Background and Objectives

Diversified agricultural operations on Oahu have increased since the closure of Waialua Sugar Company in 1995. The new agriculture industries which have emerged following sugarcane include: seed corn production, vegetable and melon farming, and orchard crops. Unlike sugarcane, which was planted extensively and was a two-year crop, most of the new crops are short term in nature (3 months or less) and are planted on much fewer acres. A common practice among the new farming enterprises is the use of bare ground fallow between cropping cycles (Fig. 1). The advantages of bare ground fallow are that insect pest, soil-borne diseases, and weed pressures are significantly reduced. The main disadvantage to the bare ground fallow approach to pest management is the loss of top soil from erosion. Soil sediment from eroded fields into nearby water bodies contains nitrogen (N) and phosphorus (P) which are considered to be non-point source pollutants. The soil sediment itself also serves as a source of turbidity when it is eroded into streams and coastal waters.

The objectives of this project were to:
1. Investigate the use of two types of grass cover crops (barley and oats) for reducing soil N and P in soils that normally are subjected to a bare ground fallow period following seed corn production.
2. Demonstrate the effectiveness of the grass cover crops in suppressing weeds (a main concern in short term row cropping systems).

Methods

The project was conducted at 8 separate field sites located in the Kaiaka – Waialua Bay watershed. Grass cover crops, barley (TAM 500) and oats (TAM 833), were planted in a randomized complete block design of 3 treatments (oats, barley, and bare ground) and 3 replicates. Plot size was 20 ft. X 100 ft. Grass seeding rate was 70 lb./A and was mechanically incorporated to a depth of 1.0 in. All grass plots were irrigated immediately after planting by overhead irrigation. Bare ground plots were maintained weed free throughout the course of the growing cycle. No weeding was done in the grass plots.

Four plantings were established in November 2002 and plowed down in January 2003. Four additional test plantings were installed in February 2003 and plowed down in May 2003. Soil samples were collected in all plots to establish baseline N and P levels. Additional soil samples were taken from each plot mid-way through the growing cycle and immediately after plowdown of the cover crops. Tissue samples were collected from the grass plots prior to plowdown to examine N and P uptake from the soil by determining tissue N and P accumulation. No fertilizers were applied to any of the plots.

Figure 1. Bare ground fallow following seed corn.
Results

Soil N and P were extremely variable. In some cases soil N and P were higher in all plots after cover crop planting. This was probably because the plots were too small to effectively assess the removal of N and P from the soil. However, tissue analysis revealed that very large amounts of N and P were accumulating in the grass cover crops. The range of N accumulation (and removal from the soil) was 155 lb./A to 532 lb./A for barley and 163 to 546 lb./A for oats. P accumulation was much lower ranging from 11 lb./A to 29 lb./A for barley and 10 lb./A to 61 lb./A for oats. Because of the removal of large amounts of N from the soil by these cover crops this approach to reducing non-point source pollution by grass cover cropping has potential as a Best Management Practice (BMP) for growers utilizing bare ground fallow systems.

Weed suppression in the test plots was excellent if the seeding was uniformly distributed (Fig. 2). In most cases the grass covered 90 – 100% of each plot and “out competed” the major weed pests in these fields: spiny amaranth (Amaranthus spinosus), Aiea morning glory (Ipomoea triloba), purple nutsedge (Cyperus rotundus), and guinea grass (Panicum maximum). Each of these weed species were major weed problems in sugarcane production. Because of the aggressiveness of these weeds bare ground fallow is maintained by seed producers to minimize their proliferation. The bare ground fallow approach normally includes a plowdown of crop residue followed by 1 or 2 additional plow downs of sprouting weeds. The bare ground fallow approach also utilizes an herbicide spray if additional weed control during the fallow period is required.

Field Day and Grower Training

A field day was conducted on April 25, 2003, to demonstrate the use of the grass cover crops for weed suppression. Additionally, a Grower Training session was conducted at Pioneer Hi-Bred International, Inc. ’s facility in Waialua on May 21, 2003. The purpose of the training session was to detail how to use cover crops as an alternative to bare ground fallow for managing weeds between cash crops. Cost comparisons between the bare ground fallow practice and cover cropping were presented:

<table>
<thead>
<tr>
<th>OPERATION</th>
<th>BARE GROUND $/acre</th>
<th>COVER CROPPING $/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn Plow Down</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Seed Cost</td>
<td>-</td>
<td>44</td>
</tr>
<tr>
<td>Seed Incorporation</td>
<td>-</td>
<td>25</td>
</tr>
<tr>
<td>Second Plowing Round</td>
<td>25</td>
<td>-</td>
</tr>
<tr>
<td>Third Plowing Round</td>
<td>25</td>
<td>-</td>
</tr>
<tr>
<td>Herbicide Application</td>
<td>40</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL</td>
<td>115</td>
<td>94</td>
</tr>
</tbody>
</table>

If a third plowing round and herbicide application are used to maintain a bare ground fallow then the cost for cover cropping is reduced for the grower. Costs for bare ground fallow practices (plowing and herbicide application) were obtained from Pioneer Hi-Bred International, Inc. Seed cost was the highest single component of both practices and could be reduced more if large volumes of seed are purchased (1,000 pounds of seed were secured for the project).

Additional benefits of cover cropping were also discussed with the growers: minimizing loss of valuable top soil, increased soil organic matter, reduced pesticide applications, and refugia for natural enemies (Fig. 3). Barley and oats seed were distributed to growers to trial on their own farms. As diversified agriculture increases in Hawaii the use of cover crops for maintaining soil and general environmental health will be an important management tool.
Participants and Cooperators

This project was designed and conducted as a cooperative community and industry endeavor. The lead organization was the Hawaii Farm Bureau Federation (HFBF). Businesses and organizations involved in the execution of all project tasks were:

Project Manager: Dr. John McHugh, Hawaii Farm Bureau Federation
Grower Logistics: Dr. Mike Austin, Pioneer Hi-Bred International, Inc.
Student Coordinator: Jenny Falcon, Pioneer Hi-Bred International, Inc.
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Community Logistics: Lynne Constantinides, Crop Care Hawaii, LLC
Technical Advisor: Dr. Carl Evensen, University of Hawaii at Manoa

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