Ethiop. J. Agric. Sci. 33(4) 74-89 (2023) Special Issue

Effect of Different Storage Methods on Growth, Seed Quality and Corm Yield of Taro (*Colocasia esculenta* L. (Schott.)) in Southwestern Ethiopia

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Abstract

Taro is a staple root crop in the south, central, western, and southwestern parts of Ethiopia. However, its production is limited due to several factors. The seed corm storage condition is one of the main factors that affects the production of taro. A study was conducted in 2021 and 2022 to determine the suitable storage methods for corms of taro for seed production. Five different storage methods (a cemented floor in a warehouse; under a tree shade covered with grass; a raised mesh-wired bed under a thatched roof shelter; an underground pit covered with grass; and an underground pit covered with soil) were evaluated using a completely randomized design with three replications. A widely adopted variety known as Denu was used. Data on seed quality, growth, and yield parameters were measured. Results indicated that there was a significant ($p<0.05$) variation among storage methods in terms of seed quality, growth, and corm yield of taro. Seed quality attributes such as percentages of clean and sprouted seed corms, number of verticals per hill and leaves per plant, and the total number of sprouts were significantly higher in the seed corms stored on the cemented floor in the warehouse. Similarly, the highest values for corm number and weight per plant, as well as taro corm yield, were recorded in the seed corms stored on the cemented floor. In conclusion, storing taro seed corms on a cemented floor within a warehouse improved seed quality, growth, and taro corm yield. It is, therefore, recommended that farmers in the area adopt this method. However, further study on the economic efficiency of those storage methods is required to justify farmers' investment.

Keywords: Corm sprouting; Corm yield; Vegetative growth; Seed storage

Introduction

Taro (*Colocasia esculenta* L.) is a major root crop of the monocotyledonous family *Araceae*, subfamily *Aroideae* (Lebot, 2009; Mare, 2009). It is widely grown for its edible storage root, which provides a high-energy food source (Ramanatha *et al.*, 2010; Momoko *et al.*, 2018). Among root and tuber crops, taro held the fifth position in terms of area and production coverage worldwide, after potatoes, cassava, sweet potato, and yam (FAO, 2023). In Ethiopia, the crop is grown mainly in hot and humid areas of the southern, southwestern, and western parts of the country. Locally referred to as "Godere," it is grown as a staple food crop and a source of income for small-holder farmers. Taro can be propagated vegetatively through corms, suckers, cormels, cut corms or setts, etc., but corms or storage tubers are best and preferred by farmers (Yebo and Dagne, 2015). Usually, it is planted in April–May and matures in 7-9 months in the lowland, including the study area.

In taro, seed storage is an important activity that helps maintain planting materials for the next cropping season and sustain their availability and supply. Because of its short storage period, taro is a particularly perishable crop when compared to other root and tuber crops. Usually, farmers maintain or store the seed corms immediately after harvest for the next cropping season using different storage methods, *viz*., traditional low-cost, open, and well-ventilated areas or places. As reported frequently by several farmers and growers during a preliminary survey, a large amount of planting material is lost during the storage period due to the absence of an appropriate storage method. According to Elias (2018), the stored planting material can easily deteriorate and reduce its quality when it is kept in poor storage conditions. Several research reports also reveal a very high incidence of fungal decay and corm weight loss under inappropriate storage conditions (Matthews, 2002; Bammite *et al.*, 2018).

In general, this crop needs to be stored in cool, dry places, and the best results were also observed from traditional storage methods, as reported by Modi (2004). The author has also noted that different storage conditions have a significant effect on sprouting and seedling emergence. Moreover, a number of studies have documented the impact of storage conditions on seed corm availability and supply on taro (Matthews, 2002; Modi, 2004 and 2007; Bammite *et al.*, 2018). Consequently, it is important to identify inexpensive and easily applicable storage methods for small-scale farmers so that seed loss is minimized and their supply is maintained. This notion led to the conduct of this study to identify suitable seed storage methods that can improve the growth, crop stand seed quality, and corm yield of taro at Teppi, Southwestern Ethiopia.

Materials and Methods

Description of the study site

The study was carried out at Teppi Agricultural Research Center during the main cropping season from January 2021 to December 2022, under rainfed conditions. The center is situated at Teppi Town, in the Sheka administrative zone of the Southwestern Ethiopian Peoples Regional State. It is located about 611 kilometers from Ethiopia's capital, Addis Ababa. The geographical coordinates of the center are 7 ° 10' N latitude and 35 ° 25' E longitude, with an elevation of 1,200 meters above sea level. High temperatures and high humidity are the area's defining climate characteristics (Hailemikael *et al.*, 2008). Comprehensive meteorological information including temperature and daily relative humidity (RH) was recorded for storage months (January, February, March, and April) (Table 1).

Table 1. Monthly minimum and maximum temperature (°C) and monthly rainfall (mm) of the study area during 2021 and 2022 cropping seasons

Months	2021				2022			
	Temperature		Rainfall	Relative Humidity	Temperature		Rainfall	Relative Humidity
	Min.	Max.			Min.	Max.		
January	18.3	29.3	32.2	62.1	19.6	32.8	14.2	62.9
February	18.2	31.3	5.6	61.4	20.2	34.1	4.2	55.5
March	19.9	31.0	79.2	58.7	21.1	32.6	86.8	58.0
April	20.6	28.3	82.2	66.9	20.2	28.0	293.4	68.6

Experimental design, treatments, and procedures

There were five different storage methods used as treatments: a cemented floor in a warehouse, under a tree shade covered with grass, a raised mesh-wired bed under a thatched roof shelter, an underground pit (1 m x 1 m) covered with grass, and an underground pit (1 m x 1 m) covered with soil. Raised mesh wire beds and an underground pit covered with soil were regarded as farmers' practices. A completely randomized design with three replications was employed to set up the experiment. A widely adapted taro cultivar called "Denu" was used in this study. Sample seed corms were harvested from the taro seed multiplication farm in January, both during the 2021 and 2022 cropping seasons. The seed corms were carefully separated from their mother corms and thoroughly cleaned. Thirty kilograms of clean, uniform-sized seed corms were allocated for each storage method and replicated three times. Since there is a 70–90 day gap in the area between harvesting and the next planting, the seed corms were stored for 80 days in the 2021 and 2022 cropping seasons, respectively.

Subsequently, the stored seed corms of each storage method were then transplanted into the field on April 17, 2021, and April 2, 2022, respectively, for additional evaluation of growth and yield performance. For field evaluation, the experimental field was divided into three blocks; each block consisted of five experimental plots. Within each plot, the seed corms stored in each storage method were randomly assigned and planted separately. A total of 15 experimental units of 4 m by 3 m size were employed in this investigation, and 50 cm of planting space was kept between rows and between plants (Buke and Gidago, 2016). According to Buke and Gidago (2016), the first and second earthling-up practices were conducted along with the blanket recommendation of nitrogen fertilizer application, which was applied in two equal splits at 45 and 90 days after planting, respectively. The phosphorus fertilizer was applied once during planting, following the blanket recommendation. Each experimental plot received the same application of all other recommended agronomic practices. The crop was harvested manually at the stage of physiological maturity, recognized by the yellowing and withering of the plant leaves, as outlined by Buke and Gidago (2016).

Data collection

The quality parameters of the seed cormes, including the final weight of the seed corm (kg), the weight loss of the seed corm (%), the number of clean seed cormes, the sprouted seed cormes, the total sprouts, the decayed seed cormes, and the damaged seed cormes, were recorded at the end of the storage period. After the end of the sixth month after planting, measurements were made of the following growth parameters for the plants in the middle rows: plant height (cm), total crop stands, vertical number per hill, and leaf number per plant. According to Mare (2009), the dry matter accumulation of the root and shoot of the taro plant progressively increased up to 150 days after emergence and subsequently decreased until 240 days after emergence or the crop matured. Conversely, the build-up of dry matter on the cormes grew steadily until they reached maturity. During the harvest process, the yield and related parameters, such as the number of corms per plant, the weight of corms per plant (g), and the corm yield per plot (kg), were recorded. Subsequently, the corm yield was converted to tons per hectare.

Statistical analysis

The data collected in this study were subjected to statistical analysis. R software 4.2.1 was used for the analysis of variance (ANOVA). Significant differences between treatment means were delineated by the least significant differences (LSD) at the probability level of 5%.

Results and Discussion

Seed corm quality parameters of taro

The results of the analysis of variance revealed that the seed quality parameters, including the percentages of clean seed corms, sprouted seed corms, total sprouts, and weight loss, were significantly ($p<0.05$) influenced by different storage methods. These pre-planting storage methods, however, had no significant ($p>0.05$) effect on the percentages of non-sprouted seed corms, decayed seed corms, or diseased seed corms. In particular, when comparing different storage methods, seed corms that were stored on a cemented floor within a constructed warehouse exhibited significant differences concerning the percentages of clean and sprouted seed cormes as well as overall sprouts (Table 3 and Figure 1). The highest percentages of clean seed corms (93.7%), sprouted seed corms (92.8%), and total sprouts (94.8%) were recorded from seed corms that were stored on a cemented floor within a constructed warehouse. The seed corms that were stored under tree shade covered with grass were followed by 84.5%, 83.5%, and 85.7% of clean seed corms, sprouted seed corms, and total sprouts, respectively. On the contrary, the lowest percentages of clean seed corms, sprouted seed corms, and total sprouts were noted, in seed corms that were stored on a one-meter raised mesh weir bed under a thatched roof shelter, as presented in Table 3 and Figure 1.

Table 3. The percentages of clean and sprouted taro seed corms are affected by the pre-planting storage method (mean of two seasons, 2021 and 2022).

Storage Methods	Clean Seed Corms (%)		Mean	Sprouted Seed Corms (%)		Mean
	2021	2022		2021	2022	
Cemented Floor	89.9[a]	97.5[a]	93.7[a]	89.7[a]	95.9[a]	92.8[a]
Under Tree Shade	85.0[ab]	83.9[b]	84.5[b]	84.9[ab]	82.1[b]	83.5[b]
Mesh Wire Bed	75.2[b]	64.2[d]	63.7[d]	74.8[b]	61.9[d]	62.3[d]
Grass-Covered Pit	80.4[ab]	70.4[c]	75.4[c]	80.3[ab]	68.2[c]	74.3[c]
Soil-Covered Pit	76.4[b]	70.0[c]	73.2[c]	75.9[b]	67.9[cd]	71.9[c]
Mean	81.4	77.2	78.1	81.1	75.2	77.0
$LSD_{(0.05)}$	11.3*	5.4*	8.4*	11.8*	6.2*	9.0*
SEM	2.4	4.0	3.2	2.4	4.0	3.2
CV(%)	7.0	21.2	13.0	7.4	21.6	13.2

NB: Means within a column followed by the same letter are not significantly different at the 5% level of the LSD test, * = p<0.05, NS = not significant, CV = coefficient of variation, SEM = standard error of mean

A higher percentage of clean and sprouted seed corms, as well as the total sprouts observed in the seed corms stored on a cemented floor within a constructed warehouse, can be attributed to the prevailing conditions of moderate aeration and relative humidity, together with a higher temperature during the storage process. This storage condition directly contributes to the higher rate of transpiration and respiration, ultimately resulting in improved initiation and growth of sprouts. This outcome is in line with the research of Agbor-Egbe and Rickard (1991), who noted that taro corms held in ambient storage conditions sprouted more frequently and had higher temperatures and ideal relative humidity. The findings of the previous study conducted by Modi (2004) also confirmed the significant influence of storage temperature and air conditions on the sprouting of seed corms in taro. Furthermore, increased and hastened sprouting has previously been reported by Ovono *et al.* (2010) in yam when seed tubers are kept at an ambient temperature of 25 °C. Previous research on the ginger and turmeric seed rhizomes by Kaushal *et al.* (2017), Lee *et al.* (2020), and Retana-Cordero *et al.* (2021) also reported similar findings.

On the contrary, lower percentages of clean and sprouted seed corms, as well as the total sprouts of seed corms stored on a one-meter raised mesh weir bed, can be due to the effects of the storage environment, mainly temperature, relative humidity, and aeration. This storage condition directly contributes to the higher rate of transpiration and moisture loss; ultimately, it yields a greater number of dried and shriveled seed corms. Overall, the percentages of clean and sprouted seed corms, as well as the total sprouts, were noticeably reduced at the end of the storage period. This result is consistent with the findings of Osunde and Orhevba (2009), who found that yam tubers placed on conventionally raised structures sprouted less. Deshi *et al*. (2018) also observed the reduced growth of sprouts in potato tubers when kept in well-aerated storage conditions. Furthermore, the deleterious effects of poor storage structure on viability losses of taro seed corms have also been reported by Modi (2007), Chukwu and Nwosu (2008), Alam *et al*. (2014), and Ridwan *et al*. (2023).

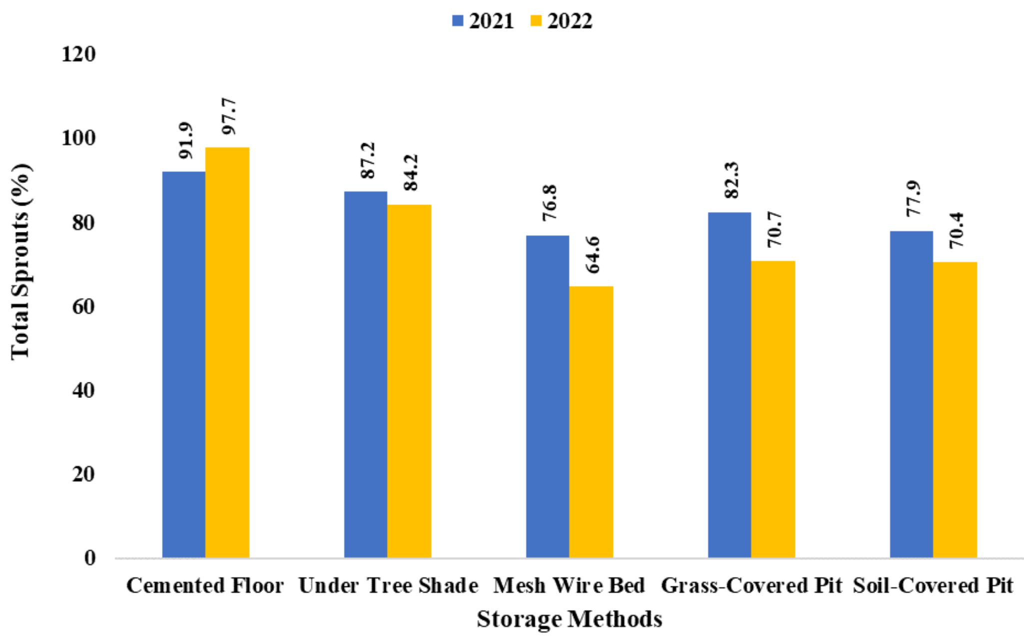

Figure 1. Percentage of total sprouts of the seed corm as influenced by storage methods

In comparison to other seed storage methods, the method of keeping seed corms on a one-meter raised mesh wired bed beneath a thatched roof shelter has shown notable variations in terms of seed weight loss (Figure 2). Consequently, the highest percentage of seed weight loss (28.9%) was recorded in seed corms that were stored on a one-meter raised mesh wired bed. On the contrary, the lowest percentage of seed weight loss (8.9%) was seen in the seed corms kept under a grass cover pit, followed by 9.0% in the seed corms kept under a soil-covered pit, as displayed in Figure 2. The observed differences among the different storage methods in terms of seed weight loss range from 8.9% to 28.9%. The reason behind the higher weight loss of seed corms kept in a raised mesh wired bed at a height of one meter is that the temperature was greater and the aeration was moderate during the storage duration (Treche and Agbor-Egbe, 1996; Afek *et al.*, 2000; Sohany *et al.*, 2016; Chindi, 2020; Kakade *et al.*, 2023). This storage environment specifically resulted in a higher rate of transpiration and moisture losses; ultimately, this led to a significant weight loss of the seed corms during the storage period. Moreover, the significant reduction in moisture also plays a role in the increasing amount of dried and shriveled seed corms that are generated at the end of the storage period.

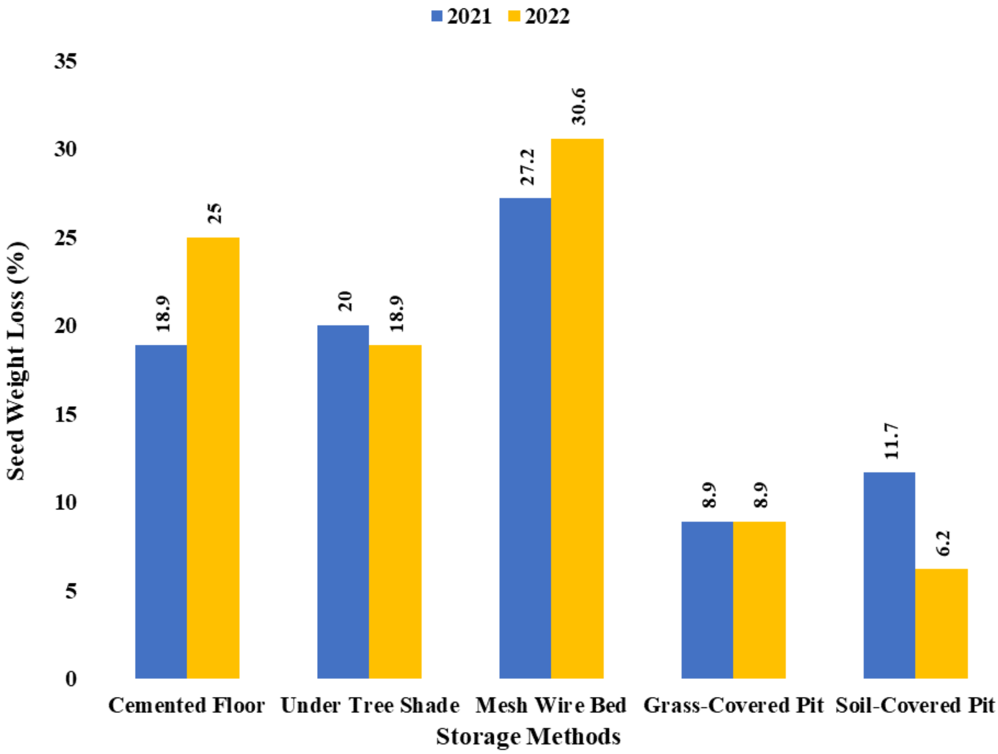

Figure 2. Percentage of seed weight loss as influenced by storage methods

The findings are consistent with earlier research by Osunde *et al*. (2008), Umogbai (2013), and Osunde *et al*. (2003). All observed the highest percentage of seed weight loss in yam when tubers were stored in a traditionally constructed raised structure at a height of 1.8 meters. According to studies conducted by Olusoga *et al*. (2016), Lee *et al*. (2020), Retana-Cordero *et al*. (2021), and Ridwan *et al*. (2023), improper storage conditions have an impact on the rate of transpiration and moisture loss of stored taro seed corms and yam seed tubers. The second-highest percentage of seed weight loss (22.0%) found in seed corms kept on a cemented floor may be related to the stored seed corms' increased rate of transpiration and respiration as a result of better sprouting, as Lv *et al*. (2021) and Prakhongsil *et al*. (2022) have explained for the rhizomes of ginger and turmeric.

On the contrary, the minimal seed weight losses observed in seed corms stored in grass-covered pits and soil-covered pits can be due to the lower temperature of the storage method compared to the storage temperature of other methods. This condition resulted in a reduced rate of transpiration, respiration, and moisture losses; ultimately, this led to lower weight losses in the stored seed corms. This is consistent with the observation made by Alam *et al*. (2014) that seed weight loss in taro was minimal when the seed corms were kept in pits. Osunde *et al*. (2008) and Umogbai (2013) reported similar results in yam; seed tubers that were stored in pits exhibited the lowest weight losses. Comparable results have also been reported by Gebre *et al*. (2008) in potato tubers and by Chowdhury and Hassan (2013) in onion bulbs, all of which found that storage in pits resulted in the lowest seed weight losses.

Growth attributes of Taro

The impact of different pre-planting storage methods ($p<0.05$) on taro growth attributes, including the number of verticals per hill and leaves per plant, is presented in Table 4. However, these pre-planting storage methods did not have a significant ($p>0.05$) effect on other growth parameters such as total plant stands and plant height. During the study period, seed cormes stored on a cemented floor within a constructed warehouse exhibited significant differences in growth attributes compared to seed cormes stored using different methods. The seed corms kept on a cement floor during the 2021 and 2022 cropping seasons showed the highest vertical numbers (3.8 $hill^{-1}$) and (4.1 $hill^{-1}$), respectively. As shown in Table 4, the seed corms stored using the same method also generated the highest leaf counts (6.6 $plant^{-1}$) and (8.6 $plant^{-1}$) in the 2021 and 2022 cropping seasons, respectively. Similarly, the pooled mean analysis revealed that seed corms stored in the same manner had the highest vertical number (4 $hill^{-1}$) and leaf number (7.6 $plant^{-1}$). In contrast, the method of storing seed corms in a one-meter raised mesh wired bed under a thatched roof shelter exhibited the lowest values of vertical number per hill and leaf number per plant (Table 4).

Improved sprout initiation and growth during the storage period can be the reason for the increased quantity of taro plant verticals and leaves seen in seed corms kept on a cemented floor. This enhanced growth is likely due to the higher storage temperature and optimal available light, along with the minimal air moisture and aeration provided by this storage method. This storage environment contributes to the higher rate of transpiration and respiration of the seed corms, ultimately resulting in improved spouting. This, in turn, led to early field emergence and improved the subsequent growth of taro seedlings. Modi (2007) also discussed the enhanced mobilization of starches due to stimulated enzymatic activities when stored seed corms start sprouting; ultimately, this improved the potential of the corms for rooting and shooting. The current findings corroborated those of Modi (2004), who noted that using sprouted seed corms as planting material led to an increase in the development of taro plants. Similar findings have also been previously reported in studies by Tschannen *et al.* (2005) and Johansen and Molteberg (2012), who found that using sprouted seed tubers as planting materials increased yam plant growth and seedling emergence, respectively. Conversely, fewer verticals and leaves on taro plants, which are derived from seed corms kept on a raised mesh wired bed one meter above ground, may correspond with weaker sprouting and shrunken seed corms, which are mostly the result of improper storage conditions. This, in turn, directly contributes to the poor emergence and reduced growth of seedlings. The strong relationship between potato plant stem growth and seed tuber sprouting was also noted by Cavalcante *et al*. (2019). The authors observed that the emergence and shoot growth of potatoes were reduced when the number of sprouts grown on the seed tuber decreased. Hailemichael and Seyoum (2016) have also reported a similar finding in their study on ginger plants.

Table 4. Effects of pre-planting storage method on vertical and leaf number of taro (mean of two seasons, 2021 and 2022)

Storage Methods	Number of Verticals (hill^{-1})		Mean	Number of Leaves (plant^{-1})		Mean
	2021	2022		2021	2022	
Cemented Floor	3.8^{a}	4.1^{a}	4.0^{a}	6.6^{a}	8.6^{a}	7.6^{a}
Under Tree Shade	3.7^{ab}	3.4^{b}	3.6^{ab}	5.4^{ab}	7.6^{b}	6.5^{b}
Mesh Wire Bed	3.1^{c}	2.8^{b}	2.9^{c}	4.4^{c}	5.8^{d}	5.1^{c}
Grass-Covered Pit	3.2^{bc}	3.2^{b}	3.2^{bc}	4.9^{bc}	7.2^{bc}	6.0^{bc}
Soil-Covered Pit	3.3^{bc}	3.1^{b}	3.2^{bc}	5.2^{bc}	6.7^{c}	6.0^{bc}
Mean	3.4	3.3	3.4	5.3	7.2	6.2
$LSD_{(0.05)}$	0.5*	0.7*	0.6*	1.2*	0.8*	1.0*
SEM	0.15	0.07	0.18	0.65	0.24	0.49
CV(%)	7.2	10.8	9.0	21.3	5.9	13.6

NB: Means within a column followed by the same letter are not significantly different at the 5% level of the LSD test, * = $p<0.05$, NS = not significant, CV = coefficient of variation, SEM = standard error of mean

Taro yield and yield attributes

Tables 5 and 6 demonstrate how different pre-plant storage methods affect taro yield attributes, such as the number and weight of corms produced per plant and the corm yield. Different pre-planting storage procedures had a significant ($p<0.05$) influence on the number and weight of corms, according to the results of the analysis of variance (Table 5). Similarly, these storage methods also had a significant ($p<0.05$) effect on the corm yield of taro both during the 2021 and 2022 cropping seasons (Table 6).

During the study period, the method of storing seed corms on a cemented floor within a constructed warehouse showed a significant difference in terms of the number and weight of corms per plant compared to seed corms stored using different pre-planting storage methods. Therefore, during the 2021 and 2022 cropping seasons, respectively, the seed corms placed on the cemented floor produced the largest corm numbers (11.6 plant^{-1}) and (18.5 plant^{-1}) (Table 5). Similarly, this storage method also yielded the maximum corm weights (657.4 g plant^{-1}) and (1009.2 g plant^{-1}) both during the same cropping seasons, respectively. According to the pooled mean analysis result, the highest number of corms (14.3 plant^{-1}) and the weight of the corm (819.0 g plant^{-1}) were found in seed corms that were stored in the same manner, as presented in Table 5. On the contrary, during the 2021 and 2022 cropping seasons, seed corms stored on a one-meter raised mesh weir bed beneath a thatched roof shelter had the lowest values for corm number and weight per plant (Table 5).

The increased number of corms per plant observed in the seed corms stored on the cemented floor can be attributed to improved plant growth with better assimilation and translocation of photosynthate to the sink (corms). This improvement was mainly due to increased sprouting of the stored seed corms; ultimately, this led to early field emergence and improved seedling growth. This observation aligns with the finding of Modi (2004), who reported that enhanced seedling emergence and growth of taro plants resulted in the highest number of corms per plant. Cavalcante *et al*. (2019) and Moletsane *et al*. (2022) have also reported similar findings on potatoes. The authors found that, as compared to seed tubers with fewer sprouts during planting, seed tubers with many sprouts generated the greatest number of tubers per plant. On the yam plant, similar results have also been reported by Tschannen *et al*. (2005) and Johansen and Molteberg (2012).

The greater weight of taro corms per plant produced from seed corms stored on a cemented floor within a constructed warehouse may be due to the higher number of seed corms produced per plant. This is mainly due to better sprouting and the early field emergence of seedlings, which led to enhanced plant growth and prolonged photosynthetic assimilation. Subsequently, this development resulted in improved partitioning and allocations of the dry matter; ultimately, this led to increased corm production per individual taro plant. The result supports the observations of Tsedalu *et al*. (2014), who found that early established, vigorously grew taro plants generated a greater number of corms per plant than did weakly grown taro plants. Numerous research have also demonstrated a positive correlation between the growth and yield attributes of taro plants (Paul and Bari, 2012; Fantaw *et al*., 2014; Gebre *et al*., 2015; Norman *et al*., 2015; and Richard *et al*., 2020).

On the contrary, the reduced number and weight of corms per plant observed in the seed corms stored on a one-meter raised mesh weir bed could be due to poor sprouting of the seed corms and reduced growth of plants. This, in turn, directly contributes to the decline in assimilation and translocation of photosynthetic material into the corms (the sink). Consequently, this regression led to reduced corm production per individual taro plant. Tsedalu *et al*. (2014) and Lewu *et al*. (2017) also discussed the relationship between taro plants' performance and their capacity for photosynthetic assimilation.

Table 5. Effects of pre-planting storage method on taro corm weight and number (mean of two seasons, 2021 and 2022)

Storage Methods	Number of Corms ($plant^{-1}$)		Mean	Weight of Corms (g $plant^{-1}$)		Mean
	2021	2022		2021	2022	
Cemented Floor	11.6^{a}	18.5^{a}	14.3^{a}	657.4^{a}	1009.2^{a}	819.0^{a}
Under Tree Shade	9.4^{b}	17.8^{a}	12.1^{b}	604.2^{a}	769.7^{b}	667.0^{b}
Mesh Wire Bed	8.0^{c}	13.1^{b}	11.5^{b}	449.1^{b}	635.4^{c}	585.0^{c}
Grass-Covered Pit	8.6^{bc}	13.9^{b}	11.6^{b}	506.9^{b}	728.2^{bc}	633.0^{bc}
Soil-Covered Pit	8.2^{c}	13.7^{b}	11.7^{b}	456.0^{b}	653.2^{c}	589.0^{c}
Mean	9.2	15.4	12.2	534.7	759.1	658.6
$LSD_{(0.05)}$	0.8*	1.0*	1.1*	59.5*	109.9*	50.0*
SEM	0.24	0.32	0.33	0.66	1.21	0.78
CV(%)	4.5	3.6	4.7	5.9	7.7	5.8

Means followed by the same letter(s) within a column are not significantly different at the 5% level of the LSD test, * = $p<0.05$, NS = not significant, CV = coefficient of variation, SEM = standard error of mean

When compared to the seed corms stored in different pre-planting storage methods, there were significant differences in the corm yield of the seed corms kept on a cemented floor over the study period. During the 2021 and 2022 cropping seasons, the seed corms housed on the cemented floor yielded the highest corm yields, measuring 26.7 and 30.3 tons ha^{-1}, respectively (Table 6). Likewise, the pooled mean analysis result showed that the corm yield of taro from seed corms stored in the same manner was highest (25.7 tone ha^{-1}), followed by corm yield from seed corms stored under tree shade covered with grass (22.6 tone ha^{-1}). On the contrary, the method of storing seed corms on a raised mesh weir bed at a height of one meter under a thatched roof shelter produced the lowest corm yield of taro throughout the study period, as shown in Table 6.

The enhanced productivity of individual plants in terms of the number and weight of corms produced can be the reason for the higher taro corm yield observed in the seed corms kept on a cemented floor. This efficiency results from enhanced plant growth with better photosynthetic assimilation and conversion into dry matter, which is mainly due to increased sprouting of seed corms as well as improved emergence and growth of seedlings. According to Eze and Nwofia (2016) stated that the weight and number of corms produced by each plant have a significant impact on the yield of the taro crop. The present finding is consistent with earlier research conducted by Kader and Rolle (2004) and Richard *et al*. (2020), which suggested that the enhanced corm yield of taro is mostly due to an increase in the number and weight of corms produced per plant. Their findings also discuss that vigorous plant growth directly contributes to enhanced light interception and translocation of photosynthesized materials into the sink (the corms); ultimately, this led to an increased number and weight of corms yielded per plant. The number and weight of corms per plant, as well as the growth attributes of the plants, had a significant impact on the corm production of taro, as reported by Paul and Bari (2012), Fantaw *et al*. (2014), Tsedalu *et al*. (2014), Gebre *et al*. (2015), and Norman *et al*. (2015). Lewu *et al*. (2017) also observed that vigorously performing taro plants yielded a higher corm yield compared to other taro plants. Similarly, Tschannen *et al*. (2005) also found the highest yield of potato tubers when the sprouted seed setts were used as a planting material.

On the contrary, the decreased number and weight of corms produced by each individual plant can be the reason for the lower taro corm yield observed in the seed corms kept on a one-meter raised mesh wired bed. This result is primarily triggered by poor emergence and reduced plant growth, which in turn led to a weak assimilation and translocation of photosynthate into the seed corms (sinks). Subsequently, this phenomenon directly contributes to the decrease in seed corm production in terms of number and weight per plant. This result is in line with the findings of Midmore and Roca (1992), who reported that potato plants that showed diminished growth ultimately produced the lowest tuber yield. Similarly, Babu *et al*. (2013) have shown that improper storage techniques and damaged stored seed rhizomes have a negative impact on the sprouting of seed rhizomes and the field growth of ginger plants.

Table 6. Effects of pre-planting storage method on fresh taro corm yield (t ha^{-1}) (mean of two seasons, 2021 and 2022)

Storage Methods	Year		Mean
	2021	2022	
Cemented Floor	26.7^{a}	30.3^{a}	25.7^{a}
Under Tree Shade	22.7^{b}	23.1^{b}	22.6^{b}
Mesh Wire Bed	18.0^{c}	19.1^{c}	20.5^{c}
Grass-Covered Pit	20.8^{bc}	21.8^{bc}	20.9^{bc}
Soil-Covered Pit	18.8^{c}	19.6^{c}	20.7^{bc}
Mean	21.4	22.8	22.1
$LSD_{(0.05)}$	3.8	3.3	2.1
SEM	1.16	0.66	0.63
CV(%)	9.4	7.7	4.9

Means followed by the same letter(s) within a column are not significantly different at the 5% level of the LSD test, * = $p<0.05$, NS = not significant, CV = coefficient of variation, SEM = standard error of mean

Conclusion

The overall results of this study revealed that seed quality parameters, including the percentages of clean seed corms, sprouted seed corms, and the total number of taro sprouts were significantly ($p<0.05$) influenced by different pre-planting storage methods. In particular, the method of storing seed corms on a cemented floor within a warehouse improved seed quality attributes such as clean and sprouted seed corms and total sprouts. Conversely, seed corms kept on a one-meter raised mesh wired bed beneath a thatched roof shelter showed the highest percentage of seed weight loss along with decreased seed quality attributes. During the study period, seed corms stored on a cemented floor consistently outperformed other storage methods in terms of growth and yield attributes. The highest corm yield of taro was obtained from seed corms that were stored on a cemented floor within a constructed warehouse. Therefore, it is shown that the best way to store seed corms to increase seed quality, plant growth, and corm yield is to keep them on a cemented floor within a constructed warehouse. For taro growers in the study area, the previously indicated pre-plant storage approach can be advised; nevertheless, additional research on economic evaluation is required to confirm the practice's viability.

Acknowledgement

This research was financially supported by the Ethiopian Institute of Agricultural Research (EIAR) and the contribution of Teppi Agricultural Research Center (TARC) is also greately appreciated.

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