Performance of Guinea grass (*Panicum maximum* Jacq cv. Likoni) forage area according to the population of wire grass (*Sporobolus indicus* L.)

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The influence of wire grass (*Sporobolus indicus* L.) (0, 2, 4 and 6 plants/m²) on yield, cost and quality of Guinea grass (*Panicum maximum* Jacq cv. Likoni) biomass was studied in a calcic ferralsol, through a completely random design and ten repetitions. The wire grass height did not vary with the increase of its population and the area of the soil covered was increased 

\((P < 0.001)\). There was an inverse ratio

\((r = -0.88) (P < 0.001)\) between Guinea grass yield and wire grass population. The forage cost increased from 25.21 to 78.63 pesos, for 0 and 6 plants of wire grass/m², respectively. The chemical composition of the soil did not vary with the treatments. The highest wire grass population produced lower 

\((P < 0.05)\) content of organic matter digestibility (OMD) and Ca \((P < 0.01)\). There was no effect on the chemical composition of Guinea grass. In the wire grass, only CP and P were lower \((P < 0.01)\) with the population increase. It is concluded that the increase of wire grass population diminished the Guinea grass yield, elevated the cost of biomass production and altered some indicators of forage quality. Further studies on the possible effects of wire grass population on biomass quality of improved pastures are recommended.

**Key words:** *Panicum maximum*, *Sporobolus indicus*, weeds population, yield, cost

Wire grass (*Sporobolus indicus* L.) is a weed invading Cuban grasslands and those of other tropical and sub-tropical regions (Sánchez et al. 1991). During many years, in the southern part of the United States, this weed has introduced in bermuda grass (*Cynodon dactylon*) grasslands (Mislevy and Martín 2002). In Argentina and other Latin American countries, wire grass is one of the most disseminated species and of difficult control. In Mexico, this plant is in the states of Campeche, Chiapas, Chihuahua, Colima, Distrito Federal, Durango, Guerrero, Hidalgo, Jalisco and Michoacán. In this last, wire grass grows naturally and reaches from 1000 to 2250 m a.s.l. This species is of great ecological and phenotypical plasticity, meaning that it could have a wide range of natural enemies. Due to its aggressiveness when invading, it damages seriously from the economical point of view.

At present, no efficient method is known for controlling wire grass. The traditional techniques do not eliminate it due to its similar physiological characteristics to those of grass improved pastures with photosynthetic pathway C\(_4\) (Feldman and Refi 2006). Besides, wire grass may provoke, in a short period of time, high degree of invasion and infestation in different agroecosystems of cultivated pastures (Crespo and Fraga 2005). Under these conditions, searching techniques for its efficient control is a need for producers, technicians and scientists (Padilla 2002, Sardiñas et al. 2005 and Valenciaga and Mora 2007).

Adjei et al. (2003) stated that the burning and mechanical cutting stimulates the appearance of new tillers in wire grass, as the active buds in the basis of the air stems allow them to regrow easily after cutting.

Although they have not been counted so far, the Cuban grasslands show high infestation levels of wire grass. Due to its low palatability, this weed becomes a real threat for improved pastures, when using continuous grazing. How the yield of these pastures is affected when wire grass increases is not known either. The objective of this study was to assess the effect of the invasion of wire grass on yield, cost and quality of biomass in a forage area of Guinea grass.

**Materials and Methods**

A completely randomized design was used with ten repetitions. Frames of 2 x 2 m, being as experimental unit, were used for the samplings. The treatments consisted of populations of 0, 2, 4, and 6 wire grass plants/m².

The experiment was conducted in a forage area of Guinea grass in the Institute of Animal Science, in the Mayabeque province, Cuba. This facility is between 22° 53’ NL and 82° 02’ WL, at 92 m a.s.l. The area was not fertilized in the last five years. The soil corresponded to the calcic ferralsol type (Hernández et al. 2005), equivalent to the Inceptisol. The treatments were randomly distributed in a previously selected area, with wire grass population between 0 and 6 plants/m². Frames of 2 x 2 m were placed, according to the number of plants/m². Uniformity cut at 10 cm height was conducted, and at 120 d of regrowth, corresponding to the rainy season. Yield, height and area covered by forage were determined through the sample of ten frames (4 m² each). In order to measure the yield and botanical composition, the Guinea grass was manually harvested and separated from wire grass. Besides, three heights per frame were measured and the area covered by each of them was determined. Samples of 200 g of Guinea grass and wire grass were selected to determine ash, CP, Ca, P, CF, OMD (AOAC 1995), NDF and ADF (Goering y van Soest 1970). A sample, composed of three sub-samples in each frame, was determined to analyze N, P, K, Ca,
Mg, OM and pH (Jackson 1970).

Cost sheets were elaborated for each treatment. The expenses of salary, oil, machinery, mechanical labors, seeds and other elements needed for forage production were calculated. After having this information, the costs for each treatment were calculated. The current prices were also considered, according to the methodology of Cino et al. (2007).

The data processing was conducted through the statistical software InfoStat, version 1.0 (Rienzo et al. 2001). When necessary, the mean values were compared through the multiple range test of Duncan (1955). The percentages of covered area and those of the decrease of guinea grass biomass production were transformed according to the arc sine \(\sqrt{\%} + 0.375\)

**Results and Discussion**

The lowest (P < 0.01) height and area covered by Guinea grass were presented with the invasion of plants/m\(^2\) of wire grass (table 1). The raise of the weed population increased (P < 0.001) its area covered but did not affect the height.

The previous statement could be associated, among other causes, with the effect of the competition for vital space between wire grass and Guinea grass. According to Alemán (2004), the transformation of the botanical composition with the increase of the weed density is within the main elements that could determine this type of competition is. The similarity between wire grass height and the density increase indicates that there was no intra-specific competition. In observations conducted in agroecosystems of improved pastures invaded of wire grass, with populations superior to those of this study, reduction in the weed height is not indicated. This, apparently, does not influence the competition between plants of the same species.

The Guinea grass yield decreased and that of the wire grass increased (P < 0.001), as its population raised (table 2). This increase had a negative economic effect. The cost of t/ha of Guinea grass DM augmented from 25.2, with 6 plants/m\(^2\), to 78.63 Cuban pesos, when frequency was zero. Ferrell et al. (2006) also found that middle and high populations of wire grass reduced the biomass yield of the *Paspalum notatum* (bahiagrass) natural pasture from 1.16 t of DM ha\(^{-1}\) to 0.59 and 0.15, respectively.

The knowledge on the economical threshold of weeds in tropical pastures is still limited. Dias-Filho (1990) refers that, apparently, this type of plants affects since the initial stage of establishment and during the useful life cycle of the grassland. The highest production cost of the dry matter ton of Guinea grass could be related to the diminishing of biomass availability, as the weed population increased, raising the production ha\(^{-1}\) price. These results indicate the necessity of applying methods for minimizing the damages these plants may cause, because the economical losses are considerable (Bray

<table>
<thead>
<tr>
<th>Wire grass plants m(^{-2})</th>
<th>Height (cm)</th>
<th>Covered area, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Guinea grass</td>
<td>Wire grass</td>
</tr>
<tr>
<td>0</td>
<td>87.4(^{a})</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>82.4(^{ab})</td>
<td>41.9</td>
</tr>
<tr>
<td>4</td>
<td>75.3(^{b})</td>
<td>54.7</td>
</tr>
<tr>
<td>6</td>
<td>64.6(^{c})</td>
<td>49.4</td>
</tr>
</tbody>
</table>

SE (±) 3.5** 3.6 4.2** 3.5***

\(^{abc}\) Means with different letters per column differ at P < 0.05 (Duncan 1955)

( ) Real values. \(^{1}\)The area covered was of 100 % in all repetitions

***P < 0.01 ****P < 0.001

<table>
<thead>
<tr>
<th>Wire grass plants m(^{-2})</th>
<th>Wire grass (t MS ha(^{-1}))</th>
<th>Guinea grass (t MS ha(^{-1}))</th>
<th>Guinea grass cpst($ t MS ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-</td>
<td>2.1(^{a})</td>
<td>26.2(^{a})</td>
</tr>
<tr>
<td>2</td>
<td>0.1(^{a})</td>
<td>1.8(^{b})</td>
<td>31.3(^{b})</td>
</tr>
<tr>
<td>4</td>
<td>0.5(^{b})</td>
<td>1.2(^{c})</td>
<td>48.8(^{b})</td>
</tr>
<tr>
<td>6</td>
<td>0.9(^{c})</td>
<td>0.7(^{d})</td>
<td>78.6(^{c})</td>
</tr>
</tbody>
</table>

SE (±) 0.05*** 0.09*** 0.08***

\(^{abc}\) Values with different letters per column differ at P < 0.05 (Duncan 1955)

***P < 0.001
The cost of the damages of this undesirable species in the grasslands is hard to determine. Apart from diminishing the dry matter yield of the pasture, quality is affected, reducing the animal intake. The additional expenses for keeping the grassland and the forage area free of weeds should be added.

As wire grass population increased, the percentage of Guinea grass biomass production decreased (P < 0.001). This was adjusted to the linear equation $Y = 2.20 - 0.25 x$, $SE = \pm 0.019$, $r = -0.88$. Likewise, the Guinea grass biomass production was reduced to 66%, with wire grass population of 6 plants/m², in respect to the control (figure 1).

The lowest height, covered area and yield of Guinea grass obtained with the highest wire grass population indicate the competition that could be established between this weed and Guinea grass. This, together with the negative correlation between the increase of wire grass and Guinea grass biomass production, confirm the statement of Dias-Filho (2005). This author refers that per each kilogram of weight increase of the weeds, the equivalent diminish of the improved pastures yield is produced. The literature describes that weeds reduce the yield of the agricultural crops in 25% (Labrada 1996). However, Alemán (2004) informed that the losses could reach 50%. In this study, the results indicated damages of 68% with the highest wire grass density, surpassing that reported for improved pasture which is of 30% (Anon 2010).

The results of Ferrell et al. (2006) show that the accumulation of bahiagrass biomass was reduced from 1.164 kg ha⁻¹, with scarce wire grass population, to values of 590 and 154 kg ha⁻¹ for middle and high populations, respectively. These results confirm the hypothesis that this weed can affect the biomass production of improved pastures in different tropical and sub-tropical regions. (Sardiñas 2009).

The yield diminishing, %

$Y = 2.20 - 0.25 \pm 0.019 x$

$R^2 = 0.88***$

$SE = \pm 0.20$

Figure 1. Diminishing of Guinea grass yield according to the wire grass invasion
The values of CP (2.96 %) and P (0.22 %) in wire grass were lower as their population increased (P < 0.01). However, ash (7.32 %), Ca (0.64 %), CF (37.41 %), OMD (51.71 %), CF (37.41 %), ADF (44.81 %) and NDF (80.37 %) were not affected.

Studies conducted on soils with very low fertility show that weeds, in respect to improved grasses, are capable of extracting nutrients from the soil more easily. This leads also to the superiority of their content. Dias-Filho (2005) reported higher contents of N and P in weeds predominating in a degraded grassland of *Hyparrhenia rufa* with ten years of age in the Brazilian Eastern in respect to the improved pasture.

The same did not occurred in this experiment, maybe because the nutrients range of the experimental area was acceptable for this type of soil (Crespo et al. 2006). This could influence on the fact that the majority of the nutrients studied were not affect by the effect of the treatments. The fact that in this study Guinea grass had the highest content of ash, CP and P compared with wire grass, confirm that the nutrients content of the soil favored improved pasture more than weeds.

The diminishing of some bromatological elements as weeds increase could be associated to the excluding competence among species for the ecological niche, water, light and nutrients, shown in yield and their components. In respect to the biomass quality, although it was not so evident, it was also affected by the infestation level. That was shown by the Guinea grass OMD and wire grass CP and P, which were inferior when the population of this weed was higher. Likewise, the values of Ca, CP, and P had similar performance when assessing integrally the improved pasture and the weed in the ecosystem. It seems that the diminishing of OMD could be associated with the increase of NDF rather than with the wire grass density. This is because the pasture was cut at 120 d of regrowth.

Similar results were found by Ramírez et al. (2010) in Guinea grass, when studying the effect of age on different indicators of the plant quality in cattle soils of Granma province, Cuba.

The CP contents of 5.07 % in Guinea grass and of 2.96 % in wire grass also indicate low biomass quality in a grassland agroecosystem invaded by this weed.

These results are an alert on the negative effect of wire grass on the biomass volume and quality of forage areas. New studies with this and other pastures on lower fertile soils are needed.

It is concluded that the largest wire grass populations diminished the forage yield and increased the production cost of each DM ton produced by Guinea grass. The increase of wire grass influenced on the deterioration of some bromatological indicators of Guinea grass and wire grass, mainly on CP, Ca, and OMD. The contents of N, P, K, Ca, Na, OM and pH of the soil were not affected.

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