United States Department of Agriculture

September 2019

FINAL STUDY REPORT
E. "Kika" de la Garza PMC
Kingsville, Texas

Effects of Seed Burial on Buffelgrass [*Pennisetum ciliare* (L.) Link] Germination in South Texas

John Reilley and Shelly Maher

ABSTRACT

Buffelgrass is an exotic grass that has been planted on or invaded an estimated 4 million ha of south Texas. Re-establishment of native plants in areas dominated by buffelgrass may increase biodiversity and improve these areas as habitat for a variety of native wildlife. A key to better understanding and managing buffelgrass populations might be through its recruitment dynamics. A field trial to document the effects of seed burial duration on buffelgrass seed germination was conducted at two locations in south Texas. Twelve transects were established at the USDA-Natural Resources Conservation Service, "Kika" de la Garza Plant Materials Center (PMC) and at Falcon State Park. Each transect consisted of twenty randomly placed aluminum meshed bags containing 30 seeds and buried 2-3 inches beneath the surface. Seed packets were harvested at three different time periods, approximately 11, 20 and 39 months after burial in 2012-2015.

John Reilley, PMC Manager, 3409 N FM 1355, Kingsville, Texas 78363, john.reilley@usda.gov

Non-germinated seeds were counted and placed in a germination chamber to determine potential seed viability and germination. Seed from Falcon Park and the PMC germinated 11, 20 and 39 months after field burial, indicating buffelgrass seed remained viable 39 months after burial. Regardless of the buffelgrass control method, controlling the buffelgrass seedbank is likely to take 2 to 4 years. It is unlikely that a landowner is willing to forgo plant coverage for this length of time because of the negative impacts to livestock grazing, wildlife habitat and soil erosion.

INTRODUCTION

Buffelgrass is an exotic grass that threatens arid and semiarid ecosystems in the U.S.A., Mexico, and Australia. Buffelgrass was introduced as a pasture grass and has been planted in or has invaded an estimated 4 million ha of south Texas. Areas dominated with buffelgrass support lower abundance and variety of grassland birds and fewer insects than native grasslands (Flanders et al. 2006) and decreases herbaceous species richness (Jackson 2005). Herbaceous plants are an important source of food and habitat for a variety of wildlife including several species of grassland birds, lagomorphs, and ungulates. In addition, buffelgrass frequently forms dense swards (Humphreys 1967, Low 1997), which may reduce the amount of usable space (Guthery 1997) for bobwhite quail (*Colinus virginianus*) and other grassland birds. Re-establishment of native plants in areas dominated by buffelgrass may improve these areas as habitat for a variety of native wildlife and increase biodiversity. A key to better understanding and managing buffelgrass populations might be through its recruitment dynamics. Buffelgrass is a prolific seed producer and spreads and persists by its seed. Thus, it is important to understand its persistence in the soil. Here we report results from a field trial that documents the effects of seed burial duration on seed germination of buffelgrass at two locations in south Texas.

MATERIALS AND METHODS

The field trial was conducted at two locations between 2012 and 2016. In 2012 'Pecos' buffelgrass seed was secured from a commercial source. The seed was lab tested in May 2011. Purity was 92% and germination 90% with a total pure live seed of 83% (germination x purity/100) The PMC germination test in March 2012 revealed a 21% active germination within 28 days. All seed was stored in a seed cooler both before field placement and following field retrieval. The seed cooler was set at a temperature of 48 F and a relative humidity of 48%

In May of 2012 twelve transects, 10 meters in length and spaced 1 meter apart were established at the PMC in Kingsville, Texas and at Falcon State Park, Roma, Texas. The soil type was a Copita fine sandy loam at Falcon State Park and a Cranell sandy clay loam at the PMC. Each transect consisted of twenty randomly placed aluminum meshed bags containing 30 seeds and buried 2-3 inches beneath the surface. Four transects were randomly chosen and seed packets harvested at three different time periods from 2012 to 2015. Packets were retrieved from Falcon Park at 11, 22 and 39 months after burial. Packets were retrieved from the PMC at 11, 20 and 41 months after burial. Seeds that germinated inside the bags were recorded. Non-germinated seeds were counted and placed in a seed cooler to await germination testing. Germination testing occurred anywhere from 1 week to 3 months following retrieval. An environmental chamber adjusted for light and temperature (12 h dark at 20°C and 12 h light at 30°C, Fulbright et al. 1983) was used to determine potential seed viability and germination. Only germination testing was conducted during this experiment. No tetrazolium testing for viability was performed.

Plastic boxes of 13 x 13 x 3.5 cm, with tight fitting lids were used to germinate the seeds. The substrate for each container was one sheet of K-24 Kimpack 14 ply cellulose paper and one of blue paper (both are from Anchor paper Co. St. Paul, Minn.). We recorded seed germination at 3, 5, 7 days and then once/week for 4 weeks. The substrate was moistened with distilled water at the beginning of the test and as necessary during the test. Seeds were considered germinated if both the radicle and coleoptile exceeded the seed in length and the seedling was normal according to the seedling evaluation criteria of the Association of Official Seed Analyst (AOSA) for comparable grasses (AOSA 1992). Seedlings were removed as they were counted.

RESULTS AND DISCUSSION

Both sites were disturbed by burrowing animals which impacted the total number of packets retrieved. Four transects were retrieved from Falcon State Park on April 5, 2013 (Table 1). The number of seed packets ranged from 12 to 17. The total number of seeds recovered was 1,739. Ten percent of these seeds had germinated in the field and 19% in the germination chamber. A second retrieval was conducted at Falcon State Park on March 7, 2014. The number of recovered packets ranged from 13 to 17. The total number of seeds was 1,803. The percentage of germination decreased in comparison to the first retrieval. One percent of these seeds germinated in the field and 6% germinated in the germination chamber. The final retrieval was conducted on September 15, 2015. The number of seed packets recovered ranged from 12 to 18. The total number of seeds retrieved was 1,291. Twelve percent of the seeds germinated in the field and 2% germinated in the germination chamber. Rainfall during this period (May 2012- September

Table 1. Buffelgrass seed statistics from two south Texas locations. USDA-NRCS E. “Kika” de la Garza Plant Materials Center, Kingsville, Texas.

Location/Planting Date[1/]	Retrieval Date[2/]	Seed Packets Retrieved	Number of Seeds Recovered	% Field Germination[3/]	% Germination Chamber[4/]
Falcon State Park May 18, 2012					
	Apr 5, 2013	12-17	1739	10	19
	Mar 7, 2014	13-17	1803	1	6
	Sept 15, 2015	12-18	1291	12	2
PMC May 21,2012					
	Apr 15, 2013	8-14	1187	1	26
	Dec 30, 2013	7-10	963	0	13
	Nov 2, 2015	5-8	293	33	2

1/ Falcon State Park, Roma, Texas; PMC (E. “Kika” de la Garza Plant Materials Center, Kingsville, Texas;
2/ retrieval date represents ~11, 20, 40 months after burial; 3/ percent seed germinated from seed packets buried in the field; 4/ percent seed germinated in germination chamber (12 h dark at 20°C and 12 h light at 30°C)

2015) was 11 inches in 2012, 31 inches in 2013, 19 inches in 2014 and 13 inches in 2015. The historical average precipitation is 17 inches.

The first retrieval of seed packets occurred on April 15, 2013 at the PMC. The number of seed packets ranged from 8 to 14. The total number of seeds recovered was 1,187 seeds. One percent of the seed germinated in the field and 26% in the germination chamber. The second retrieval from four transects was conducted on December 30, 2013 with the number of seed packets ranging from 7 to 10. The total number of seeds recovered was 963. There was no evidence of field germination; however, 13% of the seed germinated in the germination chamber. The final retrieval of seed was on November 2, 2015. Packets recovered ranged from 5 to 8. The total number of seeds was 293. There was 33% field germination and 2% germinated in the germination chamber. Rainfall during this period (May 2012- October 2015) was 11 inches in 2012, 24 inches in 2013, 29 inches in 2014 and 34 inches in 2015. The historical average precipitation is 24.6 inches.

'Pecos' buffelgrass had good seed viability 20 and 22 months after burial. In a study on Airlie island off the western coast of Australia (Dixon et al. 2002) observed that buffelgrass seed remained viable in the seed bank for 3 years but after 18 months germination rapidly declined. This is similar to the results observed at the two sites in south Texas. These results suggest seed production must be controlled for at least 2 years and probably closer to 4 years to have any impact on the soil seed bank.

Management options to control buffelgrass must affect (1) seed input into the soil seedbank and (2) the persistence of seeds in the soil seedbank. Limiting seed input requires methods that prevent flowering of the target plant or destroys seeds while still attached to the mother plant. Mechanical and chemical control are viable options for intense control of buffelgrass. Prescribed fire is not a recommended control measure because buffelgrass is resistant to drought, fire and heavy grazing (Bryant 1962) (Hodgkinson 1989). Disking and moldboard plowing are the two most common tillage methods for buffelgrass control. Disking generally affects the top 15-20 cm of soil, which is effective for burying seeds in the soil, but it also can bring previously buried seeds to the surface. Moldboard plowing on the other hand can bury seed without the problem of bringing seed to the soil surface because of the depth in which it turns the soil over. However, it requires a large amount of horsepower and fuel to operate. Both mechanical control methods run the risk of erosion because of the exposed soil. Herbicides such as Arsenal® and Roundup® can kill buffelgrass plants but generally require repeated application (Tjelmeland et al. 2008). Grace et al. (2016) suggested combining herbicides with prescribed fire for effectively controlling tanglehead [*Heteropogon contortus* (L.) P. Beauv. ex Roem. & Schult].

CONCLUSION

'Pecos' buffelgrass seed remained viable after more than 20 months of burial at two sites in south Texas. These results provide evidence that established plants of buffelgrass must be controlled, by either tillage or chemical means for at least 2 to 4 years to have any impact on the buffelgrass soil seed bank.

LITERATURE CITED

Bryant, W.G. 1962. Buffelgrass (*Cenchrus ciliaris* L.) for erosion control. Journal of Soil Conservation, New South Wales 17 (3): 135-147.

Dixon, I. R., Dixon, K.W., and Barrett, M. 2002. Eradication of buffelgrass (*Cenchrus ciliaris*) on Airlie Island, Pilbarra Coast, Western Australia. Turning the Tide: the eradication of invasive species. Veitch, C.R. and Clout, M.N. eds. IUCN, Gland Switzerland. pp. 92-101.Flanders, A.A., Kuvlevsky Jr., W.P., Ruthven III, D.C., Zanglin, R.E., Bingham, R.L., Fulbright, T.E., Hernandez, F. and Brennan, L.A. 2006. Effects of invasive exotic grasses on South Texas rangeland breeding birds. The Auk. 123: 171-182.

Grace, J.L., Wester, D.B., Bryant, F., Edwards, J., and Hernandez, F. 2015. Tanglehead research in South Texas rangelands. Caesar Kleberg Wildlife Research Institute, Newsletter, August 2015. Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville, www.ckwri.tamuk.edu/home/news/article/tanglehead-research-on-south-texas-rangelands/

Grace, J.L., Tjelmeland, A.D., Smith, F.S., Mitchell, S.L., Rideout-Hanzak, S., Lloyd-Reilley, J., Maher, S.D., and Wester, D.B. 2016. Effects of Depth and Duration of Burial on Tanglehead (*Heteropogon contortus*) Seed Viability and Germination in Southern Texas. Ecological Restoration 34(1): 7-10.

Guthery, F. S. 1997. A philosophy of habitat management for northern bobwhites. J. Wildl. Manage. 61:291-301.

Hodgkinson, K.C., Ludlow, M.M., Mott, J.J., and Baruch, Z. 1989. Comparative responses of the savannah grasses *Cenchrus ciliaris* and *Themeda tiandra* to defoliation. Oecologia 79(1):45-52.

Humphreys, L. R., 1974. A guide to better pastures for the tropics and sub-tropics. Wright Stevenson & Co. (Aust.) Pty. Ltd.

Jackson, Janice. 2005. Is there a relationship between herbaceous species richness and buffelgrass (*Cenchrus ciliaris*)? Austral. Ecology. 30 (5): 505-517.

Low, T. 1997. Tropical pasture plants as weeds. Tropical Grasslands 31: 337-343.

Tjelmeland, A.D., Fulbright, T.E., and Lloyd-Reilley, J. 2008. Evaluation of herbicides for restoring native grasses in buffelgrass-dominated grasslands. Restoration Ecology. 16: 263-269.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at How to File a Program Discrimination Complaint and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

USDA is an equal opportunity provider, employer, and lender.

Helping People Help the Land