Riparian Health Assessment of Kennedy Creek

Background:

Riparian health is critical to water quality and quantity, stream stability and habitat for fish and wildlife. A Riparian Zone is the interface between the upland area and the aquatic zone. Riparian communities usually include or border water in the form of a river, wet meadows, creeks or springs. The Riparian community includes a vast and productive diversity of plants and fungi which are sought out by livestock and wildlife. The structure, function and management of these areas are not well understood compared to other types of land area. Many agricultural and industrial practises can and have drastically altered these zones. A healthy Riparian Zone, in terms of plant species, plant vigor and bank stabilization, will have enhanced filtering ability and thus less risk of water contamination from outside sources.

The constant need for consumable water for ourselves, our pets, our livestock and the fish and wildlife that surround us, requires us to focus on what is needed to keep that water clean and flowing. There are many benefits to a healthy riparian zone such as sediment filtering, stream bank building, water storage, aquifer re-charging, fish and wildlife habitat and dissipating stream energy. Evaluating the health of water systems requires a hands-on assessment.

Objective:

To determine the general state of riparian health along sections of the Kennedy Creek in the MD of Acadia.
To provide producers with information about riparian zones.

Description:

Lacey Ryan, Conservation Agronomist, completed Riparian Health assessments at sites along the Kennedy Creek in 2012 and 2013. She found the overall quality of the creek vegetation is very good, including a remarkable variety of native species of both flowering and non-flowering plants and trees. Unfortunately, Lacey also found invasive species at each of the sites, resulting in a ‘functioning but at risk’ status for these areas. Invasive species can be a major obstacle in improving the areas to a ‘functional and healthy’ assessment.

Another factor Lacey noticed was detrimental impact (both old and recent) on parts of the bank. Wildlife and/or livestock can significantly damage a stream bank in the spring when as the frost melts away and the banks becomes soft. When animals are allowed access at this time they can breakdown the banks and inhibit vegetative capabilities. A best management practice for riparian areas is to limit or restrict access of livestock to steam banks, particularly in the spring. It must also be monitored properly throughout the summer and fall,

Further monitoring of the riparian sites was planned for 2014, but were not completed due to a manpower shortage. The sites will be re-visited in 2015. Water samples were collected at three sites along the Kennedy Creek to establish benchmarks of water quality parameters. Samples will be again collected at these sites in 2015.

Bio-Control of Canada Thistle With the Stem Mining Weevil

Background

Canada thistle (*Cirsium arvense*) is a competitive noxious weed that is widespread across Alberta and much of North America. This perennial herb can grow up to 4 feet tall, has prickly leaves and urn-shaped purple flowers. It causes intensive crop losses from its extensive, horizontal creeping root system. Canada thistle is attracted to sites that have had disturbance and moisture, either by overgrazing, tillage and/or earthmoving. It is listed under the Alberta Weed Control Act as noxious. Canada thistle has a high tolerance to many different environmental conditions and is highly competitive with other vegetation. It is prevalent in many locations such as riparian areas that do not allow for chemical or mechanical control methods. Biological control agents, such as the weevil are of interest in controlling Canada thistle in sensitive areas.

There are 4 beetles that are considered as potential biocontrol agents for Canada thistle including the Stem-mining weevil, scientifically known as *Hadropontus litura* (formerly *Ceutorhynchus litura*). *H.litera* has one generation per year with 3 distinct stages of life: larva, pupa and adult. The adult lifespan is approximately 10 months as they overwinter in the soil and leaf litter, emerging in the spring to feed on rosette leaf foliage and stem tissue. Eggs are laid in May and June in the mid vein of the leaf and hatch 9 days later. The larva tunnel down the stem into the root collar consuming plant tissue and when several larva are present the stem turns black from tunneling and dies several days later. Early summer, once fully fed, the larva will emerge from the thistle shoot. This is the where the main damage happens to the thistle because it opens up holes to where secondary invaders, such as nematodes, parasite and fungi enter and further damage the stems. They then enter the soil, and the papal stage begins, in which they transform into adults. A few weeks later (late June and July) these new adults emerge from the soil and feed on the thistle foliage until heavy frost occurs in fall.

Reported success of the weevils seem to vary according to geographic locations. Research in the Eastern States, California and British Columbia have indicated that *h.litura* provides poor to moderate control when used alone; however, integrating additional tactics may enhance its efficacy. Research carried out in the mid-western states (i.e. Idaho and Montana) and Alberta indicate higher incidences of impact on Canada thistle populations. This could be open to a number of different interpretations but conjecture on the part of some researchers is that stronger winter conditions could be a factor in the geographic locations where Canada thistle are being negatively impacted by the stem mining weevil. Other biological factors, such as rust, might also be more readily apparent in these regions and so add to Canada thistle decline when the stem mining weevil is introduced.

The weevils are imported from Montana in dishes of 105 individuals at $125 (US). The weevils do procreate every year and while some documentation indicates that they will migrate, as long as they have a food source they remain rather sedentary and populations expand within a thistle stand. As they reproduce and feed on Canada

thistle, an absence of this habitat will eliminate their existence. Adults can fly very well and are active on warm summer days, however they are content to stay among the thistle patch.

Weevils are not '*a be all and end all'* for the eradication of Canada thistle but may have a place in controlling the weed in sensitive areas of the environment. CARA is working with other ARECA member groups to evaluate establishment, survival and impact of the *h.litera* at several locations in Alberta.

Hadroplontus litura

DESCRIPTION: Weevil - 2 to 3 mm mottled-grey color with white cross marking on back



BACKGROUND	LIFE CYCLE					
Habitat	**Adult Emergence**	**Egg Laying**	**Larva Development**	**F1**	**Adult Life Span**	**Over Winters**
Dense stands 5 to 10 plants/m^2 surrounded by bare soil	Coincides with rosette stage	May to June eggs laid in mid vein of leaf (generally in clusters of 2-5, up to 120 eggs are laid)	Eggs hatch between 5-9 days, they then mine down the stem to root collar	Late June to early July	10 months	Adult in leaf litter

ATTACK		COLLECTION		NOTES
Stage	**Damage**	**Life Stage**	**Method**	
Larvae	Stem and root miner	Adults on warm sunny August days	Sweep net, aspirator	Adults can withstand some spring flooding
Adult	Minor rosette and leaf damage			

Objective:
To evaluate establishment, survival and affect of the Stem mining weevil on Canada thistle.

Project Description:
CARA, along with other ARECA member groups, introduced the Stem-Mining Weevil as a bio-control agent to help control Canada thistle populations at various points in Alberta. The purpose of this project is to decrease and control Canada thistle populations in sensitive areas such as riparian zones, organic farms and native pasture. It is hoped the weevil may be a tool to reduce the use of chemicals to control weeds in sensitive areas.

The *h.litera were* imported from Montana and introduced to two sites in September of 2012, one in the MD of Acadia and to the second in Special Areas 4. Weather conditions and thistle stand qualities were recorded. Winter started early in the Special areas and the MD of Acadia and there is concern that this may impact the survivability of the weevils.

The sites were visited in June 2013 to investigate winter survival rate of the weevils. Although no stem mining weevils (*Hadropluntus litura*) were observed at the MD of Acadia site, Canada thistle Bud Weevils (*Larinus planus*) were found. Damage was found in the plants, so there is optimism that the stem mining weevils are living and reproducing in this stand. Definitive identification of the stem mining weevils were not observed in 2014 either.

Weevil Damage 2013

Canada Thistle Bud Weevils

No weevils were found but significant damage to the Canada thistle stand at the Special Area 4 site was observed in June 2013. The damage was not likely due to weevils, however, as the plant loss was more extensive than weevil activity could have made in the time period since they were released. Exact cause of the damage has not been determined. The site was revisited in late July and again in September 2013 with no sign of weevils. No weevils were observed at this site in 2014 either.

Another release of weevils imported from Montana was made at both sites in 2014. Survival and impact of the weevils will continue to be monitored.

Release site in Special Area 4, September 2014.

Release site in MD of Acadia, September 2014

Stem mining weevil as released
(white container is approximately 3 inches in diameter)

CARA Shelterbelt Demonstration

Cooperator: Mark Strutt, Oyen

Shelterbelt Demonstration

CARA continues to maintain and monitor a Shelterbelt Demonstration site adjacent to the CARA Centre at Oyen. It was initially developed in the summer of 2004 with seedlings obtained from the PFRA Shelterbelt Enhancement Program. Eight tree species, including Colorado Spruce, Green Ash, Manitoba Maple, Chokecherry, Villosa Lilac, Hawthorn, Sea Buckthorn and Silver Buffaloberry were planted May 28, 2004. Once the seedlings were planted, a drip tape irrigation system was laid out at the base of the trees. Black plastic mulch, which comes in rolls four feet wide, was placed along the entire length of the row out using an applicator pulled by a small tractor. Two discs, one on each side of the unit, cut a small trench in the soil when the machine moves forward. As the mulch unrolls, discs near the back of the unit throw soil over each edge of the plastic, securing it to the ground. A small hole is then cut where each seedling has been planted and the tree is gently pulled upright. The drip tape irrigation system consists of a plastic tape which has outlets at regular intervals that allow a slow trickle of water to be delivered directly to the root systems of the seedlings. At the CARA Centre, the water source consists of two 1250 gallon water tanks on either side of the equipment storage shop. Rain water is collected from the roof of the shop and then piped to the trees. Rainfall was abundant in 2010 so the drip tape was only used in the fall when the water tanks were drained for the winter. In 2011, the trees were watered twice during the summer and once late in the fall. Strips of lodge pole pine and spruce trees were added to the nursery in the spring.

Adequate precipitation during the past few years has limited the need for direct watering or by the drip tape. The progress of all species included in the demonstration has been maintained and monitored. Few losses have occurred and most species are showing good growth for our prairie climate. The plastic mulch has become weathered in places, particularly where it was not held firmly to the soil. Deer hooves have broken the plastic in several places. Damage from wildlife has also caused leaks in the drip tape.

In 2013, rows of dogwood and hawthorn were added to the shelterbelt demonstration site which were also used as the base for a mulch demonstration. Dogwood, Green Ash, White Spruce, Hedge Rose, Hawthorn were also planted in a random (forest) pattern near the CARA Center (see following reports). No watering was done at the site except for the new seedlings in 2013.

Wildlife Planting and Shelterbelt Mulch Demonstration

Background:
Applying mulch suppresses weeds, keeps soil warm in the winter and cools it in the summer. It also conserves moisture, supports and encourages numerous beneficial organisms, such as earthworms and eliminates stress in shallow-rooted plants. Mulch improves soil structure and drainage and can provide aesthetically pleasing and beneficial effects. Overall, the healthiest plants are those that have access to a consistent supply of water and nutrients and mulch helps with this. Mulches allow for moisture retention, weed reduction as well as increased competitiveness and survival in shelterbelts.

Shelterbelts provide many benefits to a property and can also support local wildlife. With some design considerations, shelterbelts can provide even better habitat for various wildlife species. The treed areas can act as wildlife corridors and provide pest control benefits for farm yards and fields. Shelterbelts increase opportunities for viewing wildlife and also provide an environment for game birds and other hunted species. Additionally, insectivorous birds residing in a shelterbelt will feed on many nuisance pests, perhaps reducing the need for costly chemical insecticides. Predatory birds, such as hawks, kookaburras and owls, will nest in shelterbelts and consume pests such as mice, rats and rabbits.

Traditionally shelterbelts are planted in a straight row pattern. Planting in a curved pattern, however, can make a shelterbelt more “wildlife friendly”. The curves allow various animal species to easily hide from predators and also act as a better windbreak compared to that of straight rows. Curved shelterbelts can be planted to follow the contours of the land, working better with mother nature around creeks, rivers and wetland areas. They will generally take up more space, however, which can take land out of production and result in management issues for large field equipment.

Objectives:
To demonstrate the benefits of various mulches for weed reduction and moisture retention in new shelterbelts.
To demonstrate benefits to wildlife habitat in curved shelterbelt vs straight row plantings.

Digging holes to plant the saplings

Weed control in 2014

Large Rock and Landscape Fabric

Gravel and Landscape Fabric

Wood Chips

Grass Clippings

Straw

Hay

Mulch Application

- Hay from a large square hay bale was easy to handle and layed down well
- The compact flakes allowed no sunlight, making it a very effective mulch.
- The straw was also from a large square, however it was not as compact and stayed more fluffy, allowing the wind to pick it up and sunlight to poke through so it ended up with more weeds and a more "messy" application process and appearance.
- The landscape fabric under both rock applications was very easy to lay out but the rocks called for a lot of manual labour.
- The woodchips also required some labour to unload and had to be spread with a rake once on the ground.
- The grass clippings were collected by a lawn mower bag and were easy to spread.

Summary of mulch application and weed control:

Mulch	Application	Weed Reduction	Comments
Landscape Fabric/ Large Rock	High Labour	Medium	Fabric can be costly for long lengths of shelterbelts; good use for old rock piles
Landscape Fabric/ Large Rock with Gravel	High labour	High	Can be costly for long lengths of shelterbelts; good use for old rock piles
Landscape Fabric/ Gravel	Medium	High	Can be costly for long lengths of shelterbelts
Wood Chips	Medium	Low*	Cost depends on availability
Hay	Easy	High	Low cost
Straw	Messy/Medium	Medium	Low cost
Grass Clippings	Easy	Medium	Low cost

*buckwheat seed came along with the chips

Observations:

Weed growth was monitored in 2013:

- The landscape fabric and rock had minimal to no weed production
- The grass hay mulch had very small amounts of weed production, most likely due to the solid coverage it provided.
- There were a few more weeds in the straw mulch area and even more in the wood chip and grass clippings.
- The most weed growth appeared in the rototilled area.
- Fungal growth was found on some trees within the wood chip mulch where the chips had blown close to the tree trunks. The increased moisture in this area created a good environment for the fungus. The fungus was removed and there were no further problems once the chips were maintained at least 4 inches away from the tree trunks.
- Buckwheat weed seeds were inadvertently imported with the wood chips, demonstrating the importance of knowing where the mulches are coming from and what may come along with it.

- The hay and straw seemed to settle a few weeks after application so another layer was applied to keep it at 4 inches thick which seems optimum to reduce weed production.
- The large rock/landscape fabric mulch strip initially had areas of fabric showing as well as some weed growth in it. More large rock was added to one half of the area to fill the gaps and gravel was added to the rest of the strip to reduce weed production.
- Moisture retention in the mulched strips was significantly better than that of the rototilled area. The trees required watering only once after planting and twice during the summer of 2013.
- The trees in the mulch appeared to grow much faster and better than those of the rototilled area.
- Similar trends were observed in 2014.

Forest Planting Demonstration

Background
Trees many benefits, such as produce oxygen, conserve water, offer shade, filter water, prevent soil erosion, prevent flooding, provide food and medicine and create economic opportunities. In a natural forest situation, trees and shrubs of different species often help each other grow. Roots of trees and plants share nutrients and where there resources are plentiful, a symbiotic relationship typically occurs. Beneficial biological soil organisms can move from one plant to another as well, and often require multiple plant species to thrive. Plants and trees of different species form roots in different depths of the soil and are able to reach different nutrient and moisture levels. In natural settings, trees and shrubs co-exist in random, unorganized fashion.

Objectives:
To demonstrate establishment and growth of several trees and shrubs when planted in a random fashion.
To demonstrate adaptability of several trees and shrubs to local growing conditions.

Project Description:
Hedge rose, hawthorn, green ash, white spruce, dogwood samplings were planted in a random arrangement and spacing into a mowed stand of alfalfa/weed mix adjacent to the CARA Center at Oyen on May 29, 2013. A dramatic difference in the growth of these trees and shrubs was observed compared to those planted nearby with mulch. The lack of water retention in these areas negatively affected the tree growth and there were some sapling fatalities. Growth of these trees was monitored in 2014 as well. Weeds and other plant growth was mowed and the seedlings were watered 3 times during the summer. Growth is still not comparable to those planted in 2013 with mulch.

Scots Pine Sapling at time of planting

Flags indicate where and what species were planted

Water Systems Inventory

Several producers within the Special Areas and the MD of Acadia have been visited during the past few years to add their information to a stock watering system inventory. At each location, pictures, system details, ease of use and satisfaction of performance information was gathered. Expansion of the inventory will continue each year. The information is being compiled into a manual to serve as an excellent reference for anyone wishing to develop a new watering system or modify an existing setup. The inventory includes energy efficient, off site and frost-free systems. Contact the office for more information.

Soil Health Initiative

Background:
Soil history shows that many civilizations have collapsed from unsustainable land use. The impact of soil disturbance has been very much underestimated. Soil modification has been taking place indirectly through changes in the vegetative cover, with the forest clearance, natural cycle processes have been interrupted. The United Nations estimates that 2.5 billion acres have suffered erosion since 1945 and that 38% of global cropland has become seriously degraded.

Here in east central Alberta, some of the soils have been farmed for over 115 years. Organic matter levels have deteriorated from production and harvesting of crops as well as natural wind and water erosion events. While soil health is becoming more of a priority among producers, there is considerable *'ground'* to make up. With this in mind, it is time that we start giving the land more attention.

On December 5, 2014 the 68th UN General Assembly declared 2015 the International Year of Soils (IYS) (A/RES/68/232). The Food and Agriculture Organization of the United Nations has been nominated to implement the IYS 2015, within the framework of the Global Soil Partnership and in collaboration with Governments and the secretariat of the United Nations Convention to Combat Desertification.

The IYS 2015 aims to increase awareness and understanding of the importance of soil for food security and essential ecosystem functions.

The specific objectives of the IYS 2015 are to:

- Raise full awareness among civil society and decision makers about the profound importance of soil for human life;
- Educate the public about the crucial role soil plays in food security, climate change adaptation and mitigation, essential ecosystem services, poverty alleviation and sustainable development;
- Support effective policies and actions for the sustainable management and protection of soil resources;
- Promote investment in sustainable soil management activities to develop and maintain healthy soils for different land users and population groups;
- Strengthen initiatives in connection with the SDG process (Sustainable Development Goals) and Post-2015 agenda;
- Advocate for rapid capacity enhancement for soil information collection and monitoring at all levels (global, regional and national).

At CARA, we have already started to create some awareness on principle soil interactions and to understand the interactions of the different soil components by presenting activities such as soil workshops (Oyen and Acadia Valley) to farmers and through the Classroom Agriculture Program (CAP) to elementary students. Figure 1 was used in this program to demonstrate to the students the importance of the micro-organism populations in the soil and how their interactions play an important role in

keeping the soil healthy. Other activities initiated during 2014 include field demonstration and trials with mycorrhizae, cocktail crops and humalite applications. These demonstrations will be monitored in 2015 and additional field trials will be established.

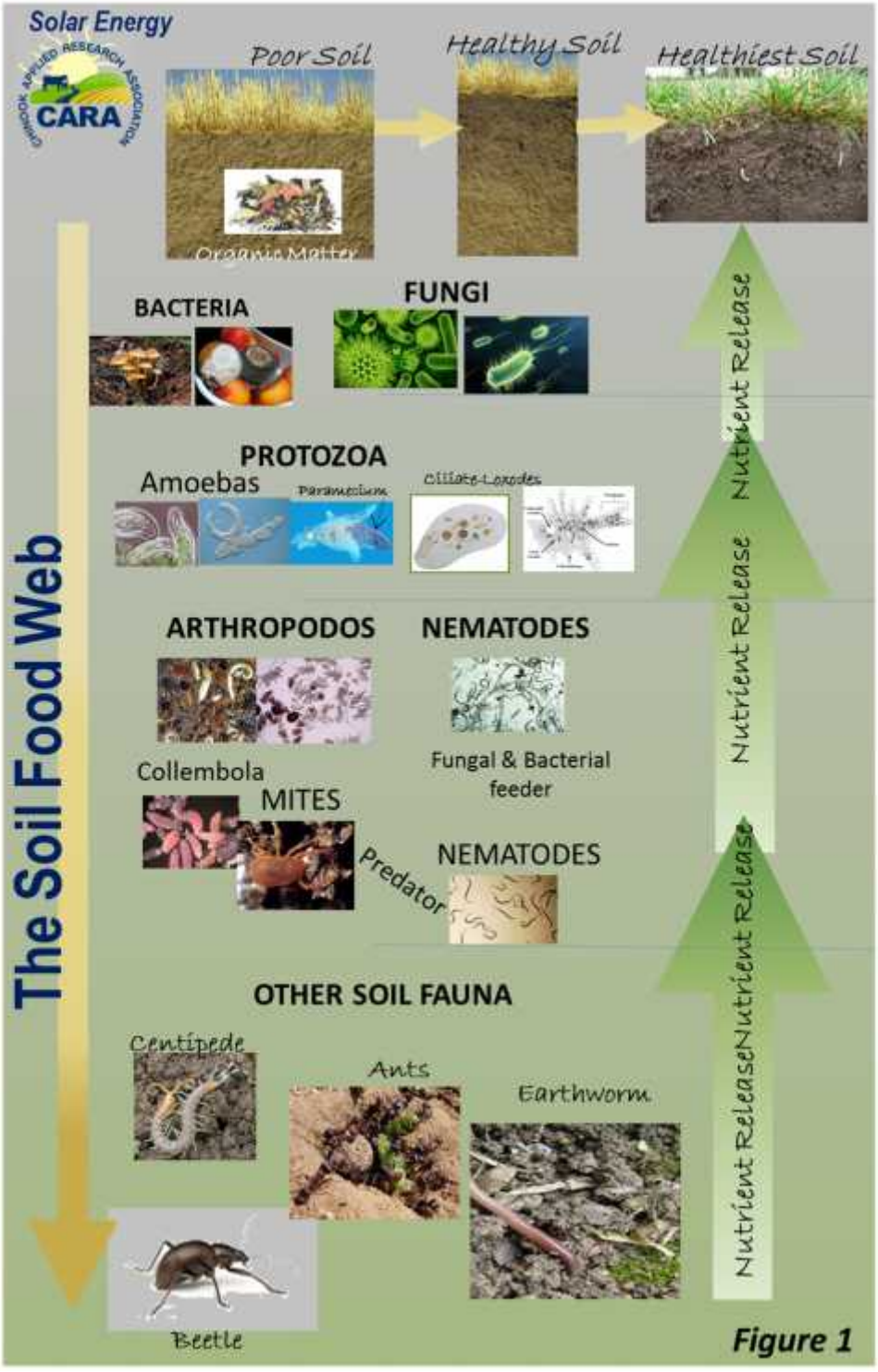

Figure 1

What is a healthy soil?

Soil health has been defined as:

“The continual capacity of soil to function as a vital living system, within ecosystem and land-use boundaries, to sustain biological productivity, promote the *quality of air and water environments and maintain plant, animal and human health” (Pankhurst* et al., 1997).

A more recent definition by FAO members (2008) is a more broad explanation of soil health:

"*Soil health is the capacity of soil to function as a living system, with ecosystem and land use boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and promote plant and animal health. Healthy soils maintain a diverse community of soil organisms that help to control plant disease, insect and weed pests, form beneficial symbiotic associations with plant roots; recycle essential plant nutrients; improve soil structure with positive repercussions for soil water and nutrient holding capacity, and ultimately improve crop production. A healthy soil does not pollute its environment and does contribute to mitigating climate change by maintaining or increasing its carbon content.*"

What are the benefits of a healthy soil?

Healthy soils have many benefits. One of the most important benefits is that healthy soil holds more water (by binding it to organic matter (OM)), improves water use efficiency, and loses less water to runoff and evaporation. As OM increases, it will holds up to 20 times its weight in water.

What are the basic soil health principles to build soil health?

Five principles have been reported to be the most important components to accomplish healthy soils:

1. Minimize mechanical soil disturbance
2. Keeping the soils covered at all times (armor the soil)
3. Growing a living root year around
4. Increase plant diversity above ground to increase diversity below
5. Incorporate livestock grazing

1. Minimize mechanical soil disturbance

Physical soil disturbance such as tillage and overgrazing can result in significant disturbance of the soil physical, chemical and biological properties. Soil microbial activities are disrupted and limit their capacity to promote crop development.

2. **Keeping the soils covered at all times (armor the soil)**
   Bare soil increases soil temperature. It can decrease and kill soil biological activities. Vegetation, plant residue and organic mulch protect the soil surface and feed billions of micro-organisms which recycle nutrient and combat pest infestation to plant roots. Those micro-organisms also create soil pores where more roots can find air, nutrients and water.

3. **Growing a living root all year**
   Living roots will provide a food source for soil microbes (beneficial bacteria and micorrhizal fungi). They also contribute to the formation of soil aggregates.

4. **Increase plant diversity above ground to increase diversity below**
   Increasing plant diversity is connected with soil root diversity. Studies have shown that specific soil microbes require specific plant types. Soils are more productive when there are more diverse microbial activities in the soil. Plant diversity through rotation and cocktail cover crops will support balanced and diverse soil populations that might reduce weed and pest infestations

5. **Incorporate livestock grazing**
   Land responds positively to the presence of livestock, provided management is appropriate. Farmers have found that using rotational grazing is the fastest and most economical way of improving the soil health. Microbial population also increase and stimulate nitrogen fixing bacteria activities. Addition of manure and urine to the soils recycles nutrients. It is important that the grazing system will allow adequate rest for the plants between periods of grazing

One of the primary goals to improve soil health is to increase more organic matter in the soil for feeding the microbes. These microbes will help to improve soil organic matter which captures and holds more water and nutrients, growing more and larger plants that can gather more sunlight to power the process. This constant recycling is dependent on management of the land. Following these five principles will allow the site production to increase its productivity.

CARA's Soil Nutrient Specialist Dr. Yamily Zavala has designed an on-line survey for collection of soil information in cropping systems. Once appropriate questions, pictures, etc. have been added to represent forage production the survey will be distributed amongst local producers. The data will be used to document soil health constraints, site characteristics and other conditions. Survey results will be the starting point for a long term extension effort on soil health indicator evaluation, monitoring and management strategies. This survey will be the beginning of one-on-one consultations with participating farmers. Other ARECA groups are interested in using the survey for their area producers as well which will result in a larger data base for soil health in Alberta.

Soil Health Initiative: Cocktail Cover Crop

An area of about 5 acres (SE 13 28 08 W4) was selected to evaluate the effect of a Cocktail Cover Crop (CCC) with different levels and types of humalite on the soil health condition. CCC is a general term for a mixture of various crop types seeded together for the purpose of improving soil health. This crop mixes can be used as an alternative to fallow.

Soil physical and chemical properties as well as weed populations were measured prior to stablishing the CCC and will be measured during the next three years period for this project. Proper techniques are being investigated for future measurements of biological characteristics.

On the area selected for the CCC, there was evidence of intense agricultural machinery traffic. A field penetrometer was used to measure soil compaction. Two PSI (pound per square inch) measurements were done: 200 psi and 300 psi with two soil moisture contents, dry and wet (1 cm rain). With a penetration resistance of 200 psi, soil compaction was measured at 3.8 cm for the dry condition and 7.8 cm for the wet condition. Only 70% of roots are able to penetrate those depths. Roots will not penetrate the soils with reading above 300 psi.

Several reasons are important for using CCC mixtures in soil health management: they will increase microbial activities, improve the roots-microbes-soil aggregates relationships, nutrient cycle, soil structure, increase of organic matter content and soil moisture, among other important benefits.

In this study the CCC mixture contained: prosso millet, peas, fababean, oats, triticale and tillage radish. It was planted on August 11 on a chem-fallow of canola.
The purpose of planting this cocktail at this time was to give the crops the opportunity of growing for at least 2 months before a killing frost. During this period, it was expected that soil biological activities might be started considering the different crop species involved in this study.

Evaluation will be continue during a 3 years period (2015-2018) to evaluate physical, biological and chemical changes on the improvement of the soil health management of this area. Picture 1 shows different development growth stages of the CCC

. Picture 1 Cocktail Cover Crop development growth stages