Canada-Saskatchewan Irrigation Diversification Centre

Agrochemicals in Soil and Groundwater under Irrigated Potato Production

Research Highlights: March 2001

Introduction

Irrigated potato production is rapidly expanding in Western Canada including Saskatchewan. Potatoes are a high-value crop grown under intensive management. Because of the high value, producers may be inclined to apply excess fertilizer, water and pesticides to ensure maximum yield. However, leaching of agrochemicals into groundwater is often considered to be of greatest risk under irrigation, especially with poor management. The fate of agrochemicals under irrigated potato production has not been looked at in detail. The objective of this Canada-Saskatchewan Irrigation Diversification Centre (CSIDC) study was to monitor potential agrochemical movement in the soil and groundwater under irrigated potato.

Study Description

The study was conducted on two irrigated fields (North and South) at CSIDC that were each split into four quadrants. The Dark Brown Chernozemic soil in these fields ranges from a fine sandy loam to a silty loam texture. Research in the South field started in 1998 with a seed potato crop (*cv.* Penta) followed by a canola crop in 1999 and a wheat crop in 2000. The study was repeated in the North field with potatoes in 1999. In the potato year, one of four fertilizer treatments (Table 1) was applied on each quadrant of the fields. Nitrogen (N) was applied as urea (46-0-0) in all treatments except for the fertigation **(FERT)** treatment where urea-ammonium nitrate solution (28-0-0) was used. Phosphorus (P) and potassium (K) were applied at the same rate on each quadrant. The potato crops were treated with insecticide, herbicide and fungicide as required. The canola crop was fertilized with 50 kg N/ha (44 lb/ac) and 46 kg P_2O_5/ha (40 lb/ac).

Sampling for agrochemicals.

Prior to the initiation of this study, a piezometer was installed in each of the four quadrants on both fields. Samples of groundwater were collected from the piezometers and analyzed for nitrate (NO_3^-), ammonia (NH_3), phosphorus (P) and pesticides throughout the spring, summer and fall each year. Soil samples were collected to measure NO_3^-, NH_4^+ (ammonium) and available P. Potato yield, size and grade were measured for each treatment.

Table 1. Nitrogen treatments in leaching study on potato in 1998 and 1999.

Treatment in Potato Year	N Incorporated Before Planting	Broadcast Before Hilling	Applied as Fertigation
		kg/ha (lbs/ac)	
300	300 (270)	0	0
200	200 (180)	0	0
FERT			
1998	100 (90)	0	56 (50)
1999	100 (90)	0	34 (30)
SPLIT	100 (90)	100 (90)	0

Yield Results

High fertilization rates did not translate into higher yields (Table 2). Yields in 1999 were lower than in 1998 due to cool, wet conditions that slowed potato development and favoured diseases and pests and earlier harvest. Canola following potato showed no carry-over yield benefit from the high fertilizer treatments.

Groundwater Levels and Soil Moisture

Groundwater levels rose under the potato crop in both years (Figure 1). In 1998, the rise in water levels was attributed to heavy rainfall events in addition to scheduled irrigation. In 1999, the water table dropped under the canola crop. Soil moisture levels were also higher under potato. This means that the potatoes were not using all of the water provided. Therefore, even well-managed irrigation can result in excess water moving below the potato root zone.

Agrochemicals in Soil and Water

Nitrate levels were higher in the soil in both years under potato but differences were hard to determine because of site conditions. In general, soil and groundwater NO_3^- was higher in the **300** treatment but subsequently decreased under canola under all but the **300** treatment. Soil P was also greater under potato but decreased when canola was grown. These results clearly show that the groundwater will be contaminated by excess fertilizer use.

None of the pesticides applied to the potato fields were detected in the groundwater. Movement of a pesticide in soil mostly depends on its water solubility, how quickly it breaks down, how it reacts with the soil and the amount of water flowing through the soil.

Acknowledgements

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Table 2. Total yield response to fertilizer treatments of Penta potato in 1998 and 1999 and canola in 1999.*

Treatment in Potato Year	Potato		Canola
	1998	1999	1999
	Mg/ha (Cwt/ac)		kg/ha (bu/ac)
300	33.9 (302)	14.0 (125)	1335 (59)
200	31.6 (282)	16.9 (150)	1631 (72)
FERT	34.9 (311)	19.4 (173)	1566 (69)
SPLIT	33.2 (296)	18.8 (167)	1396 (62)

* The difference in yield between treatments was only statistically significant in the 1999 potato crop.

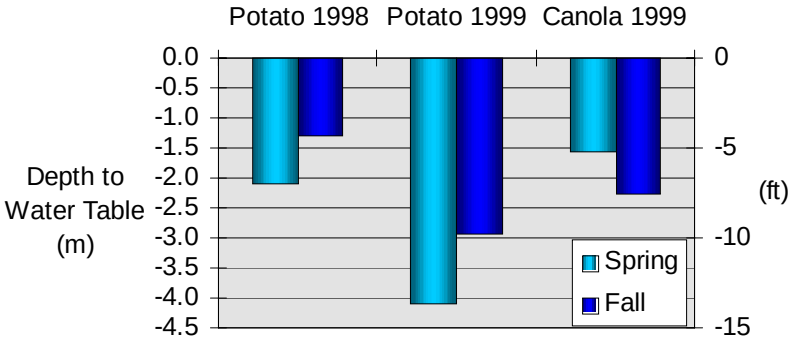

Figure 1. Average depth to water table under potato and canola. Note that the water table rose under potato but dropped under canola.

Pesticide application to potato on the trial.

The Bottom Line...

Even well-managed potato irrigation will likely result in water moving through the soil and will raise the water table. Nitrogen will move into the groundwater if applied at high rates. In this preliminary study, no pesticides were found to leach into the groundwater, further monitoring is required.

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