Higher Polytechnic School of Chimborazo (In Spanish: Escuela Superior Politécnica de Chimborazo - ESPOCH)

Faculty of Livestock Sciences

A Thesis by Decsy Mariuxi Gualinga Ulcuango, April 2023
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"EVALUATION OF A PASTURE OF Medicago sativa VAR. CUF 101 (ALFALFA) PLUS Plantago lanceolata (PLANTAIN FORAGE) USING CROP BOOSTER TECHNOLOGY AT THE TUNSHI EXPERIMENTAL STATION"

Abstract by Harvest Harmonics Corp, Worldwide Distributor of Crop Booster™ Technology

Overview

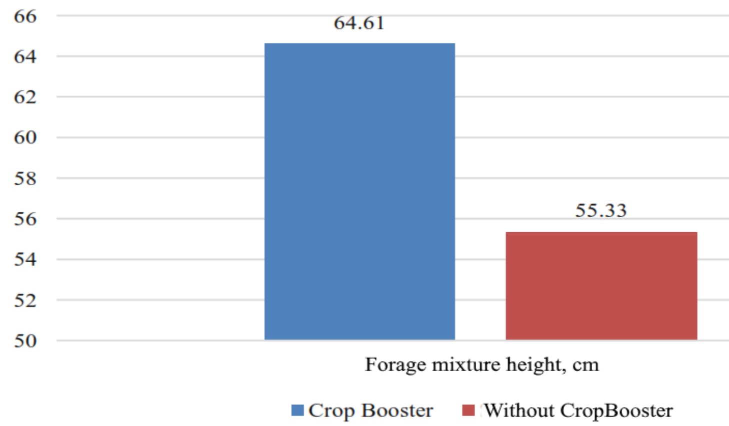
Following a successful science trial with Crop Booster technology in July 2021 another trial was conducted by an ESPOCH student team in 2023 led by student Zootechnical Engineer Ms. Decsy Mariuxi Gualinga Ulcuango in the experimental station of Tunshi in central Ecuador. She tested the effects of Crop Booster on the cultivation of alfalfa and plantain forage mix.

As seen in the results summary table below, based on Table1-3 in the Thesis, Crop Booster boosted all factors of growth and production. At the conclusion of the Thesis, the student Engineer also calculated and found positive Benefit/Cost ratios in all three cuts of the season, namely Day 30, Day 40, and Day 50.

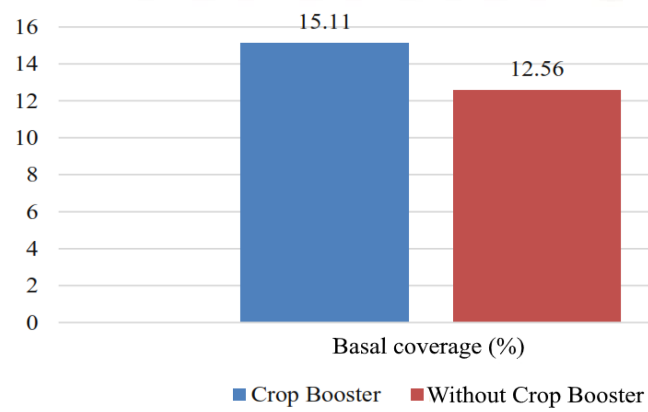
Variable	Crop Booster	without Crop Booster	GAIN*
Forage Mix height	64.61 cm	55.33 cm	**17%**
Basal cover	15.11 %	12.56 %	**20%**
Aerial cover	23.72 %	19.33 %	**23%**
Production of GF (Green Forage)	19.00 t/GF/ha/cut	15.67 t/GF/ha/cut	**21%**
Production of DM (Dry Matter)	4.47 t/DM/ha/cut	3.13 t/DM/ha/cut	**43%**

The complete Thesis, in Spanish, is attached below after this 4-page Abstract.

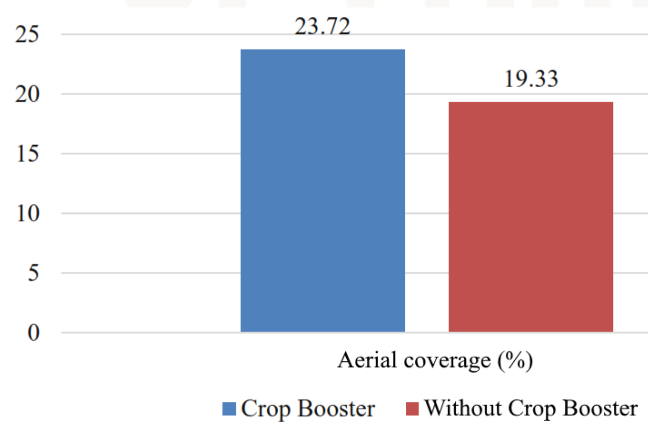
The graphs below show the major benefits discovered and calculated in the Thesis:



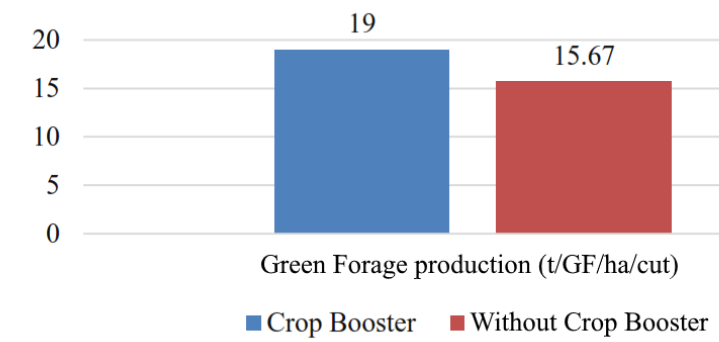
Graph 1-3: Height of the Forage Mix due to the Crop Booster Technology Effect



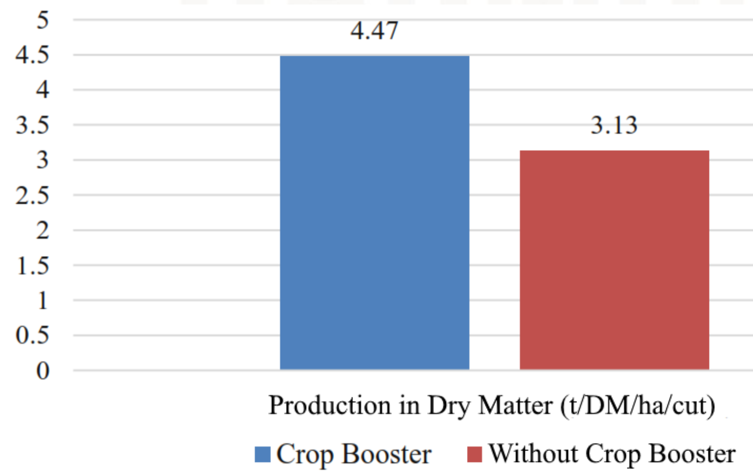
Graph 2-3: Basal Cover of the *Medicago sativa* and *Plantago lanceolata* Forage Mix due to the Crop Booster Technology Effect



Graph 3-3: Aerial Cover of the *Medicago sativa* and *Plantago lanceolata* Forage Mix due to the Crop Booster Technology Effect

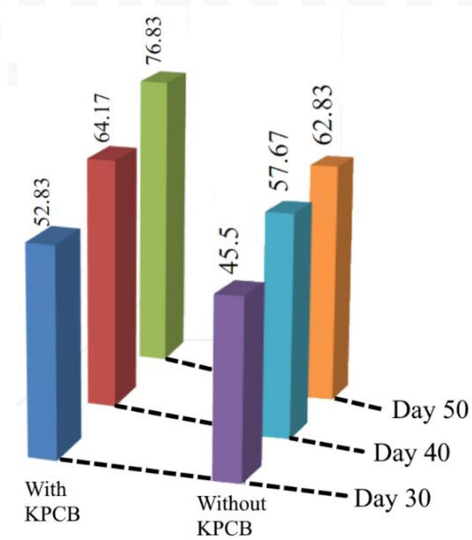


Graph 3-3: Aerial Cover of the *Medicago sativa* and *Plantago lanceolata* Forage Mix due to the Crop Booster Technology Effect

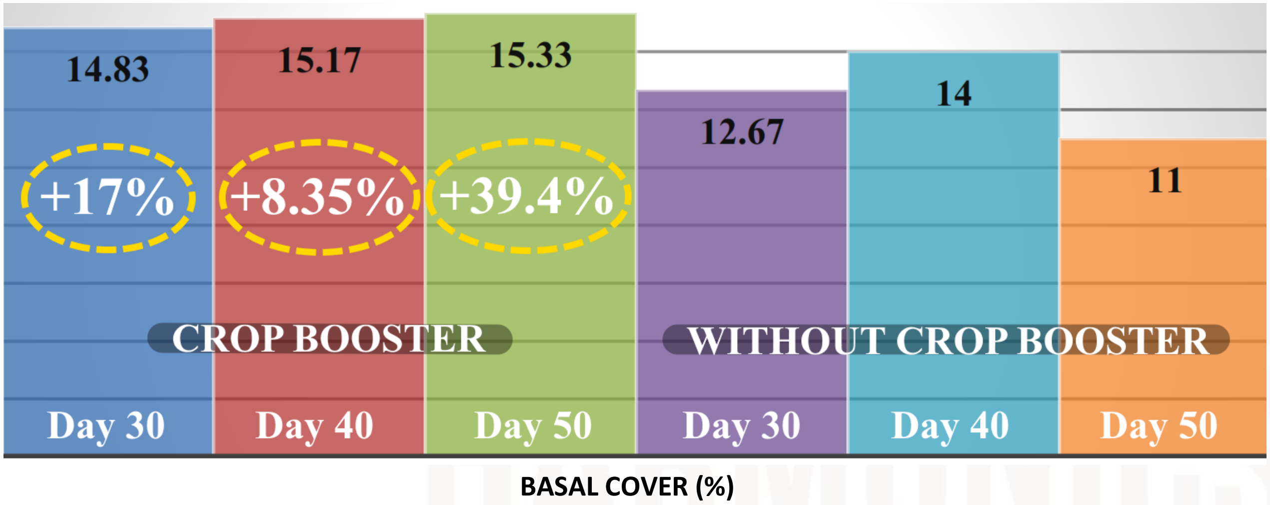


Graph 5-3: Dry Matter Production of the *Medicago sativa* and *Plantago lanceolata* Forage Mix due to the Crop Booster Technology Effect

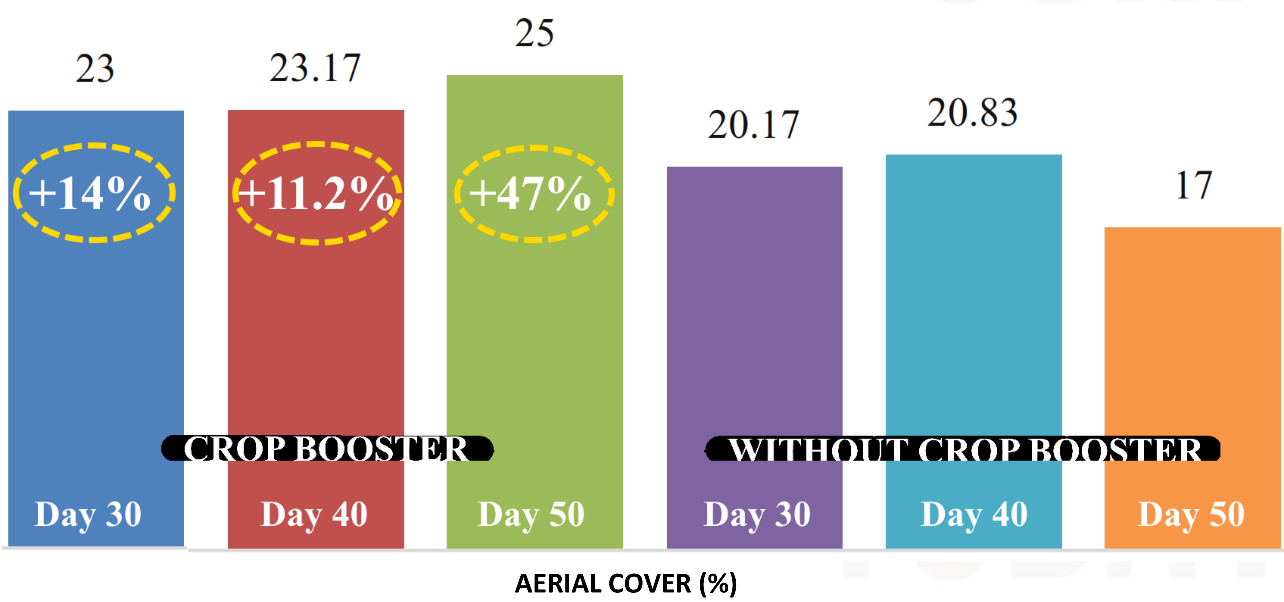
HEIGHT (cm)



Graph 11-3: Height in cm of the *Medicago sativa* and *Plantago lanceolata* Forage Mix due to the Interaction between Technology and Cutting Age



Graph 12.3: Basal Cover of the *Medicago sativa* and *Plantago lanceolata* Forage Mix due to the Interaction between Technology and Cutting Age



Graph 13-3: Aerial Cover of the *Medicago sativa* and *Plantago lanceolata* Forage Mix due to the Interaction between Technology and Cutting Age

Source: http://dspace.espoch.edu.ec/handle/123456789/19577

POLYTECHNIC HIGHER SCHOOL OF CHIMBORAZO

FACULTY OF LIVESTOCK SCIENCES

ZOOTECNIA PROGRAM

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Curricular Integration Project

Type: Experimental Work

Submitted in partial fulfillment of the academic degree of:

ZOOTECNIST ENGINEER

AUTHOR:

DECSY MARIUXI GUALINGA ULCUANGO

Riobamba – Ecuador

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DIRECTOR: Eng. SANTIAGO FAHUREGUY JIMÉNEZ YÁNEZ M. Sc.

Riobamba – Ecuador

2023

I, **Decsy Mariuxi Gualinga Ulcuango**, declare that this Curricular Integration Project is my own work, and the results therein are authentic. The texts in the document that originate from other sources are properly cited and referenced.

As the author, I assume legal and academic responsibility for the contents of this Curricular Integration Project; the intellectual property belongs to the Polytechnic Higher School of Chimborazo.

Riobamba, April 12th, 2023

Decsy Mariuxi Gualinga Ulcuango
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The tribunal for the Curricular Integration Project certifies that: The Curricular Integration Project, type: experimental work, titled "**EVALUATION OF A PASTURE OF Medicago sativa VAR. CUF 101 (ALFALFA) PLUS Plantago lanceolata (PLANTAIN FORAGE) USING CROP BOOSTER TECHNOLOGY AT THE TUNSHI EXPERIMENTAL STATION**," conducted by Miss **Decsy Mariuxi Gualinga Ulcuango**, has been thoroughly reviewed by the Members of the Curricular Integration Project tribunal, meeting scientific, technical, and legal requirements. Therefore, the Tribunal authorizes its presentation.

	FIRMA	FECHA
PRESIDENT OF THE TRIBUNAL	________________	______________
Eng. Santiago Jiménez M. Sc. **TITLE WORK DIRECTOR**	________________	______________
Eng. Carlos Santos Mgs. CP **MEMBER OF THE TRIBUNAL**	________________	______________

DEDICATION

To my parents, Antonio Gualinga and Marcia Ulcuango, who with their love, patience, and effort have allowed me to achieve yet another dream today. Thank you for instilling in me the example of hard work and courage, for not fearing adversity because God is always with me.

Decsy

ACKNOWLEDGEMENT

I am thankful to God for guiding me on the right path, for never abandoning me, for blessing me with an excellent family, for allowing me to meet outstanding teachers and friends, and for filling my heart with the light of your spirit, enabling me to achieve this goal.

To my parents, **Antonio Gualinga** and **Marcia Ulcuango**, for being the primary supporters of my dreams and instilling precious values in me. They are the ones whose love has always driven me to pursue my goals and never abandon them in the face of adversity. They have also provided the material and financial support for me to focus on my studies and never give up. For their unwavering support in the daily struggles and warm refuge along the endless paths of life, I love them dearly. Thanks to my siblings, **Jenniffer** and **Joel**, for trusting and believing in my aspirations.

I am deeply grateful to my mentor, **Eng. Santiago Jiménez**, and advisor **Eng. Carlos Santos**, for their dedication and patience. Without their precise guidance and corrections, I would not have been able to reach this long-cherished milestone. Thank you for your guidance and all your advice; I will carry them with me forever in my professional future.

To **Eng. Carlos Taco** for his support and contribution to my research.

To **Mr. Fulvio Balmelli**, the inventor of Crop Booster Technology, which enabled me to conduct new research at the Tunshi Experimental Station.
Technology Name: Kyminasi Plants
Product Name: Crop Booster
Inventor's Name: Fulvio Balmelli
Inventor's ORCID Number: 0000-0001-6212-7195

Decsy Gualinga

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF GRAPHS

LIST OF ANNEXES

RESUMEN

El objetivo de este estudio fue evaluar una pastura de *Medicago sativa* var. CUF 101 (Alfalfa) más *Plantago lanceolata* (Llantén forrajero), utilizando la tecnología Crop Booster en la Estación Experimental Tunshi, se utilizó 36 unidades experimentales con una superficie de 85 m^2. Para el análisis estadístico se utilizó el método de Diseño de Bloques Completamente al Azar (DBCA) bajo un arreglo bifactorial, que contó con 2 tratamientos y 6 repeticiones, para lo cual se midió las respuestas del efecto del tratamiento asignado, el experimento tuvo el siguiente modelo lineal aditivo Yijk = µ + Ai + Bj + ABij + € ijk. Para el análisis y prueba de significancia se realizó mediante el análisis de Varianza, prueba de Tukey P <0.05 y P<0,01. Los resultados obtenidos en esta investigación demostraron la mejor altura a los 50 días con 76,83 cm utilizando la tecnología Crop Booster, mientras que la cobertura basal y aérea de la mezcla forrajera fue mejor a los 50 días con 15,33 % y 25 % respectivamente. La mayor producción de forraje verde y materia seca se obtuvo a los 30 días con 21,50 t/FV/ha/corte y 4,81 t/MS/ha/corte respectivamente, siendo la tecnología Crop Booster la más eficiente. Se recomienda establecer mezclas forrajeras utilizando la Tecnología Crop Booster tomando en cuenta los 25, 35 y 45 días para determinar la producción que tienen las diferentes mezclas en otras pasturas en diferentes zonas, alturas y tiempos.

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Palabras clave: < Crop Booster>, < micro transmisores >, < tecnología >, < ondas >, < fase luminosa >, < innovador >, < radiofrecuencia>, < fotosíntesis >.

ABSTRACT

The objective of this study was to evaluate a *Medicago sativa* var. CUF 101 (Alfalfa) plus *Plantago lanceolata* (Plantain Forage) pasture using Crop Booster technology at the Tunshi Experimental Station. Thirty-six experimental units with an area of 85 m2 were used. For statistical analysis, a Completely Randomized Block Design (CRBD) with a two-factor arrangement was employed, consisting of 2 treatments and 6 repetitions. The responses to the assigned treatment effect were measured using the following linear additive model: Yijk = μ + Ai + Bj + ABij + € ijk. The analysis and significance test were conducted through Analysis of Variance, Tukey's test with $P < 0.05$ and $P < 0.01$. The results obtained in this research demonstrated that the best height was achieved at 50 days with 76.83 cm when using Crop Booster technology. Additionally, the basal and aerial coverage of the forage mixture was highest at 50 days, with 15.33% and 25%, respectively. The highest production of green forage and dry matter was obtained at 30 days, with 21.50 t/GF/ha/cut and 4.81 t/DM/ha/cut, respectively, and Crop Booster technology proved to be the most efficient. It is recommended to establish forage mixtures using Crop Booster technology, considering 25, 35, and 45 days to determine production in different pastures in various regions, altitudes, and times.

Keywords: < Crop Booster>, < micro transmitters >, < technology >, < waves >, < light phase >, < innovative >, < radio frequency >, < photosynthesis >.

INTRODUCTION

Ecuadorian livestock farming is based on grazing, as evidenced by the national land area that encompasses 73% of cultivable pastures and 27% of natural pastures. In coastal areas, it represents 56.64%, in mountainous regions 28.43%, and in eastern and undefined areas 14.94%. Besides being the most cost-effective feed, pastures are used for livestock feed and provide animals with good productivity (León, 2018, p. 39).

Livestock farming developed in Ecuador's grasslands is an important foundation for social and economic development. It satisfies people's basic food needs and is a significant source of employment and income (León, 2018, p. 39). In general, animals consume forage species and crop products, which can be used directly for grazing or supplied as hay, silage, etc.

New technologies in agriculture have become an alternative to improve production rates in the country's pastures. Low-frequency radio wave irrigation systems have been implemented to enhance plant functional efficiency and soil health. Since these transmitted waves align with the natural molecular frequencies of the soil and grasses, they can receive these instructions, enhancing their function. The signals are designed to increase the absorption and efficient use of water, nitrogen, and light to maximize energy production in the light phase of photosynthesis (Buriticá, 2021, p. 2).

Crop Booster technology is an innovative irrigation system that has yielded positive results in crops because it has no adverse environmental impact and increases yields. Moreover, it contains low-intensity radiofrequency microtransmitters that positively affect plant metabolism, allowing them to be reached more efficiently (Organiko Latam, 2021, p. 2).

By implementing new irrigation techniques, the aim is to improve pasture quality, thereby increasing yields and reducing cutting time. The technology implemented in the irrigation at the Tunshi Experimental Station is the Crop Booster technique, which allows for increased forage production and higher nutritional value in pastures.

Based on the above, the goal is to evaluate an irrigation system that improves forage yield and quality at the Tunshi Experimental Station. The advancements in this research could lead to a new alternative beneficial for farmers in increasing sustainability and profitability indices.

Based on the above, this research has the following objectives:

- Determine the productive behavior in a *Medicago sativa* var pasture. CUF 101 (Alfalfa) plus *Plantago lanceolata* (Forage plantain), using Crop Booster technology at three cutting ages (30, 40 and 50 days).
- Know the bromatological value of a forage mixture, *Medicago sativa* var. CUF 101 (Alfalfa) plus *Plantago lanceolata* (Forage plantain).
- Evaluate the benefit/cost using Crop Booster technology.

CHAPTER I

1. THEORETICAL FRAMEWORK

1.1. Alfalfa

Alfalfa is one of the most widely used forage crops because it produces large quantities of high-quality dry matter. The purpose of these crops is to produce forage that can be used directly for grazing or preserved as hay to make hay rolls, bales, or hay packs (Díaz, 2020, p. 4).

It is a perennial crop, as its production cycle lasts several years (up to 6-8 years). Its persistence depends on various factors, primarily management practices related to the climate and soils of each region. Harvests are more frequent during the growing season, and the number of harvests depends on production goals, management, operational conditions, and weather conditions in each individual season (Díaz, 2020, p. 4-5).

1.1.1. Taxonomic Scale

It is a plant of Mediterranean origin, rich in vitamins and minerals, suitable for medicinal use. Alfalfa (ITIS, 2019, p. 4) belongs to the following taxonomic classes as shown in Table 1-1.

Table 1-1: Taxonomic Classification of Alfalfa *(Medicago sativa)*

Reino:	Vegetal
División:	Magnoliophyta
Clase:	Magnoliopsida
Subclase:	Rosidae
Orden:	Fabales
Familia:	Fabaceae
Subfamilia:	Faboideae
Tribu:	Trifolieae
Género:	Medicago
Especie:	Medicago sativa L.

Source: (ITIS, 2019)

1.1.2. Botanical Description

Alfalfa belongs to the legume family and is a perennial herb with an upright growth habit. It has a crown from which shoots grow. The leaves are trifoliate, although the first true leaf is smooth. The flowers are blue, purple, or white and grow in clusters from the leaf axils. The fruit is a legume (pod) that is not peeled and contains 2 to 6 seeds measuring 1.5 to 2.5 mm, pale yellow in color, and kidney-shaped (Bonvillani, 2018, p. 6).

1.1.2.1. The root

The taproots of alfalfa are very deep, reaching the water table or rocky bed at a depth of 2 to 5 meters. This deep root system partly reflects its ability to access water from deeper layers and, thus, its natural resistance to drought. The plant can reproduce as lateral roots form shoots and produce stems that form new clusters (Guevara, 2020, p.17).

1.1.2.2. The stem

Alfalfa has vertical stems, and during postnatal development, axillary buds appear between the cotyledons, giving rise to the first stem. On the stem, the closer the first axillary bud grows to the first floral node, the faster it grows.

Old stems turn brown, harden, and die, while new stems emerge in late summer. The same occurs after each cut. The entire set of stems forms a crown, which emerges above the soil surface in warm climates and is buried in the soil surface in cold climates (Guevara, 2020, p.17).

1.1.2.3. The leaves

They are compound and flat (at the ends of the stem in leaflets) and include:

- Stipules: A pair of leaf-shaped appendages at the base and sides of the stem. Medicago has a fused margin.
- Petiole: The stem that connects the axis to the rest of the plant.
- Small Leaves: Small leaves that join together to form the leaf itself.
- Peciolule: The small petiole that connects the leaf to the stem (Guevara, 2020, p.17).

1.1.2.4. The flowers

They are pentagonally lobed and have 5 different petals with the following names:

- Standard: Upper petals, usually the largest.
- Wings: Placed on both sides of the standard.
- Keel: The last two front petals fused to one edge.

The calyx consists of 5 sepals joined at the base. The stamens (male part) consist of two bundles of stamens fused together. The pistil (female part) consists of a single carpel in which the ovary, style, and stigma are clearly visible. There are several ovules in the ovary. The stigma is filiform, with the stigma at the top, and the style and stigma are protected by a keel along with the stamens. The flowers are collected in axillary clusters. The first inflorescence is usually at the node level (Guevara, 2020, p.17).

1.1.2.5. Fruit

A long, coiled pod with 3 to 5 turns without separation. The seeds are arranged one after another, following the position of the ovules in the ovary (Guevara, 2020, p.17).

1.1.2.6. Seed

According to (Guevara, 2020, p.17), the seed consists of a cord, embryo, and proteins.

- Funicle: It is the connecting element between the seed and the pod. When the seeds are ripe, they dry up and disappear.
- Seed Coat: The seed's covering that protects it and gives it its yellow color.
- Embryo: It contains the outlines of the future plant, including:
- Radicle: Conical, it is the outline of the future root.
- Hypocotyl: Located as a continuation of the radicle, its extension allows the above-ground part of the plant to appear.
- Stem: Extension of the hypocotyl that supports the cotyledons.
- Germ: The stem from which the plant emerges.
- Cotyledons: These are the outlines of the first leaf.
- Proteins: The reserve tissue rich in sugar that is favorable for the embryo's germination.

1.2. CUF 101 Variety

Alfalfa CUF101 was developed by the University of California, United States. It was one of the first to be introduced and remains one of the most planted varieties today, although it has been technically surpassed by others. CUF 101 belongs to group 9, which means it stops growing for a very short time in winter. It is resistant to green and blue aphids, has a short dormancy period, and a small canopy. Suitable for hay and good forage production. It is susceptible to foliar diseases (Fertisa, 2019, p.1).

1.2.1. Characteristics of Alfalfa CUF 101 by Guasch Semillas

According to (Fertisa, 2019, p.1), the characteristics of Alfalfa CUF 101 are as follows:

- Certified Fiscalized Seed by the National Institute of Seeds (INASE).
- Varietal purity of this alfalfa is guaranteed. Plantings are done with basic original seed imported directly from California, USA.

- Production is carried out in plots exclusively intended for seed production and does not come from dual-purpose pastures (grazing/seed). The plots are monitored by technicians from INTA (National Agricultural Technology Institute). The most modern techniques available for alfalfa seed production are applied to these plots.
- Excellent physical purity. Weed control is carried out from the moment prior to planting and is monitored during various stages of cultivation. Once the seed is harvested, it is processed using specific machinery to remove the presence of weeds and foreign matter.
- Germination Power. It is guaranteed that the germination power of this seed significantly exceeds the minimum requirements of current legislation, ensuring excellent vigor for greater confidence in pasture establishment.
- Pelleted Seed. The seeds have been subjected to pelleting. This process involves coating alfalfa seeds with an adhesive material that contains symbiotic Rhizobium meliloti bacteria. Pelleting provides the seed with the following advantages: better effective nodulation, increased nitrogen fixation, improved germination, faster emergence, and better plant stand.

1.2.2. General Description

A perennial legume, drought-tolerant, and of high nutritional value. In the country, alfalfa is considered one of the main forage crops, capable of providing large quantities of green forage, irreplaceable due to its high protein content. Additionally, it is a significant nitrogen fixer, increasing soil fertility (Fertisa, 2019, p.1).

According to (Fertisa, 2019, p.1), the general description is distributed as follows:

- **Soils**

Deep, well-drained, neutral, and refined soils, preferably those that have survived several agricultural cycles.

- **Planting Season**

Preferably in autumn, also in spring.

- **Planting Density**

It should be regulated based on climatic conditions, soil types, and production purpose (direct grazing or cutting). Recommended rates are 10 to 12 kg/ha for pure plantings and 6 to 8 kg/ha in mixtures.

- **Planting Depth**

In heavy (clayey) soils, it should be 1 cm to 2.5 cm, and in light (sandy) soils, more than 2.5 cm.

- **Identification**

Leaves with three leaflets, serrated at the top, violet or blue flowers, spiraled fruits with one to four spikes.

1.3. Plantain Forage (*Plantago lanceolata*)

1.3.1. Origin and Description of Plantain Forage

Plantago lanceolata is a perennial plant native to Eurasia, found in tropical regions around the world. In Ecuador, it is found in both the coastal mountains and the highlands, and sometimes in the jungle. It is a small herb, about 0 cm tall, with pink, simple, wide, ovate leaves, a base with irregular teeth, and light green in color. The flowers are light green. The flowers are unisexual, small, in spikes 6-25 cm long, amber-green in color, and 2 mm long. The fruit has an oval capsule that is 2 mm long. The seeds are small, round or granular, and dark in color (Robles, 2022, p. 24).

1.3.2. Taxonomic Scale

According to (Robles, 2022, p. 25), the taxonomic classification of Plantain *(Plantago lanceolata*) is as follows:

Table 2-1: Taxonomic Classification of Plantain Forage (*Plantago lanceolata*)

Reino:	**Plantae**
Subreino:	Tracheobionta
División:	Fanerógama Magnoliophyta
Clase:	Magnoliopsida
Subclase:	Asteridae
Orden:	Lamiales
Familia:	Plantaginaceae
Género:	Plantago
Especie:	Plantago lanceolata L.

Fuente: (Robles, 2022)

1.3.3. General Characteristics

Plantain is a widely distributed perennial species in natural grasslands with temperate climates. It is characterized by a fibrous and dense root system, which makes it somewhat drought-resistant. It contains high concentrations of minerals such as calcium, selenium, magnesium, phosphorus, zinc, copper, and cobalt, which are increasingly important in low-fertility pastures and soils. Furthermore, it contains compounds with beneficial biological activity in animals, such as antimicrobial and/or anti-inflammatory activity, is resistant to pest and disease attacks (Etcheverría, 2019, p. 1).

Figure 1. Root System of *Plantago lanceolata*

Source: (Etcheverría, 2019)

1.3.4. Soil and Climate Requirements

Plantain adapts to various types of soils and levels of organic matter. However, it is moderately tolerant of compacted soils and does not tolerate wet or highly saline soils. It can adapt to a wide range of pH levels (4.2-7.8), with 5.8 being the optimal value. It is often found in soils with low fertility. However, it responds quite well to nitrogen fertilization, promoting an increase in the number of leaves, shoot growth, and total biomass (Etcheverría, 2019, p.1).

Climatically, it requires annual precipitation exceeding 600 mm. It is resistant to frost and moderately drought-resistant.

1.3.5. Commercial Varieties

The only commercial variety available in the national market is the equivalent of New Zealand Tonic. It is characterized by early flowering, winter growth, and yields similar to some permanent pastures (Etcheverría, 2019, p.1).

1.3.6. Establishment

Plantain requires suitable soil temperature and planting depth. Establishment is rapid when the soil temperature is equal to or greater than 10°C, not more than 1 cm deep, and with good weed control (Etcheverría, 2019, p.1).

Figure 2. Pure Plantain Forage Meadow in Vegetative State

Source: (Etcheverría, 2019)

According to (Etcheverría, 2019), good weed control before establishment is essential because it is highly sensitive to herbicides, especially phenoxy herbicides such as MCPA, 2,4-D, or clopyralid, diflufenican, or fluoridamine.

Below are the steps to establish a plantain pasture:

a) Sowing Date.

If establishing pure plantain, it can be sown in dry, hot, and cold conditions. Avoid late summer planting as establishment is very slow and will reduce competition with other species or weeds. For mixed sowing, plant in winter as it has a better chance of competing with other species in the mixture.

b) Sowing Rate.

- Pure plantain: 8 to 10 kg per hectare
- Mix with grasses: 2 to 3 kg per hectare
- Mix with legumes: 5 to 10 kg per hectare

c) Fertilization.

In general, for mixed crops without clover, it is recommended to apply 60 kg per hectare of N, 50 kg per hectare of P2O5, and 25 kg per hectare of K2O at the time of planting, and 30-40 kg per hectare after each grazing during the growth period. In mixtures with clover, nitrogen is supplied by the clover. Typically, fertilization for optimal growth will reduce the amount of plantain over time when it is part of the mixture.

d) Persistence.

It varies depending on whether it is sown alone or in a mixture and the management it receives. Under suitable environmental and management conditions, persistence is three to five years. In mixed sowings, the number of plants rarely exceeds 20% of the total number of plants in the pasture.

e) Expected Yield.

Average yields range between 8 and 12 tons of dry matter per hectare. To achieve maximum yield, it is necessary to use rotational or strip grazing, either alone or in combination.

1.3.7. Types of Pastures with *Plantago lanceolata*

There are different types of pastures, some of which are mentioned by Etcheverría (2019, p. 2):

a) Pure or monoculture

b) Mixture with grasses. Mixing with ryegrass is quite common. Although plantain establishes rapidly, ryegrass is a highly competitive species, which hinders successful plantain establishment.

c) Mixture with legumes

d) Multispecies. One of the mixtures that has yielded excellent results in both New Zealand and the United Kingdom includes *Plantago lanceolata*, *Cichorium intybus* (Chicory), *Trifolium repens*, and *Trifolium pratense*. It exhibits good summer growth and allows for weight gain in lambs and sheep of up to 350 g per day.

Figure 3. Plantain and Ryegrass Meadow for Lamb Fattening, Using Electric Fence, Pucón

Source: (Etcheverría, 2019)

Figure 4. Mixed Seven Veins Meadow

Source: (Etcheverría, 2019)

1.3.8. Final Considerations

Plantain is a good forage alternative for grazing, but it requires effective weed control and appropriate sowing dates to achieve successful establishment. It provides quality forage during critical periods in sheep farming, such as lactation and flushing, as well as for finishing steers (Etcheverría, 2019, p. 2).

1.4. Crop Booster Technology

1.4.1. Description

Crop Booster (CB) is a new technology integrated into irrigation systems that uses low-frequency radio waves to enhance the functional efficiency of plants and soil health. Crop Booster increases both the quantity and quality of the harvest:

- Improves soil health and nutrient availability
- Increases root density
- Enhances and balances plant nutrient uptake and utilization
- Improves photosynthetic efficiency under warmer, drier, and/or cloudier conditions.

The device is connected to the irrigation system and activates when water flows through it (Balmelli, 2019, p. 1).

1.4.2. Mechanism of Action

Crop Booster's micro transmitters transmit precise instructions to plants using radio wave pulses at different frequencies. Because these frequencies are transmitted and align with the natural molecular frequencies of soils and plants, these instructions can be received by them, allowing for improved functionality (Balmelli, 2020, p. 1).

1.4.3. Benefits of Crop Booster Technology

The primary advantage of this micro transmitter lies in the soil, as it provides more oxygen, enabling it to produce more roots and improve water penetration, resulting in significant water savings. Additionally, it reduces pests and diseases. The device reduces conductivity from 2.3 to 1.7 and sodium from 1.1 to 0.6, preventing salt accumulation in plants (Organiko Latam, 2021).

1.4.4. Results Observed with Crop Booster Technology

1.4.4.1. Greater growth and vigor

- **100% Increase in Production, 0% Pesticide Usage**

Depending on the climatic conditions and altitude, the Valle del Cauca region in Colombia typically harvests 1 kg of bell peppers per plant in the first harvest. By using Kyminasi Plant Booster technology, they harvested 2 kg in the first round. Furthermore, the crops were very healthy, free from pests and diseases, so there was no need to use agrochemicals, something that hasn't happened in the last 17 years (Harvest Harmonics, 2021, p.12).

1.4.4.2. More Production

- **100% Increase in Production**

Kyminasi Plant Booster technology was installed at the Polytechnic University of Chimborazo in a forage mixture of alfalfa, ryegrass, and clover (recently installed). The pasture was ready for grazing on day 45, whereas the usual time for this area and this type of mixture is 3 months. A 100% coverage without empty spaces and an intense green color were observed, indicating a higher concentration of chlorophyll (Harvest Harmonics, 2021, p.52).

1.4.4.3. Better Quality

- **10% Increase in Size**

Hortifruit is one of the world's largest blueberry producers. They improved the flavor in terms of Brix/acid ratio, had 10% more fruit (88% vs. 4%), and had no bruising (83% vs. 79%). Additionally, the fields with KPB were more productive, resulting in an additional cost of $12,497 for technology usage (Harvest Harmonics, 2020, p.60).

1.4.4.4. Soil Health

Crop Booster signaling helps bind minerals in the soil and prevents nutrient loss. It also activates soil nitrogen-fixing bacteria and inhibits nitrogen volatilization from wet soil. Furthermore, it improves soil compaction properties. The frequency appears to increase the molecular attraction of minerals in the soil, cumulatively causing a loosening effect. CB tracers optimize soil water retention, and thanks to the loosening, they increase the rate of water infiltration into the soil. Less water is needed to moisten the soil (Organiko Latam, 2020, p.23).

1.4.5. Crop Booster Signals Stimulate Plant Physiology

1.4.5.1. Plant health

The Crop Booster signal indicates better absorption and balanced use of essential macronutrients: nitrogen, phosphorus, and potassium. The signaling improves and helps balance the absorption and utilization of secondary micronutrients. It also promotes the absorption and utilization of nitric oxide, which is important for the "growth, development, immunity, and environmental interactions of plants" (Organiko Latam, 2021, p.20).

1.4.5.2. Plant health: nutrient balance

Calcium is in balance with magnesium, phosphorus, and potassium. Similarly, calcium, magnesium, sulfur, copper, zinc, manganese, and silicon dioxide (SiO_2) are processed together to promote iron (Fe) absorption. There is increased boron absorption, while CB signaling inhibits excessive sodium absorption and reduces soil electrical conductivity (Organiko Latam, 2021, p.25).

1.4.5.3. Crop Booster improves Photosynthesis

Crop Booster signals are designed to increase the absorption and effective use of water, nitrogen, and light to enhance energy production in the light phase of photosynthesis. Crop Booster signals stimulate increased carbon dioxide absorption and glucose metabolism efficiency to accelerate the dark response.

Due to the improvements mentioned above, no matter which carbon fixation method the machine uses (C3, C4, or CAM), Crop Booster expands the range of conditions. Photosynthesis can occur, for example, when the weather is cloudy. Crop Booster action increases the ability to utilize more resources like available effective light (Organiko Latam, 2020, p.25).

1.4.6. What Exactly Is the Crop Booster Device?

The technology consists of more than 3000 unique harmonic signals programmed into small transmitters installed in irrigation systems. Its function is quite simple because oxygen molecules in the water have a negative charge (ions), and as they move in a linear direction, they create an electromagnetic field, pick up harmonic signals stored in a small transmitter, and send them to the soil and plants (Harvest Harmonics, 2020, p. 20).

CHAPTER II

2. METHODOLOGICAL FRAMEWORK

2.1. Location and Duration of the Experiment

The present experimental work was conducted at the Tunshi Experimental Station - ESPOCH, located at kilometer 12 on the road to Licto in the Riobamba Canton, Chimborazo Province, at an altitude of 2750 meters above sea level, Latitude: -1.672711, and Longitude: -78.648308. The meteorological conditions of the Riobamba Canton are described in Table 3 below.

Tabla 1-2: Meteorological Conditions at the Tunshi Experimental Station of ESPOCH

PARÁMETROS	UNIDADES	VALOR PROMEDIO AÑO 2018
Temperatura	°C	13,10
Precipitación	mm	558,60
Humedad relativa	%	71,00
Heliofanía	Medias horas de sol	5,2

Source: (Estación Agrometeorológica de la Facultad de Recursos Naturales, 2018)

2.2. Experimental Units

For this research, 36 pre-established plots were used, with each plot having dimensions of 5 x 17 meters. The size of each experimental unit was 85 square meters suitable for the production of a forage mixture.

2.3. Materials, Equipment, and Facilities

2.3.1. Field Materials

- Identification tags
- Tape measure
- Notebook for notes
- Manual tools (rake, sickle, machete, hoes)
- Stakes
- Strings
- Boots
- Overall
- Pens
- Photographic camera
- Record sheets
- Square

- Crop Booster Removal Attachment

2.3.2. Equipment

- Scale
- Rainstar T41 Reel System
- 40 hp Pump
- Crop Booster Device
- Nutrition and Bromatology Laboratory
- Tractor

2.4. Experimental Treatment and Design

In the present study, the influence of Crop Booster technology (Factor A) on the productivity of a forage mixture composed of Alfalfa and Plantain forage expressed in green forage (GF) and dry matter (DM) was studied at 30, 40, and 50 days (Factor B) with 6 repetitions. There were a total of 36 Experimental Units distributed under a Completely Randomized Block Design (CRBD) in a bifactorial arrangement.

$$Yijk = \mu + Ai + Bj + ABij + € \, ijk$$

Where:
Yijk= Value of the variable.
μ = Overall mean.
Ai= Effect of Crop Booster
Bj= Effect of cutting ages.
ABij= Interaction of Crop Booster and Cutting Ages
€ijk = Experimental error

2.4.1. Experiment Scheme

The experimental design used was a Completely Randomized Block Design (CRBD) in a bifactorial arrangement, with 2 treatments and 6 replications each, which will be evaluated with a control treatment as detailed in Table 2-2 below:

Tabla 2-2: Experiment Scheme

Tecnología Crop Booster	Edades de corte	Código	No de repeticiones	No total de parcelas
FACTOR A	**FACTOR B**			
Crop Booster	30 días	CBE30	6	6
Crop Booster	40 días	CBE40	6	6

Crop Booster	50 días	CBE50	6	6
Sin Crop Booster	30 días	SCBE30	6	6
Sin Crop Booster	40 días	SCEB40	6	6
Sin Crop Booster	50 días	SCEB50	6	6
TOTAL				36

Source: Gualinga, Decsy, 2023

2.5. Experimental Measurements

The experimental measurements considered for this research were:

2.5.1. Productive Variables

- Plant height (cm)
- Aerial coverage (%)
- Basal coverage (%)
- Green forage production (t/GF/ha/cut)
- Dry matter production (t/DM/ha/cut)

2.5.2. Nutritive Forage Quality Variables

- Proximate analysis (DM, Protein, Ash, Fiber, Ether Extract), %

2.5.3. Economic Variables

- Benefit/cost.

2.6. Statistical Analysis and Significance Tests

The experimental results obtained were subjected to the following statistical analyses:

- Analysis of Variance (ANOVA).
- Mean separation according to Tukey (P0.05)

2.6.1. Analysis of Variance (ADEVA) Scheme

The scheme of the applied Analysis of Variance is described in Table 3-2 below.

Table 3-2: Analysis of Variance (ADEVA) Scheme

Fuente de variación	Grados de libertad
TOTAL	35
Factor A	1
Factor B	2
Interacción A*B	2

Repeticiones	5
Error experimental	25

Source: Gualinga, Decsy, 2023

2.7. Experimental Procedure

- The experimental work was carried out in a pasture composed of *Medicago sativa* var. CUF 101 (Alfalfa) plus *Plantago lanceolata* (Forage Plantain), located at the Tunshi Experimental Station of the Polytechnic School of Chimborazo.
- At the beginning of the study, water access was cleaned, and an equalization cut was made, dividing 3060 m2 of land into 36 plots of 85 m2 each. Additionally, it was fertilized with Fertiforraje, using two quintals per hectare. Fertilization was done by broadcasting.
- Sprinkler irrigation was performed with and without the Crop Booster system every 5 days depending on the weather conditions.

  - At 30, 40, and 50 days, the grass height, aerial coverage, basal coverage, green forage production, dry matter production, and samples for subsequent bromatological analysis were evaluated.

  - At the end of the experimental work, the data was tabulated, and bromatological analysis of the samples at 30, 40, and 50 days was performed.

2.8. Evaluation Methodology

2.8.1. Productive Variables

2.8.1.1. Plant Height (cm)

It was determined using the Canfield Line, where it was measured from the ground base to the midpoint of the highest leaf, and the plants in contact with the transect were measured using a tape measure. Then, all the data were summed to obtain an overall average (Guaranga, 2020, p.23).

2.8.1.2. Basal coverage (%)

It was determined using the Canfield Line method, which involved drawing a diagonal transect in each plot, and plants in contact with it were evaluated. Using a tape measure, the area occupied on the ground by each plant was measured, and all the coverages of each plot were summed. The percentage of basal coverage was obtained by a simple rule of three (Guaranga, 2019, p.23).

2.8.1.3. Air coverage (%)

It was determined using a transect, and the aerial part of all plants in contact with this transect was measured using a tape measure. Then, all the data were summed, and the percentage of aerial coverage was calculated using a simple rule of three (Guaranga, 2019, p.23).

2.8.1.4. Green forage production (t/MV/ha/cut)

It was determined by weight. A representative sample from each plot was cut using a 1 m^2 quadrant, and it was left for regrowth at a height of 5 cm. The obtained weight was related to 100% of the plot, and green forage production was estimated in t/ha/cut (Tiupul, 2020, p.27).

2.8.1.5. Dry matter production (t/MS/ha/cut)

Dry matter production was determined in the Nutrition and Bromatology laboratory of the Faculty of Animal Sciences based on the grass's moisture percentage. It was subjected to drying, and the dry matter production was obtained by weight difference, allowing the calculation of dry matter yield per hectare (Guaranga, 2019, p.24).

2.8.2. Nutritive Forage Quality Variables

2.8.2.1. Proximate analysis (MS, Protein, Ash, Fiber, Ether extract), %

To perform the proximate analysis of the pastures composed of *Medicago sativa* var. CUF 101 (Alfalfa) plus *Plantago lanceolata* (Forage Plantain), a 500 g sample was taken from each plot at 30, 40, and 50 days. These samples were then taken to the Nutrition and Bromatology laboratory of the Faculty of Animal Sciences for analysis.

2.8.3. Economic Variables

2.8.3.1. Cost Benefit

It was determined through the benefit/cost indicator, which was calculated using the following expression:

$$\text{Benefit/ Cost} = \frac{\text{Total Income}}{\text{Total Expenses}}$$

CHAPTER III

3. ANALYSIS AND INTERPRETATION OF RESULTS

3.1. Productive Performance of a Pasture of *Medicago sativa* var. CUF 101 (Alfalfa) plus *Plantago lanceolata* (Plantain Forage) with Crop Booster Technology (Factor A)

3.1.1. Height of the forage mixture Comprising of *Medicago sativa* plus *Plantago lanceolata*, (cm)

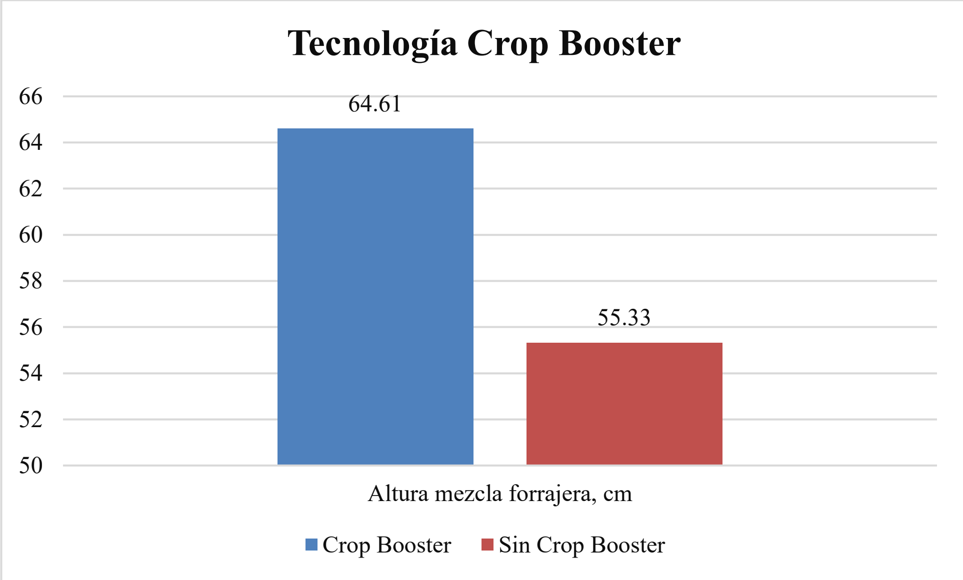
When evaluating the height of the forage mixture composed of *Medicago sativa* and *Plantago lanceolata*, it was evident that there were highly significant differences ($P<0.01$) due to the Crop Booster Technology (Factor A). The highest height, 64.61 cm, was recorded with the use of the technology, while the lowest value, 55.33 cm, was reported without the technology, as shown in Table 1-3 and Graph 1-3.

Table 1-3: Productive Performance of the Forage Mixture *Medicago sativa* var. CUF 101 (Alfalfa) plus *Plantago lanceolata* (Plantain Forage) using Crop Booster Technology (Factor A)

VARIABLE	TECNOLOGÍA CROB BOOSTER				EE	Prob.	Sig.
	Crop Booster		Sin Crop Booster				
Altura mezcla forrajera, cm	64,61	a	55,33	b	1,04	0,0001	**
Cobertura basal (%)	15,11	a	12,56	b	0,47	0,0007	**
Cobertura aérea (%)	23,72	a	19,33	b	0,72	0,0002	**
Producción de forraje verde (t/FV/ha/corte)	19,00	a	15,67	b	0,50	0,0001	**
Producción en materia seca (t/MS/ha/corte)	4,47	a	3,13	b	0,10	0,0001	**

E.E.= Error estándar; **Prob.** = Probabilidad; **Sig.** = Significancia. Prob. > 0,05: No existen diferencias estadísticas; Prob. ≤ 0,01: Existen diferencias altamente significativas. Prob. ≤ 0,05: Existen diferencias significativas.

Source: Gualinga, Decsy, 2023



Graph 1-3: Height of the Forage Mixture due to the Crop Booster Technology Effect

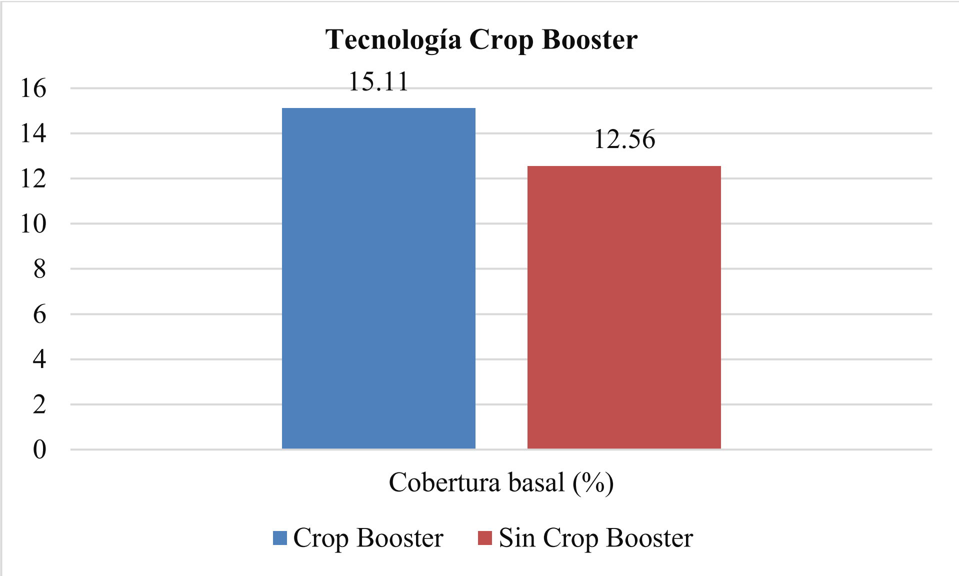
Source: Gualinga, Decsy, 2023

The results obtained in this research are superior to those reported by (Pérez, 2021. p. 35) who, when assessing the productivity of a forage mixture consisting of alfalfa, white clover, and ryegrass using the Crop Booster device and normal irrigation, achieved a height of 49.6 cm. This suggests that the use of this technology in irrigation increases the grass's height. The low-frequency waves emitted by the device allow plants to better absorb and metabolize nutrients, resulting in increased yield and growth.

This is in line with Velásquez (Velásquez, 2022. p. 31), who stated that with the irrigation system provided by the Crop Booster device, they achieved taller plants at 40.7 cm. Similarly, (Herrera, 2021. p. 16) reported that, in a maize field studied, the best height at 76 days was 282.16 cm. These results were influenced by water, as it is necessary for the absorption and mobility of nutrients that move from the soil through the roots and stems, thanks to solar energy that activates a suction pump-like mechanism.

3.1.2. Basal Coverage of the Forage Mixture Comprising *Medicago sativa* plus *Plantago lanceolata* (%)

When evaluating the percentage of basal coverage of a forage mixture due to the crop booster's effect (Factor A), highly significant differences ($p<0.01$) were recorded, with the best coverage at 15.11% when using the Crop Booster, while without this device, a basal coverage of 12.56% was obtained. This can be observed in Table 1-3 and Graph 2-3.



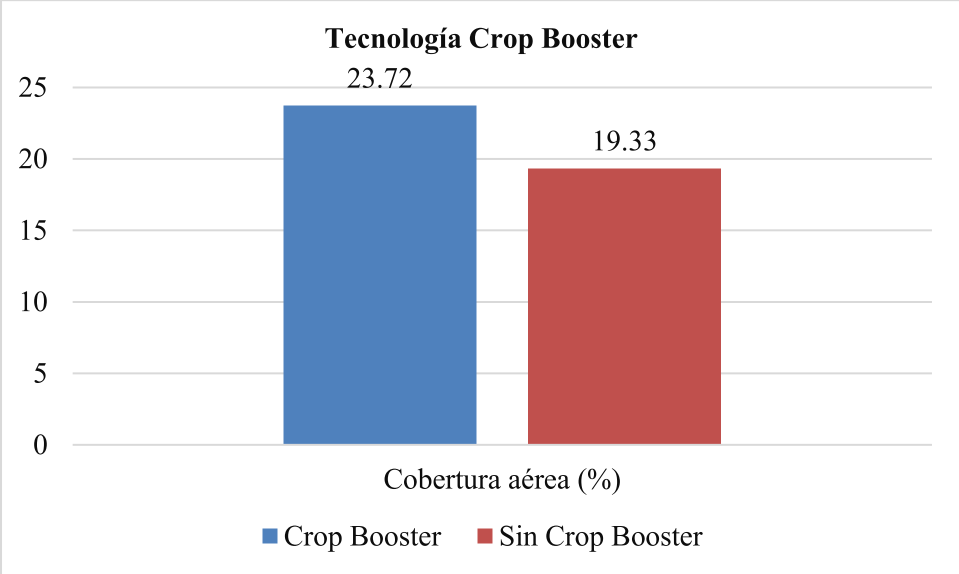
Graph 2-3: Basal Coverage of the *Medicago sativa* and *Plantago lanceolata* Forage Mixture due to the Crop Booster Technology Effect

Source: Gualinga, Decsy, 2023

The results obtained in this research are lower than those reported by (Pérez, 2021. p. 36), who, when assessing the productivity of a forage mixture composed of alfalfa, white clover, and ryegrass using the device and normal irrigation, obtained a coverage percentage of 261.2%. This shows that the Crop Booster technology helped improve basal coverage because low-frequency waves transported by water during irrigation allowed for greater development and growth of the grass.

3.1.3. Aerial Coverage of the Forage Mixture Comprising *Medicago sativa* plus *Plantago lanceolata* (%)

When evaluating the percentage of aerial coverage of a forage mixture composed of *Medicago sativa* and *Plantago lanceolata*, highly significant differences ($P<0.01$) were observed due to the Crop Booster Technology (Factor A), with values of 23.72% when using the device, while without the use of the technology, it was 19.33%, as shown in Table 1-3 and Graph 3-3.



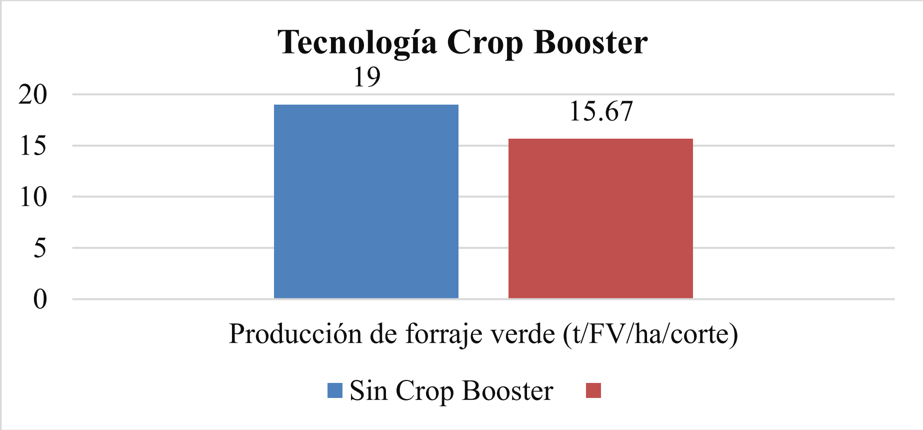
Graph 3-3: Aerial Coverage of the *Medicago sativa* and *Plantago lanceolata* Forage Mixture due to the Crop Booster Technology Effect

Source: Gualinga, Decsy, 2023

Comparing the data from this research with (Pérez, 2021. p. 36), it was inferior. However, using the Crop Booster device, an aerial coverage of 557.6% was obtained. This was due to the installation of this equipment in the irrigation system, which allowed for greater production and development of the grass. This is because the crop booster improved the absorption and use of water, leading to increased aerial coverage in the forage mixture.

3.1.4. Green Forage Production of the Forage Mixture Comprising *Medicago sativa* plus *Plantago lanceolata*, (t/GF/ha/cut)

When evaluating the production of green forage of a mixture composed of *Medicago sativa* and *Plantago lanceolata*, highly significant differences ($P<0.01$) were determined due to the Crop Booster Technology (Factor A), with values of 19 t/FV/ha/cut, and 15.67 t/FV/ha/cut, with the highest value reported when using the device, as shown in Table 1-3 and Graph 4-3.



Graph 4-3: Green Forage Production (t/GF/ha/cut) of the *Medicago sativa* and *Plantago lanceolata* Forage Mixture due to the Crop Booster Technology Effect

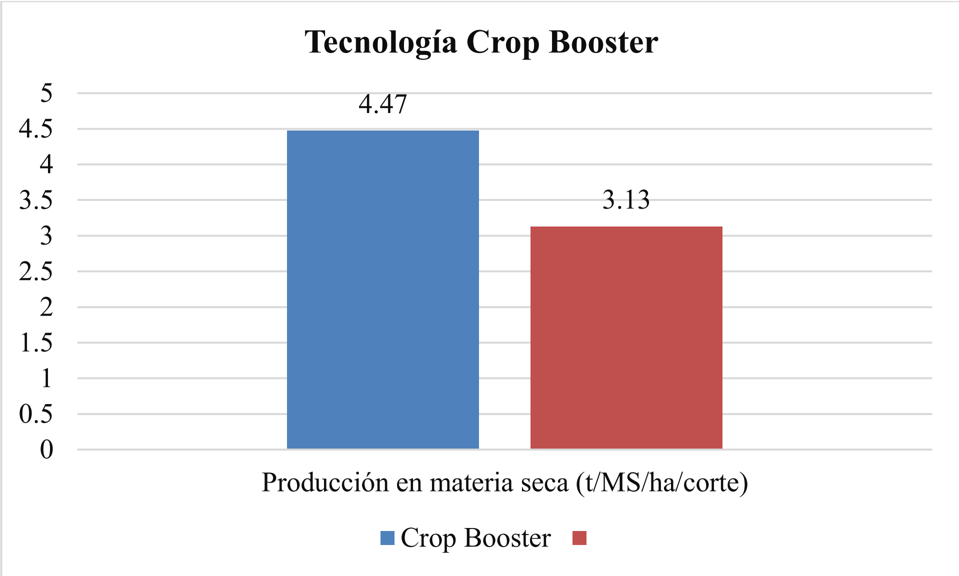
Source: Gualinga, Decsy, 2023

The data reported in this study were higher than those achieved by (Pérez, 2021, p. 37), who, when evaluating a forage mixture composed of alfalfa, ryegrass, and white clover with the Crop Booster device, obtained a production of 14252 fv/kg/ha/cut. This was due to the combination of intelligent irrigation and the crop booster technology, resulting in better production and increased growth and development of the plants.

On the other hand, the data obtained in this research were lower than those reported by (Velásquez, 2022, p.38), who, when using this technology, recorded a yield of 38513.89 fv/kg/ha/cut, which exceeded this research. However, this crop booster improved the innate botanical characteristics of the variety, such as density, weight of stem and leaf parts, development, and senescence of these tissues. It also helped plants grow stronger, healthier, and faster, with less fertilizer and fewer pesticides.

3.1.5. Dry Matter of a Mixture Comprising *Medicago sativa* plus *Plantago lanceolata* (t/DM/ha/cut)

When evaluating the production of dry matter in a forage mixture composed of *Medicago sativa* and *Plantago lanceolata*, it was found that there were highly significant differences ($P<0.01$) due to the Crop Booster Technology (Factor A), with values of 4.47 t/MS/ha/cut and 3.13 t/MS/ha/cut. The highest value was reported when using the crop booster, as shown in Table 1-3 and Graph 5-3.



Graph 5-3: Dry Matter Production of the *Medicago sativa* and *Plantago lanceolata* Forage Mixture due to the Crop Booster Technology Effect.

Source: Gualinga, Decsy, 2023

(Pérez, 2021, p. 38), states that the forage mixture composed of alfalfa, ryegrass, and white clover used two irrigation systems, implementing the Crop Booster technology, which resulted in a production of 4271.32 kg/ms/ha/cut, compared to 1498.68 kg/ms/ha/cut with normal irrigation. This confirms higher production with intelligent irrigation

On the other hand, the data obtained in this research were higher than those reported by (Arteaga, 2016, p. 24-25), who, when evaluating a forage mixture composed of Brachiaria brizantha - Pueraria phaseoloides at two resting ages with fertilization, achieved the highest dry matter production of 1980.0 kg/ha. This was due to the Crop Booster device, which improved the grass using radio wave pulses at different frequencies.

3.2. Productive Performance of a Pasture of *Medicago sativa* var. CUF 101 (Alfalfa) plus *Plantago lanceolata* (Plantain Forage) at Different Cutting Ages (Factor B)

3.2.1. Height of the forage mixture made up of *Medicago sativa* plus *Plantago lanceolata*, (cm)

When determining the height of a forage mixture composed of *Medicago sativa* and *Plantago lanceolata*, it was observed that there were highly significant differences ($P<0.01$) due to the cutting age (Factor B). The highest height was 69.83 cm at 50 days, while the lowest height was 49.17 cm at 30 days, as seen in Table 2-3 and Graph 6-3.

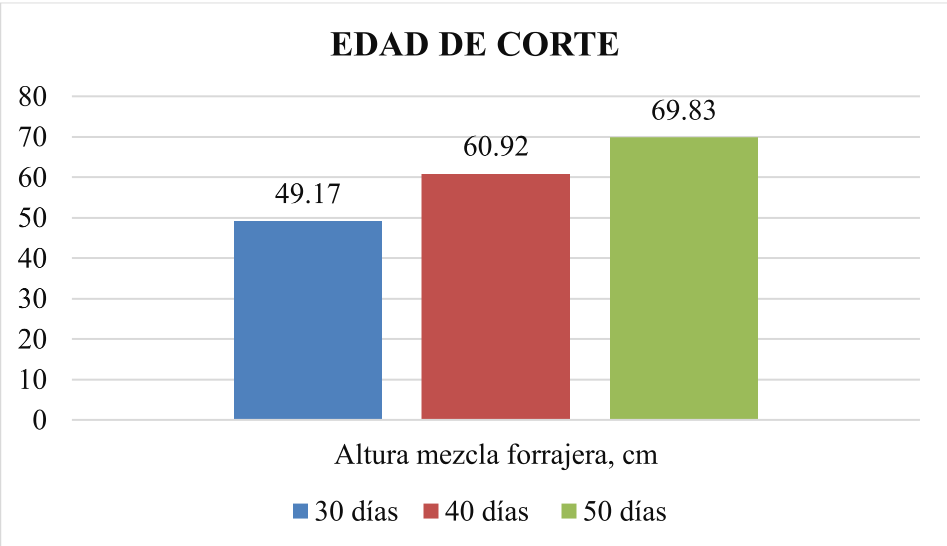
However, the data obtained in this research were lower than those reported by (Tiupul, 2020, p. 35-36), who reported the best height in a forage mixture at 45 days with a value of 74.33 cm, compared to the values obtained in this research, which were lower at 35 days, recording 63.35 cm. (Velásquez, 2022, p. 31.) recorded the best heights at 40.7 cm, which were statistically similar to the other grass varieties that reached heights of 28.70 to 29.10 cm.

The data obtained in this study suggest that the microtransmitters in the Crop Booster technology send frequency waves through the water, allowing the plant to absorb all the micronutrients in the soil.

Table 2-3: Productive Performance of the Forage Mixture *Medicago sativa* var. CUF 101 (Alfalfa) plus *Plantago lanceolata* (Plantain Forage) by Cutting Age (Factor B)

VARIABLE	EDAD DE CORTE						EE	Prob.	Sig.
	30 días		40 días		50 días				
Altura mezcla forrajera, cm	49,17	c	60,92	b	69,83	a	1,27	0,0001	**
Cobertura basal (%)	13,75	a	14,58	a	13,17	a	0,58	0,2359	ns
Cobertura aérea (%)	21,58	a	22,00	a	21,00	a	0,88	0,7233	ns
Producción de forraje verde (t/FV/ha/corte)	18,58	a	17,17	ab	16,25	b	0,61	0,0394	*
Producción en materia seca (t/MS/ha/corte)	3,60	a	4,03	a	3,77	a	0,12	0,0612	ns

E.E.= Error estándar; **Prob.** = Probabilidad; **Sig.** = Significancia. Prob. > 0,05: No existen diferencias estadísticas; Prob. ≤ 0,01: Existen diferencias altamente significativas. Prob. ≤ 0,05: Existen diferencias significativas.
Elaborado por: Gualinga, Decsy, 2023



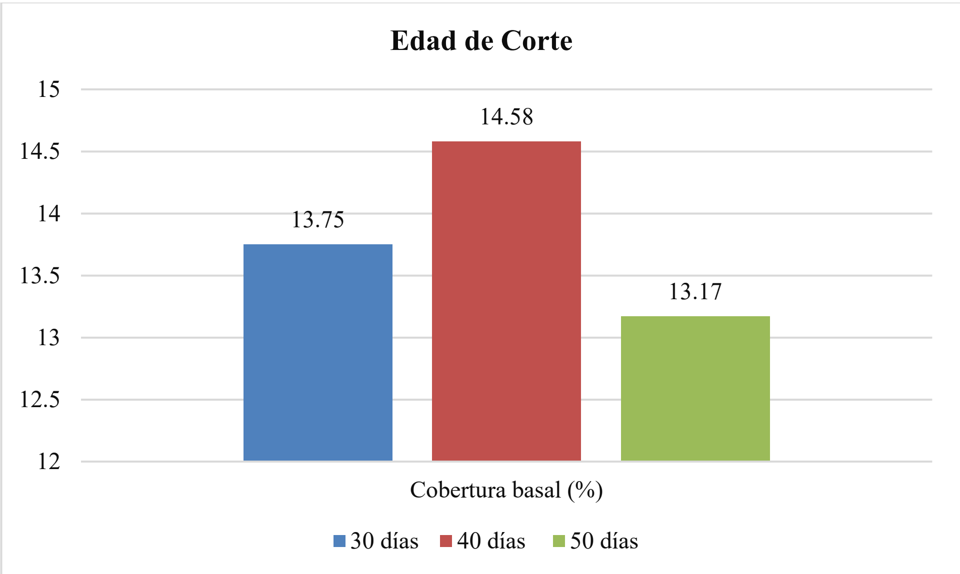
Graph 6-3: Height of the Forage Mixture due to the Cutting Age Effect.

Source: Gualinga, Decsy, 2023

3.2.2. Basal Coverage of the Forage Mixture Comprising *Medicago sativa* plus *Plantago lanceolata*, (%)

When determining the basal coverage of a forage mixture composed of *Medicago sativa* and *Plantago lanceolata*, it was observed that there were no statistical differences (P≥0.05) due to the cutting age (Factor B). However, there were numerical differences, with coverages of 14.58% and 13.77% at 40 and 50 days, respectively, as shown in Table 2-3 and Graph 7-3.

The values recorded in this study were lower than those reported by (Pérez, 2021, p. 36), who, when comparing normal irrigation with the use of Crop Booster, achieved coverages of 54% and 74.8%, with the Crop Booster being the better one. (Morocho, 2020, p.34) recorded the highest basal coverage in Treatment T3 (60 days of cutting) with an average of 49.35%, followed by Treatment T2 (45 days of cutting) with 43.65%, and the lowest response was in Treatment T1 (30 days of cutting) with 36.46%, all of which are higher than this research.

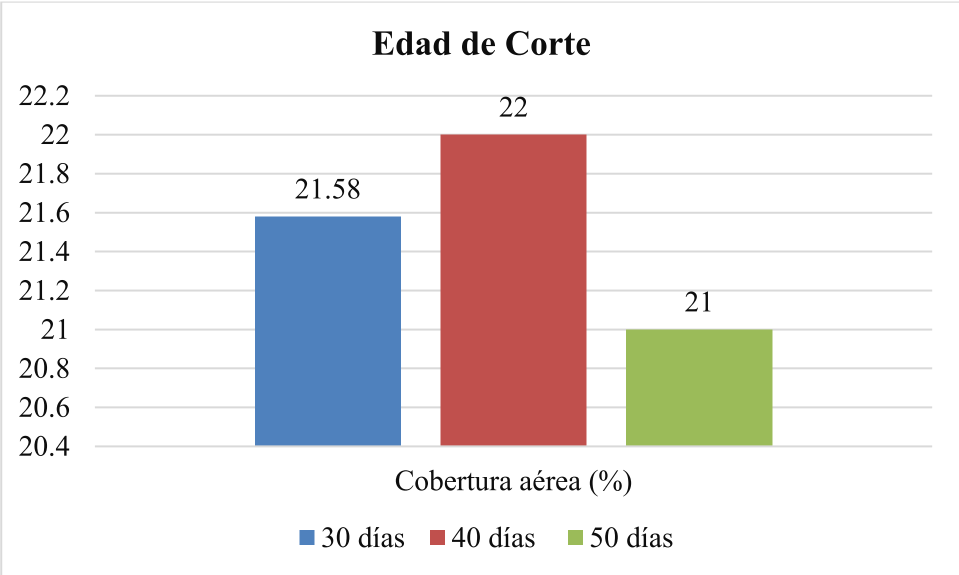


Graph 7-3: Basal Coverage of the *Medicago sativa* and *Plantago lanceolata* Forage Mixture due to the Cutting Age Effect

Source: Gualinga, Decsy, 2023

3.2.3. Aerial Coverage of the Forage Mixture Comprising *Medicago sativa* plus *Plantago lanceolata* (%)

When determining the aerial coverage of a forage mixture composed of *Medicago sativa* and *Plantago lanceolata*, it was observed that there were no statistical differences (P≥0.05) due to the cutting age (Factor B). However, numerically, there was greater aerial coverage at 40 days with 22%, while the lowest was at 50 days with 21%, as seen in Table 2-3 and Graph 8-3.



Graph 8-3: Aerial Coverage of the *Medicago sativa* and *Plantago lanceolata* Forage Mixture due to the Cutting Age Effect

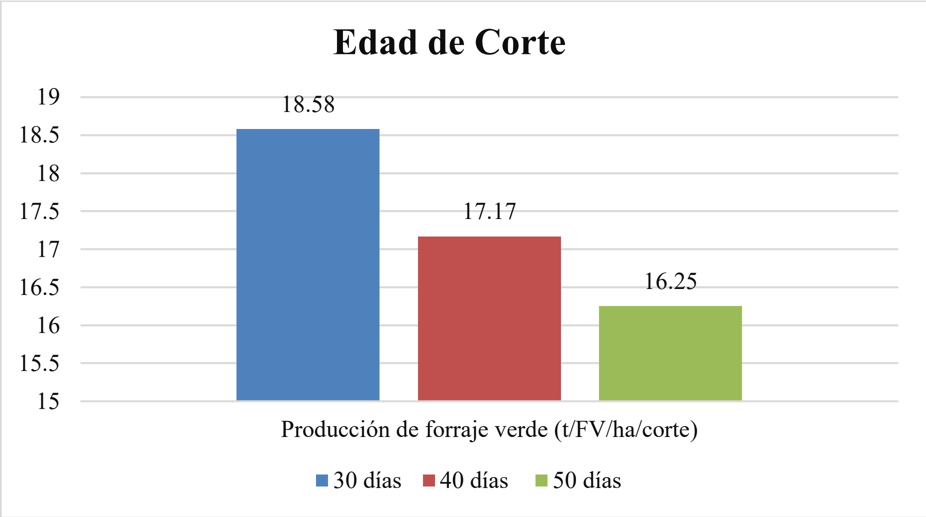
Source: Gualinga, Decsy, 2023

Comparing the results of this research, it was determined that they were lower than the data obtained by (Tiupul, 2020, p. 31), who established that the percentage of aerial coverage was higher at 45 days, with a value of 69.78%, while the lowest percentage was recorded at 35 days, with 54.98%.

When comparing the results obtained with (Morocho, 2020, p. 35), , who used the hybrid grass Cuba OM 22 (*Pennisetum purpureum Schumach* x *Pennisetum glaucum L.*) at three cutting ages, he achieved the best aerial coverage by cutting the hybrid Cuba OM-22 at 30 days with 98.60%, decreasing to 83.33% at 45 days, and the lowest percentage was at 60 days of cutting with 76.77%, results that are higher than this research. However, the Crop Booster technology influenced the cutting age, as the signals are designed to increase the absorption and effective use of water, nitrogen, and light to increase energy production in the light phase of photosynthesis.

3.2.4. Green Forage Production of the Forage Mixture Comprising *Medicago sativa* plus *Plantago lanceolata* (t/GF/ha/cut)

When determining the production of green forage of a mixture composed of *Medicago sativa* and *Plantago lanceolata*, it was observed that there were significant differences (P≤0.05) due to the cutting age (Factor B). Values of 18.58 t/FV/ha/cut at 30 days and the lowest production was 16.25 t/FV/ha/cut at 50 days were recorded, as seen in Table 2-3 and Graph 9-3.



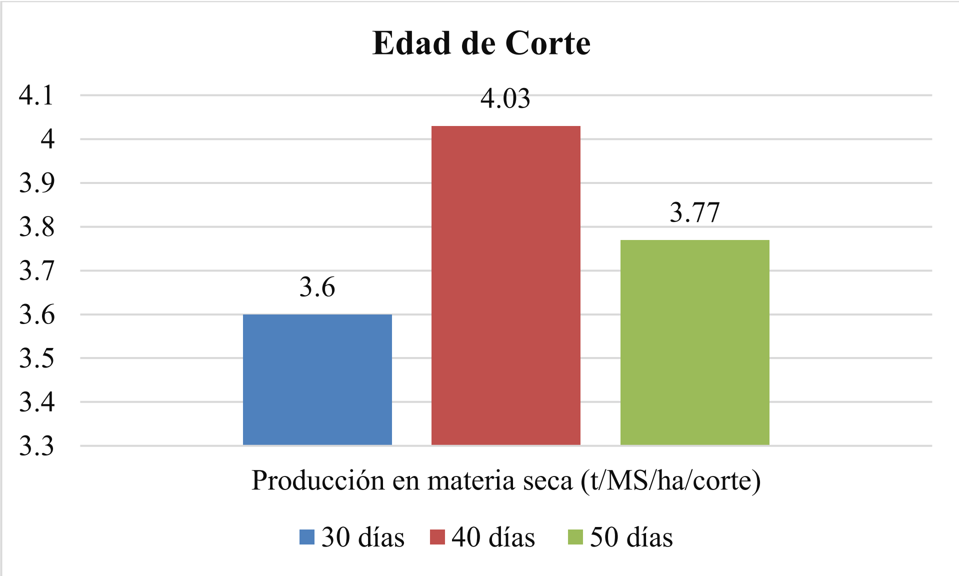
Graph 9-3: Green Forage Production (t/GF/ha/cut) of the *Medicago sativa* and *Plantago lanceolata* Forage Mixture due to the Cutting Age Effect.

Source: Gualinga, Decsy, 2023

(Morocho, 2020, p. 37), when evaluating the production of green forage of Pennisetum purpureum Schumach x Pennisetum glaucum L. (Cuba OM-22), managed to achieve the highest biomass production in Treatment T3 (60 days of cutting) with an average of 102.46 t/ha/cut, followed by Treatment T2 (45 days) with a production of 66.88 t/ha/cut, and the lowest value was recorded in Treatment T1 (30 days of cutting) with an average of 21.72 t/ha/cut, all of which are higher than this research. However, the data recorded in this study were higher than those reported by (Tiupul, 2020, p. 46), who, at 35 days, obtained an average of 11.95 t/FV/ha/cut, while at 45 days, a lower production of 10.35 t/FV/ha/cut was reported, which is lower than this research.

3.2.5. Dry Matter Production of a Mixture Comprising *Medicago sativa* plus *Plantago lanceolata* (t/DM/ha/cut)

When determining the production of dry matter in a forage mixture composed of *Medicago sativa* and *Plantago lanceolata*, it was observed that there were no statistical differences (P≥0.05) due to the cutting age (Factor B). However, numerically, the highest value was recorded at 4.03 t/MS/ha/cut at 40 days, while the lowest production was 3.60 t/MS/ha/cut at 30 days, as seen in Table 2-3 and Graph 10-3.



Graph 10-3: Dry Matter Production of the *Medicago sativa* and *Plantago lanceolata* Forage Mixture due to the Cutting Age Effect.

Source: Gualinga, Decsy, 2023

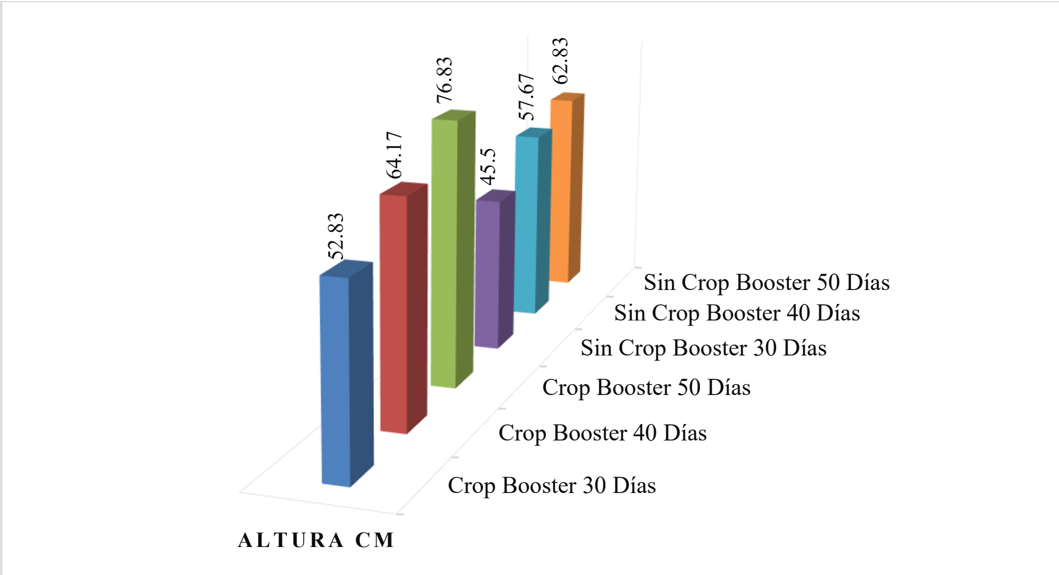
The results obtained in this study were higher than those reported by (Tiupul, 2020, p.48), who reported statistical differences in dry matter production, which was higher at 35 days, with a value of 2.26 t/MS/ha/cut, while at 45 days, a lower production of 1.99 t/MS/ha/cut was reported.

On the other hand, the data obtained by (Morocho, 2020, p. 39) are higher than this research. He reported the highest dry matter production at 60 days of regrowth with 12.43 t/ha/cut, followed by plots harvested at 45 days with 8.61 t/ha/cut, and the lowest production was at 30 days with 2.78 t/ha/cut. This demonstrated that the Crop Booster technology, through the transmitted frequencies, helps improve soil health and nutrient availability, which influences the cutting age on dry forage production.

3.3. Productive Performance of a Pasture of *Medicago sativa* var. CUF 101 (Alfalfa) plus *Plantago lanceolata* (Plantain Forage) due to Crop Booster Technology (Factor A) and Different Cutting Ages (Factor B) (Interaction Factor A x Factor B)

3.3.1. Height of the forage mixture Comprising of *Medicago sativa* plus *Plantago lanceolata*, (cm)

When analyzing the variable of forage height in a mixture composed of *Medicago sativa* and *Plantago lanceolata*, corresponding to the interaction of Factor A (Crop Booster technology) x Factor B (Cutting Age), it was demonstrated that there were no statistical differences ($P \geq 0.05$), but there were numerical differences. At 50 days, heights of 76.83 cm were recorded, compared to 62.83 cm, indicating that the use of the device influenced greater height, as shown in Table 3-3 and Graph 11-3.



Graph 11-3: Height in cm of the *Medicago sativa* and *Plantago lanceolata* Forage Mixture due to the Interaction between Technology and Cutting Age

Source: Gualinga, Decsy, 2022

The results obtained were lower than those recorded by (Guaranga, 2019, p. 35), who studied national alfalfa (*Medicago sativa*) at different cutting times and demonstrated that the most effective treatment was at 60 days at 12:00 with a height of 84.24 cm. The lowest value was at 45 days at 16:00 with 62.82 cm. This was due to the use of Crop Booster technology, which, through microtransmitters, aids crop development, improving color, quality, aeration, and soil mineral enrichment.

Table 3-3: Agro-botanical Performance of the Forage Mixture (*Medicago sativa* and *Plantago lanceolata*) due to the Interaction between Crop Booster Technology and Cutting Age

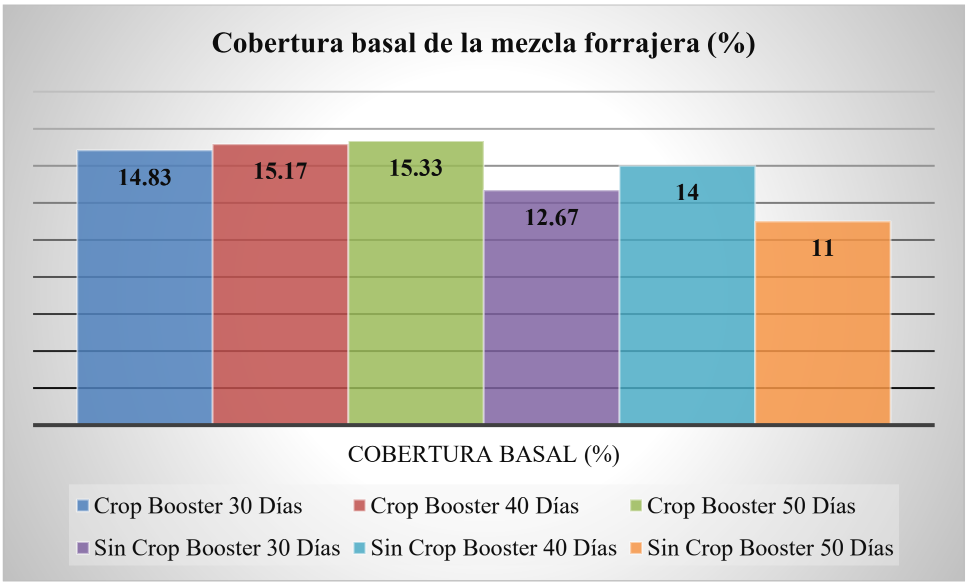
VARIABLE	EFECTO DE LA INTERACCIÓN ENTRE LA TECNOLOGÍA CROP BOOSTER Y LA EDAD DE CORTE												EE	Prob.	Sig.
	Crop Booster 30 días		Crop Booster 40 días		Crop Booster 50 días		Sin Crop Booster 30 días		Sin Crop Booster 40 días		Sin Crop Booster 50 días				
Altura mezcla forrajera, cm	52,83	b	64,17	b	76,83	a	45,50	c	57,67	b	62,83	b	1,80	0,0932	ns
Cobertura basal (%)	14,83	a	15,17	a	15,33	a	12,67	ab	14,00	ab	11,00	b	0,81	0,1593	ns
Cobertura aérea (%)	23,00	a	23,17	a	25,00	a	20,17	ab	20,83	ab	17,00	b	1,24	0,0579	ns
Producción de forraje verde (t/FV/ha/corte)	21,50	a	18,67	ab	16,83	b	15,57	b	15,63	b	15,82	b	0,88	0,0349	*
Producción en materia seca (t/MS/ha/corte)	4,62	ab	4,81	a	3,97	bc	2,58	d	3,25	cd	3,57	c	0,17	0,0003	**

E.E.= Error estándar; **Prob. =** Probabilidad; **Sig. =** Significancia. Prob. > 0,05: No existen diferencias estadísticas; Prob. ≤ 0,01: Existen diferencias altamente significativas. Prob. ≤ 0,05: Existen diferencias significativas.

Source: Gualinga, Decsy, 2023

3.3.2. Basal Coverage of the Forage Mixture Comprising *Medicago sativa* plus *Plantago lanceolata* (%)

When analyzing the variable of basal coverage in a mixture composed of *Medicago sativa* and *Plantago lanceolata*, corresponding to the interaction of Factor A (Crop Booster technology) x Factor B (Cutting Age), it was demonstrated that there were no statistical differences ($P \geq 0.05$). However, there were numerical differences, with values of 15.33% and 14% at 50 and 40 days, respectively, as shown in Table 3-3 and Graph 12-3.



Graph 12.3. Basal Coverage of the *Medicago sativa* and *Plantago lanceolata* Forage Mixture due to the Interaction between Technology and Cutting Age

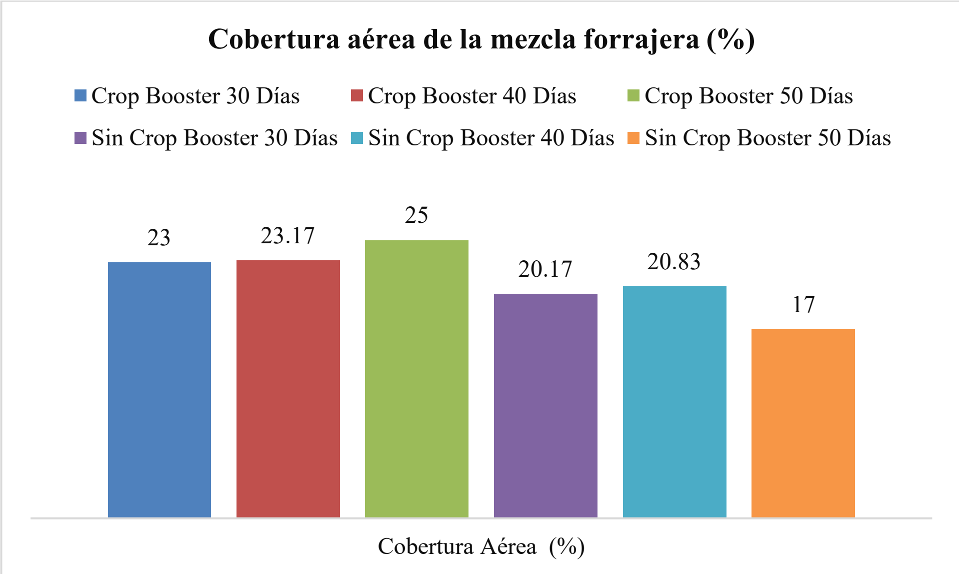
Source: Gualinga, Decsy, 2023

The results obtained were lower than those reported by (Tiupul, 2020, p. 31), who studied a forage mixture of *Medicago sativa*, *Lolium perenne*, and *Dactylis glomerata* at different ages and cutting times (AxB). They recorded numerical differences where at 35 days at 16:00, they achieved a value of 84.38%, which was the best, while the lowest response was at 45 days at 14:00, with a value of 74.38%. This was influenced by the climatic conditions in this research, as well as the established cutting time in the pasture.

3.3.3. Aerial Coverage of the Forage Mixture Comprising *Medicago sativa* plus *Plantago lanceolata* (%)

When analyzing the variable of aerial coverage in a mixture composed of *Medicago sativa* and *Plantago lanceolata*, corresponding to the interaction of Factor A (Crop Booster technology) x Factor B (Cutting Age), it was demonstrated that there were no statistical differences ($P \geq 0.05$).

However, numerically, values of 25% were recorded at 50 days, while without the use of the technology, it was 20.83% at 40 days, as shown in Table 3-3 and Graph 13-3.



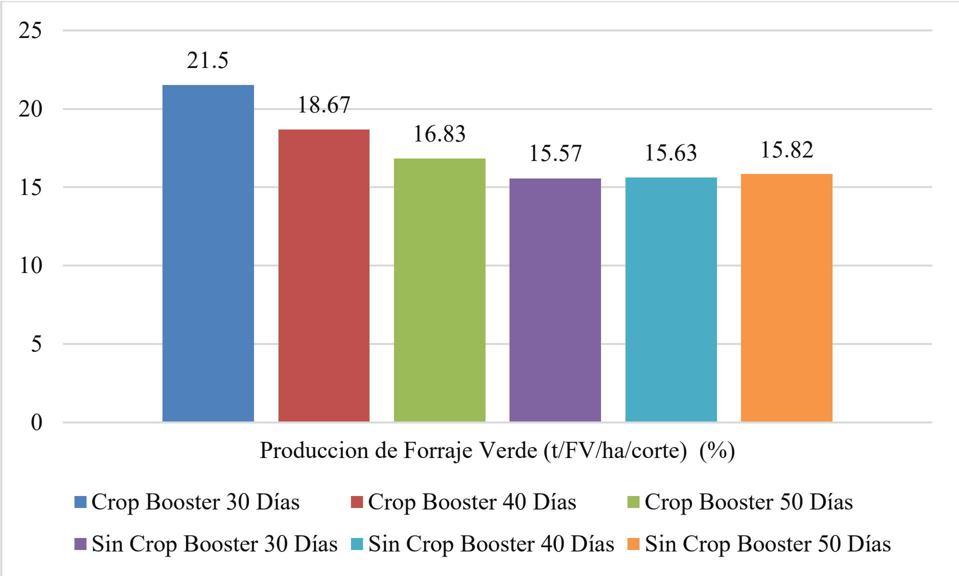
Graph 13-3. Aerial Coverage of the *Medicago sativa* and *Plantago lanceolata* Forage Mixture due to the Interaction between Technology and Cutting Age

Source: Gualinga, Decsy, 2022

The results obtained were lower than those reported by (Guaman, 2020, p. 26-27), who studied the productive evaluation of *Dactylis glomerata* (Bluegrass) and showed a higher percentage of aerial coverage when fertilizing the grass with humus (T2), reaching 66.40%. The lowest response was obtained when using chicken manure (T3) as fertilizer, with a value of 60.30%. This was due to the type of forage mixture used in the research.

3.3.4. Green Forage Production of the Forage Mixture Comprising *Medicago sativa* plus *Plantago lanceolata* (t/GF/ha/cut)

When analyzing the variable of green forage production in a mixture composed of *Medicago sativa* and *Plantago lanceolata*, corresponding to the interaction of Factor A (Crop Booster technology) x Factor B (Cutting Age), it was demonstrated that there were significant differences ($P \leq 0.05$). Using the device resulted in production values of 21.5 t/FV/ha/cut at 30 days, whereas without the technology, it was 15.82 t/FV/ha/cut at 50 days, as shown in Table 3-3 and Graph 14-3.



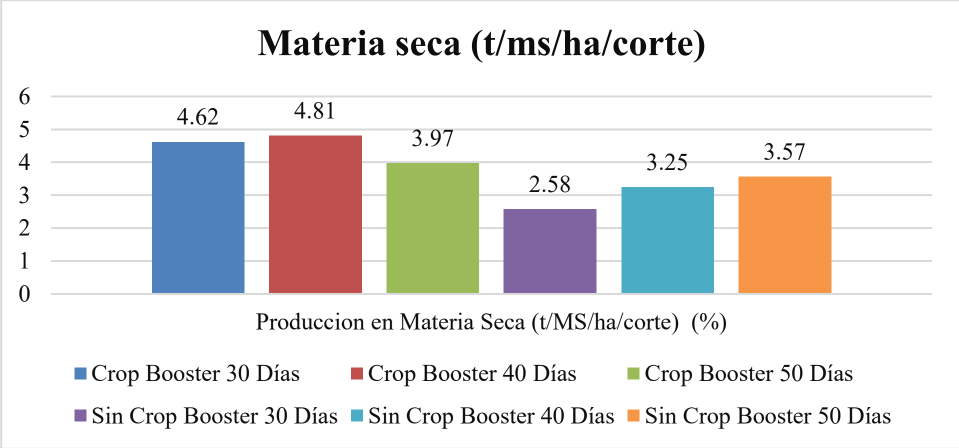
Graph 14-3: Green Forage Production (t/GF/ha/cut) of the *Medicago sativa* and *Plantago lanceolata* Forage Mixture due to the Interaction between Technology and Cutting Age

Source: Gualinga, Decsy, 2023

The results obtained for green forage production were higher than the study by (Robles, 2022, p. 25), who evaluated a mixture of English Ryegrass (Lolium perenne L.), Bluegrass (Dactylisglomerata L.), and White Clover (Trifoliumrepens L.). The results showed that at 21 days after cutting, it was 7545.00 kg/ha of DM, at 42 days after cutting, it was 12727.50 kg/ha of DM, at 63 days after cutting, it was 12627.50 kg/ha of DM, and at 84 days after cutting, it was 10916.25 kg/ha of DM. These results were due to the time established in this research since the microtransmitters of Crop Booster technology transmit precise instructions to the plants using radio wave pulses at different frequencies. These instructions can be received by the plants, allowing for an improvement in green forage production.

3.3.5. Dry Matter Production of a Mixture Comprising *Medicago sativa* plus *Plantago lanceolata* (t/DM/ha/cut)

When analyzing the variable of dry matter production in a mixture composed of *Medicago sativa* and *Plantago lanceolata*, corresponding to the interaction of Factor A (Crop Booster technology) x Factor B (Cutting Age), it was demonstrated that there were highly significant differences ($P \leq 0.01$). Production values of 4.81 t/MS/ha/cut at 40 days and 2.58 t/MS/ha/cut at 30 days were reported. The best production result was achieved with the implementation of the Crop Booster, as shown in Table 3-3 and Graph 15-3.



Graph 15-3: Dry Matter Production of the *Medicago sativa* and *Plantago lanceolata* Forage Mixture due to the Interaction between Technology and Cutting Age

Source: Gualinga, Decsy, 2023

The results obtained for dry matter production were higher than the study by (Oñate, 2019, p. 41), who evaluated the agronomic performance of three varieties of alfalfa (Medicago sativa L.) with different doses of phosphate fertilization and obtained 4.52 t/ha per cut for purple-flowered alfalfa and between 2.12 and 2.79 t/ha per cut for introduced varieties. This indicates that the implementation of the device improves and helps balance the uptake and utilization of secondary micronutrients, thus enhancing dry matter production.

3.4. Bromatological Behavior of a Pasture of *Medicago sativa* var. CUF 101 (Alfalfa) plus *Plantago lanceolata* (Plantain Forage) at Different Ages

Table 4-3: Bromatological Behavior of the Forage Mixture (*Medicago sativa* and *Plantago lanceolata*) due to the Interaction between Crop Booster Technology and Cutting Age

TECNOLOGÍA CROP BOOSTER	EDAD DE CORTE	Materia Seca (%)	Proteína (%)	Extracto etéreo (%)	Cenizas (%)	Fibra (%)
Crop Booster	30 días	21,54	22,12	1,52	9,39	31,16
	40 días	23,28	23,76	1,49	11,06	32,59
	50 días	23,57	21,86	1,21	11,40	33,86
Sin Crop Booster	30 días	17,18	21,62	1,30	8,85	28,03
	40 días	20,68	21,88	1,23	10,48	29,00
	50 días	22,56	21,34	1,13	11,05	31,10

Source: Gualinga, Decsy, 2023

3.4.1. Dry Matter %

When evaluating the dry matter content of a mixture composed of *Medicago sativa* and *Plantago lanceolata*, using Crop Booster technology, it was determined that at 50 days of cutting, there was a higher crude fiber content, with an average of 23.57%. This was higher compared to the grass cut at 30 and 40 days of regrowth, which had 21.54% and 23.28% of dry matter, respectively, as shown in Table 4-3.

Meanwhile, (Pérez, 2021, p- 39), when evaluating the matter content of the forage mixture using the Crop Booster device, found a content of 29.97% compared to 27.15% with normal irrigation. These results are higher than those in this study, which was likely due to differences in climatic conditions or soil types used in the research.

3.4.2. Ash %

Regarding the ash content of a mixture composed of *Medicago sativa* and *Plantago lanceolata*, using Crop Booster technology, it was determined that at 50 days of cutting, there was a higher ash content, with an average of 11.40%. This was higher compared to the grass cut at 30 and 40 days of regrowth, which had 9.39% and 11.06% ash content, respectively, as shown in Table 4-3.

According to (Pérez, 2021, p-39), when evaluating the ash content in a forage mixture using the Crop Booster device, it was 1.3% compared to 1.5% with normal irrigation. The data in this study were lower, which suggests that the technology contributes to improving and balancing the uptake and utilization of secondary micronutrients.

3.4.3. Raw fiber %

When evaluating the content of raw fiber in a mixture composed of *Medicago sativa* and *Plantago lanceolata*, using the Crop Booster technology, it was concluded that at 50 days of cutting, there was a higher content of raw fiber, with an average of 33.86%, exceeding the grass cut at 30 and 40 days of regrowth, which had 31.16% and 32.59% of raw fiber, respectively, as shown in Table 4-3.

According to (Pérez, 2021, p. 40), quien corrobora estos datos al utilizar el dispositivo Crop Booster quien alcanzó el 16.97 % de fibra y con el riego normal el 16.2 % estos datos fueron inferiores a este estudio, de esta forma se evidencio que existió mayor fibra cruda en el pasto que se instaló el dispositivo Crop Booster ya que aceleró el tiempo de corte y desarrollo, a diferencia del riego normal que fue más lento.

3.4.4. Raw protein %

When evaluating the protein content of a mixture composed of *Medicago sativa* and *Plantago lanceolata*, using the Crop Booster technology, it was observed that at 40 days of cutting, there was a higher protein content, with an average of 23.76%. This was higher compared to the grass cut at 30 and 50 days of regrowth, which had 22.12% and 21.86% protein content, respectively. This indicated that the protein content of the forage mixture was reduced, as shown in Table 4-3.

On the other hand, (Pérez, 2021, p-39), when evaluating the protein content of a forage mixture using the Crop Booster device, achieved 9.58% compared to 8.93% with normal irrigation. The data were lower than in this study, suggesting that this variable increased due to the fact that this device has a microtransmitter with over 3000 acoustic frequencies that positively influence plant development, improving metabolism and absorption.

3.4.5. Ether Extract %

When evaluating the fat content of a mixture composed of *Medicago sativa* and *Plantago lanceolata*, using the Crop Booster technology, it was observed that at 30 days of cutting, there was a higher fat content, with an average of 1.52%. This was higher compared to the grass cut at 40 and 50 days of regrowth, which had 1.49% and 1.21% ether extract, respectively, as shown in Table 4-3.

In his study, (Pérez, 2021, p. 40) showed that the content of non-nitrogenous ether extract in the forage mixture using the Crop Booster device was 0.95% compared to 0.1% with normal irrigation. The data previously mentioned were lower than those of this research, indicating that variations in fat content were due to the difference in forage harvest ages. Additionally, this technology transmits natural molecular frequencies from soils and plants, allowing for the improvement of their functions.

3.5. Economic Analysis

When conducting the economic analysis of forage production in a mixture of alfalfa and plantain using Crop Booster technology at three cutting ages, higher profitability was obtained by implementing the device in irrigation, with a benefit/cost ratio of 1.46. This means that for every dollar invested, there is a return of 46 cents when using the device at 30, 40, and 50 days.

Table 5-3: Economic Analysis of Forage Mixture Production Comparing Crop Booster Technology vs. Without Crop Booster Technology at 30 Days

	Tecnología Crop Booster			**Sin la Tecnología Crop Booster**		
	Cantidad	Valor Un	Total	Cantidad	Valor Un	Total
INGRESO						
Diesel para sistema de riego y tractor	1	285	285	1	285	285
Acople para retiro de Tecnología Crop Booster	1	100	100	1	100	100
Fertilizante Completo para pastos	1	120	120	1	120	120

Agua de Riego (tarifa volumétrica)	1	150	150	1	150	150
Piola 6mm	1	15	15	1	15	15
Estacas 1,50 m	1	73,5	73,5	1	73,5	73,5
Letrero	1	8	8	1	8	8
Reactivos Laboratorio	1	200	200	1	200	200
Imprevistos	1	100	100	1	100	100
TOTAL, INGRESOS		1051,5	1051,5		1051,5	1051,5
EGRESOS						
Pnd FV (Tn/ha/corte) Cargas	614	2,5	1535	428	2,5	1070
TOTAL, EGRESOS						
B/C			1,46			1,02

Source: Gualinga, Decsy, 2023

Table 6-1: Economic Analysis of Forage Mixture Production Comparing Crop Booster Technology vs. Without Crop Booster Technology at 40 Days

	Tecnología Crop Booster			**Sin la Tecnología Crop Booster**		
	Cantidad	Valor Un	Total	Cantidad	Valor Un	Total
INGRESO						
Diesel para sistema de riego y tractor	1	285	285	1	285	285
Acople para retiro de Tecnología Crop Booster	1	100	100	1	100	100
Fertilizante Completo para pastos	1	120	120	1	120	120
Agua de Riego (tarifa volumétrica)	1	200	200	1	200	200
Piola 6mm	1	15	15	1	15	15
Estacas 1,50 m	1	73,5	73,5	1	73,5	73,5
Letrero	1	8	8	1	8	8
Reactivos Laboratorio	1	200	200	1	200	200
Imprevistos	1	100	100	1	100	100
TOTAL, INGRESOS		1101,5	1101,5		1101,5	1101,5
EGRESOS						
Pnd fv (Tn/ha/corte) Cargas	590	2,5	1475	448	2,5	1120
TOTAL, EGRESOS						
B/C			1,34			1,02

Source: Gualinga, Decsy, 2023

Table 7-3: Economic Analysis of Forage Mixture Production Comparing Crop Booster Technology vs. Without Crop Booster Technology at 50 Days

	Tecnología Crop Booster			**Sin la Tecnología Crop Booster**		
	Cantidad	Valor Un	Total	Cantidad	Valor Un	Total
INGRESO						
Diesel para sistema de riego y tractor	1	285	285	1	285	285
Acople para retiro de Tecnología Crop Booster	1	100	100	1	100	100
Fertilizante Completo para pastos	1	120	120	1	120	120
Agua de Riego (tarifa volumétrica)	1	250	250	1	250	250
Piola 6mm	1	15	15	1	15	15
Estacas 1,50 m	1	73,5	73,5	1	73,5	73,5
Letrero	1	8	8	1	8	8
Reactivos Laboratorio	1	200	200	1	200	200
Imprevistos	1	100	100	1	100	100
TOTAL, INGRESOS		1151,5	1151,5		1151,5	1151,5
EGRESOS						
Pnd fv (Tn/ha/corte) Cargas	481	2,5	1202,5	452	2,5	1130
TOTAL, EGRESOS						
B/C			1,04			0,98

Source: Gualinga, Decsy, 2023

CONCLUSIONS

- The Crop Booster technology installed in the irrigation system had the greatest impact at 50 days of cutting, achieving a height of 76.83 cm, basal coverage of 15.33%, and aerial coverage of 25%. The benefits were evident in the production of green forage volume and dry matter, with 21.50 t/FV/ha/cut and 4.81 t/MS/ha/cut at 30 days.

- The bromatological values of a forage mixture consisting of *Medicago sativa* var. CUF 101 (Alfalfa) and *Plantago lanceolata* (Plantain forage) using Crop Booster technology were 33.86% for fiber at 50 days and 23.76% for protein at 40 days. This technology aids plants in efficiently performing their metabolic functions, such as the absorption of secondary micronutrients.

- Through a benefit-cost analysis, higher profitability was determined when using the Crop Booster device in the forage mixture, with a profitability indicator of 1.46 USD, while without the technology, profitability was 1.02 USD.

RECOMMENDATIONS

- Establish forage mixtures using Crop Booster Technology, considering the 25, 35, and 45-day intervals to determine the production of different mixtures. This can be applied to various pastures in different regions, elevations, and timeframes.

- Conduct similar research processes to consolidate the results, and explore experiments with other varieties and species.

- Extend the study of the technology used in this research to share the findings with the community, aiming to benefit livestock farming and improve the living conditions of producers.

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ANNEXES

Annex A. Determination of the Percentage of Height of a Forage Mixture due to the Crop Booster Technology and Cutting Age.

1. Resultados Experimentales

Tecnología Crop Booster	Edad de Corte (días)	Código	Repeticiones Altura, cm					
FACTOR A	**FACTOR B**		**I**	**II**	**III**	**IV**	**V**	**VI**
Crop Booster	30 días	CBE30	55	51	48	55	54	54
Crop Booster	40 días	CBE40	64	61	63	70	65	62
Crop Booster	50 días	CBE50	67	79	79	80	78	78
Sin Crop Booster	30 días	SCBE30	48	48	41	52	43	41
Sin Crop Booster	40 días	SCEB40	54	61	63	60	53	55
Sin Crop Booster	50 días	SCEB50	65	65	57	75	51	64

2. Análisis de la varianza

Variable	N	R^2	R^2Aj	CV
ALTURA	36	0,88	0,84	7,34

2.1. Cuadro de Análisis de la Varianza (SC tipo III)

F.V.	SC	gl	CM	F	p-valor
Tecnología Crop Booster	774,69	1	774,69	39,93	<0,0001
Edad corte	2578,72	2	1289,36	66,46	<0,0001
Repeticiones	245,14	5	49,03	2,53	0,0554
Tecnología Crop Booster*Ed...	101,39	2	50,69	2,61	0,0932
Error	485,03	25	19,40		
Total	4184,97	35			

3. Separación de medias según Tukey (p<0,05)

3.1. Tecnología Crop Booster (A)

Tecnología Crop Booster	Medias	n	E.E.		
Crop Booster	64,61	18	1,04	A	
Sin Crop Booster	55,33	18	1,04		B

3.2. Edad de Corte (B)

Edad corte	**Medias**	**n**	**E.E.**			
50 días	69,83	12	1,27	A		
40 días	60,92	12	1,27		B	
30 días	49,17	12	1,27			C

3.3. Interacción (A*B)

Tecnología Crop Booster	Edad corte	Medias	n	E.E.			
Crop Booster	50 días	76,83	6	1,80	A		
Crop Booster	40 días	64,17	6	1,80		B	
Sin Crop Booster	50 días	62,83	6	1,80		B	
Sin Crop Booster	40 días	57,67	6	1,80		B	
Crop Booster	30 días	52,83	6	1,80		B	
Sin Crop Booster	30 días	45,50	6	1,80			C

Annex B. Determination of the Percentage of Basal Coverage of a Forage Mixture due to Crop Booster Technology and Cutting Age

1. Resultados Experimentales

Tecnología Crop Booster	Edad de Corte (días)	Código	Repeticiones % Cobertura Basal					
FACTOR A	FACTOR B		I	II	III	IV	V	VI
Crop Booster	30 días	CBE30	15	20	13	13	14	14
Crop Booster	40 días	CBE40	20	16	12	13	14	16
Crop Booster	50 días	CBE50	14	15	16	19	14	14
Sin Crop Booster	30 días	SCBE30	14	13	12	12	13	12
Sin Crop Booster	40 días	SCEB40	18	16	12	10	14	14
Sin Crop Booster	50 días	SCEB50	12	13	11	8	10	12

2. Análisis de la varianza

Variable	N	R^2	R^2Aj	CV
COBERTURA BASAL	36	0,59	0,42	14,41

2.1.Cuadro de Análisis de la Varianza (SC tipo III)

F.V.	SC	gl	CM	F	p-valor
Tecnología Crop Booster	58,78	1	58,78	14,79	0,0007
Edad corte	12,17	2	6,08	1,53	0,2359
Repeticiones	55,00	5	11,00	2,77	0,0401
Tecnología Crop Booster*Ed...	15,72	2	7,86	1,98	0,1593
Error	99,33	25	3,97		
Total	241,00	35			

3. Separación de medias según Tukey (p<0,05)

3.1.Tecnología Crop Booster (A)

Tecnología Crop Booster	Medias	n	E.E.	
Crop Booster	15,11	18	0,47	A
Sin Crop Booster	12,56	18	0,47	B

3.2.Edad de Corte (B)

Edad corte	Medias	n	E.E.	
40 días	14,58	12	0,58	A
30 días	13,75	12	0,58	A
50 días	13,17	12	0,58	A

3.3.Interacción (A*B)

Tecnología Crop Booster	Edad corte	Medias	n	E.E.		
Crop Booster	50 días	15,33	6	0,81	A	
Crop Booster	40 días	15,17	6	0,81	A	
Crop Booster	30 días	14,83	6	0,81	A	
Sin Crop Booster	40 días	14,00	6	0,81	A	B
Sin Crop Booster	30 días	12,67	6	0,81	A	B
Sin Crop Booster	50 días	11,00	6	0,81		B

Annex C. Determination of the Percentage of Aerial Coverage of a Forage Mixture due to Crop Booster Technology and Cutting Age

1. Resultados Experimentales

Tecnología Crop Booster	Edad de Corte (días)	Código	Repeticiones % Cobertura Basal					
FACTOR A	FACTOR B		I	II	III	IV	V	VI
Crop Booster	30 días	CBE30	23	23	22	23	23	24
Crop Booster	40 días	CBE40	28	28	21	15	22	25
Crop Booster	50 días	CBE50	23	23	25	31	24	24
Sin Crop Booster	30 días	SCBE30	22	22	18	20	21	18
Sin Crop Booster	40 días	SCEB40	26	23	21	14	20	21
Sin Crop Booster	50 días	SCEB50	21	20	16	13	14	18

2. Análisis de la varianza

Variable	N	R^2	R^2 Aj	CV
COBERTURA AÉREA	36	0,59	0,42	14,11

2.1.Cuadro de Análisis de la Varianza (SC tipo III)

F.V.	SC	gl	CM	F	p-valor
Tecnología Crop Booster	173,36	1	173,36	18,79	0,0002
Edad corte	6,06	2	3,03	0,33	0,7233
Repeticiones	87,81	5	17,56	1,90	0,1297
Tecnología Crop Booster*Ed...	59,06	2	29,53	3,20	0,0579
Error	230,69	25	9,23		
Total	556,97	35			

3. Separación de medias según Tukey (p<0,05)

3.1.Tecnología Crop Booster (A)

Tecnología Crop Booster	Medias	n	E.E.	
Crop Booster	23,72	18	0,72	A
Sin Crop Booster	19,33	18	0,72	B

3.2.Edad de Corte (B)

Edad corte	Medias	n	E.E.	
40 días	22,00	12	0,88	A
30 días	21,58	12	0,88	A
50 días	21,00	12	0,88	A

3.3.Interacción (A*B)

Tecnología Crop Booster	Edad corte	Medias	n	E.E.	
Crop Booster	50 días	25,00	6	1,24	A
Crop Booster	40 días	23,17	6	1,24	A
Crop Booster	30 días	23,00	6	1,24	A
Sin Crop Booster	40 días	20,83	6	1,24	A B
Sin Crop Booster	30 días	20,17	6	1,24	A B
Sin Crop Booster	50 días	17,00	6	1,24	B

Annex D. Determination of the Percentage of Green Forage Production of a Forage Mixture due to Crop Booster Technology and Cutting Age

1. Resultados Experimentales

Tecnología Crop Booster	Edad de corte (días)		Repeticiones % Producción Forrajera					
FACTOR A	**FACTOR B**	**Código**	**I**	**II**	**III**	**IV**	**V**	**VI**
Crop Booster	30 días	CBE30	21	22	22	22	23	19
Crop Booster	40 días	CBE40	24	19	16	20	24	21
Crop Booster	50 días	CBE50	16	16	16	18	18	17
Sin Crop Booster	30 días	SCBE30	15	16	15	17	13	14
Sin Crop Booster	40 días	SCEB40	16	15	15	19	12	18
Sin Crop Booster	50 días	SCEB50	15	15	15	17	16	16

2. Análisis de la varianza

Variable	N	R²	R² Aj	CV
Pdn FV	36	0,63	0,49	12,39

2.1.Cuadro de Análisis de la Varianza (SC tipo III)

F.V.	SC	gl	CM	F	p-valor
Tecnología Crop Booster	99,04	1	99,04	4,32	0,0001
Edad corte	28,86	2	14,43	3,13	0,0613
Repeticiones	35,76	5	7,15	1,55	0,2106
Tecnología Crop Booster*Ed…	35,50	2	17,75	3,85	0,0349
Error	115,33	25	4,61		
Total	314,48	35			

3. Separación de medias según Tukey (p<0,05)

3.1.Tecnología Crop Booster (A)

Tecnología Crop Booster	Medias	n	E.E.	
Crop Booster	18,99	18	0,51	A
Sin Crop Booster	15,68	18	0,51	B

3.2.Edad de Corte (B)

Edad corte	Medias	n	E.E.	
30 días	18,51	12	0,62	A
40 días	17,16	12	0,62	A B
50 días	16,34	12	0,62	B

3.3.Interacción (A*B)

Tecnología Crop Booster	Edad corte	Medias	n	E.E.	
Crop Booster	30 días	21,44	6	0,87	A
Crop Booster	40 días	18,68	6	0,87	A B
Crop Booster	50 días	16,85	6	0,87	B
Sin Crop Booster	50 días	15,82	6	0,87	B
Sin Crop Booster	40 días	15,63	6	0,87	B
Sin Crop Booster	30 días	15,57	6	0,87	B

Annex E. Determination of the Percentage of Dry Matter Production of a Forage Mixture due to Crop Booster Technology and Cutting Age

1. Resultados Experimentales

Tecnología Crop Booster	Edad de corte (días)	Código	Repeticiones % PF MS					
FACTOR A	**FACTOR B**		**I**	**II**	**III**	**IV**	**V**	**VI**
Crop Booster	30 días	CBE30	4,73	4,57	4,87	4,58	4,78	4,16
Crop Booster	40 días	CBE40	5,88	4,47	3,62	4,64	5,29	4,97
Crop Booster	50 días	CBE50	3,75	4,03	3,64	4,27	4,03	4,11
Sin Crop Booster	30 días	SCBE30	2,76	2,57	2,72	2,84	2,24	2,33
Sin Crop Booster	40 días	SCEB40	3,44	3	3,17	4,06	2,45	3,37
Sin Crop Booster	50 días	SCEB50	3,54	3,12	3,52	3,67	3,78	3,79

2. Análisis de la varianza

Variable	N	R^2	R^2 Aj	CV
Pdn F MS	36	0,83	0,76	11,26

2.1. Cuadro de Análisis de la Varianza (SC tipo III)

F.V.	SC	gl	CM	F	p-valor
Tecnología Crop Booster	16,03	1	16,03	87,63	<0,0001
Edad corte	1,15	2	0,57	3,13	0,0612
Repeticiones	1,00	5	0,20	1,09	0,3880
Tecnología Crop Booster*Ed...	4,25	2	2,13	11,63	0,0003
Error	4,57	25	0,18		
Total	27,00	35			

3. Separación de medias según Tukey (p<0,05)

3.1. Tecnología Crop Booster (A)

Tecnología Crop Booster	Medias	n	E.E.	
Crop Booster	4,47	18	0,10	A
Sin Crop Booster	3,13	18	0,10	B

3.2. Edad de Corte (B)

Edad corte	Medias	n	E.E.	
40 días	4,03	12	0,12	A
50 días	3,77	12	0,12	A
30 días	3,60	12	0,12	A

3.3. Interacción (A*B)

Tecnología Crop Booster	Edad corte	Medias	n	E.E.				
Crop Booster	40 días	4,81	6	0,17	A			
Crop Booster	30 días	4,62	6	0,17	A	B		
Crop Booster	50 días	3,97	6	0,17		B	C	
Sin Crop Booster	50 días	3,57	6	0,17			C	
Sin Crop Booster	40 días	3,25	6	0,17			C	D
Sin Crop Booster	30 días	2,58	6	0,17				D

Annex F. Summary of Productive Performance in a Medicago sativa var. CUF 101 (Alfalfa) plus Plantago lanceolata (Plantain Forage) Meadow due to Crop Booster Technology and Cutting Age

1. **Comportamiento productivo de la mezcla forrajera (*Medicago sativa* y *Plantago lanceolata)*, por efecto de la Tecnología Crop Booster (Factor A).**

VARIABLE	TECNOLOGÍA CROB BOOSTER				EE	Prob.
	Crop Booster		Sin Crop Booster			
Altura mezcla forrajera, cm	64,61	a	55,33	b	1,04	<0,0001
Cobertura basal (%)	15,11	a	12,56	b	0,47	0,0007
Cobertura aérea (%)	23,72	a	19,33	b	0,72	0,0002
Producción de forraje verde (t/FV/ha/corte)	18,99	a	15,68	a	0,51	0,0001
Producción en materia seca (t/MS/ha/corte)	4,47	a	3,13	a	0,10	<0,0001

2. **Comportamiento productivo de la mezcla forrajera (*Medicago sativa* y *Plantago lanceolata),* a diferentes edades de corte, (Factor B).**

VARIABLE	EDAD DE CORTE						EE	Prob.
	30 días		40 días		50 días			
Altura mezcla forrajera, cm	49,17	c	60,92	b	69,83	a	1,27	<0,0001
Cobertura basal (%)	13,75	a	14,58	a	13,17	a	0,58	0,2359
Cobertura aérea (%)	21,58	a	22,00	a	21,00	a	0,88	0,7233
Producción de forraje verde (t/FV/ha/corte)	18,51	a	17,16	a	16,34	a	0,62	0,0613
Producción en materia seca (t/MS/ha/corte)	3,60	a	4,03	a	3,77	a	0,12	0,0604

3. Comportamiento productivo de la mezcla forrajera (*Medicago sativa* y *Plantago lanceolata*), por el efecto de la interacción entre la Tecnología Crop Booster y la Edad de Corte.

VARIABLE	EFECTO DE LA INTERACCIÓN ENTRE LA TECNOLOGÍA CROP BOOSTER Y LA EDAD DE CORTE												EE	Prob.
	Crop Booster 30 días		Crop Booster 40 días		Crop Booster 50 días		Sin Crop Booster 30 días		Sin Crop Booster 40 días		Sin Crop Booster 50 días			
Altura mezcla forrajera, cm	52,83	b	64,17	b	76,83	a	45,50	c	57,67	b	62,83	b	1,80	0,0932
Cobertura basal (%)	14,83	a	15,17	a	15,33	a	12,67	ab	14,00	ab	11,00	b	0,81	0,1593
Cobertura aérea (%)	23,00	a	23,17	a	25,00	a	20,17	ab	20,83	ab	17,00	b	1,24	0,0579
Producción de forraje verde (t/FV/ha/corte)	21,50	a	18,67	ab	16,83	b	15,57	b	15,63	b	15,82	b	0,88	0,0349
Producción en materia seca (t/MS/ha/corte)	4,62	ab	4,81	a	3,97	bc	2,58	d	3,25	cd	3,57	c	0,17	0,0003

Annex G. Determination of the Percentage of Dry Matter of a Forage Mixture due to Crop Booster Technology and Cutting Age

1. **Resultados Experimentales**

Tecnología Crop Booster	Edad de corte (días)	Código	Repeticiones % MS					
FACTOR A	FACTOR B		I	II	III	IV	V	VI
Crop Booster	30 días	CBE30	22,10	21,21	22,39	21,14	20,49	21,90
Crop Booster	40 días	CBE40	24,16	23,64	22,46	23,41	22,36	23,62
Crop Booster	50 días	CBE50	23,32	24,45	23,06	24,12	22,53	23,95
Sin Crop Booster	30 días	SCBE30	17,87	16,50	17,98	17,02	17,34	16,40
Sin Crop Booster	40 días	SCEB40	21,82	20,31	20,65	21,51	20,67	19,14
Sin Crop Booster	50 días	SCEB50	22,91	21,42	22,93	22,02	22,97	23,10

2. **Análisis de la varianza**

Variable	N	R²	R² Aj	CV
MATERIA SECA	36	0,93	0,90	3,41

2.1. Cuadro de Análisis de la Varianza (SC tipo III)

F.V.	SC	gl	CM	F	p-valor
Tecnología Crop Booster	63,34	1	63,34	118,03	<0,0001
Edad corte	86,98	2	43,49	81,05	<0,0001
Repeticiones	3,35	5	0,67	1,25	0,3169
Tecnología Crop Booster*Ed...	16,75	2	8,38	15,61	<0,0001
Error	13,42	25	0,54		
Total	183,83	35			

3. **Separación de medias según Tukey (p<0,05)**

3.1. Tecnología Crop Booster (A)

Tecnología Crop Booster	Medias	n	E.E.		
Crop Booster	22,80	18	0,17	A	
Sin Crop Booster	20,14	18	0,17		B

3.2. Edad de Corte (B)

Edad corte	Medias	n	E.E.			
50 días	23,07	12	0,21	A		
40 días	21,98	12	0,21		B	
30 días	19,36	12	0,21			C

3.3. Interacción (A*B)

Tecnología Crop Booster	Edad corte	Medias	n	E.E.				
Crop Booster	50 días	23,57	6	0,30	A			
Crop Booster	40 días	23,28	6	0,30	A			
Sin Crop Booster	50 días	22,56	6	0,30	A	B		
Crop Booster	30 días	21,54	6	0,30		B	C	
Sin Crop Booster	40 días	20,68	6	0,30			C	
Sin Crop Booster ,	30 días	17,19	6	0,30				D

Annex H. Determination of the Percentage of Ash of a Forage Mixture due to Crop Booster Technology and Cutting Age

1. **Resultados Experimentales**

Tecnología Crop Booster	Edad de corte (días)	Código	Repeticiones % Ceniza					
FACTOR A	**FACTOR B**		**I**	**II**	**III**	**IV**	**V**	**VI**
Crop Booster	30 días	CBE30	9,78	8,89	9,60	9,22	9,12	9,76
Crop Booster	40 días	CBE40	10,80	10,31	10,50	11,52	11,39	11,82
Crop Booster	50 días	CBE50	11,87	11,34	11,40	11,88	11,66	10,26
Sin Crop Booster	30 días	SCBE30	8,20	9,44	9,34	9,07	8,11	8,95
Sin Crop Booster	40 días	SCEB40	9,94	10,85	10,84	10,02	10,39	10,80
Sin Crop Booster	50 días	SCEB50	10,89	10,88	11,64	10,59	11,56	10,75

2. **Análisis de la varianza**

Variable	N	R^2	R^2 Aj	CV
CENIZA	36	0,81	0,73	5,27

2.1. Cuadro de Análisis de la Varianza (SC tipo III)

F.V.	SC	gl	CM	F	p-valor
Tecnología Crop Booster	2,18	1	2,18	7,30	0,0122
Edad corte	29,33	2	14,66	49,08	<0,0001
Repeticiones	0,34	5	0,07	0,23	0,9471
Tecnología Crop Booster*Ed...	0,09	2	0,05	0,16	0,8561
Error	7,47	25	0,30		
Total	39,41	35			

3. **Separación de medias según Tukey (p<0,05)**

3.1. Tecnología Crop Booster (A)

Tecnología Crop Booster	Medias	n	E.E.		
Crop Booster	10,62	18	0,13	A	
Sin Crop Booster	10,13	18	0,13		B

3.2. Edad de Corte (B)

Edad corte	Medias	n	E.E.		
50 días	11,23	12	0,16	A	
40 días	10,77	12	0,16	A	
30 días	9,12	12	0,16		B

3.3. Interacción (A*B)

Tecnología Crop Booster	Edad corte	Medias	n	E.E.		
Crop Booster	50 días	11,40	6	0,22	A	
Crop Booster	40 días	11,06	6	0,22	A	
Sin Crop Booster	50 días	11,05	6	0,22	A	
Sin Crop Booster	40 días	10,47	6	0,22	A	
Crop Booster	30 días	9,40	6	0,22		B
Sin Crop Booster	30 días	8,85	6	0,22		B

Annex I. Determination of the Percentage of Raw Fiber of a Forage Mixture due to Crop Booster Technology and Cutting Age

1. **Resultados Experimentales**

Tecnología Crop Booster	Edad de corte (días)	Código	Repeticiones % Fibra					
FACTOR A	**FACTOR B**		**I**	**II**	**III**	**IV**	**V**	**VI**
Crop Booster	30 días	CBE30	31,29	31,72	30,73	31,20	30,80	31,22
Crop Booster	40 días	CBE40	33,12	32,06	33,02	33,28	31,08	32,97
Crop Booster	50 días	CBE50	33,14	34,73	35,24	34,37	33,03	32,67
Sin Crop Booster	30 días	SCBE30	28,89	27,78	27,33	28,56	27,63	28,01
Sin Crop Booster	40 días	SCEB40	29,46	28,93	29,30	29,48	28,67	28,15
Sin Crop Booster	50 días	SCEB50	30,65	32,53	30,90	31,22	30,21	31,10

2. **Análisis de la varianza**

Variable	N	R²	R² Aj	CV
FIBRA	36	0,93	0,91	2,11

2.1. **Cuadro de Análisis de la Varianza (SC tipo III)**

F.V.	SC	gl	CM	F	p-valor
Tecnología Crop Booster	89,84	1	89,84	210,50	<0,0001
Edad corte	50,45	2	25,23	59,11	<0,0001
Repeticiones	5,37	5	1,07	2,52	0,0562
Tecnología Crop Booster*Ed...	1,03	2	0,52	1,21	0,3147
Error	10,67	25	0,43		
Total	157,36	35			

3. **Separación de medias según Tukey (p<0,05)**

3.1. **Tecnología Crop Booster (A)**

Tecnología Crop Booster	Medias	n	E.E.	
Crop Booster	32,54	18	0,15	A
Sin Crop Booster	29,38	18	0,15	B

3.2. **Edad de Corte (B)**

Edad corte	Medias	n	E.E.	
50 días	32,48	12	0,19	A
40 días	30,79	12	0,19	B
30 días	29,60	12	0,19	C

3.3. **Interacción (A*B)**

Tecnología Crop Booster	Edad corte	Medias	n	E.E.	
Crop Booster	50 días	33,86	6	0,27	A
Crop Booster	40 días	32,59	6	0,27	B
Crop Booster	30 días	31,16	6	0,27	C
Sin Crop Booster	50 días	31,10	6	0,27	C
Sin Crop Booster	40 días	29,00	6	0,27	D
Sin Crop Booster	30 días	28,03	6	0,27	D

Annex J. Determination of the Percentage of Raw Protein of a Forage Mixture due to Crop Booster Technology and Cutting Age

1. **Resultados Experimentales**

Tecnología Crop Booster	Edad de corte (días)	Código	Repeticiones % Proteína					
FACTOR A	**FACTOR B**		**I**	**II**	**III**	**IV**	**V**	**VI**
Crop Booster	30 días	CBE30	22,65	21,77	21,76	22,48	21,80	22,28
Crop Booster	40 días	CBE40	24,32	23,57	23,09	24,38	23,62	23,57
Crop Booster	50 días	CBE50	21,82	21,54	21,76	22,47	21,82	21,76
Sin Crop Booster	30 días	SCBE30	21,36	21,95	21,61	21,66	21,94	21,17
Sin Crop Booster	40 días	SCEB40	21,56	21,89	21,68	21,86	21,73	22,56
Sin Crop Booster	50 días	SCEB50	21,79	20,88	21,82	20,91	21,77	20,88

2. **Análisis de la varianza**

Variable	N	R²	R² Aj	CV
PROTEÍNA	36	0,84	0,78	1,85

2.1. Cuadro de Análisis de la Varianza (SC tipo III)

F.V.	SC	gl	CM	F	p-valor
Tecnología Crop Booster	8,45	1	8,45	50,48	<0,0001
Edad corte	9,83	2	4,91	29,36	<0,0001
Repeticiones	0,68	5	0,14	0,81	0,5521
Tecnología Crop Booster*Ed...	3,72	2	1,86	11,12	0,0004
Error	4,18	25	0,17		
Total	26,86	35			

3. **Separación de medias según Tukey (p<0,05)**

3.1. Tecnología Crop Booster (A)

Tecnología Crop Booster	Medias	n	E.E.	
Crop Booster	22,58	18	0,10	A
Sin Crop Booster	21,61	18	0,10	B

3.2. Edad de Corte (B)

Edad corte	Medias	n	E.E.	
40 días	22,82	12	0,12	A
30 días	21,87	12	0,12	B
50 días	21,60	12	0,12	B

3.3. Interacción (A*B)

Tecnología Crop Booster	Edad corte	Medias	n	E.E.	
Crop Booster	40 días	23,76	6	0,17	A
Crop Booster	30 días	22,12	6	0,17	B
Sin Crop Booster	40 días	21,88	6	0,17	B C
Crop Booster	50 días	21,86	6	0,17	B C
Sin Crop Booster	30 días	21,62	6	0,17	B C
Sin Crop Booster	50 días	21,34	6	0,17	C

Annex K. Determination of the Percentage of Ether Extract of a Forage Mixture due to Crop Booster Technology and Cutting Age

1. Resultados Experimentales

Tecnología Crop Booster	Edad de corte (días)	Código	Repeticiones % EE					
FACTOR A	FACTOR B		I	II	III	IV	V	VI
Crop Booster	30 días	CBE30	1,65	1,57	1,37	1,49	1,45	1,58
Crop Booster	40 días	CBE40	1,44	1,53	1,62	1,48	1,45	1,44
Crop Booster	50 días	CBE50	1,23	1,19	1,22	1,18	1,23	1,21
Sin Crop Booster	30 días	SCBE30	1,26	1,21	1,35	1,31	1,32	1,38
Sin Crop Booster	40 días	SCEB40	1,27	1,24	1,18	1,17	1,25	1,27
Sin Crop Booster	50 días	SCEB50	1,13	1,15	1,11	1,14	1,15	1,13

2. Análisis de la varianza

Variable	N	R²	R² Aj	CV
EE	36	0,88	0,83	4,85

2.1. Cuadro de Análisis de la Varianza (SC tipo III)

F.V.	SC	gl	CM	F	p-valor
Tecnología Crop Booster	0,30	1	0,30	74,71	<0,0001
Edad corte	0,38	2	0,19	46,88	<0,0001
Repeticiones	0,01	5	1,3E-03	0,33	0,8913
Tecnología Crop Booster*Ed...	0,06	2	0,03	7,01	0,0038
Error	0,10	25	4,1E-03		
Total	0,85	35			

3. Separación de medias según Tukey (p<0,05)

3.1. Tecnología Crop Booster (A)

Tecnología Crop Booster	Medias	n	E.E.	
Crop Booster	1,41	18	0,02	A
Sin Crop Booster	1,22	18	0,02	B

3.2. Edad de Corte (B)

Edad corte	Medias	n	E.E.	
30 días	1,41	12	0,02	A
40 días	1,36	12	0,02	A
50 días	1,17	12	0,02	B

3.3. Interacción (A*B)

Tecnología Crop Booster	Edad corte	Medias	n	E.E.	
Crop Booster	30 días	1,52	6	0,03	A
Crop Booster	40 días	1,49	6	0,03	A
Sin Crop Booster	30 días	1,31	6	0,03	B
Sin Crop Booster	40 días	1,23	6	0,03	B C
Crop Booster	50 días	1,21	6	0,03	B C
Sin Crop Booster	50 días	1,14	6	0,03	C

Annex L. Summary of Proximate Analysis of a Forage Mixture due to Crop Booster Technology and Cutting Age

1. Comportamiento bromatológico de la mezcla forrajera (*Medicago sativa* y *Plantago lanceolata)*, por efecto de la Tecnología Crop Booster (Factor A).

VARIABLE	**TECNOLOGÍA CROB BOOSTER**				**EE**	**Prob.**
	Crop Booster		**Sin Crop Booster**			
% MS	22,80	a	20,14	b	0,17	<0,0001
% Ceniza	10,62	a	10,13	b	0,13	0,0122
% Fibra	32,54	a	29,38	b	0,15	<0,0001
% Proteína	22,58	a	21,61	b	0,10	<0,0001
% EE	1,41	a	1,22	a	0,02	<0,0001

2. Comportamiento bromatológico de la mezcla forrajera (*Medicago sativa* y *Plantago lanceolata),* a diferentes edades de corte, (Factor B).

VARIABLE	**EDAD DE CORTE**						EE	Prob.
	30 días		40 días		50 días			
% MS	19,36	c	21,98	b	23,07	a	0,21	<0,0001
% Ceniza	9,12	b	10,77	a	11,23	a	0,16	<0,0001
% Fibra	29,60	c	30,79	b	32,48	a	0,19	<0,0001
% Proteína	21,87	b	22,82	a	21,60	b	0,12	<0,0001
% EE	1,41	a	1,36	a	1,17	b	0,02	<0,0001

3. Comportamiento bromatológico de la mezcla forrajera (*Medicago sativa* y *Plantago lanceolata*), por el efecto de la interacción entre la Tecnología Crop Booster y la Edad de Corte

VARIABLE	**EFECTO DE LA INTERACCIÓN ENTRE LA TECNOLOGÍA CROP BOOSTER Y LA EDAD DE CORTE**												EE	Prob.
	Crop Booster 30 días		Crop Booster 40 días		Crop Booster 50 días		Sin Crop Booster 30 días		Sin Crop Booster 40 días		Sin Crop Booster 50 días			
% MS	21,54	bc	23,28	a	23,57	a	17,19	d	20,68	c	22,56	ab	0,30	<0,0001
% Ceniza	9,40	b	11,06	a	11,40	a	8,85	b	10,47	a	11,05	a	0,22	0,8561
% Fibra	31,16	c	32,59	b	33,86	a	28,03	d	29,00	d	31,10	c	0,27	0,3147
% Proteína	22,12	b	23,76	a	21,86	bc	21,62	bc	21,88	bc	21,34	c	0,17	0,0004
% EE	1,52	a	1,49	a	1,21	bc	1,31	b	1,23	bc	1,14	c	0,03	0,0038

Annex M. Commencement of Fieldwork in a *Medicago sativa* var. CUF 101 (Alfalfa) plus *Plantago lanceolata* (Plantain Forage) Meadow due to Crop Booster Technology and Cutting Age

1. **Terreno donde se realizará el trabajo de campo**

2. **Materiales para utilizar en el Experimento**

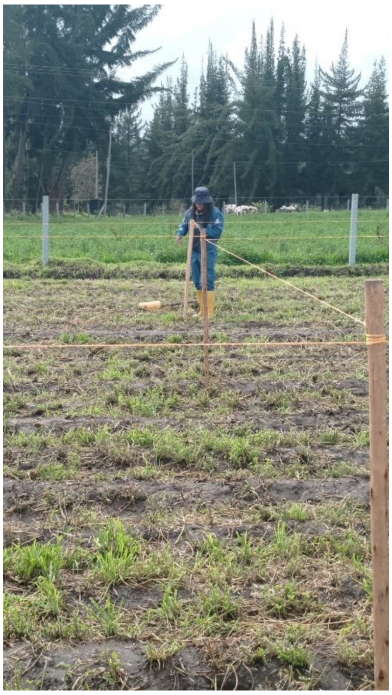




3. **Corte de igualación y fertilización**



4. Ubicación de las parcelas con sus respectivos letreros



5. Primer riego con y sin la tecnología Crop Booster

6. Autor con el sistema de riego

Annex N. Commencement of Productive Measurements in a Medicago sativa var. CUF 101 (Alfalfa) plus Plantago lanceolata (Plantain Forage) Meadow due to Crop Booster Technology and Cutting Age

1. **Medición de altura, cobertura basal y cobertura aérea de la planta**


2. **Pesaje de producción forrajera de MV**



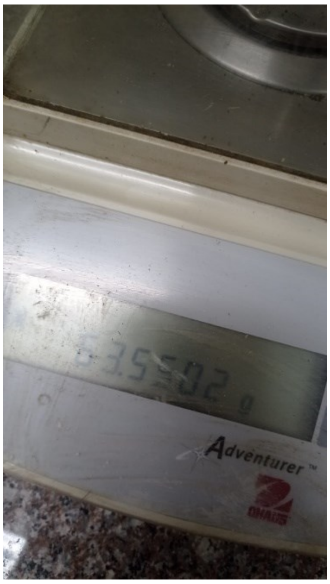
Annex O. Laboratory Data in a *Medicago sativa* var. CUF 101 (Alfalfa) plus *Plantago lanceolata* (Plantain Forage) Meadow due to Crop Booster Technology and Cutting Age

1. **Muestras para Materia Seca**

2. **Muestras para sacar Cenizas**

3. **Pasos para sacar Fibra**

4. **Pasos para sacar Estracto Etero**



5. **Pasos para sacar Proteína**