PASTURE SEED PRODUCTION TECHNOLOGY IN BRAZIL.

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ABSTRACT

Efficient and low cost production systems, which rely on the use of cultivated pastures, are the basis of beef and milk production in Brazil. The success of these pasture-based systems would not be possible without the support of an aggressive and dynamic pasture seed production sector to supply the internal demand, which is estimated to be around 90000 tons per year. The market is dominated by grass species and among them, *Brachiaria. brizantha* cv. Marandu accounts for more than 80% of the total seed volume in the market. Seed production systems in Brazil vary from highly specialized to opportunistic accordingly to the grass species. For *Brachiarias* spp and *Panicum maximum* production systems vary from specialized to intermediate while for *Andropogon gayanus* the production system is opportunistic. Mechanized ground sweeping harvesting is widely used. Until the last decade São Paulo State used to concentrate the pasture seed production sector. Recently, however, there is a clear tendency for the sector to move to the Cerrado region where pasture seed production is carried out in rotation with annual crops. Main contributions to the sector came from innovative producers, although official research has played a supporting role.

Introduction

In Brazil, beef and milk production are based on efficient and low cost production systems, which rely on the use of cultivated pastures as the main feed source for the herd. The existence of adapted tropical pasture cultivars and ample availability of pasture seeds in the market were the two most important factors supporting the development of these pasture-based beef and milk production systems. Ample seed availability in the market was only possible through the development of an aggressive and dynamic pasture seed production sector. Nowadays, the Brazilian tropical pasture seed industry supplies seeds for an immense internal market and is the world's largest in the exporting market. Thirty years ago, when pastures seed production activities started in Brazil, production systems were based on opportunistic hand harvesting of roadsides or pasture areas, either through cutting of inflorescences or ground sweeping. The technological development of the sector during this thirty year was impressive and it was basically based on the effort of innovative seed producers with the support of official research. This article describes the pasture seed production systems used in Brazil and brings an overview of the technologies used in these systems.

The Brazilian Tropical Pasture Seed Market

Prior to the seventies, most of the cultivated Brazilian pastures were established with the use of cuttings. At the beginning of the seventies, the Brazilian government set a strategic program to develop agriculture in the Cerrado, a region characterized by a savanna like vegetation, covering an area of 204 million hectares in the center of the country. Cattle exploitation, based on cultivated pastures, was one of the main activities in this program and this has produced a large pasture seed demand that was initially supplied by importation from Australia. Mainly because of transportation costs, the price of Australian seeds was prohibitive and this was the driven force for the first attempts to produce tropical pasture seeds locally (Santos & Santos Filho, 1999).

The Brazilian seed market is the largest in the world. It is estimated that the total volume of seed commercialized yearly amounts to 90000 ton, with a gross value of about 250 million dollars, which is equivalent to the Brazilian hybrid corn seed gross value in the market. To achieve these figures it is estimated that every year, about 14% of the area with cultivated tropical pastures in the country, approximately 100 million hectares, are renewed (10%) or planted (4%) using seeds. Considering an average seeding rate of 7 kg/ha of commercial seeds, yearly estimated demand for seed is about 98 000 ton. It is recognized, however, that approximately 50 % of this demand is supplied by the organized seed sector, the other half being supplied by non-organized and opportunistic seed traders (TSUHAKO, 1999).

The Brazilian market is almost entirely dominated by grass species, especially by *Brachiaria* cultivars, which account for approximately 80% of the market as shown in table 1. This market dominance reflects the excellent agronomic adaptation showed by the *Brachiaria* genera to the low soil fertility conditions prevailing in the Cerrado region, the main region for pasture development projects in the country. The Region is also the main market for *Panicum maximum* cultivars, although for this species, pasture establishment occurs in soils with better natural fertility or in areas in which soil fertility has been upgraded throughout previous cycles of annual cropping.

Pastures seed production systems in Brazil

Similar to the pasture seed production systems in other tropical countries, the Brazilian seed production systems vary from highly specialized to opportunistic accordingly to the grass species (Table 3). Highly specialized systems are used for *Brachiaria. brizantha* cv. Marandu, *Brachiaria decumbens* cv. Basilisk and with *Panicum maximum* cv. Mombaça and cv. Tanzania. For these species/cultivars, areas are planted exclusively for seed production, and there is heavy use of fertilizers and chemicals. Less specialized or intermediate systems, in which seeds are harvested in contracted pasture areas, occur with common *Bracharia humidicola* (probably the Australian cultivar Tully) and cv. Lhanero. In this case, fertilizer is applied at the beginning of the growing season and grazing is only allowed after harvesting. *Andropogon gayanus* cv. Planaltina seed production is a typical opportunistic system in which decision about harvesting or not a pasture area is based on yearly perspectives of market prices and seed demand. Adequate closing date is the only agronomic decision producers make in the *A. gayanus* seed production system.

The first efforts to produce and commercialize tropical pasture seeds in Brazil happened in São Paulo State and, for a long time, the northern and west region of this State were the main *B. decumbens* and *B. brizantha* cv. Marandu seed production areas in the country (Hopkinson et al., 1996). Nowadays, there is a clear tendency for the pasture seed industry to move northward to Mato Grosso and Goiás States, where economical, agricultural and social conditions are more adequate for the pasture seed production activity. Initially, also, seed supply to the entire country came from few big seed companies located in São Paulo State. Very few of these companies still exists. Presently, there is an increasing number of small seed firms in Central Brazil that supply pasture seeds to clearly defined regional markets. Closeness to the market and to seed production area, personal relationship with clients and much lighter business structure give this regional firms an expressive advantage in the market competition.

Size and structure of seed production areas in these states is highly variable. While in Mato Grosso, with 39 registered producers, the average seed production area per producer is around 770 ha, in Goias State, this average seed production area is around 160 ha. In Mato Grosso do Sul producers are in an intermediate position, with an average seed production area of 352 ha (Table 2). In the three states, registered areas for seed production of *B. brizantha* cv. Marandu accounts for more than 50% of the total seed production area in the state.

Location of the seed production areas

The correct choice of a seed production area is a main requirement for the success of the activity, mainly for specialized systems. A great part of the activities in tropical pasture seed production in Brazil happen in the Cerrado region between the latitudes of 15 and 22 ° south. Climate in the region fits the physiological needs for seed production of many tropical grasses and legumes. In most of the region, annual rainfall is around 1500 mm with well defined rainy and dry seasons. Restriction to seed production occurs in the northern part of the region, towards the Amazon region, where dry season is shorter and annual rainfall is around 1800 mm. These conditions may reduce seed quality, restrict use of ground sweeping harvest and increase the incidence of inflorescence diseases, which reduces seed yields. Depending on the species, drier conditions in the eastern part of the region or cooler temperatures in the southern part, might restrict seed production. Because of the climatic suitability of such a large area, economical and agricultural factors played an important role in the definition of the regions where pasture seeds are produced in Brazil.

The comparative higher land and labor costs in São Paulo, allied to development of ground sweeping machinery, motivated the industry to move to the Central states. This central region has an area of 49 million hectares with cultivated pastures (Sano *et al*., 1999) and being in this main pasture seed market gives strategic advantages to the seed industry.

In Mato Grosso seed production areas are located in the central part of the state while in Goiás state, these areas are mainly in the southern and central part. In both states, seed production areas of *B. brizantha* cv. Marandu, *B. decumbens*, and *P. m*aximum cultivars are located in regions of intensive annual cropping.

In these states, areas for pasture seed production are established in rotation with annual crops like soybean. Seed crops are produced in owned or rented land and renting contracts can last for one or two years. The integration of grass seed production and soybean production activities has biological and economical importance for the farm sustainability. The grass seed crop takes advantage of the high soil fertility conditions necessary for crop production and of the nitrogen transferred to the soil by the soybean crop. In combination, the grass reduces weed infestation, discontinue pests and diseases cycles, and restore soil physical properties favoring the following annual crop cycle.

B. humidicola seed production occur in regions where the species has shown good adaptation as pastures. Normally, because the need for combine harvesters these areas are coincide or are nearby regions with intensive crop production. In Mato Grosso do Sul State, these areas are in the center of the State while in Mato Grosso State they are located in the east region, by the border with Goiás State.

The opportunistic characteristics of *A. gayanus* production system is responsible for the coincidence between the seed production regions with those where this grass was successfully adopted as pasture. The main seed production areas are in the center north and west of Goias State and in the south of Tocantins State.

When selecting areas for seed production, mainly when ground sweeping harvesting will be used, seed producers give great importance for the local physical and chemical soil characteristics. Soils with medium texture, mainly those developing a hard surface during the dry season, are preferred for mechanized ground sweeping harvest. Clay soils tend to produce aggregates with size similar to the seed size and that are troublesome to remove from seed lots. To reduce fertilizer costs, preference is for areas with soils of high natural fertility or for areas where soil fertility was upgraded by annual cropping. Intensive seed production systems depend on fertilizers, chemicals and mechanization, and it is advantageous to locate seed production areas inside highly developed cropping regions to take advantage of all the necessary infrastructure for soybean, corn and other annual crops.

Seedbed preparation and establishment of seed production areas

Harvesting efficiency in ground sweeping method depends on an even, uniform and compacted soil surface. Plowing, heavy and light harrowing are necessary to produce a smooth and fine seed bed. Still to achieve those conditions, the area is compacted with an iron roller weighing 500 to 700 kg after seeding. Row seeding facilitates both weed control and cutting operations and it is the preferred seeding method for ground sweeping harvest. Row spacing varies from 70 to 90 cm for *B. brizantha* and *P. maximum* while a narrower spacing, around 60 to 70 cm, is used with *B. decumbens* (Table 3). Research contribution to the definition of optimum row spacing for maximum seed yields in ground sweeping harvest method was small. The row spacing adopted by seed producers come from their own trial and error observations, although research confirmed that the best row spacing for *B. brizantha* cv. *Marandu* is 90 cm (Jabur & Favoretto, 1993). Research findings also showed that seed yield declines as row spacing increased from 30 cm to 90 cm in *B. decumbens* cv. Basilisk (Souza & Macedo, 1993). For *B. humidicola*, seeding method is not an important factor because of their stoloniferous growth habit and also because the seed production areas are established with the main intention of pasture production

Optimum seeding rates for establishment of seed production areas tend to be higher than that used for pasture establishment because the objective is to achieve a dense and closed stand as earlier as possible in the growing season. In Brazil, in the absence of research data, seeding rate is a point of debate among seed producers and there is a great variation in the seeding rate used to establish grass seed production areas. Generally, there is a tendency to use the smaller seeding rates than that indicated for pasture establishment specially for *Brachiaria* spp and *P. maximum* established in rows. For *P. maximum* seeding rates vary from 1,0 to 1,5 kg/ha of pure germinating seeds (PGS) while for *B. brizantha* these rates range from 1,5 to 2,5 kg/ha of PGS. With other species, in intermediate and opportunistic seed production systems, used respectively for *B. humidicola* or *A. gayanus*, higher seeding rates are used for establishment of pastures which are intended for seed harvesting in the first or second year after seeding.

Crop seeders, with a range of modifications, are used for row seeding of pasture seed production areas. Modifications to achieve correct seeding rates include changes in the number of holes in the disk of seeders. Another strategy is to mix the grass seed with fertilizers, normally single superphosphate, to increase volume and facilitate the use of crop seeders with small pasture seeds. Modifications in crop seeders also aim a correct seeding depth. For example, removing of burying disks in the seeders is a common measure to achieve the superficial seeding required for small *P. maximum* or *A. gayanus* seeds.

Weed control

A weed free seed production area is the most efficient strategy to avoid problems and losses during seed cleaning and to achieve established market standards. Weeds are a problem during the establishment phase when it can compete with grass plants and reduce seed yield. After this establishment phase, well established and vigorous grass stands can outcompete weeds and overcome the problem. In areas with a long history of cultivation, weed seeds existing in the soil seed bank can contaminate seed lots during the ground sweeping harvest. In these situations, deep plowing is used to bury seed bank and reduce weed infestation. Selective herbicide 2 4 D, is widely used in Brazil to control broadleaf weeds in grass seed areas. There is little use of post emergent herbicides , which do not affect tropical grasses, as demonstrated by Loch and Harvey (1993) in Australia and by Pereira *et al*., (2000) in Brazil.

Fertilizer application

Intensive seed production requires heavy fertilizer application for high seed yields and soil tests are used to define fertilizer application levels. In Brazil, however, there is little research to define fertilizer levels for maximum grass seed yields and fertilizer rates are based on evidence from forage production trials, such as those indicated by Vilela *et a.,* (1998) and on experience accumulated with other annual crops. The rotation of grass seed production activity with soybean is an efficient strategy to reduce fertilizer costs.

During seeding of a new seed production area, most producers apply a fertilizer formula, containing low nitrogen, high phosphorus and medium potassium levels. Lime to achieve soil basis saturation around 50 to 60% and micronutrients, normally applied during the soybean crop cycle, are sufficient to supply grass requirements for seed production. Eventually, producers use foliar applications of micronutrients mixes, again without research findings to support this procedure.

Crop management

Proper management, correct choice of a seed production area and establishment of a dense and vigorous initial stand, form the basis for the achievement of high seed yields. In intensive systems, management can optimize yields, reduce costs, and assure return for the activity. The main management tools in pasture seed crops are defoliation, throughout cutting or grazing, followed by nitrogen fertilization. Using these tools it is possible to obtain a heavy and synchronized inflorescence production, restricted to a short period of time, which coincides with favorable conditions for seed setting and filling (Loch, 1980). Synchronized flowering and seed setting make it easier to define harvest timing and help to reduce seed losses during combine harvesting.

There is plenty of research evidence indicating that, once other plant nutrients are adequately supplied, nitrogen is the key nutrient for high yields in grass seed crops. Timing and amount of nitrogen are the two main management decisions seed producers have to face. Research has shown that the main benefits from fertilizer nitrogen occur when it is applied once and shortly after cutting or closing. Fertilizer nitrogen increases tillering and results in higher inflorescence density and seed yield. Tillering in *B. decumbens* starts shortly after cutting (Stür and Humphreys, 1985) and, consequently, fertilizer nitrogen should be applied soon after cutting or closing to increase tiller density in a seed crop. Compared to the effect on tiller density, the effect of nitrogen on other seed yield components is much smaller. Mainly when evaluated on the standing seed yield, seed quality responses to nitrogen are erratic (Humphreys and Riveros, 1986, Loch *et al.*, 1999). Nitrogen requirement is affected by various factors such as: species and cultivars, stand age, other growth factors (nutrients, water, radiation) and seeding pattern. Also, mainly for urea, climatic conditions can increase nitrogen volatilization losses if the fertilizer is not incorporated in the soil. Research has attempted to define optimum nitrogen application levels for a number of species (Loch *et al.,* 1999). A general application rate of 100 kg/ha of nitrogen is indicated for *B. decumbens* (Humphreys and Riveros, 1986). It is possible to obtain two combine harvest per growing season in *B. decumbens* and *B. brizantha*, and Souza, (1991) recommends 100 kg/ha at the beginning of the rainy season and 150 kg/ha after the first harvest, in January/February, to obtain a second harvest in May. Carmo *et al.*, 1988 have shown response to 35 and 150 kg/ha of nitrogen in *B. decumbens*. With *B. humidicola,* the highest yields were obtained with nitrogen application varying between 75 and 150 kg/ha (Mecelis and Oliveira, 1984; Mecelis and Schamas, 1988).

In seed production areas of *B. brizantha* and *B. decumbens*, using ground sweeping harvest, plants grow without check during the all growing season. In these areas, seed producers apply nitrogen twice during the crop cycle. The first application, around 50 kg/ha of nitrogen, occurs when plant start to regrow from the previous crop stubble. Second application, using the same amount of nitrogen, occurs when the inflorescence population is setting seed and a second population of new tillers starts to grow from the basis of the plants. Producers claim that this split nitrogen application guarantee a good seed yield from this second population of tillers. It is also claimed that a heavy nitrogen application at the beginning of the growing season results in greater lodging of the stand.

Areas for ground sweeping are not grazed or cut during the growing cycle because trampling from grazing cattle can disturb the even and compacted soil surface and reduce sweeping efficiency.

Closing date is the only important management decision in the opportunistic *A. gayanus* seed production system and pasture areas are normally closed to grazing in January/February (Andrade and Thomas, 1984)

Harvesting

In Brazil, following a tendency observed in other countries, with the development and specialization of the pasture seed industry, there is a greater use of mechanized harvesting methods, in replacement of manual harvesting. Labor costs, strict labor laws, availability of adequate machinery and greater seed demand from the market, which can not be supplied using manual harvesting methods, are some reasons for this replacement.

Manual cutting of inflorescences and organization of these inflorescences in piles for sweating, was the main harvesting method for *P. maximum* (Souza, 1980) and for *A. gayanus* (Ferguson and Andrade, 1999). Also, for *B. brizantha* and *B. decumbens,* manual ground sweeping was the main source of seeds in the market. Ground sweeping to collect shattered seeds started in São Paulo and peasants employed this harvesting method at the roadsides or in contracted pastures. Seed lots originating from ground sweeping had much greater germination and vigor than those from combine harvesting and, even considering the low physical purity, they became the market choice.

Single destructive harvest of the standing crop, using combine harvesters, and recovery of mature seeds shed from the standing crop, using mechanized ground sweepers, are the two most common harvesting methods in Brazil. Combine harvesting is the main method for *B. humidicola* and *A. gayanus*, although manual harvesting and ground sweeping is eventually used for the last species. Ground sweeping is the only method used for *B. decumbens* and *B. brizantha* cv. Marandu. For *P. maximum* cultivars combine harvesting is still an important method although there is an increasing tendency for the use of ground sweeping harvest (Table 3).

Combine harvesting

Combine harvesting is restricted to few grass species, although in the past it was widely used in Brazil (Souza and Rayman, 1988). Because of the stoloniferous growth habit, which make it impossible to collect shattered seeds, combining is the only harvesting method for *B. humidicola* and *B. dictyoneura*. In these two grass species, the decision about harvest timing is based on degree of seed shattering and the standing seed yield holds available for harvesting before shattering for approximately a week. Harvesting occurs in January/February, during the rainy season, and, consequently, seed handling and drying are the main problems in *B.humidicola* seed production. Inadequate seed drying is considered the main cause of low seed quality in *B. humidicola* (Magalhães and Groth, 1988).

Combining is the main harvesting method for *A. gayanus,* Combining is highly advantageous in the opportunistic production system of *A. gayanus* because it allows rapidly harvesting of extensive pasture areas. Harvest timing is based on color change of the inflorescence and on degree of seed shattering and normally happens in the end of May or beginning of July.

Ground sweeping harvesting

This is the main harvesting method for *B. brizantha* and *B. decumbens*. The long dry season occurring in the seed production regions, the greater seed yields and the higher germination and vigor of seed lots from ground sweeping made this harvesting method widely adopted. The method involves cutting of the grass mat, disposing of this cut material in windrows to expose shattered seeds and sweeping. Initially, all these operations were manual. Labor requirement was around 50 to 60 labor days per hectare and sophisticated operational logistics were developed for managing the great number of labor men required for harvesting of large areas. Gradually, the first two operations, cutting and windrowing became mechanized with the use of adapted hay machinery. Only recently the sweeping operation was totally mechanized with the development of ground sweep harvesters pulled and powered by tractors. The sweeper has a cylindrical broom, made of steel bristles and with 0,8m diameter, that sweeps the seeds into screens and fans where impurities are separated. The ground sweeper has a working band 1,6 to 1,8 m wide, and the partially cleaned seeds are collected in bags. The ground sweep harvesting system involves three totally mechanized operations: cutting is done with lateral disk mowers at ground level. Alternatively, many producers transform old combine harvesters into mowers. Using hay rakes, the cut material is raked into large windrows, opening the area for sweeping. Once the area is cut and windrowed, it is possible to sweep 1 to 2 hectares per day. Subsequently, windrows are moved aside to allow sweeping the area beneath them. The system is very efficient and little seed is left on the soil, although this efficiency is dependent on the grass stubble height, as higher grass stubble reduces sweeping efficiency.

The mechanization of ground sweeping had great impact in the pasture production system in Brazil. Considering that labor for harvesting accounted for about 60 % of final seed costs, the elimination of labor reduced the seed price in the market. These sweeping machines released the harvesting operation from labor dependency allowing farmers, mainly those involved in crop production, to enter in the pasture seed production activity. It also allowed the establishment of seed production activities in regions where labor was not available. These points explain the establishment of successful pasture seed production activities in regions of Mato Grosso, Goiás and Bahia states. In some regions, however, where manual ground sweeping was a traditional practice, mechanization has generated unemployment.

Tropical Legume Seed Production

It is minimal the share of tropical pasture legumes in the pasture seed industry in Brazil. Since the beginning of the seventies there have been an enormous effort from research and extension services to increase the use of tropical legumes Brazil. Among other reasons, this effort was unsuccessful mainly because the first legume cultivars indicated to farmers, all of them Australian cultivars, were not adapted and did not fulfill the expectations farmers had about this technology. This was in sharp contrast with the success the Australian cultivars of grasses had in Brazil e.g. *B. decumbens* cv. Basilisk. This lack of success of tropical legume in the past has created a strong resistance against the technology among farmers. Only recently, with the release of adapted cultivars by official research, this resistance is reducing.

Main pasture legumes in the market are *Calopogonium mucunoides* and *Pueraria phaseoloides.* Total seeds in the market are estimated to be around 200 – 300 tons of *C. mucunoides* and 50 to 100 tons of *P. phaseoloides* per year which represents a very small share in the tropical pasture seed industry in Brazil

C. mucunoides seeds are produced in the Central Brazil where it is used in mixed grass-legume pastures. Flowering occurs towards the end of the rainy season and harvesting occurs during the dry season. Harvesting is normally made with combine harvesters but mechanized ground sweeping is becoming an important harvest method for this species.

In the Northwest part of the Cerrado region, in the states of Rondonia and Acre, farmers started to recognize the importance of *P. phaseoloides* for animal production and there is a growing demand for seeds. Main *P. phaseoloides* seed production areas are locate in Rondonia and Acre and harvesting is based on manual picking of mature pods in plantation areas, where the legume is used as a green cover.

Stylosanthes guianensis cv. Mineirão is a cultivar released in 1993 that only recently had seeds available in the market. This cultivar is a good forage producer, well adapted to low soil fertility conditions, with outstanding water stress tolerance and capacity to keep green forage during the dry season. Flowering and seed setting occurs late in the dry season and seed yields are relatively low. The northwest of Minas Gerais state is the only seed production region for this cultivar. Seed production areas are established in rows 50 cm apart using a seeding rate of 0.7 kg/ha. Establishment is slow and it is necessary the use of post emergent herbicides, normally those indicated for weed control in soybean and bean crops. Harvesting is done in two operations, the first using a combine harvester collect the standing seed yield. In a second operation, shattered seeds are collected throughout ground sweeping, after cutting and windrowing the stand that remained below the combine harvester cutting height.

Conclusion

The development of the Brazilian pasture seed industry during the last three decades was impressive. From a position of world main importing country in the beginning of the seventies, this industry developed to be able to attend a huge internal market and to become the largest tropical pasture seed exporter in the world. Official research, however, did not have an expressive participation in this development, and many breakthroughs, with impact on the industry, for example, the development of ground sweeper harvester, come from innovative producers and businessmen, who were able to solve a clear and imperative demand from the sector. Research played a support role explaining physiological phenomena and proposing solutions to specific problems based on the international literature on temperate and tropical pasture seed production or based on the experience with other crops. The specialization and development of the seed industry is generating a series of new demands, for example, fine adjustments in crop management for the maximization of yields. Research will play an important role in solving this second generation of problems. Efficiency of this research, however, will depend on the development of a clear and defined channel of communication and financial support between the seed industry and research institutions.

In the near future, protection procedures will be extended to pasture cultivars in Brazil, with consequences for the seed industry. Protection laws will require the adoption of seed certification schemes, which in turn demands a much better organized market and sector, an outcome that is beneficial for the seed industry. Protection laws also provide the warranty necessary for multinational seed companies to enter in the market and this may impose a strong competition with the established national seed firms. Coupling with this possible threat will depend on the capacity of the national seed firms to establish strong associations in which capital and advantages of each firm will be strategically aggregated.

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Table 1 - Species/cultivars participation in the Brazilian pasture seed market.

Species/cultivars	Estimated participation in the market (%)
Brachiaria brizantha cv. Marandu	70
Brachiaria decumbens cv. Basilisk	7
Brachiaria humidicola	6
B. ruziziensis, B. brizantha MG4	4
Panicum maximum cv. Mombaça and cv. Tanzania	10
Panicum maximum (others cvv.)	1
Andropogon gayanus cv. Planaltina	2

Table 2 - Profile of species, number of seed producers, and registered seed production areas for the 1998/1999 growing season in Goiás, Mato Grosso do Sul and Mato Grosso states.

	Goiás	Mato Grosso. do Sul	Mato Grosso	Total area per species
Species	---------------------1000 hectares--------------------			
A. gayanus cv Planaltina	1,9	0,1	1,7	3,7
B. brizantha cv Marandu	12,0	6,0	17,0	35,0
B. decumbens	1,3	0,7	0,7	2,7
B. humidicola common	1,9	2,7	6,0	10,6
B. humidicola cv Lhanero	0,3	0,2	0,8	1,3
P. maximum cv. Tanzania	1,9	1,3	3,1	6,3
P. maximum cv. Mombaça	0,9	2,5	0,9	4,3
Total area in each state	20,2	13,5	30,2	63,9
Number of seed producers	123	40	39	202
Average area/producer	160	325	769	

Sources: Matsuoka, 1999; Guardalini, 1999; Peters, 1999.

Table 3 - Seed production technology for the main grass species/cultivars in Brazil

Species/cultivars	Production System - Characteristics	Establishment/ fertilization	Management	Main harvesting methods	Yields Kg/ha of pure seed
B.brizantha cv. Marandu *B. decumbens* cv. Basilisk	Intensive, in rented cropping areas, contracts for 1 to 2 years	In rows 70 to 90 cm apart for *B. brizantha* and 60 cm apart for *B. decumbens*	1º year crops: nitrogen application 30-40 days after seeding 2º year crops: split nitrogen application: at the start of rainy season and in January/February	Mechanized ground sweeping	500 –800 *for B. brizantha* cv. Marandu and 400 to 600 kg for *B. decumbens*
P. maximum cv. Tanzania and Mombaça	Intensive, in rented cropping areas, contracts for 1 to 2 years	In rows 1m apart	1º year crops: nitrogen application 30-40 days after seeding 2º year crops: nitrogen applied at the beginning of rainy season	Combine harvesting and mechanized ground sweeping	60 to 80 kg/ha combine harvesting 150 to 200 kg/ha mechanized ground sweeping
B. humidicola common and cv. Lhanero	Semi intensive, harvesting occur in contracted pasture areas	Stoloniferous species, normally broadcast seeding	Nitrogen fertilizer application at the beginning of the rainy season	Combine harvesting	common: Very low yield in first year crop. Second year crop yields vary from 30 to 60 kg/ha cv. Lhanero: 100 to 200 kg/ha
A. gayanus cv. Planaltina	Extensive opportunistic system with harvesting on pasture areas	No planting specifically for seed production	Nitrogen fertilizer might be occasionally applied by the closing time in January/February	Opportunistic combine harvest	40 to 60 kg/ha combine harvesting and 80 to 120 kg/ha hand harvesting (sweating)