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Saving the heirloom Corn varieties of Kalinga Province

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Abstract

Heirloom corn is one of the distinctive and significant cultivars grown in Kalinga Province. Factors such as shifting to GM corn, reduction of corn area, entry of OPV varieties, and the age of farmers impact heirloom corn varieties in Kalinga. This study looked into the ex-situ characterization of heirloom corn varieties and the effect of fertilizer on the growth and yield of heirloom corn. The genetic base of heirloom corn consisted of twenty-four accessions in ex-situ characterization with eighty-four descriptors. Quantitative and qualitative characteristics of white and purple heirloom corn were determined. The cultivars possess a unique qualitative character to distinguish their traits. The ex-situ characterization shows a slight variation in both quantitative and qualitative data for the cultivars tested. Field trials of heirloom corn planted in the two experiment areas showed no significant difference in the variables tested except in the plant height of heirloom corn under the Tabuk City condition. Sole ammonium phosphate (16-20-0) significantly affected the weight of the kernel and the yield of purple corn. The combined Ultimax organic and ammonium phosphate fertilizer did not yield significantly. Ammonium phosphate application is more effective in a sloped area than organic fertilizer. This phenomenon may be due to the faster release of inorganic fertilizer than organic fertilizer, which has a slow release; moreover, combining inorganic and organic fertilizers significantly improved heirloom corn. Farmers in Kalinga province must continuously cultivate and bequeath these cultivars to the young generation to preserve heirloom corn germplasm.

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Introduction

Heirloom corn is one of the unusual and essential varieties in Kalinga Province. The study collected existing heirlooms, recorded them, and conducted field tests to conserve them. Zea mays, sometimes known as corn, is a significant food crop in the Philippines and is used as a staple meal by 20% of the country's citizens (World Food Program, 2012), particularly in the southern Visayas and Mindanao islands (Logroo *et al.*, 1996). The product provides a livelihood for five million Filipinos. Corn comes in third overall regarding gross value added (GVA) in agriculture, behind only rice and coconut (PCARRD, 2006). The crop has significant economic value as a primary component of animal and poultry diets and as a raw material for various industrial goods, including starch oil, artificial sweeteners, and organic liquids (Siopongco *et al.*, 1999). In 2010, Php70 billion, or US$1.7 billion, was spent on corn production (Bureau of Agricultural Statistics 1).

The two most common kinds of maize grown in the Philippines are yellow and white. In times of rice shortage, white maize is the most important staple food, especially for those living in rural regions (Gerpacio *et al.*, 2004). Kalinga has flint and glutinous white, yellow, and purple heritage corn varieties. Although it does not receive much notice, purple corn has been commonly grown and enjoyed in other regions worldwide. White maize is eaten as a vegetable or a snack in regions where rice is the primary food. "Poor man's rice" is frequently used to describe white maize. Purple corn and other colored maize are not commonly grown in the Philippines (Greenpeace). Around 22 percent of the world's maize supply, according to data from 1990 to 2005,

Eighty-one countries agree that genetic deterioration in crops is mainly caused by replacing native species and varieties with better or foreign ones (FAO, 1997). Population pressure, environmental deterioration, legislation/policy, pests/weeds/diseases, shifting agricultural systems, and species overexploitation are additional factors contributing to genetic erosion. According to Greenpeace (2012), farmers may soon lose access to the traditional OPV of white corn for planting since genetically modified organism (GMO) contamination in maize types is already occurring among varieties patented and held by agrochemical corporations. It demonstrates the ineffectiveness of RA 7308, often known as the "Seed Industry Development Act," which requires the government to "conserve, maintain, and develop the plant genetic resources of the nation and supply the local communities with the genetic resources they need." It is essential to preserve landraces and crop wild relatives to preserve genetic resources for future crop improvement (Ford–Lloyd *et al.*, 2011). Crop wild relatives and landraces offer valuable genetic material for breeding current improved lines, reducing the susceptibility of inbred crops to diseases and pests, enhancing performance, and adding distinctive features (Lopes *et al.*, 2015). The heirloom corn of Kalinga is no different from other corn varieties in danger of being lost. Hence this study aims to conserve the Kalinga heirloom corn varieties. Furthermore, it looks into the ex-situ characterization (qualitative and quantitative) of the two heirloom corn varieties. The field trials aim to look into the effect of organic and inorganic fertilizers on the heirloom corn cultivars' growth and yield production.

Material and methods

Survey and Documentation of Production Areas and Profiling of Farmers

Before the research was conducted, free prior informed consent (FPIC) was secured from indigenous communities in Barangay Balinciagao, Pasil, Kalinga, and Pantikian, Balbalan, Kalinga. A structured questionnaire was used for data gathering. The data-gathering procedures were under the provisions of the Indigenous Peoples' Act. Purple corn production site was mapped to identify places where heirloom corn is grown in the study area.

Ex-Situ Characterization of Heirloom Corn Varieties

The ex-situ characterization was conducted at Sitio Luyucan, Lacnog, Tabuk City, Kalinga. The area was dry-cultivated with a carabao-mounted plow. After two weeks, it was harrowed twice to incorporate crop residues and eradicate newly emerged weeds using a combed-tooth harrow mounted on a hand tractor.

An area of 288m² was used in the experiment and arranged in a randomized complete block design (RCBD) with three replications, or blocks. The crop was manually planted on March 17, 2020, and received immediate light irrigation. The data collection was based on the biodiversity descriptors list, with 84 parameters considered. However, essential characters for the ex-situ characterization were subjected to analysis following the factorial experiment in a randomized complete block design using analysis of variance. Duncan's multiple-range test was used to compare means at 1% and 5% levels of significance. The soil at the experimental site has a pH of 6.88. Vermicompost at 6.25kg/plot was applied two weeks before planting, and the 46-0-0 was applied 16 days after planting at 2.0kg/plot.

Weeds were controlled using a mechanical weeder at the crop's seedling, early, and late whorl stages. Manual weeding was applied during the crop's tasseling, silking, milking, and maturity stages. No herbicide was applied to the crop for the whole duration of the experiment. Immediately after crop emergence, twenty consecutive plants were tagged as representative sample plants—ten for measurable characters and ten for observable characters. Tassel bagging and silking bagging of purple corn cultivars were done 53 and 59 days after sowing (DAS) to avoid cross-pollination with white corn cultivars.

Sucking insects such as armyworms were damaging during the vegetative stage but were successfully controlled using Virtako 40 WG insecticide at 10g/15 L per knapsack sprayer. Virtako 40 WG is used against Lepidoptera, sucking, and soil pests in various crops. However, it was tested successfully against Armyworm occurrences in maize, as observed. Manual removal of armyworms was also used to eradicate them. An alternate application of systemic insecticide was made to protect and save the crop from insect pest occurrences, and rodenticide was applied 64 DAS to control rat occurrences.

Harvesting of the heirloom corn cultivars was done manually according to the asynchronous maturity of the crop. The white corn cultivar was harvested at an average of 89.67 DAS, and the purple corn cultivar at 94.42 DAS. The kernels were sundried. Moisture content was determined using the pH meter at 14 percent before appropriately storing the seeds.

Field trial

The first field trial was conducted in the Barangay Balinciagao, Pasil, Kalinga in January 2021. An area of 76 m2 was prepared by removing weeds and allowing natural decomposition. The experimental site was laid out following an RCBD in a single-factor experiment. The treatments are as follows: T_0 – No Fertilizer Application; T_1 – 100% Ultimax organic fertilizer at the recommended rate; T_2 – 100% ammonium phosphate (16-20-0) of the recommended rate; T_3 – 50% Ultimax organic fertilizer at the recommended rate + 50% ammonium phosphate (16-20-0) of the recommended rate. The amount of fertilizer used was determined based on the soil analysis and the fertilizer's nutrient analysis.

The Ultimax organic fertilizer was applied one week before planting, following the computed amount of 1,043 g per plot. Ammonium phosphate (16-20-0) was applied at 20 DAS at 120g/plot. The weeds in the experimental area were controlled by hand weeding. No herbicide was applied during the entire duration of the study. There had been no incidents of insect pest occurrences observed.

The second field trial was conducted in April 2021 at Pantikian, Balbalan, Kalinga. An area of 187 m2 was used, and the experiment was laid out in an RCBD with four treatments and four replications. The treatments consisted of T_1 -- no fertilizer applied; T_2 -- 1,800g of bio-synergy per plot; T_3 -- 240g of ammonium phosphate per plot; and T_4 -- 900g of bio-synergy plus 120g of ammonium phosphate per plot. Likewise the amount of fertilizers is based on soil analysis and the nutrient analysis of the fertilizers.

In both experimental sites, heirloom corn cultivars were planted in each plot (2m x 3m). The spacing between plants and rows was 60cm by 30cm, with two plants per hill. Bio-synergy organic fertilizer was applied one week before sowing, and ammonium

phosphate was applied 15 days after sowing. The heirloom corn cultivated in Balinciagao was manually harvested at 117 days and at 110 days for the heirloom corn in Pantikian, Balbalan, Kalinga. Manual threshing separated the kernel from the ear, allowing fast drying at 14 percent moisture. The science research assistants assigned to the project collected data at the two experimental sites. Average plant height, ear height, ear length, ear diameter, the weight of 1000 corn seeds, and yield per plot were taken. The collected data were computed and analyzed using analysis of variance (ANOVA) in the RCB design.

Result and discussion

Profiling of Heirloom Corn Farmers

The site maps where heirloom corn cultivars are produced are shown in Fig. 1 and 2. The site mapping (GPS) findings revealed an average of 260.43m2 per farmer in Pantikian and 210.52m² per farmer in Balinciagao, as shown in Table 1. It was found that farmers in Pantikian, Balbalan devote an area of 105m² to 1,033m2 to heirloom corn, while heirloom corn farmers in Balinciagao devote 30 m² to 852 m². Of the 51 farmers profiled, 40 are growing heirloom corn in Pantikian, Balbalan, and out of the 30 farmers profiled, 23 are planting heirloom corn. Considering that these are sloped and mountainous locations, it showed that farmers in Balinciagao Norte tilled a lesser area. The farmer's perception of the heirloom corn's sustainability and conservation impacts how much area is set aside for its cultivation. The continuous reduction and the introduction of new corn varieties by private individuals threaten heirloom cultivars, resulting in genetic erosion. Row 5 in Table 1 shows that the respondents' primary source of income is farming; other farmers are wage earners, and a few rely on support and assistance from the government. Since most of the respondents profiled are elders, they receive their elderly allowances and poverty funds monthly. The respondents have an average income of PHP 50,000–250,000. Interestingly, heirloom corn farmers in the study sites are advanced in age, which impacts the conservation and sustainability of producing heirloom corn.

Table 1. Summary of profiled heirloom corn farmers.

Barangay	Balinciagao Norte, Pasil, Kalinga	Pantikian, Balbalan, Kalinga
Area cultivated with heirloom corn	4,842 m²	10,417.5 m²
No. of farmers cultivating HVC	23	40
Sources of Income		
- Farming	42.31%	40.74%
- Wages	25%	23.46%
- Allowance for elderly	11.54%	13.58%
- Poverty funds	21.15%	4.94%
Age of heirloom corn farmers		
- 71-80 yrs old	-	13.46%
- 61-70 yrs old	30%	30.77%
- 31-40 yrs old	20%	7.60%
- 20-30 yrs old	3.33%	-
Sources of Planting Materials		
- Own harvest	(26) 86.67%	(44) 84.62%
- Other farmers	(4) 13.33%	(8) 15%

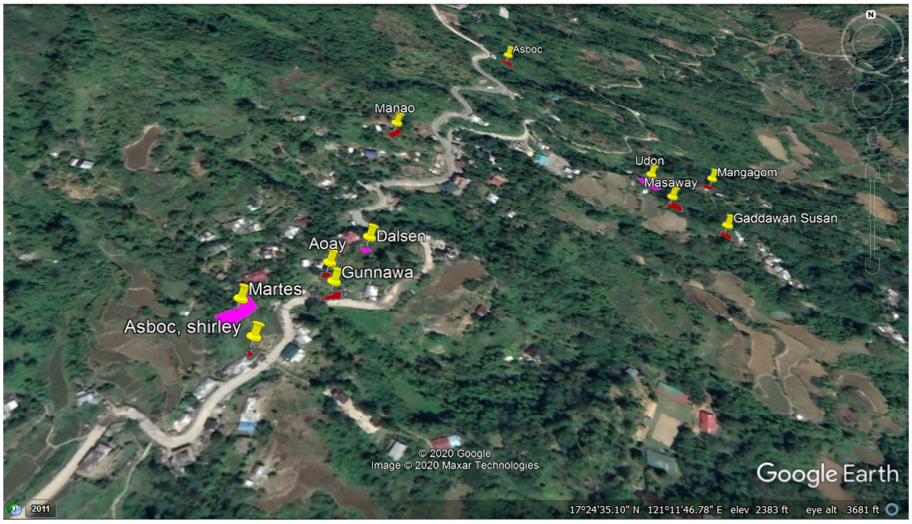

Fig. 1. Site Map at Balinciagao Norte, Pasil, Kalinga.

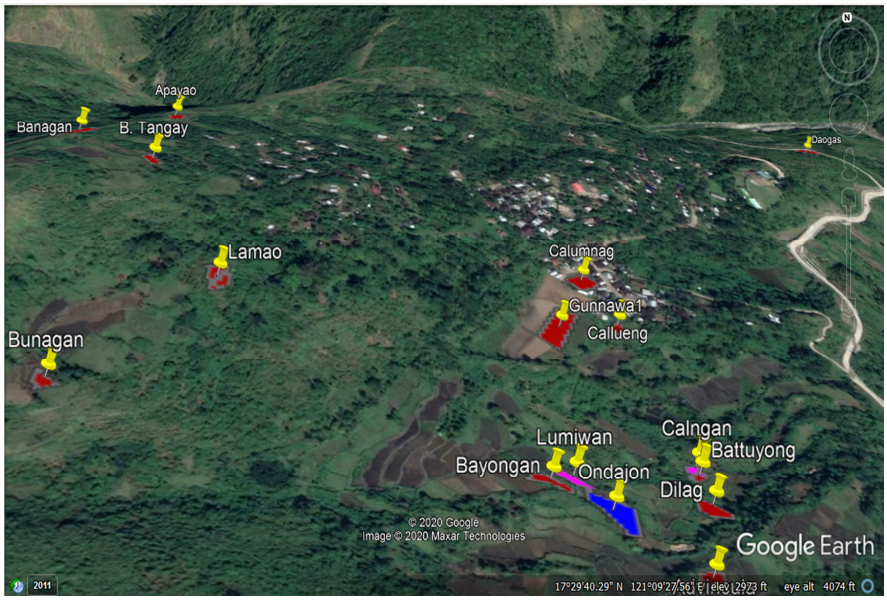

Fig. 2. Site Map at Pantikian, Balbalan, Kalinga.

Qualitative characters of Heirloom Corn under Ex-situ condition

The result of ex-situ characterization is presented in Table 2. The quantitative characteristics of the purple and white heirloom corn are compared along 24 characteristics, where heirloom purple and white are compared using ANOVA and DMRT for mean comparison. The number of days to tasseling revealed that purple and white corn did not significantly differ. The number of days to silking revealed that the purple corn cultivar has longer days to silking, with a mean of 60 days than the white corn cultivars, with 57 days. Data shows that purple corn cultivars mature longer than white corn at 94 days for the mean days to maturity, while white corn cultivars mature early at 90 days. Statistical analysis revealed a highly significant difference between the two cultivars. The experiment results are similar to (Transon & Defourny, 2017) findings that open-pollinated varieties (OPV) have asynchronous growth, produce flowers and ears at different periods, and reach maturity on different days.

Table 2 shows the quantitative characteristics of the heirloom corn cultivars of Kalinga. It can be gleaned from the table that white corn cultivars obtained a longer leaf than purple corn cultivars, with a difference of 9.21cm. Analysis revealed a highly significant difference in the leaf length of the crop. The purple corn cultivar has a broader leaf than the white corn cultivar, but the white corn cultivar has a longer leaf than the purple cultivar. The white corn cultivar is more advantageous at trapping sunlight for photosynthesis than purple corn because it has longer leaves than purple corn. The venation index of the heirloom corn cultivars showed that the purple cultivar revealed a higher venation index of 10.71 than that of the white corn cultivar, with a mean of 6.80. Thus, a highly significant difference was noted in the venation index of the heirloom corn cultivars. The leaf width of the crop is proportionate to the number of venation indexes, as shown in the leaf width parameter. White corn cultivars had more leaves per plant than the purple corn cultivar. It means that the more leaves per corn plant, the taller the plant. On the number of leaves above the uppermost ears, the white corn cultivar had a higher mean of 6, while the white corn cultivar had a mean of 5. However, the statistical analysis showed no significant difference in the mean number of leaves above the uppermost ear of the crop. The leaves of heirloom corn cultivars below the uppermost ear showed that the white corn cultivar had a higher mean number of 7 compared to 6 for the purple corn cultivar, with a highly significant difference at 1% level significance.

With a very significant difference at a 1% significance level, the white corn cultivar is taller than the purple

corn cultivar by 78cm. The above result on the heirloom corn's height confirms the findings of this study on plant height. This study found that the height of the corn is directly related to the number of leaves. The more leaves the corn plant has, the taller it is. The purple corn's average ear height is 74.41cm, but the white corn's average ear height is 116.73cm. According to statistical findings, there is a significant difference in the ear height of the crops. The height of the corn ear is related to the height of the plant. It can be observed that the taller the plant, the higher the occurrence of the corn ear.

The purple cultivar has a larger stem diameter at the base (1.73cm) than the white corn cultivar (1.72cm). However, there is no discernible difference in the diameter of the two cultivars. It indicates that the stem diameter of the two corn cultivars is similar. The white corn cultivar obtained a more extended lateral branch than the purple corn cultivar, indicating a highly significant difference in the lateral branch length of the heirloom corn cultivars.

After the milk stage of the heirloom corn cultivar, the tassel parameters were measured. The results demonstrate that purple corn produced longer tassels with a mean length of 47.13cm as opposed to 42.50cm for white corn cultivars; however, the numerical variance has no statistical difference.

The average length of white corn's main axis above the lowest lateral branch is longer than purple corn's main axis above the lowest lateral branch. However, the white corn's main axis above the highest lateral branch is shorter than the purple corn's main axis above the highest lateral branch. Statistically, the main axis, lowest, and highest lateral branches are not significantly different. The lateral branch length of the heirloom corn cultivars revealed that white corn cultivars obtained a more extended lateral branch with a difference of 12.62cm than the purple corn cultivar. This difference is significant at the 1% level.

Table 2 also shows the ear characteristics of heirloom corn varieties in terms of ear length, peduncle length, ear diameter, cob diameter, and rachis diameter. The results showed that the white corn produced ears that are longer on average, measuring 13.84cm compared to 11.56cm for the purple cultivar. The numerical difference is not statistically significant. The white corn cultivar had an average peduncle length of 7.57cm, while the purple corn cultivar had an average peduncle length of 5.70cm. This difference is highly significant. The white corn cultivar's mean ear diameter (4.04cm) is similar to that of the purple corn cultivar (3.91cm). The cob diameter of the heirloom corn cultivars showed that the white corn cultivar had a bigger diameter of 2.58cm than that of the purple corn cultivar, with a diameter of 2.22cm; the difference is highly significant. The bigger the diameters of the cob, the more kernels are attached. On the rachis diameter, the heirloom corn cultivars' measurements are similar. The kernel parameter revealed a significant difference between white and purple corn cultivars, with the latter producing kernels that are, on average, 1.88mm longer. The purple corn has a wider kernel (8.04mm) than the white corn (3.80mm), with a significant statistical difference. By comparing the heirloom corn cultivars' kernel thickness, it was discovered that the white corn cultivar's kernel is thicker by 3.23mm than the purple cultivar corn. It also shows that maize varieties differ considerably in thickness at the 1% level. As a result, it may be claimed that the two cultivars' maize kernel sizes cannot be compared.

Data from Table 2 reveals that white corn cultivars produced 11 kernel rows and purple corn cultivars produced 13; the variation in the number of kernel rows is very substantial. Regarding the average number of kernels produced per row, the white corn cultivar had a mean of 25, while the purple corn cultivar had a par of 24, with no discernible difference. With a mean unshelled weight of 128g, white corn cultivars are heavier than purple corn, whose mean unshelled weight is 82.80 g, according to research on the unshelled weight of heirloom corn varieties. The statistical analysis showed a highly significant variation in the unshelled weight characteristics. In other words, the yield is higher when the heirloom corn ear is heavier and unshelled. The weight of the corn varieties after shelling showed

a similar pattern. The purple corn cultivar has a shelled weight of 14.49g, and the white corn cultivar weighs 18.35g.

Despite variations in the numerical data, the statistical analysis still produced no statistically significant results for this parameter. Also, the findings indicate that statistically speaking, 1000 kernels of white maize cultivars weigh more than 1000 kernels of purple corn cultivars. The finding is projected on a ton-per-hectare basis. The purple corn cultivar produced 0.70t/ha, and the white corn cultivar produced 1.56t/ha. The highly significant difference between the two cultivars demonstrated that purple corn cultivars have less promise than white heirloom corn. Because mice and other pests are drawn to the aroma of purple cultivars, insect and pest infestations can significantly impact their yield.

Table 2. Quantitative characters of Kalinga Heirloom corn cultivars.

Parameter	Cultivars	
	Purple cultivar	White cultivar
Days to tasseling	53[a]	54[a]
Days to silking	60[a]	57[b]
Days to maturity	94[a]	90[b]
Leaf length (cm)	76.76[b]	85.97[a]
Leaf width (cm)	7.75[a]	7.04[a]
Total number of leaves per/plant	11[b]	13[a]
No. of leaves above the uppermost ear	5[a]	6[a]
No. of leaves below the uppermost ear	6[b]	7[a]
Plant height (cm)	135[b]	213[a]
Ear height	74.41[b]	116.73[a]
Stem diameter @ the base (cm)	1.73[a]	1.72[a]
Lateral branch (cm)	20.80[a]	33.42[b]
Tassel length (cm)	47.13	42.5
Length of the main axis above lowest lateral branch (cm)	34.12b	40.43[a]
Length of the main axis above highest lateral branch (cm)	24	21.18
Length of the lateral branch (cm)	20.80	33.42
Tassel peduncle (cm)	18.00[b]	29.28[a]
Tassel branching space (cm)	7.21	7.03
Ear length (cm)	11.56	13.84
Peduncle length (cm)	5.70	7.57
Ear diameter (cm)	3.91	4.04
Cob diameter (cm)	2.22[b]	2.58[a]
Rachis diameter (cm)	1.32	1.40
Kernel length (mm)	9.33[a]	7.45[b]
Kernel width (mm)	8.04[a]	3.80[b]
No. of kernel rows	13[a]	11[b]
No. of kernel/row	24	25
Unshelled weight (g)	82.8[b]	128.27[a]
Shelled weight (g)	14.49	18.35
No. of bracts	12	11
Weight of 100 seeds (g)	261.07	265.08
Yield tons/ha	0.70[b]	1.56[a]

Note: Means followed by common letters are not significantly different from each other by DMRT at 1% & 5% levels of significance.

Qualitative characters of Heirloom Corn under Ex-situ condition

Table 3 reflects the observed traits of heirloom corn varieties. The findings indicate that most of the characteristics of the two cultivars are different. Both heirloom corn varieties show modest anthocyanin coloration in the sheath and at the base of the glumes, and moderate to medium anthocyanin coloration is seen for the remaining glumes.

The purple cultivar has a pointed apex, and the white cultivar shows a pointed to rounded apex. Both varieties exhibit prominent blade margin undulation, while the stems are green. Sheath pubescence varies, with the purple cultivar having sparse pubescence while the white exhibits moderate pubescence. Both cultivars displayed a dangling orientation and a somewhat recurved leaf.

The anthocyanin coloring of glumes, excluding bases, differs. The white corn has weak to medium anthocyanin coloration of glumes, while the purple has weak anthocyanin coloration of glumes, excluding the base. A low degree of anthocyanin is evident in the anthocyanin coloration of silks, leaf sheaths, internodes, brace roots, and cob glumes. Anthocyanin content, a kind of flavonoid with antioxidant qualities, among other things, has been linked to purple pigmentation in maize, such as that of the kernel (Lao *et al.*, 2017).

The purple heirloom corn had varied coloring in its kernels. Both varieties of heirloom corn have medium-colored anthers that contain anthocyanins. Both of the heirloom corn varieties had the same type of tassels, which were yellowish in hue. The medium type is in heirloom purple corn, while the observed stay-green variety is essential in white.

The findings show that there is a significant difference between white and purple heirloom corn in terms of days to silking, maturity, leaf length, venation index, the total number of leaves per plant, number of leaves below the uppermost ear, plant height, ear height, peduncle length, cob diameter, length of the lateral branch, length of the tassel peduncle, kernel length,

Table 3. Qualitative variables of heirloom corn cultivars of white and purple corn cultivar under ex-situ characterization.

Qualitative Variables	Heirloom Corn Cultivars	
	White	Purple
Anthocyanin coloration of the sheath	Weak	Weak
Shape of Apex	Pointed to Rounded	Pointed
The intensity of the green color	Dark	Dark
The undulation of margin of blade	Strong	Strong
Stem Color	Green	Green
Sheath Pubescence	Intermediate	Sparse
leaf orientation	Pendant	Pendant
The angle between blade and stem	Very small to small	Medium
Curvature of blade	Moderately Recurved	Moderately Recurved
Degree of stem zigzag	Weak	Strong
Anthocyanin coloration at the base of glumes	Very Weak	Weak
Anthocyanin coloration of glumes excluding base	Weak	Weak to Medium
Anthocyanin coloration of anthers	Medium	Medium
Tassel type	Tertiary	Tertiary
Tassel color	Yellowish	Yellowish
The density of spikelets of tassel	Moderately Lax to Medium	Moderately Lax to Medium
Anthocyanin coloration of silks	Weak	Weak
Silk Color	Light Yellow	Light Yellow
Anthocyanin coloration of the leaf sheath	Weak	Weak
Anthocyanin coloration of internodes	Weak	Weak
Anthocyanin coloration of brace roots	Weak	Weak
Stay green (after milk stage)	High	Medium
Husk cover	Intermediate	Intermediate
Husk fitting	Intermediate	Intermediate
Husk Tip Shape	Long	Short
Ear shape	Tapered/Cylindrical-Conical	Tapered/Cylindrical-Conical
Ear tip shape	Short, Pointed	Blunt
Ear orientation	Semi-erect	Semi-erect
Anthocyanin coloration of glumes of cob	Weak	Weak
Kernel Row arrangement	Irregular	Irregular
Cob color	White	White
Kernel Type	Floury	Floury
Kernel Color	White	Variegated
The shape of the upper kernel surface	Level	Rounded
Pericarp color	Colorless	Brown
Aleurone Color	Colorless	Colorless
Endosperm Color	White	White

width, and thickness, number of kernel rows, and unshelled weight. Days to tasseling, leaf width, number of leaves above the uppermost ear, stem diameter at the base and below the uppermost ear, ear length, ear diameter, rachis diameter, tassel length, length of the central axis above the uppermost and above the lowest lateral branch, tassel branching, and number of kernels per ear did not differ.

Heirloom corn cultivars typically have horizontal leaves and asynchronous growth during the vegetative stage. They exhibit different reproductive strategies for producing silk, tassels, and ears in the same field. Heirloom corn cultivars mature at a different stage than other varieties. If cultural control is maintained, these cultivars have a higher potential yield.

Fig. 3. Some of the BDL measurements during reproductive stage.

Crop Production of Purple Corn at Balinciagao Norte, Pasil, Kalinga

The field trial was conducted in two experimental locations: Pantikian, Balbalan, Kalinga and Balinciagao

Norte, Pasil, Kalinga. These cultivars have been perennially planted in certain places for many years. It was observed that the purple corn generated a tassel after 54.58 days, identical to what was discovered during the ex-situ characterization. The numerical difference in the days of tasselling is not statistically significant. There were no appreciable variations in the treatment tested for the purple corn's silking, which had a grand mean of 60.33 days, a plant height of 129.50cm, and an ear height of 97.19cm.

Table 4 shows that the weight of the purple corn kernel increases significantly after being fertilized with an inorganic fertilizer like 16-20-0. Compared to T0, T3, and T1, the application of inorganic fertilizer (16-20-0) exhibited the highest kernel weight at 136.93g. However, it was found that neither 100% Ultimax organic fertilizer nor combined Ultimax organic fertilizer and 16-20-0 produced the second-heaviest weight of 99.80 grams. The results show that using or combining only organic fertilizer with inorganic fertilizer will produce little difference or results.

Table 4 displays how the suggested organic and inorganic fertilizer rates affected the yield (tons per hectare) of heirloom corn. The experiment's findings demonstrate that the yield per plot is highly significant. The yields per plot results of the experiment were extrapolated to tons per hectare. The estimated yield of Kalinga's purple corn under Balinciagao, Pasil, Kalinga conditions is 5.56tons/ha. The application of inorganic fertilizer (16-20-0) yields 8.35tons/ha; the non-application of fertilizer yields 6.40tons/ha; the application of 100% Ultimax organic fertilizer yields 4.32tons/ha; and the application of combined Ultimax and inorganic fertilizer produces 4.32tons/ha.

Table 4. Growth and yield results of field trial under Balinciagao Norte, Pasil, Kalinga.

Treatments/Parameter	Ave. Plant Height (cm)	Ave. Ear Height (cm)	Ave. Ear Length (cm)	Ave. Ear Diameter (mm)	Weight of 1000 seeds(g)	Yield (Tons/ha)
T_0 – No application	±130.08	±93.26	±8.67	±3.87	±99.8^{b}	±6.41^{ab}
T_1 – 1,043 g/plot of Ultimax organic fertilizer	±120.82	±97.46	±7.85	±3.61	±85.43^{d}	±4.32^{bc}
T_2 – 120 g/plot of Recommended (16-20-0)	±134.99	±93.14	±13.63	±4.19	±136.93^{a}	±8.35^{a}
T_3 – 521.5 g Ultimax Fertilizer + 60 g/plot (16-20-0)	±126.11	±104.88	±8.0	±3.70	±87.6^{c}	±3.16^{c}

Note: Means not sharing letter in common differ significantly by DMRT

Fig. 4. Fertilizer application.

Crop Production of Purple Corn at Pantikian, Balbalan, Kalinga

Table 5 shows the data from the field trial in Pantikian, Balbalan. It was found that there is no appreciable variation in the average height of purple corn. The typical ear height, ear length, and ear diameter of heirloom corn applied with the treatments evaluated did not result in appreciable parameter variations—the benefit of using organic fertilizer and ammonium phosphate on heirloom corn is similar.

Table 5. Growth and yield results under field trial at Pantikian, Balbalan, Kalinga condition.

Treatments/Parameter	Ave. Plant Height (cm)	Ave. Ear Height (cm)	Ave. Ear Length (cm)	Ave. Ear Diameter (mm)	Weight of 1000 seeds (g)	Yield (Tons/ha)
T_0 – No fertilizer application	±244.04	±125.07	±13.86	±4.49	±372.5^{c}	±13.0^{b}
T_1 – 1,800 g/plot Bio-synergy fertilizer	±258.48	±132.42	±15.12	±4.75	±430^{ab}	±16.06^{a}
T_2 – 240 g/plot of recommended inorganic fertilizer (16-20-0)	±262.90	±128.75	±15.46	±4.62	±395^{bc}	±15.64^{a}
T_3 – 900 g Bio-synergy fertilizer + 120 g/plot inorganic fertilizer (16-20-0)	±257.77	±132.54	±15.49	±4.72	±452.5^{a}	±16.1^{a}

Note: Means not sharing letter in common differ significantly by DMRT

Fig. 5. The heirloom corn farmers during the Field Day at Pantikian, Balbalan, Kalinga.

The different combinations of fertilizers affect the weight of 1000 Kalinga purple corn seeds. Applying 900 g Bio-Synergy organic fertilizer + 120g/plot of ammonium phosphate at the recommended rate (16-20-0) produced the heaviest weight of 452.5g of 1000 seeds. Applying 100% Bio-Synergy organic fertilizer or 100% recommended ammonium phosphate produced a lighter 1000 seeds, and the non-application of fertilizer produced the lowest weight of 1000 kernels at 372.5g. Mixing organic and inorganic fertilizers brought about the heaviest corn kernels, and the non-application of fertilizer brought about the lightest heirloom corn kernels. Fertilizer application aids in increasing plant weight, and mixing organic and inorganic fertilizers increases kernel weight.

The experiment's actual yield (kg) per plot was extrapolated to yield tons per hectare under the Pantikian, Balbalan, Kalinga ecosystems. The highest yield estimate was found when the recommended inorganic fertilizer (16-20-0) and organic fertilizer (bio-synergy) were applied together. Plants receiving 100% bio-synergy applications produced 16.06 tons/ha of yield, and plants receiving 100% 16-20-0 produced 15.64 tons/ha of yield. The lowest yield was found when no fertilizer was applied. This cultivar's estimated yield is greater than the average yield across the country. The experiment's findings on yield (13.0 to 16.1 tons/ha) in Pantikian, Balbalan, Kalinga are much higher than the harvest in Pasil, Kalinga, which ranges from 3.16 to 8.35 tons/ha. It is also observed that the application of organic fertilizer in Pantikian results in a high yield.

Conclusion

The site mapping and profiling results indicate that more heirloom corn cultivars are grown in a larger area in Barangay Pantikian, Balbalan, Kalinga than in Barangay Balinciagao Norte, Pasil, Kalinga. Agriculture is the main source of revenue for both of the selected barangays. Most of the farmers profiled make between PHP 50,000 and PHP 250,000. Most of the farmers in the profiles who are growing heirloom corn are between 60 and 70 years old. The barangays of Pantikian, Balbalan, Kalinga, and Balinciagao, Pasil, Kalinga, have many elderly farmers who cultivate heirloom corn. The aging of farmers and the introduction of new types, such as

yellow corn, impact the preservation of heirloom corn in Kalinga province.

Based on the field trial's findings, the heirloom corn cultivars performed differently in Tabuk City conditions since the yield was much lower than heirloom corn cultivars in Pasil and Balbalan. Under various fertilizer rates, heirloom corn cultivars yielded higher in Pantikian, Balbalan, Kalinga than the heirloom corn in Balinciagao Norte, Pasil, Kalinga. This potential for purple corn yield response shows that the plant favored cool environments over hot ones (over 33 °C).

The heirloom corn grown in the province of Kalinga, especially in Pantikian, Balbalan, and Balinciagao Norte, Pasil, Kalinga, stands apart from other varieties of heirloom corn grown elsewhere. The characterization reveals that some distinguishing characteristics of heirloom corn differ from those of other corn cultivars. Generally, heirloom corn varieties show horizontal leaves and asynchronous growth during the vegetative stage. They have varied reproductive activity in the same field while producing silk, tassels, and ears. Heirloom corn cultivars mature at different times and in distinct stages. However, it is thought that heirloom corn's in-situ description is equivalent.

Recommendation(S)

Before going extinct, heirloom corn cultivars must be preserved. The two identified areas show potential for the conservation of heirloom corn. Mass production and seed storage are advised to preserve and maintain these cultivars, particularly in areas where heirloom cultivars are grown. The local government and other local farming organizations need to motivate and inspire young farmers to produce heirloom corn. A barangay ordinance must be passed to prevent GM maize from contaminating heirloom corn produced within its boundaries.

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