

At locations where the India variety was planted side-by-side with the Sunshine variety, results show that the India variety grows taller and produces more robust stems. The Sunshine variety grows shorter and produces a bushy plant structure (Fig. 8).



Fig. 8. Sunshine variety planted at US CERL in Champaign, IL

### **Karyotypics of Vetiver**

Dangers and risks of introducing exotic vetiver into an established ecosystem have been ignored or are non-existent in literature. Further research on vetiver indicated that most cultivars do not produce viable seed. If the plant was a triploid and thus sterile, it could be introduced on U.S. Army lands without any environmental concern. Karyotypic testing performed at the University of Illinois showed that both cultivars of India and Sunshine had a chromosome number of  $2n = 2x = 20$  (Fig. 9). This confirmed that the plant is diploid and capable of producing mature fertile seed.

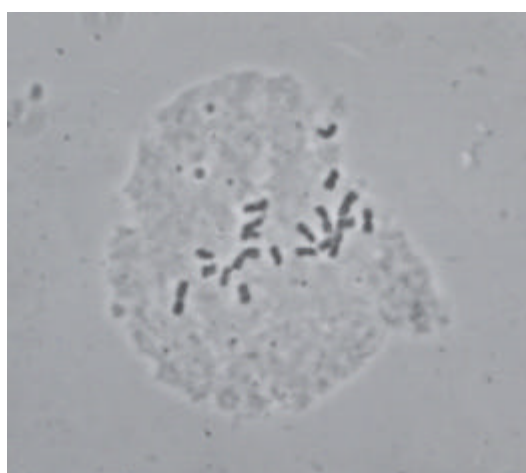


Fig. 9. Sunshine diploid chromosomes

### **Seed Viability and Seed Germination**

There is no evidence in the literature that a thorough evaluation of seed production and germination has ever been conducted. Viable seed production is an area of concern. We do not want exotics introduced in the United States that may become invasive to native plant species.

The Ft. Polk experience has shown that the Sunshine variety only flowered occasionally, producing few inflorescences which did not produce mature seed. Nonetheless, when the Sunshine variety was grown at CERL in Champaign, Illinois (IN), and Ft. Bragg, NC, more plants than expected started flowering in late August and produced mature seed. Things were more alarming with the India variety. The entire population flowered at each and every location where it had been planted and produced mature inflorescences as shown in Fig. 10. Flowering of the India variety starts late August and

continues through October. Flowers and seed heads are purple and over two feet long. No birds have been noticed eating the seed and all seed are shed over ground by the time winter arrives.

Mature inflorescences were collected from both Sunshine and India varieties. The seed heads were sent to Purdue University in West Lafayette, Indiana, for testing. The number of seeds for inflorescence was counted and approximately 400 seeds were selected for seed germination under controlled laboratory environment. Seed numbering and germination test data are given in Figs. 11 and 12 and Appendices A and B. Appendix C shows the number of seeds tested over a four-week period and the number of seeds germinated during each week.

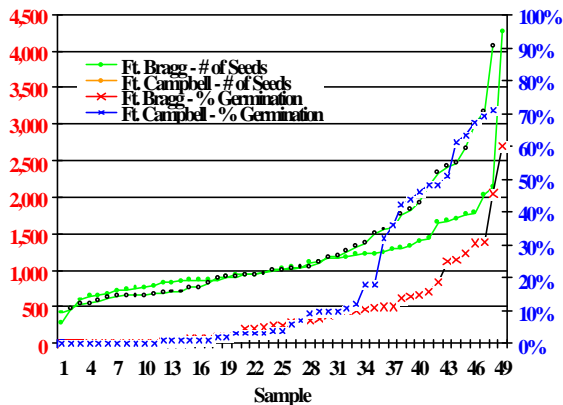


Fig. 11. India variety

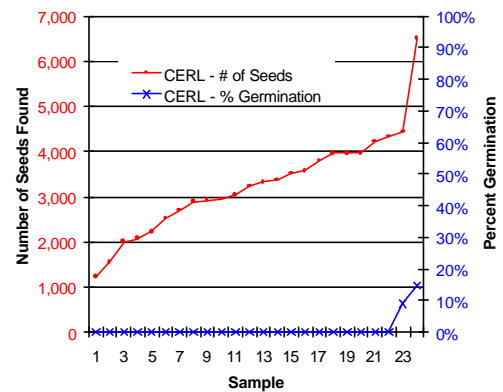


Fig. 12. Sunshine variety

### Geographical Range for Vetiver Survival

As shown in Table 1, the vetiver was planted at 18 U.S. Army installations and on two private land sites. All sites are located within the mid-eastern parts of the United States. No effort was made to field-test vetiver survival in the mid-western states because of low amounts of annual rainfall. Fig. 13 overleaf illustrates the approximate range for vetiver survival in the United States.

### Conclusion

Introduction of an exotic plant like vetiver on U.S. Army lands is a matter of serious concern unless it is proven that the plant will not become an invasive weed. Seed viability and germination tests have shown that vetiver does produce viable seeds that germinate under a controlled laboratory environment. However, five to seven years of field plantings of vetiver on several U.S. Army lands have demonstrated that vetiver seed does not germinate and establish plants under actual field conditions. Results have also shown that vetiver is a passive plant that does not like competition from native plant species. Thus there is little chance that it will ever invade native grasses. However, these results may not be taken as conclusive. More research is needed to determine the behaviour of the plant under more humid and warmer climatic conditions of the deep south-eastern states of the United States. In these states, how the plant will respond if planted in fertile wetlands is also uncertain. For example, Sunshine vetiver is known not to flower or produce mature seed under Louisiana conditions. However, the same plant did flower and produced mature fertile seed when planted at Champaign, IL, and Ft. Bragg, NC. Before promoting the use of vetiver in the United States, the risks associated with this plant must be carefully examined even though initial indications are that the plant is not an aggressive colonizer and simple methods are available for its control.

On erosion control effectiveness, the results have shown that vetiver can survive on infertile and sandy soils where even native plants do not grow at all. When planted early in the spring in rich fertile soils, the vetiver plants have grown over 13 feet tall and produced 17-33 healthy tillers to provide an excellent sediment filter and effective hedge against erosion.

## Future Research Goals

Research is needed to develop a triploid ( $2n = 2x = \text{odd number}$ ) to ensure seed sterility. This can be accomplished through cross-pollination between vetiver and its close relatives. Research in the United States and abroad has demonstrated that vetiver has no parallel as a bio-terrace, biological filter and hedge against erosion. The plant can survive a wide range of soil conditions. Thus it possesses excellent potential for erosion control under U.S. Army-unique environments. To be applied across the United States, the plant must be tolerant to cold winters of the North. This can be accomplished by using techniques of genetic engineering to identify and transfer cold-tolerant genes of winter hardy plants into vetiver cultivars.

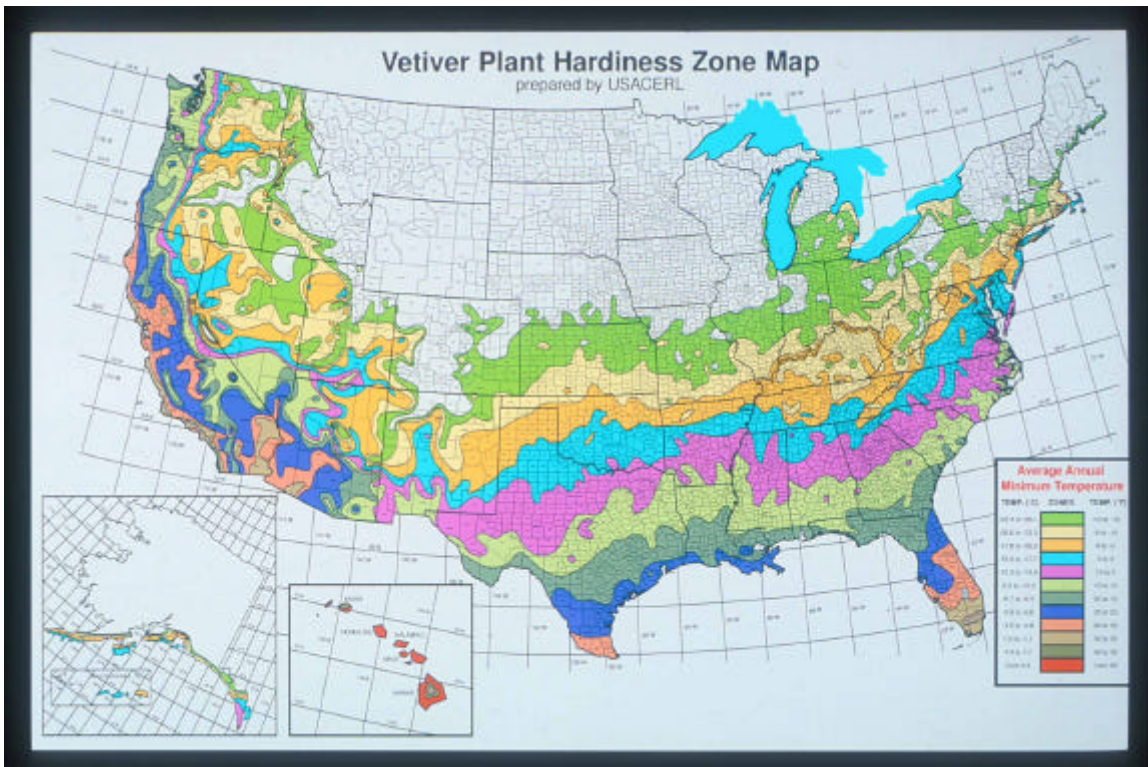


Fig. 14. Vetiver plant hardiness zone map