



## CROP ESTABLISHMENT AND SOIL FERTILITY ON MARITIME ORGANIC GRAIN FARMS

*Final Research Report E2008-41*

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### INTRODUCTION

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Crop establishment and vigour are key factors influencing the success of grain crops. Establishment rate is important because it affects crop density and the competitiveness of the crop stand, tillering or branching, days to maturity and yield. The vigour, or health and growth rate, of the crop affects the crop's resistance to diseases and insects, competitiveness with weeds, ability to capture resources, and ultimately yield and quality. High crop establishment rates are key for optimizing yield, competing with weeds and allowing uniform growth and maturity.

Key factors affecting crop establishment are:

- soil fertility
- seed contact with the soil
- depth of planting
- soil temperature & moisture
- seed quality
- predation by insects
- presence of disease
- competition with weeds

Poor crop establishment appears to be a growing problem on organic and conventional farms. Farmers can have significant influence on crop establishment through their seed selection, seed bed preparation, seeding techniques, timing of seeding, soil fertility management and crop rotation planning. Ensuring that crop establishment is optimized not only improves crop performance; it could reduce seeding rates and can be a cost-saving measure for your farm.

Soil fertility is a key factor influencing crop establishment, yield, quality, and weed competition. Organic farmers have to keep good records about soil fertility and the amendments they use for certification purposes.



However, this information has not been compiled and reviewed for farms at a regional level. A controlled soil sampling program for grain producers will provide a baseline for discussing soil fertility issues and could help identify any management concerns for growers. The objective of this study was to find out what the typical crop establishment rates and soil fertility levels were on organic farms in the Maritimes in 2007.

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### WHAT WAS DONE

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In the spring of 2007, planting variables and soil characteristics were measured on 16 organic or transitional farms, comprising of a total of 32 fields currently in organic grain production. Grain crops included barley, oats, hullless oats, wheat and Red Fife wheat (a heritage milling wheat). Soil samples were also collected from mixed crop fields, although establishment and yield data were not collected.

Soil samples were collected in the spring and sent to either the NS or PEI provincial laboratories. Seeding rates were measured through seeder calibration. Samples of seed used to determine kernel weight and germination rate were provided by the farmers. All establishment and yield data were collected from 10 small quadrat samples per field. The June crop density data was collected prior to fingerweeding while July crop density data followed fingerweeding.

## RESULTS – SOIL FERTILITY

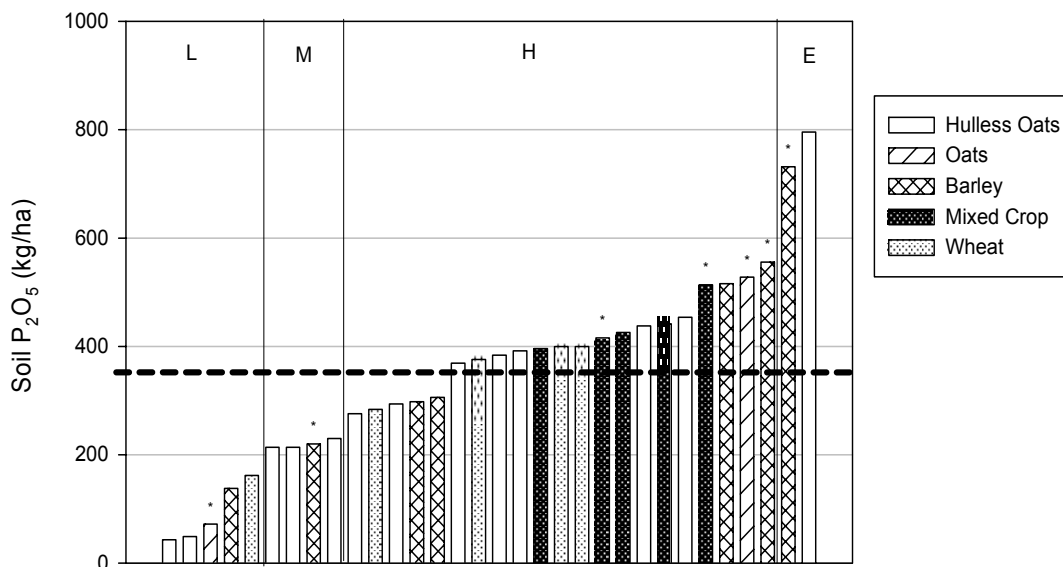
Soil phosphorus (P) levels were higher on average than expected (Figure 1). Many of the farms included in this survey were relatively new to organic, and several of the farms surveyed were dairy farms. For the last few years, researchers have not considered excessive soil P to be a problem on organic farms. These results show that some farms may be adding too much P to their soil, indicating a need to carefully manage nutrient levels. Adequate soil P is critical for crop establishment in cool soils. Excessive P levels in a field can indicate that too much manure is being used and runoff from these fields could negatively affect surrounding water quality. Overall, soil pH and potassium (K) levels (Table 1) were acceptable to good, with the exception of a few fields.

**Table 1. Soil characteristics of organic grain farms in NB and PEI in 2007. Nutrient level ratings as per the Nova Scotia Department of Agriculture**

		Average	Minimum	Maximum
Organic Matter	%	3.62	2.5	5.7
pH		6.32	5.6	7.2
Potassium (K <sub>2</sub> O)	kg/ha	224	19	566
	Rating	M	L-	H+
Calcium (Ca)	kg/ha	2051	1140	3572
	Rating	L+	L-	M
Magnesium (Mg)	kg/ha	185	27	338
	Rating	M-	L-	M

Interestingly, the fields with low soil K did not always correspond with fields low in P. Potassium is an important nutrient for improving crop establishment, and is essential for building strong stems to reduce lodging.

Calcium levels were low, suggesting amendments are warranted to help reduce disease and lodging issues. On average, the ratio of calcium to magnesium (Ca:Mg) was high at 14:1, and ranged from 5:1 to >20:1 (optimum is in the 7-10:1 range). Field specific nutrient management programs are recommended to ensure nutrient supply for crop health.



**Figure 1. Soil phosphorus (P<sub>2</sub>O<sub>5</sub>) levels measured on grain farms in NB and PEI in 2007. The vertical lines on the graph divide the nutrient level ratings into low, medium, high, excessive (based on NSDA ratings). The dashed horizontal line indicates the average soil phosphorus level over all farms and crops. An \* above a bar indicates a dairy farm.**

## RESULTS – ESTABLISHMENT RATES

In cereals, conventional farmers would target 300 plants m<sup>-2</sup> as a minimum stand density. For the cereal crops we sampled, the barley, wheat and hulless oat stand densities were relatively low, but the oat and Red Fife wheat crop densities were over 300 plants m<sup>-2</sup> on average (Table 2).

Establishment rates were particularly low in hulless oats (51%) and Red Fife wheat (52%). For the hulless oat, this is a common problem as seed without a hull is easily damaged and attacked by insects and diseases. Hulless oat is known to have lower germination and establishment due to damage occurring during harvest, storage/handling and planting. Seeding rates need to be increased substantially in this

crop, and seed should have high germination and vigour.

The Red Fife wheat seeding rate was very high (over twice the rate for other wheat); competition among crop seedlings decreased the establishment rate, but produced a good stand density. Barley establishment losses may be associated with higher fungal diseases. With seed treatments becoming common practice, there may not be much resistance to diseases.

Yield results are slightly higher than those reported by the farmer (not shown). This is in part due to the sampling method and timing of sampling which resulted in collection of all heads and kernels. This method would not take into account harvesting losses from the combine.

**Table 2. Average crop parameters measured for various grain crops grown in New Brunswick and Prince Edward Island in 2007**

		Barley	Hulless Oats	Oats	Wheat	Red Fife
Number of fields		5	11	5	2	2
Seeding Rate (kg ha <sup>-1</sup> )	mean	141	178	143	112	180
	range		131 - 210	125 - 180		
Seed TKW (g)	mean	45	32	34	38	26
	range	44 - 45	29 - 36	31 - 36		
Weed Seeds (% of grain sample)	mean	1	5	.	0	.
	range	0 - 2	1 - 13	.		.
Germination Rate (%)	mean	90	68	74	69	74
	range	86 - 92	34 - 80	58 - 98		
Seeding Density (seeds m <sup>-2</sup> )	mean	320	556	395	296	691
	range		452 - 655	347 - 489		
June Crop Density (plants m <sup>-2</sup> )	mean	237	281	304	236	354
	range	196 - 251	191 - 393	281 - 457	233 - 293	350 - 357
Establishment Rate (%)	mean	76	51	68	80	52
	range		31 - 77	43 - 81	79 - 81	51 - 52
July Crop Density (plants m <sup>-2</sup> )	mean	167	194	206	153	279
	range	137 - 187	113 - 317		153 - 154	270 - 287
Heads m <sup>-2</sup>	mean	253	254	248	280	.
	range	203 - 331	145 - 333	186 - 325	274 - 286	.
Harvest TKW (g)	mean	33	35	38	35	35
	range	29 - 41	30 - 45	28 - 53	35 - 36	
Yield (t ha <sup>-1</sup> )	mean	2.5	2.0	3.3	1.7	2.3
	range	1.8-3.8	0.9-3.6	2.5-4.4	1.4-2.0	1.7-3.0

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## RECOMMENDATIONS

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*For good crop establishment, the following practices are recommended:*

- Only plant early (in cold soils) if your soil phosphorus (P) and potassium (K) levels are medium or high
- Rotate crops to avoid disease
- Maintain soil pH between 6.2 and 6.5
- The seeding density of cereal crops should be higher than 350 seeds/m<sup>2</sup> + 25% if fingerweeding
- Select high quality seed with the following attributes:
  - Large kernels
  - Clean of weed seeds
  - Disease free
  - Undamaged
  - High germination and vigour (from last crop year)
- Ensure good seed-soil contact with proper seedbed preparation and good in-furrow packing on the seeder
- Adjust seeding rate for germination and seed size
- Plough sods or green manure crops in at least 3 weeks before planting to avoid toxicity issues
- Seeding depth should be 2-2.5 cm; if required, plant deeper to moisture

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## CREDITS

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**Crop establishment depends on many factors, including having a well prepared seedbed**

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## THE BOTTOM LINE...

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In a survey of Maritime organic or transitional grain producers, soil sampling results revealed the following:

- Soil phosphorus levels were higher than expected,
- Soil pH and potassium levels were acceptable to good, and
- Calcium levels were low.

Grain establishment rates ranged from 51 – 80% with lowest rates for hulless oat and Red Fife wheat. A high seeding rate for Red Fife wheat resulted in an emergence density of 352 plants m<sup>-2</sup>, while other grains ranged from 236 – 304 plants m<sup>-2</sup> prior to fingerweeding. An increase in the number of heads m<sup>-2</sup> or in kernel weight helped grain crops with low initial plant density achieve medium to high yields.

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