COMBINATION AIR SEEDER/ CULTIVATOR/ SPRAYER FOR INTERSEEDED SMALL GRAIN/ COTTON CROPPING SYSTEM

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Abstract

Small grain-cotton rotation systems have proven successful in combating wind and water erosion, minimizing wind damage to cotton, and increasing cotton yields on the Texas Southern High Plains. The system with greatest producer appeal has been a terminated wheat or rye-cotton system since cotton can be harvested every year. However, insufficient stubble and residue often occur due to lateness in small grain establishment if sown after cotton harvest. A combination tillage tool has been designed to sow a small grain into growing cotton at the last cultivation or even later with minimal crop damage due to quick raising shanks and sweeps. Spring weed control and/or small grain termination can be accomplishment with a quick attaching hooded sprayer. The implement also allows simultaneous small grain and furrow dike establishment without degradation of the dikes. Successful stands of spring wheat, winter wheat and rye have been established on silty clay loam and fine sand loam soils in both diked furrows and undiked tractor and gage wheel rows.

Introduction

Cotton yields increased steadily on the Texas Southern High Plains between the late 1940s and the mid 1960s. During this period irrigation was expanding in the area and a rotational sequence of cotton and grain sorghum was predominant. Wheat and other small grains were often included in the rotations also. Although expanding irrigation explained part of the yield increase, dryland yields for the period also increased (Neal and Ethridge, 1986).

A downward trend in both irrigated and dryland cotton yields began in 1966 and continued until very recently. This decline has been attributed to several factors, including decreased irrigation well yields due to declining underground water levels, increased fertilizer prices with corresponding decrease in use, and a 5- to 10-fold increase in fuel prices. These reasons, in addition to commodity price disparity, caused the cotton-sorghum cropping rotation to slowly give way to a continuous cotton monoculture, due to economic advantages of cotton production over sorghum.

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Concern that the monoculture cotton production practice was a major contributor to the yield decline on the Southern High Plains has led to recent research on numerous rotational cropping systems, many of which involve wheat (Keeling et al., 1989; Segarra et al., 1991). Various levels of minimum-till or no-till practices have also been incorporated in the wheat-cotton rotations to decrease inputs, as well as to combat wind erosion and minimize wind damage to cotton. Bordovsky et al. (1994) found in a 6-year experiment that irrigated cotton yield was increased about 13% when rotated with wheat but when the rotation was combined with no tillage operation the yield increase jumped to 25 percent. Another practice introduced in the mid 1970s on the Southern High Plains to conserve water and prevent runoff was furrow diking (Bilbro and Hudspeth, 1977; Lyle and Dixon, 1977). Diking has been utilized in both irrigated and dryland production, primarily with the more traditional production systems, where it has been shown to increase yields and reduce runoff (Gerard et al., 1984).

The conservation tillage practice with the greatest producer appeal has been a terminated small grain cotton system in which a small grain is sown in cotton stalks following harvest and chemically terminated before spring planting of cotton. This system has shown an economic advantage over conventional cotton and over rotations with other summer crops for the same reason noted above, since cotton is harvested every year (Keeling et al., 1994). A drawback to this system, however, has sometimes been the lateness in which the small grain is sown due to late cotton harvest and/or late emergence due to cold temperatures or dry conditions. For whatever the cause of late establishment, the result can be insufficient stubble height in the spring for adequate wind protection or insufficient surface residue.

A combination tillage tool was, therefore, designed which could establish a small grain into growing cotton late in the season for early emergence. This has been accomplished previously with modified and shielded grain drills (Banks, 1993, Davis, 1994). This reported implement, however, was designed to function also as an adjustable cultivator/sprayer so that different zones between crop rows could be cultivated or could combine spraying with cultivation. With the sweep/spray combination, early season weed control can be accomplished while allowing the standing small grain stubble to remain in the furrow. It was also designed to simultaneously establish the small grain and undisturbed furrow dikes which has been difficult with modified drills used for this purpose.

Procedures

The combination implement was built around a basic three-bar (20-inch spacing) stiff-shank cultivator with 5 shanks and sweeps per furrow. Figure 1 shows the configuration of the sweeps on each bar. The quick-raising shanks are located on the front two bars. Any combination of shanks may be raised or lowered as needed. To the third bar is attached either a cultivator sweep, a sweep seeding shoe, or a quick-attaching hooded sprayer. Early season weed control configuration might include lowering only the sweeps adjacent to the cotton row in combination with the hooded sprayer. The hooded sprayer has been modified with a stub shank for quick attachment with the cultivator shank clamp. Seeding can take place at the last cultivation with all of the sweeps lowered and the seeding shoe in place. Or it can be accomplished later in the season with the front four sweeps raised above the tool bar leaving only the seeding shoe in the middle for minimal crop contact.

Figure 2 gives a side schematic view of the quick mounting air seeder and the parallel-linkage quick-raising shanks. The air seeder is attached on angle-iron guides for easy positioning and is attached with 4 bolts. The air seeder model being used on the 4-row experimental prototype is a Gandy Model 62DN12C with 8 bushel seed capacity and 12 outlets. The parallel linkage arrangement on the sweep shanks allows the sweeps to be raised above the bottom of the tool bar where they are held with a pin. Pulling the pin releases the shank to its down position.

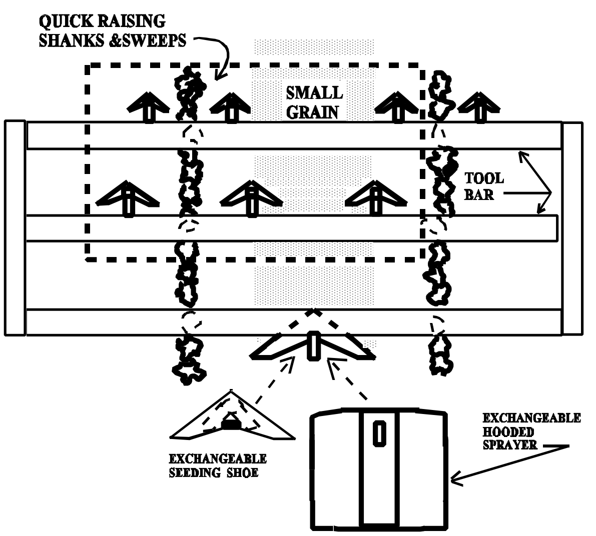

Figure 1. Top view of sweep and sprayer configuration of air seeder/cultivator/spray implement.

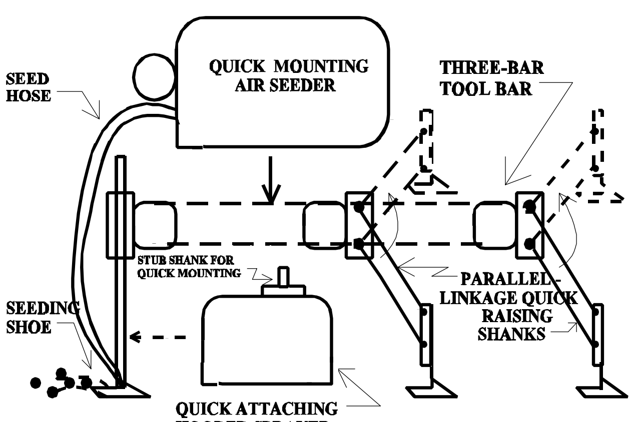

Figure 2. Side view schematic of air seeder and quick raising shanks.

Results

Successful stands of spring wheat, winter wheat and rye have been established on both silty loam and fine sandy loam soils in both diked furrows and undiked tractor and gage wheel rows. The cultivator and spray functions will be tested next spring.

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