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# SMALL RUMINANTS FOR BIOLOGICAL CONTROL OF INVASIVE WEEDS

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**ABSTRACT:** The invasion of fallow cropland, pasture and woodland by native and non-native weeds is a common problem throughout the Caribbean and southern USA. In Florida alone, 29% of non-cultivated plants are classified as non-native. Coral vine (*Antigonon leptopus*), cogongrass (*Imperata cylindrica*), Japanese climbing fern (*Lygopodium japonicum*), and leucaena (*Leucaena leucocephala*) are well-documented examples of non-natives that have become widespread invasive species in the Caribbean. The use of intensive, short duration goat/sheep browsing (ISDGB) may be an efficacious, remunerative, and ecologically mild form of manipulating unwanted vegetation. Growing concern about invasive plants, in conjunction with a strong small ruminant market, provides a fortuitous opportunity to combine profitable animal husbandry with biological control of weeds. Both stocking rates and rotations have proven important in reducing perennial brush by using small ruminants, but the key word is "reduction" and not "eradication". Even when heavy stocking rates force intensive browsing, goats and sheep cannot always completely destroy target species, and these can still make a comeback in subsequent years from rootstocks or soil seed banks. Timing for ISDGB or combinations of different weed control methods that include ISDBG may have to be developed to ensure long-term eradication. An additional concern is the potential damage to non-target plants, such as desirable native species. The commercial application of ISDGB requires greater knowledge, including effects of prior vegetation manipulation, season of application, stocking rates, duration of exposure, and growing conditions, all of which combine to affect the degree of successful weed control and subsequent survival of desirable native species. A consortium of researchers in Puerto Rico, St. Croix, and the southeastern USA is currently studying how best to implement ISDGB with the assistance of a Southern Sustainable Agricultural Research and Education grant.

Keywords: Goats, sheep, brush control, biological weed management

**RESUMEN:** La invasión de malezas nativas y exóticas en tierras cultivables en descanso, en pastizales y en bosques es un problema común a través del sur de los Estados Unidos y del Caribe. En Florida, el 29% de las plantas no cultivables están clasificadas como no nativas. Ejemplos de especies que se han documentado como especies invasivas que se han dispersado en todo el Caribe son *Antigonon leptopus*, *Imperata cylindrica*, *Lygopodium japonicum*, y leucaena (*Leucaena leucocephala*). El uso del ramoneo intensivo, de corta duración (RICD) con cabras/ovejas es una forma moderada para la manipulación de vegetación no deseada, la cual puede ser efectiva, remunerada y ecológicament aceptable. La preocupación del aumento de las plantas invasoras en unión con un mercado pequeño pero fuerte del rumiante, proporciona una oportunidad fortuita de combinar la agricultura animal con el control biológico de malezas. El promedio de abastecimientos y la rotación han demostrado ser un factor importante en la reducción de arbustos perennes con el uso de pequeños rumiantes. Incluso cuando el promedio

de abastecimiento es alto, fuerzan el ramoneo intensivo donde las cabras y las ovejas no siempre pueden destruir completamente las especies claves, y éstas todavía pueden hacer una reaparición en años siguientes a partir de rizomas o bancos de semillas del suelo. El cronometraje para RICD o las combinaciones de diferentes métodos de control de malezas que incluyen RICD deberían ser desarrollados para asegurar la erradicación a largo plazo. Una preocupación adicional es el potencial de daños para plantas no claves, como especies nativas deseables. La aplicación comercial de RICD requiere de gran conocimiento, incluyendo efectos de la manipulación de vegetación previa, la temporada de la aplicación, el promedio de abastecimiento, la duración de la exposición, y las condiciones cultivables, donde todas se combinan para afectar el grado de control de malezas y la supervivencia subsiguiente de especies nativas deseables. Un consorcio de investigadores en Puerto Rico, Santa Cruz y los Estados del Sureste de los Estados Unidos están actualmente estudiando cómo implementar mejor el RICD con la asistencia de una subvención del programa de Educación e Investigación Agrícola Sostenible del Sur (SARE, por sus siglas en inglés).

Palabras clave: Cabras, ovejas, control de arbustos, manejo biológico de malezas

## INTRODUCTION

The invasion of fallow cropland, pasture and woodland by native and non-native weeds is a common problem throughout the southern USA, Puerto Rico and the U.S. Virgin Islands (USVI). In Florida alone, 29% of non-cultivated plants are classified as non-native (Langland and Stocker, 2001). Native honey mesquite (*Prosopis glandulosa*), cedar (*Juniperus* spp.), and greenbrier (*Smilax* spp.) are examples of widespread southeastern USA invasive plants resulting from overgrazing by cattle with resulting disruption in the natural balance in plant communities (Welch and Hyden, 1996; Racher and Britton, 1997; Taylor and Fuhlendorf, 2003). Kudzu (*Pueraria lobata*), coral vine (*Antigonon leptopus*) cogongrass (*Imperata cylindrica*), Japanese climbing fern (*Lygopodium japonicum*), leucaena (*Leucaena leucocephala*) and white Acacia (*Albizia lebbeck* L. (Benth.) are well-documented examples of non-natives that have become widespread invasive species in the region (Miller, 1988; Engle et al., 1994; Langland and Stocker, 2001; Terrill et al., 2003; USDA-NRCS, 2001). Most of the non-native species have proven very difficult to eradicate once established. For example, current guidelines for kudzu control warn that repeat applications of herbicide may be necessary for 5 to 10 years after initial treatment (Demers and Long, 2002). In Puerto Rico, Catclaw mimosa (*Mimosa pigra* L.), an aggressive woody shrub which forms an impenetrable prickly thicket, and climbing mimosa (*Mimosa casta* L.) are also invasive non-native plants (E. Valencia, personal observations) occurring in high rainfall areas.

Non-chemical methods exist for controlling invasive weeds. Non-grass weedy invaders can sometimes be suppressed by using grass-fueled fires (Briggs et al., 2002) but this method rarely results in 100% eradication and is sometimes a socially or environmentally unacceptable means of brush management. Other methods commonly used include grubbing, root-plowing, removal by hand, chaining, and herbicides (Taylor, 1992; Hart, 2001), all of which have environmental and economic downsides. Biological control of regrowth following mechanical or chemical brush control has proven more effective than single-control approaches (Magee, 1957; Green and Newell, 1982). The use of small ruminants for biological control may be more socially acceptable (Ball, 2004), and their forage predilection (Huston, 1978) and specialized

digestive tracts (Huston et al., 1986; Hofman, 1989) make them better brush control tools than other larger ruminants. In addition, goat and sheep feed preferences are determined by a complex mixture of genetics, learned behavior, and feed availability (Malechek and Provenza, 1983) that can be manipulated to produce specific modifications in plant communities.

The use of intensive, short duration goat/sheep browsing (ISDGB) may be an efficacious, remunerative, and ecologically mild form of manipulating vegetation (Muir et al., 1997; Briggs et al., 2002). The use of small ruminants for brush control is not completely unknown in the southern USA (Bull, 2000) and has been supported by SARE grants (LS01-119) in the past. The commercial application of this practice, namely contracting herds specifically to suppress invasive vegetation (Ball, 2004), is not, however, widespread in the southeastern USA or in USA Caribbean territories, but has been successful elsewhere (Green and Newell, 1982). At the same time, market demand for goat and sheep meat is strong (www.vdacs.virginia.gov/livestock/goatprice.html), indirectly encouraging over-stocking on ecologically sensitive rangelands, where most small ruminants have traditionally been raised (Malechek and Leinweber, 1972), and in the eastern United States, where most producers have limited land areas to utilize. The growing invasive plant problems, in conjunction with a strong small ruminant market, provide a fortuitous opportunity to combine profitable animal husbandry with biological control of weeds. The details for this union of circumstances, however, have not been developed.

Both stocking rates and rotations have proven important in reducing perennial brush using small ruminants in regions outside the southeastern USA, Puerto Rico and the U.S. Virgin Islands (Muir et al., 1997; Torrano et al., 1999; Tsiouvaras et al., 1999; Mellado et al., 2003), but the key word is "reduction" and not "eradication". Even when heavy stocking rates force intensive browsing, goats and sheep cannot always completely destroy target species (Muir et al., 1997; Torrando et al., 1999), and these can still make a comeback in subsequent years from rootstocks or soil seed banks (Torrando et al., 1999). Heavy browsing can even stimulate some browse production (Provenza et al., 1983) whereas season of vegetation removal can also affect regrowth vigor (Hardesty et al., 1988). Timing for ISDGB or combinations of different weed control methods that include ISDBG may have to be developed to ensure long-term eradication.

Although clear-cutting brush will often increase forage immediately available to small ruminants (Pfister and Malechek, 1986; Kirmse et al., 1987; Schacht and Malechek, 1990), subsequent flock or herd management can have a strong effect on the plant-animal interface. Continuous grazing tends to produce superior control (Lym et al., 1997) but often at a cost to animal production. Heavy stocking can reduce the quality of browse available to goats and sheep (Malechek and Leinweber, 1972), all of which can be detrimental to flocks/herds. Desirable species (a strong movement by landowners in the region favors natives) may also be vulnerable to eradication if stocking rates or grazing duration exceeds the tolerance level (Green & Newell, 1982), mostly determined by their place on the palatability scale of the particular flock or herd being used (Allan and Holst, 1996).

A review of the literature on the use of small ruminants for the biological control of brush makes one thing clear: Successful vegetation suppression, with or without the use of small ruminants, is governed by a complex set of factors. The commercial application of ISDGB requires greater knowledge, including effects of prior vegetation manipulation, season of application, stocking rates, duration of exposure, and growing conditions, all of which combine to affect the degree of successful weed control. A Southern Region Sustainable Agricultural Research and Education grant has allowed researchers in various locations to address these

concerns. The objective of this paper is to describe this research and present preliminary findings.

## MATERIALS AND METHODS

In Texas, ISDGB plant: animal interface trials have focused on goats browsing greenbrier and honey mesquite. With both these species, the first concern is access since the greenbrier's viney growth and the honey mesquite's tree canopy put most of the growth above the browse line. Treatments include cutting to browse level prior to ISDBG and herbicide applications following browsing.

In Georgia, ISDGB trials will focus on sheep and goats browsing kudzu. The research paddocks were laid out in a field of well-established kudzu (More than 20 years old) that has had no fertilizer input for the life of the stand. In addition to animal species, treatments will include ISDGB and set-stocked, continuously grazed kudzu paddocks.

In Puerto Rico, ISDGB was initiated March 2003 in the Gurabo area (a wet site). Replicated paddocks infested with the shrubby plant *Albizia lebbeck* (>80%; white acacia) were fenced and stocked with mature goats. Goats were removed when grass and available shrub were less than 1000 kg/ha and moved to another paddock. Another study was laid out in paddocks invaded with *Mimosa pigra* (catclaw) and *Mimosa casta* L. (climbing mimosa). Replicated plots were stocked with goats and rotated every 14 d. Percentage damage to the bark of acacia was estimated and number of dead or dying plants counted 6 mo later. In the Mimosa plots, percentage changes in composition were also determined.

Work in St. Croix (U.S. Virgin Islands) has started on selectively controlling corral vine by using St. Croix hair sheep. Acceptability of the vine was the first concern.

## RESULTS AND DISCUSSION

Preliminary results from Texas indicate that greenbrier is palatable, regrows easily, and responds well to herbicide once weakened by ISDBG. Honey mesquite, on the other hand, is unpalatable [leaves may actually be toxic to ruminants according to Holechek et al. (1990) because of high phenol content] and may succumb only to herbicide treatments. The preliminary work in Georgia indicates that kudzu is a highly palatable, nutritious forage for both sheep and goats and that regular plant removal weakens regrowth potential of this species.

Preliminary results show a 50% reduction of Acacia shrubs in paddocks 6 mo after initiation of ISDGB in Puerto Rico. In the Mimosa study, most of the climbing mimosa patches were eradicated as all of the existing plants were grazed and very little regrowth occurred. Although catclaw mimosa was observed to be browsed by goats, damage to the bark of the shrubby tree was minimal as no death of catclaw occurred. It is possible that the mature plants need to be cut and ISDGB imposed on new regrowth.

When sheep were pre-conditioned to eating corral vine on St. Croix by being offered only that plant in confinement for three weeks, they appeared to accept it readily once presented with other forages in invaded paddocks. Initial results indicated that the sheep do control vines, eventually cutting stems that connect to plants climbing into the canopy. Regrowth was less palatable than initial growth, and research will be designed to determine why. Since corral vine is a deep-rooted perennial, complete control will likely be achieved only when weakened regrowth is sprayed with herbicide; this approach will be tested.

Table 1. Invasive species targeted by intensive, short duration goat/sheep browsing (ISDGB) at cooperating research locations.

| Species | Common names | Growth Habit | States/territories where targeted | Origin |
|---|---|---|---|---|
| *Antigonon leptopus* | Coral vine | Vine | U.S. Virgin Islands<br>Puerto Rico | Exotic |
| *Leucaena leucocephala* | Tantan | Tree | U.S. Virgin Islands<br>Puerto Rico<br>Florida | Exotic |
| *Albizia lebbeck* | White Acacia | Tree | Puerto Rico | Exotic |
| *Mimosa pigra; casta* | Mimosas | Vine; shrub | Puerto Rico | Exotic |
| *Lygopodium japonicum* | Japanese climbing fern | Vine | Florida | Exotic |
| *Prosopis juliflora* var. *glandulosa* | Honey mesquite | Tree | Texas | Native |
| *Smilax* spp. | Greenbriar | Vine | Texas<br>Georgia<br>Florida | Native |
| *Lespedeza cuneata* | Sericea lespedeza | Vine | Georgia | Exotic |

## CONCLUSIONS

The ISDGB research to date shows a degree of promise. Control of most (but not all) invasive species is possible, but complete eradication appears unlikely. Future research efforts will focus on multiple control methods such as mechanical, fire and herbicide treatments which, when used in conjunction with ISDGB, will result in eradication of undesired plant stands.

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