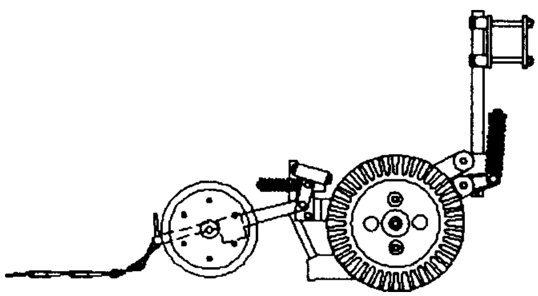


Figure 6. Yetter seeder coulter showing plastic depth gage wheel and drag chain attachment.

Minimum-Till Applications

A grower in Newberry County obtained an excellent stand of soybeans using the drill to seed soybeans following wheat using a single disking behind the combine. By towing the drill behind a deep-tillage tool that provided minimum soil disturbance in corn stubble, satisfactory wheat stands were established in plots in Barnwell County in the fall of 1992.

No-Till Applications

In late May and early June 1992, soybeans and cotton were interseeded into standing wheat in Barnwell County, and soybeans were interseeded in Florence and Newberry counties. Soybean stands were excellent. The cotton stand, both in uniformity along the row and emergence of seedlings, compared favorably with that obtained with a John Deere #71 planter.

In June 1992, the grower cited above in Newberry County used the drill to no-till plant soybeans after burning a wheat field with very good results. In October 1992, 20 acres of no-till wheat were planted directly behind the combine in soybean stubble (soybeans had been sod-planted into fescue sod) at the same farm in Newberry County. In a smaller field of about 1 acre in size, wheat was no-till planted into corn stubble (stalks mowed with rotary mower). In both cases, an excellent stand of wheat was established. On another farm in Newberry County in December 1992, 15 acres of no-till wheat were planted with the dill directly behind the combine in soybean stubble. The grower was very pleased with the wheat stand.

CONCLUSIONS

The Clemson no-till/interseeding drill shows considerable promise for both no-till and interseeding applications. Studies are continuing to evaluate the drill performance under different soil and crop residue conditions. A manufacturing agreement has been signedwith Valkenburg Equipment Corporation located at Greenwood, South Carolina to manufacture and market the drill. The first unit was delivered to a grower in the fall of 1992 to be used primarily for interseeding applications.

LITERATURE CITED

Buehring, N.W., D.R Reginella, and MA. Blaine. 1990. Long-term wheat and soybean response to an Intercropping system. Proc. 1990 Southern Conservation Tillage Conf., pp. 65-68, Raleigh, N.C.

Conservation Tillage Systems and Management. 1992. MWPS-45, MidWest Plan Service, Agr. & Bio. Engr. Dept., Iowa State Univ., Ames, IA.

Garner, T.H., A. Khalilian, C.E. Hood, and MJ. Sullivan. 1992. Wheat/cotton cropping systems for coastal plain soils. Proc. Beltwide Cotton Production Conf., Memphis, TN.

Khalilian, A, C.E. Hood, J.H. Palmer, T.H. Garner, and G.R Bathke. 1991. Soil compaction and crop response to wheat/soybean interseeding. TRANSACTIONS ASAE 34(6):2299-2303.

Khalilian, A. 1992. Personal Communication. Clemson University Edisto Res. & Ed. Center, Blackville, SC.

Porter, P.M. 1992. Personal Communication. Clemson University Edisto Res. & Ed. Center, Blackville, SC.

Soybean Digest. 1993. Corn/Soybean Edition 53(5):7-16.

Wendte, K.W. 1975. Systems for double-cropping soybeans. M.S. Thesis, Dept. of Agr. Engr., Univ. of Ill., Urbana- Champaign.