# Cover Crops for Weed Control in Conservation-Tilled Soybean

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## INTRODUCTION

In the southeastem USA, soybean *[Glycine max* (L.) Merr.] is generally grown doublecropped with wheat *(Triticum aestivum* L.). Doublecropped soybean in wheat stubble is the most common conservation tillage practice in the South. In southern Brazil, however, soybeans are.grown in rotation with the cover crop black oat *(Avena strigosa* Schreb.). This practice has become the major production system on millions of acres of conservation- tilled soybean. One principal advantage of black oat is its demonstrated ability to suppress weeds. The Brazilian system for managing cover crops and growing conservation-tilled soybean is much different than that used in the southern USA. The Brazilian system is based on terminating the cover crop during early reproductive growth by treating with a herbicide and mechanically rolling the covers to form a dense mat on the soil surface. In 1995, we began a study to determine the suitability of black oat as a cover crop for conservation-tilled soybean using the Brazilian system of managmg cover crops. We wanted to compare the Brazilian system using black oat and *two* common cover crops used in the southeastem USA, i.e., rye *(Secale cereale* L.) and wheat *(Triticum aestivum* L.). Results reported here are for the first 2-yr of the *study* (1995 and 1996).

## MATERIALS *AND* METHODS

The study site was a Dothan fine sandy loam (fine-loamy, siliceous, thermic Plinthic Paleudult) in southeastern Alabama. It had been in conservation tillage (strip-tilled) for the previous 8 yr and had a high population of Palmer Amaranth *(Amaranthus palmeri* S. Watts.). Soybean was grown in a strip-plot design of four replications. Horizontal plots were winter covers of black oat, rye, wheat, or fallow. Dominant winter weeds in the fallow system were cutleaf evening primrose *[Oenothera laciniota* Hill] and chickweed *[Stellaria media* (L.) Vill.]. Cover crops were sown in November of 1994, 1995, and 1996 and were terminated with an application of glyphosate (1.0 lb a.i./a) 3 wk prior to planting 'Stonewall' soybean in early May each year. Within 3 d following glyphosate application, the covers were rolled with a modified stalk chopper to lay all residue flat on the soil surface. Soybean was drilled on 7-in. row widths using a Great Plains no-till drill. Seeding rate was 100 lb/a. In 1995, soil crusting resulted in a stand failure in the winter fallow plots, and this treatment was replanted on 23 May, 14 d after the first planting.

Vertical plots were herbicide input levels: none, low, or high. The low herbicide input level consisted of a preemergence application of pendimethalin (0.75 lb a.i./a) + metribuzin (0.38 lb ai/a). For the high input level, preemergence applications of pendimethalin (0.75 lb a.i./a) + Canopy@ [metribuzin+chlorimuron (0.60 lb a.i./a)] were followed by a post-directed application of clorimuron (0.5 *oz* a.i./a) approximately 40 d after planting. Because the site has a well developed hardpan, it was paratilled prior to planting the cover crop in November of 1994; in 1996, the site was paratilled 2 wk prior to planting soybean. Residue disturbance was minimal and residue formed a dense mat over the soil surface.

Weed control was determined by visual ratings (0 to 100 % control scale) early in the season (approximately 30 d after planting) and late in the season at 51 and 80 d after planting, respectively, in 1995 and 1996. In 1995, we also determined weed biomass and control ratings for grasses (primarily large crabgrass *[Digitaria sanguinalis* (L.) Scop.] and Texas panicum *[Panicum texanum* Buckl.]) and sedges *(Cyperus esculentus* L. and *C. rotundus* L.), sicklepod *(Cassia obtusifolia* L.), and Palmer amaranth. We then determined Pearson correlation coefficients between ratings and weed biomass to measure the validity of visual ratings. Correlation coefficients ranged from 0.77 to 0.94; consequently, in 1996 we only used visual ratings to measure weed control. Weed control ratings in Table 1 are averaged over all dominant weed species.

Recommended practices were used for insect control. Soybean yield was determined by combining a 5-ft wide section from within the 30-ft long plots.

## RESULTS AND DISCUSSION

In 1995, residue production was similar for all

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winter cereal covers, averaging 4665 lb dry matter/a. Winter weeds produced 1260 lb dry matter/a in fallow plots. The severe winter of 1996 resulted in differences in residue produciton by the covers. Dry matter averaged 5580, 3900, 1175, and 780 lb/a for rye, wheat, black oat, and winter fallow, respectively, in 1996.

In 1995 there was a significant cover x herbicide input level interaction. Without herbicide, all covers provided better control than winter fallow but wheat was inferior to black oat and rye for weed control (Table 1).

Severe low temperatures during the winter of 1995-96 killed the black oat, resulting in similar residue production as winter weeds in the fallow plots. As in 1995, there was a significant cover x herbicide input level interaction. Without herbicide, weed control was related to biomass production, with the exception that rye offered superior weed control to wheat. When herbicides were used, weed control was similar regardless of winter cover crop.

In 1995, soybean yields averaged across herbicides were 40, 18.3, 38, and 35.7 bu/a for black oat, winter fallow, rye, and wheat covers, respectively (Table 2). Yields were similar with the low and high herbicide input levels, averaging 30% greater than when no herbicides were used. Highest yield was obtained with the black oat cover and the low herbicide input system (44 bu/a).

In 1996, the rye cover resulted in the highest yields (48.1 bu/a), averaged across herbicide input levels (Table 1). As in 1995, yields were similar for the high and low herbicide levels, averaging 112% greater than when no herbicides were used. The 1996 season was extremely wet and weed pressure was severe. Surprisingly, at the low herbicide input level, soybean yield following the winter killed black oat cover was significantly greater than when soybean followed winter weeds (fallow) with similar residue amounts. Yield levels at the low herbicide level closely matched weed control ratings (Table 1). Some researchers have reported allelopathic interactions with herbicides where certain plants can increase the effectiveness of some herbicides. Whether this is the case with the winter killed black oat or whether the effect was due to some unknown residual rotational response, we cannot say at this time.

Preliminary results indicate: 1) rye and black oat are more effective cover crops than wheat for weed control in conservation soybean but inferior cold tolerance of black oat compared to rye may limit its zone of adaptation; 2) a strong yield benefit for planting conservation tilled soybean using the Brazilian management system, i.e., cover crops grown to produce large amounts )>4,000 lb/a of residue rolled to form a dense mat on the soil surface. In addition, evidence suggests that black oat may provide some type of a residual rotational or synergistic response to soybean yield when used within a standard herbicide program. This needs to be investigated further.

**Table. 1. Soybean yields as affected by cover crop and herbicide system.**

| | 1995 | | | | 1996 | | | |
|---|---|---|---|---|---|---|---|---|
| | Herbicide Input System | | | | Herbicide Input System | | | |
| Cover Crop | High | Low | None | *mean* | High | Low | None | *mean* |
| | ---grain yield (bu/a)--- | | | | | | | |
| Black oat | 38.9 | 43.7 | 37.5 | *40.0* | 47.7 | 51.0 | 17.2 | *38.6* |
| Fallow | 24.1 | 22.3 | 9.4 | *18.6* | 51.2 | 41.7 | 15.2 | *36.1* |
| Rye | 37.7 | 39.8 | 36.2 | *37.9* | 52.3 | 54.5 | 37.7 | *48.2* |
| Wheat | 40.4 | 38.9 | 27.9 | *35.7* | 52.5 | 47.7 | 24.0 | *41.4* |
| ***mean*** | *35.3* | *36.2* | *27.7* | | *50.9* | *48.8* | *23.5* | |

1995 $LSD_{(0.10)}$ for cover crop = 7.9; for herbicide level = 6.4; for cover crop within herbicide level interaction = ns; for herbicide level within cover crop interaction = ns.
1996 $LSD_{(0.10)}$ for cover crop = 3.8; for herbicide level = 4.4; for cover crop within herbicide level interaction = 8.0; for herbicide level within cover crop interaction = 8.7.

**Table 2. Soybean weed control as affected by cover crop and herbicide system.**

| | 1995 | | | | 1996 | | | |
|---|---|---|---|---|---|---|---|---|
| | Herbicide Input System | | | | Herbicide Input System | | | |
| Cover Crop | **High** | Low | None | *mean* | High | Low | None | *mean* |
| | ---weed control (%)--- | | | | | | | |
| Black oat | 95 | 95 | 86 | *92* | 89 | 86 | 22 | *66* |
| Fallow | 92 | 85 | 29 | *69* | 91 | 82 | 16 | *63* |
| Rye | 95 | 95 | 83 | *91* | 91 | 88 | 58 | *79* |
| Wheat | 95 | 91 | 61 | *82* | 93 | 84 | 29 | *69* |
| ***mean*** | *94* | *92* | *65* | | *91* | *85* | *31* | |

1995 $LSD_{(0.10)}$ for cover crop = 8; for herbicide level = 8; for cover crop within herbicide level interaction = 12; for herbicide level within cover crop interaction = 11.
1996 $LSD_{(0.10)}$ for cover crop = 4; for herbicide level = 6; for cover crop within herbicide level interaction = 7; for herbicide level within cover crop interaction = 9.