Rehabilitating abandoned saline soils using *Licorice naked* – A cost effective approach for the Hungry Steppes of Central Asia

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Background

It is estimated that annually between 2-3% of the irrigated area of the Hungry steppe (Mirzachul) – one of the largest irrigated regions of Central Asia – is taken out of crop production due to salinization. The application of excess surface waters to fields results in the development of elevated water tables that mobilize salt, bring it to the soil surface. When soils become highly saline farmers abandon affected fields leaving behind large tracks of saline/ waterlogged soils (Plate 1). The rehabilitation of these areas often requires significant technical expertise and financial investment. There are, however, low cost strategies that can be used to rehabilitate these soils.

Plate 1. Abandoned salt affected fields due to rising water tables and inappropriate water management. Salt is deposited on the soil surface as a white crust.

A recent study undertaken on an abandoned salt affected field in the Hungry steppes of Uzbekistan has demonstrated the efficacy of *Licorice naked* in bring these soils back into production after 4 years.

Plate 2. *The soil surface showing deposits of salt and organic matter.*

Licorice naked – a species with unique characteristics

Licorice naked belongs to the family leguminous (Fabaceae L.) and therefore fixes nitrogen in its roots. It is a perennial shrub species that grows to a height of 1.5 m (Plate 2). The plant has a fusiform root system with numerous suckers that are often more than 1 m in length and are able to grow to depths exceeding 17 m in dry areas in search of water. The plant is commonly grown in Asia for its root that are used for medicinal purposes. Its aboveground vegetation is high in protein (12%) and

Plate 3. *Licorice naked* a shrub species that is able to grow on salt affected soils.

Five species of *Licorice naked* have been found to be well adapted to the climatic and soil conditions of the Hungry Steppes.

Licorice naked was established in the autumn of 1999 on abandoned highly saline soils located on the shirkat "Navbahor", Bayauut district of Syrdarya province, Uzbekistan, in the Mirzachul valley, Hungry steppes. After the first year (2000) in which the crop established, annual forage production increased from 3.6 in 2001 to 5.1 t ha^{-1} 2003 (Figure 1). In addition, root harvests undertaken in 2002 and 2003 resulted in yields 5.6 and 8.5 t ha^{-1}.

Cotton and wheat yields following Licorice

After 4 years under Licorice the field was reverted back to a cotton / wheat rotation. The yields of both crops were significantly higher than crops grown on adjacent saline fields (Figure 2). Yields of wheat after licorice increased from 0.87 t ha^{-1} on saline fields to 2.42 t ha^{-1} – a 2.8 fold increase. Similarly, cotton yields increased from 0.31 t ha^{-1} to 1.89 t ha^{-1} – a 6 fold increase due to the remediation affects of licorice. The average yields of wheat and cotton for the Hungary Steppes is 1.75 and 1.5 t ha^{-1} respectively. These results clearly show that *Licorice naked* was able to increase the productivity of these abandoned saline fields, exceeding the regional average yields for wheat and cotton, thereby generating increased incomes for farmers.

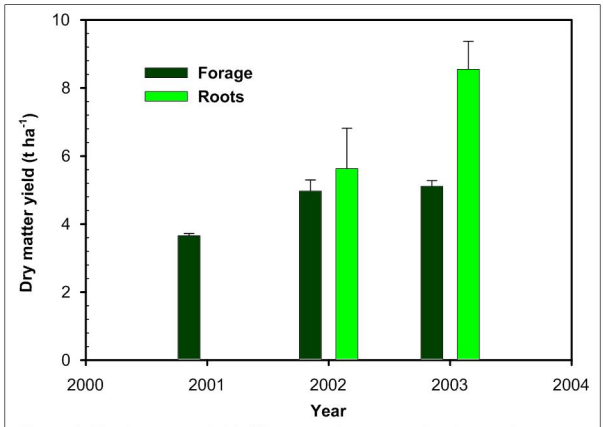

Figure 1. The dry matter yield of forage and roots over the 4 years that *Licorice* was grown.

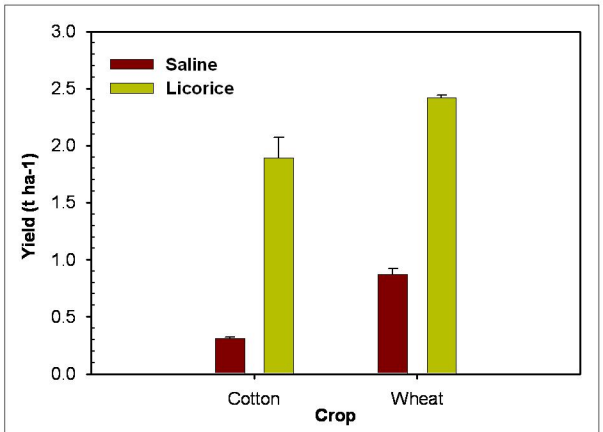

Figure 2. Yields of cotton and wheat after 4 years under licorice compared to an adjacent saline field.

What has *Licorice naked* done to these fields to increase their productive potential?

There are three main factors that contributed to bring these abandoned saline soils back into economic production.

1. Lowering the water table:

At the start of the study the watertable for both the Licorice and adjacent saline field were the same (Figure 3). At the end of 4 years the watertable height had risen closer to the surface in the saline field whilst the watertable in the Licorice treated field had declined to greater than 3 m from the surface (Figure 3). By lowering the watertable the risk of salts moving up into the surface horizons through capillary rise is significantly reduced.

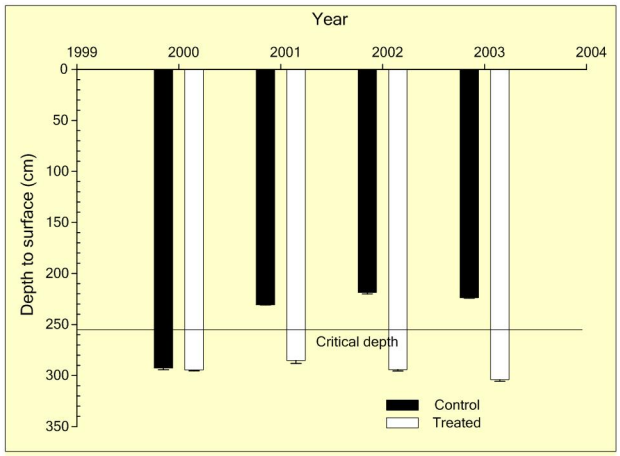

Figure 3. The height of the watertable at the over the entire period of the *Licorice naked* cropping cycle compared to an untreated control field. The horizontal line is the critical depth of the watertable to avoid surface horizon salinity development.

2. Reduced the amount of salt in the profile:

The total amount of salts in the top 2 m of the profile increased between 2000 and 2003 on the adjacent saline field from 210 to 305 t ha^{-1} (Figure 4). This is due to the rising watertable (Figure 3) and its affect on mobilizing salts. In contrast, in the field cropped to licorice the salt content declined from 215 to 185 t ha^{-1} (Plate 6).

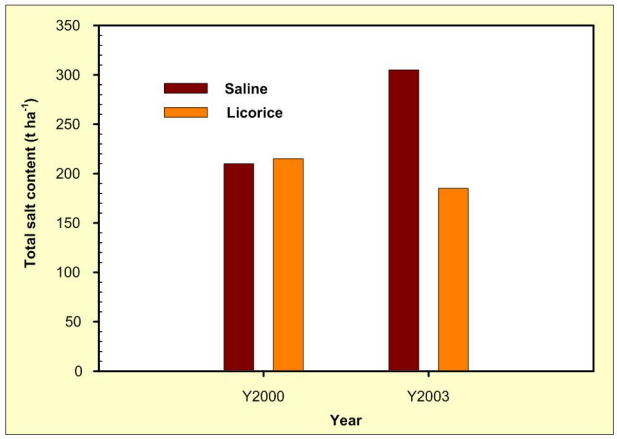

Figure 4. Changes in the total salt content between 2000 and 2003 in a saline and licorice cropped fields.

3. Increasing the organic carbon content:

Organic carbon plays an important role in maintaining the structural stability of soils thereby increasing several soil physical properties. Licorice has an extensive and deep root system which resulted in an increase in organic matter content between 2000 and 2003 when compared to an adjacent abandoned saline field (Figure 5). This will have positive effect on the physical and chemical properties of the soil.

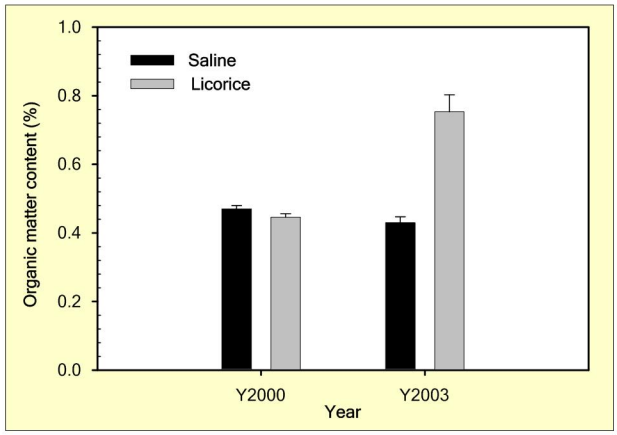

Figure 5. Changes in the organic matter content of the top 0 - 50 cm of soil profiles of a saline abandoned field and adjacent field cropped to licorice between 2000 and 2003.

Conclusions:

Technical strategies for arresting salinity are invariably capital intensive and are often beyond the means of national budgets of regional governments let alone the farmer. The use of *Licorice naked* as an alternative approach to reclaim abandoned saline soil has been demonstrated to be an effective means of bringing these soils back into production. The cost of establishment and maintenance of a crop of *L. naked* is approximately US$ 50 ha^{-1}. In addition, the crop of *L. naked* has the potential to generate income for farmers over the remediation period through the production of high quality forage for feeding to livestock and the sale of root material at plough-out that can be used in drinks and medicinal preparations, resulting in a net positive income stream. A significant advantage of this approach to remediation is that it can be adopted by individual farmers and does not require the collective action of a community or irrigation command area as is commonly a prerequisite for several technical approaches.

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