Materials and Methods

Project Design

Two crop rotations were initiated in the spring of 1998 at the WSU Wilke Research and Extension Farm near Davenport, WA, and on 5 cooperators' fields within a 30-mile radius of Davenport (near Mondovi, Deep Creek, Harrington, Sprague, and Wilbur). A sixth site at Egypt was discontinued after 1 year. Approximately 210 acres of the Wilke farm were placed into replicated strips or plots representing a 3- or 4-year rotation. The 3-year rotation was a modification of the traditional winter wheat/spring grain/fallow rotation commonly practiced in Lincoln County. This rotation was winter wheat/spring cereal/broadleaf. The 4-year rotation was modeled after a rotation found to be successful in the Northern Great Plains. This rotation is spring cereal/winter wheat/warm season grass/broadleaf. As mentioned above, the plots at the Wilke farm were replicated 3 times to allow statistical analysis of the data. Cooperator plots were not replicated, but multiple samples were collected in each field. Plot size ranged from 8 to 10 acres at the Wilke farm and 10 to 100+ acres on cooperator farms. With the exception of the Wilke farm in 1998, each part of the rotation was present each year in all locations. Each cooperator chose either a 3- or 4-year rotation to establish, while the Wilke farm had both rotations present. Within a rotation, cooperators were allowed to choose individual crops and varieties within a crop-type they believed would suit their farm operations, available moisture, and market opportunities. All field operations were performed using grower equipment. Data were also collected from 2 conventional tillage farms near the Wilke farm for comparison.

Sampling

Within a field or strip, 3 permanent sampling points were established where most sampling occurred over the 4 years of the project. Sampling methods are described below.

Weed populations. From the field sampling position, a 100-ft. transect was laid out at a 45° angle to the crop rows. A marker, 2 feet in length, was placed across the transect, 1 foot on either side. The number and species of each weed within this belt were tallied and recorded. Weed populations were evaluated once in the spring 4 weeks after planting and once prior to harvest.

Stand counts. A marker, 3 feet in length, was placed at 3 of the established random positions. The total number of crop plants on either side of the marker within the furrow were tallied and recorded for each field.

Insect populations. Insect monitoring occurred 4 weeks after planting and every 2 weeks during the growing season. At 5 predetermined random locations, 5 sweeps were taken at a 45° angle to the crop rows using an insect sweep net. All insects collected in the net were placed in plastic bags, labeled, placed in a cooler, and frozen for later identification.

Crop yield. All crops were harvested using commercially available equipment. Crop yield was determined from elevator and individual farmers' records.

Crop residue. Post harvest residue was evaluated in the fall at 3 locations in each field. A hoop, 42 inches in diameter (1 m^2), was placed on the ground over the residue. All residue within the hoop was clipped to ground level, with small pieces and old residue raked into a pile. The collected residue was placed into a 5-gallon bucket with a sieve screen on the bottom to sift out the unwanted soil. The residue was placed in a brown paper bag and weighed. Post harvest residue was evaluated immediately following harvest prior to fall seeding. If weather conditions were not favorable immediately following harvest, residue from late harvested crops was collected and evaluated in the spring prior to field operations.

Soils. Soil samples were collected and then analyzed by a commercial firm. Three locations were sampled within each field to create a field composite. Samples were collected to a depth of 6 feet using a subsoil probe. Samples from each foot were collected separately and labeled. Each sample was analyzed using the following parameters: nitrate, and moisture (1-6 ft.), sulfates (1-3 ft.), ammonium nitrate, phosphorus, pH, and organic matter (0-1 ft.). At the beginning and end of the 4-year rotation, pH and organic matter were measured in the top 1 foot, at 0-2", 2-4", and 4-12", to determine any changes over the project period.

Water infiltration. Water infiltration was measured at previously established random locations within each of the fields. The method is a standard developed by the USDA (1999). The sampling area was cleared of surface residue to the soil surface. A 6-inch diameter hard plastic ring was driven into the ground to a depth of 3 inches. The soil was firmed around the inside edges of the ring to prevent seepage and minimize disturbance to the rest of the soil surface inside the ring. The soil surface inside the ring was lined with a sheet of plastic wrap to completely cover the soil and ring. The ring was filled with 444 ml (or 1") of distilled water. The plastic wrap was removed gently by pulling it out, and leaving the water in the ring. The time required for the 1" of water to infiltrate into the soil until the surface glistened was recorded and later calculated into inches per hour it takes the soil to absorb the water.

Earthworms. Sampling methods used were national sampling protocols developed by Jill Clapperton for Worm Watch (Clapperton 1998). Modified hand sorting was used to determine the number and species diversity of earthworms. This method was used to study what species of earthworms were present in the soil.

In the spring, a location was chosen that occurred in a moist area, not on a dry hilltop. If there was a lot of surface residue it was sorted through to find any surface or litter dwelling earthworms. If any worms were found they were placed in a container, counted, and recorded on a data sheet. A shovel was used to dig and carefully scoop out the soil and place it on a plastic sheet to the side. The modified hand-sort method was used to gently break up the soil clumps and search for worms or cocoons and bag them for identification. Following identification all earthworms would be returned to the soil and soil surface residue returned back to place. Sampling was repeated at 6 locations in 11 different fields at the Wilke farm and 3 locations in each field at the Harrington farm.

Economics. A schedule of field operations performed for the year by each cooperator and at the Wilke farm operator were collected by team members. Based on farm prices and schedule of

field operations, a set of enterprise budgets were engineered for each operation estimating costs and returns. This is a commonly accepted practice in the farm management profession.