

THE U.S. ARMY EXPERIENCE: COLD TOLERANCE AND SEED VIABILITY CHARACTERISTICS OF VETIVER

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Abstract

Three varieties of vetiver (*V. zizanioides*), viz. Sunshine, Louisiana, “Boucard” of Leakey, Texas, and India-origin, were planted at 18 U.S. Army installations during 1990-1996. The results of this research study are presented in this paper. The objective of the study was twofold: investigate and determine the cold tolerance and agronomic characteristics of vetiver under various soil and climatic conditions, and determine the flowering, seed production and seed viability characteristics to avoid potential introduction of another invasive species such as Kudzu (*Pueraria phaseoloides*) into the United States. It was concluded that occasionally a few plants from the entire population of the Sunshine variety may flower and produce mature seed. The results showed that the entire population of India-origin vetiver species flowers profusely and produces mature seed. Seed germination tests conducted under controlled laboratory environment indicated seed viability ranging between 0 and 71 percent for the India-origin and 0 and 15 percent for the Sunshine variety. Nevertheless, field observations have shown that mature and viable seeds would seldom germinate and establish plants. Under actual field conditions, seedlings did not establish and develop to maturity.

The results of cold tolerance and winter hardiness studies showed that vetiver is not cold resistant above latitude 40° N. Vetiver is non-invasive, non-aggressive and does not like competition from native grasses. Erosion and sediment control effectiveness results have shown that the grass performs well on rich, fertile soils in humid regions compared with poor plant establishment in sandy soils.

Introduction

The United States Army operates and manages approximately 12.6 million acres of land to support its combat training mission. U.S. Army land managers are confronted with more difficult training-land maintenance problems than ever before. Greater demands are made on them as force modernization programmes using more mobile weapon systems (Fig. 1) operate over larger areas, resulting in severe land disturbance and soil erosion and sedimentation problems.

Obviously, the candidate grasses selected for erosion control and restoration of critically disturbed U.S. Army lands must possess, among other desirable characteristics, the following minimum attributes:

1. be resilient to tracked and wheeled vehicular traffic,
2. be able to survive under nutrient-deficient, critically disturbed soil conditions (where topsoil has eroded and soil structure is almost completely destroyed) and
3. be capable of plant growth and establishment under natural conditions with no supplemental irrigation water.

Given the level of environmental concern and the prior unpleasant experience with Kudzu (*Pueraria phaseoloides*) – a so-called miracle grass for erosion control from Southeast Asia – the introduction of an exotic plant species is a definite “no-go” in the United States. Though vetiver has been in the country for over 150 years, it is still an unknown plant in the botanical and erosion control community. Vetiver is a tropical grass species that grows well in hot and humid regions of the world. Initial uses involved oil extraction for a small perfume industry and growth for ornamental purposes. As an erosion control measure at U.S. Army lands, the vetiver was first planted at Ft. Polk, Louisiana (LA), in the spring of 1990. The material was obtained from a local retired farmer, Mr. Eugene Le Blanc of Sunshine Village, LA. It was propagated in a greenhouse by USDA Plant Material Center (PMC) researchers at Baton Rouge, LA. Due to the lack of further information, this cultivar of vetiver obtained from Sunshine Village is referred to as the Sunshine variety in this report.



Fig. 1. Mobile weapon land disturbance

Objective

Following the successful results at Ft. Polk, it was decided to expand the field testing to other U.S. Army installations. Since the grass is inherently a tropical plant, it was decided to field-test it in the warm and humid climates of the south and southeast. There is serious environmental concern that must be addressed before its introduction on U.S. Army lands. Therefore the main objectives of this research were to demonstrate that the plant will not become an invasive and uncontrollable weed problem and to document the geographical range for its survival.

Procurement of Parent Material

Search for plant material revealed immediately that vetiver seedlings were not available in desirable quantities for planting at several installations. To meet project requirements, the following sources/vendors were contracted to propagate parent material for field planting at selected sites.

1. USDA, Plant Material Center (PMC), Baton Rouge, LA
2. USDA-PMC, Columbus, Georgia (GA)
3. Eugene Le Blanc, Sunshine, LA
4. Gueric Boucard, Leakey, Texas (TX)

The material obtained from Louisiana was the Sunshine variety. The source of vetiver material obtained from Gueric Boucard of Leakey, TX, could not be ascertained. Vetiver material received from USDA-PMC, Columbus, GA, was propagated from germplasm obtained from India and is designated as the India variety in this paper.

Vetiver Propagation and Field Planting

Vetiver material obtained from Gueric Boucard and Eugene Le Blanc was raised in field nurseries. The seedlings supplied by the USDA-PMC researchers were planted in 6"-diameter nursery pots and grown over winter in heated greenhouses for a period of four to six months. During this time the plants produced four to six healthy tillers (Fig. 2). Vetiver crowns were removed from the pots and the dead portion of the lower roots was cut (Fig. 3) before planting in the field. Pot-grown seedlings were planted four inches deep in rows. Spacing between plants was 12 inches. Two tablets, weighing 21 grams each, of slow-release fertilizer of 20:10:5 (N₂, P₂O₅, K₂O) were placed approximately four inches away from the freshly planted seedlings. No supplemental water was applied after planting.

Table 1 shows where the vetiver cultivars were planted at various locations.



Fig. 2. Vetiver tiller



Fig. 3. Cutting lower roots of tiller

	GA	TX	VA	TX
1	CA	W	VA	TX
2	CA	M	VA	TX
3	CA	M	VA	TX
4	CA	M	VA	TX
5	CA	M	VA	TX
6	CA	M	VA	TX
7	CA	M	VA	TX
8	CA	M	VA	TX
9	CA	M	VA	TX
10	CA	M	VA	TX
11	CA	M	VA	TX
12	CA	M	VA	TX
13	CA	M	VA	TX
14	CA	M	VA	TX
15	CA	M	VA	TX
16	CA	M	VA	TX
17	CA	M	VA	TX
18	CA	M	VA	TX
19	CA	M	VA	TX
20	CA	M	VA	TX

Results

Plant Growth Characteristics

Some 50 000 plant seedlings obtained from Boucard of Leakey, TX, were planted at Ft. Benning, GA, and Ft. Stewart, GA, during June-July 1994. The contractor delivered the field-grown seedlings as single stems. Not a single plant survived at either location. The actual cause of 100-percent mortality could not be ascertained. It seems likely that tender singular stems died during the five to seven days' transit period because of excessive heat stress in confined trucks during hot weather.

The following year, seedlings of the India variety, provided by USDA-PMC Columbus, GA, were planted at several U.S. Army installations including Ft Stewart, GA. Ft Stewart has good soils and abundant rainfall. The plants grew fast and within four months of transplanting started producing flowers. Fearing that they may have another Kudzu at hand, the land managers demanded the destruction of all plants. Efforts to convince them to let some of the plants survive till seed maturity did not succeed.

Though the vetiver did not perform well at several U.S. Army installations during subsequent years, plant establishment was astounding at all locations during the first year of planting. This may be due to fertilizer application at planting time and nutrient deficiency during the following years.

Under greenhouse controlled conditions, the Sunshine variety grown in nutrient rich soil with adequate water exhibited a rooting depth equal to its aboveground height. As shown in Fig. 4, the roots were over three feet long within 12 weeks. At one Ft. Campbell site, the India variety was planted on the banks of a non-perennial stream in a wooded area. The soil at that site was sandy loam very rich in

nutrients. The plants grew over 13 feet (Fig. 5) in just one summer. This substantiates the fact that vetiver is a wetland plant, as indicated by its name “*zizanioides*” or riverside. The number of tillers counted at the site ranged between 17 and 32 erect stems.



Fig. 4. Vetiver roots shown to grow in excess of 3 feet in 12 months

Vetiver planted at sandy loam sites at Ft. Campbell grew over 7 feet tall (Fig. 6) and produced profound clumps during its first year of planting. However, most plants did not survive the cold winter. Over the past five years, some are still surviving but are being taken over by native species.



Fig. 5. Nutrient at Ft. Campbell



Fig. 6. Sandy loam at Ft. Campbell

At the other extreme, India and Sunshine varieties of vetiver were planted in almost pure sandy soils at Ft. Bragg, North Carolina (NC), as shown in Fig. 7. The plant growth was not as robust as those planted at Ft. Campbell. It is encouraging to note that vetiver is the only plant species still surviving while all efforts to establish natives have failed at that site.



Fig. 7. India and Sunshine varieties in sandy loam at Ft. Bragg