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ABSTRACTS

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POTATO CROP RESPONSES TO SOIL AND WATER MANAGEMENT

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A three-year study of soil and water management in potato cropping systems was completed during 1994. This work was supported by the Aroostook Water & Soil Management Board via U.S. Army Corps of Engineers Funding and by several other grants obtained by University of Maine researchers. Growth, yield, and quality responses of 1993 and 1994 potato crops receiving varied supplemental irrigation programs will be reported. An alternative method of enhancing crop water status by "improving" the soil and enhancing its ability to supply water to the potato crop was also studied.

In one experiment, we examined the effects of drought stress and varying supplemental irrigation programs on growth and productivity of four potato varieties ('Superior', 'Atlantic', 'Shepody', and 'Russet Burbank'). Supplemental irrigation was applied with an overhead sprinkler system utilizing scheduling based on gypsum moisture blocks. During both growing seasons (1993 and 1994), "drought" imposed from mid-July to late August with "rain-out" shelters reduced plant biomass production, leaf growth, and tuber yields (yield reduction: 17% for 1993 and 25% for 1994). Yield loss in response to the "drought" was greater for 'Superior' and 'Russet Burbank' (-19% and -22%, respectively) than for the other two varieties (-14%) during 1993, while 'Russet Burbank' displayed the greatest yield loss (-39%) during 1994. Supplemental irrigation very slightly increased yields during 1993 (6%, not statistically significant) with few effects on tuber size or external quality. The 1994 growing season was drier than 1993 and consequently, supplemental irrigation strongly and significantly increased tuber yields and size (Table 1). 'Atlantic' and 'Superior' displayed more yield response to irrigation than 'Russet Burbank' and 'Shepody'. Specific gravity declined with increased irrigation during 1994. Percent rot increased with increasing levels of supplemental irrigation during both growing seasons. During 1994, the increase in tuber rot was correlated with incidence of late in the crop foliage. Biomass and leaf area index measurements during 1994 confirmed the irrigation treatment's effectiveness at reducing plant water stress, especially from mid-season onward. Preliminary analysis of leaf water potential and leaf temperature data indicate that the supplemental irrigation treatments significantly reduced plant water stress.

A second field study, examined soil improvement with organic amendments (cull potato compost and animal manure) and/or green manure crops as alternatives to the use of supplemental irrigation for water management. During both growing seasons (1993 and 1994), early crop growth (cv. 'Superior') and late-season haulm vigor were strongly enhanced by the amendment treatment. Irrigation enhanced mid-season crop growth during 1994, enhanced late-season haulm vigor, and significantly improved plant water status. U.S.#1 yields were increased by 29 cwt/A (15%) and 70 cwt/A (29%) by the soil amendment treatment during 1993 and 1994, respectively. Rotation crop did not affect yield, tuber size or quality during either growing season. Supplemental irrigation did not increase yields during 1993, but increased U.S. #1 yields by 83 cwt/A (36%) during 1994 (Table 2). Irrigation greatly reduced tuber specific gravity during 1994, while use of the soil amendment did not. Tuber size was enhanced by irrigation and by soil amendment use during 1994. During both growing seasons,

supplemental irrigation and soil amendment treatments resulted in greater tuber rot incidence; however, the effect of irrigation was much greater than that of the soil amendment.

Table 1. Irrigation Effects on Yield and Selected Quality Attributes of Four Potato Varieties. Presque Isle, Maine -- 1994.

Irrigation Treatment	Yield (cwt/A)					% Rot	Spec. Grav.
	Total (4-Variety Average)	US#1 >2-1/4" Atl.	US#1 >2-1/4" Sup.	US#1 >4oz. R.B.	US#1 >4oz. Shep.	(storage)	
Artificial Drought "Rain-out"	224	149	165	130	157	0.1	1.084
Rain-fed Check	299	174	208	270	249	0.4	1.093
Slight Irrig.	353	280	283	288	296	0.2	1.084
Mod. Irrig.	378	316	320	275	318	1.0	1.080
Frequent Irrig.	389	316	360	281	296	3.7	1.080
Excess Irrig.	387	301	340	288	324	5.2	1.080
Irrigation Effect	**					**	**

Table 2. Irrigation and Soil Amendment Effects on Yield and Selected Quality Attributes of Superior Potatoes. Presque Isle, Maine -- 1994.

Irrigation Treatment	Soil Amend.	Yield Tot.	Yield US#1 >2-1/4"	% >2-1/2"	% Rot (field)	Spec. Grav.
No Irrigation	-	219	147	30	0.07	1.093
	+	279	204	40	0.14	1.092
Reduced Irrig.	-	269	201	40	0.39	1.082
	+	361	284	49	0.40	1.082
Moderate Irrig.	-	304	232	45	0.69	1.079
	+	371	298	57	1.59	1.077
Irrigation Effect		**	**	*	**	**
Amendment Effect		**	**	**	**	NS
Interaction		NS	NS	NS	**	NS

AROOSTOOK WATER AND SOIL MANAGEMENT PROJECT: A SOILS PERSPECTIVE

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ABSTRACT

The results of a multi-year study of soil and water management in potato cropping systems are discussed. This project consists of two experiments examining the effects of levels of water availability on tuber yield and quality of four potato varieties, and the effects of soil amendment, crop rotation and supplemental water treatments on tuber yield and quality of a single variety. Experiment II, the focus of this summary, consists of three irrigation treatments (rainfall only, reduced and moderate) on four soil amendment (-/+) and crop rotation (oat/green manure) combinations. Our report focuses on the 1993 and 1994 responses of the soil and the potato crop to the amendment and rotation treatments.

INTRODUCTION

Production of a quality potato crop depends upon an adequate and consistent supply of water and nutrients. For decades, this has been accomplished through the application of external inputs (irrigation, fertilization, etc.). This continues even today, however, in some regions the increases in inputs do not necessarily deliver comparable increases in output. In retrospect, perhaps adequate inputs have, in general, been available, but have not been efficiently managed. Fundamental deficiencies in soil quality may exist that, when corrected, will lead to less reliance on external inputs. Furthermore, soil resource management may be more accessible to growers than an input system (an irrigation system, for example).

Responses in Soil Physical Properties (Experiment II).

Bulk Density. Organic matter addition did not statistically affect soil bulk density. Bulk density for amended plots was the same or slightly lower than the unamended plots. It is possible that density improvements are real, but may require more time to evolve due to deficient organic matter levels. Amount of rock fragments may influence or mitigate expression of treatment effects. Similar results have been found in other on-farm studies.

Water Stable Aggregates The combined application of compost and manure within the irrigation/soil management experiment has resulted in significantly enhanced soil structure as measured by water stable aggregate content. In 1993, total water stable aggregate content of the soil increased from 34% to 40% (d.w. basis) after a single season of application. Results from similar studies conducted