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## Seed Quality Maintenance of Organic Corn Under Ambient Conditions: Los Baños, Laguna, Philippines


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### Abstract

Local research and published literature on the physiological and biochemical qualities after storage of organic seeds are currently lacking. Most of the available studies are from international sources and primarily focus on the health benefits of organic produce and products, as well as on yield and meat quality of livestock fed with organic products. Therefore, this research was conducted from April 2021 to October 2023 to develop a storage protocol for organic corn that is practical and adaptable to the conditions of smallholder farmers. Organic corn seeds were collected from farmers in Batanes, Ifugao, Kalinga, and Mountain Province. After initial quality tests, seeds with moisture content (MC) of 10% and below were stored for nine months under ambient conditions at UPLB. Packaging containers used were glass and plastic bottles with silica gel and drying beads as desiccants. Storage of organic corn seeds inside glass bottles with either drying beads or silica gel, under ambient conditions and MC of 10% and below, can maintain high germination and seedling emergence after nine months of storage. From the initial range of 89-97%, germination remained high at 81-97% after nine months of storage, which was confirmed by the high seedling emergence results. This implies that organic seeds, with MC of 10% and below, can be stored in glass bottles for nine months or more under ambient room conditions. This result is particularly valuable for organic farmers who lack access to cold storage facilities but need to store their seeds for the next planting season.


## INTRODUCTION

Every farmer has, at some point, observed the effects of poor seed quality, including slow germination, damping-off, poor stands, weak seedlings, and mixed or genetically contaminated lots. Since organic farmers depend heavily on preventive or cultural approaches to promote crop health, vigorous seed can be viewed as the first line of defense against the challenges of poor soil, soilborne pathogens, and other unfavorable conditions.

In general, many organic farmers have been reluctant to use organic seed due to issues of availability (Capouchová, et al, 2012), pricing, and lower quality. However, as the demand for organic seed has grown, and the industry has matured, the capacity to produce high quality seed has increased (Elias, et al, 2015). Under Philippine conditions, the organic seed industry is still in its infancy with only a few academic and government players. There has been little indication so far that the private seed industry is ready to engage in organic seed production.

As of 7 July 2025, the Philippine government's registry of organic establishments listed 354 organic




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farms divided into 154 integrated farms, 172 farms for crops, one aquaculture farm, and 27 apiculture, livestock, and poultry farms, with a total area of 575.57 hectares (DA-BAFS, 2025). Out of these, only 20 (5.6%), with a hectarage of 257.29, are third-party certified and the rest or 334 (94.4%), with a land area of 318.28 ha, are Participatory Guarantee System (PGS)-certified. Of all 326 organic integrated and farms for crops, only five are producing organic seeds and four of these are Department of Agriculture (DA) research or experiment centers. These DA centers are producing organic grain, legumes, and vegetable seeds for free distribution to smallholder organic farmers.

The above list, though, is not a true picture of the organic crop, aquaculture, livestock and poultry producers in the country. In fact, there are thousands of organic farmers and practitioners who are not included in the DA-BAFS list since they are not third-party or PGS-certified. This is primarily due to the very tedious process and high cost of organic certification that small organic operators cannot afford (de Guzman et al., 2017).

Published literature on organic seeds is mostly foreign and focused on the production aspects (Seufert et al., 2012; Cox et al., 2015) and meat quality of livestock fed with organic products (Średnicka-Tober, 2016). No local literature was found on the physiological and biochemical qualities of organic seeds. Available literature and research results on organic corn seeds are mostly foreign and focused on the health benefits of organic produce and products, yield (Seufert et al., 2012; Cox et al., 2015), meat quality (Srednicka-Tober, 2016), and others. The same is happening in the local field, with only one publication found related to seeds, specifically on the organic breeding and seed production of organic vegetables (PCAARRD, 2016).

Corn is the second most important crop in the Philippines after rice. The total corn production in 2018 was 7.77M MT with a total harvest area of 2.51M ha and an average yield of 3.09MT/ha. Cagayan Valley is the top yellow corn producer, while the Bangsamoro Autonomous Region in Muslim Mindanao or BARRM is the top white corn producer (PSA, 2019). The Philippine Statistics Authority estimates that out of the total corn produced in the country in 2018, 72% was yellow, while 28% was white (Salazar, et al., n.d.).

Yellow flint corn is preferred for feed because of high carotene content and is very important in the poultry industry, especially the egg-laying type (layers), while white flint is the type used for food in the country. The glutinous and sweet corn types are favorite snack items, while the other colors are associated with better nutrition because of the usual higher antioxidant content. These genetic materials, however, are rare and are usually low yielding (Salazar, et al, n.d.).

Since seed is the main input in any crop production, corn's quality and storability must be ensured to maintain its quality as food, planting material, and major livestock feed ingredients. Additionally, research must not only focus on the crop and seed production aspects but also on the science and technology of seeds, particularly of open-pollinated variety (OPV) and traditional corn, to help achieve the goal of converting at least 5% (NOAB, 2012), which was recently increased to 7% of the total agricultural area of the country to organic production.

Even with the availability of good crop variety, high seed quality needs to be ensured since this is the first defense against biotic and abiotic stresses. This research aimed to develop appropriate storage protocols for organically produced corn that is applicable and easily adapted to the conditions of smallholder farmers.

## MATERIALS AND METHODS

A maximum of eight kilograms each of traditional or open-pollinated varieties of yellow, white, and multi-colored organic[1] grain corn was procured from farmers of Batanes[2], Ifugao[2], Mountain Province[2], and Kalinga[2] (Figure 1). The initial seed quality was tested, and subsequent storage experiments were conducted in the Seed Science and Technology Laboratory (SSTL) of the Institute of Crop Science, College of Agriculture and Food Science, University of the Philippines Los Baños

[1]Organic, in this study, encompasses all levels of certification, i.e., first-, second-, and third-party, or PGS-certified. [2]Resolution Granting Permission to Conduct the Research and Endorsement for the Issuance of Certificate Precondition or Free and Prior Informed Consent (FPIC) was obtained from each of these provinces of indigenous peoples, in compliance with the National Commission of Indigenous Peoples (NCIP) Administrative Order No. 3, Series of 2012.

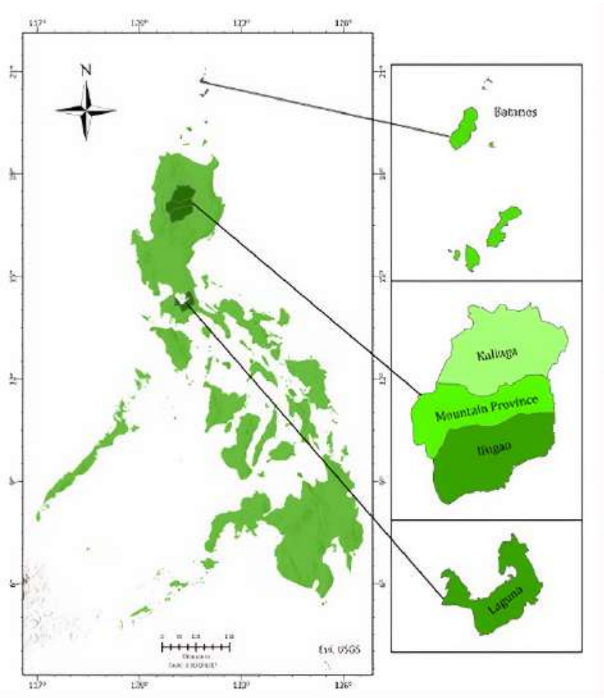


**Figure 1.** Location of the provinces where the farmer-produced organic corn seeds were procured and the site of seed storage experiments in Seed Science and Technology Laboratory, University of the Philippines Los Baños, Los Baños, Laguna (S.C. Cantimprate, 2025).

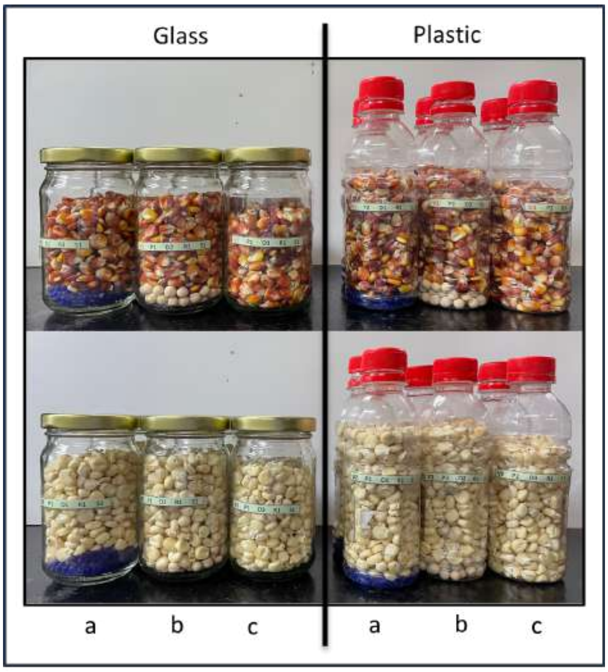


**Figure 2.** Storage set-up of organic corn seeds in glass (left) and plastic (right) bottles with silica gel (a), drying beads (b), and control or no desiccant (c).

[3]Weight of 400 seeds was calculated based on the 1,000 seed weight of each "variety" specified in Table 1

(UPLB), Laguna, over a span of 1.5 years from April 2021 to October 2023. UPLB is located at 45masl with coordinates of 14.16052895oN 121.2425o E (Elevation of UPLB, 2025).

Seeds were stored for nine months under ambient conditions at the SSTL. Using silica gel and drying beads, MC of seeds were lowered to 10% and below before these were stored inside 230 ml plastic bottles and 250 ml glass bottles with rubberized screw cap, with and without silica gel and Rhino drying beads as desiccants (Figure 2). Each treatment combination contained 200 seeds[3] each for germination and seedling emergence tests, plus 10 g for the MC test. The silica gel or drying beads were first placed at the bottom of the container before the seeds were loaded at 10% of the seed weight for each desiccant.

The variables measured were MC, germination , and seedling emergence. MC was determined using high constant temperature oven drying of 130-133°C for four hours, while filter paper and soil (to simulate field conditions) were used as media for germination and seedling emergence tests, respectively. Germination/seedling emergence and MC were calculated using the following formulas:

Number of normal seedlings

(1) $$\text{Germination (\%)} = \frac{\text{Number of normal seedlings}}{\text{Number of seeds tested}} \times 100$$

(2) $$\text{Moisture Content (\%)} = \frac{(M2 - M3)}{(M2 - M1)} \times 100$$

where:

M1 = weight in grams of the container and its cover

M2 = weight in grams of the container, its cover, and its contents before drying

M3 = weight in grams of the container, its cover, and its contents after drying

The experiments were laid out in CRD with three replications of four subsamples of 50 seeds each for germination and seedling emergence, and two replications of 5g each for MC. Data were consolidated and analyzed using Statistical Tool for Agricultural Research (STAR) and means were compared at 5% level of significance using LSD.

## RESULTS AND DISCUSSION

The storage experiment was conducted in the SSTL, UPLB which has an average temperature of 30.41ºC (86.74ºF) and relative humidity of 87.48% during the storage period (The Global Historical Weather and Climate Data, 2025). The farmer-produced organic corn seeds were first-party certified; thus, each variety was labelled according to its dominant color, including white, red, yellow, and purple with white (Figure 3). Initial seed quality tests results, before storage, showed high physical purity at 99.6-100%, low MC of 5.3-9.6%, high germination of 89-97%, and high seedling emergence of 80-98% (Table 1).

### I. Batanes[4]

### Moisture content

MC of Batanes red was significantly affected by storage container, desiccant, and storage time. The glass bottles with rubberized screw cap were able to maintain lower MC (7.8%) compared to plastic bottle (8.4%) (Table 2). The use of silica gel and drying beads as desiccants resulted in lower MC of 8.1 and 7.7%, respectively, compared to seeds stored without any desiccant (8.6%). Across storage containers and desiccants, MC decreased up to six months then slightly increased in the last month of storage at 9.4%.

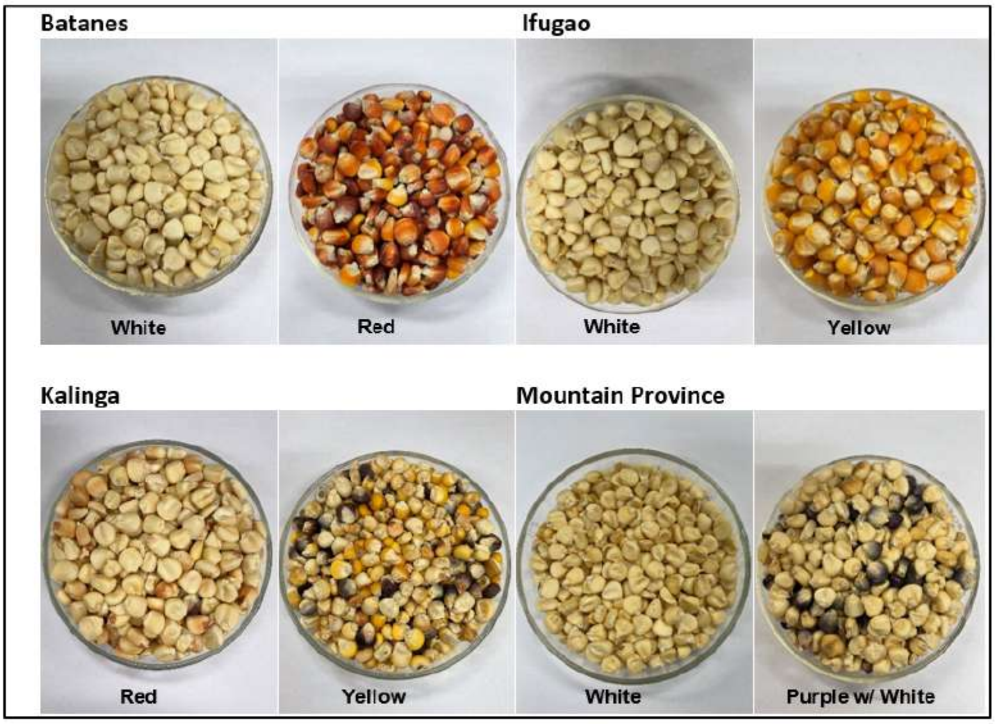


**Figure 3.** Farmer-produced organic corn seeds from Batanes, Ifugao, Kalinga, and Mountain Province named after their dominant color.

**Table 1.** Initial seed quality of organic corn seeds, at storage set-up, from Batanes, Ifugao, Mountain Province, and Kalinga.

| INITIAL SEED QUALITY | BATANES | | IFUGAO | | MOUNTAIN PROVINCE | | KALINGA | |
|---|---|---|---|---|---|---|---|---|
| | White | Red | White | Yellow | White w/ Purple | Pure White | Red | Yellow |
| Purity (%) | 100 | 100 | - | - | 99.7 | 99.9 | 99.7 | 99.6 |
| 1,000 seed weight (g) | 315.8 | 281.8 | 269.7 | 300 | 233.9 | 320.8 | 172.3 | 252.3 |
| Moisture content (%) | 5.3 | 9.3 | 9.4 | 9.5 | 9.0 | 9.6 | 9.0 | 8.8 |
| Germination (%) | 90 | 96 | 95 | 94 | 90 | 97 | 89 | 92 |
| Seedling emergence (%) | 80 | 87 | 93 | 98 | 89 | 96 | 87 | 87 |

[4]Farmer-produced organic red and white corn seeds were sourced from Itbayat Island, Batanes and were received in the SSTL on April 30, 2021.

**Table 2.** Percent moisture content of Batanes red organic corn seeds, stored for nine months, as affected by storage container, desiccant, and time.

| STORAGE FACTOR | MOISTURE CONTENT* (%) |
|---|---|
| Container[1] | |
| Glass | 7.8 b |
| Plastic | 8.4 a |
| Desiccant[2] | |
| Silica gel | 8.1 b |
| Drying beads | 7.7 b |
| Control | 8.6 a |
| Time[3] (months) | |
| 0 | 10.3 a |
| 3 | 6.9 c |
| 6 | 6.0 d |
| 9 | 9.4 b |

*means with the same letter, under each storage factor, are not significantly different

[1] SE = 0.21

[2] SE = 0.26

[3] SE = 0.30

**Table 3.** Percent germination of Batanes red organic corn seeds, stored for nine months, as affected by desiccant and time.

| STORAGE FACTOR | GERMINATION* (%) |
|---|---|
| Desiccant[1] | |
| Silica gel | 90 b |
| Drying beads | 92 a |
| Control | 90 b |
| Time[2] (months) | |
| 0 | 96 a |
| 3 | 89 b |
| 6 | 89 b |
| 9 | 90 b |

*means with the same letter, under each storage factor, are not significantly different

[1] SE = 0.68

[2] SE = 0.79

The interaction between storage container, desiccant, and time significantly affected MC of Batanes white. The use of glass bottles, with or without desiccant, resulted in lower MC after nine months of storage. In general, MC of the white corn from Batanes decreased up to six months before increasing at nine months of storage (Figure 4). The fluctuation of MC can be attributed to the saturation of the desiccants by the end of the storage period.

## Germination

Desiccant and time were significant for the germination of Batanes red. The use of drying beads, regardless of storage container and time, resulted in a germination of 92%, with the lowest germination of 90% for both silica gel and control (Table 3). From the initial germination of 96% (Table 1) and across storage container and desiccant, germination decreased to 90% after nine months of storage (Table 3).

For Batanes white, the interactions between storage container and desiccant, as well as between desiccant and time were significant. From the initial germination of 90%, it decreased to 86% for seeds inside glass containers without desiccant, 85% for glass and plastic containers with drying beads, and

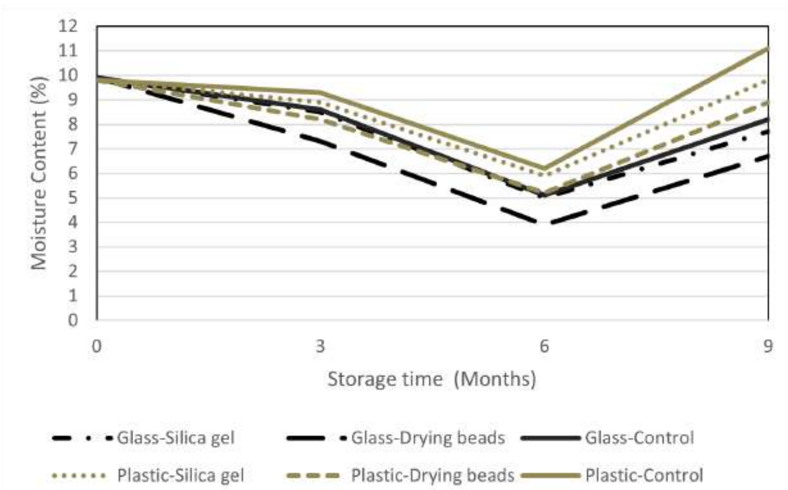


**Figure 4.** Percent moisture content of Batanes white organic corn seeds, stored for nine months, as affected by the interaction among storage container, desiccant, and time.

82% (the lowest) in glass with silica gel (Table 4). In terms of germination during nine months of storage, across all storage containers, the highest germination was in the container without desiccant at 85%, followed by drying beads and silica gel at 84% and 81%, respectively.

### Seedling Emergence

The interaction between storage container and time was significant for SE of Batanes red. Despite the fluctuations on the third and sixth month of storage, higher final percentage SE was observed in Batanes red stored in glass bottle at 86% compared to seeds stored inside plastic bottles at 76% after nine months of storage (Table 5).

The interaction of storage container, desiccant, and time was significant for Batanes white corn. Seeds stored in glass bottles had higher percentage of SE compared to the ones stored in plastic bottles (Figure 5). Fluctuation was observed throughout the experiment but regardless of container and type of desiccant used, high SE was maintained until nine months of storage.

### II. Ifugao[5]
### Moisture Content

The interaction of storage container, desiccant, and time was significant for MC of Ifugao white. Glass bottle as storage container, with or without any desiccant, minimized the change in MC throughout the storage period (Figure 6). Meanwhile, corn seeds stored in plastic bottles exhibited consistent increase

**Table 4.** Percent germination of Batanes white organic corn seeds, stored for nine months, as affected by the interaction between storage container and desiccant and between time and desiccant.

| STORAGE FACTOR | GERMINATION*(%) | | |
|---|---|---|---|
| | Desiccant | | |
| | Silica gel | Drying beads | Control |
| Container | | | |
| Glass | 82 a | 85 a | 86 a |
| Plastic | 84 a | 85 a | 83 b |
| Time (months) | | | |
| 0 | 90 a | 90 a | 90 a |
| 3 | 85 b | 82 b | 82 b |
| 6 | 78 c | 84 b | 82 b |
| 9 | 81 bc | 84 b | 85 b |

*means with the same letter, under each storage factor at each type of desiccant, are not significantly different

**Table 5.** Percent seedling emergence of Batanes red organic corn seeds, stored for nine months, as affected by the interaction between storage container and time.

| STORAGE FACTOR | SEEDLING EMERGENCE* (%) | | | |
|---|---|---|---|---|
| | Time (months) | | | |
| | 0 | 3 | 6 | 9 |
| Container[1] | | | | |
| Glass | 87 a | 71 b | 83 a | 86 a |
| Plastic | 87 a | 81 a | 76 b | 76 b |

*means with the same letter are not significantly different
[1] SE = 0.97

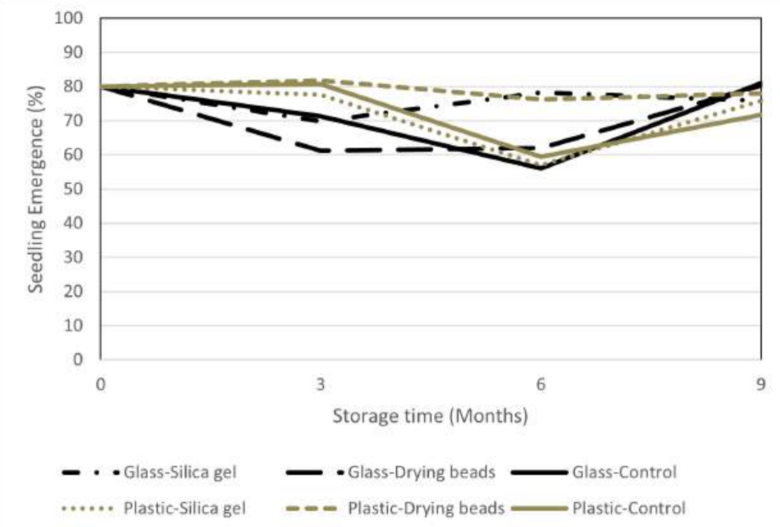


**Figure 5.** Percent seedling emergence of Batanes white organic corn seeds, stored for nine months, as affected by the interaction among storage container, desiccant, and time.

[5]Farmer-produced organic yellow and white corn seeds were sourced from Bolog, Kiangan, Ifugao on May 6, 2022.

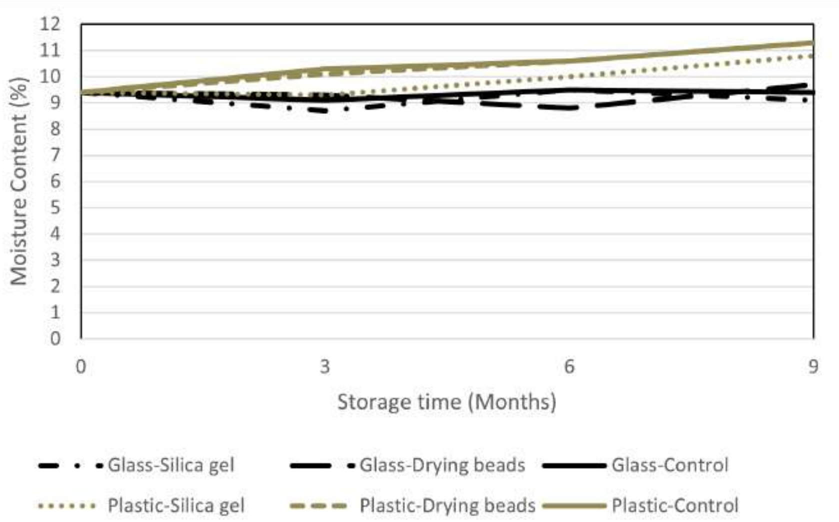


**Figure 6.** Percent moisture content of Ifugao white organic corn seeds, stored for nine months, as affected by the interaction among storage container, desiccant, and time.

in MC up to the end of the nine months of storage.

For Ifugao yellow, the interactions between storage container and time, as well as between storage container and desiccant were significant. Despite the fluctuation over the 9 months of storage, glass container consistently showed lower and below 10% MC as compared to plastic bottle (Table 6). For the desiccant, the use of silica gel resulted to the lowest MC at 9.2% as compared to drying beads and control with 9.7% and 9.6% MC, respectively, across storage container and time.

## Germination

The interactions between storage container and desiccant, as well as between desiccant and time were significant for Ifugao white corn seeds stored for nine months. From the initial germination of 95% (Table 1), seeds stored inside plastic bottles with silica gel resulted in slightly lower germination of 94%, while the ones stored in all other treatment combinations maintained the 95% germination after nine months of storage (Table 7). In terms of the interaction between desiccant and time, high germination was maintained at 93%, 94%, and 95% for silica gel, drying beads, and control, respectively.

The interaction between storage container, desiccant, and time was significant for germination rate of Ifugao yellow corn seeds. From the initial germination of 94% (Table 1), Ifugao yellow corn

**Table 6.** Percent moisture content of Ifugao yellow organic corn seeds, stored for nine months, as affected by the interaction between storage container and time.

| STORAGE FACTOR | MOISTURE CONTENT* (%) | | | |
|---|---|---|---|---|
| | Time (months) | | | |
| | 0 | 3 | 6 | 9 |
| Container | | | | |
| Glass | 9.5 a | 9.5 a | 8.6 a | 9.1 b |
| Plastic | 9.5 a | 10.0 a | 9.0 a | 10.9 a |

*means with the same letter are not significantly different

**Table 7.** Percent germination of Ifugao white organic corn seeds, stored for nine months, as affected by the interaction between storage container and desiccant and between time and desiccant.

| STORAGE FACTOR | GERMINATION* (%) | | |
|---|---|---|---|
| | Desiccant | | |
| | Silica gel | Drying beads | Control |
| Container | | | |
| Glass | 95 a | 94 a | 94 b |
| Plastic | 94 a | 95 a | 96 a |
| Time (months) | | | |
| 0 | 95 a | 95 a | 95 b |
| 3 | 94 a | 95 a | 97 a |
| 6 | 94 a | 94 a | 93 c |
| 9 | 93 a | 94 a | 95 b |

*means with the same letter, under each storage factor at each type of desiccant, are not significantly different

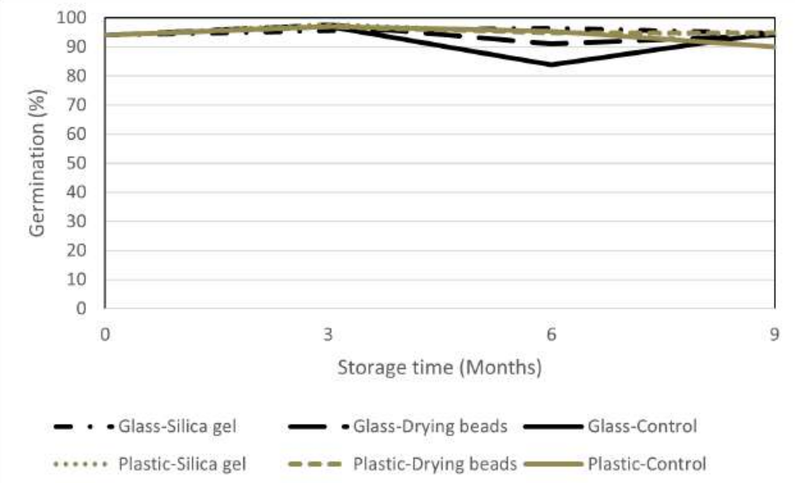


**Figure 7.** Percent germination of Ifugao yellow organic corn seeds, stored for nine months, as affected by the interaction among storage container, desiccant, and time.

seeds maintained a high germination percentage regardless of the storage container and type of desiccant used, with plastic container without desiccant resulting in the lowest germination at 90% (Figure 7). Only a slight fluctuation was observed at six months, which may be attributed to the shift in humidity during November 2022.

### Seedling Emergence

Time was significant for germination of Ifugao white corn seeds. There was a decrease in SE over time from the initial 93% to 91% at the end of the nine months storage period. For Ifugao yellow corn, desiccant and the interaction between storage container and time were significant. Specifically for desiccant, SE was the highest at 97% for drying beads, with silica gel and control not significantly different from each other at 96% and 95%, respectively. Despite a slight fluctuation, both storage containers were able to maintain a high germination of 95% at the end of the 9-month storage time (Table 8).

### III. Mountain Province[6]
### Moisture Content

The interaction of storage container, desiccant, and time significantly affected MC of Mountain Province white corn seeds. The use of glass bottle, with or without any desiccant, minimized the change in MC throughout the storage period (Figure 8). Corn seeds stored in plastic bottles exhibited increased MC up to the last storage period. Compared to silica gel and control, the use of drying beads inside either glass or plastic bottle resulted in lower MC after nine months of storage. The interaction of storage container and time was significant for MC of Mountain Province purple with white corn seeds. Glass as seed container resulted in lower MC over nine months storage period as compared to plastic bottles (Table 9).

**Table 8.** Percent seedling emergence of Ifugao yellow organic corn seeds, stored for nine months, as affected by the interaction between storage container and time.

| STORAGE FACTOR | SEEDLING EMERGENCE* (%) | | | |
|---|---|---|---|---|
| | Time (months) | | | |
| | 0 | 3 | 6 | 9 |
| Container | | | | |
| Glass | 98 a | 94 b | 97 a | 95 a |
| Plastic | 98 a | 96 a | 94 b | 95 a |

*means with the same letter are not significantly different

**Table 9.** Percent moisture content of Mountain Province purple with white organic corn seeds, stored for nine months, as affected by the interaction between storage container and time.

| STORAGE FACTOR | MOISTURE CONTENT* (%) | | | |
|---|---|---|---|---|
| | Time (months) | | | |
| | 0 | 3 | 6 | 9 |
| Container | | | | |
| Glass | 9.0 a | 9.2 a | 8.1 b | 8.5 b |
| Plastic | 9.0 a | 10.0 a | 10.2 a | 11.2 a |

*means with the same letter are not significantly different

[6]Farmer-produced organic white and purple with white corn seeds were sourced from Besao, Mountain Province on September 15, 2022.

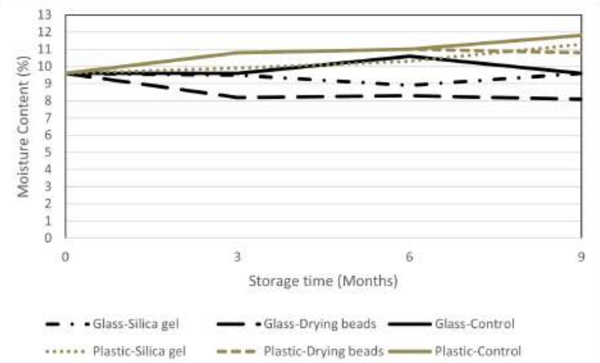


**Figure 8.** Percent moisture content of Mountain Province white organic corn seeds, stored for nine months, as affected by the interaction among storage container, desiccant, and time.

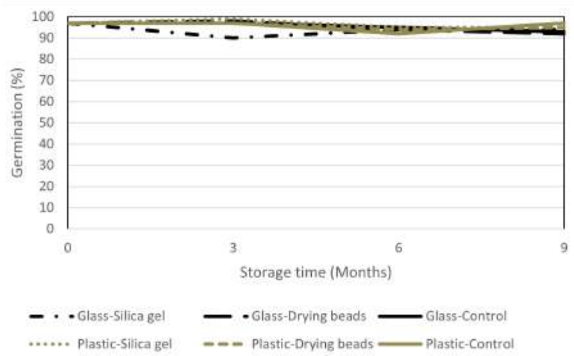


**Figure 9.** Percent germination of Mountain Province white organic corn seeds, stored for nine months, as affected by the interaction among storage container, desiccant, and time.

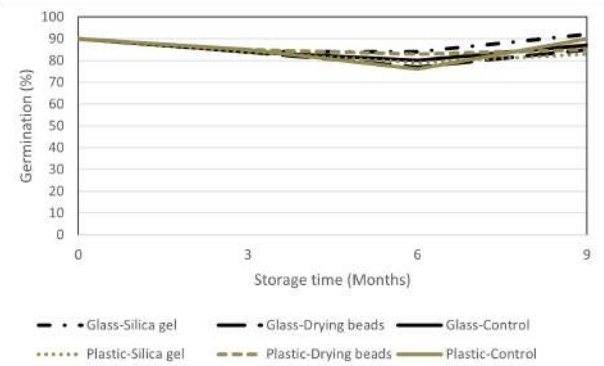


**Figure 10.** Percent germination of Mountain Province purple with white organic corn seeds, stored for nine months, as affected by the interaction among storage container, desiccant, and time.

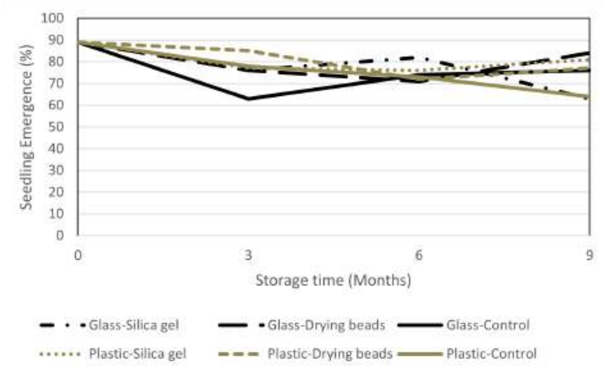


**Figure 11.** Percent seedling emergence of Mountain Province purple with white organic corn seeds, stored for nine months, as affected by the interaction among storage container, desiccant, and time.

### Germination

For both Mountain Province white and purple with white corn seeds, the interaction of storage container, desiccant, and time was significant. Similar to the results in Ifugao, the germination of the Mountain Province white remained high from an initial of 97% to 92% for glass with drying beads and 97% for plastic without desiccant after nine months of storage (Figure 9). The germination of the purple with white corn seeds decreased from three to six months and significantly increased afterwards at 92% and 83% for silica gel, in glass and plastic container, respectively (Figure 10).

### Seedling Emergence

The interaction between storage container, desiccant, and time was significant for Mountain Province purple with white corn seeds, although the interaction was not significant for white corn. Unlike the results in the germination test, the SE of the purple with white fluctuated throughout the storage period (Figure 11). The use of different storage containers and desiccants had no observable trend, which may be attributed to a variety of factors including the soil used and inherent seed vigor. From the initial 89%, glass with drying beads and silica gel resulted in the highest SE of 84% and the lowest SE of 63%, respectively.

## IV. Kalinga[7]

### Moisture Content

The interaction between storage container and time was significant for both Kalinga red and yellow corn seeds where MC increased during the storage

[7]Farmer-produced red and yellow organic corn seeds were sourced from Pasil, Kalinga on September 9, 2022.

time of nine months. The use of plastic bottles resulted in higher MC of 11.8% (Table 10) from an initial of 9.0% (Table 1) and 11.5% from an initial of 8.8% for red and yellow corn seeds, respectively.

### Germination

The interaction between storage container and desiccant was significant for Kalinga red where corn seeds stored in plastic container with silica gel, glass container with drying beads and without desiccant resulted in the highest germination at 90%. Plastic container without desiccant, though, resulted in the lowest germination of 87% (Table 11). The interaction between storage container, desiccant, and time was significant for Kalinga yellow where seeds stored in glass container with silica gel and plastic container with drying beads resulted in highest germination at 93%, and seeds in glass container with drying beads showed the lowest at 89% after nine months of storage (Figure 12).

### Seedling Emergence

Only time was significant for SE of Kalinga red where from an initial of 87%, the seedling emergence dropped to 81% after nine months in storage across storage containers and desiccants. For Kalinga yellow,

**Table 10.** Percent moisture content of Kalinga red and Kalinga yellow organic corn seeds, stored for nine months, as affected by the interaction between storage container and time.

| STORAGE FACTOR | MOISTURE CONTENT* (%) | | |
|---|---|---|---|
| | Time (months) | | |
| | 0 | 6 | 9 |
| Container | | | |
| Kalinga red[1] | | | |
| Glass | 9.0 a | 8.7 b | 9.5 b |
| Plastic | 9.0 a | 11.2 a | 11.9 a |
| Kalinga yellow[2] | | | |
| Glass | 8.8 a | 7.4 b | 8.5 b |
| Plastic | 8.8 a | 11.0 a | 11.5 a |

*means with the same letter under each "variety" are not significantly different
[1] SE = 0.57
[2] SE = 0.80

**Table 11.** Percent germination of Kalinga red organic corn seeds, stored for nine months, as affected by the interaction between storage container and desiccant.

| STORAGE FACTOR | GERMINATION* (%) | | |
|---|---|---|---|
| | Desiccant | | |
| | Silica gel | Drying beads | Control |
| Container[1] | | | |
| Glass | 89 a | 90 a | 90 a |
| Plastic | 90 a | 89 a | 87 b |

*means with the same letter are not significantly different
[1] SE = 0.95

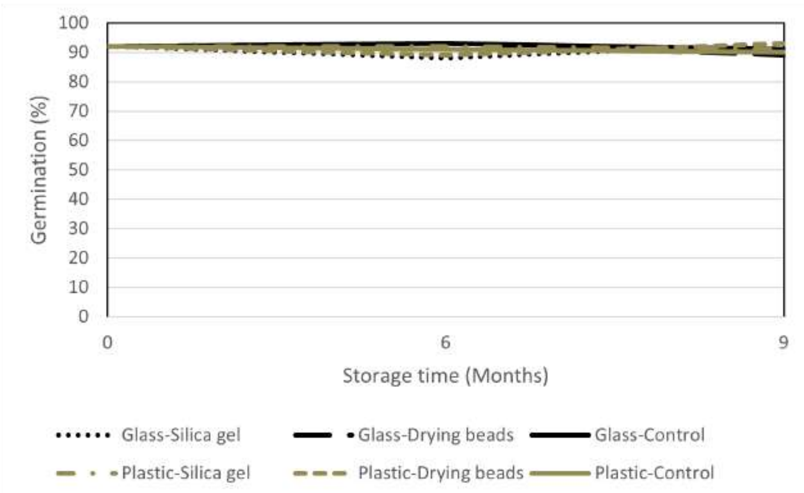


**Figure 12.** Percent germination of Kalinga yellow organic corn seeds, stored for nine months, as affected by the interaction among storage container, desiccant, and time.

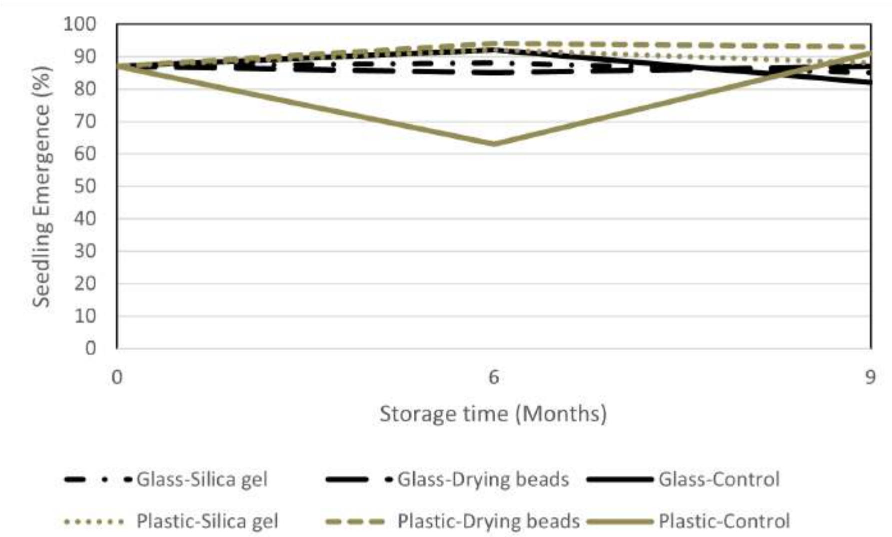


**Figure 13.** Percent seedling emergence of Kalinga yellow organic corn seeds, stored for nine months, as affected by the interaction among storage container, desiccant, and time.

the interaction between storage container, desiccant, and time was significant despite the fluctuating results for seeds stored in plastic container without desiccant after six months of storage (Figure 13). From an initial SE of 87%, the highest SE was in the seeds stored inside plastic container with drying beads at 93%, and the lowest was in glass container without desiccant at 82% after nine months of storage.

Seeds are alive and therefore begin to deteriorate as soon as they are separated from the mother plant. Seed deterioration is a process that is inexorable and irreversible and varies among population (Kapoor, et al., 2010; Prabhu, et al., 2024). It should be noted that the rate in which seed deteriorate increases significantly with the increase in seed MC and/or temperature of storage (Ellis, et al., 1985). Thus, despite the best seed storage conditions, seeds will deteriorate and eventually die after some time. This makes implementing appropriate storage practices under ambient conditions a necessity, especially for smallholder organic farmers.

Organic corn seeds used in this study were obtained from farmers of Batanes Islands and the three highland provinces of Ifugao, Mountain Province, and Kalinga. These traditional, open-pollinated corn are grown in small patches of land, harvested, and mainly used for family consumption. Only a small portion of the harvest is sold when produce is beyond the capacity of the family to consume. Corn production in these areas is rainfall dependent and thus planted only once a year. Some seeds are dried and stored for use in the next planting season. Testing of seeds to determine its capacity as good planting material is generally not carried out by the farmers.

Preliminary data from this study indicate that organic farm-saved corn seeds are of good quality with a high germination rate of 89-97% and seedling emergence of 80-98% (Table 1). For storage of nine months under ambient conditions, the use of glass bottles with screw cap lid was the most appropriate resulting in the maintenance of low MC, at 10% and below, regardless of whether the seeds were stored with or without desiccant. The use of plastic container, however, resulted in MC of as high as 11.8%. This result showed that the use of plastic container, even with desiccants, cannot guarantee that MC will remain low over a period of nine months storage under ambient conditions.

With MC of 10% and below, seeds stored for nine months maintained high germination rate of 81-97%. The highest germination was obtained from seeds stored inside glass container, with and without desiccant. High germination rates were confirmed by high seedling emergence tests results, with as high as 97% and as low as 71%. Seedling emergence tests used soil as the germination medium and was a kind of stress test for the seeds since the soil used was not sterilized and might contain various microorganisms that may or may not be harmful to the emerging seedlings.

Being hygroscopic, seeds absorb moisture when the surrounding relative humidity is high, and release moisture when it is low. This is why seeds with low MC need to be stored under hermetic conditions, that is, in containers that do not absorb moisture, and where low MC for ambient storage means 10% and below. This is because at MC of 10% and below, mites, fungi, bacteria, and most insects, cannot survive and cause damage to seeds (Bewley, et al., 2013). Thus, the use of hermetic containers, like glass bottles with screw cap lid, is appropriate for seeds stored with low moisture to maintain their quality for a longer period.

Research conducted in other countries has shown good quality organic seeds, but these were not the results of storage experiments under tropical conditions, but rather comparisons between conventionally grown and organic seeds. In trials conducted by Capouchová, et al. (2012), the germination and emergence of organic, conventional, and farm-saved seeds of oat (*Avena sativa* L.), bread wheat (*Triticum aestivum* L.) and barley (*Hordeum vulgare* L.) before sowing and after harvest were of good quality. However, they noted that the seeds originating from the certified organic farms resulted in the highest germination and emergence among the three. However, Gindri, et al. (2017) observed no differences in the physiological seed quality of common bean accessions between the organic and conventional farming systems. Cox, et al. (2015) mentioned that the greater soybean (*Glycine max* L.) seed weight in the organic versus the conventional cropping system is probably associated with different genetics of the two varieties and not the cropping system.

## CONCLUSIONS

In general, results showed that the use of glass bottles with screw cap lid, regardless of with and without desiccant, was able to maintain MC below 10% after nine months of ambient storage. Still with glass bottle as storage container, with and without desiccant, germination rate remained high at 81-97% after nine months of storage, which was confirmed by the high seedling emergence results. The use of plastic container resulted in the increased MC and lower germination rate. However, in combination with either drying beads or silica gel, as desiccant, plastic container can be used to store organic corn seeds under ambient condition, in cases where glass bottles are not available. Given the high germination and SE after nine months of storage, it can be safely recommended that organic corn seeds be stored inside glass containers with screw cap lid, with or without desiccants. Storage under these conditions can maintain high seed viablity even after one year as long as MC remains at 10% and below. The results of this study are useful of organic farmers, both for corn seeds and seeds of other crops with high carbohydrate content, who have no access to cold storage facilities but need to store their seeds for the planting season in the following year. Further studies are needed on the storability of organic seeds that will not only investigate the physiological and biochemical qualities after storage but also delve deeper into the cellular, metabolic, and chemical changes that occur during seed deterioration.

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