Multiple Cropping as a Sustainable Agriculture Practice

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MULTIPLE CROPPING: A FORM OF SUSTAINABLE AGRICULTURE

Sustainability is one of the greatest concerns in agriculture. The designation, "Sustainable Agriculture," is a wide umbrella that includes numerous agricultural systems. Cohen et al. (3) identified it as being, "A management system for renewable natural resources that uses such resources to provide food, income and livelihood for current and future generations and that maintains and improves the economic productivity and ecosystem services of these resources." This definition and even the term sustainable suggest the necessity of sustainable agriculture using sound agronomic principles. Soil erosion control, weed management, maximum efficiency of on-farm and purchased inputs, minimal leaching of pollutants through the root zone, maintenance of soil fertility by proper addition of plant nutrients and utilization of appropriate biological principles throughout the farming operation should be included among the sound agronomic principles which may result in sustainability (8, 9, 13).

Multiple cropping, the growing of two or more crops on the same field in one year, fits under the umbrella of sustainable agriculture. Multiple cropping systems result in efficient use of land resources (7). Some of these system provide year-round coverage of crop land, thus reducing erosion and sustaining topsoil. Multiple cropping systems often allow fall seeded crops to emerge and establish good above ground growth before winter and spring weeds can get established. This increases the competitive edge of the cash crop and in some cases reduces the amount of herbicides required for weed control (6, 14). Growing two or more crops in the same field during the same year is usually done either simultaneously (intercropping) or in sequence (double cropping). Studies have shown that multiple cropping has been advantageous in reducing insect pests and disease damage in some areas through diversifying the cropping system by introducing plant species that are nonhosts for certain insects and diseases (5, 10). Perhaps the most attractive aspect of multiple cropping to producers is that these systems can boost yields and increase profits (4).

RELAY INTERCROPPING VERSUS DOUBLE CROPPING

Double cropping is an important component of agriculture throughout much of the South. The most common practice is a sequence that entails harvesting a crop of winter wheat in early summer, planting soybean in the same field, and harvesting the soybean in the fall (1). Success with double cropping varies from year to year. A successful double cropping year usually depends on the amount of available moisture at the time of and following the seeding of each crop in the system. The farther north one moves, the less reliable double cropping becomes. For instance, double cropping soybean following winter wheat may be economical in the South but it is seldom economical in the Midwest. Poor soybean yields in midwestern double cropping systems often result from stand failure or low yields resulting from the short growing season (12).

The growing season in the Midwest and even in some more southern areas such as the upper Southwest is too short to allow soybean planting after the winter wheat harvest. Therefore, to lengthen the soybean growing season, various methods of planting soybean before the wheat harvest have been investigated.

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For example, relay intercropping has been examined as a possible method of reducing the risks of growing two crops a year and in extending the northern limits of a two crop system (2, 11, 12). Relay intercropping refers to a planting system in which a second crop is seeded in the same field with the first crop after the first crop has reached its reproductive stage of growth but prior to being ready for harvest.

Relay intercropping has received limited attention in the United States partly because of modest amounts of equipment tailored for planting, maintaining and harvesting relay intercropped fields. Adequate weed control systems are also limited for relay intercropping. However, besides extending the northern boundary of a two crop per year system, relay intercropping also allows crops to be planted at an optimal date when soil moisture is more readily available.

STUDY METHODS

This experiment began as an off-shoot of a larger double cropping experiment. It was conducted on the Langston University Research Station in central Oklahoma in a fine sandy loam soil. Relay intercropping was compared to double cropping as multiple cropping systems for growing winter wheat and soybean. The experiment was designed as a randomized complete block with four replications. Since wheat is more widely grown in Oklahoma than soybean, winter wheat was considered to be the primary crop in this experiment and soybean the secondary crop. Therefore, instead of relay planting soybean into standing wheat in the spring, winter wheat was relay planted into standing soybean in the fall. Plots were hand planted. Thirty-inch rows were used to reduce injury to standing soybean while relay planting the wheat with a push furrower.

The field was cultivated once a year. In the spring it was moldboard plowed and disked. Roundup was applied prior to cultivation in the spring. Weed control was maintained throughout the growing season by hand eradication. Wheat plots were harvested as above ground biomass, with the exception of one year. In 1987, wheat heads only were harvested. All plots were harvested by hand.

RESULTS AND DISCUSSION

In 1987, winter wheat heads only were analyzed for yield. Relay intercropped winter wheat (RIW) produced 0.91 tons/ac and double cropped winter wheat (DCW) produced 0.72 tons/ac. Relay intercropping yielded 26% better than double cropping. In 1988 and 1989, complete above ground winter wheat plants were harvested and dry matter weights recorded. In 1988, RIW yielded 1.24 tons/ac and DCW yielded 0.63 tons/ac. This was a 97% yield advantage for RIW. Low DCW yields for 1988 may be attributed in part to low moisture availability during the early growth stages of DCW. In 1989, RIW yielded 1.72 tons/ac of dry matter and DCW yielded 1.24 tons/ac. RIW held a 39% yield advantage over DCW for that year.

Soybean components for both the RIW and DCW systems were treated the same way. Seed yields for soybeans grown under the RIW system were 10.3 bu/ac, 15.5 bu/ac and 23 bu/ac, respectively for the years 1987-1989. Soybean yields under the DCW system were 10.7 bu/ac, 15.1 bu/ac and 26 bu/ac, respectively for 1987-1989. These yields were under dryland conditions.

Double cropping has good potential for allowing Oklahoma farmers to get two crops in a single year. Oklahoma's Southwestern growing season is long enough to accommodate select species in a two crop a year system. A double cropping system consisting of winter wheat and soybean is feasible for Oklahoma. However, getting winter wheat seeded after the soybean harvest is completed could result in poor stands and lower yields. The late fall rains could also delay winter wheat seeding to the middle of November or beyond the recommended seeding date. Relay intercropping of winter wheat into standing soybeans would allow the farmer to get into the field earlier and seed wheat at an optimal time for adequate

moisture and in time to take advantage of a lengthy growing season. These advantages from relay cropping could result in higher yields.

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