Irrigation in South West Saskatchewan

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Irrigation in South West Saskatchewan prior to the North West Irrigation Act of 1894 was limited to a few independent schemes based on the twenty odd streams which drained the Cypress Hills region. The projects were operated by individual ranchers with limited financial resources and the infrastructure did not survive the heavy runoffs of the early 1900's. The early irrigation projects in Saskatchewan consisted of diversion of small streams into nearby hay lots to provide a more certain feed supply for livestock.

John Palliser had pronounced the region an "arid desert" in 1857. Private companies such as the railways were unwilling to invest in comprehensive irrigation schemes in the region. Ironically, it was the drought of the 1930's that convinced the governments of the day to invest in irrigation infrastructure to rehabilitate the droughted and soil drifting areas. The federal government promoted systems of farm practice, tree culture, water supply, and land use and settlement to encourage greater economic security in the region. Since 1936, the Prairie Farm Rehabilitation Act has developed twenty-six storage reservoirs in the south west region which support six irrigation projects that are primarily devoted to hay and annual cereal production. The provincial government has developed nine other irrigation projects that depend on these storage reservoirs for water supply (Topham, 1982).

Today is a time of significant change in the operation of the federally owned projects. The Agricultural Environmental Services Branch of Agriculture and Agri-Food Canada (formerly P.F.R.A.) is transferring ownership of their projects to the current irrigators. Some of the projects may decide to cease operations because of economic considerations. Others believe that water is critical to the continuance of their farming operations and are hoping that through positive management decisions, the operational costs of their irrigation project can be reduced to viable levels. Regardless, this change is focusing attention on the need to increase the productivity of the irrigated lands to justify the cost expenditure on the irrigation portion of the project.

Challenges to the economic viability of the projects are numerous, and many of them are not new. A geologic formation within the region is Bearpaw shale which is frequently associated with salinity as well as restricted rooting depth due to a Solonetzic hardpan layer in the soil. These cropping constraints limit production in the region. Perennial forages, because of their multi-year growth habit and greater root zone exploration, are able to better tolerate moisture stresses and source nutrients from the soil. Flood irrigation of these land-leveled soils further redistributes the salts in the soil profile and concentrates the salinity as water moves across the soil and evaporates from the high spots and border dykes within the field.

Within some of the irrigation districts, the quality of the water for irrigation is also marginal. As the water drains over the landscape and lies in contact with the parent material, salts become dissolved in the water and accumulate in the reservoir. With a fresh influx of snowmelt water in spring, the reservoir water may be suitable for irrigation, but as the summer progresses, the dissolved salts become more concentrated as water evaporates from the reservoir. This factor becomes especially acute during years when there is little or no spring runoff because of limited snowfall. Dry falls combined with long protracted snowmelts contribute to limited spring runoff which does not dilute salts that accumulate in stored water in reservoirs. The variability of weather patterns in the region and their impact on water quality in the reservoirs complicate the suitability of the water resource for irrigation.

The water delivery system in several of these southwest projects was designed when water leakage from canals was not considered a serious detriment. Canals through lighter textured soil areas of the projects may lose significant quantities of water by seepage, which is a factor in salinization of the soils along the canals. The capacity of canals in many of the flood irrigation projects in the southwest may conduct only enough water to flood one or two fields at a time. This supply restriction limits the ability of the irrigators to convert his project to more efficient methods of irrigation. Conversion of the irrigation system to sprinkler requires the availability of a season long water delivery system. Growers whose fields are near the end of the canal may not receive water as the reservoir may become depleted before every grower receives his allocation of water.

Many of the irrigation projects follow the valley bottom such as in the Frenchman River basin. The fields are narrow and irregular in shape and not conducive to conversion to sprinkler irrigation. The soils along the lower portion of the stream valley are heavy textured which are suitable for flood irrigation but water infiltration rates under sprinkler irrigation are slow leading to higher water application costs. The soils on the upland are often glacial till which is much better suited to efficient infiltration of applied irrigation water and can be managed for tillage and other field operations more readily. The water rights granted for some of the projects are attached to the heavy textured land in the valley bottoms. The soil constraints of salinity and solodization are frequent on this type of land. It may be more feasible to deliver the available irrigation water to nearby upland fields in some cases, but the land ownership of the two parcels are not necessarily the same.

Most flood-irrigated fields have been land leveled to deliver water at a uniform rate over the entire field. This process is a type of "artificial erosion" as much topsoil is buried and in other areas subsoil is exposed to the soil surface. The normal soil nutrient supply mechanisms from the organic matter and soil minerals are altered by the land leveling and plant nutrition can be negatively impacted. Nutrient removal from the irrigated stands sown to forage is high as the majority of the aboveground growth is harvested for feeding livestock. Few ranchers allow grazing of the fields because of compaction of the moist soils by the cattle traffic. Grazing would allow for efficient nutrient replacement to the irrigated fields.

Soil testing is a useful tool to guide nutrient applications. Conventional analysis on these heavy textured soils points to phosphorus as the main requirement of irrigated alfalfa fields while plant root simulator (PRS) analysis suggests K as the major limiting nutrient. ICDC field demonstrations during summer 2010 will evaluate this issue further.

Malhi et al. (2001) found that banding of P in a narrow band at a depth of five cm on 15 cm spacing using a coulter disc opener (Figure 1) increased dry matter yield of alfalfa by 21-37% at moderate rates of annual application (Figure 3). Single banded applications of P at higher rates were also a practical means of P application (Figure 4). Since the main uptake mechanism of both phosphorus and potassium is diffusion, banding of K on these soils should be the most efficient method of application. Nutrient supply by diffusion to the plant roots will be higher when the P or K is placed in a narrow band in the soil as opposed to distributed throughout the soil or broadcast on the soil surface. Berg et al. (2007) implemented broadcast P and K rate studies on established alfalfa fields in Indiana. The researchers expressed the effect on yield of these fertilizer treatments with regression equations and developed contour plots to describe the forage yield at the various combinations of fertility for each of four years. Because alfalfa produces a high yield of forage which is removed during harvest of the crop, yield responses were observed on soil textures that would generally be considered adequate in potassium (Figure 2).

Figure 1: Coulter disk for banding P on established alfalfa stands (IPNI)

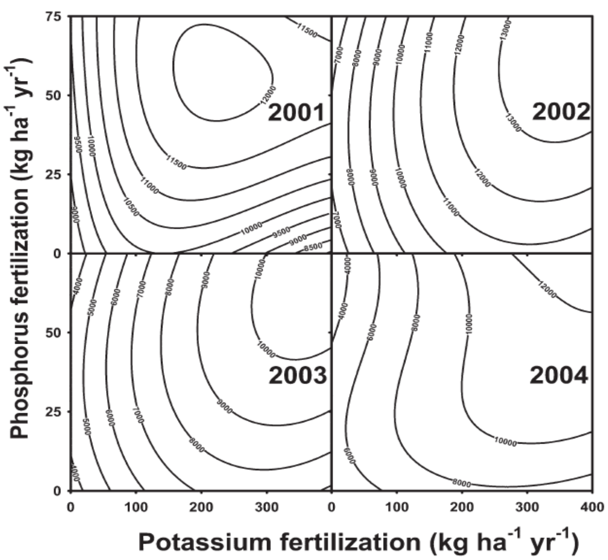

Figure 2: Influence of P & K on alfalfa hay forage alfalfa yield in Indiana. (Berg et al., 2007)

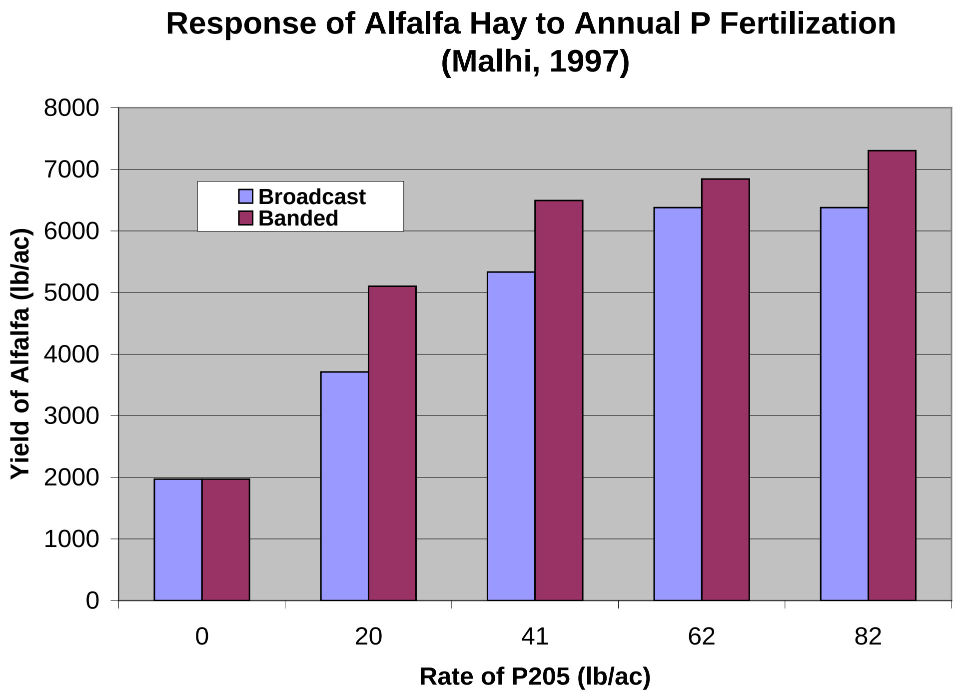

Figure 3: Alfalfa yields for broadcast and banded P for one time P application

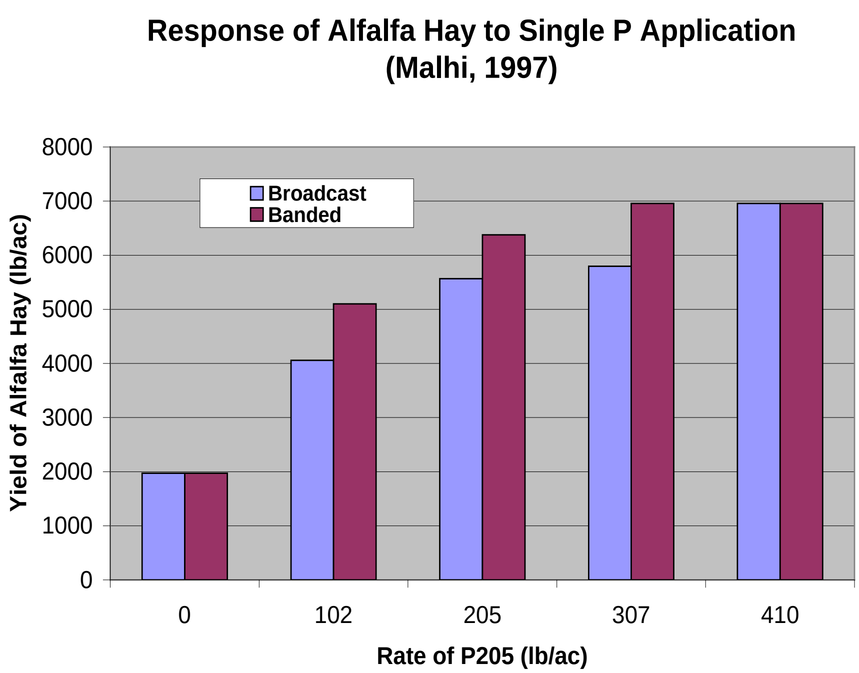

Figure 4: Alfalfa yields for broadcast and banded P for annual P application

Conclusion:

The flood irrigated projects in southwest Saskatchewan grow predominantly forages for the livestock industry. Annual crops grown on the projects are seeded to replace the forage supply while the stand is rotated to a new seeding of alfalfa. As the true costs of irrigation are charged to these producers, greater emphasis will need to be placed on agronomic principles of soil fertility and more frequent renewal of forage stands.

References:

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