Francisco de Paula
Santander University

Ocaña - Colombia

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PRODUCING CORN (ZEA MAYS) USING THE KYMINASI PLANT BOOSTER TECHNOLOGY AT THE FRANCISCO DE PAULA SANTANDER UNIVERSITY EXPERIMENTAL FARM

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Fundada el 18 de julio de 1974

INTRODUCTION

Over time, Colombian fields have been deteriorating due to extensive rains, prolonged droughts, and inadequate practices- causing low quality production of green forage for animals.

The constant technological developments in agriculture have been of high importance in recent years, with technologies such as the Kyminasi Plant Booster significantly improving the agricultural production of forage and all crops.

The Francisco de Paula Santander University (UFPSO) experimental farm decided to install and test the Kyminasi Plant Booster technology with the goal of improvement of corn crops (Zea Mays) for animal feed.

HISTORICAL FIELD ISSUES

Source: Francisco de Paula Santander University

Low crop yields due to soil deterioration

High production costs

OBJECTIVES

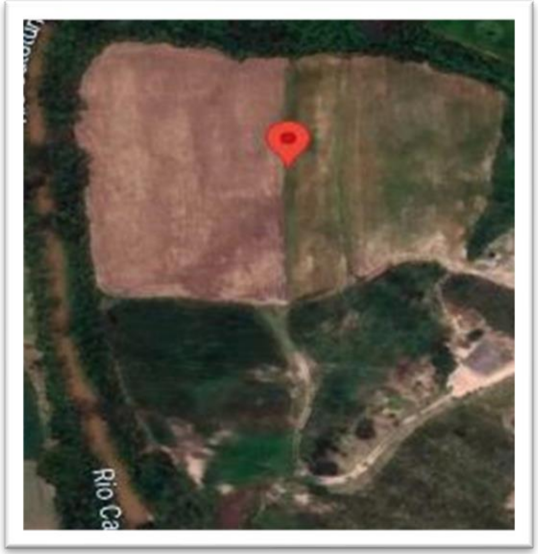
Grow corn/ maize (Zea Mays) using the Kyminasi Plant Booster technology on the UFPSO experimental farm

Install the Kyminasi Plant Booster technology on the UFPSO experimental farm as an improvement strategy for corn crops (Zea Mays) in animal feed

Develop procedures for the use of the Kyminasi Plant Booster technology in corn crops (Zea Mays)

Determine the effects of the use of the Kyminasi Plant Booster technology in forage corn (Zea Mays)

STUDY DESCRIPTION



Source: https://www.google.com.co/maps

Field & Growing Analysis → Yield Analysis → Treatment Comparison

Period: September 1 to December 15, 2021.

Location: the experimental farm of the Francisco de Paula Santander Ocaña University, Colombia.

OBJECTIVES

FIRST OBJECTIVE: INSTALL THE KYMINASI PLANT BOOSTER TECHNOLOGY ON THE UFPSO EXPERIMENTAL FARM AS AN IMPROVEMENT STRATEGY FOR CORN CROPS (ZEA MAYS) IN ANIMAL FEED

- Kyminasi Plant Booster Device

Source: Francisco de Paula Santander University

OBJECTIVES

Evaluate soil characteristics prior to planting corn (Zea mays) and after harvesting the crop.

- Analyzed by the Colombian Agricultural Research Corporation (AGROSAVIA)
- Comparison between initial and final results

PROTOCOL

❖ Soil health analysis

Soil sample from the two fields

Source: Francisco de Paula Santander University

Note: No fertilizer or pesticides were used on the control or KPCB field.

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RESULTS

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		FIELDS BEGINNING		FINAL KPCB CROP BOOSTER		ANALIYIS COMPARISON
Analytical Determination	**Unit**	**Value**	**Interpretation**	**Value**	**Interpretation**	
pH	pH Units	6.26	Slightly acidic	6.62	Nearly neutral or neutral	pH Stabilization
Electrical Conductivity (EC)	dS/m	0.30	Not saline	0.16	Not saline	Decrease of (EC)
Organic Matter (OM)	g/100g	1.41	Low	1.28	Low	Decrease of (OM)
Organic Carbon (OC)	g/100g	0.82		0.74		Decrease of (OC)
Phosphorus (P) Available (Bray II)	mg/kg	27.52	Medium	34.48	Medium	Increase of (P)
Sulfur (S) available	mg/kg	11.39	Medium	8.28	Low	Decrease of (S)
Capacity Interc Cationic Effect (CICE)	cmol(+)/kg	10.30	Medium	9.23	Low	Decrease of (CICE)
Boron (B) Available	mg/kg	0.63	High	0.14	Low	Decrease of (B)
Acidity (Al+H)	cmol(+)/kg	ND	Not shown	ND	Not shown	
Interchangeable Aluminum (Al)	cmol(+)/kg	ND	Without restrictions	ND	Without restrictions	
Calcium (Ca) available	cmol(+)/kg	7.89	High	7.36	High	Decrease of (Ca)
Magnesium (Mg) Available	cmol(+)/kg	2.15	Medium	1.64	Medium	Decrease of (Mg)
Potasium (K) Available	cmol(+)/kg	0.14	Low	0.12	Low	Decrease of (K)
Sodium (Na) Available	cmol(+)/kg	<0.14	Normal	<0.14	Normal	Decrease of (Na)
Olsen Iron (Fe) Available	mg/kg	96.16	High	51.72	High	Decrease of (Fe)
Olsen Copper (Cu) Available	mg/kg	4.38	High	2.77	Medium	Decrease of (Cu)
Olsen Manganese (Mn) Available	mg/kg	5.62	Medium	5.41	Medium	Decrease of (Mn)
Olsen Zinc (Zn) Available	mg/kg	3.65	High	3.52	High	Decrease of (Zn)
Calcium saturation	%	77	High	80	High	Increased calcium saturation
Magnesium saturation	%	21	Medium	18	Medium	Decreased magnesium saturation
Potassium saturation	%	1	Low	1	Low	Low amount of potassium in both fields
Sodium saturation	%	1	Normal	1	Normal	Normality of sodium saturation
Aluminum Saturation	%	0	Normal	0	Normal	Normality of Aluminum saturation

Soil analysis at the beginning and the end of using the KPCB Crop Booster

Analysis indicates pH stabilization & increase in Phosphorous

Fundada el 18 de julio de 1974

Source: *(AGROSAVIA, 2022)*

RESULTS

		SOWING BEGINNING		END OF HARVEST CONTROL FIELD		COMPARISON ANALYSIS FIELDS
Analytical Determination	**Unit**	**Value**	**Interpretation**	**Value**	**Interpretation**	
pH	pH Units	6.26	Slightly Acidic	6.12	Slightly Acidic	Increased Soil Acidity
Electrical Conductivity (EC)	dS/m	0.30	Not saline	0.20	Not saline	Decrease of (EC)
Organic Matter (OM)	g/100g	1.41	Low	1.05	Low	Decrease of (OM)
Organic Carbon (OC)	g/100g	0.82		0.59		Decrease of (OC)
Phosphorus (P) Available (Bray II)	mg/kg	27.52	Medium	25.10	Medium	Decrease of (P)
Sulfur (S) available	mg/kg	11.39	Medium	7.15	Low	Decrease of (S) available
Capacity Interc Cationic Effect (CICE)	cmol(+)/kg	10.30	Medium	9.10	Low	Decrease of (CICE)
Boron (B) Available	mg/kg	0.63	High	0.10	Low	Decrease of (B) available
Acidity (Al+H)	cmol(+)/kg	ND	Not shown	ND	Not shown	
Interchangeable Aluminum (Al)	cmol(+)/kg	ND	Without restrictions	ND	Without restrictions	
Calcium (Ca) available	cmol(+)/kg	7.89	High	7.20	High	Decrease of (Ca) available
Magnesium (Mg) Available	cmol(+)/kg	2.15	Medium	1.50	Medium	Decrease of (Mg) available
Potasium (K) Available	cmol(+)/kg	0.14	Low	0.02	Low	Decrease of (K) available
Sodium (Na) Available	cmol(+)/kg	<0.14	Normal	<0.14	Normal	Decrease of (Na) available
Olsen Iron (Fe) Available	mg/kg	96.16	High	51.39	High	Decrease of (Fe) available
Olsen Copper (Cu) Available	mg/kg	4.38	High	2.44	Medium	Decrease of (Cu) available
Olsen Manganese (Mn) Available	mg/kg	5.62	Medium	5.30	Medium	Decrease of (Mn) available
Olsen Zinc (Zn) Available	mg/kg	3.65	HIgh	3.40	High	Decrease of (Zn) available
Calcium saturation	%	77	High	85	High	Increased Calcium Saturation
Magnesium saturation	%	21	Medium	22	Medium	Increased Magnesium Saturation
Potassium saturation	%	1	Low	1	Low	Normality in potassium saturation
Sodium saturation	%	1	Normal	1	Normal	Normality in sodium saturation
Aluminum Saturation	%	0	Normal	0	Normal	Normality in aluminum saturation

Soil analysis at the beginning and the end of using the KPCB Crop Booster

Minimal decrease in soil nutrients

Source: *(AGROSAVIA, 2022)*

PROTOCOL

❖ Mechanized Planting

Source: Francisco de Paula Santander University

- Crop Booster Field:
  60 pounds of corn seed
- Control Field:
  50 pounds of corn seed

OBJECTIVES

SECOND OBJECTIVE: DEVELOP PROCEDURES FOR THE USE OF KPCB TECHNOLOGY IN CORN CROPS (ZEA MAYS)

Determine the local benefits of the KPCB technology on corn from planting to harvest.

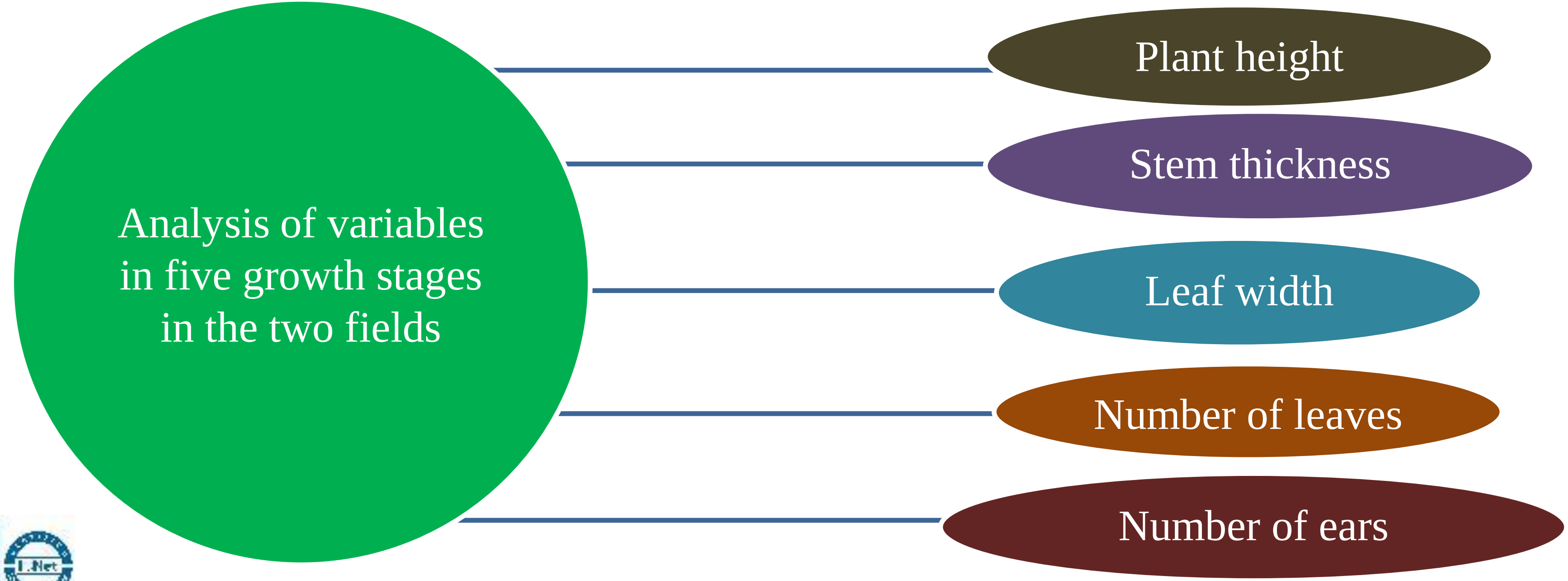
Record growth at each stage

Source: Francisco de Paula Santander University

Source: Francisco de Paula Santander University

OBJECTIVES

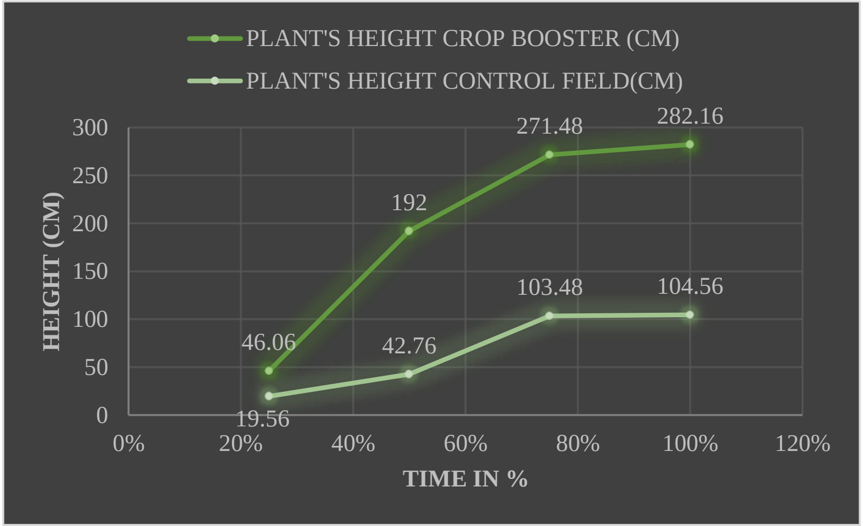
EVALUATION OF CORN (ZEA MAYS) PLANT GROWTH MEASUREMENTS AND VIGOR WITH AND WITHOUT KPCB USE



RESULTS

Plant Height

- Cultivation Stages



Note: Plant height with respect to time.

Source: Francisco de Paula Santander University

RESULTS

PLANT HEIGHT COMPARISON

%	KPCB Crop Booster	Control Field
25	46.06 ± 10.89 [a]	19.56 ± 4.20 [a]
50	192.00 ± 12.18 [b]	42.76 ± 13.97 [b]
75	271.48 ± 6.19 [c]	103.48 ± 24.51 [c]
100	282.16 ± 3.44 [d]	104.56 ± 28.87 [c]
P - value	0.000	0.000

Source: Francisco de Paula Santander University

- Control Field
  75% and 100%

RESULTS

PLANT HEIGHT COMPARISON

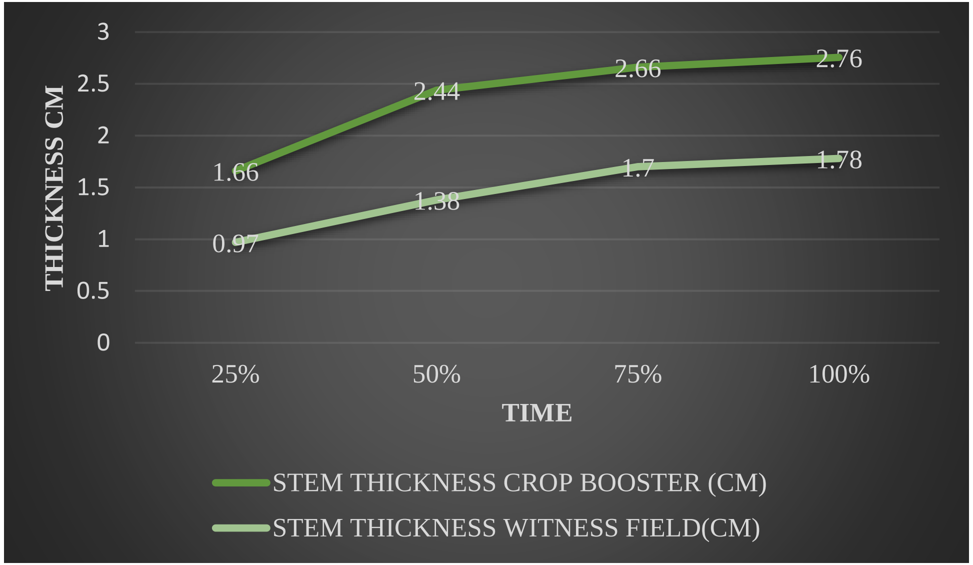
Treatment	25%	50%	75%	100%
KPCB Crop Booster	46.06 ± 10.89	192.00 ± 12.18	271.48 ± 6.19	282.16 ± 3.44
Control Field	19.56 ± 4.20	42.76 ± 13.97	103.48 ± 29.51	104.56 ± 28.87
P - value	0.000	0.000	0.000	0.000

Source: Francisco de Paula Santander University

RESULTS

Plant Stem Diameter

- Cultivation stages



Note: Stem thickness between the two study fields

Source: Francisco de Paula Santander University

RESULTS

PLANT STEM DIAMETER COMPARISON

- KPCB Crop Booster
  50%, 75% and 100%
- Control Field
  75% and 100%

%	KPCB Crop Booster	Control Field
25	1.66 ± 0.43[a]	0.97 ± 0.37[a]
50	2.44 ± 0.36[b]	1.38 ± 0.31[b]
75	2.66 ± 0.45[b]	1.70 ± 0.34[c]
100	2.76 ± 0.44[b]	1.78 ± 0.33[c]
P - value	0.000	0.000

Source: Francisco de Paula Santander University

RESULTS

PLANT STEM DIAMETER COMPARISON

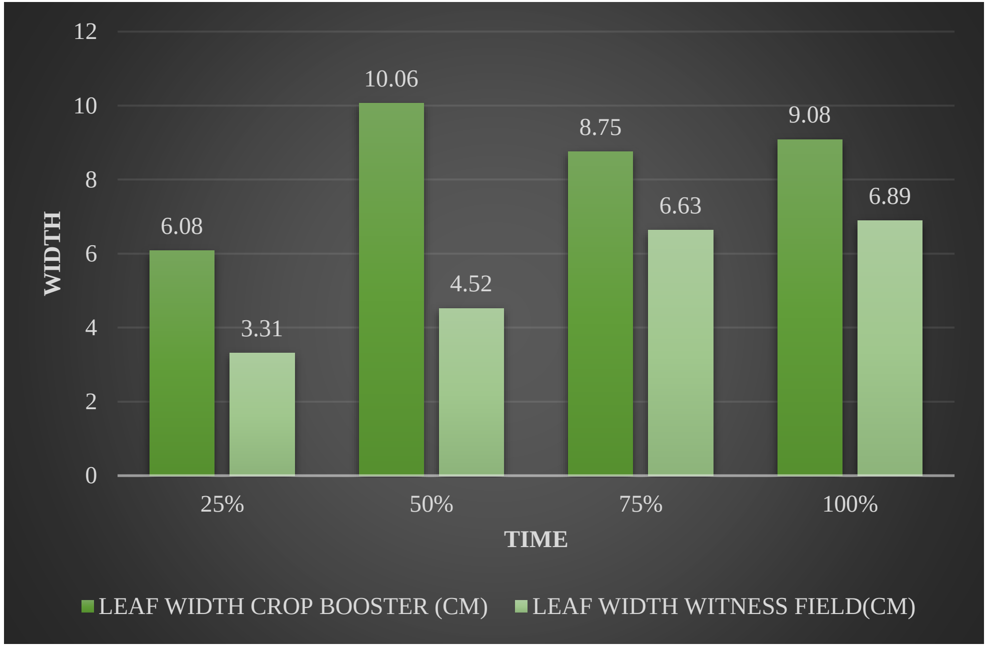
Treatment	25%	50%	75%	100%
KPCB Crop Booster	1.66 ± 0.43	2.44 ± 0.36	2.66 ± 0.45	2.76 ± 0.44
Control Field	0.97 ± 0.37	1.38 ± 0.31	1.70 ± 0.34	1.78 ± 0.33
P - Value	0.000	0.000	0.000	0.000

Source: Francisco de Paula Santander University

RESULTS

Leaf Width

- Cultivation stages



Source: Francisco de Paula Santander University

RESULTS

LEAF WIDTH COMPARISON

- KPCB Crop Booster 75% and 100%
- Control Field 75% and 100%

%	KPCB Crop Booster	Control Field
25	6.08 ± 1.27[a]	3.31 ± 0.74[a]
50	10.06 ± 3.00[b]	4.52 ± 1.27[b]
75	8.75 ± 0.70[c]	6.63 ± 0.96[c]
100	9.08 ± 0.70[c]	6.89 ± 1.02[c]
P - value	0.000	0.000

Source: Francisco de Paula Santander University

RESULTS

LEAF WIDTH COMPARISON

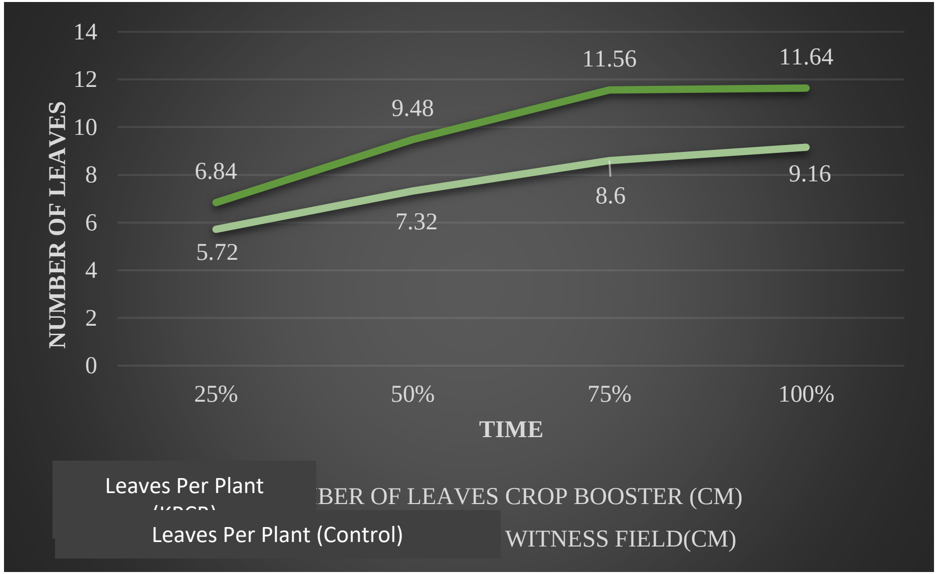
Treatment	25%	50%	75%	100%
KPCB Crop Booster	6.08 ± 1.27	10.1 ± 3.0	8.75 ± 0.69	9.1 ± 0.70
Control Field	3.31 ± 0.74	4.52 ± 1.3	6.63 ± 0.96	6.9 ± 1.01
P - value	0.000	0.000	0.000	0.000

Source: Francisco de Paula Santander University

RESULTS

Leaves Per Plant Comparison

- Cultivation stage %



Source: Francisco de Paula Santander University

RESULTS

LEAVES PER PLANT COMPARISON

- KPCB Field
  75% and 100%
- Control Field
  75% and 100%

%	KPCB Crop Booster	Control Field
25	6.84 ± 0.85[a]	5.72 ± 0.84[a]
50	9.48 ± 1.58[b]	7.32 ± 1.44[b]
75	11.56 ± 0.96[c]	8.06 ± 1.38[c]
100	11.64 ± 1.08[c]	9.16 ± 1.55[c]
P - value	0.000	0.000

Source: Francisco de Paula Santander University

RESULTS

LEAVES PER PLANT COMPARISON

Treatment	25%	50%	75%	100%
KPCB Crop Booster	6.84 ± 0.85	9.48 ± 1.58	11.56 ± 0.96	11.64 ± 1.08
Control Field	5.72 ± 0.84	7.32 ± 1.44	8.06 ± 1.38	9.16 ± 1.55
P – value	0.000	0.000	0.000	0.000

Source: Francisco de Paula Santander University

RESULTS

AVERAGE CORN EAR WEIGHT PER PLANT COMPARISON

KPCB Crop (Top)

Control Crop (Bottom)

815 % Increase in Average Corn Ear Weight Per Plant With KPCB

- KPCB Field: 485 grams per ear
- Control Field: 53 grams per ear

Source: Francisco de Paula Santander University

RESULTS

QUANTITY OF CORN EARS PER PLANT COMPARISON

KPCB Crop (Top)

Control Crop (Bottom)

100 % Increase in Quantity of Corn Ears Per Plant With KPCB

- KPCB Field: 2 ears per plant
- Control Field: 1 ear per plant

Source: Francisco de Paula Santander University

RESULTS

Comparison of the spread of pests and weeds in corn crops with and without the use of KPCB

- Armyworm (*Spodoptera frugiperda*)

Source: Francisco de Paula Santander University

Appearance of pests (Spodoptera frugiperda) in the fields.	
Treatments	**Plants affected by damage**
Crop Booster	1 plant out of 10 plants
Control Field	4 plants out of 10 plants

Source: Francisco de Paula Santander University

Note: No pesticides were used on the control or KPCB field.

RESULTS

Comparison of the spread of pests and weeds in corn crops with and without the use of KPCB

- Paraquat: 2.5 liters per field was applied to control weeds on both fields.

Source: Francisco de Paula Santander University

RESULTS

THIRD OBJECTIVE: DETERMINE THE EFFECT OF THE USE OF THE KPCB TECHNOLOGY IN THE PRODUCTION OF FORAGE CORN (ZEA MAYS)

Analysis of information obtained (harvest data)

Quality standards according to USDA

Category	PB (%MS)	FAD (%MS)	FND (%MS)	RFV
Supreme	>22	<27	<34	>180
Premium	20-22	27-29	34-36	150-180
Good	18-20	29-32	36-40	125-150
Normal	16-18	32-35	40-44	100-125
Current	<16	>35	>44	>100

Source: Estándares de calidad *según el USDA Livestock, Hay & Grain Market News (Putnamy Undersander, 2006).*

RESULTS

USDA Quality Grades

USDA Quality Grades earned in the fields studied

Field	Category	PB (%MS)	FAD (%MS)	FND (%MS)	RFV
KPCB Crop Booster	Current	8.7 (<22)	35.1 (>35)	45.69(>44)	125 (>100)
Control Field	Current	6.04 (<22)	38.3 (>35)	47.6 (>44)	115 (>100)

Source: Francisco de Paula Santander University

RESULTS

Crop Yield In Linear Meters In Each Field

- 1 lineal meter
- 5 points in each field

Crop Booster		Control Field	
# Sample	**Kg**	**# Sample**	**Kg**
1	7.44	1	1.55
2	7.36	2	1.2
3	8.8	3	1.8
4	7.22	4	1.6
5	7.15	5	1.73
Average	7.59	**Average**	1.58

Source: Francisco de Paula Santander University

Source: Francisco de Paula Santander University

Source: Francisco de Paula Santander University

RESULTS

CORN & FORAGE PRODUCTION IN BOTH FIELDS

Note: This measurement includes both the corn ears and the corn forage (leaves & stems)

Capacity= 1m lineal → Kg mts lineal
Meters row → X

X = Amount Fv x row

1 groove → Amount Fv x row
Number of crop rows → X

X = PDN FV crop

Crop Booster	Control Field
79,664 Kg	11,672 Kg

Source: Francisco de Paula Santander University

Source: Francisco de Paula Santander University

Source: Francisco de Paula Santander University

RESULTS

EFFICIENCY OF WATER USE IN THE FIELDS

Source: Francisco de Paula Santander University

50% decreased water usage, improvement in water use efficiency, reduction of water use by 94,770 liters

Control field: Sprinkling 1 hour per furrow, use of 189,540 liters throughout the field

KPCB Crop Booster: Sprinkling 30 minutes per furrow, use of 94,770 liters throughout the field

RESULTS

BRIX RATING AND TITRATABLE ACIDITY (TA)

- Dissolved sugars
- Plant acidity

Source: Francisco de Paula Santander University

Brix Degrees in the Two Harvests		Titratable Acidity of the Two Fields	
KPCB Crop Booster	**Control Field**	**KPCB Crop Booster**	**Control Field**
11.60%	8.70%	2.51%	3.74%
11.40%	8.40%	2.48%	3.79%
11.70%	8.60%	2.47%	3.75%

Source: Francisco de Paula Santander University

RESULTS

RELATIONSHIP BETWEEN BRIX DEGREES AND TITRATABLE ACIDITY

- The comparison of this analysis indicates the maturity index

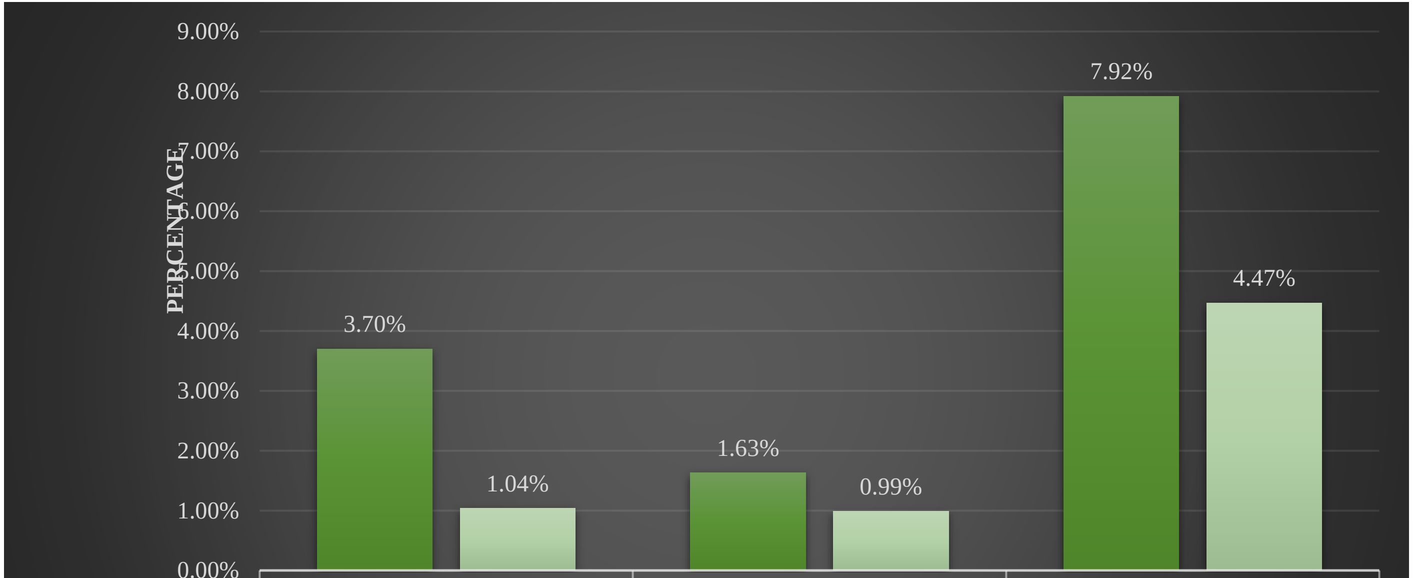
KPCB Crop Booster			
Samples	**Brix Degrees (%)**	**Titratable Acidity**	**Maturity Index**
1	11.60	2.51	4.62
2	11.40	2.48	4.6
3	11.70	2.52	4.64

Control Field			
Samples	**Brix Degrees (%)**	**Titratable Acidity**	**Maturity Index**
1	8.70	3.74	2.3
2	8.40	3.79	2.22
3	8.60	3.75	2.29

Source: Francisco de Paula Santander University

RESULTS

BROMATOLOGICAL ANALYSIS IN BOTH FIELDS



	PROTEIN	FAT	MINERALS
CROP BOOSTER	3.70%	1.63%	7.92%
WITNESS FIELD	1.04%	0.99%	4.47%

Source: Francisco de Paula Santander University

RESULTS

SHELF LIFE OR POST-HARVEST TIME

KPCB Crop Booster

Days	Temperature	pH	Smell	Palatability	Fungus Presence	Forage loss
1	31°C	5.1	FRESH	90%	NONE	0%
2	55°C	6.3	FRESH	80%	PRESENCE	20% INTERMEDIATE LAYER
3	67°C	7.2	FERMENTED	50%	PRESENCE	40%
4	91°C	7.9	ACID	20%		50%

Source: Francisco de Paula Santander University

RESULTS

SHELF LIFE OR POST-HARVEST TIME

Control Field

Days	Temperature	pH	Smell	Palatability	Fungus Presence	Forage loss
1	35°C	5.5	FRESH	80%	NONE	20%
2	60°C	6.7	FERMENTED	50%	PRESENCE	60%
3	80°C	7.8	ACID	30%	PRESENCE	80%
4	98°C	8.0	ACID	0%	PRESENCE	100%

Source: Francisco de Paula Santander University

FINAL DIAGNOSIS

In the second half of 2021, new professional practices were carried out by UFPSO in the area of forage crops for animal feed. UFPSO installed and tested the KPCB, which is a technology that is making farming more efficient and allowing for a greater amount of forage to be produced for animals, especially in times of drought or environmental issues.

Source: Francisco de Paula Santander University

CONCLUSION

815 % Increase in Average Corn Ear Weight Per Plant & 100% Increase in Quantity of Corn Ears Per Plant Without Fertilizers Using KPCB

Increased Combined Corn Ear And Forage Yields By 583% Or 67,992 Kg Even Without Fertilizers Using KPCB

Quality And Kernel Protein Improvement From 1.04% Protein Level On The Control Field To 3.70% Protein With The KPCB Technology

50% Decreased Water Usage, Reduction Of Water Use By 94,770 Liters, And Overall Improvement Of Water Use Efficiency With KPCB Technology

CONCLUSION

KPCB corn plants had better color, size, and health than the control corn. KPCB corn plants had more leaves overall and the leaves were bigger and wider than the control corn plants.

KPCB increased the nutrient density of the corn and forage by improving protein content by 2.65%, fat content by 0.64%, and mineral content by 3.45%.

Corn quality improved with KPCB use as there was an increase in Brix degrees by 3% and a decrease in Titratable Acidity by 1.25 pH.

CONCLUSION

KPCB improved the shelf-life duration and palatability of the corn and forage.

There was reduced pest damage and a lower incidence of armyworms observed even without any pesticides using KPCB. This is a 100% reduction in pesticide use with KPCB.

KPCB plants produced two ears of corn per plant and the control corn plants only produced one ear of corn per plant.

KPCB corn plants were an average of 282 centimeters (cm) in height and 2.76 cm in stem diameter. The control corn plants were an average of 105 cm in height and 1.78 cm in diameter.

RECOMENDATIONS

Explore new KPCB applications & investigations

Source: https://acortar.link/tWTJUt

Analyze maximum sprinkler irrigation times

Source: https://acortar.link/khVLcb

REFERENCES

Washington State University Extension. (2020). *Manejo de Pasturas y Problemas de Pastoreo.* washington.

AGROSAVIA. (2022). *REPORTE DE RESULTADOS LABORATORIO DE QUIMICA ANALITICA.* Norte de Santader, Ocaña. Retrieved on 02, 2022

ANTONIO I., R. A. (01, 2012). *EVALUACION DEL CULTIVO DE MAIZ (Zea Mays), COMO COMPLEMENTO A LA ALIMENTACION DE BOVINOS DE LECHE EN EPOCAS DE ESCASEZ DE ALIMENTO. CAYEMBE - ECUADOR.* Retrieved on 12/06/2021, from dspace.ups.edu.ec: https://dspace.ups.edu.ec/bitstream/123456789/1832/15/UPS-YT00102.pdf

Colegio de Ingenieros Agronomos de Chile. (2019). *NUEVAS TECNOLOGÍAS PARA EL AGRO; CROP BOOSTER.* Retrieved from https://colegioingenierosagronomoschile.cl/nuevas-tecnologias-para-el-agro-crop-booster/

González, E., Ceballos, J., & Benavides, O. (2015). Producción de forraje verde hidropónico de maiz Zea mays L. en invernadero con diferentes niveles de silicio. *scielo*.

Haley, O. (August, 2017). el papel de un producto foliar en el alivio de los efectos inducidos por herbicidas en el crecimiento y desarrollo en Zea Mays, Triticum aestivum y Glycine max. *proquest*.

Herrera Carvajal, L. C. (2021). Matriz DOFA.

INTAGRI. (2018). plantas C3, C4 y CAM. *articulos tecnicos de intagri*, 5. Retrieved on 01/06/2022, from https://www.intagri.com/public_files/125.-Plantas-C3-C4-y-CAM.pdf

Jaramillo A., M. A. (2012). *“Evaluación del rendimiento de tres Variedades de Maíz (Zea maíz), con dos distancias de siembra, en la Parroquia Zumba, Cantón Chinchipe, Provincia de Zamora Chinchipe”*. Retrieved on 12/06/2021, from dspace.unl.edu.ec: https://dspace.unl.edu.ec/jspui/bitstream/123456789/5488/1/Jaramillo%20Amari%20Manuel.pdf

REFERENCES

Jewsbury, G. (14 de 08 de 2016). *PLANTAS FORRAJERAS [Diapositiva de PowerPoint]*. Retrieved on 12/06/2021, from Cátedra Botánica Taxonómica: http://www.agro.unc.edu.ar/~wpweb/botaxo/wp-content/uploads/sites/14/2016/08/Forrajeras.-2016.pdf

khan academy. (2016). *Fotorrespiración: las plantas C3, C4 y CAM*. Retrieved from khanacademy: https://es.khanacademy.org/science/biology/photosynthesis-in-plants/photorespiration--c3-c4-cam-plants/a/c3-c4-and-cam-plants-agriculture

Nieto Sierra, D., Meneses Buitrago, D., Morales Montero, S., Hernandez Oviedo, F., & Castro Rincon, E. (2020). caracteristicas productivas de cultivos forrajeros en sistemas de produccion deleche, nariño, colombia. *scielo*.

organikolatam. (2019). *organikolatam*. Retrieved from https://organikolatam.com/tecnologia/: https://organikolatam.com/tecnologia/

organikolatam. (2021). *CROP BOOSTER, BIOFÍSICA APLICADA A LA AGRICULTURA*. Retrieved from organikolatam: https://organikolatam.com/2021/06/24/crop-booster-biofisica-aplicada-a-la-agricultura/

UFPSO. (2021). *UFPSO*. Retrieved from Granja Experimental UFPSO: https://ufpso.edu.co/granja

UFPSO. (2021). *Universidad Francisco de Paula Santander Ocaña - Colombia*. Retrieved from https://ufpso.edu.co/Mision-vision

UFPSO. (2021). *Universidad Francisco de Paula Santander Ocaña - Colombia OBJETIVOS INSTITUCIONALES DE LA UFPSO*. Retrieved from https://ufpso.edu.co/Objetivos: https://ufpso.edu.co/Objetivos

Washington University. (2021). *Manejo de pasturas y problemas de pastoreo*. Retrieved from https://extension.wsu.edu/animalag/content/manejo-de-pasturas-y-problemas-de-pastoreo/

Constitución política de Colombia [Const]. Art. 65. 4 de julio de 1991 (Colombia).

La ley 1876 de 2017. Por medio de la cual se crea el sistema nacional de innovación agropecuaria y se dictan otras disposiciones. 29 de diciembre de 2017. D.O. No. 1876

THANK YOU