United States Department of Agriculture

FINAL STUDY REPORT (July 2026)
Cape May Plant Materials Center
Cape May Court House, NJ

Evaluation of reproductive performance attributes of two American beachgrass (*Ammophila breviligulata*) strains

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ABSTRACT

Vegetative installation of 'Cape' American beachgrass (*Ammophila breviligulata*) is common practice for dune restoration efforts in the Mid-Atlantic coastal region. The widespread use of an asexually propagated clonal variety raises concerns about the impact on the genetic diversity of existing American beachgrass populations. One of the primary characteristics of Cape at its release in 1972 was reduced seedhead production compared to other strains evaluated. The objective of this study was to compare the reproductive fitness of Cape against a wildland collection of American beachgrass from a native dune system. Culm production, seedhead formation, seed production, and culm viability were assessed over four growing seasons. Cape produced significantly less seedheads and seeds than the wildland collection. Overall, there was no significant difference in culm size or culm production between the two strains. Time between harvest and planting was significantly negatively associated with culm viability regardless of American beachgrass strain.

INTRODUCTION

Vegetative installation of American beachgrass has been considered the standard practice for dune rehabilitation and vegetating newly constructed dunes in the Mid-Atlantic coastal region for generations (Sheahan, 2014). It has proven competitive adaptations that make it an ideal species for dune stabilization purposes (Krajnyk & Maun, 1982). Its vigorous rhizome growth and spread creates an extensive network that stabilizes dunes. Its ability to survive and emerge from burial under sand makes it a natural choice for the shifting sands of the coastal dune environment (Maun & Lapierre, 1984). These characteristics coupled with wide commercial availability provide an explanation as to why American beachgrass is one of the most commonly used species for dune stabilization (Krajnyk & Maun, 1982).

'Cape' American beachgrass is a cultivar developed and selected for survival, vigor, culm production, and biomass production for the purpose of dune stabilization in the Mid-Atlantic coastal region (Gaffney & Duell, 1974; USDA-NRCS, 2023). It is one of the most common named American beachgrass varieties planted for dune restoration projects along much of the northern Atlantic coast and the most often used variety in New Jersey (Skaradek et al., 2003; Slaymaker et al., 2015; Wootton et al., 2016). Cape is a clonal variety asexually propagated via vegetative divisions (USDA-NRCS, 2023). With growing efforts in natural resources restoration practices to preserve local genotypes, valid concerns regarding the impact of the broad use of Cape on the genetic diversity of native localized American beachgrass genotypes must be addressed (Slaymaker et al., 2015). Gaffney and Duell (1974) recognize and discuss these concerns in Cape's registration documentation in reporting that Cape produced fewer seedheads than other strains during

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developmental trials and would therefore minimize genetic changes due to volunteer seedling production.

While the report that Cape produces fewer seedheads than other strains may assuage some concerns for genetic impacts to local native populations, it does not completely resolve them. American beachgrass procreates both through sexual reproduction via seed dispersal and asexual cloning via vegetative means (Maun, 2009). Research suggests that asexual clonal reproduction via vegetative spread and dispersal of vegetative material is the primary means of reproduction for the species (Krajnyk & Maun, 1982: Maun, 2009). With the precautionary concerns of Cape's impact on genetic diversity of native American beachgrass populations and the species' reproductive traits, the question of Cape's specific reproductive performance attributes in comparison to wild native genotypes becomes more critical.

The objective of this study was to compare reproductive fitness of Cape to a wildland collection of American beachgrass from a native dune system with a primary focus on seed production.

MATERIALS AND METHODS

The study was conducted at the New Jersey Plant Materials Center (NJPMC) in Cape May Court House, NJ (39.124237, -74.785967) in a Hammonton sandy loam (Soil Survey Staff, n.d.). A weed free planting area for the study was prepared using tillage equipment in the spring. The study was a randomized complete block design with four replications and two treatments: Cape and an American beachgrass assigned accession number 9094776 collected from a natural American beachgrass stand (no documentation of dune revegetation plantings) from the native dune system (40.477114, -74.008772) of the Sandy Hook Unit of Gateway National Recreation Area. Each plot was a 20 ft row of each American beachgrass strain with 1.5 ft in row spacing (Figure 1).

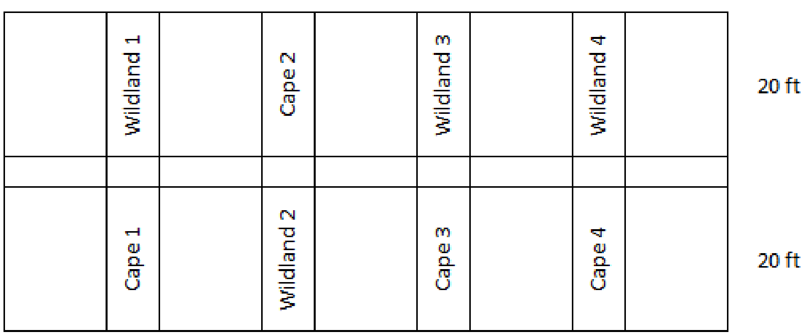

Figure 1. A diagram of the study plots from an American beachgrass trial study at the New Jersey Plant Materials Center, Cape May Court House, NJ.

Plants for this study were harvested from vegetative increase production fields at the NJPMC on 6 April 2021 and divided into individual culms to produce plugs. Culms were planted in 1 quart size pots using Pro-Mix all-purpose potting mix (Quakertown, PA) as the planting medium. Potted culms were held on an Aquamat irrigation system (Soleno Textile inc., Laval, QC) to maintain even and consistent moisture in a temperature (20.3-37.4 °C) controlled greenhouse for 64 days until field planting.

Rooted plugs were planted on 9 June 2021. The plot rows were manually weeded using hand tools the first 2 years of the study until the American beachgrass had established. Preemergent chemical herbicide applications (Table 1) were used to minimize weed pressure. Alleys were rototilled regularly to control weeds and prevent cross contamination of American beachgrass strains. All plants were trimmed to approximately 20 in at the beginning of each growing season to remove remaining seedheads and avoid duplicative counting of annual seedhead production.

Table 1. Details of all chemical herbicide applications during American beachgrass variety trial study at the New Jersey Plant Materials Center, Cape May Court House, NJ.

Date	Active ingredient	Rate	EPA Reg. No.
		qt/ac	
14 Apr. 2022	pendimethalin	1.250	241-418
5 May 2022	dimethylamine salt	0.8350	34704-120
5 May 2022	clopyralid	0.1125	42750-89
8 May 2023	pendimethalin	2.000	241-418
8 May 2023	dimethylamine salt	1.000	34704-120

Culm counts were conducted at the end of the first growing season (2021) and in the spring of 2025 after seed production data collections were completed. After one growing season, individual plants were distinguishable and accurate culm counts were possible. After two growing seasons, individual plants had spread via rhizomatous growth and were no longer distinguishable making culm per plant counts subjective. The 2025 culm counts were conducted by harvesting American beachgrass from 10 randomly selected sample quadrats (0.25 ft^2) from each treatment. The harvested materials were separated into individual culms for counts.

Seedhead counts were conducted at the end of each growing season by dividing each treatment row into 2 ft samples (10) and counting the number of seedheads present in each sample. Randomly selected seedheads (10) were collected from each treatment row to examine seed production after counts were completed. Exact dates of field data collection activities are reported in Table 2. Seedheads were weighed before seed was extracted and cleaned via seed cleaning equipment (hammermill and air screen seed cleaner). Seeds were counted and weighed to analyze seed production performance and seed mass.

Table 2. Details of data collection dates during American beachgrass variety trial study at the New Jersey Plant Materials Center, Cape May Court House, NJ.

Year	Culm Count	Seedhead Count	Seedhead Harvest	Plant Harvest
2021	9 Dec.	9 Dec.	NA	NA
2022	NA	22 Nov.	22 Nov.	NA
2023	NA	11 Dec.	11 Dec.	NA
2024	NA	1 Nov.	1 Nov.	NA
2025	10 Apr.	NA	NA	9 Apr.

The cleaned culms harvested from the sample quadrats were used to assess culm diameter and culm viability. The diameter of five randomly selected culms from each sample (5 culms x 10 samples x 4 plots x 2 treatments = 400 culms) was measured 3 in above soil surface as described for the Critical Area Planting NRCS conservation practice standard in the “Measuring Stem Diameter” section of Plant Materials Evaluation Procedures (USDA-NRCS, 2019). Culm viability was assessed by planting 25 randomly selected culms from each treatment row (25 culms x 4 plots x 2 treatments = 200 culms) into 50cell (2x2x5 in) trays using Pro-Mix all-purpose potting mix (Quakertown, PA) as the planting medium. The culm viability test was initiated 2 days after harvest. The process was replicated 15 days after harvest to assess longevity of culm viability. Culms were stored dry in a cinder block building without temperature control from harvest until planting. Daily high and low temperatures are reported in Table 3 (ONJSC, 2026). All culms were assessed for viability 9 weeks after harvest.

Table 3. Daily maximum and minimum temperatures during the culm storage period from an American beachgrass variety trial study at the New Jersey Plant Materials Center, Cape May Court House, NJ.

Date	Daily Max Temperature (°C)	Daily Minimum Temperature (°C)
9 Apr. 2025	10.0	-0.6
10 Apr. 2025	12.2	2.8
11 Apr. 2025	8.3	6.1
12 Apr. 2025	6.1	3.9
13 Apr. 2025	16.1	4.4
14 Apr. 2025	18.3	4.4
15 Apr. 2025	18.3	10.0
16 Apr. 2025	15.6	7.8
17 Apr. 2025	15.6	3.9
18 Apr. 2025	18.3	2.2
19 Apr. 2025	29.4	14.4
20 Apr. 2025	25.0	8.3
21 Apr. 2025	16.7	6.7
22 Apr. 2025	27.2	13.3
23 Apr. 2025	19.4	8.3
24 Apr. 2025	25.0	5.6
25 Apr. 2025	23.3	8.3
26 Apr. 2025	24.4	13.3

Statistical analysis of data was conducted using Statistix 10 data analysis software (Analytical Software, Tallahassee, FL). ANOVA and Tukey Honestly Significant Difference (HSD) tests were conducted for plant attributes with normally distributed data sets. Kruskal-Wallis one-way analysis of variance and Dunn's all-pairwise comparisons tests were conducted for plant attributes with non-normally distributed data sets. Culm viability analysis was conducted using a series of chi-square goodness of fit tests.

RESULTS AND DISCUSSION

Average culm production was inconsistent for the 2 years it was examined. The two strains showed no significant difference after one growing season. After four growing seasons, the wildland strain displayed a significantly greater average number of culms produced per sample quadrat. However, when the data sets from both years were statistically analyzed as a single set, no significant difference in culm production between the strains was indicated. Although greater culm diameter was an attribute displayed by Cape during developmental comparative trials, culm diameter showed no significant difference between the two American beachgrass strains in this study (Gaffney & Duell, 1974; USDA-NRCS, 2023).

Neither strain produced any seedheads during the first growing season. Both strains produced seedheads after the second growing season with no significant difference in the number produced indicated. However, after both the third and fourth growing seasons, the wildland strain produced significantly more seedheads than Cape. When the data sets from all 3 years were statistically analyzed as a single set, the data displayed a significant difference between strains in seedhead production. These data support the anecdotal observation reported by Gaffney and Duell (1974).

Seedhead mass data consistently indicated that the wildland strain produced seedheads with a greater mass than Cape seedheads. This study only reports 2 years of seedhead mass data for Cape because neither strain produced any seedheads during the first growing season and Cape did not produce any seedheads in 2023. When the data sets from the 2 years that Cape produced seedheads were statistically analyzed as a single set, the data displayed a significant difference between strains in seedhead mass.

The wildland strain consistently produced a statistically significant greater number of seeds per seedhead than Cape. This finding is consistent with the reported poor seed production of Cape (Gaffney & Duell, 1974; USDA-NRCS, 2023). The lack of Cape seed production provides an explanation for the significant difference in seedhead mass between the two strains. The Cape seedheads consisted nearly exclusively of only light floral structures that would be considered waste chaff during the seed cleaning process whereas the wildland strain seedheads included the denser mature seed as a constituent. Seed mass data was extremely limited due to the lack of seed production by Cape.

Table 4. Average reproductive attribute data from an American beachgrass variety trial study at the New Jersey Plant Materials Center, Cape May Court House, NJ.

Strain	Year	Avg. Culm Count	Avg. Culm Diameter	Avg. Seedhead Count	Avg. Seedhead Mass (g)	Avg. Seeds Produced / Seedhead	Total Seed Mass (g)	Avg. Seed Mass (g)
wildland	2021	12.4^{A*}	NA	0	NA	NA	NA	NA
Cape	2021	12.8^{A*}	NA	0	NA	NA	NA	NA
wildland	2022	NA	NA	4.3^{A*}	$1.61^{A†}$	17.83^{A*}	2.10	0.003
Cape	2022	NA	NA	2.4^{A*}	$1.02^{B†}$	0.00^{B*}	NA	NA
wildland	2023	NA	NA	1.8^{A*}	1.64	6.47	0.62	0.003
Cape	2023	NA	NA	0.0^{B*}	NA	NA	NA	NA
wildland	2024	NA	NA	4.0^{A*}	2.14^{A*}	9.15^{A*}	1.33	0.004
Cape	2024	NA	NA	0.5^{B*}	0.96^{B*}	0.056^{B*}	0.002	0.002
wildland	2025	18.6^{A*}	0.24^{A*}	NA	NA	NA	NA	NA
Cape	2025	14.5^{B*}	0.23^{A*}	NA	NA	NA	NA	NA
wildland	all	15.5^{A*}	NA	3.4^{A*}	1.80^{A*}	11.31^{A*}	4.05	0.003
Cape	all	13.6^{A*}	NA	1.0^{B*}	1.00^{B*}	0.02^{B*}	0.002	0.002

**Means with the same letter for the same plant attribute and year are not significantly different according to Dunn's test at P<0.05.*
†Means with the same letter for the same plant attribute and year are not significantly different according to Tukey's HSD at P<0.05.

The increased duration between harvest and planting significantly negatively impacted culm viability of Cape and the wildland strain American beachgrass reducing average viability from 92 to

30% and 86 to 26% respectively (Figure 2). Chi-square tests (Tables 5 and 6) indicated that duration between harvest and planting is significantly associated with culm viability for both American beachgrass strains. This finding supports the general American beachgrass planting guidelines recommendation to plant culms within 1-3 days after harvest (Eberhardt et al., 2025). Additional Chi-square tests (Tables 7 and 8) indicated that culm viability is not significantly associated with beachgrass strain at durations of 2 or 15 days between harvest and planting.

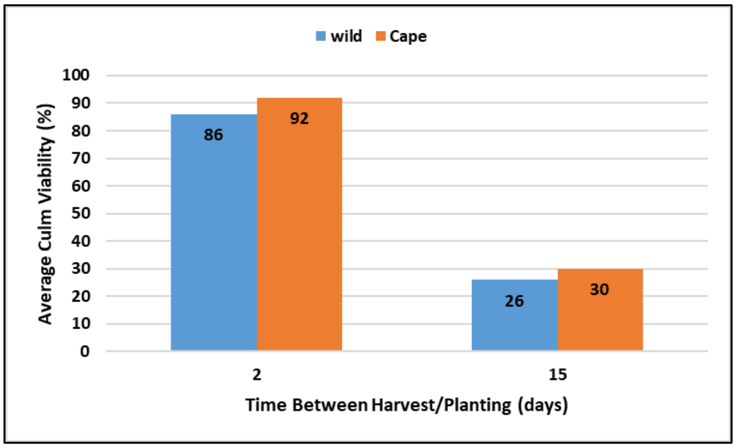

Figure 2. A chart showing average culm viability data from an American beachgrass trial study at the New Jersey Plant Materials Center, Cape May Court House, NJ.

Table 5. Results of chi-square analysis of Cape American beachgrass culm viability after varying durations between harvest and planting. Culm viability was examined as part of a broader American beachgrass variety trial study at the New Jersey Plant Materials Center, Cape May Court House, NJ.

Days	Viable	Nonviable	Chi-square	*P*-value
2	92	8		
15	30	70		
			80.79	<0.001

Table 6. Results of chi-square analysis of wildland strain American beachgrass culm viability after varying durations between harvest and planting. Culm viability was examined as part of a broader American beachgrass variety trial study at the New Jersey Plant Materials Center, Cape May Court House, NJ.

Days	Viable	Nonviable	Chi-square	*P*-value
2	86	14		
15	26	74		
			73.05	<0.001

Table 7. Results of chi-square analysis of culm viability of Cape and wildland germplasm American beachgrass strains planted 2 days after harvest. Culm viability was examined as part of a broader American beachgrass variety trial study at the New Jersey Plant Materials Center, Cape May Court House, NJ.

Strain	Viable	Nonviable	Chi-square	*P*-value
wildland	86	14		
Cape	92	8		
			1.84	0.1751

Table 8. Results of chi-square analysis of culm viability of Cape and wildland collection American beachgrass strains planted 15 days after harvest. Culm viability was examined as part of a broader American beachgrass variety trial study at the New Jersey Plant Materials Center, Cape May Court House, NJ.

Strain	Viable	Nonviable	Chi-square	*P*-value
wildland	26	74		
Cape	30	70		
			0.4	0.5287

CONCLUSION

This study demonstrated differences in reproductive performance between Cape and a wildland collection germplasm American beachgrass based on average culm production, seedhead formation, and seed production. Cape displayed less reproductive fitness than the wildland collection germplasm based on reproductive attributes examined: significantly less production of seedheads, seed, and culms (after the fourth growing season). Anecdotal claims made without supporting data of limited seedhead formation and poor seed set of Cape compared to other American beachgrass strains are supported by data produced in this study (Gaffney & Duell, 1974; USDA-NRCS, 2023). No significant differences in culm viability were found between Cape and the wildland collection strain regardless of duration between harvest and planting treatments. The extended duration treatment (15 days) significantly negatively impacted culm viability of both American beachgrass strains.

The findings of this study suggest that Cape does not have a vegetative reproductive fitness advantage over the randomly selected native, wildland American beachgrass population used for comparison. The wildland native strain displayed greater sexual reproductive fitness than cape via seed production. Even so, the widespread use of solely Cape for dune restoration has impacted the genetic diversity of American beachgrass populations in restored areas in New Jersey likely because of the species' capability to reproduce asexually via self-cloning vegetatively (Maun, 2009; Slaymaker et al., 2015). While preserving genetic diversity of native populations is a priority for most conservation efforts, the widespread and reliable commercial availability of Cape in quantities required for large scale restoration efforts often make it the most feasible option.

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APPENDIX

Study photos:

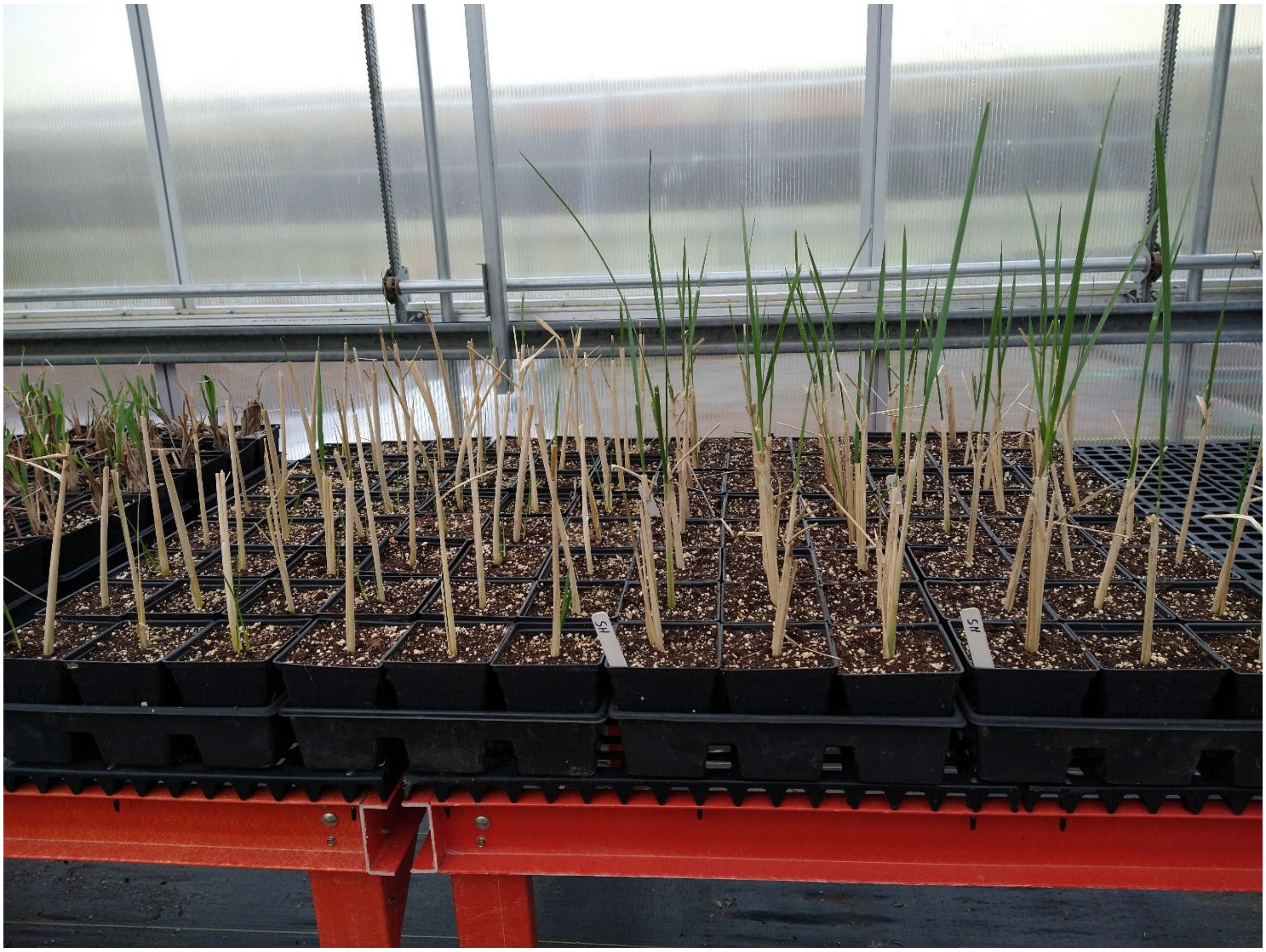


Figure 3. Cape (left) and the NJ wildland strain (right) American beachgrass germplasms display varied timelines to break dormancy.

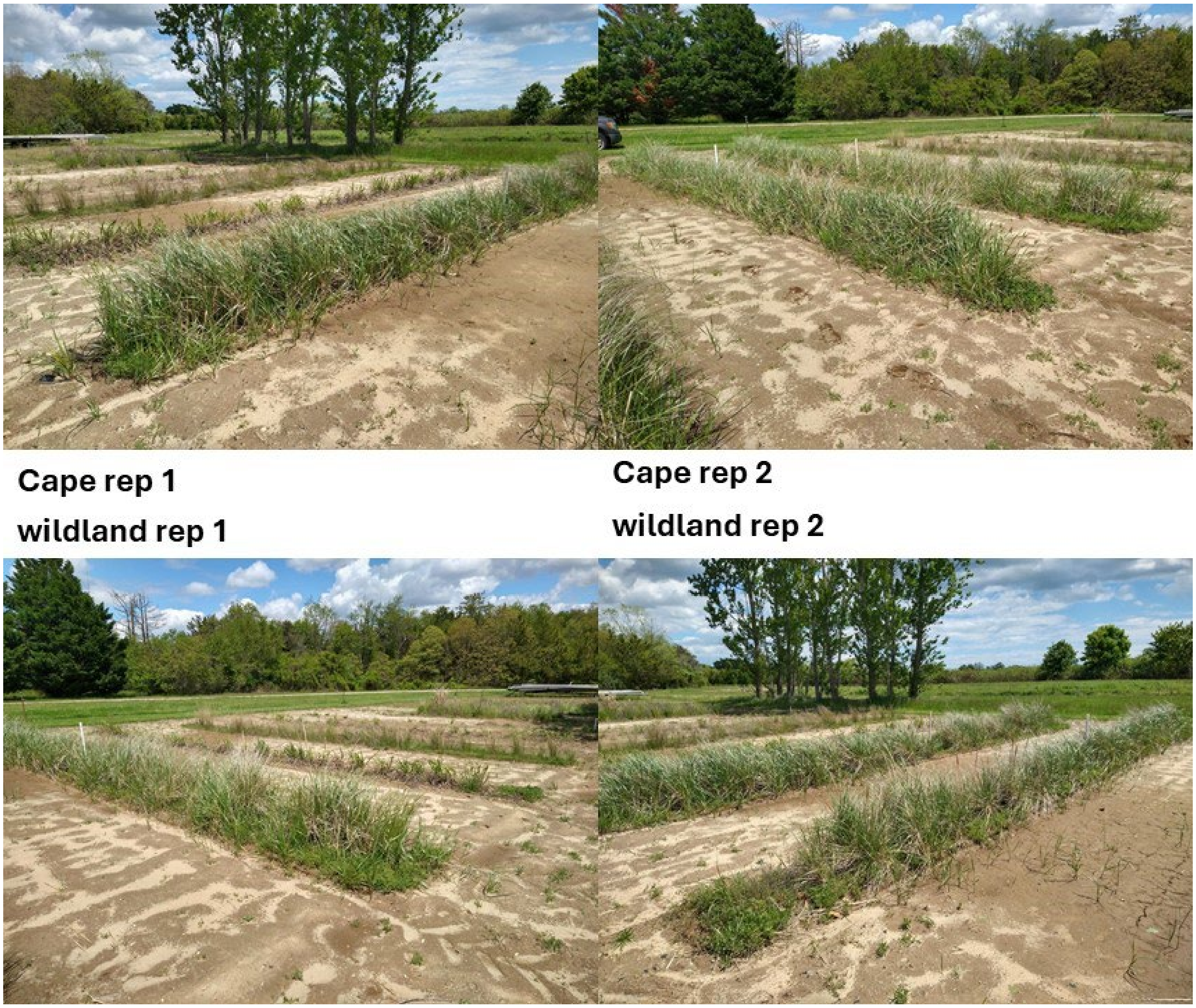
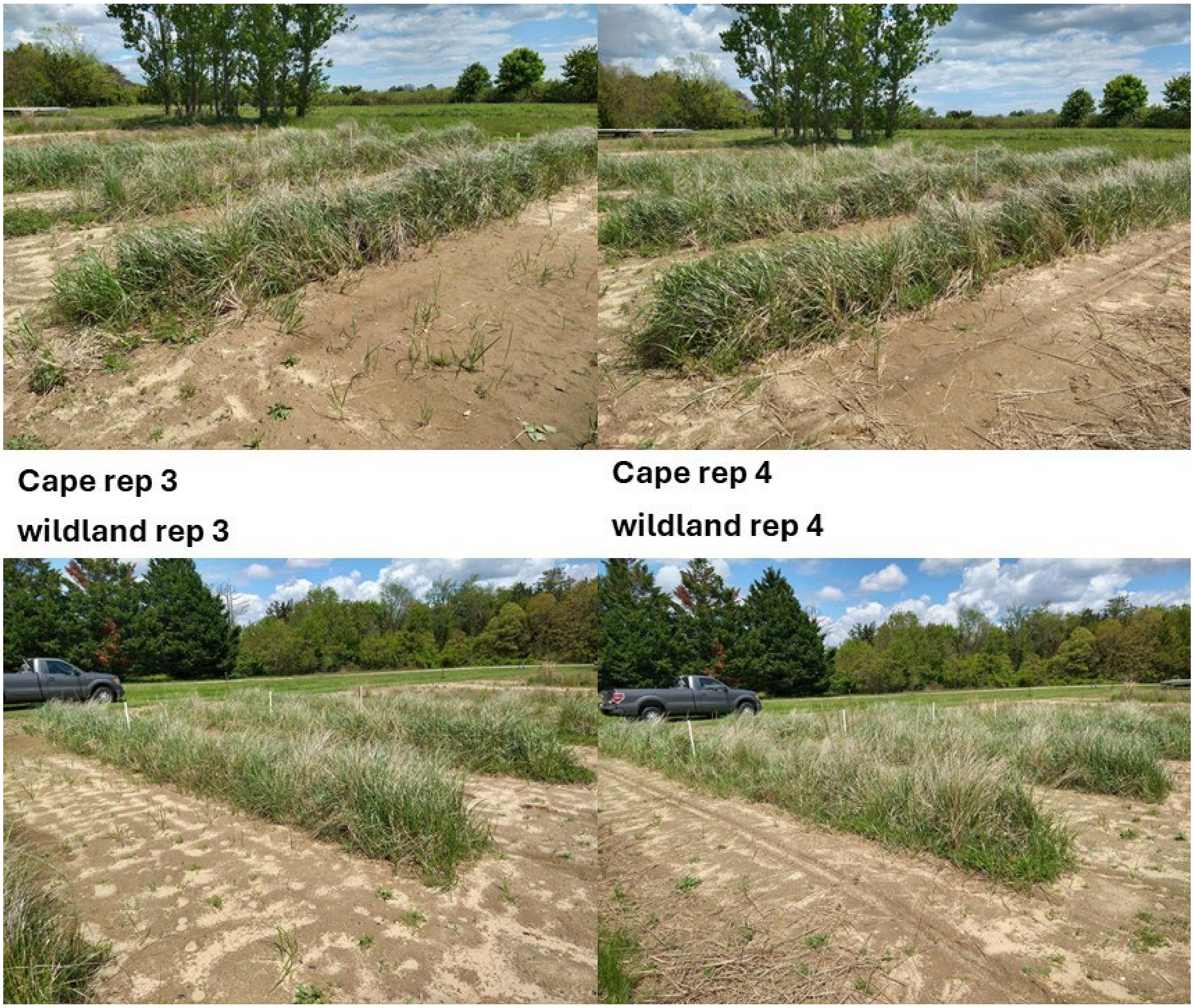


Figure 4. Replicated study plot rows of Cape and wildland strain American beachgrass germplasms 2 years after planting from a variety trial study at the New Jersey Plant Materials Center, Cape May Court House, NJ.



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