Potato

Canada-Saskatchewan Irrigation Diversification Centre

Cultivar Specific Fertility Management

Research Highlights: March 2001

Introduction

Sixteen nutrients are essential for plant growth and development. Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca) and Sulphur (S) are required in relatively large amounts. In Saskatchewan, nitrogen and phosphorus are the two most limiting nutrients for crop production including potato.

Potato cultivars are divided into three maturity classes: early, mid-season, and late (Table 1). Nutrient management can vary to optimize tuber yields, size distribution, and quality for the diverse maturity classes. Early maturing cultivars require high rates of nutrients early in the growing season, and therefore respond best to preplant fertilization. Later maturing cultivars use nutrients over a longer growing period. In regions with long growing seasons, potato crops respond positively to split application of N (pre-plant and post-emergent). The post-emergent N can be applied as granular fertilizer or through fertigation. Saskatchewan has a relatively short growing season and potatoes will have less time to respond to later applications of fertilizer.

Nitrogen (N)

Nitrogen plays a key role in vegetative growth and in tuber production. Supplemental N should be applied based on soil sampling and foliar tests to optimize yield. Symptoms of N deficiency include early senescence, higher susceptibility to disease, and lower yield. Excess nitrogen can delay maturity, lower specific gravity, reduce potato yield and adversely affect processing quality. High N levels can result in undesirable darker fry colour.

The quality of table and processing potato tubers is closely related to soil fertility and moisture. There is a trade-off between yield and quality at high levels of nitrogen and water. Producers are advised to apply recommended amounts and appropriate types of N fertilizer. Assessing your soil's nutrient status is the first step in designing an effective nutrient management program. Soil testing should be done, in the spring or fall, to identify levels of available micro and macronutrients and design the fertility program accordingly.

Nitrogen moves readily through the soil and is subject to leaching, particularly in the light irrigated soils suited for potato production. Excessive or inappropriate use of N can significantly increase the cost of production and may lead to environmental pollution through gaseous loss and nitrate contamination of ground and surface water.

The Canada-Saskatchewan Irrigation Diversification Centre (CSIDC) is conducting research to develop cost effective fertility management practices for commercial potatoes suited for Saskatchewan growing conditions. This includes the effects of different sources, rates, and timing of N for both seed and consumption grade potatoes.

N Source: Urea versus Ammonium Sulphate

Previous studies have shown variable responses by different cultivars to N sources. The 1998 to 2000 tests at CSIDC examined the effects of urea and ammonium sulphate at three rates of application (100, 200, 400 kg

Table 1. Yield and processing quality for commercial potato cultivars grown in Saskatchewan in response to nitrogen application.

Cultivar	Maturity Class	Market Class	Optimum N Range kg/ha*	Tuber Yield Potential T/ha (Cwt/ac)		Tuber Specific Gravity	Fry Colour^
				Seed	Consumption		
Russet Burbank	Late	French Fry	150-200	43.6 - 54.0 (389 - 482)	39.4 - 48.5 (352 - 433)	1.078 - 1.096	0
Ranger Russet	Late	French Fry	150	46.7 - 59.6 (417 - 532)	37.8 - 510 (337 - 455)	1.082 - 1.105	0
Shepody	Mid	French Fry, Table	150-200	50.1 - 61.1 (447 - 545)	47.3 - 57.6 (422 - 514)	1.065 - 1.094	00
Russet Norkotah	Mid	Table	150-200	46.8 - 64.6 (418 - 577)	34.1- 59.9 (304 - 535)	1.076 - 1.086	1
Norland	Early	Table	150-200	44.0 - 486 (393 - 434)	42.1 - 44.5 (376 - 397)	1.069 - 1.071	1

* 150 kg/ha = 135 lb/ac; 200 kg/ha = 180 lb/ac.
^ Fry colour: lightest colour (highest quality) = 000; darkest colour = 4.

N/ha; 90, 180, 360 lb N/ac) on tuber yield and specific gravity for Norland, Russet Norkotah, Russet Burbank, and Shepody potatoes.

The yield response to N source was variable between the two years. In 1999-2000, ammonium sulphate produced higher seed and consumption grade yields for all cultivars compared to urea. By contrast, ammonium sulphate and urea produced similar yields in 1998. Further studies are needed to determine the effects of N source in relation to growing conditions, on yield and quality for various cultivars and the market classes for which the crop is grown.

N Rates

Potato yield response and quality characteristics (specific gravity and fry colour) were examined over a wide range of N levels (50, 100, 150, 200, 400 kg N/ha; 45, 90, 135, 180, 360 lb N/ac). The study included Ranger Russet, Shepody and Russet Norkotah potato. Spring soil tests indicated 30-35 kg N/ha (27-32 lb/ac) at 0-30 cm (0-12 in) depth.

For Ranger Russet, 150 kg applied N/ha (135 lb/ac) appeared to be the optimum. Shepody and Russet Norkotah yields increased with rates up to 200 kg N/ha (180 lb/ac). Nitrogen, in excess of 200 kg/ha (180 lb/ac) produced no consistent yield effects. There was a slight reduction in tuber specific gravities for all the cultivars with increased N application. There were no consistent differences in fry colour for the various cultivars associated with the different N rates. Optimum fertilizer rates for the various cultivars are shown in Table 1.

The study also showed that both wider 91 x 30 cm (36 x 12 in) and closer 91 x 15 cm (36 x 6 in) spacings required similar amounts of N for optimum yield.

Timing of N Application

In the relatively cool and short Saskatchewan growing environment, timing of N application is critical to ensure proper maturity and maintain superior yield and quality characteristics. A study was conducted to examine the effects of split applying N for Russet Norkotah, Ranger Russet and Shepody potato. The treatments compared yield and quality attributes when N (soil applied) was given as a single application (at planting) or 2, 3 and 4 split applications.

Nitrogen applied at planting or split applied, half at planting and half at hilling, produced higher yields. Delayed application of N (i.e., 3 or 4 splits) did not affect yields but slightly reduced tuber specific gravity.

Phosphorus (P) and Potassium (K)

Effects of phosphorus and potassium on potato were also studied at CSIDC. Sixty kg P_2O_5/ha (55 lb/ac) appeared sufficient for most cultivars tested. In some cases potatoes benefited for rates up to 120 kg P_2O_5/ha (110 lb/ac). Tuber specific gravity and fry colour were not affected by P fertilizer.

No yield benefits were obtained for K fertilizer treatments due to high levels of K naturally present in the soil.

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The Bottom Line...

Proper nitrogen fertilizer management is essential for maintaining high yields and quality of potatoes. High moisture conditions, excess nitrogen can lower potato quality. Optimum fertilizer rates vary among cultivars but range from 150 to 200 kg N/ha (135 to 180 lb N/ac). Phosphorus rates between 60 and 120 kg P_2O_5/ha (55 and 110 lb/ac) was optimum for potato. Potassium application had no effect on potato yield.

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