entrosur e-ISSN:2706-6800

INSTITUTO TECNOLÓGICO CORPORATIVO EDWARDS DEMING

Identification of Weeds in Banana Crops (*Musa* × *paradisiaca* L.) Using NDVI

Determinación de malezas en el cultivo de plátano (*musa* × *paradisiaca* l.) por NDVI

Pedro Vélez Duque[1]

Published
Instituto Tecnológico Superior Corporativo
Edwards Deming. Quito - Ecuador

Frequency
April–June
Vol. 1, No. 29, 2026
pp. 1–15
http://centrosuragraria.com/index.php/revista

Dates of receipt
Received: January 22, 2026
Approved: March 15, 2026

Corresponding author
pvelez@uagraria.edu.ec

PhD. Universidad Agraria del Ecuador, Facultad Ciencias Agrarias, Escuela de Posgrado pvelez@uagraria.edu.ec

https://orcid.org/0000-0001-5886-4387

Abstract: The purpose of this study was to identify, characterize, and classify weeds present in banana (Musa × paradisiaca L.) crops using the Normalized Difference Vegetation Index (NDVI) and spectral image analysis. An applied, descriptive, documentary, and field study was conducted at the Milagro University Campus "Dr. Jacobo Bucaram Ortiz," where the most common weed species, their adaptive characteristics, and their degree of impact on the crop were recorded. The results showed a high prevalence of Cyperus rotundus (35%), Imperata cylindrica (30%), and Amaranthus sp. (20%), species known for their resistance and ability to spread. NDVI analysis allowed the crop areas to be categorized into four levels of infestation, identifying critical zones with values below 0.2, which exhibited sparse vegetation and high infestation. Likewise, the use of spectral images enabled the precise delineation of zones with higher weed density, facilitating decision-making for selective management. It is concluded that NDVI is an effective tool for monitoring, diagnosing, and planning sustainable weed control strategies in banana cultivation.

Keywords: NDVI; weeds; spectral images; remote sensing; banana cultivation; geoinformation; infestation; spectral classification; agricultural management.

Resumen: El presente estudio tuvo como finalidad identificar, caracterizar y clasificar las malezas presentes en el cultivo de plátano (Musa × paradisiaca L.) mediante el uso del Índice de Vegetación de Diferencia Normalizada (NDVI) y análisis de imágenes espectrales. Se desarrolló una investigación aplicada, descriptiva, documental y de campo en el Campus Universitario Milagro "Dr. Jacobo Bucaram Ortiz", donde se registraron las especies de malezas más frecuentes, sus características adaptativas y su grado de impacto sobre el cultivo. Los resultados evidenciaron una alta prevalencia de Cyperus rotundus (35%), Imperata cylindrica (30%) y Amaranthus sp. (20%), especies reconocidas por su resistencia y capacidad de propagación. El análisis de NDVI permitió categorizar las áreas del cultivo en cuatro niveles de afectación, identificándose zonas críticas con valores menores a 0.2, que presentaron escasa vegetación y alta infestación. Asimismo, el uso de imágenes espectrales posibilitó la delimitación precisa de zonas con mayor densidad de malezas, facilitando la toma de decisiones para el manejo selectivo. Se concluye que el NDVI constituye una herramienta efectiva para el monitoreo, diagnóstico y planificación de estrategias sostenibles de control de malezas en el cultivo de plátano.

Palabras clave: NDVI; malezas; imágenes espectrales; teledetección; cultivo de plátano; geoinformación; infestación; clasificación espectral; manejo agrícola.

Introduction

Banana cultivation (Musa × paradisiaca L.) represents one of the pillars of agriculture in tropical areas, particularly in Ecuador, where its production impacts the economy and food security. However, the presence of weeds reduces the productivity of this crop, resulting in significant economic losses. This problem persists due to the lack of effective techniques for monitoring and specifically controlling weeds, which affect plants in different ways depending on their type and density.

This study will propose an innovative approach to addressing this problem through the use of the Normalized Difference Vegetation Index (NDVI) and spectral analysis, geoinformation tools that enable the assessment of plant health and the detection of areas affected by weeds. By classifying the areas most vulnerable to weed infestations, more efficient and sustainable control measures can be prioritized.

The objective of this research is to identify and characterize weeds in banana crops, pinpointing areas with the highest infestation levels to optimize management. The methodology employs spectral imagery to enhance the accuracy of detecting problem areas, thereby providing a comprehensive approach to understanding and mitigating the impact of weeds on banana crops.

The article titled 'IDENTIFICATION OF WEEDS IN BANANA CROPS (MUSA × PARADISIACA L.) USING NDVI' is an applied and descriptive study, as its main objective is to identify, characterize, and categorize the most common weeds in banana crops using the Normalized Difference Vegetation Index (NDVI) and spectral analysis, with the aim of generating practical information to optimize agronomic management and control strategies. By combining field data collection, image processing, and geospatial analysis, it seeks to offer concrete solutions to improve crop productivity and sustainability, while detailing the distribution and extent of weed impact in a specific context, with regard to the following objectives:

entrosur e-ISSN:2706-6800
INSTITUTO TECNOLÓGICO CORPORATIVO EDWARDS DEMING

Major Weeds in Banana Cultivation

In banana cultivation, various weeds can compromise crop growth and yield by directly competing for essential resources. Some of the most prevalent weeds in tropical and subtropical areas include nutgrass (*Cyperus rotundus)*, barnyard grass (*Imperata cylindrica),* and pigweed (*Amaranthus sp.)* (Quispe and Velázquez, 2023) .

1. Cocillo *(Cyperus rotundus)*

Cyperus rotundus (coquillo), Imperata cylindrica (grama), and Amaranthus sp. (bledo). Cyperus rotundus is known for its resistance to traditional control techniques and its ability to regenerate rapidly, making it one of the most problematic weeds in tropical soils (R. F. SOUZA et al., 2021) .

2. Cock's-foot *(Imperata cylindrica)*

Imperata cylindrica produces rhizomes that allow it to spread rapidly, forming dense colonies that make it difficult to eradicate and reduce the growing space for plantains (Catalina Vidal et al., 2021) .

3. Amaranth *(Amaranthus sp.)*

Amaranthus sp., with seed production reaching thousands per plant, ensures continuous dispersal, becoming a recurring threat in every crop cycle (Rojas Rivas et al., 2020)

Adaptive and Resistance Characteristics of the Most Prevalent Weeds s

Cyperus rotundus:

It is a perennial plant with a deep root system, which allows it to withstand periods of drought and efficiently compete for nutrients in the soil. Its ability to regenerate from tuber fragments makes this species difficult to control, as even after the application of herbicides or mechanical weeding techniques, it has a high regrowth capacity (R. F. SOUZA et al., 2021) .

Imperata cylindrica:

This rhizome system allows the plant to regenerate rapidly and expand its ground cover, competing directly with banana crops for space, light, water, and nutrients. Imperata cylindrica is resistant to drought and fire, allowing it to survive in diverse environmental conditions and become a dominant weed in tropical areas, severely affecting banana crop productivity. (Catalina Vidal et al., 2021) .

Amaranthus sp.:

It has a rapid growth rate and high seed production, reaching thousands of seeds per plant. These characteristics make it an invasive and persistent weed, with a remarkable ability to adapt to banana-growing areas. It aggressively competes for soil nutrients and can grow rapidly to exceed the height of the banana crop, reducing light availability and affecting crop growth. Furthermore, some Amaranthus species have developed resistance to certain herbicides, complicating their control in agricultural production systems (Rojas Rivas et al., 2020) .

Impact of Weeds on Banana Crop Productivity

The presence of weeds in banana cultivation has a significant impact on productivity, affecting both plant development and fruit quality. It is estimated that weed infestation can reduce the yield of a banana crop by 20% to 40%, depending on the density and type of weed present (R. F. SOUZA et al., 2021) . *Cyperus rotundus* and *Imperata cylindrica,* being fast-growing weeds, represent constant competition for water and nutrients, which directly affects the health and development of banana plants, thereby reducing their capacity for optimal growth. Furthermore, it has been observed that in areas with high weed infestation, the fruit produced is smaller and of lower quality, resulting in a considerable economic impact on producers. This cumulative impact highlights the need for proper and specific weed management to preserve the sustainability and productivity of the crop.

Classify the degrees of damage caused by weeds that attack the banana crop .

Degrees of Weed Infestation in Banana Crops

The degrees of weed infestation in banana crops can be classified based on the Normalized Difference Vegetation Index (NDVI) analysis, according to the intensity of the infestation and the impact on crop growth. In cases of high infestation, weeds can reduce production by more than 40%, directly affecting growers' profitability (Andrés González Ruiz et al., 2023) . This categorization facilitates the identification of the most affected areas, which is essential for applying differentiated and specific management strategies based on the degree of infestation as determined by NDVI, thereby optimizing the resources used.

Scarce or no vegetation (NDVI < 0.2): Represents areas where vegetation is severely damaged or absent, possibly due to heavy weed infestation or extreme conditions that hinder crop growth. These areas are critical and require priority intervention.

Mixed vegetation cover (NDVI 0.2–0.4): Indicates areas with a mix of desired vegetation and weeds. Competition for nutrients, water, and light may be limiting banana growth. This category indicates a moderate level of impact that requires localized management.

entrosur e-ISSN:2706-6800
INSTITUTO TECNOLÓGICO CORPORATIVO EDWARDS DEMING

Vigorous vegetation (NDVI 0.4–0.6): Corresponds to areas where crop vegetation predominates, but there is still a minimal presence of weeds that does not significantly affect yield. These areas should be monitored to prevent an increase in weed infestation.

Dense and healthy vegetation (NDVI > 0.6): Areas where the crop is in optimal condition and weeds have minimal or no presence. These areas are ideal for maintaining preventive management and protecting the crop.

Factors Influencing the Degree of Infestation

The degree of infestation is influenced by several factors, including weed density and their ability to spread. For example, ***Imperata cylindrica*** and ***Cyperus rotundus*** are fast-growing weeds with a high dispersal capacity, which increases their impact in humid growing areas. Studies suggest that the density of these weeds is closely linked to nutrient availability and rainfall patterns, which determine their spread and the type of control needed to keep their impact low (Andrés González Ruiz et al., 2023) .

The extent of impact is determined by several factors, including:

- **Environmental conditions:** Factors such as the availability of water, light, and nutrients directly influence competition between the crop and weeds. For example, in areas of high humidity, ***Imperata cylindrica*** can quickly become dominant.
- **Crop management:** Weeding practices and the use of herbicides influence the ability of weeds to invade and affect the crop.

Effects of the Degree of Infestation on Crop Yield and Quality.

The impact on banana yield increases as weeds reach a high level of infestation, since competition for water and nutrients reduces plant vigor and fruit quality. A study conducted by (Echávez Plata, 2022) demonstrated that in areas with high infestations of *Amaranthus sp.*, fruit size and average bunch weight decreased significantly. This negative impact underscores the need to classify severity levels and adopt appropriate control measures, which ensures the long-term sustainability and productivity of banana cultivation.

Identifying the highest weed populations in banana cultivation using spectral imagery at the Milagro University Campus "Dr. Jacobo Bucaram Ortiz."

Importance of Detecting Areas with High Weed Populations s

Detecting areas with high weed concentrations is crucial for optimizing banana crop management, as it allows control efforts to be directed at specific zones. This approach not only reduces herbicide use but also limits environmental impact. Spectral images, such as those used by the Normalized Difference Vegetation Index (NDVI), provide accurate data on weed distribution, helping to identify critical areas with high populations of . In Zone 5, the use of this technology can facilitate localized management, increasing the efficiency of agronomic resources.

Use of Spectral Images for Weed Identification

Analysis using spectral imagery allows for differentiation between desired and undesired vegetation based on the vegetation's reflectance. In banana cultivation, the NDVI allows for the detection of areas where weeds predominate over the crop, which is essential for planning selective control measures (Rodrigo Bautista, 2019) . This approach has proven effective in previous studies, successfully identifying areas of high infestation with precision and reducing the time and cost of manual interventions.

Mapping Weed Distribution

In the context of mapping weed distribution, creating maps that show infestation density provides growers with a visual tool to identify the most affected areas and focus control efforts on priority areas. The use of NDVI enables real-time monitoring of the location and extent of weeds, which facilitates the ongoing evaluation of the effectiveness of the implemented strategies. Recent research shows that the application of spectral mapping can reduce management costs by up to 30% in high-density crops, such as bananas, increasing both the sustainability and profitability of production. (Duque Vazquez, 2023) .

Methodology

The study will focus on addressing the problem of weed infestation in banana cultivation, utilizing specialized knowledge of geoinformation and weed management to obtain practical results that optimize control methods in the field.

A comprehensive review of existing literature, including books, scientific articles, and previous studies, will be conducted to establish a theoretical framework regarding the most common weeds in banana crops, their impact, and control methods.

In the field, direct observation and systematic sampling of weeds present in banana plots will be carried out. Weed density and distribution will be recorded, while in the laboratory, samples will be

e-ISSN:2706-6800

identified using NDVI to understand the relationship between weeds and the environment.

The presence, distribution, and degree of impact of weeds on banana crops in a specific region of Ecuador will be documented and described.

NDVI images will be obtained via satellite, covering the entire Zone 5 of the banana-growing region. These images will be captured at different stages of the crop cycle to observe variations in weed infestation.

The collected images will be processed using geospatial analysis software to calculate NDVI values. These NDVI values will enable the identification of areas with healthy vegetation and areas affected by weeds. Zones will be categorized as low, medium, or high based on the level of weed infestation, according to the identified weed density. Each category will be represented on a map to facilitate visualization and decision-making. The data obtained will be compared with previous studies on the use of NDVI in weed detection to refine interpretations and ensure the accuracy of the results.

Geospatial maps will be created to represent critical areas, allowing farmers to identify the zones most in need of intervention. These maps will serve as a tool for planning weed management strategies in banana cultivation.

The project will combine the deductive method and the analytical method.

Deductive method: This will be used to start from general principles of remote sensing and weed management, applying them to the specific context of banana cultivation. This allows for a logical application of prior knowledge about geoinformation to local needs.

Analytical method: This will allow the data collected from spectral images to be broken down into categories of weed infestation and specific locations. Through this analysis, infestation patterns can be identified and selective control interventions applied, promoting sustainability and effectiveness in weed management.

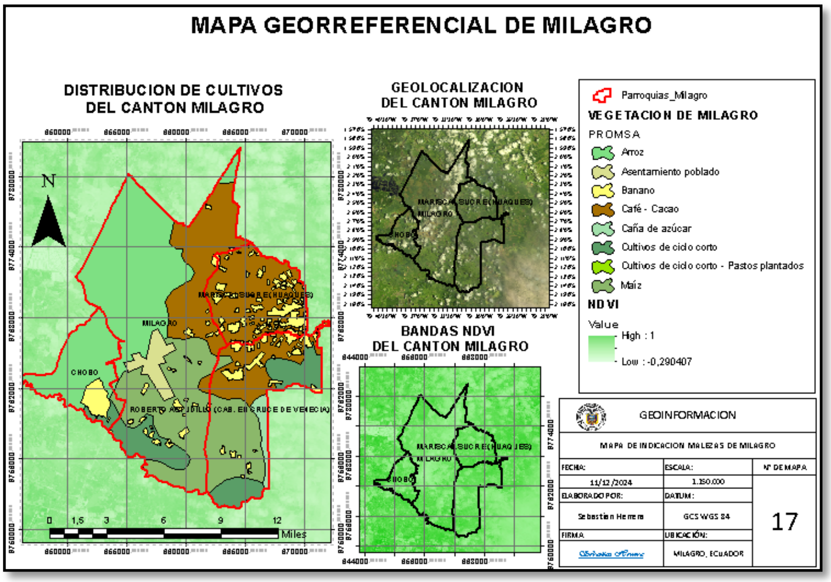
The research techniques used include:

Direct observation through the analysis of NDVI images, which allows for the observation of weed distribution without interfering with the crop. Measurement of spectral parameters to analyze the intensity of weed infestation and its distribution in the field. Comparative analysis of data obtained from different points within the study area, facilitating the identification of high-density weed zones and the evaluation of effective control methods.

Results

Most common weed types affecting the cultivation of plantains ( ).

Figure 1. Georeferenced map of the Milagro canton



Author: (Vélez, 2024)

Likewise, a detailed analysis was conducted of the impact that each weed species has on the development of the plantain crop ( ), considering factors such as competition for nutrients, light, and space. During the evaluation process, it was determined that some species exhibit greater aggressiveness and resistance to conventional control methods. To complement the information obtained, a morphological characterization of the predominant weeds was performed, identifying their main distinctive features. This analysis allowed us to establish relationships between the abundance of certain species and the soil conditions of the land. Additionally, the management practices implemented by local farmers were analyzed, evaluating their effectiveness and sustainability. The data collected served as the basis for proposing integrated control strategies. In this way, the aim is to

Centrosur e-ISSN:2706-6800
INSTITUTO TECNOLÓGICO CORPORATIVO EDWARDS DEMING

reduce the incidence of weeds without affecting the ecological balance of the agroecosystem.

Table 1. *Most common weeds identified in banana cultivation*

Common Name	Scientific Name	Relative Frequency (%)
Coquillo	Cyperus rotundus	35%
Bermuda grass	Imperata cylindrica	30%
Amaranth	Amaranthus sp.	20%
Barnyard grass	Barnyardgrass	10%
Purslane	Portulaca oleracea	5%

Source: Observations made at the Milagro University Campus.

Analysis Results

Dominance of Cyperus rotundus: This species was the most common, accounting for 35% of the weeds found. Its propagation via tubers and its resistance to traditional control methods explain its high prevalence.

Impact of Imperata cylindrica and Amaranthus sp.: These species ranked second and third with relative frequencies of 30% and 20%, respectively. Both possess adaptive characteristics that make them competitive, such as rhizomes in Imperata cylindrica and high seed production in Amaranthus sp.

Minor presence of Echinochloa crus-galli and Portulaca oleracea: Although less frequent, these species have an impact on specific areas of the crop due to their rapid growth and competition for nutrients.

Degrees of weed infestation in banana crops

To categorize the degrees of weed infestation in banana crops, Normalized Difference Vegetation Index (NDVI) values were used. The data obtained allowed for the classification of crop areas into four categories: sparse or no vegetation, mixed vegetation cover, vigorous vegetation, and dense, healthy vegetation.

Table 2. *Categories of impact based on NDVI in banana cultivation*

Category	NDVI Range	Area (%)	Description
Little or no vegetation	< 0.2	15%	Severely affected areas, predominantly bare soil or weeds.
Mixed vegetation cover	0.2–0.4	35%	Significant presence of weeds competing with the crop.
Vigorous vegetation	0.4–0.6	30%	Predominant crop, but with moderate weed presence.
Dense and healthy vegetation	> 0.6	20%	Crop in optimal conditions with minimal or no weeds.

Source: Analysis of spectral images at the Milagro University Campus.

Critical areas: 15% of the crop showed little or no vegetation, indicating areas with high weed infestation or conditions unfavorable for crop growth. These areas require priority attention.

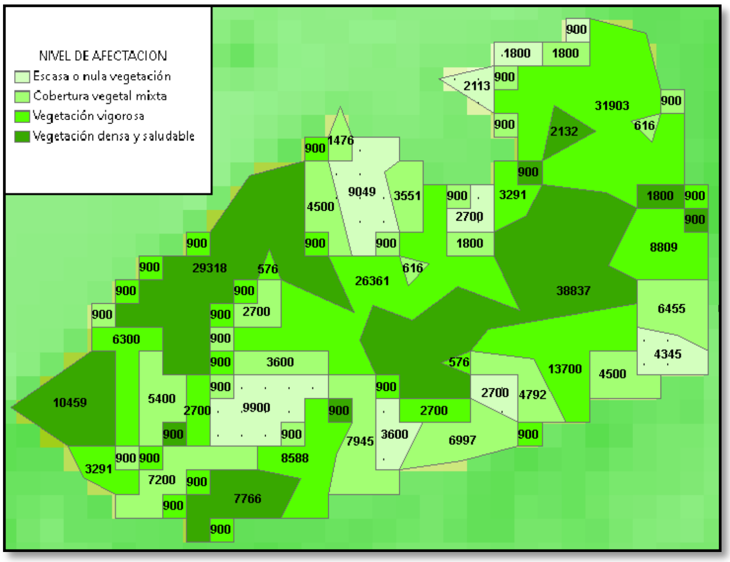
Significant weed presence: 35% of the areas showed mixed vegetation cover, indicating direct competition between weeds and the banana crop. These zones require localized and consistent management.

Moderately Affected Crop: In 30% of the area, vigorous vegetation indicates good crop development, but with weeds present that could increase their impact without proper control.

Optimal zones: 20% of the area showed dense and healthy vegetation, representing the desired crop condition. These zones require preventive monitoring to maintain their condition. Identification of the largest weed population in the banana crop using spectral imagery at the Milagro University Campus "Dr. Jacobo Bucaram Ortiz" Based on the analysis of spectral imagery and the data reflected in the image, the affected areas were identified according to vegetation levels and their distribution in square meters.

entrosur e-ISSN:2706-6800
INSTITUTO TECNOLÓGICO CORPORATIVO EDWARDS DEMING

Figure 2. Weed-infested areas



Author: (Vélez, 2024)

Table 3. *Areas affected by weeds according to NDVI values*

NDVI range	**Classification**	**Total Area (m²)**
< 0.2	Little or no vegetation	39,318
0.2–0.3	Mixed vegetation cover	38,837
0.3–0.4	Vigorous vegetation	26,361
> 0.4	Dense and healthy vegetation	13.7

Source: NDVI analysis at Milagro University Campus, 2024.

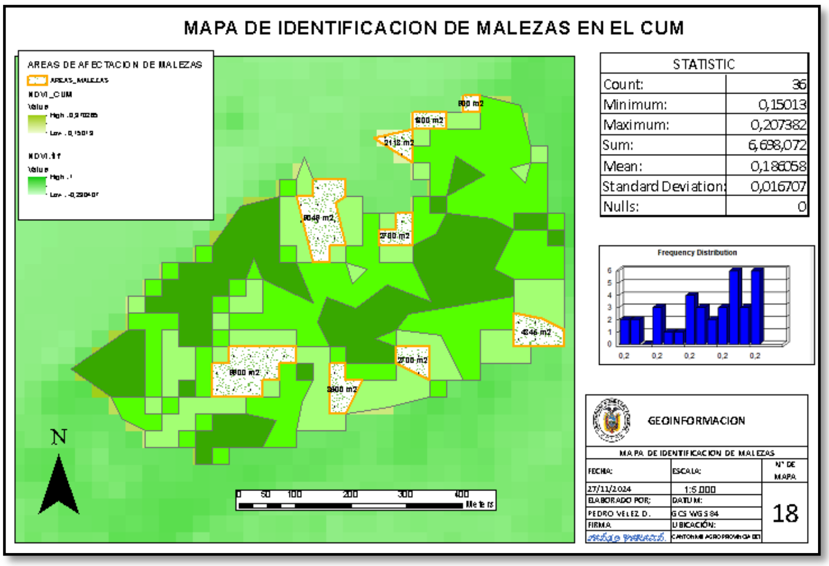
Critical areas (NDVI < 0.2): These represent the largest affected area at 39,318 m². These zones require immediate management to prevent further damage to crops.

Mixed vegetation cover (NDVI 0.2–0.3): These cover a significant area of 38,837 m². These zones contain a mix of weeds and desired vegetation, indicating the need for regular management to prevent weed proliferation.

Vigorous vegetation (NDVI 0.3–0.4): These areas cover 26,361 m². In these areas, competition with weeds is moderate, and the crop shows good development but still requires monitoring.

Dense and healthy vegetation (NDVI > 0.4): Covering 13,700 m², these areas reflect optimal vegetation. It is important to maintain these conditions through good agricultural practices.

Figure 3. Map of weed identification using NDVI at the “CUM”



Author: (Vélez, 2024)

The results obtained in this study demonstrate that the use of the Normalized Difference Vegetation Index (NDVI) is an effective tool for the detection and characterization of weeds ( ) in banana cultivation. The high frequency of species such as Cyperus rotundus and Imperata cylindrica confirms the findings of Souza et al. (2021) and Vidal et al. (2021), who highlight these species’ ability to adapt to adverse conditions and resist conventional control methods.

Analysis of NDVI values allowed for the establishment of a clear relationship between vegetation vigor and the degree of infestation. Areas with values below 0.2 showed minimal coverage and a high presence of weeds, while sectors with values above 0.6 exhibited dense and healthy vegetation. These findings are consistent with those reported by González Ruiz et al. (2023), who demonstrated that a decrease in NDVI is directly associated with competition for light, water, and nutrients between weeds and the main crop.

Furthermore, the classification of affected areas using spectral imagery allowed for a more precise spatial interpretation of the problem. This

entrosur e-ISSN:2706-6800
INSTITUTO TECNOLÓGICO CORPORATIVO EDWARDS DEMING

geospatial approach, similar to that employed by Duque-Vázquez et al. (2023), demonstrated that multitemporal NDVI analysis can optimize the planning of selective management strategies, reducing the indiscriminate use of herbicides and promoting localized weed control.

The differentiated behavior of the observed species also suggests a strong influence of edaphic and agricultural management factors. In particular, the dominance of Cyperus rotundus in areas with high humidity is consistent with the findings of Echávez Plata et al. (2022), who found that microclimatic conditions determine the persistence and aggressiveness of certain invasive species in tropical crops. Meanwhile, the expansion of Amaranthus sp. in areas of high radiation indicates its remarkable adaptability, a pattern previously noted by Rojas-Rivas et al. (2020).

The results also reveal the usefulness of NDVI as an indicator for continuous crop monitoring. The index's ability to differentiate between desired and undesired vegetation provides a quantitative basis for agronomic decision-making. In this regard, the integration of spectral imagery and NDVI analysis could complement traditional management practices, improving crop sustainability by reducing costs and minimizing environmental impacts, as suggested by Vigabriel Navarro et al. (2024).

Finally, it is important to note that, while NDVI made it possible to identify critical areas and categorize levels of damage, factors such as image spatial resolution, cloud cover, and temporal variability can limit the accuracy of the results. Future research should consider the combined use of additional spectral indices (such as EVI or SAVI) and machine learning techniques to improve weed detection and classification. This would strengthen the integrated management of banana cultivation and advance toward more efficient and sustainable agroecological management.

Conclusions

The analysis identified the most common weeds in banana cultivation at the Milagro University Campus "Dr. Jacobo Bucaram Ortiz," revealing a high prevalence of species such as Cyperus rotundus and Imperata cylindrica, which pose a significant challenge for crop management.

The degrees of weed infestation were successfully categorized, allowing impact levels to be established based on NDVI values. It was found that the highest infestation occurs in areas with sparse or no vegetation, highlighting the need to implement differentiated management strategies according to the detected level of infestation.

The use of spectral imagery allowed for the precise identification of areas with the highest weed populations, contributing to the geographic localization of critical zones. This technology proved to be an effective tool for monitoring and managing weeds in the crop, optimizing agricultural decision-making.

References

Andrés González Ruiz, Guadalupe Alfonso López Urquídez, Carlos Enrique Aíl-Catzím, Carlos Alfonso López Orona, Raymundo Medina López, & Mitzi Dayanira Estrada Acosta. (2023). Weed population density and diversity indices in wheat crops under two planting types. *Advances in Agricultural Research*, *27* (Special Issue). https://doi.org/10.53897/revaia.23.27.17

Angie Daniela Alarcón Montaña, Montaña, A. D. A., Miguel Ángel Rozo Arango, & Arango, M. Á. R. (2021). *Application of spectral indices to determine the transformation of dry forest in Agua de Dios (Cundinamarca, Colombia)*. *18* (1). https://doi.org/10.18041/1794-4953/avances.1.7070

Catalina Vidal, Vidal, C., Giovanni Larama, Larama, G., Aníbal Riveros, Riveros, A., Claudio Meneses, Meneses, C., Pablo Cornejo, & Cornejo, P. (2021). Main Molecular Pathways Associated with Copper Tolerance Response in Imperata cylindrica by de novo Transcriptome Assembly. *Plants*, *10* (2), 357. https://doi.org/10.3390/plants10020357

Edgar Francisco Duque-Vazquez, Horacio Rostro-González, Re. Sanchez-Yanez, Noé Saldaña-Robles, & Jonathan Cepeda-Negrete. (2023). Weed Detection Through Color Recognition and Its Integration into a Mobile Application. *Journal of Agri-Food Science and Innovation of the University of Guanajuato*, *4* (2), 82-98. https://doi.org/10.15174/cia.v4i2.12

Edgar Rojas-Rivas, Rojas-Rivas, E., Angélica Espinoza-Ortega, Espinoza-Ortega, A., Angélica Espinoza-Ortega, Espinoza-Ortega, A., Humberto Thomé-Ortíz, & Thomé-Ortiz, H. (2020). *Consumption and purchase intention of amaranth (Amaranthus sp.) in Mexico; an ancient grain with functional properties*. *13* (3). https://doi.org/10.32854/agrop.vi.1669

Fernando Ricardo Dos Santos Quispe & Edilberto Pozo Velázquez. (2023). Identification of weeds associated with aloe vera (Aloe vera barbadensis M.) cultivation in the department of La Paz, Bolivia.

entrosur e-ISSN:2706-6800

INSTITUTO TECNOLÓGICO CORPORATIVO EDWARDS DEMING

Journal of Agricultural and Natural Resource Research and Innovation, *10* (2), 7-14. https://doi.org/10.53287/akmo9760po36m

Griselda E. Sánchez Vallduví, Griselda Estela Sánchez Vallduví, Santiago J. Sarandón, & Santiago Javier Sarandón. (2021). Analysis of the ecological sustainability of different weed management strategies in oilseed flax (Linum usitatissimum L.) cultivation in Argentina. *Journal of the Faculty of Agronomy*, *120* (2), 082-082. https://doi.org/10.24215/16699513e082

Kristinne Lilleth Echávez Plata, Kristinne Lilleth Echávez Plata, Kristinne Lilleth Echávez Plata, Irma Quintero-Pertuz, Irma Quintero-Pertuz, Irma Quintero-Pertúz, Eduino Carbonó-Delahoz, Eduino Carbonó-Delahoz, & Eduino Carbonó-Delahoz. (2022). Analysis of the risk of invasion by introduced weeds associated with banana crops in the department of Magdalena, Colombia. *Journal of the Colombian Academy of Exact, Physical, and Natural Sciences*. https://doi.org/10.18257/raccefyn.1520

Luz María Vigabriel Navarro, Javier Mauricio Osorio Leyton, Carlos Eduardo Quezada Lambertin, & Jean-Paul Benavides López. (2024). Estimation of barley (Hordeum vulgare L.) crop biomass using multispectral remote sensing. *Journal of Agricultural and Natural Resource Research and Innovation*. https://doi.org/10.53287/iguo9951ru99j

R. F. SOUZA, Robson Fábio Alves de Souza, L. M. S. DONATO, Luan Mateus Silva Donato, G. A. P. FERREIRA, Gilberto Alves Ferreira, G. L. P. MENEZES, G. L. P. MENEZES, N. O. SOARES, Núbia Soares, L. D. T. SANTOS, & Leonardo David Tuffi Santos. (2021). Control methods for managing Cyperus rotundus in horticulture. *Animal and Plant Production: Innovations and Current Issues*. https://doi.org/10.53934/9786599539633-50

Rodrigo Bautista, Bautista, R., Patricia Constante, Constante, P., A. Gordon, Gordon, A., Darío Mendoza, & Mendoza, D. (2019). Design and implementation of a computer vision system for NDVI data analysis in spectral images of broccoli crops obtained using a remotely piloted aircraft. *Infociencia*, *12* (1), 30-35. https://doi.org/10.24133/infociencia.v12i1.1230