SEASONAL GROWTH OF "ALGODÃO-BRAVO" (*IPOMOEA CARNEA* SPP. *FISTULOSA*)[1]

RAINER HAASE[2]

ABSTRACT - *Ipomoea carnea* spp. *fistulosa*, a native woody perennial, is capable of spreading rapidly over seasonally flooded grassland in the Brazilian Pantanal, South America's largest wetland, thus conflicting with the local cattle ranching. *I. carnea* is controlled by mowing at the onset of the rainy season, as close as possible before the seasonal flooding. Often, however, flooding begins after the plant has had enough time to re-sprout enabling it to survive. The objective of this study was to verify if *Ipomoea carnea* plant's production follows a seasonal cycle, and, if so, at which point in this cycle, the plant is most vulnerable to mechanical control measures. Seasonal dynamics of stem and leaf production of *I. carnea* were studied. The results showed that growth of *I. carnea* is fastest at the onset of the rainy season in November/December. Production declines when seasonal flooding commences in January/February and almost ceases towards the begin of the dry season in May/June. This leads to the proposal that *I. carnea* could be controlled more effectively if the weed were mown in the early dry season when its production and its capability to re-sprout is lowest, and if any new sprouts were cut by hand when the seasonal flooding starts.

Index terms: biomass, production, pasture weed, Pantanal.

CRESCIMENTO SAZONAL DO "ALGODÃO-BRAVO" (*IPOMOEA CARNEA* SPP. *FISTULOSA*)

RESUMO - *Ipomoea carnea* spp. *fistulosa*, arbusto perene nativo, tem a capacidade de se propagar rapidamente nos campos inundáveis do Pantanal matogrossense, a maior região húmida da América do Sul, causando conflito com a criação de gado local. *I. carnea* é controlada por roçagem no começo da época das chuvas, o mais próximo possível antes do começo da enchente. Porém é freqüente que a enchente ocorra após tempo suficiente para o crescimento da rebrota e para a sobrevivência da planta. O objetivo deste trabalho foi verificar se a produção da planta *Ipomoea carnea* obedece a um ciclo sazonal, e, se assim for, em que ponto do ciclo a planta é mais vulnerável ao controle mecânico. Foi pesquisado o ritmo sazonal da produção de folhas e galhos de *I. carnea*. O resultado mostra que *I. carnea* cresce mais rápido no início da época das chuvas, entre novembro e dezembro. A produção diminui quando começa a enchente em janeiro/fevereiro, e quase não há crescimento em maio/junho com a chegada da época da seca. Conclui-se que *I. carnea* pode ser controlada mais efetivamente se a planta for roçada no início da época da seca, período de sua menor produção, diminuindo sua capacidade de rebrotar e se todo rebento rebrotado for manualmente roçado no início da enchente.

Termos para indexação: biomassa, produção, planta invasora, Pantanal.

INTRODUCTION

Ipomoea carnea spp. *fistulosa* (Mart. ex Choisy) D. Austin (Convolvulaceae) is a native woody perennial of the American tropics (Austin, 1977), which attained pan tropical distribution (Johri, 1984), probably because of its use as an ornamental and in grafting of sweet potato [*Ipomoea batatas* (L.) Lam.] cultivars. Within the Pantanal, South America's largest wetland located in the mid-west of Brazil, dense stands of the 2-3 m tall and little lignified stems of *I. carnea* occur in open unshaded areas subject to shallow seasonal flooding lasting up to six months (Allem & Valls, 1987). *I. carnea* is locally known as "algodão-do-Pantanal" or "algodão-bravo" (Frey, 1995), referring to the hairy cover of the seeds.

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Areas of natural disturbance along banks of seasonal rivers and drainage channels are the common habitats of *I. carnea*. As the seasonally flooded natural grassland of the Pantanal has been used as native pasture for cattle ranching during the last 200 years, disturbance is also caused by overgrazing, burning practice, and occasional land clearing activities involving machines. The results of the latter actions are well known to the local ranchers. When vegetation is burned or shrubs cleared away from the seasonally flooded grassland by bulldozers during the dry season, it will only take until the next rains for newly exposed seeds of *I. carnea* to germinate and for the species to cover large parts of the cleared areas. Where the grassy vegetation cover is gradually degraded over a long period by overgrazing and trampling of cattle, *I. carnea* often also germinates but needs much more time to cover large areas. In this way the species, which is left almost untouched by cattle, turns into a typical pasture weed. The process sometimes takes many years and is not always readily understood by the ranchers.

Besides causing problems as a pasture weed, *I. carnea* is reported to be a toxic plant (Corrêa, 1926; Tokarnia et al., 1979). Feeding experiments, however, showed that cattle have to ingest a large quantity of the plant before effects of intoxication start to show (Tokarnia et al., 1960).

The usual way of controlling the weed is by mowing it at the onset of the rainy season. This is usually done with a gyro-mower pulled by a tractor. Ranchers try to do this as close as possible before the seasonal flooding, just before the soil becomes too wet to operate a tractor. An early flooding right after mowing is desirable because the stumps of *I. carnea* reportedly die when completely covered with water soon after cutting. In most areas of the Pantanal, however, up to two months pass between the time of heavy rains, and the onset of the flooding, the stumps of the mown plants re-sprout, so that they have grown up to a height just above the flooding level surviving easily. The cut-off stems left on the ground do not die during this time of the year because of the frequent rains, but grow adventitious roots and re-sprout instead.

Thus, mowing *I. carnea* at this time of the year often multiplies the plants, especially when done with a gyro-mower which leaves the cut-off stems entire and, therefore, with a good capability to regrow. Better results of controlling the weed were already achieved by using a “knife drum”, a large water-filled steel drum with several blades on its surface. This is pulled over the vegetation by a tractor and cuts the stems into small pieces which can resprout and outgrow the flooding level far less successfully than whole stems.

The objective to study above-ground biomass of *I. carnea* was to verify if the plant’s production follows a seasonal cycle, and if so at which point in this cycle *I. carnea* is most vulnerable to mechanical control measures.

MATERIAL AND METHODS

The two field sites of the study were located in the northern part of the Pantanal. The tropical climate of the area has a distinct wet and dry season. The yearly average rainfall is 1,275 mm with most of the rain falling between November and April. June, July, and August mark the dry season with cooler days. The annual mean temperature is 25.8° C (Cadavid García, 1984). The Pantanal is a flat alluvial plain receiving the runoff from a catchment twice the size of itself, thus, most of the region is flooded for six months during and after the rainy season. In the late dry season, on the other hand, large areas dry out completely.

Two permanent plots of 5 x 5 m subdivided into five strips of 5 x 1 m were marked in dense pure *I. carnea* stands of different ages in two different locations. Plot 1 (16° 57' S, 56° 53' W, 100 m a.s.l.) was set up in a dense stand of *I. carnea*, covering about 10 ha. Six years prior to the study, the top soil (heavy clay) of the area was severely disturbed and partly removed in order to be used for the construction of dams. According to the land owner the area became infested with *I. carnea* within one year after the soil disturbance. Attempts to reduce the weed cover by mowing failed. The study plot was established where *I. carnea* had been mown two years earlier. The plot was subject to flooding for 4-5 months of the year with a maximum layer of water 20 cm deep.

Plot 2 (16° 21' S, 56° 37' W, 110 m a.s.l.) was located in an area characterized by sandy soils and small stands of *I. carnea* of 0.1 - 0.5 ha. The study plot was set up in a stand of recently germinated plants of *I. carnea* subject to 4 months of seasonal flooding with a maximum layer of water 40 cm deep. *I. carnea* had germinated after shrubs had been cleared away with a bulldozer leaving the topsoil exposed. Table 1 shows details of the study plots.

Stem density in the plots was similar at the begin of the study. The sampling period was from November 1991 to November 1992 for plot 1 and from December 1991 to November 1992 for plot 2. In both plots, the individual stems of the multi-stemmed *I. carnea* shrubs were marked with numbered plastic tags, as were all new shoots and branches which were both treated as individual stems. Sampling on the plots was done fortnightly in the following manner. The stem of *I. carnea* has an upper part which is green due to the chlorophyll of the primary bark, and a lower part which is gray due to the formation of secondary bark. Lengths of both stem parts and their upper and lower diameters were measured to the nearest 0.5 and 0.1 cm, respectively. Leaf widths and the number of new, old and shed leaves with reference to the preceding measurement were recorded. The number of shed leaves was counted from the leaf scars, and the width of shed leaves was set equal to the width of the largest leaf on the particular stem. Rainfall was recorded fortnightly for each plot and the water level was measured on every sampling occasion during the flooding season.

Least square regression equations were established to estimate stem and leaf dry weights from the measured variables. Prior to harvesting *I. carnea* plants, lengths and upper and lower diameters of both green and gray stem sections, as well as leaf widths were recorded. Harvested stems and leaves were dried at 80°C, stems were weighed to the nearest mg and leaves to the nearest 0.1 mg. The obtained equations were used to calculate stem and leaf dry weights for each tagged stem.

Standing crop of stem and leaf biomass per unit area was calculated as the sum of dry weights of all stems or leaves in a subplot (5 x 1 m) divided by the area of the plot. Stem production was calculated as the sum of positive differences of stem dry weights between two sampling occasions. Leaf production was calculated as the sum of differences of the individual stems’ leaf dry weights between two sampling occasions.

RESULTS AND DISCUSSION

Table 2 shows the least square regressions which were used to calculate stem and leaf dry weights. The best fit of the regression curves for stems was found when plotting dry weights of upper (green) stem sections (length ≤ 30 cm, diameter ≤ 0.7 cm) against the volumes of the corresponding truncated cone [$V = \pi/3(r_1^2+r_1r_2+r_2^2)L$], where r_1 is the lower and r_2 the upper stem diameter. For lower (gray) stem sections (length > 30 cm, diameter > 0.7 cm), dry weight was plotted against the volume of a cylinder ($V = \pi r^2 L$) using only the lower stem diameter.

Fig. 1 shows the seasonal changes of dry weight standing crop and production as well as flooding level and rainfall in both study plots. Stem production in both plots was high during the first half of the rainy season and standing crop of stems quickly increased in both plots until they were flooded. Production then dropped and the increase in stem standing crop slowed down. At the onset of the dry season, stem production nearly stopped and stem standing crop declined due to mortality. At the start of the next rainy season, stem production increased as did standing crop (Fig. 1A, B).

Leaf production and standing crop of leaves was also high in the first half of the wet season, dropped sharply during the period of flooding and reached a minimum at the start of the dry season. After the first rains of the following wet season, which started early

TABLE 1. Characteristics of the two study plots of *I. carnea*.

Plot description	Plot	
	1	2
Rainfall (Oct-91 to Nov-92)	1180 mm	1260 mm
Sampling period	Nov. 91 to Nov. 92	Dec. 91 to Nov. 92
Size	25 m^2	25 m^2
Stem density	2.4 m^{-2}	2.6 m^{-2}
Seasonal flooding	Jan. 92 to May 92	Feb. 92 to Jul. 92
Maximum water depth	40 cm	20 cm

for plot 1, leaf production increased and led to a higher standing crop of leaves in both plots (Fig. 1C, D).

In both plots, the life span of leaves was shortest (< 3 weeks) at the onset of the rains when they were growing fast and attaining their maximum size. Dur-

TABLE 2. Allometric regressions of stem and leaf dry weights of *I. carnea* on stem volume and leaf width, respectively.

Dry weight (g)	Independent variable	Intercept	Slope	r^2	P	n
Upper stem[1]	Cone volume (cm^3)	0.190	1.010	0.96	< 0.01	78
Lower stem[2]	Cylinder volume (cm^3)	3.448	0.210	0.97	< 0.001	177
Leaf	Width (cm)	-0.205	0.075	0.86	< 0.001	191

[1] Length < 30 cm, max. diameter < 0.7 cm.
[2] Length > 30 cm, max. diameter > 0.7 cm.

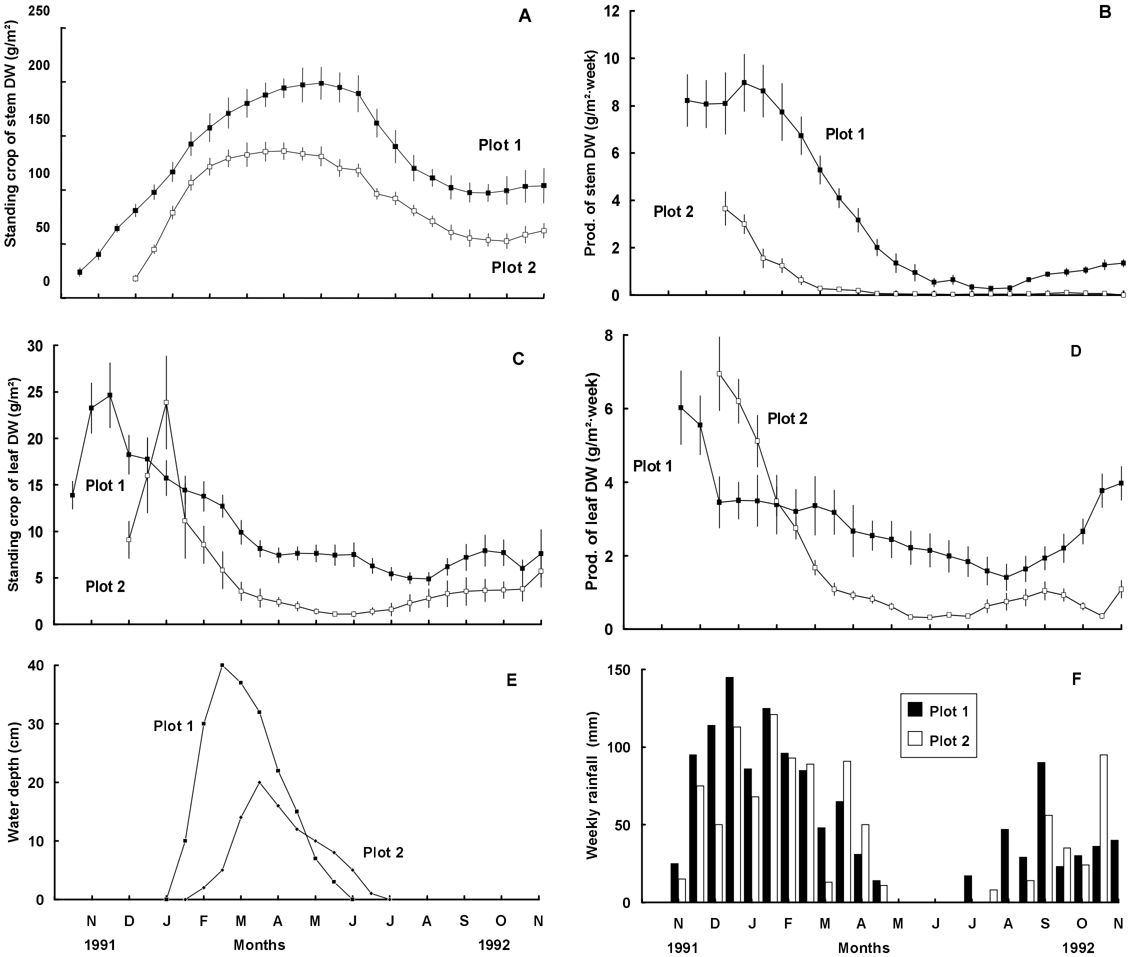

FIG. 1. Seasonal variation of standing crop and production of *I. carnea* in two study plots. A: standing crop of stem dry weight; B: production of stem dry weight; C: standing crop of leaf dry weight; D: production of leaf dry weight (values are means (± 1 S.E.) of five subplots of 5 x 1 m); E: height of seasonal flooding; F: rainfall.

ing the dry season, the plants produced only small leaves with a life span of up to six weeks.

The results show that growth of *I. carnea* follows a seasonal pattern. The plants grow most vigorously during the first two months of the rainy season. Growth declines when the habitat is flooded by rain and river water. Although *I. carnea* tolerates seasonal flooding to a certain degree, flooding slows down the production of the species. Growth further decreases during the dry season and is at a minimum until the onset of the next wet season. Apparently, *I. carnea* grows best when the soil is well watered by rain. Excess of water during the flooding season as well as lack of water in the dry season set limits to the plant’s growth.

It can be hypothesised that cutting *I. carnea* during the dry season, as soon as the soil is dry enough to support tractors, would be more efficient for its control than cutting it in the early wet season. In the dry season, the species has minimal growth and probably the least capability to re-sprout. Cut-off stem parts, especially when cut into small pieces with a “knife drum”, would probably not survive the dry season and re-sprouting after mowing would be minimal. Any new shoots emerging after mowing can be cut by hand because the soft new shoots are very easy to cut. At the same time, all new seedlings can be cut or pulled out by hand. This hand cutting can be done when the area is just about to be flooded, as it does not depend on a hard and dry soil surface, as is the case when a tractor is used. Stumps of *I. carnea* are then completely covered by water before they re-sprout. In this way, cutting as a control measure for the weed could be more effective.

CONCLUSIONS

1. Above-ground biomass production of *Ipomoea carnea* spp. *fistulosa* follows a distinct seasonal cycle: it is highest in the first half of the rainy season, slows down when seasonal flooding starts, and is lowest in the dry season.

2. It is assumed that *I. carnea* is most vulnerable to mechanical control measures at two points in its seasonal growth cycle: in the early dry season and at the onset of the seasonal flooding.

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