# "EVALUATION OF THE FORAGE QUALITY OF INIAP 180 CORN *(Zea mays)* USING CROP BOOSTER TECHNOLOGY AT THE STATION EXPERIMENTAL TUNSHI"

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## SUMMARY

The present work aimed to evaluate the forage quality of *Zea mays* (Corn) INIAP 180, using Crop Booster technology at the Tunshi Experimental Station. The methodology used in 128 plots already established, each plot with a dimension of 7 x 7 m (49m ^ 2), the size of each experimental unit was 3136 m² suitable for the production of *Zea mays* (CORN) INIAP 180, of which 64 plots with the use of Crop Booster Technology and 64 plots without the use of Crop Booster Technology.
An evaluation of the forage quality of Zea mays (CORN) INIAP 180 was also carried out, showing that the application of Crop Booster technology proved to be the treatment that had the greatest impact in terms of germination time (11 days), plant height (305.04 cm), number of plants with cobs (22.75), green forage production (8.9 kg/m2), and dry matter production (24.38 t/ha). Similarly, when evaluating the bromatological characteristics of corn forage, better results were obtained when using the Crop Booster device for protein content (8.54%), fat (1.73%), fiber (4.19%), and nitrogen-free extract (1.05%). As a result, greater profitability was obtained when Crop Booster technology was applied, with which a benefit/cost of 1.47 was obtained, which represents that for every dollar USD invested, a profitability of 47 cents USD (47%) is expected. It is concluded that Crop Booster technology increased the yield of the evaluated corn forage. It is concluded that when evaluating corn forage quality, the most satisfactory results were achieved using Crop Booster technology. It is recommended that this study be expanded. Future research should consider the variables pH, field capacity, and irrigation depth.

**Keywords:** <FORD QUALITY>, <INIAP 180 CORN>, <CORN *(Zea mays)*>, <CROP BOOSTER TECHNOLOGY>, <TUNSHI EXPERIMENTAL STATION>.

## ABSTRACT

The objective of this work was to evaluate the forage quality of *Zea mays* (Com) INIAP 180, using Crop Booster technology at Estación Experimental Tunshi. The methodology that was used in 128 plots already established each plot with a dimension of 7 x 7 m (49m^2), the size of each experimental unit was 3136m² suitable for the production of *Zea mays* (CORN) INIAP 180, of which 64 plots with the use of Crop Booster technology and 64 plots without the use of Crop Booster technology. The evaluation of the forage quality of Zea mays (CORN) INIAP 180 was also carried out, showing that the application of Crop Booster technology proved to be the treatment that obtained the highest incidence in terms of germination time (11 days), plant height (305.04 cm) numbers of plants with cobs (22.75) production of green fodder (8.9 kg/m2) and production of dry matter (24.38 T/ha). Likewise, when evaluating the bromatological characteristics of maize forage, better results were obtained when using the Crop Booster device for the content of protein (8.54%), fat (1.73%), fiber (4.19%) and nitrogen-free extraction (1.05%). As a result, higher profitability was obtained when Crop Booster technology was applied, with which a profit / cost of 1.47 was obtained, which represents that for every USD dollar invested, a return of 47 USD cents (47%) is expected. It concludes the Crop Booster technology provided increased yield of the evaluated corn forage. Concluding that when evaluating the forage quality of corn it is appreciated that the most satisfactory results were achieved by using the Crop Booster technology and recommending to expand the present study, in future investigations it will be followed that the variables pH, field capacity and irrigation sheet are taken into account.

**Keywords:** <FORAGE QUALITY>, <INIAP CORN 180>, <CORN *(Zea mays)* <CROP BOOSTER TECHNOLOGY>, <TUNSHI EXPERIMENTAL STATION>

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# I. INTRODUCTION

Maize *(Zea mays)* is the only cereal grain that can be used as food for humans or animals at any stage of growth or production and is an economically important crop worldwide due to its usefulness. In the highlands of Ecuador, it is one of the most

important due to the large amount of land dedicated to the crop and its role as a staple food in people's diet (Galarza, 2022, p.1).

There are many factors that can inhibit the proper development of a corn plant, and crop yield is of great importance. The ability to give crops the tools to cope with adverse conditions allows us to avoid limiting plants to situations that cause yield losses (Martínez, 2022, p. 14).

A food source for humans and livestock, this crop is the source of many industrial products.
A 2014 study found that dry durum corn accounted for 40% of global cereal production, with global corn production reaching 1,025.6 million tons in 2016 with an average annual yield of 5.69 tons (Páliz, 2015, p.10).

Climate change and its impact on agricultural production and productivity, particularly those associated with changes in rainfall, drought, excessive humidity, and the geographic redistribution of pests, diseases, and insects, have new implications for production, and the development of new maize varieties creates technological challenges.

This is because techniques are needed to increase productivity and adaptability to different environments, as well as resistance and/or tolerance to the various biotic and abiotic stresses that affect crops (Salguero, 2018, p.17).

Agricultural productivity can be increased through a variety of measures, including government incentives for technology adoption, funding of universities and research centers for agricultural innovation, and the provision of various training programs (Duran, 2016, p. 14).

Animal feed almost always contains corn as a main ingredient, its supposed contribution

Energy, its content and its low variability in chemical composition make it one of the preferred ingredients among manufacturers. Research in genetic improvement, plant nutrition, phytopathology and entomology plays an important role in Ecuador, since it seeks to solve the problem of water scarcity and its optimization. On the other hand, the use of biotechnology and its applications to increase crop yields is still in its infancy. Advances in genetic improvement are one of the most important factors in improving yields in the two most important producing regions of the country (the Coast and the Sierra) (Caviedes, 2019, p. 20).

Seeds are one of the most important costs for farmers, and the creation of new technologies helps optimize seeds to obtain maximum production yield. Important processes occur in plants that increase or decrease agricultural production; in fact, there are biological, chemical, and physical factors that can alter the quality and quantity of crops (Galego, 2022, p. 2).

The new Crop Booster technology can drastically improve these aspects of harvesting, which is why growers around the world are testing it on different crops. This technology helps your plants grow stronger, healthier, and faster with less fertilizer and pesticides. The Crop Booster is a microgenerator with more than 3,000 audio frequencies (Buritica, 2022, p. 10).

Crop Booster microtransmitters use radio pulses of different frequencies to send precise instructions to your plants. Because the transmitted frequencies match the

Natural molecular frequencies of soil and plants can receive these instructions and improve their function. This has a positive effect on plant growth, such as improving the uptake and use of water, oxygen, nitrogen, nitric oxide, and carbon dioxide, as well as light and glucose metabolism (chlorophyll photosynthesis) in plants (Buritica,

2022, p. 10).

The purpose of this research is to evaluate the forage quality of *Zea mays* (Corn)
INIAP 180, using Crop Booster technology at the Tunshi Experimental Station. In addition, agronomic and production parameters were evaluated after 120 days.

and bromatological of *Zea mays* (CORN) INIAP 180 using Crop Booster technology and analyze the benefit/cost using Crop Booster technology and without using said technology in Corn through the benefit-cost indicator.

## II. MATERIALS AND METHODS

**Location and duration of the experiment**

This work was carried out at the Tunshi Experimental Station, Licto Parish, ESPOCH, located at Km 12 Via Licto, Riobamba Canton, Chimborazo Province, at an altitude of 2960 - 3320 meters above sea level, Latitude -1°48ÿ19.58 and longitude -

78°36ÿ4.36 longitude with a duration of 120 days in the Titling work.

**Experimental units**

For this research, 16 already established plots were used, each plot with a dimension of 7 x 7 m (49m^2), the size of each experimental unit was 3136m² suitable for the production of *Zea mays* (CORN) INIAP 180, of which 8 plots with the use of Crop Booster Technology and 8 plots without the use of Crop Booster Technology.

**Treatments and experimental design**

Comparative descriptive statistics were used between the two treatments and to verify significance a Student's t-test was applied, used in the 2 treatments, Crop Booster and Without Crop Booster with 8 repetitions and 8 Experimental Units.

**Statistical analysis and significance tests**

Descriptive statistics (mean, median and mode) and standard deviation and Student's t test were used.
assuming equal variances.

**Experimental procedure**

The results obtained when evaluating the forage quality of *Zea mays* (CORN) INIAP 180, the activities carried out were:

• Cleaning of water accesses.
• It was subsequently divided into 64 plots with Crop Booster, each of them having a dimension of 49 m2 and was divided into 64 plots without Crop Booster with the same area.
• Then, the INIAP 180 *"Zea mays"* corn was planted in both treatments.
• After sowing, irrigation was carried out every 8 days until the tenth week using the sprinkler method with the Crop Booster system and without the Crop Booster system.
Booster.
• From the eighth week, weed killer was sprayed for both treatments and in the twelfth week, weeding and hilling were carried out, adding a 15-15-15 fertilizer plus a quintal of Urea, giving a total of 2 quintals of 15-15-15 and 2 of Urea for the 2 treatments.

• From the eleventh week, watering was carried out every 15 days until the 120 days for which the Experimental Work was established.
• Fertilization took place in the twelfth week

chemistry with microelement fertilizer, in which a dose of 2 kg per 400 liters was used.
At 120 days the variables of the

Forage production, plant height measurements, germination time (120 days), number of leaves (units, length between nodes (cm), flowering time (days), height (cm), forage production

green (t/FV/ha), dry matter production (t/DM/ha), number of cobs (units) and the extraction of samples for bromatological analysis.

• It was finally done the calculation of the Benefit/Cost, comparing irrigation with and without Crop Booster Technology.

## III. RESULTS AND DISCUSSIONS

**Evaluation at 120 days of the agronomic, productive and bromatological parameters of the *Zea mays* (CORN) INIAP 18O, using Crop Booster technology at the Station Experimental Tunshi**

***Germination time (days)***

According to the analysis of table 1, it is recorded that *Zea mays* (CORN) INIAP 180 with the application of Crop Booster technology has a germination time of 14 days, and without the use of
Crop Booster technology the germination time was of 11 days; as shown in Illustration 1.

**Table 1:** Statistical evaluation of quality
INIAP 180 corn fodder

| STATISTICS DESCRIPTIVE | Technology | Medium | Mistake typical | Deviation Standard | Sum | P(T<=t) two queues |
|---|---|---|---|---|---|---|
| Time of Germination (Days) | No Crop Booster | 14.00 | 0.00 | 0.00 | 112.00 | |
| | With Crop Booster | 11.00 | 0.00 | 0.00 | 88.00 | ns |
| Number of Leaves (Units) | No Crop Booster | 14.00 | 0.00 | 0.00 | 112.00 | 4.26ÿ5 |
| | With Crop Booster | 15.13 | 0.13 | 0.35 | 121.00 | ** |
| Length of the root (Centimeters) | No Crop Booster | 22.16 | 0.12 | 0.34 | 177.30 | 2.68ÿ7 |
| | With Crop Booster | 24.85 | 0.11 | 0.31 | 198.80 | ** |
| Length between knots (Centimeters) | No Crop Booster | 21.98 | 0.05 | 0.14 | 175.80 | 5.38ÿ8 |
| | With Crop Booster | 30.33 | 0.35 | 1.00 | 242.60 | ** |
| Days to the bloom male (Days) | No Crop Booster | 75.29 | 0.21 | 0.59 | 602.30 | 2.80ÿ10 |
| | With Crop Booster | 60.03 | 0.34 | 0.98 | 480.20 | ** |
| Days to the bloom female (Days) | No Crop Booster | 100.39 | 0.13 | 0.36 | 803.10 | 2.69ÿ9 |
| | With Crop Booster | 85.89 | 0.38 | 1.07 | 687.10 | ** |
| Height of the plant (Centimeters) | No Crop Booster | 220.08 | 1.20 | 3.39 | 1760.60 | 1.03ÿ9 |
| | With Crop Booster | 305.04 | 0.99 | 2.80 | 2440.30 | ** |
| Number of corncobs (Units) | No Crop Booster | 1.00 | 0.00 | 0.00 | 8.00 | 0.47 |
| | With Crop Booster | 2.00 | 0.00 | 0.00 | 16.00 | ns |
| Number of plants with cob (Units) | No Crop Booster | 14.25 | 0.37 | 1.04 | 114.00 | 8.69ÿ8 |
| | With Crop Booster | 22.75 | 0.16 | 0.46 | 182.00 | ** |
| Number of plants without cob (Units) | No Crop Booster | 1.63 | 0.18 | 0.52 | 13.00 | 0.01 |
| | With Crop Booster | 1.00 | 0.00 | 0.00 | 8.00 | * |
| Number of plants with two ears of corn (Units) | No Crop Booster | 12.50 | 0.19 | 0.53 | 100.00 | 2.73ÿ9 |
| | With Crop Booster | 21.75 | 0.16 | 0.46 | 174.00 | ** |
| Production of Green Forage Kg/m2 | No Crop Booster | 5.79 | 0.04 | 0.10 | 46.30 | 7.06ÿ10 |
| | With Crop Booster | 8.90 | 0.07 | 0.19 | 71.20 | ** |
| Production of Dry Matter | No Crop Booster | 24.03 | 0.41 | 1.17 | 192.20 | 0.48 |
| | With Crop Booster | 24.38 | 0.24 | 0.67 | 195.03 | ns |

Proper management, i.e., the provision of necessary water and nutrients, increases yield.

productive, and helps plants grow stronger, healthier and faster, as well as stimulating greater absorption and use of carbon dioxide

carbon and the efficiency of glucose metabolism to accelerate the dark reaction of photosynthesis and plant growth.

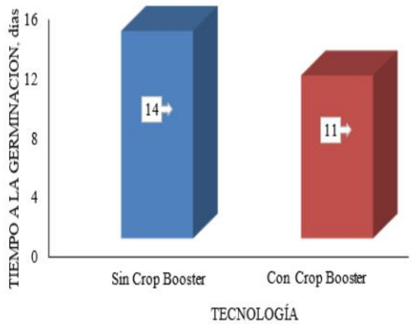


**Illustration 1:** Germination time behavior of *Zea mays* (CORN) INIAP 180

***Number of leaves***

According to the analysis of table 1, it is recorded that INIAP 180 corn *(Zea mays)* with the application of Crop Booster technology reports a number of leaves of 15.13 units and 14 units without Crop Booster technology, as shown in the illustration 2.

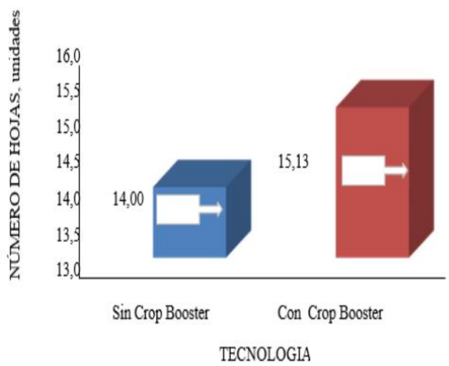


**Illustration 2:** Behavior of the number of leaves per plant of *Zea mays* (CORN)-INIAP 180.

That is to say, the use of Crop Booster technology positively influences the development of the plant, which is corroborated by the assessments of (Caviedes, 2019, p.12), who mentions that this technology improves the absorption and use of water, oxygen, nitrogen, nitric oxide, carbon dioxide, and the metabolism of light and glucose of the plant (chlorophyll photosynthesis), since the performance of crops, whether vegetative or reproductive, depends largely on access to an adequate supply of mineral nutrients.

essential, which resulted in 14 leaves.

The results presented in this research are higher than the records of (Izquierdo, 2012, p.10) who, when carrying out the analysis of variance for the number of leaves per plant of the Zea mays (CORN) crop, on average obtained that the INIAP 180 variety presented 10 leaves/plant.

A similar result was found in the research of (Obando, 2019, p.14), who when evaluating the morphological characterization of corn, the total number of leaves counted was 10.9 leaves, where most of the leaves were in a hanging-type orientation.

*Root length, cm*

According to the analysis of table 1, it is recorded that *Zea mays* (CORN) INIAP 180 with the application of Crop Booster technology has a root length of 24.85 cm and 22.16 cm without Crop Booster technology as shown in illustration 3.

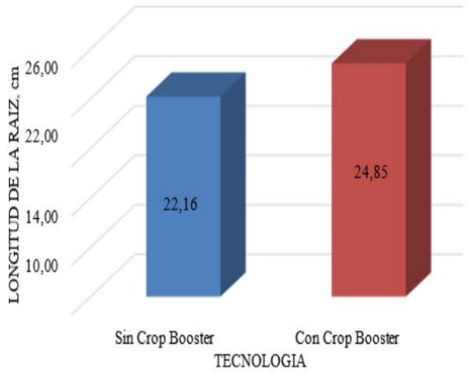


**Illustration 1:** Behavior of the length of the *Zea mays* root (CORN) INIAP 180

This means that Crop Booster technology oxygenates the soil and helps roots grow and absorb nutrients more quickly. It does a great job of working from the inside out of the plant, which is reflected in increased root density, balancing the absorption and utilization of nutrients by plants.

***Length between knots, cm***

According to the analysis of table 1, it is recorded that Zea mays (CORN) INIAP 180 with the application of Crop Booster technology presented a length between nodes of 30.33 cm and 21.98 cm, without Crop Booster technology, as shown in illustration 4.

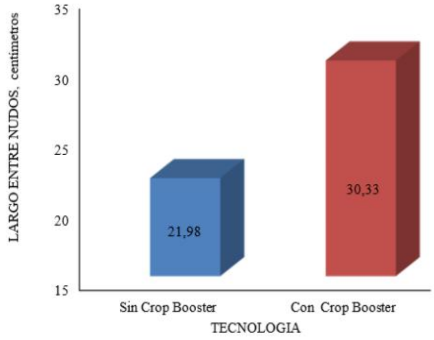


**Illustration 2:** Behavior of the length between knots from *Zea mays* (CORN) INIAP 180.

The results obtained demonstrate that the technology improves the efficiency of growth and development of plants, resulting in a superior length of nodes, this is possibly due to the fact that the transmitted frequencies coincide with the natural molecular frequencies of soils and plants, these instructions are received by them, allowing to improve their functions since growth is increased through conditions of

favorable growth (adequate humidity, nutrients and temperature, etc.) and is diminished by stressful growth conditions (abnormal temperatures, nutrient deficiencies, humidity, etc.).

It should be noted that a shoot begins at each node (axil of each leaf) from the first leaf (below the ground) to approximately the 13th leaf (above the ground). Shoots that develop at nodes above the ground can differentiate into reproductive tissue (ears), and shoots that develop below the ground can differentiate into vegetative tissue (stems or tillers).

***Days to male flowering***

According to the analysis of table 1, it is recorded that *Zea mays* (CORN) INIAP 180 with the application of Crop Booster technology presented male flowering at 60.03 days and 75.29 days without the technology.
Crop Booster technology, as shown in illustration 5.

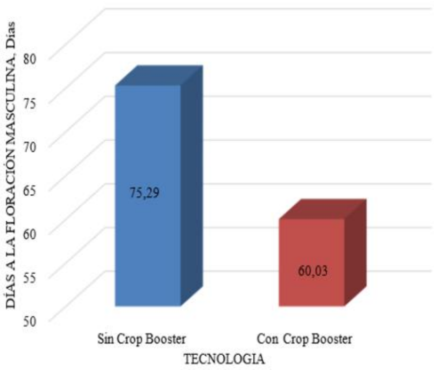


**Illustration 5:** Behavior of the days to male flowering of *Zea mays* (CORN) INIAP 180

As the tips of the male flowers and the tip of the female spike appear, the plant's growth rate slows. The middle and lower internodes of the stem have reached their maximum development. About two days before the male spikelets begin to release pollen, the internodes at the top of the stem give one last stretch, and the tufts finally emerge from between the upper leaves, propelled by this push from the upper end of the stem.

The male flowers that crown the plant produce millions of pollen grains. Pollen release generally begins shortly after the male flowers have been propelled from the leaf whorl by the elongation of the last upper internodes of the stem. Pollen grains produced in the male inflorescence, carried by the wind, can fertilize several female spikes.

The results found in the present research are lower compared to the study by (Obando, 2019, p.12), who reported that the average male flowering was 65 days.

While, (Guacho, 2014, p.10), in the agro-morphological characterization of corn *(Zea mays* L.), recorded the number of days elapsed from sowing until 50% of the plants in each plot presented pollen release an average of 131.07 days.

***Female flowering days***

According to the analysis of table 1, it is recorded that *Zea mays* (CORN) INIAP 180 with the application of Crop Booster technology has female flowering at 85.89 days and 100.39 days without Crop Booster technology. Booster, as shown in illustration 6.

In this regard (Buritica, 2022, p. 25), he mentions that the days to female flowering are the days the corn plant needs after planting to produce the female flower. The female flower or corn cob receives pollen and fertilization occurs. From there, the grain growth process begins.

Generally 1-2 corn cobs are left per plant.

The main spike or female inflorescence develops on the apex of a lateral branch at approximately the height of the sixth node counting from top to bottom.

At low planting densities or in highly productive varieties, ears of corn can be produced that bear the ear and grain below the main ear. The female inflorescence corresponds to the spike; its axis is thick and cylindrical, called the "crown." The spikes, in turn, are covered by bracts or twisted leaves, commonly called "husks."

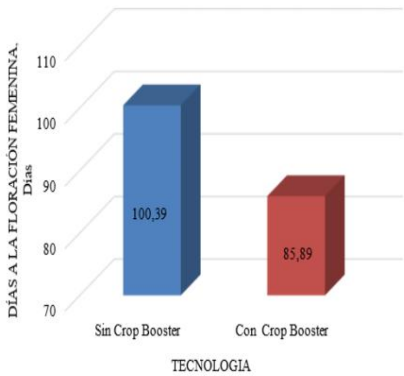


**Illustration 6:** Behavior of the days to female flowering of *Zea mays* (CORN) INIAP 180

Each corn plant produces between seven and eight ear sprouts, but generally only one, the apical one, becomes productive. Only in brighter conditions, such as those found at the edges of pastures or in low-density crops, can the plants produce a second productive ear.

According to the research carried out by (Obando, 2019, p.21), female flowering was 152.5 days. For his part, (Robledo, 2015, p.25), with respect to female flowering, it presented a number of days of (90 days), stating that this is positive because it maintained good precocity, which is an important factor for use in delayed sowing dates.

***Plant height, cm***

According to the analysis of table 1, it is recorded that *Zea mays* (CORN) INIAP 180 with the application of Crop Booster technology reported an average value of 305.04 cm in height and 220.08 cm without the application of Crop Booster technology, as shown in illustration 7.

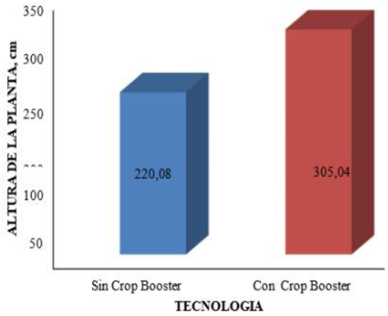


**Illustration 7:** Plant height behavior of *Zea mays* (CORN) INIAP 180

This is likely because Crop Booster technology optimizes both quantity and quality, helping plants grow stronger and healthier. It improves nutrient availability in the soil, increases root density, and balances plant absorption of macro- and micronutrients.

The above results are superior when compared with those of (Villón, 2019), who reported a value of 207.60 cm for plant height, while (Ramírez, 2017), when evaluating the height of the plant, reached an average of 112 cm, indicating that this could be due to the fact that the effect of the Crop Booster guarantees a better fixation of its nutrients, since when applied foliarly the plant absorbs the nutrients in the vegetable more quickly, thus favoring its development and growth through its nutrition.

***Number of ears per plant***

According to the analysis of Table 1, it is recorded that *Zea mays* (CORN) INIAP 180 with the application of Crop Booster technology reports 2 cobs per plant and 1 cob per plant without the application of Crop Booster technology, as shown in Illustration 8.

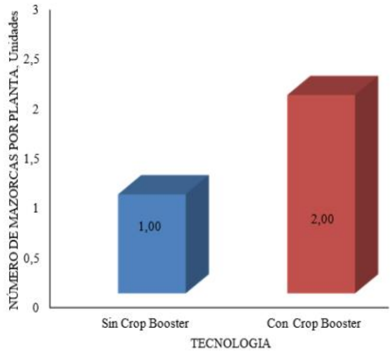


**Illustration 8:** Behavior of the number of ears per plant of *Zea mays* (CORN) INIAP 180

It should be noted that these plants produce one or two ears of corn per plant, where the quality of the ear will depend on various conditions, including temperature during pollination and water availability during growth, so it could be said that the use of Crop Booster technology favors corn production.

Crop yield is considered to depend on the plant's adaptation to the environment and the development it can achieve in the planted area. When plants are under stress due to the agroclimatic environment where they are established, this adaptability impacts productivity.

The results obtained are related to the study by (Gamboa, 2014, p.22) who found 2 cobs per plant, while (Guacapiña, 2018, p.28), in the evaluation and adaptation of corn *(Zea mays),* reported that the plants had 1 cob per plant.

***Number of plants with cob, units***

According to the analysis of table 1; it is recorded that *Zea mays* (CORN) INIAP 180 with the application Crop Booster technology reported 22.75 plants/cob and 14.25 plants/cob without the use of Crop Booster technology, as shown shown in illustration 9.

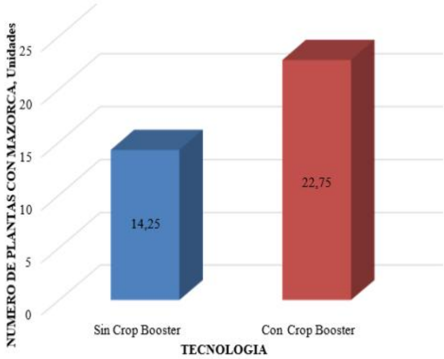


**Illustration 9:** Behavior of the number of plants with cobs of *Zea mays* (CORN) INIAP 180

Therefore, it can be stated that the application of Crop Booster technology favors the development of plants in greater proportion, offering a balanced diet for the plants, which is reflected in an increase in production, since it allows the biochemical processes to be carried out correctly, which directly impacts the development of the plant and its productive performance. According to the research of (Obando, 2019, p.32), it was recorded that the total number of plants with cobs was 10.9 (Badillo, 2016, p.20) when evaluating the crop performance of *Zea mays* (CORN) INIAP 180, the highest number of plants with cobs was 14.38.

### *Number of plants without cob, units*

According to the analysis of table 1; it is recorded that *Zea mays* (CORN) INIAP 180 with the application of Crop Booster technology reported 1 plant without cob and 1.63 plants without cob use of Crop Booster technology, as shown shown in illustration 10.

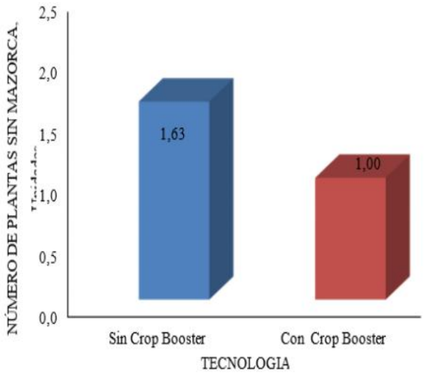


**Illustration 10:** Behavior of the number of plants without cobs of Zea mays (CORN) INIAP 180

The results obtained in the present investigation are superior to those observed in the study carried out by (Guzmán, 2020, p. 32), who in the evaluation of the development and yield of the corn crop *(Zea mays L.)* when determining the number of plants without cobs, considers that the lowest production in the trial was 13.63 plants without cobs.

In the same way (Guacapiña, 2018, p.22), he found higher values than those obtained in the present study, since 12.15 plants did not present an ear, pointing out that this may be related to disease outbreaks which depend on the conjunction of various factors such as the presence of a pathogen, crop management and the environment, in severe cases the plants may not produce an ear, or, when there are, its diameter is considerably reduced, or its grain formation is deficient.

### *Number of plants with two ears, units*

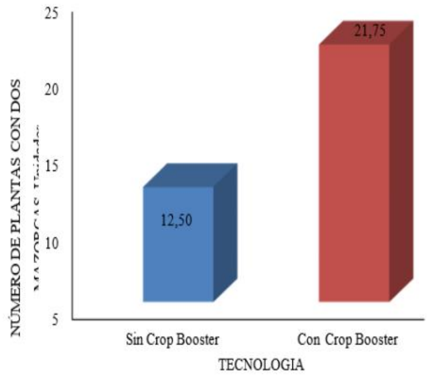


**Illustration 11:** Behavior of the number of plants with two ears of *Zea mays* (CORN) INIAP 180

According to the analysis of table 1, it is recorded that *Zea mays* (CORN) INIAP 180 with the application of Crop Booster technology reported 21.75 plants with 2 ears and 12.5 plants with two ears without. management with Crop Booster technology, as shown shown in illustration 11.

Indeed, the frequencies transmitted by Crop Booster match the natural molecular frequencies of both plants and soil, improving their functions, resulting in healthy plants with accelerated growth and greater production, therefore more profitable.

For (Silva, 2008, p.32), the variance of the number of plants with two ears of corn obtained as a result that 5.7 plants had two ears of corn, stating that this was due to the fact that the population density had inverse effects on the number of ears of corn per plant, since at a higher population density there is less interception of solar radiation per plant and the alteration that causes the decrease in the number of ears of corn per plant occurs.

***Green fodder production Kg/ m2***

According to the analysis of Table 1, it is recorded that *Zea mays* (CORN) INIAP 180 with the application of Crop Booster technology reported 8.9 kg/m2 of green forage production and 5.79 kg/m2 without the use of Crop Booster technology, as shown in Illustration 12.

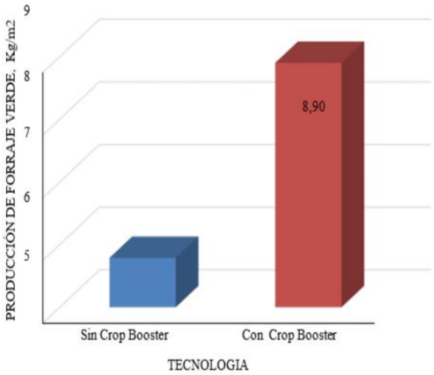


**Illustration 12:** Behavior of green matter forage production of *Zea* mays (CORN) INIAP.

This is likely because Crop Booster technology is beneficial for both the soil and the plant, as it produces growth activators that plants can absorb and that promote plant nutrition and resilience, increasing forage production rates.

(Guacapiña, 2018, p.35), for the Green Matter yield variable (Kg/ m2 ), establishes the best responses with 9.52 Kg/m2 , pointing out that the green forage yield can be significantly increased with increases in population density above the traditional density used for forage production, but the competition between plants was mainly reflected in the reduction of the size of the corn cob as the number of plants per m2 increases.

.

While (Masaquiza, 2016, p.32), in the evaluation of corn (Zea mays) yield, he found an average value of 8.95 kg/m2 .

***Forage production in dry matter***

According to the analysis in Table 1, Zea mays (MAIZE) INIAP 180 with the application of Crop Booster technology recorded 24.38 T/ha of dry matter production and 24.03 T/ha without the use of Crop Booster technology, as shown in Figure 13.

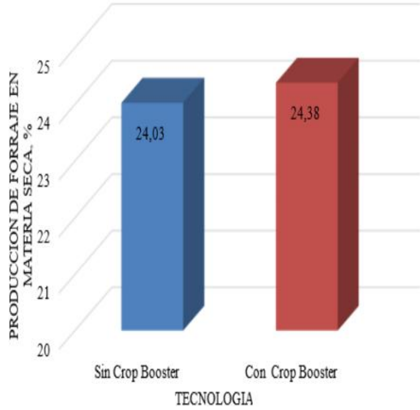


**Illustration 13:** Behavior of forage production in dry matter of *Zea mays* (CORN) INIAP 180.

This demonstrates once again that using Crop Booster technology improves nutrient mobility, allowing plants to absorb nutrients more easily and thus generate better yields.

The high yields of aboveground biomass in corn are linked to the genetic characteristics of the ecotype, as well as environmental conditions, planting date, and crop agronomic management.

The ecotypes showed a high positive correlation between plant height and dry and green forage yield. The genetic potential for green and dry forage yield in maize is attributed to the high genotypic correlation with plant height, considering that greater plant heights increase the stem-to-leaf ratio, and simultaneously, dry and green matter production increases.

According to the research carried out by (Velazquéz, 2022, p.33), the dry matter yield obtained from each of the treatments, with the aim of knowing the production generated with the Crop Booster device, obtained an average of 19.17 kg/MS.

For his part (Guacapiña, 2018, p.38), in the analysis of variance for the variable Dry Matter Forage Yield of INIAP 180 corn variety, he reported that the general average was 16.68Kg/MS.

**Bromatological analysis of corn *(Zea mays)* INIAP 180.**

**Table 2:** Evaluation of the bromatological quality of INIAP 180 corn.

| STATISTICAS DESCRIPTIVAS | Percentage of Humedad | | Percentage of Proteína Raw | | Percent cut of Fat | | Percent cut of Fiber | | Percent cut of Ash | | Percent Extract to Free Of Nitrogeno | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Without Crop Booster | Con Crop Booster | Without Crop Booster | Con Crop Booster | Without Crop Booster | Con Crop Booster | Without Crop Booster | Con Crop Booster | Without Crop Booster | Con Crop Booster | Without Crop Booster | Con Crop Booster |
| Average | 76.35 | 75.62 | 6.80 | 8.54 | 1.57 | 1.73 | 3.79 | 4.19 | 10.51 | 8.96 | 0.98 | 1.05 |
| Mistake typical | 0.19 | 0.24 | 0.07 | 0.08 | 0.02 | 0.04 | 0.07 | 0.08 | 0.09 | 0.26 | 0.24 | 0.19 |
| Median | 76.39 | 75.65 | 6.80 | 8.50 | 1.56 | 1.74 | 3.77 | 4.09 | 10.49 | 9.25 | 0.98 | 1.00 |
| Fashion | 76.89 | #N/D | #N/D | #N/D | #N/D | #N/D | 3.77 | 4.08 | 10.49 | #N/D | #N/D | 1.00 |
| Deviation standard | 0.53 | 0.67 | 0.21 | 0.23 | 0.05 | 0.12 | 0.20 | 0.24 | 0.25 | 0.72 | 0.67 | 0.54 |
| Varianza to the sample | 0.28 | 0.46 | 0.04 | 0.06 | 0.00 | 0.01 | 0.04 | 0.06 | 0.06 | 0.52 | 0.45 | 0.29 |
| Range | 1.51 | 2.25 | 0.64 | 0.73 | 0.12 | 0.32 | 0.58 | 0.74 | 0.92 | 1.73 | 1.98 | 1.59 |
| Minimum | 75.38 | 74.58 | 6.48 | 8.21 | 1.51 | 1.59 | 3.55 | 3.83 | 10.08 | 8.08 | 0.23 | 0.45 |
| Maximum | 76.89 | 76.83 | 7.12 | 8.94 | 1.63 | 1.91 | 4.13 | 4.57 | 11.00 | 9.81 | 2.21 | 2.04 |
| P(T<=t) two queues | 0.02 ** | | 0.00 ** | | 0.014 * | | 0.01 ** | | 0.006 * | | 0.84 ns | |

***Humidity percentage, %***

According to the analysis, it is recorded that *Zea mays* (CORN) INIAP 180 with the application of Crop Booster technology presented a humidity percentage of 75.62%, and 76.35% without the use of Crop Booster technology, as shown in illustration 14.

This is corroborated by the observations of (Buritica, 2022, p. 38), who mentions that humidity is a vitally important factor for proper plant development, directly affecting yield, since without the necessary humidity for plants to grow, they will not grow properly. In general, water not only contributes to the meteorological and textural properties of a plant, but through its interactions with the different components, it determines the type of reactions that can occur in them.

With reference to the study carried out by (Pérez, 2022, p.42), the total moisture content of the forage mixture when using the Crop Booster device the following result was obtained 70.03% while with normal irrigation 72.85%. When irrigating with the Crop Booster device in the pastures, growth and development is accelerated, which is why there is less humidity and the consumption time is accelerated, unlike the grass that was with normal irrigation there is more humidity because the grass is more tender and development is slow.

Likewise, the results reported in the study by (Castaño, 2020, p.36) recorded that the total moisture content of the forage mixture was higher compared to the present investigation since the corn forage showed a moisture content of 75.15% indicating that this may be due to climatic factors and harvest age.

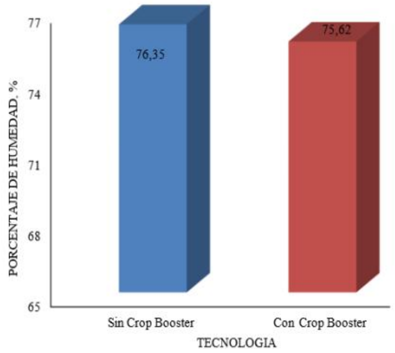


**Illustration 14:** Humidity percentage behavior of *Zea mays* (CORN) INIAP 180

**Crude protein percentage, %**

According to the analysis it is recorded that *Zea mays* (CORN) INIAP 180 with the application of Crop Booster technology reported a crude protein percentage of 8.545%, and 6.8% without Crop Booster technology, as shown in illustration 15.

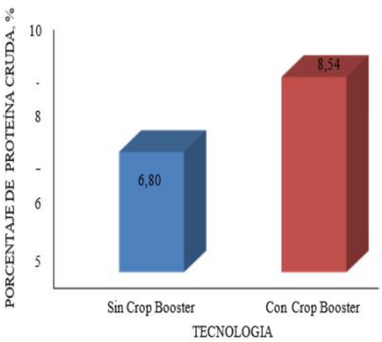


**Illustration 15:** Humidity percentage behavior of *Zea mays* (CORN) INIAP 180

According to (Pérez, 2022, p.38) when evaluating the protein content of the forage mixture when using the Crop Booster device it was 8.70% and with normal irrigation it was 8.93%, it may indicate that the quality of the forage mixture improved when using the technology in irrigation because the low frequency waves it emits help to have better metabolism and absorption.

**Fat percentage, %**

According to the analysis, it is recorded that Zea mays (CORN) INIAP 180 with the application of Crop Booster technology reported a fat percentage of 1.73%, and 1.57% without the use of Crop Booster technology, as shown in illustration 16.

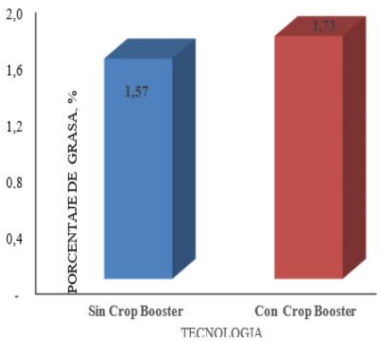


**Illustration 16:** Fat percentage behavior of *Zea mays* (CORN) INIAP 180.

These results are superior when compared to those of (Pérez, 2022, p.39), who when evaluating the fat content of the forage mixture using the Crop Booster device was 1.18% and with normal irrigation it was 0.93%, having a higher percentage of fat in the grass and higher production.

**Fiber percentage %**

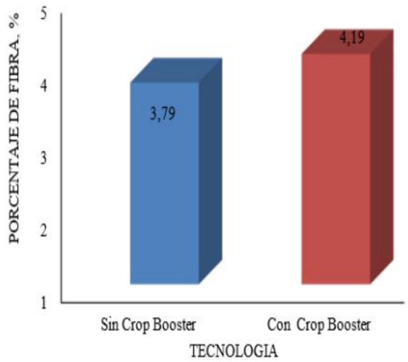


**Illustration 3:** Fiber percentage behavior from *Zea mays* (CORN) INIAP 180

According to the analysis, it is recorded that Zea mays (CORN) INIAP 180 with the application of Crop Booster technology registered a fiber percentage of 4.19 %, and 3.79% without the use of Crop Booster technology, as shown in illustration 17.

In this regard (Pérez, 2022, p.45), when evaluating the crude fiber content in the forage mixture when using the Crop Booster device it was 3.5% and with normal irrigation it was 2.7% (Expressed on a dry basis). There is more crude fiber in the grass where the Crop Booster device was installed, this is because The cutting and development time was accelerated, unlike normal irrigation where the time is slow.

**Ash percentage %**

According to the analysis it is recorded that *Zea mays* (CORN) INIAP 180 with the application of Crop Booster technology reported an ash percentage of 8.96 %, and 10.51% without the use of Crop Booster technology, as shown in illustration 18.

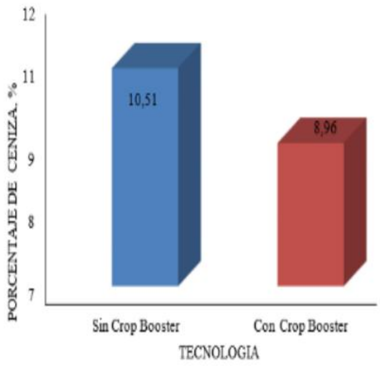


**Illustration 18:** Ash percentage behavior of *Zea mays* (CORN) INIAP 180

In relation to the study by (Pérez, 2022, p.58), the ash content in the forage mixture when using the Crop Booster device was 1.3% and with normal irrigation it was 1.5%, while Usca (2015, p.46) showed that plants that grow in different soils try to keep their elements in

a certain proportion, which mainly affects its chemical composition.

**Percentage of nitrogen-free extract %**

According to the analysis, *Zea mays* (CORN) INIAP 180 with the application of Crop Booster technology reported a nitrogen-free extract percentage of 1.05%, and 0.98% without the use of Crop Booster technology, as shown in Figure 19.

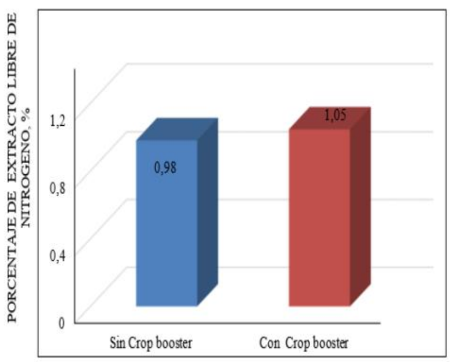


**Illustration 19:** Behavior of the percentage of nitrogen-free extract of *Zea mays* (CORN)
INIAP 180

While (Pérez, 2022, p.28), when evaluating the content of non-nitrogenous free extract of the forage mixture when using the Crop Booster device it was 0.95% and with normal irrigation 0.41%, because it is a substance that helps heat and movement energy such as sugar, glucose, starch, said component is used in ruminant feeding.

**Economic evaluation through the indicator Benefit/Cost**

Through economic analysis using the benefit/cost indicator, taking into consideration the expenses incurred and the sale of forage production as income, the highest profitability was established when Crop technology was applied.

Booster, with which a benefit/cost of 1.49 was obtained, which represents that for each USD dollar invested, a profitability of 49 cents USD (49%) is expected to be obtained, as indicated in table 2,

Below are the results obtained in the plots of the control group since the profitability obtained was only 28% or a B/C of 1.28 so it is considered that better productive and economic indices are achieved by using Crop Booster technology for corn forage, since fertilization costs are reduced, being very profitable and economically sustainable, since Crop Booster technology helps plants grow stronger, healthier and faster, with less fertilizers and pesticides, which means higher profitability.

**IV. CONCLUSIONS**

The application of Crop Booster technology increases the yield of *Zea mays* (CORN) INIAP 180 forage by improving soil quality and thus nutrient absorption.

When evaluating the forage quality of *Zea mays* (CORN) INIAP 180, the best results are observed when applying the Crop Booster technology since the best results are reported for germination time (11 days), plant height (305.04 cm) and number of plants with cobs (22.75).

When evaluating the forage quality of corn, it is seen that the most satisfactory results were achieved by using Crop Booster technology since the

Green forage production was 8.9 kg/m2 and dry matter production was 24.38%.

In turn, when evaluating the bromatological characteristics of corn forage, better results were obtained when using the Crop Booster device for the protein content (8.54%), fat (1.73%), fiber (4.19%) and nitrogen-free extract (1.05%).

Through the cost-benefit indicator, it was established that by applying Crop Booster technology, the highest profitability of 1.49 is obtained, which represents that for every USD dollar invested, a profitability of 49 USD cents (49%) is expected.

## V. RECOMMENDATIONS

Use Crop Booster technology, as it optimizes both the quantity and quality of yields, improving soil health and nutrient availability, increasing root density, and balancing plant nutrient uptake and utilization. Apply Crop Booster technology to the irrigation system, as it improves the nutritional quality of forage, resulting in greater forage production and greater economic benefits.

**Bibliographic references**


1. **BURITICA, Alejandra.** *What is technology? Crop Booster and what are its benefits in the agriculture?* [blog]. [Consultation: 2022-10-05]. Available at: https://blog.croper.com/what-is-crop-booster-technology-and-what-are-its-benefits-in-laagricultura/#:~:text=Alejandra%20Buritic%C3%A1&text=Help%20the%20plants%20a, the development of the plant.

2. **CAVIEDES, Mario.** *"INIAP-180" New high-yield corn variety.* Quito-Ecuador: INIAP, 2019.

3. **DURAN, Jose & BALDUQUE, Rafael.** *Corn pests.* Zaragoza: Ministry of Agriculture, Fisheries and Food, 2016.

4. **GALARZA, Mario.** INIAP variety corn 180. [Online] INIAP, 2022. Available at: http://repositorio.iniap.gob.ec/handle/41000/2546.

5. **GALEGO, Ocampo.** New technologies for optimize and speed up corn planting Forage crop. [Online] Available at: https://www.campogalego.es/nuevas-tecnologias-para-optimizar-y-agilizar-la-siembra-del-maiz- forrajero/.

6. **CASTAÑO, Erika.** Response to the nutritional efficiency of corn "illusion" CPR" in three cuts for silage in the Río Verde commune, Santa Elena. Santa Elena Peninsula State University, La Libertad. [Online](Thesis) Santa Elena Peninsula State University. 2020. [Accessed: 2022-07-12]. Available at: https://repositorio.upse.edu.ec/xmlui/handle/46000/5393

7. **GAMBOA, Mauritius.** *"Effect on maize (Zea mays L.) cultivation under conservation agriculture in central Chiapas Year Zero".* Tuxtla Gutierrez - Mexico: Tuxtla Technological Institute Gutierrez, 2014.

8. **GUACAPIÑA, Antonio.** *Nutritional value from corn silage (Zea mays) variety iniap 180, under different planting densities and fertilization levels.* [Online] 2018. Available in: http://repositorio.espe.edu.ec/xmlui/bitstream/handle/21000/14668/T-ESPE-057915.pdf?sequence=1&isAllowed=y.

9. **GUACHO, Edison.** *"Agro-morphological characterization of Zea mays L.) corn from the San José de Chazo locality."* Riobamba - Ecuador: Chimborazo Polytechnic School, 2014.

10. **GUZMÁN, Rocío.** Evaluation of the development and yield of corn *(Zea mays* L.) using four hybrids. [Online] 2020. Available in: https://www.redalyc.org/journal/6538/653869547005/html/.

11. **MARTINEZ, Lucas & CARCAÑO, Moisés.** Biofertilization and chemical fertilization in corn *(Zea mays* l.) in Villaflores, Chiapas, Mexico. [Online] 2022. Available in: https://revistadigital.uce.edu.ec/index.php/SIEMBRA/article/view/1425/3549.

12. **MASAQUIZA, Juan.** *Assessment of the corn (Zea mays) yield in relationship with between the application of biodegradables in the island sector, canton Cumandá.* [Online] 2016. Available at: https://repositorio.uta.edu.ec/bitstream/123456789/24084/1/thesis%20005%20Engineer%C3%AD a%20Agricultural%20-%20Juan%20carlos%20Masaqquisa%20-%20cd%20005.pdf.

13. **OBANDO, Erika.** *Characterization Morphological analysis of white floury corn (Zea mays L.) native to the province of Chimborazo.* Technical University of Ambato, Cevallos: 2019.

14. **PÁLIZ, Vicente & MENDOZA, Jorge.** *Corn pests (Zea mays).* Pichinlingue - Ecuador: Experimental Station Pichinlingue - INIAP, 2015.

15. **PÉREZ, Marcia.** *"Comparison of Pasture Management Using a Traditional Irrigation System versus Crop Booster Technology to Improve Forage Production at the Tunshi Experimental Station."* Chimborazo Polytechnic School, Riobamba, Ecuador: 2022.

16. **PEREZ, Yolanda.** *Effect of biofertilizer application on corn yield in plots with and without cover. vegetable.* [Online] INTIAGRO, 2023. Available in: https://nortonsafe.search.ask.com/web?omnisearch=yes&q=time+to+germination+of+mayz&annot=false&vendorConfigured=ask&o=APN12174&prt=SSS&ver=3.19.0.4&tpr=111&chn=store&guid=2c12d548-d0ad-451a-f173-e1df6a58bfc8&doi=2022-04-17#:~:text=https%3A//www.intag.

17. **ROBLEDO, Margarita.** Productivity of yellow-grain corn varietal hybrids for the high valleys of Mexico. [Online] 2015. Available in: https://www.redalyc.org/journal/437/43758353007/html.

18. **SALGUERO, Daniel.** *Evaluation of three methods for determining the requirement water, of the corn crop (Zea mays. l.) var iniap 102, Riobamba canton, Chimborazo province".* Riobamba - Ecuador: School Upper Polytechnic of Chimborazo, 2018.

19. **SILVA, Wilmer.** *Evaluation of the morphological and agronomic characteristics of five corn lines. yellow at different planting dates.* [Online] 2008. Available at: https://dialnet.unirioja.es/descarga/articulo/3393591.pdf

20. **VELÁSQUEZ, María.** *Evaluation of the Crop Booster device in pepper (Capsicum annum) cultivation.* University State Technique of Quevedo, Ecuador: 2022.