



Research Article

Characterization and Conservation of Native Banana Germplasm Available in Salt Ecosystem

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ARTICLE INFO	ABSTRACT
<p>Article history Received: Accepted: Published: 30 June 2024</p> <p>Keywords Banana germplasm, Coastal salt ecosystem, <i>In situ</i> and <i>Ex situ</i> conservation, <i>Musa</i> spp.</p> <p>Correspondence Litun Ahmed Labib ✉: labibpstu@gmail.com</p>	<p>This study aimed to assess, conserve, and characterize banana germplasm in Bangladesh's coastal salt ecosystem, with the goal of improving cultivation resilience and sustainability under challenging environmental conditions. Thirty-five banana germplasm were subjected to <i>in situ</i> investigation, with 11 germplasm undergoing morphological characterization, revealing significant variations in key parameters. Additionally, 11 germplasm representing <i>Musa</i> species were collected for <i>ex situ</i> conservation at the Germplasm Center, Department of Horticulture, PSTU, with three, four, and four germplasm falling under <i>Musa paradisiaca</i>, <i>Musa acuminata</i>, and <i>Musa sapientum</i>, respectively. Notably, <i>M. paradisiaca</i> (kacha kola), <i>M. acuminata</i> (atia kola), and <i>M. sapientum</i> (table banana) exhibited promising traits in terms of morphological characteristics, total yield, and shelf-life. Among these, germplasm MP01 (<i>M. paradisiaca</i>), MA17 (<i>M. acuminata</i>), and MS09 (<i>M. sapientum</i>) demonstrated superior potential for maximizing production and profitability within the coastal salt ecosystem region. These findings offer valuable insights for banana cultivation in similar challenging environments, contributing to enhanced agricultural sustainability and livelihoods.</p>
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Introduction

Banana, belonging to the genus *Musa* within the family Musaceae, holds a distinguished status as one of the most significant fruit crops worldwide. Revered for its rich flavor, nutritional richness, and year-round availability, banana stands as an ancient cultivated plant esteemed for its multifaceted benefits (Britannica, 2020 and Kumar *et al.*, 2012). In Bangladesh, bananas are cultivated extensively across diverse regions, with notable concentrations in Rangamati, Barishal, Rangpur, Dinajpur, Noakhali, Faridpur, Tangail, and Khulna. This tropical fruit occupies a pivotal position in the nation's agricultural landscape, emerging as one of the foremost economically important crops, complementing staples like rice, wheat, and maize (FAO, 2020).

Despite its widespread cultivation, challenges persist in optimizing banana production, especially in addressing varietal adaptability and microclimatic variations across different regions (Hossain, 2014). Factors such as the absence of selected varieties suited to various agro-

ecological zones, inadequate modern production technologies, and susceptibility to diseases and pests, including Fusarium wilt, nematodes, and weevil borers, impede production, particularly in coastal inundated saline regions (Gaidashova *et al.* 2008).

However, intriguingly, certain indigenous banana races in these saline-affected areas exhibit remarkable resilience, thriving even without proper cultivation practices. Despite limited cultivation by local communities, these promising local varieties possess superior taste, size, color, and adaptability to adverse conditions, presenting a compelling subject for further research and development initiatives.

In situ conservation emerges as a vital strategy for preserving species diversity and genetic variability, albeit hindered by challenges such as limited botanical knowledge for accurate species identification and difficulties in accessing remote locations, particularly in tropical and subtropical areas like Southeast Asia (Liu *et*

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al., 2002 and Sardos et al., 2018). Bridging this gap requires selecting suitable varieties, developing updated technologies, and providing quality planting materials tailored to the coastal ecosystem (Rasmussen et al., 2015, Merritt et al., 2014, Flanagan et al., 2019, and Hunter & Heywood, 2011).

While commercial banana production is increasing, research efforts focused on enhancing local varieties in Bangladesh remain insufficient, particularly in addressing the unique challenges of salt-affected regions. Addressing these gaps holds the potential to significantly boost banana production, benefiting both farmers and commercial growers. Against this backdrop, the present study aims to contribute to the advancement of banana cultivation in Bangladesh. Through a comprehensive approach encompassing surveying, *in situ* conservation with GPS coordination, and characterization of promising *Musa* spp., alongside *ex-situ* conservation efforts at the PSTU germplasm center, the research endeavors to lay the foundation

for sustainable and resilient banana production in the coastal salt ecosystem.

Materials and Methods

Baseline information and *in situ* conservation approach

As the baseline information, *Musa* species were noted during their collection and conservation. Passport data regarding local/ Bengali, English, and scientific names of banana germplasms/accessions, and places of identification with their Global Positioning System (GPS) coordination were done using 'Vivo Y12A' model. *In situ* conservation activities were carried out in 30 farmer's homesteads within Kalapara upazila, Patuakhali, situated along the south coast of Bangladesh. A comprehensive survey was conducted to identify native *Musa* species such as *Musa paradisiaca*, *Musa acuminata*, and *Musa sapientum*. Various banana accessions were grown in these areas, selected, and labeled for further evaluation. Horticultural Genetic Resources (HGR) conservation strategies (Figure 1) pertinent to the research were implemented, following guidelines outlined by Malik et al. (2010).

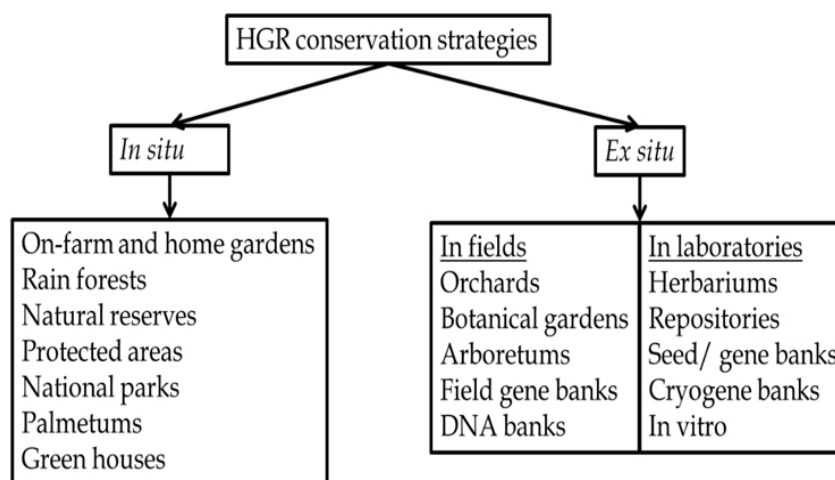


Figure 1. The conservation approaches of HGR.

Species richness (SR) and Relative prevalence (RP)

The species richness is the number of species within an area, giving equal weight to each one as suggested by Chao and Chiu (2016). The percentage of homesteads containing a particular species is one of the indicators of the relative prevalence of that particular species in that area. The percent of homesteads having the fruit species was calculated for all the species then the relative prevalence of a species was calculated using the formula:

$$RP = \frac{\text{Population of the species per homestead}}{\% \text{ homestead with the species}}$$

The relative prevalence value was calculated to rank the species into different groups according to Millat-e-Mustafa (1997).

Morphological characterization

The number of leaves was counted from the sample plants and their average was taken as the number of leaves per plant. To identify the days required for bunch maturity the date of emergence of inflorescence and those of the harvesting were recorded. Total crop duration was calculated by the summation of days required for flowering and flowering to bunch maturity. The number of hands per bunch was counted after harvest. The number of fingers per bunch was counted at the time of recording hands per bunch. At the time of harvest, the bunch was cut with 10 cm long peduncle

above the first hand. Then the bunch was weighed in a balance and recorded in kilograms (kg). The yield per hectare was calculated from the weight of the bunch multiplying by the number of plants per hectare (tons/ha). The pulp and skin tissues of ripe banana were separated by means of a stainless-steel knife and weighed separately. The ratio of pulp weight and skin weight was calculated by dividing the fresh weight of pulp by the weight of skin of a single fruit.

Shelf life

To calculate the shelf life of banana germplasms, the days from harvesting up to the last edible stage were taken into account.

Ex situ conservation approach

The *ex situ* conservation of native *Musa* species was done in the field gene bank or Germplasm Center (GPC), PSTU. In *ex situ* investigations, all the collected germplasms were planted in different blocks of GPC. Banana suckers were collected from collection sources for *ex situ* conservation and tagged with names. A systematic approach has been taken to characterize,

evaluate, use, and propagate the collected germplasms obtained at GPC.

Statistical analysis

The data collected from each experiment were statistically analyzed as per the design of the experiment using the RStudio software. The means for all treatments were calculated and the analyses of variances for all the traits under consideration were performed by the 'F variance test'. The significance of the difference between the pair of means was performed by the Least Significant Difference (LSD) test taking the probability level of 5% as a minimum unit of significance.

Results and Discussion

In situ conservation of native *Musa* species

The total variety of native *Musa* species found in the study area was noted in Table 1. 35 germplasms under *Musa* species were found in the study area. A passport database of these 35 germplasms was recorded. Promising *Musa* species germplasms were conserved *in situ* conditions (Table 1).

Table 1. Passport data of 35 banana germplasms conserved *in situ* in salt ecosystem

<i>Musa</i> spp.	Germplasm Code	Local name	Latitude (North)	Longitude (East)
<i>Musa paradisiaca</i> (Kacha kola)	MP01	Kacha kola	22°01'41"	90°18'21"
	MP02	Kacha kola	22°01'48"	90°18'22"
	MP03	Kacha kola	22°01'56"	90°14'33"
	MP04	Kacha kola	22°01'56"	90°14'33"
	MP05	Kacha kola	22°01'36"	90°16'34"
<i>Musa acuminata</i> (Atia kola)	MA01	Jhama Atia	22°01'36"	90°16'34"
	MA02	Jhama Atia	22°01'42"	90°16'34"
	MA03	Jhama Atia	22°01'42"	90°16'34"
	MA04	Jhama Atia	22°01'42"	90°16'42"
	MA05	Jhama Atia	22°01'43"	90°16'35"
	MA06	Jhama Atia	22°01'42"	90°16'42"
	MA07	Jhama Atia	22°01'43"	90°16'35"
	MA08	Daud Atia	22°01'41"	90°18'21"
	MA09	Daud Atia	22°01'41"	90°18'21"
	MA10	Daud Atia	22°01'43"	90°16'35"
	MA11	Daud Atia	22°01'41"	90°18'21"
	MA12	Puita Atia	22°01'48"	90°18'22"
	MA13	Puita Atia	22°01'56"	90°14'33"
	MA14	Puita Atia	22°01'43"	90°16'35"
	MA15	Tula Atia	22°01'41"	90°18'21"
	MA16	Tula Atia	22°01'41"	90°18'21"
	MA17	Tula Atia	22°01'42"	90°16'42"
	MA18	Tula Atia	22°01'43"	90°16'35"
	MA19	Tula Atia	22°01'42"	90°16'42"
	MA20	Tula Atia	22°01'42"	90°16'42"
<i>Musa sapientum</i> (Table banana)	MS01	Sobri Kola	22°01'41"	90°18'21"
	MS02	Sobri Kola	22°01'48"	90°18'22"
	MS03	Sobri Kola	22°01'56"	90°14'33"
	MS04	Sobri Kola	22°01'56"	90°14'33"
	MS05	Sobri Kola	22°01'36"	90°16'34"
	MS06	Sobri Kola	22°01'36"	90°16'34"
	MS07	Sobri Kola	22°01'42"	90°16'34"
	MS08	Sobri Kola	22°01'42"	90°16'34"
	MS09	Sobri Kola	22°01'42"	90°16'42"
	MS10	Sobri Kola	22°01'43"	90°16'35"

Species richness and relative prevalence

Musa species were noted during their collection and conservation based on species richness and relative prevalence. According to the survey based on species richness and relative prevalence, the population, sample, and morphotype of MP01, MP02, MP05 under *Musa paradisiaca*, MA07, MA11, MA14, MA17 under

Musa acuminata and MS02, MS04, MS07, MS09 under *Musa sapientum* were higher than others and those were considered for characterization to find out which one was more suitable and profitable under each *Musa* species respectively in the salt ecosystem region (Table 2).

Table 2. Species richness and relative prevalence of *Musa* species

<i>Musa</i> spp.	Germplasm code	Population	Sample	Morphotype
<i>Musa paradisiaca</i>	MP01	1300	3	153
	MP02	1250	3	149
	MP03	1000	2	111
	MP04	950	2	126
	MP05	1250	2	142
<i>Musa acuminata</i>	MA01	1000	2	140
	MA02	800	2	138
	MA03	950	2	142
	MA04	1050	2	130
	MA05	700	2	128
	MA06	800	2	134
	MA07	1350	3	146
	MA08	650	2	135
	MA09	500	2	125
	MA10	750	2	124
	MA11	1250	3	150
	MA12	1050	2	122
	MA13	1100	2	143
	MA14	1300	3	144
	MA15	550	2	122
	MA16	800	2	113
	MA17	1250	3	152
	MA18	950	2	111
	MA19	900	2	110
	MA20	600	2	129
<i>Musa sapientum</i>	MS01	1200	2	146
	MS02	1250	2	147
	MS03	850	2	144
	MS04	1370	2	149
	MS05	1050	2	141
	MS06	1100	2	140
	MS07	1250	2	145
	MS08	1000	2	122
	MS09	1260	2	148
	MS10	950	2	122

Morphological characterization

The number of leaves per plant at the flowering stage exhibited significant variation among different banana cultivars (Table 3). In *Musa paradisiaca*, the cultivar MP01 demonstrated the highest number of leaves per plant (10.45), whereas the lowest count was observed in MP05 (9.83). Among *Musa acuminata* cultivars, MA17 displayed the highest leaf count per plant

(13.12), while the lowest count was recorded in MA14 (11.22). Similarly, within *Musa sapientum*, the cultivar MS09 exhibited the maximum number of leaves per plant (9.33), with the minimum count noted in MS02 (8.51). These findings corroborate previous studies by Wilberforce *et al.* (2015) and Hoque (2008).

Table 3. Growth and Development attributes of *Musa paradisiaca*, *Musa acuminata* and *Musa sapientum* germplasms in salt ecosystem

<i>Musa paradisiaca</i>				<i>Musa acuminata</i>				<i>Musa sapientum</i>			
Germplasm Code	No. of leaves per plant	Days to bunch maturity	Crop duration (Days)	Germplasm Code	No. of leaves per plant	Days to bunch maturity	Crop duration (Days)	Germplasm Code	No. of leaves per plant	Days to bunch maturity	Crop duration (Days)
MP01	10.45	91.33	365	MA07	11.67	96.56	355	MS02	8.51	87.83	350
MP02	10.12	88.35	353	MA11	12.23	101.14	364	MS04	8.89	88.23	351
MP05	9.83	85.82	342	MA14	11.22	92.79	334	MS07	9.02	90.18	353
-	-	-	-	MA17	13.12	108.50	391	MS09	9.33	92.46	354
LSD at 5%	1.21	2.80	4.12	LSD at 5%	1.35	2.13	3.89	LSD at 5%	1.39	1.65	2.85
Level of sig.	*	*	*	Level of sig.	*	*	*	Level of sig.	*	*	*
CV (%)	7.39	1.79	1.72	CV (%)	7.57	1.92	1.89	CV (%)	6.18	1.35	1.54

* = Significant at 5% level of probability; CV = Coefficient of Variation

The time required for bunch maturity varied significantly among different banana cultivars, indicating distinct maturity patterns (Table 3). In *Musa paradisiaca*, the cultivar MP01 exhibited the longest time to reach maturity, with an average of 91.33 days, while MP05 demonstrated the shortest time, with an average of 85.82 days. Among *Musa acuminata* cultivars, MA17 displayed the highest time for bunch maturity, averaging 108.50 days, whereas MA14 required the shortest time, averaging 92.89 days. Similarly, within *Musa sapientum*, the cultivar MS09 required the maximum time for bunch maturity, averaging 92.46 days, while MS02 showed the shortest time, averaging 87.83 days. These findings are consistent with previous research by Wilberforce *et al.* (2015), Tigabu *et al.* (2015), and Gaidashova *et al.* (2008).

Crop duration varied significantly among different banana cultivars, with distinct life cycles observed within each species (Table 3). Among *Musa paradisiaca* cultivars, MP01 exhibited the longest crop duration, averaging 365 days, while MP05 showed the shortest duration, averaging 342 days. In *Musa acuminata*, the cultivar MA17 displayed the maximum crop duration,

averaging 391 days, whereas MA14 had the minimum duration, averaging 334 days. Similarly, within *Musa sapientum*, the cultivar MS09 demonstrated the highest life cycle, averaging 354 days, while MS02 exhibited the shortest duration, averaging 350 days. These findings align with previous studies by Hoque (2008), Krishnamoorthy and Kuma (2004), Halder *et al.* (2003), and Noupadja and Tomekpe (2001).

The number of hands per bunch varied significantly among different banana cultivars, indicating distinct bunch characteristics within each species (Table 4). In *Musa paradisiaca*, the cultivar MP01 produced the highest number of hands per bunch (12.47), while MP05 yielded the lowest (11.70). Among *Musa acuminata* cultivars, MA17 exhibited the maximum number of hands per bunch (12.60), while MA14 showed the minimum (10.78). Similarly, within *Musa sapientum*, the cultivar MS09 displayed the highest number of hands per bunch, averaging 10.33, whereas MS04 exhibited the lowest, averaging 8.92. These findings are consistent with prior research by Tigabu *et al.* (2015), Yoseph *et al.* (2014), and Gervacio *et al.* (2008).

Table 4. Hands per bunch and number of fingers per hand of *Musa paradisiaca*, *Musa acuminata*, and *Musa sapientum* germplasms in salt ecosystem

<i>Musa paradisiaca</i>			<i>Musa acuminata</i>			<i>Musa sapientum</i>		
Germplasm Code	Hands per bunch	No. of fingers per hand	Germplasm Code	Hands per bunch	No. of fingers per hand	Germplasm Code	Hands per bunch	No. of fingers per hand
MP01	12.47	17	MA07	11.44	15	MS02	9.43	14
MP02	12.04	16	MA11	11.75	14	MS04	8.92	15
MP05	11.70	16	MA14	10.78	13	MS07	9.78	16
-	-	-	MA17	12.60	15	MS09	10.33	16
LSD at 5%	1.16	1.45	LSD at 5%	2.37	1.74	LSD at 5%	1.63	1.74
Level of sig.	*	*	Level of sig.	*	*	Level of sig.	*	*
CV (%)	6.90	5.92	CV (%)	6.37	4.21	CV (%)	9.67	5.20

*=Significant at 5 % level of probability; CV = Coefficient of Variation

A significant variation was observed in the number of fingers per hand (Table 4). In *Musa paradisiaca*, MP01 showed the highest (17) number of fingers per hand while MP05 showed the lowest (16). On the other hand, in case of *Musa acuminata*, MA07 and MA17 showed the highest (15) number of fingers per hand while

MA14 showed the lowest (13). Moreover, in *Musa sapientum*, MS07 and MS09 found with highest (16) fingers while MS02 was found with the lowest (14) fingers. The findings are supported by Wilberforce *et al.* (2015), Tigabu *et al.* (2015), and Yoseph *et al.* (2014).

The yield per plant showed significant variation (Table 5 and Plate 1) due to the effect of different cultivars. Among the cultivars for *Musa paradisiaca*, the highest yield (22.23 kg per plant) was recorded in MP01 while the MP05 showed the lowest yield (20.62 kg per plant) of banana. On the other hand, the highest yield (20.41 kg per plant) of *Musa acuminata* was recorded in MA17

while the MA14 showed the lowest yield (17.46 kg per plant). In *Musa sapientum*, the maximum yield (17.58 kg per plant) was obtained from MS09 whereas MS02 showed the minimum yield (15.98 kg per plant). The findings align with previous studies by Sagar *et al.* (2017), Shaibu *et al.* (2012), and Chang *et al.* (2011).

Table 5. Yield per plant and pulp to peel ratio of *Musa paradisiaca*, *Musa acuminata*, and *Musa sapientum* germplasm in salt ecosystem

<i>Musa paradisiaca</i>			<i>Musa acuminata</i>			<i>Musa sapientum</i>		
Germplasm Code	Yield (Kg per plant)	Pulp: peel ratio	Germplasm Code	Yield (Kg per plant)	Pulp: peel ratio	Germplasm Code	Yield (Kg per plant)	Pulp: peel ratio
MP01	22.23	6.0	MA07	19.80	5.6	MS02	15.98	4.1
MP02	21.23	5.7	MA11	19.03	5.4	MS04	16.54	4.2
MP05	20.62	5.6	MA14	17.46	5.0	MS07	17.12	4.2
-	-	-	MA17	20.41	5.8	MS09	17.58	4.3
LSD at 5%	1.93	0.26	LSD at 5%	1.35	0.76	LSD at 5%	1.65	0.98
Level of sig.	*	*	Level of sig.	*	*	Level of sig.	*	*
CV (%)	7.42	3.14	CV (%)	6.42	2.23	CV (%)	9.34	8.44

*=Significant at 5 % level of probability; CV = Coefficient of Variation

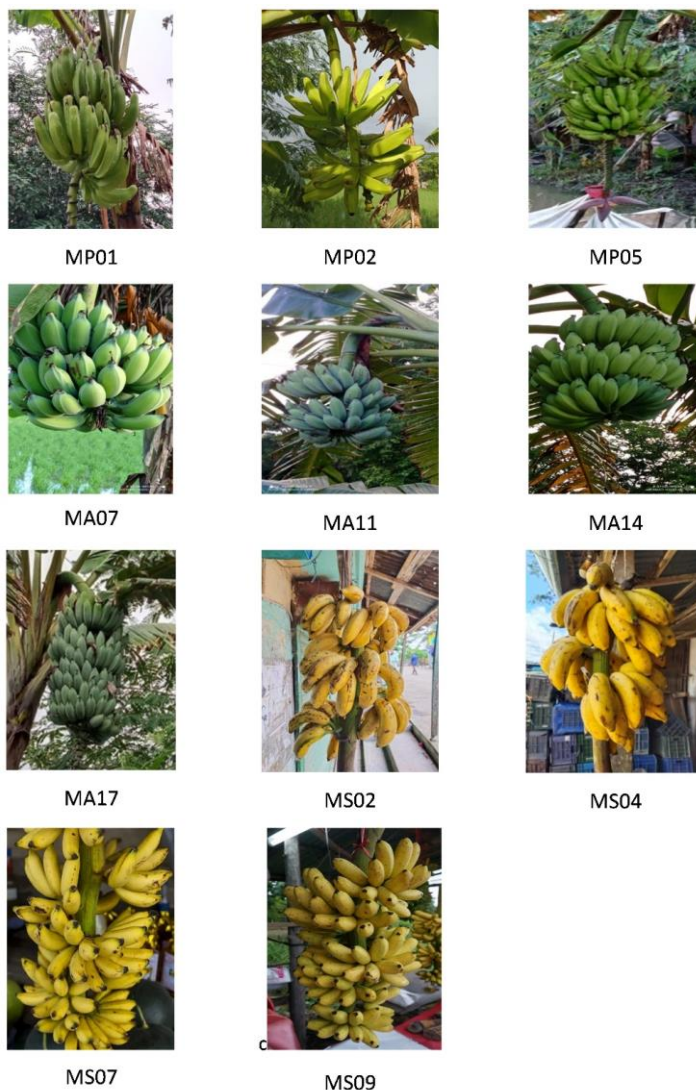


Plate 1. Fruits *Musa* species (MP01, MP02, MP05 = *Musa paradisiaca*), (MA07, MA11, MA14, MA17= *Musa acuminata*), (MS02, MS04, MS07, MS09= *Musa sapientum*)

In *Musa paradisiaca*, MP01 produced the highest yield per hectare (68.45 tons/ha) while it was the lowest (63.53 tons/ha) in MP05 (Figure 2). Moreover, in *Musa acuminata*, MA17 produced the highest yield (65.83 tons/ha) while it was the lowest (56.30 tons/ha) in

MA14 (Figure 2). Furthermore, in *Musa sapientum*, MS09 produced the maximum yield (54.87 tons/ha) whereas it was the lowest (49.86 tons/ha) in MS02 (Figure 2). The findings are supported by Wilberforce *et al.* (2015), Sagar *et al.* (2017), and Chang *et al.* (2011).

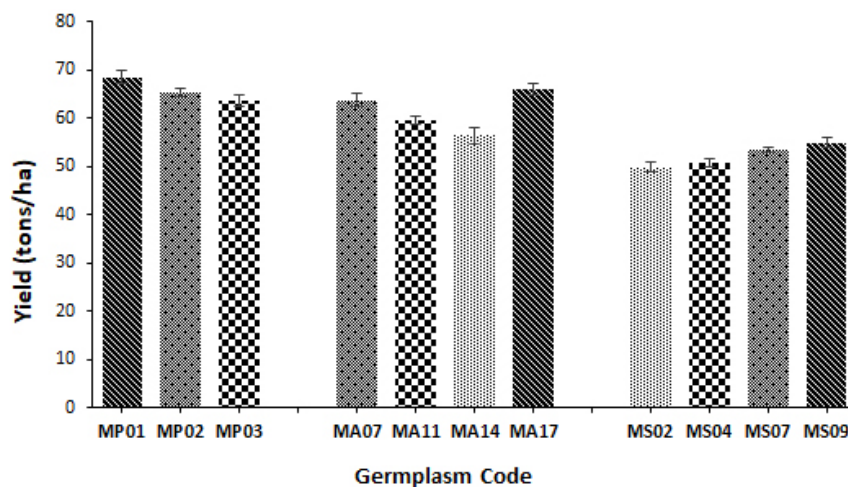


Figure 2. Yield (tons/ha) of different *M. paradisiaca*, *Musa acuminata* and *Musa sapientum* germplasms. Vertical bars represent standard error.

In table 5, for *Musa paradisiaca*, MP01 gave the highest pulp: peel ratio whereas the lowest pulp: peel ratio was MP05 (5.6). In *Musa acuminata*, the maximum pulp: peel ratio was found from MA17 (5.8) while the minimum pulp: peel ratio was recorded from MA14 (5.0). Furthermore, in *Musa sapientum*, MS09 gave the highest pulp: peel ratio (4.33) whereas the lowest pulp: peel ratio was from MS02 (4.1).

MP01 exhibited the longest shelf life, 19.56 days, while MP03 displayed the shortest shelf life, 18.20 days. Among *Musa acuminata* cultivars, MA17 demonstrated the longest shelf life, 19.08 days, whereas MA14 showed the shortest shelf life, 16.32 days. Similarly, within *Musa sapientum*, MS09 displayed the maximum shelf life, 17.11 days, while MS04 exhibited the minimum shelf life, 14.62 days. These findings are consistent with prior studies by Mimi (2013), Rashid (2013) and Bugaud *et al.* (2005), providing further support for the observed variations in shelf life duration among banana cultivars.

Shelf life

Shelf life duration varied significantly among different banana cultivars, with notable differences observed within each species (Figure 4). In *Musa paradisiaca*,

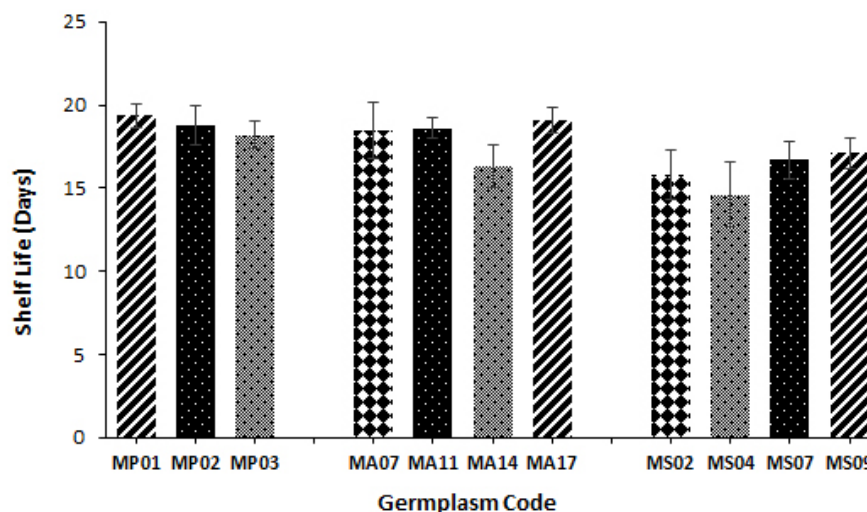


Figure 3. Shelf-life of different *Musa paradisiaca*, *Musa acuminata* and *Musa sapientum* germplasms. Vertical bars represent standard error.

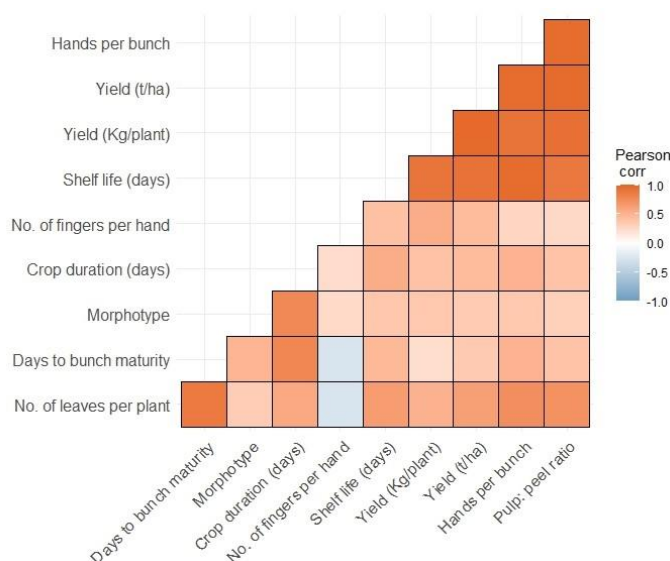


Figure 4. Correlation coefficient for morphotype, morpho-physical characterization attributes, and shelf life in the selected banana for the salt ecosystem.

Table 6. *Ex situ* conservation of *Musa* species at PSTU Germplasm Center

<i>Musa</i> spp.	Germplasm Code	Germplasm No.
<i>M. paradisiaca</i>	MP01	1
	MP02	1
	MP05	1
<i>M. acuminata</i>	MA07	1
	MA11	1
	MA14	1
	MA17	1
<i>M. sapientum</i>	MS02	1
	MS04	1
	MS07	1
	MS09	1

Ex situ conservation of *Musa* species at Germplasm Center (GPC)

Collection of germplasm propagules for the *ex situ* conservation was done at the GPC in situated with Global Positioning System (GPS) coordination at 22°27'56" north latitudes and 90°23'10" east longitudes. Germplasm propagules such as suckers were used for conservation at GPC. Eleven promising banana germplasms were collected and conserved *ex situ* conditions at GPC. Among them; 3 germplasms belonged to *M. paradisiaca*, 4 germplasms belonged to *M. acuminata* and 4 germplasms belonged to *M. sapientum* (Table 6). It represents a proactive approach to mitigate the threats posed by pests, diseases, and environmental changes to banana cultivation. By conserving a diverse array of germplasm, GPC aims to support ongoing research efforts aimed at developing resilient and productive banana varieties, thereby contributing to sustainable agriculture and global food security.

Correlation coefficient analysis

Correlation matrix revealed both strong positive and negative correlation among the variables (Figure 4). Notably, strong positive correlations were identified between crop duration, morphotype, and bunch maturity ($R^2= 0.78, 0.79$), suggesting that an increase in crop duration corresponds with elevated values in these parameters. Additionally, a notable correlation was found between the number of leaves per plant and bunch maturity ($R^2= 0.88$), indicating that an increase in leaves per plant prolongs the time to bunch maturity. Further analysis revealed significant correlations ($R^2= 0.91, 0.93, 0.96, 0.89$) among shelf life, yield, hands per bunch, and pulp: peel ratio, emphasizing their interdependence. Interestingly, a strong positive correlation ($R^2= 0.96$) was observed between hands per bunch and pulp: peel ratio, while a negative correlation ($R^2= -0.37, -0.37$) was evident between the number of fingers per bunch, number of leaves per plant, and bunch maturity, suggesting that an increase in the number of fingers per bunch may lead to decreased values in these parameters.

Conclusion

In conclusion, a diverse range of *Musa* species was identified in the salt ecosystem of Bangladesh, with 35 germplasms noted in the study area. Promising cultivars for banana production in this challenging coastal environment were highlighted through integral conservation approaches encompassing both *in situ* and *ex situ* methods. It was found that *Musa paradisiaca* MP05, *Musa acuminata* MA17 and *Musa sapientum* MS09 demonstrated superior attributes for maximum production and profitability in terms of various

parameters including leaves per plant, hands per bunch, yield, and shelf life. These cultivars show potential for cultivation by farmers in coastal salt ecosystem regions to attain high-quality banana production. Such investigations will provide valuable insights for optimizing banana cultivation practices in these challenging environments, ultimately benefiting both farmers and the agricultural sector as a whole. However, further studies are recommended to comprehensively understand the growth activity, production potentiality, adaptability capability, and fruit quality of these identified germplasms in salt ecosystem regions.

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