MUSKOKA SOIL & CROP

IMPROVEMENT ASSOCIATION

PROJECT COMMITTEE'S PROGRESS REPORT

PHASE 2

1992

NUTRITIONAL REPORT

INTRODUCTION

Phase Two of the Muskoka Soil and Crop Improvement Association consists of a continuation of our soil sampling and leaf analysis project of 1991. Feed analysis of the 1992 Hay crop were also received for the benefit of our livestock producers who co-operated in this project.

Tables showing the results of the Soil, Leaf and Feed Analysis are shown in the same as 1 Phase One report (Tables 1 through 4).

On learning from Phase One that eleven out of twelve soil tests indicated that the micro-nutrient Boron was either low or deficient, the Project Committee decided to apply Solubor at the equivalent of two pounds per acre to some of the vegetable test plots of our co-operators. Leaves were sampled from sprayed and unsprayed plants. Differences if any are shown in Tables 5A and 5B.

One co-operator applied Borax in the furrow prior to planting peas at 2 oz. per 25 feet of row.

Our hay-pasture co-operators were unable to spray Solubor on their hay-pasture fields because of time and weather conditions. A fairly wet year. Hay feed analysis is shown in Table 6.

Information regarding micro-nutrients is included at end of report.

All analysis was done by Agri-Food Laboratories in Guelph.

TABLE 1 - SHOWING CROP GROWN - SOIL pH AND ORGANIC MATTER

1991 FARM NO.	1	2	3	4	5	6	7	9	10	11	12	13	
CROP GROWN	Peas	Strawbry. New Plantg.	Home-Mixed Garden	Snapbeans	Potato	Sweet Corn	Turnip	Hay Pasture	Hay Pasture	Low Field Hay Pasture	Hay Pasture	Hay Pasture	
1992 FARM NO.	1	2	3	4	5	6	7	8	9	10	11	12	Average
Soil pH	7.4	4.5	5.6	5.7	5.9	4.9	6.3	5.5	6.6	6.3	5.9	5.9	5.9
Organic %DDM Matter	4.5	4.8	4.5	5.4	3.6	3.9	4.9	4.4	5.2	4.3	5.2	5.0	4.5

TABLE 2 - ACTUAL % BASE SATURATION OF CEC?

Potassium	6%	3%	2%	4%	2%	2%	4%	2%	1%	4%	1%	1%	3.5%
Magnesium	8%	4%	4%	8%	2%	2%	15%	11%	35%	19%	16%	7%	19%
Calcium	76%	13%	29%	29%	18%	7%	70%	20%	55%	57%	35%	31%	41.5%
Soil CEC	15	19	13	14	11	13	11	18	17	6	20	14	13

TABLE 3 - MAJOR AND MICRO NUTRIENT ANALYSIS

Phosphorous	Ex.	Xtra	Xtra	Xtra	Adeq.	Adeq.	Adeq.	Low	Adeq	Adeq	Adeq	Adeq	Key
Potassium	Xtra	Adeq	Low	Adeq	Def	Low	Adeq	Adeq	Def	Low	Low	Def	
Magnesium	Adeq	Low	Def	Adeq	Adeq	Def	Adeq	Adeq	Ex	Adeq	Xtra	Adeq	Deficient-Def
Calcium	Xtra	Def	Low	Low	Def	Def	Xtra	Low	Xtra	Low	Adeq	Adeq	Low
Zinc	Ex	Adeq	Ex	Ex	Def	Def	Def	Low	Adeq	Adeq	Adeq	Ex	Adequate-Adeq
Manganese	Xtra	Xtra	Adeq	Xtra	Adeq	Adeq	Adeq	Adeq	Xtra	Adeq	Adeq	Adeq	Extravagant-Xtra
Copper	Xtra	Adeq	Adeq	Adeq	Adeq	Adeq	Adeq	Def	Adeq	Def	Def	Def	Excessive-Ex
Iron	Adeq	Xtra	Xtra	Ex	Xtra	Xtra	Xtra	Xtra	Xtra	Xtra	Xtra	Xtra	
Boron	Low	Def	Def	Low	Def	Def	Def	Def	Low	Def	Def	Def	
Farm No.	1	2	3	4	5	6	7	8	9	10	11	12	KEY

TABLE 4

SHOWING NUMBER OF FARMS EITHER
DEFICIENT, LOW, ADEQUATE, EXTRAVAGANT OR EXCESSIVE
IN THE NINE ELEMENTS TESTED

NUTRIENT RANGE	PHOS.	POT.	MAG.	CAL.	ZINC	MAN.	COP.	IRON	BORON
Deficient	0	3	2	3	3	0	4	0	9
Low	1	4	1	4	1	0	0	0	3
Adequate	7	4	7	2	4	8	7	1	0
Extravagant	3	1	1	3	0	4	1	10	1
Excessive	1	0	1	0	4	0	0	1	0
TOTAL FARMS TESTED 12									

TABLE 5A

LEAF ANALYSIS RESULTS

NO BORAX OR SOLUBOR

CROP GROWN	PEAS	STRAW BERRY	SNAP BEANS	POTATO	CORN	TURNIP	NUTRIENT AVERAGE	AVERAGE NUTRIENT RANGE
FARM NO.	1	2	4	5	6	7		
Nitrogen %	6.36	2.08	5.26	2.75	3.03	5.61	4.22%	High
Phosphorous %	.54	.26	.46	.18	.31	.65	.41%	Medium
Potassium %	3.41	1.79	3.38	2.14	2.64	4.16	2.97%	Low
Magnesium %	.33	.21	.29	1.05	.18	.27	.615%	Medium
Calcium %	1.44	.49	1.41	1.41	.41	1.91	.925%	Low
Zinc PPM	57.74	39.36	41.17	11.43	19.48	50.84	39.50	Low
Manganese PPM	44.79	150.34	45.63	83.00	132.86	31.90	91.12	Medium
Copper PPM	10.45	7.91	14.38	5.46	6.49	7.47	9.97	Medium
Iron PPM	99.05	182.49	339.78	218.68	159.34	101.19	219.41	High
Boron PPM	29.36	29.67	25.29	30.31	5.49	20.43	17.90	Medium

TABLE 5B

LEAF ANALYSIS RESULTS

	BORAX PRE-PLANT	Solubar Spray Equiv. of 2 lb/acre.						
CROP GROWN	PEAS (1)	STRAW BERRY	SNAP BEANS (2)	POTATO	CORN	TURNIP (3)	NUTRIENT AVERAGE (4)	AVERAGE NUTRIENT RANGE (5)
FARM NO.	1	2	4	5	6	7		
Nitrogen %	5.63	2.25	5.69	3.30	3.39	N.A.	3.97	High
Phosphorous %	.49	.25	.62	.22	.30	N.A.	.42	High
Potassium %	2.90	1.77	2.96	2.00	2.62	N.A.	2.36	Low
Magnesium %	.27	.22	.27	1.14	.23	N.A.	.68	Medium
Calcium %	2.21	.55	1.28	1.28	.47	N.A.	1.68	Medium
Zinc PPM	69.50	22.97	50.42	12.96	19.96	N.A.	44.73	Low
Manganese PPM	52.50	147.35	51.42	115.71	89.32	N.A.	99.38	Medium
Copper PPM	8.00	7.49	16.47	6.48	7.98	N.A.	11.98	Medium
Iron PPM	79.00	157.34	648.52	191.02	142.71	N.A.	363.76	High
Boron PPM	50.00	103.89	1088.36	1097.25	27.44	N.A.	557.90	High

1. The results of the pre-application of Borax to planting would show that a more reasonable improvement is seen in the leaf analysis of Born the first year of the two years to which applications of Boron are expected to reach their potential.

2. The low toxicity levels and high moisture conditions were not considered when solubar was applied. Consequently, most of the leaf (canopy) was destroyed. However, buds and sets came on to supply a harvest. The plants did not suffer from mould damage due to the damp and humid season, which affected the unsprayed crop.

3. Because of weather conditions and the time element, Solubar was not applied to this crop.

4. As may be noticed, Tables 5A and 5B for Leaf Analysis are set up differently than the Leaf Analysis Table 5 contained in the Phase One report of 1991. This was done to show two important facts.

First: The difference in nutrient readings in Table 5B from those in Table 5A, with the exception of peas, could be attributed to one of the following reasons. Either the Soil Testing Laboratory's "margin of error" is showing; soil nutrient levels were different where non-sprayed and sprayed plants were grown, the application of foliar sprays such as Boron could either help or restrict the plants' ability to acquire the other necessary nutrients shown, or all three.

The higher levels of Boron in Table 5A - 1992 over Boron levels in Table 5 - 1991 are likely due to the higher soil moisture content and humidity experienced in 1992, as both these tables show analysis of plants which were not treated with Boron.

Second: By giving a "Nutrient Average" and "Average Nutrient Range", it is shown that to give a reasonable picture of our overall nutrient reserves or capabilities is impossible. This is shown clearly by comparing Farm 1 - Peas, where Boron was added to the soil and where Solubor was sprayed. The high concentrations noted re: strawberries, beans and potatoes cannot be accepted as averages, at least with regards to soil fertility, plant health, or nutritional values. Farm 1 - Peas show only a modest increase in Boron which would seem more acceptable as these plants derived this nutrient directly from the digestive systems of the soil and plant.

If a future project of this kind is considered, may it be suggested that necessary micro-nutrients be added either directly to the soil or via a fertilizer mix by all participating producers. Although foliar sprays may remedy some individual deficiencies of individual crops, this method can only be considered a quick-fix after the fact.

Application of micro-nutrients as suggested above would give producers a more accurate picture through future analysis on soil fertility and nutritional values. This would be particularly so with long standing crops such as hay pasture, berry plantations, orchards and moderate to large scale vegetable producers who have a five year or longer rotation system.

It was also noted that, with the exception of the snap beans, no appreciable difference in visual observation was seen between sprayed and non-sprayed crops. Having observed this, a very interesting picture may have developed if the finances had been available to have a sample of beans, potatoes and strawberries sent for a vitamin-nutrient analysis. This may have shown us the relationship of micro-nutrients from the leaf to the mature fruit or vegetable.

5. The nutrient averages and ranges in Table 5B were calculated using Michigan State sufficiency ranges for vegetables and potatoes. Farm No. 2 (strawberry) was included in the vegetable range. As shown in the Phase One Report, some Ontario micro-nutrient values are not available at this time. After comparing Michigan, Manitoba and available Ontario values, it was found that in most cases these values were not too far out of line with each other. As the Michigan values covered all of the nutrients tested in this report it was decided that these values would help to simplify and make this report more complete.

TABLE 6
FEED ANALYSIS

	FARM 9			FARM 10			FARM 11			FARM 12			FARM 13		
	ANALYSIS		EXPECTED	ANALYSIS		EXPECTED	ANALYSIS		EXPECTED	ANALYSIS		EXPECTED	ANALYSIS		EXPECTED
	AS FED	DRY MTR	RANGE	AS FED	DRY MTR	RANGE	AS FED	DRY MTR	RANGE	AS FED	DRY MTR	RANGE	AS FED	DRY MTR	RANGE
Moisture %	11.3			9.8			53.7			9.4			7.8		
Dry Matter %	88.7			90.2			46.3			90.6			92.2		
Crude Protein %	9.19	10.37	6.55-12.82	16.97	18.81	8.68-15.64	5.41	11.69	12.17-19.43	15.70	17.33	15.02-20.37	5.76	6.25	15.02-20.37
Calcium %	.39	.44	.34- .86	1.27	1.41	.51- 1.27	.19	.42	.79- 1.62	.74	.81	1.00- 1.76	.29	.32	1.00- 1.76
Phosphorous %	.10	.12	.14- .25	.32	.36	.17- .27	.09	.21	.21- .31	.25	.28	.21- .34	.10	.11	.21- .34
Magnesium %	.17	.20	.10- .23	.43	.48	.15- .31	.09	.20	.14- .31	.25	.28	.18- .34	.17	.19	.18- .34
Potassium %	1.39	1.57	1.32- 2.42	3.64	4.04	1.39- 2.33	1.04	2.24	1.75- 2.79	2.58	2.58	1.49- 2.52	1.08	1.17	1.49- 2.52
Acid Pet. Fibre	40.21	45.38	34.00-42.00	38.08	42.22	33.00-41.00	16.97	36.66	33.00-42.00	30.03	33.15	28.00-37.00	43.31	47.02	28.00-37.00
T.D.N. (EST)	45.24	51.07	54.59-63.00	48.91	54.23	55.29-62.59	27.45	59.59	54.40-62.59	56.13	61.96	58.79-66.09	46.69	50.69	58.79-66.09
Net Energy (LAC)	1.00	1.13	1.21- 1.41	1.09	1.21	1.23- 1.40	.61	1.33	1.21- 1.41	1.27	1.40	1.29-1.50	1.03	1.12	1.29- 1.50
CA:P RATIO		3.66:1			3.94:1			2.00:1			2.92:1			2.90:1	
Overall Average 1992-1991*	UP		DOWN	UP		DOWN	UP		SAME	UP		UP	DOWN		SAME

* The overall average or difference shown above is only a rough estimate of the complete analysis. Each producer can evaluate differences in one or more specific nutrients by comparing their 1991 and 1992 analysis keeping in mind that 1991 was a drier year than 1992.

The increasing importance of micro-nutrients not only with regards to soil fertility, abut also to the health and the physiological well being of livestock, should encourage producers to learn the relationships and interactions of different micro-nutrients concerning animal health.

Iodine, cobalt, calcium, phosphorous, potassium, copper and magnesium are just some that are well-known. With few exceptions, most nutrients in hay-pasture forages are derived from the soil. This would indicate that soil fertility and hay or pasture quality go hand-in-hand.

As an example, there is a growing suspicion that a soil low or deficient in the micro-nutrient boron may have a detrimental effect on livestock with feed fed from or livestock pastured on these soils. It would seem that this deficiency may have a direct influence on the ability of the animal to assimilate calcium.

With this in mind, and also noting that all of the hay pasture soil analysis show low or deficient readings for boron, hay-pasture producers would be encouraged to get as much information on this subject from all sources and keep up with all micro-nutrient information as it becomes available. A soil or feed analysis for calcium content may not help if the animal is unable to get the calcium it needed regardless of the soil or forage analysis, unless the analysis included boron. Boron could well beocme a necessary major micro-nutrient essential for high quality forage and animal health.

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Many thanks must go to all who helped finance, participate in, and complete this report; especially the office staff in Huntsville and Gordon Mitchell.

Respectfully Submitted,

S. John McLaughlin
Chairman
Project Committee

RECOMMENDED READING

Boron in Agriculture	- 3 pages	)
		)U.S. Borax
Boron Deficiency Symptoms and Treatment	- 1 page	)
Secondary and Micro-Nutrients for Vegetable and Field Crops	- Co-op. Ext. Service Michigan State University	
The Invisible Hand (Managing microbes to Promote Soil Fertility)	- 3 pages	)Brice Walsh
Best Management Practices re Nutrient Management and Field Crop Production	- Agriculture Canada & O.M.A.F.R.A.	

PLANT FOOD UTILIZATION

Approximate Pounds of Plant Food Nutrients Required to Produce Good Yields of Various Crops

Cereal & Feed Grains		N	P_2O_5	K_2O	Mg	Ca	S	B	Zn	Mn	Fe	Cu
Barley (grain & straw)	100 bu.	140	55	145	15	24	18	.12	.30	.75	.75	.10
Corn (grain & stover)	200 bu.	300	120	260	40	42	32	.19	.57	1.35	1.40	.15
Oats (grain & straw)	100 bu.	105	43	130	15	15	18	.07	.24	.50	.65	.07
Rice (grain & straw)	150 bu.	156	60	160	17	24	18	.07	.15	.90	.75	.06
Rye (grain & straw)	50 bu.	85	33	60	9	16	15	.05	.13	.45	.30	.05
Sorgnum (milo) (grain & stover)	180 bu.	280	125	297	41	68	34	.15	.51	.71	.90	.11
Soybeans (beans & straw)	60 bu.	330	72	144	27	102	27	22	.20	.75	1.05	.14
Wheat (grain & straw)	75 bu.	158	54	120	18	19	17	.08	.34	55	.70	.09
Forges (dry hay basis)												
*Alfalfa	10 Tons	600	140	500	50	280	50	.70	.65	1.10	1.50	.18
Blue Grass	4 Tons	140	48	140	15	32	16	.09	.24	55	.70	.06
Coastal Bermuda	10 Tons	500	80	400	45	75	60	.18	.48	.90	1.05	.12
Fescue	5 Tons	210	70	235	24	45	22	.10	.25	.65	.80	.08
Orchard Grass	6 Tons	270	84	330	26	48	33	.12	.30	.70	.85	.08
*Red Clover	5 Tons	280	62	225	30	120	25	.30	.35	.50	.65	.11
Timothy	5 Tons	180	67	280	18	40	18	.11	.31	.45	.70	.08
Fruits & Vegetables												
Apples	500 bu.	88	38	160	20	50	20	.09	.11	.28	.36	.05
Cabbage	30 Tons	195	72	210	30	72	66	.22	.23	.40	1.10	.06
Celery	50 Tons	260	110	500	40	130	70	.40	.38	.95	1.20	.12
Cucumbers	20 Tons	180	60	300	40	160	32	.28	.36	.85	1.05	.11
Grapes	10 Tons	85	30	130	15	30	22	.12	.28	.50	.60	.10
Lettuce	20 Tons	140	46	200	14	56	16	.12	.20	.45	.50	.08
Oranges	30 Tons	270	60	270	42	210	30	.48	.55	1.05	1.15	.14
Peaches	600 Bu.	96	38	120	24	90	21	.12	.26	.60	.80	.08
Potatoes	25 Tons	250	110	350	32	70	25	.18	.25	.60	1.00	.11
Tomatoes	35 Tons	245	77	400	42	77	49	.28	.42	1.15	1.50	.17
Other Crops												
Cotton	3 bales	225	90	150	36	84	39	.36	.28	.60	.80	.09
*Peanuts	5000 Lbs.	300	58	215	31	102	28	.31	.30	.80	1.20	.10
Sugar Beets	30 Tons	255	54	420	51	90	45	.24	.31	.65	1.00	.08
Sugar Cane	100 Tons	360	160	620	80	110	80	.22	.58	1.35	2.25	.23
Tobacco (burley)	4000 Lbs.	240	56	260	48	140	44	.19	.24	1.05	1.15	.10

These figures may vary with soil type, balance of nutrient levels in the soil, seasonal conditons, moisture levels and crop variety.
*Legumes normally get 50 to 65% of their nitrogen from the air.

TABLE 4. Relative response of selected crops to micronutrients.[1]

Crop	Response to Micronutrient					
	Mn	B	Cu	Zn	Mo	Fe
Alfalfa	medium	high	high	low	medium	medium
Asparagus	low	low	low	low	low	medium
Barley	medium	low	medium	medium	low	high
Beans	high	low	low	high	medium	high
Blueberries	low	low	medium			
Broccoli	medium	medium	medium		high	high
Cabbage	medium	medium	medium		medium	medium
Carrots	medium	medium	medium	low	low	
Cauliflower	medium	high	medium		high	high
Celery	medium	high	medium		low	
Clover	medium	medium	medium	low	medium	
Cucumbers	high	low	medium			
Corn	medium	low	medium	high	low	medium
Grass	medium	low	low	low	low	high
Lettuce	high	medium	high	medium	high	
Oats	high	low	high	low	low	medium
Onions	high	low	high	high	high	
Parsnips	medium	medium	medium			
Peas	high	low	low	low	medium	
Peppermint	medium	low	low	low	low	low
Potatoes	high	low	low	medium	low	
Radishes	high	medium	medium		medium	
Rye	low	low	low	low	low	
Sorghum	high	low	medium	high	low	high
Spearmint	medium	low	low	low	low	
Soybeans	high	low	low	medium	medium	high
Spinach	high	medium	high		high	high
Sudan grass	high	low	high	medium	low	high
Sugar beets	medium	high	medium	medium	medium	high
Sweet corn	high	medium	medium	high	low	medium
Table beets	high	high	high	medium	high	high
Tomatoes	medium	medium	medium	medium	medium	high
Turnips	medium	high	medium		medium	
Wheat	high	low	high	low	low	low

[1] The crops listed will respond as indicated to applications of the respective micronutrient when that micronutrient concentration in the soil is low.