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Factors that lead to degradation of grasslands, important role of mechanization

Factores que dan lugar a la degradación de los pastizales, papel importante de la mecanización

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ABSTRACT: Among the problems of physical degradation of soils, compaction and densification are the main ones, and these cause strong decreases in subsequent crop yields. The degradation of the soil structure is a problem today in Cuba, which can occur in all soils and at all levels of livestock production. Taking into account the above, this document aims to expose the main changes produced in the internal structure of soils as a result of its degradation. Soil compaction, due to the collapse or reduction of pore spaces, is the most common cause of physical restriction for root growth and development. As an aggravating factor, the degradation of the soil structure is commonly considered the most difficult type of land degradation to locate and reconvert; the reason is that this degradation is a subsurface phenomenon. Finally, it is about establishing some possible solutions to this problem, among which the main method of restoring the porosity of the limiting layers of root growth and that must take into account the chemical and physical factors of the soil, the species, the type of soil and the degree of degradation of the species that are proposed to restore, the use of plowing v+ harrow or plowing alone is the most efficient method for the recovery of pastures of the species
Keywords: Soils, grazing, trampling, compaction, soil structure, degradation, subsoilers.

RESUMEN: Entre los problemas de la degradación física de los suelos, la compactación y el adensamiento son los principales, y estos causan fuertes decrementos en los rendimientos posteriores de los cultivos de los mismos. La degradación de la estructura del suelo es un problema hoy en Cuba, que puede ocurrir en todos los suelos y a todos los niveles de producción pecuaria. Teniendo en cuenta lo anterior, este documento pretende exponer los principales cambios producidos en la estructura interna de los suelos como resultado de su degradación. La compactación del suelo, debido al colapso o disminución de los espacios de poros, es la causa más común de restricción física para el crecimiento y desarrollo de las raíces. Como agravante, la degradación de la estructura del suelo es comúnmente considerada como el tipo de degradación de tierras más difícil de localizar y reconvertir; la razón es que ésta degradación es un fenómeno subsuperficial. Finalmente se trata de establecer algunas posibles soluciones a dicha problemática, entre las cuales el método principal de restauración de la porosidad de las capas limitantes del crecimiento de las raíces y que se deben tener en cuenta los factores químicos y físicos del suelo, la especie, el tipo de suelo y el grado de degradación de las especies que se proponen restaurar, el uso de la aradura + grada o de la aradura sola resulta el método más eficiente para la recuperación de pastizales de las especies
Palabras clave: suelos, pastoreo, pisoteo, estructura del suelo, degradación, subsolador.

INTRODUCTION

The constant trampling by livestock on the grassland produces soil compaction, this implies that permeability is gradually lost, preventing water, air and nutrients from entering it, progressively reducing grassland production.

There are major problems caused by current pasture production systems such as soil erosion, early loss of forage production, long waiting periods between planting and starting production.

A grassland is considered degraded when its desirable species have lost their vigor and productive capacity per unit area and per animal and depopulated areas and undesirable species of low yield and nutritional value take their place, which causes ecological and economic deterioration. which is incompatible with productive livestock systems. Among the main causes of grassland degradation, the indiscriminate use of burning, weed invasion, pests and diseases, climatic factors and low soil fertility have been identified.

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The bovine population in the world is growing with the increase in the human population. Thus, the planet's inhabitants increased from 2.5 billion in 1950 to 6.1 billion in 2001, while the mass of cattle grew from 750 million to 1.53 billion, and that of sheep-goats from 1.04 billion to 1.75 billion, in the same period of time (Brown, 2003). This behavior constitutes a threat to livestock areas, so that currently the degraded grasslands in the world reach 650 million hectares, which represents five times the cultivated territory of the United States. If we take into account that, practically, 4/5 of the world production of bovine-goat sheep mass (52 million t) comes from grass-fed animals, it is a necessity to know the causes of the degradation of grasslands, as well as possible solutions to this problem (Brown, 2003). Cuba is not immune to this reality. For example, in the 1980s, improved pastures represented approximately 60% of the grasslands in the country. Today they barely constitute 19%, and some present a high degree of degradation (Minag-Cuba, 2004). This work aims to analyze the problem of grassland degradation, as well as its recovery in Cuba and other tropical regions. Alternatives are also offered that allow the introduction of new adapted species, replacing existing ones and replacing species that are about to degrade to restore the productivity of tropical grasslands, where unproductive species with little nutritional value predominate.

Grassland aerators have great agricultural and economic advantages over traditional renovation techniques. This characteristic has been revealed by other countries, which are trying to obtain its maximum benefit.

The technology of grassland aerators in our country does not exist and its cost is high, most of them can be imported, it must be added that most grass producers are unaware of the actions and advantages of this implement due to its limited diffusion. same in our country

DEVELOPMENT OF THE TOPIC

Magnitude of Grassland Degradation

Grassland degradation is normally accompanied by the loss of natural soil fertility. In addition, it causes a decrease in livestock productivity and causes large economic losses. According to the UN, in 1991 losses caused by pasture degradation exceeded $23 trillion, of which 2/3 occurred in Africa and Asia. It has rightly been stated that the degradation of pastures constitutes the prelude to desertification. The most pressing problems of pasture deterioration occur in much of Africa, northern India, central Asia, Mongolia, Brazil and tropical America.

Desertification is a complex process, which has human and natural causes. For example, in 1995, Winograd identified that in Latin America and the Caribbean, livestock farming has been the activity responsible for 40% of deforestation and pasture area grew by 21.4 million hectares. The livestock population increased by 26 million animals in a period of just 10 years. As a consequence of the degradation that pastures have suffered in this region, the carrying capacity decreased by 2 cows/ha, Cuba is also affected by desertification and drought in 14% of its territory, for a total of 580,000 ha, distributed in 24 edaphoclimatic subzones. Mainly, desertification develops in areas of dry environment and dry subhumid. Among the main causes of desertification the following are recognized Martínez *et al.* (1984); Spain y Gualdrón (1991); Skerman y Riveros (1992); Fuentes *et al.* (1997): - Deforestation as a source of exploitation of natural wealth, to establish new crops and plantations, as well as to obtain firewood, charcoal and roundwood. - Expansion of irrigation in inconvenient regions and use of irrigated land, applying incorrect technologies.

- High concentration of livestock in the grasslands.
- Annihilation of perennial vegetation due to the use of burning and bulldozers, inadequate techniques for the rehabilitation of pastures.
- Low or minimal reforestation plans with very little survival.
- Little application of regeneration technologies for native species.
- Reduction of the fraction of soil covered with vegetation.
- Erosion and impoverishment of the soil due to rainwater carryovers.
- Inadequate application of techniques in established grasslands or in development.

Degradation Concept

Grass is considered degraded when the desirable species has lost its vigor and productive capacity per unit area and per animal, being replaced by depopulated areas and undesirable species of low yield and nutritional value. This causes ecological and economic deterioration, incompatible with productive livestock systems. Criteria that must be considered to classify a pasture as degraded:

- Decrease in vegetation cover, small number of new plants coming from natural reseeding.
- Decrease in the production and quality of forage, even in favorable times of growth.
- Presence of broad-leaved weeds.
- Erosive processes of the soil due to the action of rain.
- Large proportion of weeds and colonization by native grasses.

According to Andrade *et al.* (2006), to characterize the degree of degradation of a grassland (table 1), the percentage of the area occupied by invasive plants is considered. The objectives of rehabilitation according to Martínez *et al.* (1984) and Spain & Gualdrón (1991) are the following: - Create a stable grass or forage production

system. - Eliminate undesirable species from the ecological system that compete for an ecological niche with improved species. - Restore the vigor, quality and productivity of the grassland. - Increase the populations of desirable species, so that they predominate in the ecosystem - Increase soil protection against erosion.

TABLE 1. Degree of degradation of a grassland

Degree of degradation	% of areas with invasive species
Productive	0-10
Mild degradation	11-35
Moderate degradation	36-60
Advanced degradation	61-100

Main Causes of Grassland Degradation

Among the main causes of grassland degradation, the following can be identified:

1. Indiscriminate use of burning: The frequent and poorly oriented use of fire can harm both the grass and the soil, since it destroys all the vegetation cover, leaving the soil unprotected until the leaves of the plants sprout. In that period, when the soil causes dragging of particles that begin the erosive process. Negative effects of burning:
   - Prevents the return of organic matter and increases its degradation.
   - Exposes the soil to erosion.
   - Promotes soil compaction. Additionally, burning reduces soil moisture, due to increased runoff rate and evapotranspiration.
2. More than a cause of the degradation of grasslands, the invasion of weeds must be conceived as a consequence of this process, since due to their opportunistic behavior weeds occupy the spaces that are eventually left open by the base grass.
3. Pests and diseases: In the tropics there are a large number of pests and diseases that attack grasses, and that in a certain way contribute to their degradation. A good example is the false meter and the saliva in the grasslands.
4. Climatic factors: Prolonged droughts can reduce the vigor and competitive capacity of the grass, leaving open spaces for the establishment of invasive plants. The dry period can also be decisive by triggering the process of occupation of areas by invasive plants in pastures previously impoverished by burning or other stress factors. Excess humidity during the rainy season can also favor the proliferation of pests and diseases. Additionally, in areas where vegetation cover is scarce, heavy rains can contribute to the loss of soil fertility through erosion and leaching. On the other hand, high rainfall that occurs in the tropics for short periods can influence soil compaction. A drop of water on bare soil can cause high compaction.

Table 2 shows the damage caused by the invasion of salivite (Monecphora bicinta fraterna):

TABLE 2. Evaluation of losses in cross-bermuda shorts in field conditions, caused by the salivite plague (Barrientos, 1986)

Treatment	Not nymph	Not adults	Yields, kg/ha	Loss, %
No damage	6.0	1.0	3245.0[a]	0.0
Moderately damaged	37.0	96.0	2088.0[b]	36.0
Very damaged	60.0	208.0	1434.0[c]	56.0
EE ±	-	-	0.180**	-

The Compaction of Agricultural Soils

Origin

According to: F. G. & P. J. (1994), soil compaction corresponds to the loss of volume experienced by a certain mass of soil, due to external forces acting on it. These external forces, in agricultural activity, have their origin mainly in:

- Soil tillage implements.
- Loads produced by tractor tires and towing implements.
- Trampling animals.

Causes

Compaction is caused by the repetitive and cumulative effect produced by heavy agricultural machinery and excessive grazing, under conditions of high soil moisture. It is not specific to agricultural soils, but places occupied by buildings and highly frequented recreational areas are also susceptible. There are two main types of compaction: that which occurs at shallow depths or that which occurs at greater depths, at the subsoil level. The first preferably takes place in the preparatory phases of the soil for planting, with the use of fertilizers and pesticides.

Compaction at the subsoil level is caused by heavy machinery used during harvest and by the dissemination of organic remains of animal origin with large capacity tanks that have heavy shafts, soil compaction is potentially the greatest threat to agricultural productivity.

The incidence of wind erosion, typical of arid and semi-arid climates, is almost always due to the decrease in the vegetation cover of the soil, either due to overgrazing or due to the elimination of vegetation for domestic or agricultural uses (Varillas, 2012).

Effects

Ribes (1996), Currently, due to poor management of agricultural machinery, this is what has produced a compaction of crop soils, observing that in our environment there is an increase in apparent density, mechanical resistance and a destruction of the soil structure. A low porosity of the soil produces less aeration and oxygenation,

which affects a decrease in the absorption of nutrients and water, aggravating this phenomenon when excessive watering occurs, causing suffocation and death of the roots.

The effects that compaction produces translate into less development of the root system of the plants. Compaction modifies the biochemical and microbiological activity of the soil. The greatest physical impact that occurs is the reduction of porosity, which implies a lower availability of both air and water for the roots of the plants. At the same time, roots have more difficulty penetrating the soil and reduced access to nutrients. The biological activity is thus substantially decreased. Another effect of compaction is increased runoff, decreasing the filtration capacity of rainwater. This increases the risk of erosion caused by water and the loss of surface soil layers and the consequent loss of nutrients. There are estimated calculations on the loss of crop productivity due to this phenomenon, which in the case of soil surface compaction reaches values of up to 13% while subsoil compaction can cause losses of between 5-35%. (Martínez *et al.*, 1992).

Prevention

Walter *et al.* (2020),Reports, one of the biggest problems is remedying soil compaction, since it implies high costs, therefore, it is better to avoid it with adequate management of soils and agricultural machinery. Among the factors so that this phenomenon does not reach levels that affect the productivity of the cultivated species, there are the following:

The Machinery

The factors described must be controlled to mitigate the effects that occur due to misuse of Machinery in agricultural work:

Weight of the machinery: the greater the ballast of the machinery, the greater the risk of compacting the soil, reaching greater depths of quench.

Tire inflation width and pressure: The larger the tire area (wider tires) and the lower the inflation pressure, the less compaction on the ground.

Wheel skating: As long as there is traction to the implements on the part of the tractor, the phenomenon of skating will always be present, which must be minimized depending on its weight, ground condition, giving permissible values of 15 - 18 % for compact floors and 25 - 30% for friable floors.

Working speed: when the pressure on the soil is maintained for a longer time, the compaction phenomenon has a greater possibility of occurring, so it would be appropriate to carry out the work at the highest possible speed. Furthermore, the number of passes planned must be the minimum necessary, since a longer time the machinery remains in the field contributes to greater compaction.

Working depth of the soil tillage implement: it is recommended to vary the tillage and/or aeration depth using similar implements for said tasks.

Soil-Related Factors

Physical factors or properties that are directly related to the condition of a soil, texture, type and stability of the structure, apparent density, historical load, resistance to deformation. Soil moisture content is related to a higher water content, the soil can deform and compact with lower pressures received. Therefore, the work must be carried out with the soil as dry as possible.

Measures to Avoid the Problem

It is necessary to resort to certain recommendations that help minimize the problem of compaction in grasslands, so that yields remain at productivity levels and do not affect significant decreases in the availability of feed for livestock and among these the following are cited:

- Incorporation of organic matter into the soil: the organic matter incorporated into the soil acts directly and indirectly, promoting the formation and stability of the soil structure, which can help prevent compaction.
- Use of vegetal covers: the penetration of the roots and their subsequent death produce continuous pores that help the movement of air and water in the soil. Through the vegetation cover, organic matter is also incorporated.
- Use of ridges for the tractor track: by building ridges for the passage of machinery wheels, the effect of compaction is prevented from reaching greater depth.
- Use of circulation tracks: by locating exclusive tracks for the transit of machinery, the unnecessary passage of machinery over the ground surface can be avoided.
- Adjust machinery to the same track: this measure is aimed at reducing the area that is used by the machinery, maintaining a single footprint for the passage of the wheels.

Corrective for Compaction

Navarro (2020), assure that, to mitigate the compaction of a soil, corrective measures can be taken such as: subsoiling, aerating and complementary measures, which have effects on the soil, in the medium and long term. The first is a task that goes from 30 to 70 cm deep and is carried out with a subsoiler or Chisel. In case of maintenance work and surface breaks in compacted areas, aerators are used, whose cutting depth can reach 20cm, having vertical cutting systems using rotating blades as implements and to complement it, plant remains are incorporated, in order to supply organic matter to the soil.

If the compaction that exists in a batch is superficial, it can be solved relatively easily with soil plowing in the first 5 cm. using aerator rollers or rotating harrows. If the compaction is deep, breakages must be carried out up to at least 40cm deep, mainly using scarifiers or subsoilers with which the hardened layer is broken to allow water infiltration and the passage of roots through the cracks

produced. Nowadays decompactions below the normal plow depth are difficult to resolve and have a high economic cost. Before using the subsoiler, you must identify how deep the compaction is and pass it 5 to 10 cm. below it, and with the soil dry enough. If subsoiling is done when the lot has soil moisture at field capacity, more compaction can be created instead of eliminating it. The subsoiler seen in Graph 2 is the tool that, when used conveniently, loosens the soil and releases the compacted layers, lifting and disintegrating them, forming a network of interconnected macropores, some of which go from the loose subsoil to the surface, acting as pathways for root penetration and water and air flow. Subsoilers normally work at depths of 30-70 cm.

Subsoiling is a high-cost task and therefore should be done only when the characteristics of the soil justify it. Before making the decision to do this work, the soil profile must be carefully studied, determining the presence of compacted soil strata. analyzing its location and spatial distribution in the lot (Walter *et al.*, 2020).

Aeration of Agricultural Soils

Gutierrez *et al.* (1987) indicates, soil aeration refers to the supply of oxygen for the proper development of microorganisms and the roots of the plants that the soil has. In other words, it is the change that occurs between the gases in the soil and the gases in the atmosphere. Among the important factors for good plant development is soil aeration, since its pores contain a mixture of water and gases, constituting the soil atmosphere.

Importance of soil aeration in grasslands

Da Silva & Kay (1994) indicates that periodic aeration of the soil is essential to keep croplands healthy. The health of Crops or pastures for livestock depends on allowing plants and herbs to form deep, strong root networks. Compacted soil is the result of the passage of tractors and large animals that crush it, which inhibits root growth and the formation of beneficial microorganisms by collapsing the necessary air pockets. Straw formation has the same effects. Consequently, the process of reinserting air holes by making holes in the soil has a healthy effect on the growth of agricultural flora by promoting root growth and improving irrigation. The optimal times to aerate the soil depend on the crop and its usual growing season.

Gaseous Composition of Soil Air

Valenzuela (2022), explains, the gaseous composition of the soil is as follows:

Oxygen

Above the soil surface, the atmosphere contains about 21% O2, 0.035% CO and more than 78% N_2.

In comparison, soil air has about the same level of N, but always has less O and more CO2. In the upper layers of a soil with a stable structure and abundance of macropores, the O2 content may be only slightly below below 20%. In the lower horizons of poorly drained soil, with few pores, it can fall to less than 5%, or even close to zero. When the O2 supply is virtually depleted, the soil environment is said to be anaerobic.

Low O2 contents are typical of wet soils. Although in well-drained soils, after heavy rains, the O2 content of soil air can decrease markedly, especially if it is being rapidly consumed by roots of highly active growing plants or by microorganisms that decompose conveniently available organic materials. Thus, when the soil is hot, oxygen is depleted more quickly.

Fortunately, in many soils water contains small but significant amounts of dissolved O2N. When all the pores of the soil are filled with water, microorganisms can extract, for their metabolism, most of the dissolved oxygen.

However, this small amount of dissolved O2 is quickly depleted, so if excess water is not removed, the aerobic activity of microorganisms and plant growth are endangered.

Carbon dioxide

Because the N2 content of soil air is relatively constant, there is a general inverse relationship between the contents of the other two main components -O and CO- with O decreasing as CO2 increases. Although the absolute differences in the amounts of CO2 may not be considerable, when compared they are significant. Thus, when soil air contains only 0.35% CO2, this gas is around 10 times more concentrated than in the atmosphere. When the CO2 concentration becomes as high as 10%, it can be toxic to some plant processes.

Other gases

Usually soil air has higher water vapor contents than the atmosphere, in fact, it is saturated, except at the surface or in its immediate proximity. Under waterlogging conditions, the concentrations of certain gases formed by the decomposition of organic matter, such as methane (CH) and hydrogen sulfide (H2S), are also noticeably higher in soil air. Another gas produced by anaerobic microbial metabolism is ethylene (CH2). This gas is particularly toxic to plant roots, even though it is in concentrations lower than 1µL/L (0.0001%). It has been shown that when gas exchange rates between soil and the atmosphere are too slow, ethylene accumulation inhibits the growth of the roots of numerous plants.

Mechanical Prairie Renovation Technology

Techniques for the Recovery of Grasslands

The recovery or rehabilitation of a pasture consists of the restitution of its productive capacity per unit area and per animal, until acceptable ecological and economic degrees are reached. The term rehabilitation implies the presence of one or more desirable forage species that are susceptible to being conserved, stimulated or

complemented (Spain & Gualdrón, 1991). Hence, when applying any grassland recovery work, it must be taken into account that the desirable species have an acceptable botanical composition. Among the most used techniques for the effective rehabilitation of degraded grasslands are: - Double subsoiling. - Plowing - Plowing harrow - Plowing organic matter - Plowing harrow complete formula (0.5 t/ha) Among them, those with the lowest cost-benefit ratio and greatest technical-economic impact are those with harrow plowing and plowing fertilization with complete formula. Various reasons have been identified that justify the preference for the use of recovery and rejuvenation techniques for degraded grasslands five-year period 1998 - 2003, approximately 27% were degraded, for a total of 70,000 ha, which produced economic losses of 25,700 pesos in that period (Minag-Cuba, 2004). Among the advantages of rehabilitation with respect to the new sowing of degraded grasses can be found the following: - No seeds are needed and can represent a saving of up to 43% of planting costs when vegetative seed is used for sowing - Grass recovery time is reduced and better land use is achieved. - Productions of similar biomass are obtained between planting and rehabilitation, so the costs/t of MS produced when the pastures are rehabilitated are reduced. - The harmful effects of wind erosion are avoided. - The cost of rehabilitating Cuba CT-115 grass with the application of more graded plowing can be reduced between 3.1 and 8.7 times in relation to new plantations, depending on whether or not chemical fertilization is applied. Table 3 shows the economic advantage of rehabilitation with respect to new planting for several species of grasses in a state of degradation (Minag-Cuba, 2004).

Cascajosa (2005), suggests that mechanical intervention to renew degraded grasslands can be developed through several operations, which depend on the condition of the posture, the soil and the agroclimatic conditions of the place. Although disc harrows and other traditional implements have been used for renovation, some implements that do not invert the soil profile, and are based on vertical tools achieve better results.

Teams

Cascajosa (2005), explains that machines and implements have been developed in the international market for the renewal of meadows, which can only cut the soil and grass or include the application of fertilizers and seeds.

Meadow renewed with "Paratill"

Lozano (2004), explains that the tool consists of pairs of stationary arms that fit on the drawbar. In front of these you have a cutter that passes through the grass and plant residues. Observations have shown that this leaves a soil surface even smoother than a cinch plow or parabolic subsoiler.

Paratill lifts the soil instead of pressing it and gives better results when there is a moisture content close to 50% or less of the field capacity, with well-drained soil, but not very dry. Under these conditions the grass remains almost intact and the soil explodes along the natural sliding planes, producing few loose clods. With drier soil there will be larger clods, but if it is very wet, there will be stubble buildup in front of the Paratill and no soil bursting.

Cascajosa (2005), reports Paratill increases dry matter yield by 13% in the first cut, but does not significantly affect yields after this

Grassland Renovator with Chisels

Cascajosa (2005), The chisel plow is a vertical tillage tool that allows the soil to be tilled, without inverting it by superficially intermixing the plant remains. The chisel plow is an optimal tool that will allow conservation work to be carried out, in addition to promoting certain processes such as better infiltration of rainwater, reduction of ironing, better conservation of humidity, reduction of erosion, etc.

It consists of a certain number of steel arches (each chisel requires between 7 and 10 HP to be divided), generally separated 35 cm from each other, and a hardened steel spike is placed at its lower ends.

This implement is passed through the field at a depth of between 18 and 25 cm, it is considered convenient to use it at a speed of between 7 and 10 km/h. They are easy regulation tools, with minimal maintenance.

Lozano (2004), mentions the specialized equipment in Colombia for the renewal of meadows is a chisel plow, mounted in such a way that it does not allow the grass to rise. Its main objective is to break the compact layers of soil to different depths and aerate it through the layer of grass, without reversing the profile.

The operating depth of the chisels can be up to 60 cm. This depends on the depth at which they are found, if any, compact layers. Additionally, chisels help oxygenate the soil by popping clods in front of the tool.

The cut made to the sepedón helps its renewal, it develops cleanly thanks to the cutting discs that go in front of the chisels.

TABLE 3. Cost of new planting or rehabilitation for several degraded pastures, Cuban pesos (Padilla & Febles, 2007)

Species	Sowing	Rehabilitation	Differences
Fertilized likoni guinea	303.58	120.19	183.39
Unfertilized likoni guinea	225.79	91.87	133.91
Fertilized star grass	304.79	12.19	184.60
Unfertilized star grass	227.62	91.87	135.75

These slice the grassland and allow the chisels to penetrate without lifting the layer of grass.

Commercial grassland renovators are provided with an agrochemical dosing mechanism. This is driven by a guide wheel in contact with the ground that transmits the movement through a chain to the storage hopper dispenser. The agrochemical is deposited in the groove opened by the chisels according to calibration.

Bravo, D. (2000), highlights the use of chisels, which increase the porosity of the soil and break compact impermeable strata, due to the bursting of the soil into deep layers.

Japanese Grassland Renovator

Ortiz-Cañavate (2012),indicates that in 1993 they developed equipment that includes several operations: Prepares a narrow band on which to apply fertilizers, replant and cover the soil, compacting it. Preparation is done up to 10 cm using a mechanism of rotating blades fixed to a rotating shaft.

The active elements are 4 L-shaped blades and 2 straight blades, with which a T-shaped profile on the ground of 6 cm width by 10 cm depth is achieved.

- While the straight blade softens the soil by cutting the root, the L-shaped blade makes a gap wide enough for the seed bed. The power for the planting and fertilization units comes from a wheel that goes to the ground.
- The compactor wheel acts only on the hole due to the action of an independent spring

Lozano (2004), explains that the integral assembly machine operates at a width of 2.16 m and is pulled by a 60 HP tractor. The rotating unit tills a width of about 5 cm every 27cm. It has 2 sowing mechanisms for each row to sow different sizes of seed. wq

It has 8 pressure wheels with independent springs to press the seed grooves.

Seed calibration is done the same as in a fine grain seeder. In addition, different sizes of seeds can be sown, from legumes to forage.

This consists of the use of implements with rotating blades to make the necessary amount of scarification and plant legumes on an existing meadow. The blades cut grooves through grass on the ground. The cutting points of the blades have a tungsten carbide surface for working on heavy or stony soils.

Vertical Action Grassland Renewer "AerWay"

Ortiz, J. (2012), explains that an interesting machine is the so-called "AerWay" used widely in North America and several European countries.

It basically consists of a star with blades that rotate freely around an axis. Its movement originates when advancing on the ground. The blades are bent at a small angle perpendicular to the feed. With this tool aeration and scarification are done at the same time.

Some commercial models allow a toolbar to accommodate from 1 to 4 rows of discs, and can also have widths from 3.60 m to 7.9 m.

General Considerations

- For the recovery of grasslands, the chemical and physical factors of the soil, the species, the type of soil and the degree of degradation of the species that are proposed to be restored must be taken into account. The experience in Cuba indicates that mechanical work on the soil is efficient when the season, grass and weeds that are eliminated from the ecosystem are required.
- The application of tier plowing is the mechanical work that has had the most positive effect on the recovery of grass pastures, both in scientific research and in productive practice.
- The tier plowing, as a minimum tillage to the soil, it constitutes a technical-economic option for the recovery of tropical grass pastures.
- In Cuba, the use of harrow plowing or single plowing is the most efficient method for the recovery of grasslands of the species of the genus Cynodon and Panicum, when applied to the soil after the rainy period has stabilized. This cultural work can be combined with the application of chemical or organic fertilizer, when the degradation of the grassland was caused by the lack of nutrients in the soil.
- The use of graded plowing work, alone or combined with the application of fertilizer, is also an efficient method for controlling sparrow in degraded grasslands.
- Another aspect that must be taken into account is the technical-economic advantage that the rehabilitation of grasslands makes possible with respect to new crops.
- The use of harrow plowing work, after rainfall has stabilized and with adequate populations, constitutes an option that should not be neglected by the primary producer, due to the benefits it represents, in the short term, for a farm or company.

CONCLUSIONS

The degradation of grasslands is normally the loss of the natural fertility of the soils, its cause a decrease in livestock productivity and causes great economic losses. It has rightly been stated that the degradation of pastures constitutes the prelude to desertification, Cuba also It is affected by desertification and drought by 14 % desertification of its territory develops in areas of a dry and dry subhumid environment. Deforestation as a source of exploitation of natural wealth, to establish new crops and plantations, as well as to obtain firewood, charcoal and roundwood, the application of incorrect technologies.

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