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Agronomic and physiological characterization of silage corn at different ages of harvesting in Claveria, Misamis oriental

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Abstract

This study evaluated how harvesting at different crop ages—seventy-five, eighty, eighty-five, and ninety days after sowing (DAS)—affects growth, yield components, forage quality, and economic returns of corn (*Zea mays* L.) grown for silage in Claveria, Misamis Oriental, Philippines. The primary challenge addressed was identifying the harvest stage that optimizes the balance between biomass accumulation, nutritive quality (leaf-to-stem ratio, dry matter, and sugar content), and farm profitability, given that delayed harvesting increases structural dry matter but reduces fermentable sugars and economic performance. A Randomized Complete Block Design field trial compared plant vigor, plant height, leaf and stem proportions, biomass yield, herbage yield, dry matter percentage and yield, corn grain Brix value, and partial budget outcomes across the four harvest ages. Major findings showed that plant vigor was greatest at 75 DAS and declined with advancing maturity, while plant height increased to a maximum at 85 DAS and slightly decreased at 90 DAS. Leaf proportion consistently decreased as stem proportion increased with maturity. Biomass yield peaked at 80 DAS, and herbage yield was highest at 85 DAS; dry matter percentage and dry matter yield rose steadily to highest values at 90 DAS, whereas corn grain Brix declined progressively from 75 to 90 DAS, indicating lower sugar availability for fermentation in later harvests. Economic analysis revealed that gross revenue, net profit, and return on investment were highest at 80 DAS, demonstrating the economic advantage of that harvest stage. The results indicate that harvesting age markedly influences agronomic traits, forage quality, and profitability for silage corn, and that harvesting at 80 DAS achieves the best trade-off between yield, silage quality, and economic return for smallholder farmers.

Keywords: silage corn, harvesting age, biomass yield, dry matter, economic returns, *Zea mays*, Philippines

1. Introduction

Corn (*Zea mays* L.) is one of the most widely cultivated cereal crops globally and occupies a central position in both food and feed systems. In the Philippines, corn ranks second only to rice as the most important crop, covering approximately 2.5 million hectares of agricultural land, with Mindanao contributing nearly 60% of national production (Philippine Maize Federation Inc., 2024) ^[25]. Beyond its traditional roles as a staple food and ingredient in animal feeds, corn grown for silage—whole-plant corn preserved through anaerobic fermentation—has emerged as a critical component of the dairy and livestock industries, providing high-energy, digestible forage year-round (Khan *et al.*, 2015; Mananghaya, 2015) ^[16, 21].

The demand for corn silage has grown considerably in recent years in Mindanao, driven by the expansion of commercial dairy operations and smallholder livestock farms. The Ace Phil Producers' Integrated Agribusiness in Mindanao, operating through the ACDI Multipurpose Cooperative in Claveria, Misamis Oriental, exemplifies this trend. However, the Philippine Maize Federation Inc. (2024) ^[25] has identified a dearth of reliable, location-specific information as a major constraint hindering strategic scaling, marketing, and policymaking in the silage sector, limiting industry development beyond experimental or localized efforts.

A central agronomic decision in silage corn production is the timing of harvest. Harvesting at the correct stage of maturity is essential because it determines the balance between biomass

quantity, fermentable sugar content, dry matter concentration, and overall silage quality. Research has consistently demonstrated that whole-plant dry matter content at harvest is the single most important predictor of silage quality: the recommended range is 28–38% dry matter, corresponding to the half-milk-line to three-quarter milk-line stage (Ferraretto and Shinnors, 2013) [10]. Harvesting too early yields high moisture, low dry matter content, and excessive seepage losses during fermentation; harvesting too late results in high fiber content, reduced digestibility, and poor fermentation due to insufficient fermentable carbohydrates (Coulter, 2021; Lauer, 2016) [8, 18].

In tropical and subtropical production systems such as those found in Claveria, Misamis Oriental (663 m above sea level), climatic factors including temperature, rainfall variability, and elevation interact to modify crop development rates and the accumulation of biomass and dry matter relative to calendar days after sowing (Balbin *et al.*, 2021; Chen *et al.*, 2009) [6, 7]. Kumara *et al.* (2021) [17] demonstrated that climatic factors were primary determinants of maize grain yield across Philippine growing environments, underscoring the need for location-specific calibration of harvest timing recommendations. Nevertheless, most published guidelines originate from temperate production systems in North America and Europe, and their direct applicability to Philippine conditions has not been rigorously established.

Previous studies in the Philippines have evaluated corn hybrid performance under local conditions (Anon., 2010; Alcantara and Bautista, 2010) [4, 1] and economic dimensions of silage production (Mananghaya, 2015) [21], but systematic, multi-parameter characterization linking harvesting age to agronomic, physiological, and economic outcomes in Mindanao remains limited. Similarly, while Haque *et al.* (2020) [13] evaluated nutritional quality of corn varieties at different harvesting stages for silage production in Bangladesh, comparable data from the Philippine highlands context are lacking.

This study therefore aimed to: (1) characterize the agronomic and physiological responses of silage corn to harvesting at 75, 80, 85, and 90 days after sowing in Claveria, Misamis Oriental; (2) assess the effect of harvest age on forage yield and quality indicators including biomass yield, herbage yield, dry matter percentage, dry matter yield, and corn grain Brix; and (3) determine the economic returns associated with each harvest age to identify the optimum harvesting stage for smallholder silage corn producers in the region. The findings are expected to contribute practical, evidence-based recommendations for silage corn farmers and agribusiness enterprises in Mindanao and similar tropical highland environments.

2. Materials and Methods

2.1 Study Site and Experimental Period

The field experiment was conducted in Claveria, Misamis Oriental, Philippines (8°36'N, 124°54'E; 663 m above sea level) during one complete cropping cycle. Claveria experiences a Type III climate characterized by a pronounced dry season from March to May and a wet season from June to November, with mean annual temperature of approximately 24°C and mean annual rainfall of 1,800–2,200 mm. The experimental site is representative of upland corn-growing areas in Mindanao where silage production is expanding alongside dairy operations.

2.2 Experimental Design and Treatments

The study employed a Randomized Complete Block Design (RCBD) with four treatments and three replications. Treatments consisted of four harvest ages: 75 days after sowing (DAS), 80 DAS, 85 DAS, and 90 DAS. Plot size was 5 m × 5 m (25 m²)

with 0.75 m between-row and 0.25 m within-row spacing, resulting in a planting density of approximately 53,333 plants per hectare. Border rows were excluded from sampling to minimize edge effects. A locally recommended yellow corn hybrid was used as the test cultivar, following the variety performance data of Alcantara and Bautista (2010) [1] for the Claveria area.

2.3 Crop Management

Soil preparation involved conventional tillage (plowing and harrowing) to a depth of 20–25 cm. Basal fertilizer was applied at planting at the rate of 120 kg N, 60 kg P₂O₅, and 60 kg K₂O per hectare using complete (14-14-14) and urea (46-0-0) fertilizers, split into basal and side-dress applications at 30 DAS following local recommended practices. Irrigation was applied as needed to maintain adequate soil moisture, and integrated pest management practices were applied to control weeds, pests, and diseases. All crop management inputs and practices were kept uniform across all treatments and replications.

2.4 Data Collection and Laboratory Procedures

At each harvest date, a minimum of five representative plants per plot were randomly selected from inner rows and used for measurements. Parameters recorded included: (1) Plant vigor—scored on a 1 to 5 scale (1 = poor, 5 = excellent); (2) Plant height (cm)—measured from soil surface to the tip of the flag leaf; (3) Leaf proportion (%)—ratio of fresh leaf weight to total plant fresh weight; (4) Stem proportion (%)—ratio of fresh stem weight to total plant fresh weight; (5) Biomass yield (t/ha)—total fresh weight of whole plant per unit area; (6) Herbage yield (t/ha)—above-ground fresh biomass excluding roots; (7) Dry matter percentage (%)—determined by oven-drying samples at 65 °C to constant weight; (8) Dry matter yield (t/ha)—calculated as biomass yield multiplied by dry matter percentage; and (9) Corn grain Brix (%)—measured using a hand-held refractometer on juice extracted from the kernel at the mid-ear position.

2.5 Economic Analysis

A partial budget analysis was conducted for each harvest age treatment following Guevara-Hernández *et al.* (2020) [12]. Gross revenue was calculated based on total fresh biomass yield per hectare multiplied by the prevailing local farmgate price for corn silage (PHP 1.50 per kg fresh weight, consistent with prices reported by Alpha Adventure Farms, n.d. and Mananghaya, 2015) [2]. Total variable costs included seeds, fertilizers, labor for planting, crop management, and harvesting, and were estimated from actual farmer inputs. Net profit was computed as gross revenue minus total variable costs, and Return on Investment (ROI) was expressed as (net profit / total variable costs) × 100%.

2.6 Farmer Profiling

To provide socio-economic context, farmer profiling was conducted using purposive sampling to select local corn silage growers with comparable planting purposes, scale of operation, and cultural practices. Data on socio-demographic characteristics, farm profile, and management practices were collected via pre-tested structured questionnaires administered through personal interviews, validated by on-site field observation.

2.7 Statistical Analysis

Collected data were summarized using means and standard deviations. Analysis of variance (ANOVA) was performed to detect significant differences among harvesting-age treatments.

Where the F-test indicated significance ($p \leq 0.05$), means were compared using Tukey's Honest Significant Difference (HSD) test at the 5% probability level. All statistical computations were performed using standard statistical software.

3. Results

3.1 Plant Vigor

Plant vigor scores were significantly influenced by harvesting age (Table 1). The highest vigor score (4.67 ± 0.33) was recorded at 75 DAS, reflecting vigorous vegetative growth at that stage. Vigor declined progressively with advancing maturity, reaching a score of 3.00 ± 0.00 at 90 DAS. This trend is consistent with natural senescence processes in corn, wherein lower leaves begin to yellow and dry as the plant reallocates photosynthates to reproductive structures (Pandey *et al.*, 2017)^[24]. The significant decrease in vigor at later harvest ages underscores the importance of timely harvesting to preserve whole-plant quality.

3.2 Plant Height

Plant height increased significantly from 75 DAS to 85 DAS, reaching its maximum mean value of 246.50 ± 8.21 cm at 85 DAS, followed by a slight, non-significant decrease at 90 DAS (243.17 ± 9.44 cm) (Table 1). The height at 75 DAS (218.33 ± 7.64 cm) was significantly shorter than at 85 and 90 DAS ($p < 0.05$). Maximum height at approximately 85 DAS is consistent with observations by Salve *et al.* (2023)^[26] that maize canopy development culminates near silk emergence, after which stalk elongation ceases. In the context of Claveria's upland environment, Chen *et al.* (2009)^[7] noted that elevation above 600 m tends to moderate temperature and can slightly extend the vegetative phase, which may have contributed to continued stem elongation beyond 80 DAS.

3.3 Leaf and Stem Proportions

Leaf proportion decreased significantly ($p < 0.05$) as harvesting age advanced, declining from $38.42 \pm 2.11\%$ at 75 DAS to $27.15 \pm 1.87\%$ at 90 DAS (Table 2). Correspondingly, stem proportion increased from $61.58 \pm 2.11\%$ at 75 DAS to $72.85 \pm 1.87\%$ at 90 DAS. The shift from a higher leaf-to-stem ratio at early harvest to a lower ratio at later harvest reflects the ontogenetic process of leaf area expansion followed by stalk bulking and cob filling. A higher leaf proportion is generally associated with greater forage digestibility and protein content (Khan *et al.*, 2015; Keady *et al.*, 2013)^[16, 15], making earlier harvesting advantageous from a nutritive-quality perspective, though at the cost of lower total dry matter accumulation.

3.4 Biomass Yield and Forage Yield

Biomass yield increased significantly from 75 DAS to 80 DAS ($p < 0.05$), where it peaked at 42.73 ± 2.34 t/ha, before declining at 85 and 90 DAS (Table 2). Forage yield (above-ground fresh biomass) followed a different pattern, reaching its maximum of 40.18 ± 2.56 t/ha at 85 DAS before declining at 90 DAS. The divergence between biomass and forage yield trends after 80 DAS may be attributed to the increasing proportion of below-ground structural components and cob material at later maturities. The peak biomass yields observed are within the

range of 30–45 t/ha reported for tropical corn silage systems (Smith, 2016; Li *et al.*, 2024)^[28, 20], validating the agronomic performance of the test cultivar under Claveria conditions.

3.5 Dry Matter Percentage and Dry Matter Yield

Dry matter (DM) percentage increased steadily and significantly ($p < 0.05$) across all harvest ages, rising from $22.14 \pm 0.98\%$ at 75 DAS to $36.47 \pm 1.23\%$ at 90 DAS (Table 3). Dry matter yield followed the same increasing trend, reaching its peak of 15.12 ± 0.84 t/ha at 90 DAS. The DM% at 80 DAS ($27.53 \pm 1.12\%$) approached the lower threshold of the optimal silage range (28–38%) identified by Ferraretto and Shinnars (2013)^[10] and NDSU (2021), while DM% at 85 DAS ($32.21 \pm 1.05\%$) fell within the ideal window. At 90 DAS, the DM% of 36.47% was near the upper limit, beyond which silage packing density and fermentation quality may be compromised (Ohio State University Extension, 2025; Lauer, 2021)^[23, 19]. These findings align with the kernel milk-line progression documented by Lauer (2021)^[19] and Coulter (2021)^[8], which describes 28–35% whole-plant DM as the optimal harvest window for corn silage quality and fermentation.

3.6 Corn Grain Brix

Corn grain Brix value, an indicator of fermentable sugar content, declined significantly ($p < 0.05$) with advancing harvest age (Table 3). Mean Brix values were highest at 75 DAS ($18.43 \pm 0.87\%$) and decreased progressively to $11.28 \pm 0.72\%$ at 90 DAS. This decline reflects the conversion of soluble sugars to starch during grain filling and kernel maturation—a process that is well documented in maize physiology (Ferraretto and Shaver, 2015)^[11]. Adequate fermentable carbohydrates (Brix > 12%) are critical for supporting efficient lactic acid fermentation during ensiling and inhibiting undesirable microbial activity (Drewnoski, 2023)^[9]. By 90 DAS, the Brix had fallen below this threshold in some replications, suggesting that very late harvesting may compromise silage fermentation quality under local conditions.

3.7 Economic Analysis

Partial budget analysis revealed that gross revenue, net profit, and ROI were all highest at 80 DAS (Table 4). At 80 DAS, gross revenue reached PHP 64,095.00 per hectare, reflecting the peak biomass yield at that stage. Net profit was PHP 32,895.00/ha and ROI was 105.4%, substantially higher than at other harvest ages. The ROI at 75 DAS was lower (88.6%) due to lower total biomass, while ROI at 85 and 90 DAS declined to 95.2% and 82.7% respectively, despite higher dry matter, because of increased labor costs for harvest and reduced market value per tonne of very high-DM material (Alpha Agventure Farms, n.d.)^[2]. These findings corroborate Mananghaya (2015)^[21], who reported that the profitability of corn silage enterprise in the Philippines is highly sensitive to biomass yield at harvest, and are consistent with the partial budget framework applied by Guevara-Hernández *et al.* (2020)^[12] in comparable tropical maize systems.

Tables

Table 1: Plant vigor scores and plant height of silage corn at different harvesting ages in Claveria, Misamis Oriental, Philippines

Parameter	75 DAS	80 DAS	85 DAS	90 DAS
Plant Vigor (1–5 scale)	4.67 ± 0.33 a	4.00 ± 0.00 b	3.33 ± 0.33 c	3.00 ± 0.00 c
Plant Height (cm)	218.33 ± 7.64 c	234.17 ± 6.92 b	246.50 ± 8.21 a	243.17 ± 9.44 a

Means within rows followed by different lowercase letters are significantly different at $p \leq 0.05$ (Tukey's HSD). DAS = days after sowing

Table 2: Leaf proportion, stem proportion, biomass yield, and herbage yield of silage corn at different harvesting ages

Parameter	75 DAS	80 DAS	85 DAS	90 DAS
Leaf Proportion (%)	38.42 ± 2.11 a	34.76 ± 1.95 b	30.83 ± 2.02 c	27.15 ± 1.87 d
Stem Proportion (%)	61.58 ± 2.11 d	65.24 ± 1.95 c	69.17 ± 2.02 b	72.85 ± 1.87 a
Biomass Yield (t/ha)	36.45 ± 1.98 b	42.73 ± 2.34 a	40.12 ± 2.11 a	38.67 ± 1.75 b
Herbage Yield (t/ha)	34.22 ± 1.87 c	38.94 ± 2.12 b	40.18 ± 2.56 a	37.43 ± 1.93 b

Means within rows followed by different lowercase letters are significantly different at $p \leq 0.05$ (Tukey's HSD). DAS = days after sowing.

Table 3: Dry matter percentage, dry matter yield, and corn grain Brix value of silage corn at different harvesting ages

Parameter	75 DAS	80 DAS	85 DAS	90 DAS
Dry Matter (%)	22.14 ± 0.98 d	27.53 ± 1.12 c	32.21 ± 1.05 b	36.47 ± 1.23 a
Dry Matter Yield (t/ha)	8.07 ± 0.52 d	11.76 ± 0.73 c	12.93 ± 0.81 b	15.12 ± 0.84 a
Corn Grain Brix (%)	18.43 ± 0.87 a	16.22 ± 0.79 b	13.87 ± 0.65 c	11.28 ± 0.72 d

Means within rows followed by different lowercase letters are significantly different at $p \leq 0.05$ (Tukey's HSD). DAS = days after sowing.

Table 4: Partial budget analysis of silage corn production at different harvesting ages in Claveria, Misamis Oriental (per hectare basis)

Economic Parameter	75 DAS	80 DAS	85 DAS	90 DAS
Total Variable Cost (PHP)	17,300	17,300	17,500	18,200
Fresh Biomass Yield (t/ha)	36.45	42.73	40.12	38.67
Farmgate Price (PHP/kg)	1.50	1.50	1.50	1.50
Gross Revenue (PHP)	54,675	64,095	60,180	58,005
Net Profit (PHP)	37,375	46,795	42,680	39,805
Return on Investment (%)	116.0	170.5	143.9	118.7

Farmgate price based on Alpha Agventure Farms (n.d.) and Mananghaya (2015) [2]. Variable costs include seeds, fertilizers, labor, and other inputs. ROI = (Net Profit / Total Variable Cost) × 100

4. Discussion

The results of this study demonstrate that harvesting age exerts a significant and consistent effect on virtually all agronomic, physiological, and economic parameters of silage corn grown under the highland conditions of Claveria, Misamis Oriental. The progressive decline in plant vigor from 75 to 90 DAS is an expected manifestation of the shift from vegetative to reproductive growth and the onset of senescence, as reported in general maize agronomy literature (Pandey *et al.*, 2017) [24]. The peak plant height at 85 DAS followed by stabilization at 90 DAS is consistent with the cessation of internode elongation following anthesis (Salve *et al.*, 2023; Li *et al.*, 2024) [26, 20].

The inverse relationship between leaf proportion and stem proportion across harvest ages reflects the well-documented ontogenetic shift in plant biomass partitioning as corn matures. High leaf-to-stem ratios, as observed at 75 and 80 DAS, are associated with greater forage quality because leaves have higher crude protein, lower neutral detergent fiber (NDF), and better digestibility compared to stems (Khan *et al.*, 2015; Ferraretto and Shaver, 2015) [16, 11]. This finding supports the recommendation that silage corn should ideally be harvested before excessive stemming reduces the relative contribution of digestible leaf material.

The peak total biomass yield at 80 DAS and peak herbage yield at 85 DAS reflect the combined effect of continued stalk and cob filling beyond 80 DAS even as total above-ground productive biomass stabilizes. This slight divergence—where herbage yield continues to increase one stage beyond the biomass peak—may be partly attributed to the rapid cob filling that occurs between 80 and 85 DAS in tropical environments, as observed by Kumara *et al.* (2021) [17] in Philippine maize studies. The biomass yields recorded (36.45–42.73 t/ha) are consistent with, and at the higher end of, published values for tropical corn silage systems (Smith, 2016; Shah *et al.*, 2021) [28, 27], confirming that Claveria's upland agroclimatic conditions are conducive to productive silage corn cultivation.

The dry matter trajectory is perhaps the most critical finding from a silage technology standpoint. The DM% at 75 DAS (22.14%) was well below the optimal ensiling range, indicating that harvesting at this stage would result in effluent losses, poor fermentation, and nutrient leaching (Drewnoski, 2023) [9]. The DM% at 80 DAS (27.53%) approached but had not yet entered the recommended 28–38% window (Ferraretto and Shinnors, 2013) [10], while DM% at 85 DAS (32.21%) fell squarely within the optimal range and DM% at 90 DAS (36.47%) was approaching the upper limit beyond which packing and fermentation efficiency declines (Ohio State University Extension, 2025; Lauer, 2021) [23, 19]. From a purely qualitative standpoint, 85 DAS would appear to be the technically ideal harvest stage for silage fermentation quality. However, when the economic dimension is overlaid, 80 DAS emerges as the overall optimum because peak biomass at that stage generates the highest revenue and ROI, and the DM% (27.53%) is close enough to the recommended range to produce acceptable silage when the forage is properly managed and chopped to an appropriate theoretical length of cut.

The progressive decline in corn grain Brix from 18.43% at 75 DAS to 11.28% at 90 DAS is consistent with the biochemistry of kernel maturation: as the milk-line progresses and starch deposition continues, soluble sugars are increasingly polymerized into starch and structural carbohydrates (Ferraretto and Shaver, 2015) [11]. From an ensiling perspective, adequate Brix values (>12%) ensure that sufficient substrate is available for lactic acid bacteria to produce the lactic acid necessary to rapidly drop pH and stabilize the silage (Drewnoski, 2023) [9]. The data suggest that the critical Brix threshold is most reliably exceeded up to 85 DAS, and that 90 DAS harvesting may compromise fermentation in some seasons.

The economic analysis places the trade-offs between the parameters into a practical farmer decision-making framework. While 85 DAS may offer superior silage fermentation quality and 90 DAS produces the highest dry matter yield per hectare, these advantages do not translate into the highest economic return because the reduction in fresh biomass (and thus gross revenue at a fixed farmgate price per kilogram fresh weight) outweighs the quality and dry matter gains. The highest ROI at 80 DAS (170.5%) compared to 90 DAS (118.7%) represents a substantial economic incentive for earlier harvest and is consistent with the economic analyses of silage systems reported by Guevara-Hernández *et al.* (2020) [12] and Mananghaya (2015) [21]. From the perspective of smallholder and commercial dairy-linked silage producers in Claveria, this finding has important practical implications: slight under-maturity at harvest, while involving a modest compromise on DM%, is more than compensated by higher fresh yield and revenue.

These results should be interpreted in light of several study limitations. The experiment was conducted during a single cropping season, and replication across seasons and years would strengthen the confidence and generalizability of the recommendations. Rainfall variability—identified by Balbin *et al.* (2021)^[6] and Irwin (2023)^[14] as a primary driver of maize yield variability—could cause the optimal harvest window in terms of DM% to shift by several days between wet and dry seasons. Additionally, only partial budget analysis was conducted; a full cost-benefit analysis incorporating fixed costs, land rental, and opportunity costs would provide a more comprehensive economic picture for farm planning. Future studies should also assess laboratory-measured fermentation quality (pH, lactic acid, ammonia-N) of silage produced at each harvest age to validate the Brix-based inferences regarding fermentation potential.

5. Conclusion

This study demonstrated that harvesting age significantly affects all agronomic, physiological, and economic parameters of silage corn in Claveria, Misamis Oriental. Plant vigor was highest at 75 DAS and declined with maturity. Plant height peaked at 85 DAS. Leaf proportion decreased and stem proportion increased with age. Biomass yield was highest at 80 DAS, herbage yield at 85 DAS, and dry matter percentage and dry matter yield were greatest at 90 DAS. Corn grain Brix declined progressively from 75 to 90 DAS. Economic analysis revealed the highest gross revenue, net profit, and ROI at 80 DAS.

Based on the combined agronomic, physiological, and economic evidence, harvesting at 80 days after sowing is recommended as the optimum stage for silage corn in Claveria, Misamis Oriental, as it achieves the best balance between biomass productivity, acceptable dry matter content, sufficient fermentable sugar levels, and maximum economic returns. Farmers who prioritize fermentation quality and dry matter concentration may consider extending harvest to 85 DAS, accepting a modest reduction in fresh yield and revenue. Harvesting at 90 DAS is not recommended due to the combined effects of declining Brix, elevated dry matter approaching the upper ensiling limit, reduced fresh yield relative to 80–85 DAS, and lower economic returns.

These findings provide a practical, evidence-based framework for harvest timing decisions by smallholder and commercial silage corn producers in the Mindanao highlands, and contribute to addressing the knowledge gap identified by the Philippine Maize Federation Inc. (2024)^[25] regarding reliable, location-specific silage production data.

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References

- Alcantara, Bautista. Evaluates yellow corn hybrids—including NM08A4 and NM08A5—in field trials at MOSCAT. Claveria; 2010.
- Alpha Agventure Farms. 7 reasons why outsourcing corn

silage is better than producing it yourself. n.d.

- Amissah LAN, Vyn TJ, Ciampitti IA. Assessing corn recovery from early season nutrient stress under different soil moisture regimes. *Frontiers in Plant Science*. 2024;15:1344022.
- Anon. Recommended yellow corn hybrids under Claveria [Misamis Oriental, Philippines]. PCARRD Highlights. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development. 2010;70.
- Arshad M, Nawaz R, Ahmad S, Irshad MA, Irfan A, Qayyum MMN, *et al.* Effect of daily thinning on biweekly increment of growth and yield of maize (*Zea mays* L.) in mountainous agroecosystem. *BMC Plant Biology*. 2025;25:428.
- Balbin VC, Bautista RG, Guinutad ML, Camayang AGG, Magcale-Macandog PB, Almonte JL. Role of climate especially temperature and rainfall variability as primary factors influencing corn productivity. 2021-2023.
- Chen XJ, Cao GC, Jia YS, Wu DB, Chen J, Yu YX, *et al.* Influence of elevation on growth duration of maize (*Zea mays* L.). *Chinese Journal of Eco-Agriculture*. 2009;17(3):527-532.
- Coulter J. Harvest strategies for corn silage. University of Minnesota Extension. 2021.
- Drewnoski M. Options for safely using high-nitrate forage: grazing, silage and haying. University of Nebraska-Lincoln. 2023.
- Ferraretto LF, Shinnors KJ. Passage kinetics of corn silage show optimal digestibility at 32-38% DM. 2013.
- Ferraretto LF, Shaver RD. Effects of whole-plant corn silage hybrid type on intake, digestion, ruminal fermentation, and lactation performance by dairy cows through a meta-analysis. *Journal of Dairy Science*. 2015;98(4):2662-2675.
- Guevara-Hernández F, Ocaña A, Funes F. Energy and economic efficiency of maize agroecosystems under three management strategies in the Frailesca, Chiapas (Mexico). *Agriculture*. 2020;10(3):81.
- Haque MN, Sarker NR, Hossain MM. Evaluation of nutritional quality of corn (*Zea mays* L.) varieties at different harvesting stages for silage production. *Asian Journal of Crop Science*. 2020;12(2):85-93.
- Irwin S. The relative impact of crop weather variables on the U.S. average yield of corn. *farmdoc daily*. 2023;13:184.
- Keady TWJ, Gordon AW, Moss BW. Review paper on silage production and utilization. 2013.
- Khan NA, Yu P, Ali M, Cone JW, Hendriks WH. Nutritive value of maize silage in relation to dairy cow performance and milk quality. *Journal of the Science of Food and Agriculture*. 2015;95(2):238-252.
- Kumara L, Laude TP, Hernandez JE, Sanchez PB, Dorado MA, Garcia JNM, Gauna GB, Sta Cruz PC. Climatic factors affecting maize grain yield in different growing areas of the Philippines. *The Philippine Agricultural Scientist*. 2021;104(4) 2.
- Lauer J. Timing corn silage harvest. Integrated Pest and Crop Management. University of Wisconsin-Madison. 2016.
- Lauer JG. Kernel milkline: A method to determine corn silage harvest timing. University of Wisconsin-Madison Extension Agronomy. 2021.
- Li Y, Li C, Cheng Q, Duan F, Zhai W, Li Z, *et al.* Estimating maize crop height and aboveground biomass using multi-source unmanned aerial vehicle remote sensing

- and Optuna-optimized ensemble learning algorithms. *Remote Sensing*. 2024;16(17):3176.
21. Mananghaya RAK. Corn silage production as an enterprise. DOST-PCAARRD S&T Media Service. 2015.
 22. North Dakota State University Extension. Moisture matters when making good corn silage. NDSU Extension. 2021.
 23. Ohio State University Extension. Corn silage harvest timing. C.O.R.N. Newsletter. Ohio State University Extension. 2025.
 24. Pandey A, Dwivedi S, Kumar S. Plant growth analysis. ResearchGate. 2017.
 25. Philippine Maize Federation Inc. Dearth of reliable information hinders strategic scaling, marketing, and policymaking efforts, limiting the development of the silage industry beyond experimental or localized efforts. 2024.
 26. Salve DA, Maydup ML, Salazar GA, Tambussi EA, Antonietta M. Canopy development, leaf traits and yield in high-altitude Andean maize under contrasting plant densities in Argentina. *Experimental Agriculture*. 2023;59.
 27. Shah T, Khan A, Iqbal M, Rehman A, Nawaz M, Khan S. Agronomic performance and genetic variability of maize (*Zea mays* L.) hybrids under different environments. *Pakistan Journal of Agricultural Sciences*. 2021;58(2):457-465.
 28. Smith AM. Assessing the efficiency of biomass production system: A review. *Journal of Biomass Production and Utilization*. 2016.