Planting Marsh Grasses for Erosion Control

UNC Sea Grant Publication 81-09

Credits

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Introduction

Erosion is a serious threat to waterfront property along most of North Carolina's extensive estuarine shoreline. A natural process, erosion is caused by a gradual rise in sea level and prevailing wind and current conditions. But, in many cases, it is accelerated by man's intensive use and mismanagement.

As demand for shoreline property increases for homesites, recreational areas, marinas, industrial sites and other uses, its monetary value increases, and landowners become more concerned about loss of land to erosion. Almost every shoreline erosion problem is unique and must be dealt with on an individual basis. There are a variety of erosion control methods—some beneficial, some of no use and others which are even detrimental. Structural methods, such as bulkheads, groins, revetments and riprap, are often effective; however, they are expensive to construct and maintain and may have adverse environmental effects.

Transplanting salt marsh vegetation is an alternative erosion control method which is relatively inexpensive and proven to be effective on some shorelines (Fig. 1). A fringe of marsh grasses, whether volunteer or transplanted, serves as a natural erosion barrier. The aerial plant parts dissipate waves reducing their impact on the bank, and they act as a living groin by accumulating sediment which widens the beach and increases the elevation. The tough mat of roots and rhizomes which develops helps stabilize the substrate and prevents loss due to wave action.

There are many shorelines in North Carolina where environmental conditions (tide range, salinity, wave action, etc.) are unfavorable for a marsh fringe to exist. However, in many cases the natural marsh fringe has been destroyed by severe storms, dredging, filling or foot traffic. Because of exposure, wave energy and other harsh conditions, the vegetation reestablishes very slowly or not at all. Transplanting marsh grasses can accelerate this process and provide

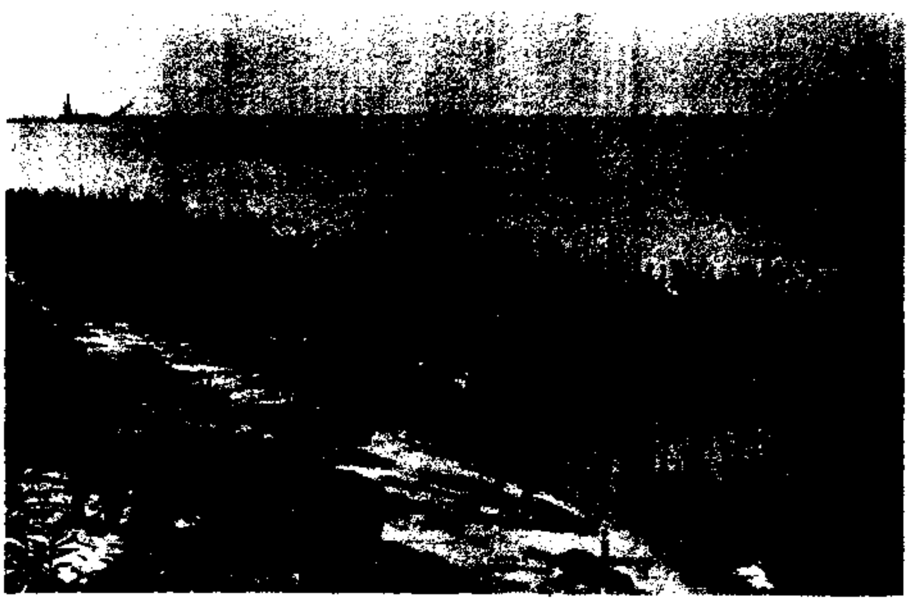

Fig. 1 Transplanted salt marsh grasses are an alternative erosion control method.

protection to the shoreline (Figs. 2 and 3). Vegetation establishment is much cheaper than structural methods of erosion control, and the new marsh becomes an environmental asset by providing shelter, food and nutrients for organisms in the surrounding estuarine waters.

Description of species

The most effective and thoroughly tested marsh species for transplanting are smooth cordgrass (*Spartina alterniflora*, Fig. 4) and saltmeadow cordgrass (*Spartina patens*, Fig. 5). Both species are perennial grasses which differ in appearance and habitat. Smooth cordgrass grows from one to six feet tall in the intertidal zone of saline areas from about mean tide level to mean high tide (Fig. 6). The leaves are usually less than half an inch in width and are relatively smooth on both upper and lower surfaces and also on the margins. Saltmeadow cordgrass grows from one to three feet tall from about mean high tide to the high water line of storm tides. Its leaves are often rolled inward, giving a wiry appearance, and are usually less than half the width of those of smooth cordgrass.

A third perennial grass, giant cordgrass (*Spartina cynosuroides*, Fig. 7), grows to eight to nine feet tall and is usually the tallest of the marsh plants where it occurs. Its leaves are usually twice as wide as those of smooth cordgrass, and there is a prominent midrib region along the center of the leaf. Both the underside of the leaf and the leaf margins are roughish. Above the elevation of the storm tide line, grasses such as American beachgrass (*Ammophila breviligulata*), coastal bermudagrass (*Cynodon dactylon*) and tall fescue (*Festuca arundinacea*) may be used to help prevent erosion from wind and rainfall runoff.

Site suitability

The feasibility of stabilizing a particular shoreline by transplanting marsh grasses is not always obvious and many

Fig. 2 An eroding shoreline transplanted with smooth cordgrass in May 1974.

plantings are subject to failure. One good indicator of success is the presence of marsh vegetation within a short distance. There are many environmental factors which affect the degree of success and must be considered when deciding if vegetation stabilization is feasible. Several of the more important ones are listed below.

Tides and slope of the shore

Periodic flooding and draining of the proposed planting area are necessary for good growth of smooth cordgrass, which is the plant most effective for shoreline stabilization in estuarine areas. In North Carolina, the estuaries south of Cape Lookout and areas near inlets have regular diurnal lunar tide cycles with a range of two to five feet. This provides a relatively wide intertidal zone for growth of smooth cordgrass. In the larger estuaries north of Cape Lookout, there is very little lunar tide effect, and rise and fall of the water level is determined by the wind (directions, speed and duration) and freshwater runoff. Under these conditions, the zone in which intertidal vegetation grows is relatively narrow, and a protective marsh fringe is more difficult to establish there.

As a general rule, the wider the intertidal zone, the more effective a planting will be in controlling erosion. Of course, slope of the bottom is an important factor in determining width of the intertidal zone; the more gentle the slope, the wider it is. Where water remains at the base of a steep bank or bulkhead at low tide, it is not possible to establish marsh grasses unless an intertidal zone is created by filling or by grading the bank.

The elevation zone which should be transplanted with smooth cordgrass at a specific site can be determined by observing water levels on the nearest natural marsh. Observe when the water is standing at the upper limit of growth and mark this limit at the planting site. Do the same for the lower level of growth. A surveyor's level may also be used to relate the elevation limits of a natural marsh to a planting site.

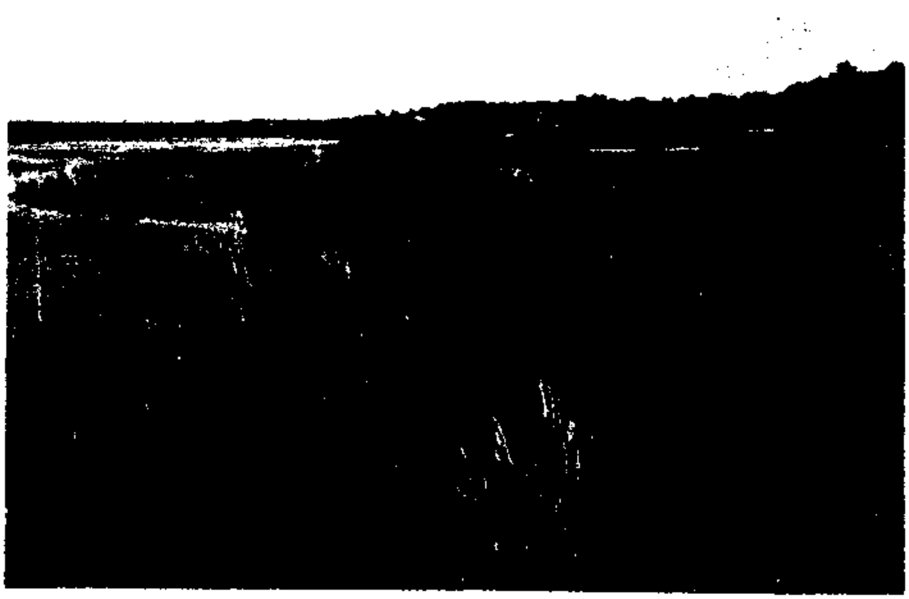

Fig. 3 The same shoreline in August 1975. This demonstrates the effectiveness of marsh vegetation for controlling shoreline erosion.

Salinity

Smooth cordgrass is adapted to areas where the salinity of the floodwater and the soil solution is in the range of 5 to 35 parts per thousand (sea water is 35 parts per thousand). It will grow if transplanted in areas with fresher water, but it is eventually crowded out by other species. Some areas with poor surface drainage become too saline to support growth of smooth cordgrass. This situation can occur in depressions where tidewater is trapped and salt becomes concentrated in the soil water due to evaporation.

Wave climate

There is a limit to the amount of stress a marsh planting can tolerate. It is most vulnerable to wave action just after transplanting, before it has taken root. Wave climate is affected by fetch (distance the wind blows over water), wind speed and duration, depth of water, slope of the shore and orientation of the site. There is a greater risk of damage if a shoreline is facing the direction of storm winds. A protected area, such as a cove, shallow water offshore and a gently sloping bottom, are factors which reduce wave energy.

Sediment supply

A moderate amount of sediment supplied to a planting from movement on shore by wave action, longshore drift or from the bank above has a stimulating effect on growth by supplying nutrients. It also increases elevation and width of the beach, protecting the eroding bank. Where there is excessive accumulation of sediment (more than 12 inches per year), damage due to burial may occur.

Nutrient supply

In many cases, the sediment in estuaries is rich in nutrients and supplies adequate amounts for plant growth. However, just as in upland soils, the nutrient status varies from one location to another. At some sites, it is necessary to apply nitrogen and phosphorous fer-

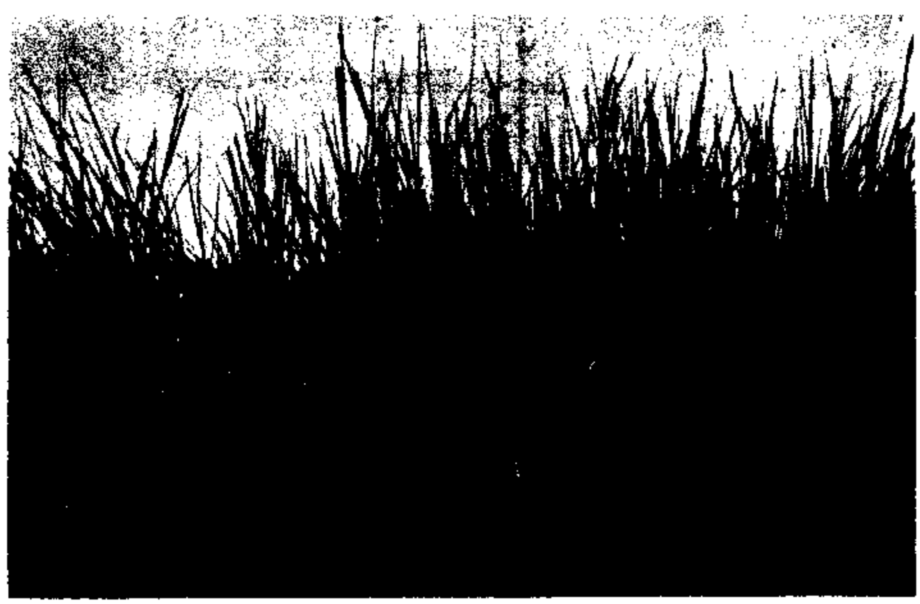

Fig. 4 Smooth cordgrass (**Spartina alterniflora**)

tilizers to establish a stand of marsh grasses. Fertilizers applied underground at planting stimulate rapid growth, thus improving chances for survival. Maintenance fertilization can be applied during the second growing season by broadcasting on the surface.

Other factors

Soil erodibility, availability of sunlight, traffic (foot or vehicular) along the shoreline, erosion from upland runoff, boat wakes and currents are all factors which affect establishment and maintenance of shoreline vegetation.

Establishment procedures

Obtaining transplants

The most effective species to transplant for shoreline erosion control is smooth cordgrass, which is adapted to the intertidal zone. Unfortunately, transplants of this species are not readily available from commercial growers in North Carolina. (There are producers in Maryland and Florida.) Plants may be obtained by digging from natural stands, or seed may be collected and seedlings grown in pots.

The best sites for digging plants are recently established marshes with open stands or along marsh edges rather than in older, well-established marshes which have developed a dense root mat. Plants from open stands or along marsh edges are more vigorous, have larger stems and are easier to obtain. Digging and separating plants is also much easier in sand. Care should be taken to minimize damage to the existing marsh. Sandy dredge disposal areas often provide a good source of transplants. Contact your County Extension or Sea Grant agent to see if such an area is available near you. Once the plants are dug, it is very important that they not be allowed to dry out. The roots should be packed in sand and kept moist until transplanting.

Smooth cordgrass may also be propagated from seed. The seed should

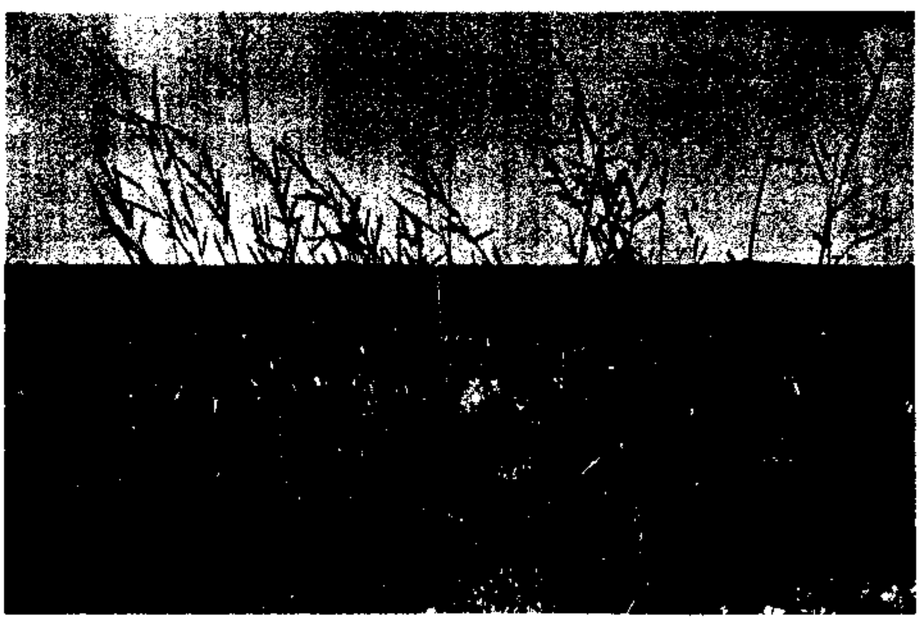

Fig. 5 Saltmeadow cordgrass (Spartina patens)

be collected when mature (late September, Fig. 8), kept refrigerated and moist for two to three weeks, threshed and then stored in a covered container filled with salt water (35 parts per thousand) at 35 to 40° F. The water for storage can be collected from the area where seed are harvested, or a solution of artificial seawater can be used.

Marsh grass seed can be planted directly on protected sites in April or May; however, direct seeding is not recommended on most shorelines because they are too exposed to wave action. There is a greater chance of success if seedlings are grown in pots and transplanted on the shoreline. The plants can be grown in any good potting soil in plastic containers. A mixture of equal volumes of topsoil, sand and vermiculite works well. If grown in a greenhouse, seed should be planted about February 1.

For this method, first soak the seed in a 25 percent household bleach solution for 15 minutes and rinse. Then cover the seed with about one-half inch of soil and keep the soil moist and the greenhouse warm. The seedlings grow slowly for about three weeks, but rapidly after that, and are ready for transplanting in May (Fig. 9). Seedlings should also be fertilized with a nutrient solution or some other suitable fertilizer such as Osmocote. If no greenhouse is available, seeding must be delayed until after danger of frost is past. Transplants or seed should be collected as near as possible to the planting site (no more than 50 miles north or south) because of genetic variation.

Transplanting date

Transplanting should be done between April 1 and June 15 if possible. Transplanting may be done later, but first-year growth is reduced by the shortened growing season.

Spacing

The closer the spacing the greater the chance of success on an exposed shoreline; however, the number of

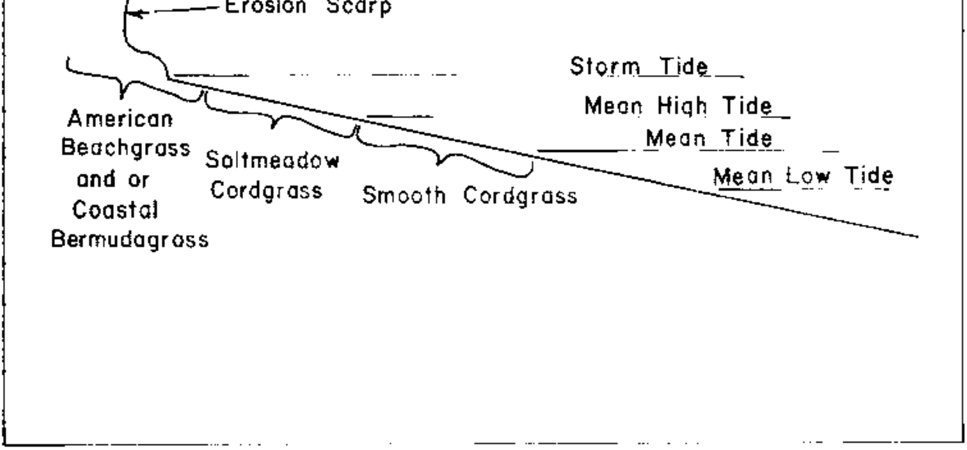

Fig. 6 Location of grass species in relation to tide level.

transplants required must be considered. For example, a 1 ft. x 1 ft. spacing requires four times as many transplants as a 2 ft. x 2 ft. spacing to transplant a given area. A 2 ft. x 2 ft. spacing has been effective on most shorelines for providing cover by the end of the first growing season. Wider spacings reduce the chance of successful establishment. All plantings should be checked frequently and those which are washed out should be replaced.

Transplanting methods

Hand planting may be done by using a dibble or shovel to open a hole four to six inches deep, inserting the plant and packing the soil around it (Fig. 10). Large areas may also be planted with a tractor-drawn mechanical transplanter if they are free of stumps and other obstacles.

Fertilizing

The need for fertilization varies from one location to another depending on the fertility of the soil and sediments which may accumulate. On many eroding shorelines in North Carolina (particularly the reddish clayey banks of rivers), supplying nitrogen and phosphorous fertilizers to transplants is critical to success (Fig. 11). Fertilizing at planting gets the plants off to a fast start which helps prevent washing out. The fertilizer material must be placed below the surface to reduce loss to tidal waters.

The slow-release fertilizers (Mag Amp and Osmocote) are more effective for this purpose than ordinary soluble materials since they provide nitrogen over a longer period of time. The slow-release fertilizers can be placed in the planting hole with little risk of salt injury. Soluble material should be placed in a hole about two inches from the plant or, if it is put in the planting hole, it should be covered with two inches of soil before inserting the plant. If the ordinary fertilizer materials are used, a second application of fertilizer may be needed after six to eight weeks. Suggested amounts of several fertilizer materials are listed on the following page.

Fig. 7 Giant cordgrass (Spartina cynosuroides) *is less salt tolerant and grows in brackish water areas.*

Fertilizer material	Analysis $N\text{-}P_2O_5\text{-}K_2O$	Approximate amount/plant
Osmocote (8-9 month release)	18-6-12	0.5-1.0 oz. (2-4 tsp.)
Osmocote (3 month release)	14-14-14	0.5-1.0 oz. (2-4 tsp.)
Mag Amp	7-40-6	0.5 oz. (2 tsp.)
+		
Osmocote	14-14-14	0.3-0.6 oz. (1-2 tsp.)
Ammonium sulfate[1]	21-0-0	0.4-0.8 oz. (1-2 tsp.)
+		
Concentrated superphosphate	0-46-0	0.2-0.4 oz. (0.5-1 tsp.)
Mixed fertilizers	10-10-10	0.8-1.6 oz. (2-4 tsp.)

[1] Ammonium nitrate may be substituted if ammonium sulfate is not available.

Fertilization at some sites is necessary the second and subsequent growing seasons. The need for this can be determined by appearance of the stand. Ordinary soluble fertilizer materials can be broadcast on the surface at low tide and the fully developed root system is able to absorb a portion of the nutrients. Fertilizer should be applied three times during the growing season (May 1, June 15 and August 1) at the rate of 100 lbs./acre N and 100 lbs./acre P_2O_5 on the first date and 100 lbs./acre N on the second and third dates.* Recommended fertilizer materials for surface application are ammonium sulfate (or ammonium nitrate) and concentrated superphosphate.

*100 lbs./acre is equivalent to about 2.3 lbs./1,000 sq. ft. This rate is expressed in terms of actual N and P_2O_5. For example, to apply 100 pounds of N, 1,000 pounds of 10-10-10 fertilizer would be needed (23 lbs./1,000 sq. ft.). If ammonium sulfate (21 percent N) is used, 476 pounds are needed to supply 100 pounds of N (11 lbs./1,000 sq. ft.).

Fig. 8 Smooth cordgrass seed heads harvested in late September.

Other plants

Plants other than or used along with smooth cordgrass may be useful in controlling shoreline erosion. In the intertidal zone of fresh to brackish water (below 10 parts per thousand) areas, giant cordgrass may be used. The same general planting instructions apply as for smooth cordgrass. At higher elevations (between mean high water and high water of storm tides) along most shorelines in the state, saltmeadow cordgrass can be planted. Propagation procedures are similar except for seed storage and fertilization. Seed may be stored dry under refrigeration. Placing fertilizer below ground and use of slow-release materials is not as critical because of less frequent flooding in this zone. Fertilization is necessary, but broadcasting fertilizer on the surface is sufficient in most cases. Above the level of high tides, a cover of vegetation should be maintained to control runoff from rainfall. In North Carolina, American beachgrass or bermudagrass (coastal or common) are good choices for sandy sites, and fescue may be used on some of the better soils.

Vegetation is an effective and economical means of erosion control on some shorelines; however, it is not a cure-all and many sites are too severe for vegetation to be of significant benefit. When deciding whether to transplant salt marsh vegetation or use a structural means of erosion control, the advice of a Sea Grant, Soil Conservation Service or County Agricultural Extension agent will be helpful. Small trial plantings of marsh vegetation are useful in determining the feasibility and benefits of a large-scale planting.

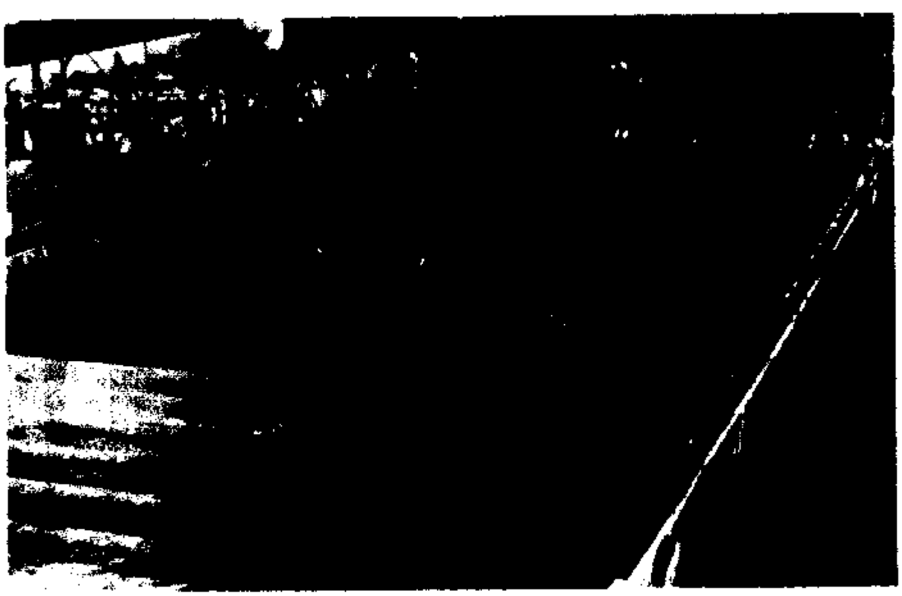

Fig. 9 Smooth cordgrass seedlings in the greenhouse.

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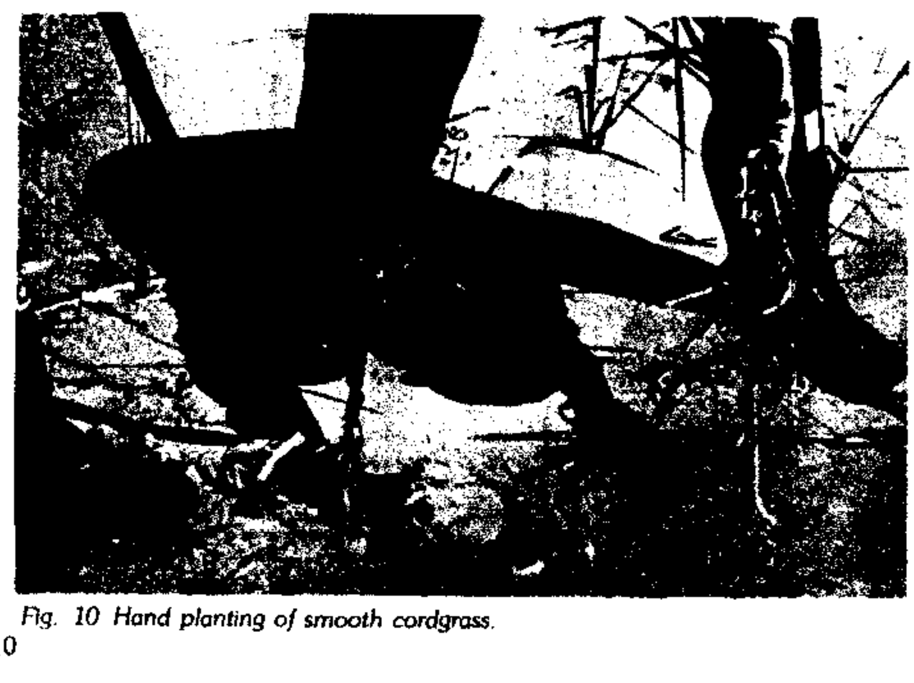

Fig. 10 Hand planting of smooth cordgrass.

Acknowledgements

This publication is a result of research supported by the UNC Sea Grant College Program, North Carolina Agricultural Research Service and the U.S. Army Corps of Engineers, Coastal Engineering Research Center. Appreciation is extended to D.M. Bryan, C.L. Campbell, Jr., U.O. Highfill and L.L. Hobbs for their assistance in the field work.

Fig. 11 The effect of fertilizer on growth of smooth cordgrass was obvious at the end of the first growing season. The row on the left was unfertilized, the center row received nitrogen, and the row on the right received nitrogen and phosphorous.

August 1981

UNC Sea Grant College Publication UNC-SG-81-09

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