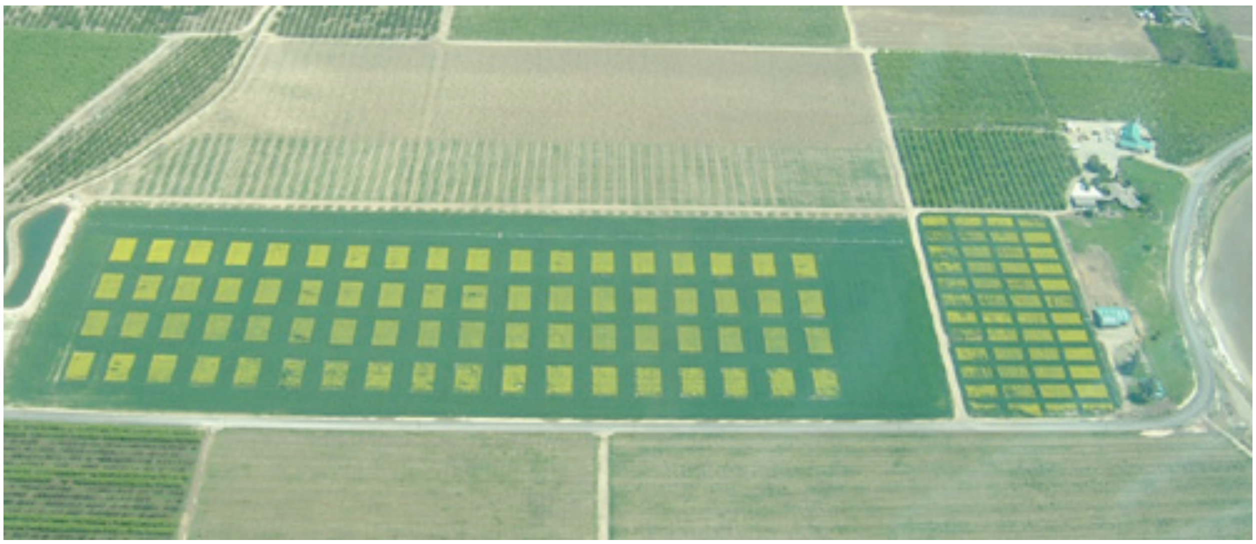
Biosolids for Biodiesel
USDA SBIR 2003-000450

Phase I Final Report

Prepared by
Emerald Ranches



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Background

The goal of this Phase I project was to determine if municipal biosolids are suitable fertilizer for growing canola for the production of biodiesel fuel. It is desirable to use biosolids as a fertilizer for canola for two reasons: farmers using biosolids as a nutrient base reduce costs associated with growing canola, and this offers municipalities a beneficial use option for their biosolids that has limited concerns in regards to food chain transfer of contaminants in biosolids. This management strategy can also provide these same municipalities an environmentally sustainable fuel source to satisfy a portion of their diesel fuel requirements.

A major obstacle to large scale use of biodiesel has been the relatively high cost of biodiesel in comparison to conventional diesel fuels. Although using biodiesel is more environmentally sound, the increased cost of biodiesel over conventional diesel has precluded large scale use of this alternative fuel by municipalities. In addition, because it is more expensive and a market is not guaranteed, there is a limited supply of domestically produced biodiesel with the majority of the fuel currently produced derived from soybean oil in Midwestern facilities.

Canola was chosen as the oil seed crop for the Phase I research because of its high oil producing capabilities and its suitability for growing in the Pacific Northwest. Canola (or rape) is the primary source for oil for biodiesel in northern Europe where conventional diesel prices are much higher than in the US and use of biodiesel receives more favorable subsidies, making it a cost effective alternative to conventional diesel.

The Phase I research involved two replicated field studies: one to test different rates of biosolids in comparison to conventional fertilizer under irrigated conditions, and the second to test biosolids, compost and fertilizer under dryland conditions. For each experiment, four types of canola were included in the experimental design. A second goal of the Phase I program was to demonstrate the feasibility of biodiesel production to both the biosolids generators as well as the farmers who contract with the municipalities to use the biosolids. Results are presented below.

Experimental Design

As outlined in the project proposal, a field study to test the feasibility of using biosolids as a fertilizer for canola to produce biodiesel was installed at Emerald Ranches in Sunnyside, WA in September 2003. The study used a randomized complete block design with three replicates and included 4 varietals of canola and a range of soil treatments. The canola varietals were identified in cooperation with Jack Brown at the University of Idaho. Each of the varieties included in the trial have previously been shown to have high oil yield. Because of this they are excellent candidates for biodiesel production. The varietals included in the study were:

- Inca Winter Canola

    - Lot 1-R1-00
- Rapier Canola
    - Lot R-H1-00
- Athena- Rapeseed
    - Lot JS03F1
- Ericka Rapeseed
    - Lot JS00WC

The soil treatments included in the field trial are

- Control
- Biosolids @ 2 dry tons/ac
- Biosolids @ 4 dry tons/ac
- Biosolids @ 6 dry tons/ac
- N as urea @ 2 split applications of 130 pounds/acre per application to equal biosolids at 4 dry tons/ac
- Biosolids + N   Fall application of biosolids @ 2 dry tons/ac + spring N as urea @ 130 pounds/acre application.

The plot plan for this study is shown in Figure 1. This will be referred to as the irrigation study.

In addition to this experiment, another field trial was included. This experiment was designed to test if the soil amendments could affect yield in the case of limited water supply. Water can be a limiting factor in yield for canola in Eastern Washington. By providing sufficient water to insure seed germination and eliminating the need for subsequent irrigation, it may be possible to grow canola more economically. Soil amendments, including biosolids and biosolids composts have been shown to increase the water holding potential of the soil. In addition, the biosolids used in the study have 31% solids content. This is typical of the anaerobically digested Class B biosolids cake that is used at Emerald Ranches. A nutrient application of the biosolids will also add substantial amount of water to the soil. This experiment also was designed based on a randomized complete block design. All 4 of the canola varietals used in the first study were included in the second. Treatments included in the second field experiment are:

- Control
- N as urea
- Biosolids @ 4 dry tons/ac
- Biosolids Compost @ 10 dry tons/ac

The plot plan for this study is shown in Figure 2. This study will be referred to as the reduced irrigation study.

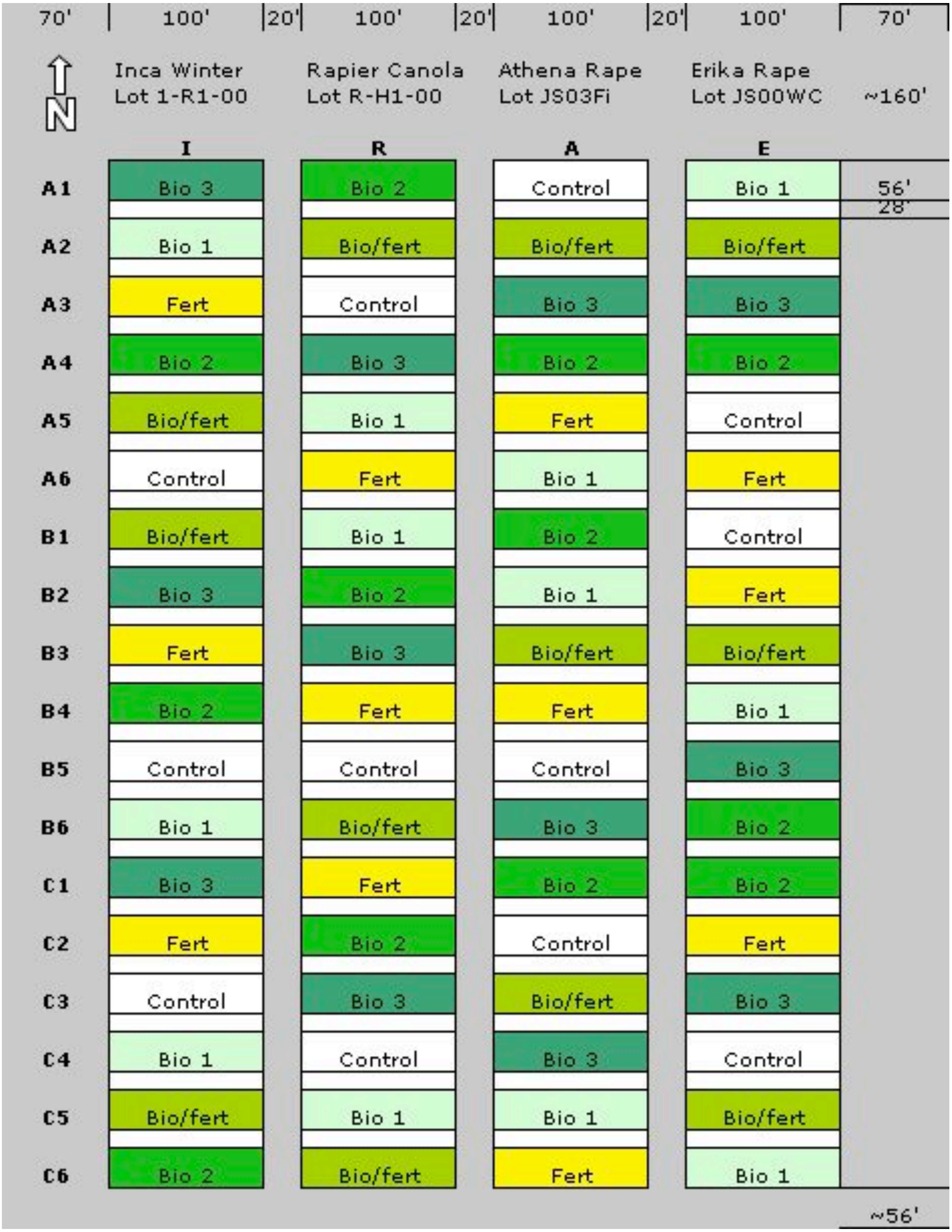

Figure 1. Plot plan for the Irrigation study

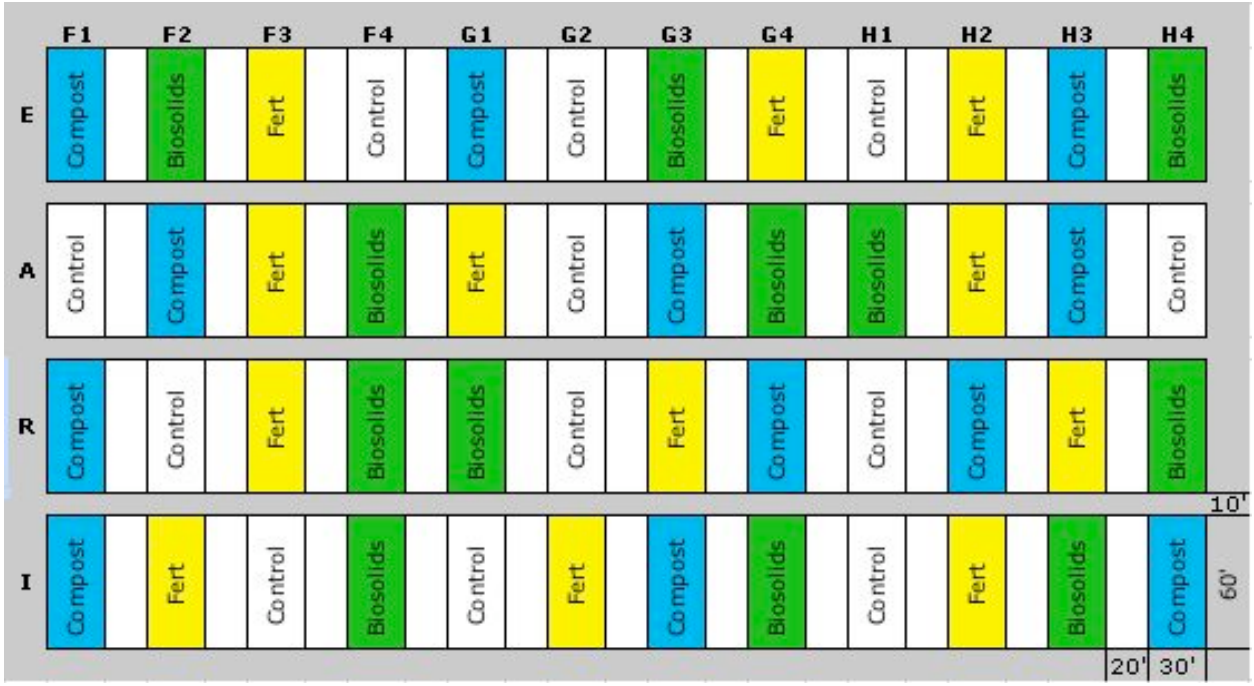

Figure 2. Plot plan for the Reduced Irrigation study

The plot area for both studies was tilled prior and after amendment addition. Plots were laid out and biosolids were surface applied using a side cast spreader. Urea was applied via a broadcast spinner spreader. Canola was drill seeded into the plots on September 20, 2003. Germination across both studies was excellent and sufficient above ground growth occurred before the winter. A spring application of urea was made to the N as urea and Biosolids + N plots in early March 2004. Plants began flowering in April and seeds were ready for harvest by the end of July. An aerial view of the plots in the fall is shown in Figure 3 and the canola plants in seed are shown in Figure 4. Plots were harvested in early August, 2004. A small plot combine was used to harvest a portion of each plot providing yield data as well as grain samples for lab analysis.

Results

Irrigation Study

Yield in this study was affected both by soil treatment and by cultivar. All of the soil treatments showed increased yield over the control soil with none of the amendments showing superior performance over another. Yield varied from 3000 lbs per acre in the control treatment to 3900 lbs per acre in the Biosolids @ 2 dry tons per acre treatment. The yield in all of the plots with soil amendments was over 3500 lbs per acre (Figure 1). Statistically, variety was much more significant than soil treatment with the highest yields observed in the Inca (3917 lbs per acre) and Athena (3975 lbs per acre) plots. Performance by the Erika and Rapier cultivars was similar with yields of 3070 and 3090 lbs per acre respectively (Figure 2). All cultivars behaved similarly across all soil treatments.

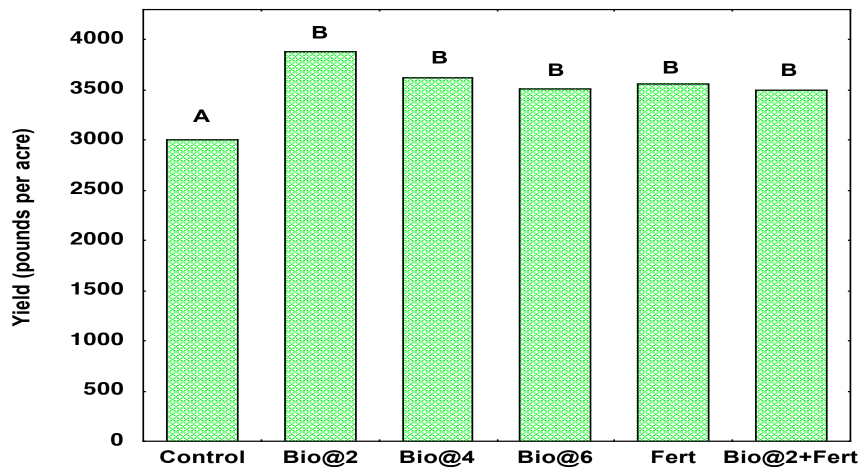

Figure 3. Yield (pounds per acre) as a function of soil treatment in the irrigated field plots. (Means with the same letter are statistically similar using the Duncan Waller procedure with p>0.05.)

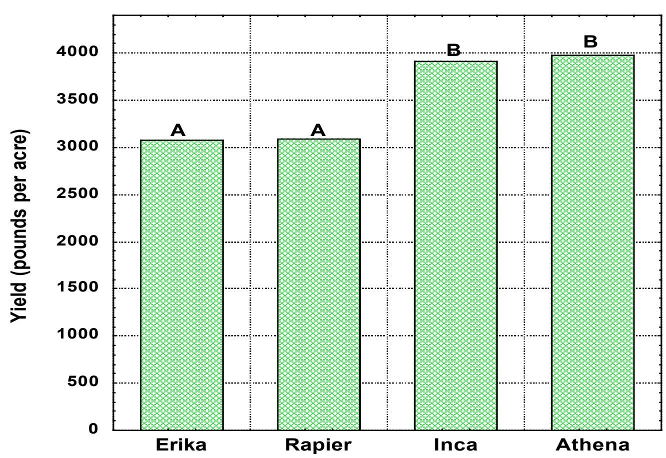

Figure 4. Yield (pounds per acre) as a function of seed cultivar in the irrigated field plots. (Means with the same letter are statistically similar using the Duncan Waller procedure with p>0.05.)

Seeds were sent to Warren Analytical Labs in Greeley, CO for total fat and fatty acid profile analysis. Duplicate samples were included in the analysis and there were no identifying marks on the sample bags to indicate treatment or cultivar. Total oil content was less than expected with values ranging from 24.7% to 27.8%. Treatment had no effect on oil content of the seed. Here, as with yield, cultivar was the primary factor affecting oil content. Rapier had the lowest oil content (24.7%) with the oil content of the remaining cultivars being statistically similar (Figure 3).

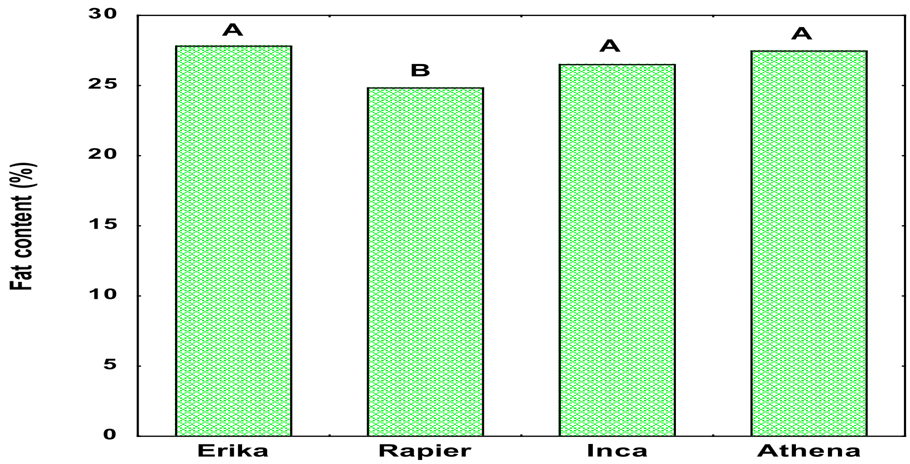

Figure 5. Total fat content of seed (%) for the different cultivars used in the irrigated field study. (Means with the same letter are statistically similar ($p>0.05$).)

Fatty acid profiles were also done on all plots seeded with Athena. There were no differences in fatty acid profile as a result of amendment addition. For example erucic acid ranged from 0.01 – 0.06 % in the control treatment, 0.01 to 0.1% in the fertilizer treatment, and 0.01 to 0.03% in the 6 t/ac biosolids treatment. These results suggest that biosolids are a suitable fertilizer to use for canola production. All biosolids amended soils had higher yields than the unamended soils.

From this study, all rates of biosolids were statistically similar to commercial fertilizer. There was no benefit associated with a split application of biosolids and fertilizer.

Reduced Irrigation Study

In the reduced irrigation study, soil amendments did not have any effect on either yield or oil content of the seed. The primary factor affecting both of those variables was the canola cultivar. The highest yield in this study was for Athena (4670 lbs per acre) and the lowest was for Inca (3750 lbs per acre) (Figure 4). Fat content was also affected by cultivar with the highest fat content seen with the Inca seed (30.4%) and the lowest in the Rapier (26.1%). (Figure 5)

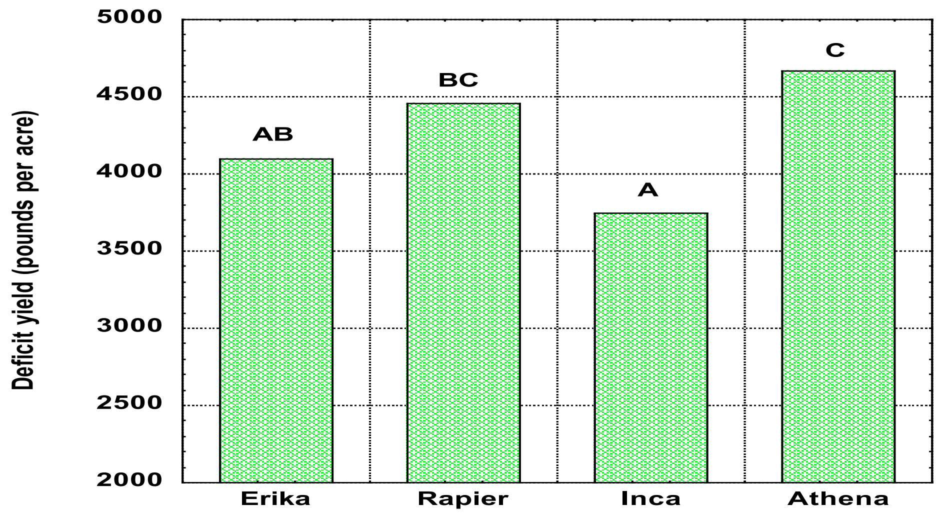

Figure 6. Yield (pounds per acre) for the different canola cultivars used in the reduced irrigation study. Means with the same letter are statistically similar p>0.05.

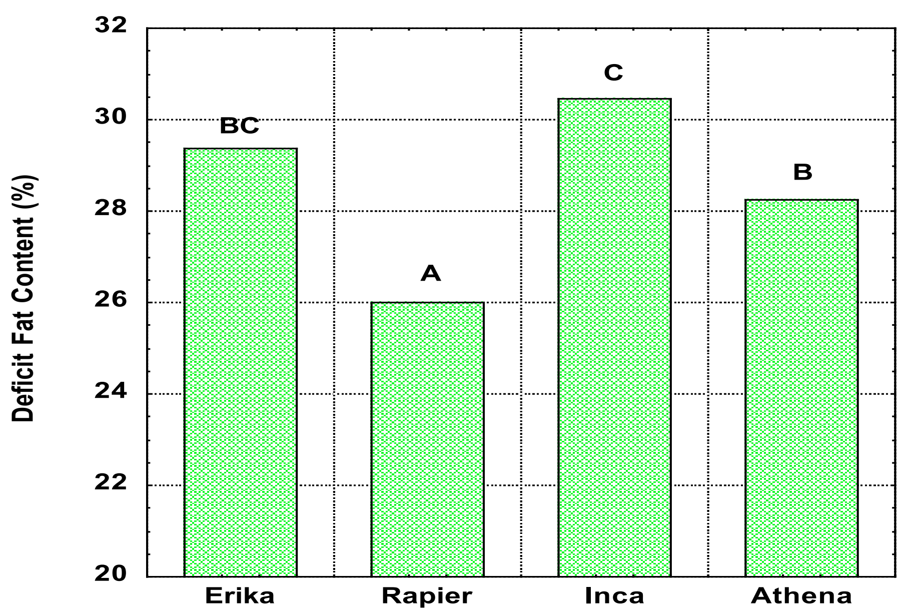

Figure 7. Oil content (%) for the different canola cultivars used in the reduced irrigation study. Means with the same letter are statistically similar p>0.05.

Overall yield was higher in the reduced irrigation study than in the irrigated study. Oil content of seed was also higher. Total yield in the irrigated field averaged 3510 pounds per acre while yield in the reduced irrigation study averaged 4240 pounds per acre. Oil content in the irrigated study averaged 26.7% compared to 28.6% in the reduced irrigation study. This suggests that the canola plants responded to water stress conditions by increasing their seed output relative to vegetative growth. It also suggests that appropriate management of canola when irrigation is available is to provide sufficient water to achieve a high germination rate and then allow water deficit conditions to develop to encourage plant stress and high seed production rates. This factor could become relative significant in the Yakima Valley where irrigation water is dependent upon winter snow pack be capture in reservoirs. The past 5 out 7 years have experienced shortages in total water deliveries. Water conservation practices of irrigating a crop into development in the fall and utilization of reduced percentage of water in the following season on higher income producing crops could become quite beneficial for water spreading issues.

Overall Experimental Results

Overall, the Athena cultivar had the highest yield for both sets of plots as well as the highest overall oil production. Total fuel production per acre was calculated by multiplying the yield by percent oil concentration and then dividing the total oil production by 8 lbs/gallon (assuming that the weight of oil a gallon of biodiesel would be equal to 8 pounds). Results are shown in Table 1. Results from the study indicated that, with restricted water supply, it is possible to produce over 140 gallons of biodiesel per acre using all of the cultivars of canola tested in these studies. In addition to the oil yield, each cultivar would produce over a ton of canola cake that is suitable for cattle feed and would increase the per acre revenue.

Table 1. Total seed yield, canola feed cake and gallons of fuel for the irrigated and reduced irrigation studies.

	Reduced Irrigation Plots			**Irrigated Plots**		
	Total Yield	Cake	Gallons of Fuel	Total Yield	Cake	Gallons of Fuel
	pounds/acre	tons/acre	per acre	pounds/acre	Tons/acre	per acre
Erika	4100	1.45	150	3070	1.11	107
Rapier	4460	1.65	145	3092	1.16	96
Inca	3750	1.30	143	3917	1.44	130
Athena	4670	1.68	165	3975	1.44	137

Demonstration

To illustrate the feasibility of using biosolids to produce biodiesel, Emerald Ranches has carried out extensive outreach efforts, involving both different municipalities and the local community. Some examples of these activities are presented below.

Biosolids Network

Annual Northwest Biosolids Management Association Conference

Biosolids generators in the Pacific Northwest host an annual conference on biosolids. In both 2003 and 2004, Dr. Chuck Henry presented results on our project at the conference. In 2004, Dr. Henry made biodiesel using canola oil as part of his presentation. This gave the attendees an opportunity to see how simple the manufacturing process is and to recognize the potential for their municipalities. One regular feature of this conference is a contest for best fruit or vegetable grown in biosolids amended soils. The winner of the competition receives the Golden Gourd award. We entered the competition this year with a bottle of biodiesel processed from the canola and are the 2004 winners of the Golden Gourd.

In addition, Emerald Ranches hosted a meeting of the Northwest Biosolids Management Association that included a tour of the canola plots. Representatives from the biosolids programs from Tacoma, Seattle/King County/ Olympia, Yakima and several other municipalities were in attendance. The director of the King County Biosolids program, Peggy Leonard has also made trips to the farm with people from the Wastewater treatment division. This has helped to publicize this project within the county infrastructure.

'BioCycle's' fourth annual conference on Renewable Energy from Organics Recycling in Des Moines, Iowa in November 2004.

Ted Durfey from Emerald Ranches presented results on our project, as well as, the benefits of sustainability to agriculture in growing canola for biodiesel production. This conference had attendance from through-out the nation, Canada, Ukraine, Puerto Rico and Guatemala.

Biosolids Environmental Management System

The King County biosolids program was certified by the Environmental Management System (EMS). This certification involves an external audit of the biosolids program and is undertaken as a means to assure exceptional biosolids management. King County is one of 6 municipalities in the US that have received EMS certification. Emerald Ranches was asked to participate in the awards ceremony as they manage a large portion of the biosolids applications and have been involved in the EMS certification process. The ceremony was attended by a number of regulatory and county officials, including Ron Sims, the King County Executive. At the end of the ceremony, Ted Durfey asked to present something to Mr. Sims. He gave Mr. Sims a 1.5 liter bottle of 'Biosolids Biodiesel- First Vintage'.

Carbon Accounting
Dr. Sally Brown and Peggy Leonard wrote a two part article for 'BioCycle Magazine' describing an accounting of the impact of the King County biosolids program on greenhouse gas emissions for the county. This trade journal is geared to publicly owned treatment plant operators and those involved in the water treatment industry. The accounting found that appropriate use of biosolids is currently gaining carbon credits for the county because of the fertilizer value of the biosolids. By targeting the use of the biosolids for specific ends, it is possible to further increase the C credits. Growing canola for biodiesel production was highlighted in the article as a means to maximize carbon credits associated with land application of biosolids. The article has been widely circulated within the county.

We have also met with biosolids generators to develop a strategy for linking land application of biosolids to biodiesel production. One option would be for municipalities to contract for biosolids management that includes a return revenue paid for as a certain amount of biodiesel from a crop grown on the land fertilized with their biosolids. The biosolids generators are ready to embrace this partnership. What remains is to outline an economic viable means to begin biodiesel processing and a plan for the gradual growth of this industry.

Economic Viability

Potential Revenue

In order for it to be financially feasible for biodiesel to be produced from biosolids fertilized canola, the per acre revenue for the farmer has to be comparable to the revenue that would be derived from wholesaling canola through conventional channels. In addition, revenue associated with growing canola has to be comparable to that of growing wheat, the small grain crop that is normally grown in Eastern Washington. The potential revenue for producing canola and canola cake for cattle feed from municipal biosolids fertilized canola can be estimated. This estimate has to be comparable to alternative crops and revenue streams if biodiesel production is to be seriously considered, and in fact, unless this profit is comparable to the revenue from growing other small grains, the venture isn't attractive. (Although there is one caveat that works well, that we will discuss later (See **Growth Plan: Identifying Partners**), and that is as a rotation crop to suppress diseases in small grain crops.) The following factors have to be taken into account for this estimate:

- Cost per acre for dryland and irrigated wheat production
- Cost per acre for dryland and irrigated canola production
- Revenue potential for dryland and irrigated wheat production
- Revenue potential for dryland and irrigated canola production
    a. Production costs for biodiesel production
    b. Potential revenue for biodiesel
    c. Potential revenue for canola cake
    d. Potential regulatory incentives for canola or biodiesel production

Costs for growing canola were calculated from the expenses accrued from this project and a Washington State University Extension Service Fact Sheet. Expenses for growing wheat were based on our own experiences and a WSU Extension fact sheet. Revenue from wheat was based on our own history of wheat production. Dave Ruud, a dry land wheat farmer and a cooperator on the next phase of the project was also tapped for information on dry land production costs and revenues for canola and wheat.

We calculated per acre revenue based on several assumptions. Farmers in the vicinity of Emerald Ranches are currently buying canola feed for their cattle from Canada. The price for the meal is $140.00 per ton. We also used $2.15 as a net price for biodiesel fuel that is revenue from the biodiesel minus processing costs (see justification in later paragraph). Currently, biodiesel prices for B100 (100% biodiesel) are approximately $2.87 off road (no tax included in sale price) and $3.37 on road. These prices are for moderate quantity wholesale purchases (Dr. Dan's Alternative Fuel Werks www.fuelwerks.com). For the purposes of this report, we will use $2.87 as our revenue from selling biodiesel. In comparison, the biosolids program in King County, WA paid an average of $1.83 for conventional diesel in September, 2004 (Peggy Leonard, King County, WA). Using a B20 (20% biodiesel) blend of biodiesel and conventional diesel fuel adds about $0.25 to the price of conventional diesel fuel.

Cost of Processing

There are two components relating to the processing costs for biodiesel: 1) oil has to be extracted from the seed and the oil has to be treated to release glycerin and become biodiesel. Many of the available cost estimates are based on large scale facilities. One of the goals of this project is to develop a program so that all aspects of production, from spreading the biosolids to producing and distributing the biodiesel, are at least partially controlled by the primary cooperators. By only participating in one stage of the process it is too easy to lose control of the product. Additionally, only participating in one aspect of the process can lead to reduced income to the point where the process is no longer economically feasible. In order to be involved in the process as a whole, it is necessary to have a relatively small scale operation. A small operation could also evaluate the economic value in being located in close proximity of seed crop production, as well as, the canola cake for cattle feed. Logistics of reduced transportation cost will assist in reducing overall production cost. To investigate the feasibility of small scale processing operations, Emerald Ranches took 1000 lbs of the canola seed harvested from our experimental plots to the University of Idaho to process it into biodiesel. The University Biodiesel program has a small scale oil crusher and diesel processing set up. Based on our trip to

U of I in combination with our experience processing hops, it will be feasible to build a complete unit, capable of processing 1 ton of seed per day for approximately $30,000.

Assuming a yield similar to what our study found of 4500 lbs/ac (2.25 t/ac), this type of facility could accommodate the seed from approximately 160 acres of canola. The net yield of biodiesel (assuming an oil content of 28%) would be about 155 gallons per acre or 25,000 gallons of biodiesel. (*One could argue that we have used the optimistic end of our study results. However, a farmer has no reason to grow a variety that yields less tonnage/oil. Also, by controlling irrigation to maximize yield, it takes the effect of a low rainfall year out of the equation.*)

For each batch of biodiesel, the following inputs and outputs are required:

Inputs
- 100 lbs oil
- 13.8 lbs methanol
- 1.15 lbs catalyst

Output
- 10.35 lbs glycerin
- 98.5 lbs biodiesel

Glycerin is a by-product of the biodiesel processing that has the potential to generate additional revenue. In 1996, glycerin sold for $1.05 to $1.08 per lb. Uses for glycerin are diverse and the demand for glycerin is expected to increase. In 1996, the price of glycerin in Europe decreased due to the high volume generated as a by-product of biodiesel manufacturing. It is likely that this will not be the case in the near future in the Pacific Northwest. It is possible that revenues associated with selling the glycerin will more than off-set the costs of the methanol and the catalyst. One of the largest producers of methanol in the Northwest is Methanex in Vancouver, BC. A US reference price for methanol was $249 per tonne (Biodiesel in British Columbia-Feasibility Study Report prepared by Wise Energy Coop www.wiseenergy.ca).

In an estimate prepared by the University of Georgia, costs for producing biodiesel were split at 75% for feedstocks and 25% for operating costs. With this cost breakdown, assuming that the costs for feedstocks other than oil (methanol and catalyst) will be offset from the sale of the glycerin, 75% of the revenue from the sale of biodiesel would be expected to cover feedstocks, with the remaining 25% covering operating costs. At $2.87 per gallon, $2.15 would be allotted for feedstock (essentially the grower's revenue, methanol and catalyst) and $0.72 would be set aside for production costs. This would translate into $0.27/lb (this is similar to the reported cost of canola oil at around $30/lb)(A study on the feasibility of biodiesel production in Georgia, George Schumaker et al., www.agecon.uga.edu/~caed/biodieselrpt.pdf).

Based now on our assumptions, the potential costs and revenues for the farmer/biosolids producer are shown in Table 2. According to our calculations based on the results from this study, canola grown in the Yakima Valley would gross $560 per acre while canola grown in Chelan Douglas County would gross $299 per acre. After costs are included, net per acre in Yakima would be $381 and in Chelan would be $219. This is in comparison to wheat where costs per acre are similar to canola. Revenues for wheat at Emerald Ranches where hard red winter wheat is grown are approximately $294 ($3.68 per bushel with 80 bu/acre average yield). In Chelan Douglas County soft white wheat is commonly grown. Revenue per acre is approximately $185 per acre ($3.36 per bushel with 55 bu/acre yield). This suggests that canola would offer a cost effective alternative to wheat for local growers in both counties.

Table 2. Estimated costs and revenues for a turnkey canola biodiesel program.

	Irrigated		Dryland	
	Costs	Revenue	Costs	Revenue
Biosolids (per acre)				
Transport (3 dt/ac /20% = 15 wt/ac)				
Storing	-		-	
Spreading	-		-	
Overhead & profit	111.00	150.00	111.00	150.00
Municipal tipping fee				
Totals	**111.00**	**150.00**	**111.00**	**150.00**
		39.00		39.00
Canola				
Growing (per acre)				
Planting and tilling				
Seed @ 8 lbs per acre	1.60		1.60	
N@150 lbs per acre[1]	0.00		0.00	
Machinery	14.30		14.30	
Tractor	10.58		10.58	
Fertilizer application[1]	0.00		0.00	
Production labor	10.06		10.06	
Irrigation	80.00			
Harvesting				
Machinery	12.96		12.96	
Custom swath	10.00		10.00	
Labor	5.75		5.75	
Fixed cost machinery	37.74		37.74	
Oil processing (per acre)				
Oil crushing/extraction	30.00	333.25	13.33	215.00
Cake production		226.80		84.00
Storage	5.00		2.22	
Totals	**217.99**	**560.05**	**118.55**	**299.00**
		342.06		180.45
Biodiesel processing (155 g/ac, 100 g/ac)				
Oil costs	333.25		215.00	
Methanol/catalyst[2]	262.88		169.60	
Processing costs	111.60		72.00	
Selling price		444.85		287.00
Glycerin		262.88		169.60
Totals	**707.73**	**707.73**	**456.60**	**456.60**
		0.00		0.00
Grand Totals (per acre)		**381.06**		**219.45**

[1]No cost for fertilizer or fertilizer application; covered in biosolids application.
[2]The cost of methanol/catalyst is assumed to be offset by the value of glycerin.

Growth Plan

Business Plan

The goal for translating our Phase I work into a sustainable portion of our operation is to slowly expand the number of acres planted in canola while simultaneously developing a small scale crushing and biodiesel processing facility; starting with identification of potential partners.

Identifying Partners

In an effort to strengthen our position with biosolids generators, we met with Dave Ruud, manager/owner of Boulder Park xxx to discuss potential partnering on this project. Mr. Ruud grows dryland wheat in Eastern Washington. He is also the lead in the Boulder Park project. Boulder Park and Emerald Ranches are the two largest distribution centers for Class B biosolids produced in Washington State. For example, in 2002, Boulder Park spread 58,000 wet tons of King County Biosolids and Emerald Ranches spread 32,000 wet tons. The Boulder Park project is very interested in cooperating on a biodiesel project.

There are a few factors that are behind this interest. Both Emerald Ranches and Boulder Park are paid by biosolids generators to site appropriate land and apply the Class B biosolids. This is a steady and lucrative source of income for both operations. There is pressure for biosolids generators to produce a Class A product. However, production of Class A biosolids can be much more costly for a municipality than a successful Class B program. One of the primary drivers for developing a Class A program is increased public acceptance; another is significantly reduced restrictions on beneficial use options.

Use of Class A biosolids is not restricted to agronomic crops and rangeland. In fact, the City of Tacoma, WA received an EPA award this year for their development of a series of biosolids products using Class A cake that are suitable for the home gardener. By producing a Class A cake, the municipalities that currently contract with Emerald Ranches and Boulder Park would potentially be able to identify local markets for their materials and would not need to truck the biosolids over the Cascades. Using biosolids to produce biodiesel would be a potential means for municipalities to continue their Class B programs. Biodiesel is attractive as it would provide fuel for the municipalities, is environmentally superior to conventional diesel fuel, and using biosolids to grow fuel reduces public concerns over food chain transfer of contaminants from biosolids. Using biosolids for biodiesel would potentially give both Emerald Ranches and Boulder Park long-term contracts to continue to distribute biosolids for East side municipalities. In addition, it would provide the municipalities with a cost effective and environmentally acceptable alternative to the treatment plant upgrades required to produce Class A biosolids.

As we discussed earlier, canola is an excellent crop for use in a wheat rotation. Currently dry land wheat farmers continuously grow wheat. This allows for invasion of grassy weeds and there is no mechanism to control disease cycles. By integrating canola into a rotation, farmers would be able to spray for grassy weeds and also break the disease cycle. This can potentially have a value Ruud identified these benefits during our meeting but also expressed some concerns. Currently, wheat growers are able to get crop insurance for crops that they have a history of cultivating. For farmers that have not grown canola, it would be important to provide some type of insurance while they were establishing the necessary history of canola cultivation to qualify for federal crop insurance programs.

Another factor which involves serious consideration is the utilization of a program that is already in place to enhance the development of growing canola for biodiesel production. The Conservation Reserve Program (CRP) was established in 1985 to provide that assets would be available, if ever, a famine was on the horizon. The asset – viable farm ground would have the ability to produce for those projected needs within a year. This is a governmental insurance policy for national security paying farmers an average of $48 a year for every acre of ground to be set aside for 10 to 15 years. In 2003, tax dollars paid about $1.7 billion for approximately 35 million acres of grassland. Some of this ground protects environmentally sensitive cropland and is beneficial habitat for migratory birds. This program provides for planting of grassland and thereafter our tax dollars are paying farmers to not farm. Other than creating income for farm families, the economic trickle down remain close to home. CRP has a provision which would allow for the production of seed crops for energy production. It may be possible to initiate utilization where some portion of that $1.7 billion is paid to the farmers to grow oil producing crops like canola on some of the 35 million acres of Conservation Reserve Program ground. Subsidized pricing to enhance the farm gate level becomes catalysis to stir agricultural interest in biodiesel production and provide a base line safety net per acre cost guarantee. As soils return to productivity, an increase will be realized in whole goods purchases (machinery & equipment), employment (disposable income) and rural agricultural communities will begin to revitalize with economic development. Ultimately, the whole process will generate a greater tax base from our rural economies and sustainability. A new industry is created, biodiesel processors that are cleaning, pressing and processing various seed crops into biodiesel. This in turns generates more whole goods purchases (machinery & equipment) and new jobs (disposable incomes). With the sales of biodiesel more revenues are generated to our taxing system, which provides the Federal Government with a financial and environmental return on investment while developing a renewable resource for future generations.

Growth Plan

At our initial meeting we each agreed to plant a minimum of 50 acres in canola for summer 2005 harvest. The agreed vision for expanding the biodiesel production capacity is to begin by growing enough canola to supply at least a portion of the on farm and biosolids distribution needs for both Natural Selection and Boulder Park. As previously discussed, the canola seed will be processed in a small scale facility that will be constructed at Natural Selection. The initial effort will be used for demonstration purposes as well. Farmers in both Yakima and Douglas Chelan counties will be able to see what is involved in growing the canola and processing the seed into fuel. The following year, the goal is to expand the acreage in canola and potentially add another small scale processing facility in Chelan Douglas County. A portion of the diesel produced after the 2nd harvest will be available to smaller municipalities. The ultimate goal of the project is to supply biodiesel for all of the municipalities that contract with Boulder Park and Natural Selection to land apply their biosolids. As we come nearer to achieving this goal, a larger crushing and processing facility would be required. A second component of the operation would be to market the smaller scale facilities that we will use in the initial phase of our operation to farms or farmers cooperatives so that the farmers can produce sufficient biodiesel to meet their on farm demand. Implementing a prototype that is larger than an experimental model, yet, smaller than large scale commercial operation, allows for the opportunity to efficiently manage for any downside financial risk. This concept is extremely important when attempting to demonstrate the long range importance in developing sustainability in agriculture through on farm or cooperative biodiesel production.

Municipal incentives

In addition to the incentives particular to local biosolids programs, there are currently municipal incentives in place in the State of Washington to encourage municipalities to use biodiesel to meet a portion of their diesel fuel requirements. The Clean Cities Coalition has a list of the incentives that are locally applicable (www.pugetsoundcleancities.org). These include:

- HB 1242, 2003 which encourages state agencies to use a B20 blend in all diesel powered vehicles
- RCW 43.19.637 which states that at least 30% of all new vehicles purchased through a state contract must be clean-fuel vehicles. If only conventionally powered vehicles are available, these may be converted to clean fuel or dual fuel use.
- Reference Executive Order 02-03 which states that each Washington state agency is encouraged to establish sustainability objectives and plan to modify its practices re resource consumption and vehicle use including a shift to clean energy for vehicles.

Ron Sims, the King County executive announced on October 26, that King County diesel powered transit vehicles would be required to use a 5% biodiesel blend (http://transit.metrokc.gov/am/vehicles/biodiesel-pilot.html). This is expected to increase demand for biodiesel in state. In addition, it signals a desire on the part of local governmental officials to integrate biodiesel into the municipal infrastructure. Emerald Ranches was invited by Mr. Sims to participate in the ceremony where this policy change was announced.

We have also established connections with Terry Lawhead, CTED, State of Washington. Community Trade and Economic Development. Mr. Lawhead attended both the on farm meeting with the Northwest Biosolids Management Association and the annual conference sponsored by the NBMA. He has also met with Ted Durfey and Chuck Henry about potential grant funding for this project. Through state agencies, there aren't any grant funds available for private sector ventures. However, there is the potential to obtain grant funding for non profit organizations or municipalities. Working with Mr. Lawhead, we have decided to pursue the potential for funding for the NBMA or participating municipalities to cover the difference in cost between conventional diesel fuel and B20. The Washington State ferry system recently received a grant from EPA Region 10 that is being used to purchase biodiesel for its ferries so that there is a precedent within local municipalities to switch diesel powered vehicles to a B20 blend.

Conclusions

The results from our Phase I effort indicate that using biosolids as a fertilizer for canola production can provide a cost effective way to grow canola for biodiesel production. Our next steps will be to translate these results into a full-scale business plan and to start making biodiesel.

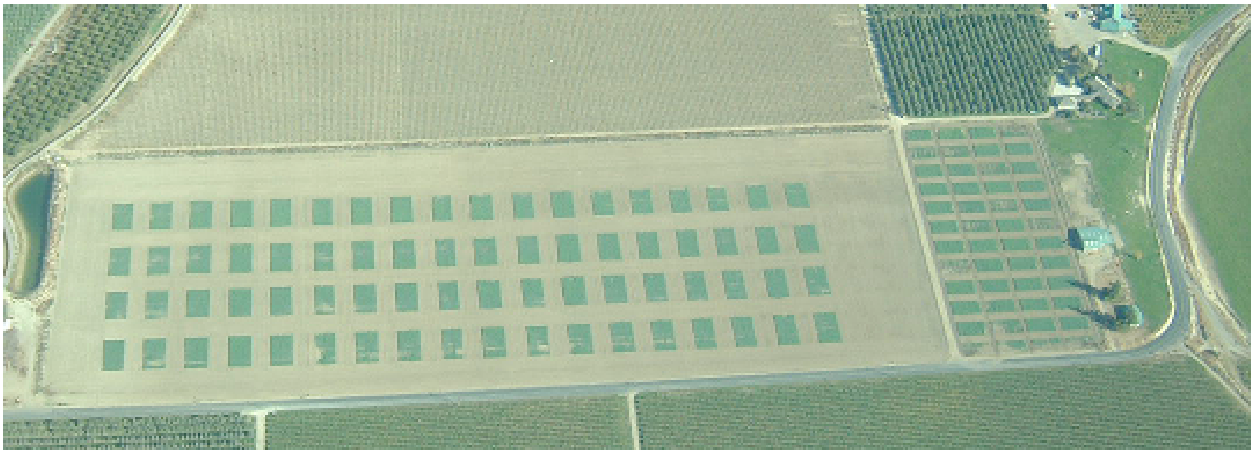

Figure 3. Aerial plot layouts for canola study (taken November 2003).

Figure 4. Canola seed pods (taken June 2004).