Soil Texture and Planting Depth Influence Buffelgrass Emergence

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Highlight: *Seedling emergence and vigor of buffelgrass (*Cenchrus ciliaris *L.), an introduced species with widespread adaptability for revegetation in South Texas, were regulated by soil texture and planting depth. Seedling establishment rate generally was highest from surface plantings and decreased with increasing planting depth to 24 mm. Percentage emergence was lower in clay than in clay loam or sandy clay loam. Based on total emergence and seedling vigor, optimum planting depths in clay loam and sandy clay loam soils were 6 to 12 mm. In clay soil, the optimum depth was 6 mm. The probability of successful seedings may be increased by considering the specific planting requirements of buffelgrass based on soil characteristics rather than a generalized depth disregarding edaphic factors.*

The initial step in a range improvement program in South Texas often is control of undesirable species through various weed and brush control practices. Revegetation with introduced species is also included in many improvement programs following weed and brush control. Species such as Rhodesgrass (*Chloris gayana* Kunth), Kleberg bluestem (*Andropogon annulatus* (Forsk.) Stapf), blue panicgrass (*Panicum antidotale* Retz.), and buffelgrass (*Cenchrus ciliaris* L.) have been established with varying degrees of success.

The South Texas Plains include over 8 million ha of level to gently rolling land most of which is utilized as rangeland (Gould, 1969). Soils range from loose sands to fine clays (Carter, 1958) and vary greatly in chemical and physical properties. These variations strongly influence species selection for seeding. Disappointing results have often been the consequence of incorrect seeding techniques, improper seedbed preparation, and use of species not adapted to local climatic and edaphic conditions.

Of several introduced grasses adapted to the South Texas Plains for revegetation following mechanical brush control, buffelgrass apparently is the best suited to the wide range of environmental conditions (Mutz, 1974). Primary methods of planting buffelgrass include drilling and broadcasting the seed aerially or with exhaust seeders during mechanical brush removal. Specific information on planting depth for buffelgrass on South Texas Plains soils is limited. Recommended planting depth for other grasses vary according to species and soil types. Anderson (1956) found the 6 to 12-mm depth to be optimum for planting several native Texas grasses. Brozostowski and Owens (1966) reported a good stand of buffelgrass from planting 12 mm deep on red sandy loam soil of East Africa.

A depth of planting study was conducted in a greenhouse to determine 1) the optimum seeding depth for buffelgrass emergence from three soil types and 2) the influence of soil texture and planting depth on seedling vigor.

Materials and Methods

Sandy clay loam, clay loam, and fine clay soils from rangeland of the eastern South Texas Plains were utilized (Table 1). The sandy clay loam was from the Hidalgo series, a member of the fine-loamy, mixed, hyperthermic family of Typic Caliustolls. The clay loam was from the Clareville series, a member of the fine, mixed, hyperthermic, family of Pachic Argiustolls. The fine clay was from the Victoria series, a member of the montmorillonitic, hyperthermic family of Udic Pellusterts.

Soils were neutral to slightly basic in reaction (Table 1). All contained high levels of calcium (usually > 2,500 ppm) and potassium (usually > 210 ppm). Soils were low in phosphorus (usually < 1 ppm) and available nitrogen. These soils are typical of South Texas Plains where revegetation with buffelgrass is practical.

Twenty live buffelgrass caryopses were planted at 0, 6, 12, and 24 mm deep in each of the soils. Each planting depth was replicated five times in each soil. Two experiments, designed as randomized complete blocks arranged as split plots, were conducted with soils constituting the main plot effect and planting depths as subplots.

Number of seedlings per pot was recorded daily for 7 consecutive days after first emergence and at 30 days after emergence. Mean differences in number of seedlings after 30 days were separated using Duncan's New Multiple Range Test. Regression analysis was utilized to estimate emergence rate (%/day) under the various treatments.

At 30 days after first emergence, number of leaves per seedling, average culm length, and oven-dry production of top growth per pot were recorded. Homogeneity of data between the experiments was tested by conducting analyses with effects of experiments as a source of variation. Since no significant difference in data variability existed between the two experiments, data were pooled for ease of presentation.

In a separate study caryopses were planted 2.5, 5, and 7.5 cm deep in sandy clay loam soil. After 30 days, seedlings emerged were counted and washed from the soil to observe extent of top growth and root development.

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Particle size analysis was conducted by method of Bouyoucos (Foth and Turk, 1972). Chemical analyses were performed by the Soil Testing Laboratory, Texas A&M University, on duplicate composite samples of each soil.

Results and Discussion

Emergence rate of buffelgrass seedlings was strongly influenced by soil texture (Fig. 1). Initial emergence was always greatest from surface seedings and generally decreased with increasing planting depth (Fig. 1). Optimum depth of planting, based on total emergence after 30 days and averaged across soils, was 6 to 12 mm (Table 2). Surface plantings and seeding at the 24-mm depth usually decreased the percentage of seedlings emerged. However, a few seedlings emerged from caryopses planted over 5 cm deep in sandy clay loam soil (Fig. 2).

Table 1. Textural components (%) and pH of soils utilized in the study of buffelgrass emergence from various planting depths.

Textural class	pH	Textural components		
		Sand	Silt	Clay
Clay	7.7	8	27	65
Clay loam	7.3	45	26	29
Sandy clay loam	7.6	75	5	20

Table 2. Percentage buffelgrass seedlings emerged 30 days after first emergence when planted at four depths (mm) in three soils in the greenhouse.[a]

Planting depth	Soil textural class			Depth mean
	Clay	Sandy clay loam	Sandy loam	
0	40 cd	39 c	38 c	39 r
6	38 c	50 e	63 f	50 s
12	20 b	54 ef	62 f	45 rs
24	10 a	49 de	54 ef	38 r
Soils mean	27 x	48 y	54 y	43

[a]Means followed by the same letter are not significantly different at the 95% level.

Table 3. Average culm length (cm) of buffelgrass seedlings 30 days after emergence from three soils in the greenhouse.[a]

Planting depth	Soil textural class			Depth mean
	Clay	Sandy clay loam	Sandy loam	
0	15.5 e	7.9 b	7.2 a	10.2 s
6	20.7 f	8.7 bc	8.1 ab	12.5 t
12	15.4 e	7.7 ab	7.1 a	10.1 s
24	10.9 d	7.0 a	6.4 a	8.1 r
Soils mean	15.6 y	7.8 x	7.2 x	10.2

[a]Means followed by the same letter are not significantly different at the 95% level.

Table 4. Oven-dry weight (mg/pot) produced by buffelgrass seedlings 30 days after emergence from three soils in the greenhouse.[a]

Planting depth	Soil textural class			Depth mean
	Clay	Sandy clay loam	Sandy loam	
0	103.8 e	85.6 d	68.9 bc	89.1 rs
6	141.3 f	97.9 de	63.0 bc	100.7 s
12	70.1 c	92.3 d	61.9 abc	74.7 r
24	55.6 a	89.5 d	55.6 ab	66.9 r
Soils mean	92.7 y	91.3 y	62.4 x	82.1

[a]Means followed by the same letter are not significantly different at the 95% level.

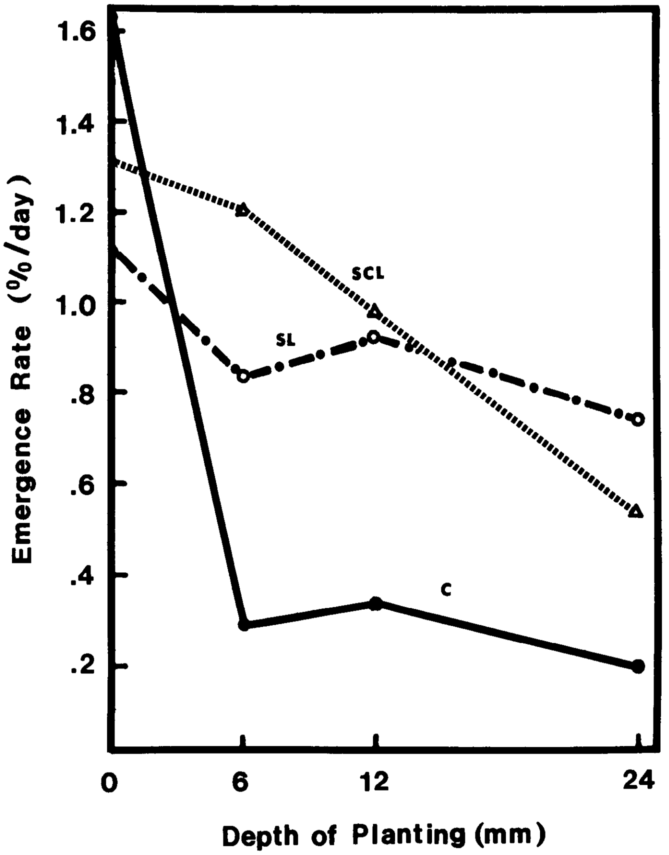

Fig. 1. *Emergence rate of buffelgrass after planting caryopses 0, 6, 12 or 24-mm deep in clay (c), sandy clay loam (scl) or sandy loam (sl) soil.*

Depth of planting significantly affected seedling growth (Tables 3 and 4). Thirty-day-old seedlings from caryopses planted below the optimum depth showed reduced vigor. Average culm length was greatest with seedlings from the 6-mm depth and least from planting 24-mm deep (Table 3) but seedling production was greatest from the 0 to 6-mm deep plantings (Table 4).

Average emergence percentage after 30 days was higher from the sandy clay loam and sandy loam than from the clay (Table 2). Although fewer seedlings usually emerged from the clay, they were longer than those from the lighter-textured soils (Table 3). Due to relatively larger seedlings from the clay, oven-dry production was equivalent to that in the sandy clay loam where a higher percentage of emergence occurred (Table 4). Least top growth was produced by buffelgrass seedlings in sandy loam soil probably due to a less favorable nutrient balance. Available nitrogen was apparently low since seedlings from the sandy loam typically were slightly chlorotic.

Although the influence of soils and of depths as independent factors were readily isolated, the optimum depth of planting varied slightly among soils. Optimum depths of seeding in the clay soil were 0 and 6 mm (Table 2). However,

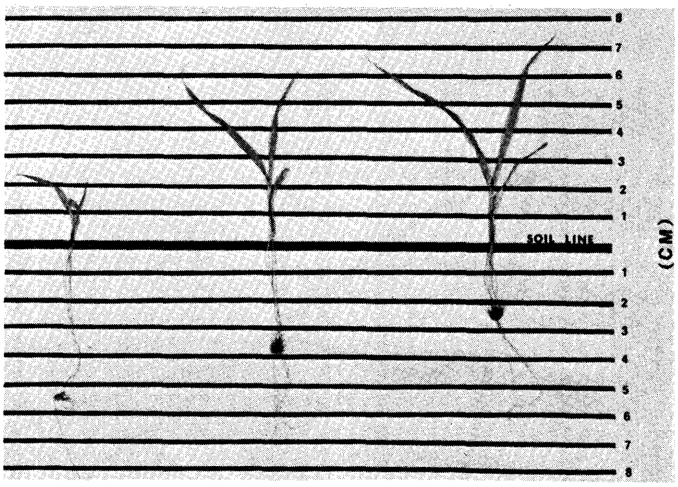

Fig. 2. *Comparative development of buffelgrass seedlings planted at various depths in sandy clay loam in the greenhouse.*

seedling emergence was not different among the 6, 12 or 24-mm depths in the clay loam or the sandy clay loam. With depths of planting apparently less critical in sandy soils, the deeper plantings could be recommended to take advantage of more favorable moisture conditions. However, planting deeper than 12 mm could result in reduced vigor of the buffelgrass seedlings and increased vulnerability to damage by insects, diseases, and harsh climate.

A comparison of seedling vigor from the four depths within soils indicated that clay soils produced the most vigorous plants from plantings at the 6-mm depth and the least vigorous seedlings from planting caryopses 24 mm deep (Tables 3 and 4). Apparently, more of the stored energy in the caryopses is utilized in shoot elongation as planting depth is increased. Less energy is available for initial vegetative growth, resulting in a seedling of low vigor. Culm length was not affected by planting depth in the sandy loam soil (Table 3). However, in the sandy clay loam, there was a trend toward decreasing culm length with planting depths greater than 6-mm.

Buffelgrass has gained wide popularity as a forage species for livestock operations in South Texas. It can be utilized effectively in conjunction with native range, has relatively high quality forage production potential, and can afford additional revenue through sale of seed. Buffelgrass has become a common component of roadside vegetation. This indicates potential to establish from surface seedings. However, our data indicate some seed cover is necessary for optimum emergence regardless of soil type. General planting depths of 6 to 12 mm may be used for seeding buffelgrass, but greatest probability for success will result from adjusting seeding depth to soil texture.

Literature Cited

Anderson, J. E. 1956. Some effects of date of planting, depth of planting and fertilization on the performance of five important native grasses of Texas. J. Range Manage. 9:46.

Brozostowski, H. W., and M. A. Owens. 1966. Production and germination capacity of buffelgrass (*Cenchrus ciliaris*) seeds. Trop. Agr. 43:1-10.

Carter, M. G. 1958. Reclaiming Texas brushland range. J. Range Manage. 11:1-5.

Foth, H. D., and L. M. Turk. 1972. Fundamentals of Soil Science. John Wiley and Sons, Inc., New York. 453 p.

Gould, F. W. 1969. Texas Plants. A checklist and ecological summary. Texas Agr. Exp. Sta. Misc. Pub. 585 (Rev.). 121 p.

Mutz, J. L. 1974. Effects of fertilization, clipping frequency and irrigation on four introduced grasses. MS Thesis, Agr. Dep., Texas A&I University, Kingsville. 50 p.