# NNY Agricultural Development Program
# 2006-2007 Project Report

## Developing New Cropping System Options for Organic Grain Production in Northern New York

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**Background:**
Organic grain production is one strategy that Northern New York farmers could use to diversify their operations and increase profitability. Fifteen to twenty percent annual increases in the organic food market coupled with the premium prices paid for certified organic grains have prompted many farmers to explore the organic option, and the amount of NNY acreage committed to organic field crop production has increased significantly in recent years.

Cropping system work in the organic rotations at the Cornell E.V. Baker Research Farm has primarily focused on the production of spring and winter wheat, grain-type soybeans, sweet corn, and alfalfa/grass hay. Solid regional markets for certified organic wheat and soybeans have helped to encourage local farmers to experiment with organic cropping systems, and most of the certified organic grain production in the area thus far has focused on these two crops. The challenge now is to find additional crop options that can be effectively and profitably inserted into the rotations. Sunflowers, flax, specialty grain corn, and dry beans have been suggested by organic farmers or marketers as possible options.

**Objectives:**

(1) To develop cropping system strategies to insert sunflowers, organic flax, and dry beans into the organic rotations at the Cornell E.V. Baker Research Farm.
(2) To acquire and test the agronomic performance of available sunflower, flax, and dry bean varieties in replicated, organically managed trials.

**Baker Farm Organic Rotations**:
A six acre field at the Baker Research Farm in Willsboro has been certified organic since 1993. The six acres were divided into ten equal blocks that have been allocated to two five-year rotations (a '*Wheat-Alfalfa/timothy*' rotation and a '*New Crop*' rotation). The *New Crop* rotation initially involved three years of alfalfa/timothy sod, followed by one year of food-grade soybeans, and one year of sweet corn. Two to three years of alfalfa/timothy sod has formed the heart of all our organic rotations. The perennial sod

serves to recharge soil health as it provides an extended period without tillage, fibrous grass roots contribute significant organic matter to the soil system, and alfalfa root nodules fix nitrogen. Weed seed banks are also reduced when the sod is mowed or hayed at regular intervals.

In an effort to diversify the cropping and marketing options in the New Crop rotation, food-grade soybeans were replaced with dry beans, sunflowers replaced sweet corn, and flax followed the sunflowers (essentially taking the place of one year of alfalfa/timothy sod). Inserting sunflowers (*Asteraceae* family) and flax (*Linaceae* family) into the rotation adds two new plant families to the system and could function to reduce the incidence of pathogen and pest problems. The advantage to adding a third annual grain crop to the rotation is that it could improve economic returns over a five year period. The downside of having three annual crops and only two years of alfalfa/timothy sod, is that the soil system has less time to recharge and soil health could potentially be compromised.

## Organic Flax Trials

Flax trials were conducted on *New Crop* rotation blocks 12-O-6 in 2006, and 12-O-9 in 2007. Fields had a Rhinebeck clay loam soil with subsurface drainage.

### *Experimental Designs*

**2006:** Untreated seed for five flax varieties was obtained from the Flax Institute at North Dakota State University. The variety trial employed a randomized complete block design with six replications. Plots were 10' wide, 20' long, and planted at a 7" row spacing. Target seeding depth was 1", and the seeding rate was 56 lbs/acre (1 bu/acre). Three tons per acre composted chicken manure and 500 lbs/acre granulated organic fertilizer (North Country Organics 5-3-4) were applied to the field in 2005. No additional fertilizer was applied. The 2006 trial was planted May 8 and harvested October 10.

**2007:** Six flax varieties were included in the 2007 trial, which followed a plowed down alfalfa/timothy sod in the rotation. Additionally, a topdress fertilizer treatment was incorporated into the study. Fertilized plots received a 500 lb/acre broadcast application of OMRI approved *Northcountry Organics 5-3-4 Pro Gro* granulated fertilizer ten days after crop emergence. A split plot experimental design with four replications was used with the topdress application as the whole plot treatment, and variety as the split plot treatment. Plot size, seeding rate, row spacing, and target planting depth were the same as in 2006. The 2007 trial was seeded May 25 and harvested October 5.

### *Weed Control*

Flax does not compete well for either above or below ground resources, so it is essential to minimize weed pressure. As flax is seeded at a narrow (7") row spacing, few post emergent cultivation options are available, and our strategy was to control the weeds as much as possible prior to seeding the crop. In both trials a late summer fallow period was imposed the year prior to trial establishment. Block 12-O-6 was fallowed following the failed 2005 sweet corn crop; this appeared to greatly reduce annual and perennial weed pressure ahead of the 2006 flax crop. Similarly, in preparation for the 2007 trial, rotation block 12-O-9 was plowed in August 2006 and fallowed for the remainder of the growing season to kill the alfalfa/timothy sod, any perennial weeds that had become established in the sod, and any annuals that may have germinated after the field was plowed.

In addition to the late season fallow periods, an early season stale seedbed strategy was employed to take out the first flush of spring annual weeds prior to establishing the trials in May. With a stale seedbed strategy the field is disced and dragged as soon as the field can be worked in the spring to encourage the germination of spring annual weed seeds. Germinated weeds are then killed by cultivation just prior to seeding the flax. No weed control measures were taken after planting, and weed control in the plots was excellent in both years.

It was interesting to note that in the 2007 trial where there were some "planter skips" at the ends of some of the plots, clusters of annual weeds became established. These weed clusters highlighted the importance of having a dense, solid crop stand to suppress weed growth during the season, even when working with a fairly non competitive crop like flax.

## Results and Discussion

**Entries:**
The 2006 flax trial included four brown seeded varieties and one yellow seeded ("golden") variety (Table 2). A second golden flax variety, *Carter* was also included in the 2007 trial. While yellow and brown seeded varieties do not differ in their composition, the yellow color is considered more desirable for human consumption.

**Flax Yields:**
2006 mean yields ranged from 636 lbs/acre for *Pembina* to 738 lbs/acre for *Omega*, but yield differences were not statistically significant (Table 1). In 2007, the mean yield for *Pembina* was significantly lower than all other entries except *Carter* (Table 1). None of the other varieties differed significantly in yield in 2007.

2007 yields were markedly higher than 2006 yields (Table 1). Higher yields in 2007 may have resulted from greater soil fertility associated with the plowed down alfalfa/timothy sod that preceded 2007 trial, and/or more favorable growing conditions. The months of May and June were exceptionally wet in 2006 (Table 3), and waterlogged clay soils during the first part of the growing season may have resulted in reduced yields.

2006 yields differed significantly with replication block (Figure 1). Yields were significantly higher in replication blocks 1-3 than in blocks 4-6. Blocks 4-6 were located in a lower and wetter section of the field. Lower production in blocks 4-6 is consistent with the idea that wet soils reduced flax yields.

The topdress fertilizer treatment did not effect yields in 2007, indicating that the plowed down alfalfa/timothy sod provided sufficient fertility for the crop.

**Variety Heights:**
Mean plant heights were greater in 2007 than in 2006 (Table 2). Taller plants in the 2007 trial accompanied higher yields and are indicative of more favorable growing conditions. Mean plant height differed with variety in both 2006 and 2007. *Nekoma* and *Pembina*

were consistently among the tallest entries, while *York* was one of the shortest varieties in both years.

In 2007, the topdress fertilizer treatment significantly increased plant height (Figure 2), indicating that the organic fertilizer application influenced plant growth, even if it didn't impact yields.

## Summary

Seed flax varieties bred for upper Midwest growing conditions performed well in northern New York trials in 2006 and 2007. Yields were comparable to those reported for identical entries in NDSU trials (www.ag.ndsu.nodak.edu/willisto/), indicating that these varieties are suitable for production in the northeast. Most varieties did not differ significantly in yield. *Pembina* was the exception as it yielded significantly less than all the other entries except *Carter* in 2007, and had the lowest mean yield in the 2006 trial.

Flax fit nicely into established organic grain rotations at the Cornell Baker Research Farm. A late summer fallow period the year prior to planting, coupled with an early season stale seedbed provided good weed control in both years. No disease, insect or lodging problems were observed in either year.

Flax growth and yield were influenced by weather conditions and rotation sequence. Yields were markedly lower in the 2006 trial which experienced an exceptionally wet May and June, and followed sweet corn in the rotation. In contrast, the 2007 trial followed a plowed down alfalfa/timothy sod and received timely rains. We hypothesized that the heavy rains in 2006 flushed much of the early season available nitrogen out of the soil, so an organic fertilizer topdress treatment was incorporated into the 2007 trial. While the fertilizer application significantly increased plant heights, it did not influence yield as the decomposing alfalfa/timothy sod provided sufficient fertility for the crop.

**Table 1.** Mean yields for flax varieties in 2006 and 2007.

| VARIETY | 2006 MEAN YIELDS (lbs/acre) | 2007 MEAN YIELDS (lbs/acre) |
|---|---|---|
| Rahab94 | 654 a | 1200 a |
| York | 656 a | 1195 a |
| Omega | 739 a | 1187 a |
| Nekoma | 676 a | 1100 a |
| Carter | | 1094 ab |
| Pembina | 636 a | 896 b |
| | LSD 0.05 = 134 | LSD 0.05 = 204 |

**Table 2**. Seed color and mean plant heights for flax varieties in the 2006 and 2007 trials.

| VARIETY | SEED COLOR | 2006 MEAN PLANT HEIGHTS (cm) | 2007 MEAN PLANT HEIGHTS (cm) |
|---|---|---|---|
| Nekoma | Brown | 52.0 ab | 73.4 a |
| Pembina | Brown | 52.0 ab | 72.0 a |
| Rahab94 | Brown | 50.2 b | 66.1 b |
| Carter | Yellow | | 64.6 b |
| York | Brown | 48.0 b | 63.8 b |
| Omega | Yellow | 54.8 a | 59.0 c |
| | | LSD 0.05 = 4.4 | LSD 0.05 = 3.3 |

**Table 3.** Monthly rainfall totals during the 2006 and 2007 growing seasons.

| | Monthly Rainfall Totals on the Cornell Baker Farm (inches) | | | |
|---|---|---|---|---|
| Year | May | June | July | August |
| 2006 | 4.08 | 4.81 | 2.73 | 1.83 |
| 2007 | 1.53 | 1.81 | 4.72 | 0.34 |

**Figure 1.** 2006 flax trial replication block mean yields.

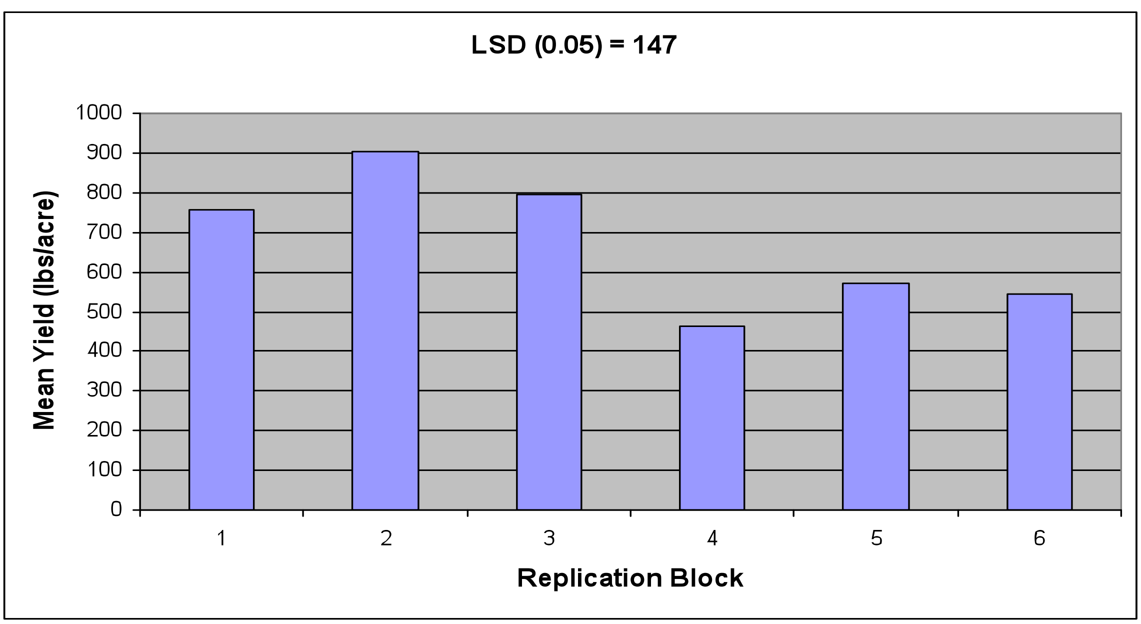
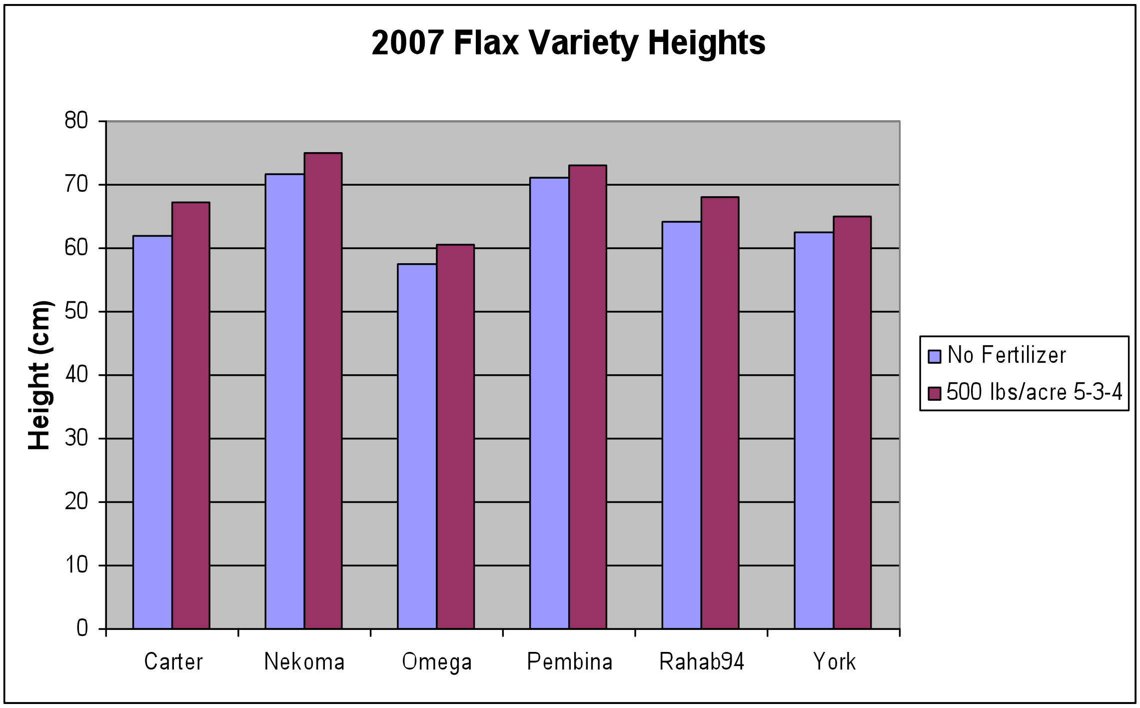


**Figure 2.** Variety plant heights with and without the fertilizer treatment in 2007




## Organic Dry Bean Production

Dry beans replaced food-grade soybeans in the organic 'New Crop' rotation at the Cornell University Willsboro Research Farm in 2006 and 2007. Dry bean trials were conducted on certified organic fields with a Rhinebeck clay loam soil and subsurface tile drainage. The 2006 trial followed a plowed down alfalfa/timothy sod in the rotation and was located on block 12-O-8. The 2007 trial was conducted on block 12-O-7 and followed sunflowers in the rotation.

### *Trial Establishment*

Certified organic seed of four dry bean varieties (Table 4) was obtained from High Mowing Seed Company in Vermont. A randomized complete block trial was designed with six replications in 2006 and four replications in 2007. Trial plots were 10' wide and 20' long, and consisted of four rows with a 30" row spacing between the rows. Target planting depth was 1" and all seed was inoculated with the appropriate *Rhizobium* sp. prior to planting. The 2006 trial was planted on June 16 (seeding was delayed by exceptionally wet weather) and harvested by hand on November 1, 3 and 6. The 2007 trial was planted May 30 and hand harvested October 22.

### *Weed Control*

The weed control strategy for dry beans included both pre-plant and post-emergent cultivation techniques. We always work to control the weeds as much as possible before seeding the crop using late season fallow periods and/or early season stale seedbeds. With dry beans planted at a 30" row spacing, post-emergent blind cultivations with a rotary hoe and between row cultivations with a variety of sweeps can also be employed.

In preparation for the 2006 trial, block 12-O-8 was plowed in August 2005 and fallowed the remainder of the growing season to kill the sod and reduce perennial and annual weed populations. Additionally, a stale seed bed strategy was used to take out two flushes of annual weeds in the spring. In a normal spring the beans would have been planted by mid May, and there wouldn't have been enough time to germinate and cultivate a second flush of weeds, but the delayed planting in 2006 allowed for an additional stale period prior to seeding. Wet weather continued after planting and there were no opportunities to do any blind cultivating with a rotary hoe. The plots were cultivated using sweeps between the rows on July 6, 2006. Weed control in the plots was generally good, primarily due to the effectiveness of the late season fallow period and stale seedbed.

The 2007 trial followed sunflowers in the rotation, so a late season fallow period was not an option. Block 12-O-7 was plowed in November following the sunflower harvest. The field was then disced and dragged in late April 2007 to create a stale seedbed, which was dragged again just prior to seeding the trial on May 30. Plots were cultivated with a rotary hoe (two passes in opposite directions) when the plants were about 4" tall and had their first set of true leaves. This blind cultivation effectively controlled germinating seedlings within and between the dry bean rows. An additional between row cultivation with sweeps was conducted in mid summer.

**Results and Discussion**: Deer browsing damage was observed in the dry bean plots in both 2006 and 2007. Plot damage in 2006 was relatively light and the impact of the deer browsing on bean yields was difficult to assess. In 2007 deer browsing damage was extensive and severe: many plots were completely destroyed, and the plots that were harvestable had markedly reduced yields (Table 4). Three strands of electrified tape surrounded the entire trial in both seasons, but clearly failed to deter the deer in 2007.

Yields varied significantly between the entries in 2006 with Black Turtle averaging over twice the yield of any other variety (Table 4). While we didn't have enough plot samples to run statistical tests on yields in 2007, black turtle yields were again much greater than any of the other varieties.

All four varieties set some pods very close to the ground, making it impossible to mechanically combine the plots without leaving significant numbers of pods in the field. Our inability to mechanically harvest any of the dry bean varieties suggests that they may not be suited to larger scale plantings. Black Turtle has the most potential for mechanical harvesting as it was taller than the other varieties and fewer pods would be missed by a combine.

**Table 4.** Mean dry bean variety yields for 2006 and 2007, and mean variety heights in 2007.

| Source | Variety | 2006 Mean Yields (lbs/acre) | 2007 Mean Yields (lbs/acre) | 2007 Mean Plant Heights (cm) |
|---|---|---|---|---|
| High Mowing Seeds | Black Turtle | 2113.5 | 1019.4 | 31 |
| High Mowing Seeds | Soldier | 953.4 | 327.9 | 27 |
| High Mowing Seeds | Maine Yellow Eye | 685.7 | 327.9 | 23 |
| High Mowing Seeds | Jacobs Cattle | 784.3 | 287.4 | 24 |
| | *Trial Mean* | 1134.2 | 539.9 | 26.6 |
| | *LSD(0.05)* | 149.6 | | |

## Organic Sunflower Production

### *Fertility*

Sunflowers replaced sweet corn in the organic 'New Crop' rotation in 2006 and 2007. Since sunflowers, like sweet corn, are considered fairly heavy feeders, our fertilizer program included both compost and a granular organic fertilizer blend. Three tons/acre composted chicken manure ("Giroux Doo" with an NPK of 2-2-1.5) was broadcast onto the field and incorporated with a disc prior to fitting the field for planting. An additional 200 lbs/acre Northcountry Organics 5-3-4 Pro Gro granular fertilizer was broadcast applied to the plots thirty to forty days after planting.

### *Trial Establishment*

Untreated seed of one edible seed variety (*Mammoth*) and one oil seed variety (*Black Oil*) was obtained from Albert Lea Seedhouse in Minnesota. Two hybrid oil seed varieties, *6949* and *Defender HO* were contributed by Seeds 2000 (Minnesota organization). A randomized complete block test design with four replications was employed. Plots were 10' wide, 20' long, and consisted of 4 rows with 30" between row spacings. Sunflowers were planted with a two row cone planter (two passes per plot) on May 31 in 2006 and May 30 in 2007. Final plot evaluations and harvest data were taken on November 6, 2006 and October 22, 2007.

### *Weed Control*

The weed control game plan for the sunflowers included spring stale seedbeds and between row cultivations with sweeps. In 2006, extensive rains after planting prevented timely cultivations of germinating weeds and the plots were not cultivated with sweeps until 40 days after planting; some between row weeds were set back by this cultivation, but significant weed populations persisted, especially within the row. The 2007 trial received two between row cultivations with sweeps before the crop became too tall to clear with our Allis Chalmers G cultivating tractor.

We did not attempt any blind post-emergent cultivations with the sunflowers. It would be interesting to experiment with either a rotary hoe or a spring tine weeder harrow, to see if they could effectively reduce within row weed populations without damaging the sunflower seedlings. In plots with good crop stands, the sunflowers competed well with the within row weeds that managed to persist.

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## *Results and Discussion*

In both years, all four varieties grew well in plots that had good stand establishment. Mammoth was almost twice as tall as the three oil seed varieties (Table 5). Selected heads were hand harvested in the fall, but extensive bird damage to the heads made it impossible to collect meaningful yield data from either test. If sunflower trials are to be conducted in the future, it will be essential to protect the plots with bird netting. The sunflowers appeared to mature slowly and many heads started to mold and rot before they had dried enough to combine. It is possible that these varieties are either too late maturing for the Northern New York growing season, or they are not well adapted to the climate conditions.

Other sunflower growers in NNY report reduced bird damage with late planted sunflowers (planted at the end of June), claiming that the seeds mature after many of the birds have already migrated south for the winter. A late planting strategy may have some merit for larger scale (multi-acre) plantings, especially given the extended growing seasons we've experienced the past two years. In our relatively small (quarter acre) test plots, however, I would expect the bird pressure to remain high well into the fall.

**Table 5.** Seed type and mean variety heights for the 2006 and 2007 sunflower variety trials.

| Source | Variety | Seed Type | 2006 Mean Heights (cm) | 2007 Mean Heights (cm) |
|---|---|---|---|---|
| Albert Lea Seeds | Mammoth | Edible | 189.6 | 274.0 |
| Albert Lea Seeds | Black Oil | Oil Seed | 156.9 | 145.8 |
| Seeds 2000 | 6946 (hybrid) | Oil Seed | 166.1 | 166.3 |
| Seeds 2000 | Defender HO (hybrid) | Oil Seed | 150.6 | 174.0 |
| | | *Trial Means:* | 189.6 | 190.0 |

## Outreach

Tabulated trial results will be posted on the Northern New York Agricultural Development Program website www.nnyagdev.org, and included in regional extension publications and meetings. A workshop on the organic flax production was presented at the NOFA-NY winter conference in Syracuse, NY, January 27, 2007.


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## For more information:


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