GLOBAL JOURNAL OF BIOLOGY, AGRICULTURE & HEALTH SCIENCES
(Published By: Global Institute for Research & Education)
www.gifre.org

DEVELOPMENT OF *HYMENACHNE ACUTIGLUMA* AND *PASPALUM ATRATUM* PASTURE ON SEASONALLY WATERLOGGED SOIL AND ITS USE AS BASAL DIET FOR DAIRY CATTLE UNDER HOUSEHOLD CONDITIONS

Nguyen Thi Hong Nhan[1], Nguyen Van Hon[1], Nguyen Thiet[1], Lam Thai Hung[2], Nguyen Hong Xuan[3], & Nguyen Trong Ngu[1*]

[1]College of Agriculture and Applied Biology, Can Tho University, Vietnam
[2]Cau Ngang Satellite, Tra Vinh University, Vietnam
[3]Can Tho University of Technology, Vietnam
*Corresponding Author

Abstract

The first experiment was set up in a field of 500 m^2 to determine the productivity and nutritional value of *Hymenachne acutigluma* and *Paspalum atratum* grasses planted on waterlogged soil. Results showed that two kinds of grasses were similar in biomass and nutritive values. The second experiment was conducted in an 800 m^2 area, Paspalum grass was planted at different spacings in wet land of approximately 20 cm in depth. No significant differences were found on grass fresh and dry yield. The third study was carried out in dairy farms of Soctrang province for 64 days. Three households were involved in the study, in each household five cows were kept individually and offered three treatments with Paspalum grass fed *ad lib* supplemented with either concentrate or cottonseed cake or a combination of cottonseed cake and Trichanthera foliage. Milk parameters and feed conversion to milk were not affected by treatments.

Key words: *Hymenachne acutigluma*, *Paspalum atratum*, *plant spacing, lactating cows, Trichanthera supplementation.*

1. Introduction

Many programs and policies have been made recently by local governments in the Mekong Delta to help farmers alleviating their poverty; one of which was the practice of raising dairy cattle. When the dairy herd expanded, the demand for feed resources increased and thus the introduction of grass as basal diet became essential. Recently, *Hymenachne acutigluma* and *Paspalum atratum* have been proven to be appropriate under low fertility and acidic soils and specially their ability to resist to waterlogged condition. In addition, they can be supplied as basal diet to dairy cattle but protein addition source such as cottonseed cake is required for better performance of the animals. However, the use of cottonseed cake is also limited because (i) a high level of gossypol contained in cottonseed cake may negatively influence milk production (Rogers Glemn and Poore, 1995) and (ii) in many cases the use of cottonseed cake does not ensure net profits to farmers due to its high cost. Hence, the search for alternative feeds for supplementation is still needed.

The multi-purpose tree *Trichanthera gigantea*, introduced into Vietnam from Colombia in 1991 has adapted readily to a wide range of ecosystems throughout Vietnam (Ha and Phan, 1995; Nhan et al., 1996). The crude protein content of the foliage (leaves and the thin stems consumed by the animals) varies from 18 to 20%. This kind of tree has been used to partly replace the protein source for laying hens and duck ration with positive results obtained (Nhan et al., 1997). In ruminant, the use of Trichanthera was also reported in lactating goats (Duyen et al., 1996), but so far data on the supplementation of Trichanthera to dairy cattle diets has been insufficient. Therefore, the present research was done to (i) examine the productivity, quality and persistence of *Hymenachne acutigluma* and *Paspalum atratum* on seasonally waterlogged land, (ii) determine an optimal plant spacing (plant density) for *Paspalum atratum* production at waterlogged condition and (iii) evaluate the effectiveness of Trichanthera and cottonseed cake supplementation on milk production of dairy cattle consuming *Paspalum atratum* as a basal diet.

2. Materials and Methods

Trial 1 was conducted in Soctrang province where the system was expanded on former rice paddy land. The soil was acidic (pH 4.0-4.5) and waterlogged for long periods during the wet season and then dried out in the dry season. The land was first cleared from weeds, and then ploughed by tractor to a depth of 20-25 cm to loosen the soil. Weeds were also removed twice during the establishment period.

The experiment was allocated in a completely randomized design consisting of two treatments and five replications (equivalent to 10 plots). The plots were *Hymenachne acutigluma* and *Paspalum atratum* grass (Photo 1). The experiment was set up in a field of 700 m^2, of which 500 m^2 were used for planting and 200 m^2 as border areas. *Hymenachne acutigluma* stems and *Paspalum atratum* tillers were planted at spacing of 50 x 50 cm. The first harvest was made at 90 days after planting and 45 days for the next cutting. At each harvest, four 0.25 m^2 quadrates were cut 5 cm from ground level in each plot. The fresh samples were weighed and a 200 g sub-sample from each plot was dried at 70^{o}C for 48 hours. The dried samples were bulked across replicates and 3 samples per treatment were used for analysis.

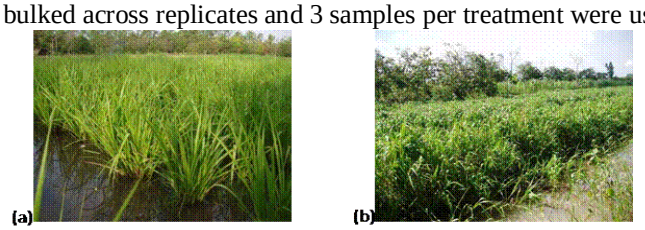

Photo 1. *Paspalum atratum* (a) and *Hymenachne acutigluma* (b) grasses on seasonally waterlogged

After each sampling cut, the remaining forage in the plots was cut 5 cm above ground level before applying fertilizer. All biomass from each plot were weighed to determine the fresh yield. The fresh biomass was sampled and pooled from the 3 replicates (1.5 kg fresh weight each), and was placed in a porous paper bag for dry matter (DM) determination and chemical analyses. A similar sample was collected to analyze on a DM basis. The content of crude protein (CP) in the samples was determined according to the procedure of AOAC (1990).

Trial 2 was carried out in the same location to trial 1 but in the wet land of approximately 20 cm in deep water. A randomized complete block design was used in this experiment. The grass was assigned to four blocks and there were four treatments in each block which were randomly assigned. Thus, a total of 16 plots were used in a size about 800 m^2 with four treatments corresponding to with four plant spacings (20 x 50 cm; 30 x 50 cm; 40 x 50 cm; 50 x 50 cm).

Trial 3 was conducted in dairy farms in Soctrang province, where Khmer farmers have become familiar with the practice of raising dairy cattle. Fifteen F1 (Holstein x Sindhi) lactating cows were allocated in a completely randomized block design. Cows were allocated to treatments on the basis of milk yield, parity and days of lactation. There were three households involved in the study to provide 5 replicates per treatment. In each family, five cows were housed in individual stall and were offered three different treatments as follows:

Control: Paspalum grass *ad lib* + 0.4 kg concentrate/kg milk.

PC: Paspalum grass *ad lib* + 4 kg/day cottonseed cake.

PCT: Paspalum grass *ad lib* + 1 kg/day cottonseed cake + 1 kg Trichanthera (DM basis).

Before the experiments started, cows were drenched against internal parasites. The animals were housed in individual shed separated from their calves and received free water and home-made mineral lick blocks at all time. They were milked twice daily at 07:00 and 15:30 by hand milking followed by suckling residual milk of the calves. All ingredients fed to cows were divided into three portions per day, grass and Trichanthera were mixed together to prevent selection; molasses was mixed with urea and cottonseed cake was given as its normal form. During the first 15 days all cows were fed the control diet. In the next 7 days the cows on treatments PC and PCT were adapted to the new diet. Milk yield was measured on all diets for a further 6 weeks. The study lasted 64 days.

Collection parameters were feed intake, milk production and milk composition. Feed intake of grass and Trichanthera were estimated daily by the difference between DM of amounts offered and refused. Milk production was recorded daily as the sum of sucked and milked raw milk. Milk intake of the calves was determined by the weight-suckle-weight technique every week (Williams et al., 1979). Milk sample was collected twice weekly at consecutive 5 a.m. and 15 p.m. milking and analyzed for total protein, butterfat lactose and total solids by the Milkotester machine. Economic analysis was made using partial budget analysis based on increased costs and increased returns of the treated animals.

Statistical analysis: the effects of treatments on milk yield and feed intake were subjected to ANOVA using the General Linear Model procedure of Minitab 13.2. Covariance analysis was applied using initial milk yield on standard diet as the covariant. When the F-test was significant, the Tukey's test for paired comparisons was used to compare means.

3. Results and Discussion

There were no significant differences on biomass between treatments in both types of grass at different times of cutting (Table 1). The average biomass of *Paspalum atratum* and *Hymenachne acutigluma* were 23.84 and 24.61 tonnes/ha/cutting in fresh in corresponding to 5.25 and 4.86 tonnes/ha/cutting in DM, respectively. Both of grasses were well adapted to waterlogged soil and remained constant at production till the fourth cutting time. In our previous studies (Nhan et al., 2009), the production of *Paspalum atratum* and *Hymenachne acutigluma* was 16.6 tonnes/ha/cutting in fresh biomass, which was lower compared to the current research. This was because grass was influenced by flood for a longer period and the first harvest was also shorter (60 vs. 90 days). However, the present finding was similar to the study of Hare et al. (1999), who reported that *Paspalum atratum* grew well on wet and waterlogged acid soil and produced about 20 tonnes DM/ha during 6 wet months.

Table 1. Biomass of *Paspalum atratum* and *Hymenachne acutigluma*

Harvest time	Grass		SE	P
	Paspalum atratum	*Hymenachne acutigluma*		
Fresh biomass, tonnes /ha				
1st	24.10	24.08	0.95	0.99
2nd	23.57	24.33	1.09	0.64
3rd	24.09	25.48	1.32	0.84
4th	23.60	24.56	0.97	0.51
DM biomass, tonnes/ha				
1st	5.00	4.52	0.19	0.14
2nd	5.53	5.00	0.27	0.22
3rd	5.25	5.00	0.22	0.46
4th	5.20	4.91	0.22	0.39
CP biomass, tonnes/ha				
1st	0.436	0.460	0.03	0.57
2nd	0.483	0.456	0.02	0.39
3rd	0.492	0.488	0.03	0.90
4th	0.478	0.472	0.02	0.85

Hymenachne acutigluma was a native grass that has been used by farmers in fattening cattle (Nhan et al., 2005) and planted for long time in the Mekong Delta but *Paspalum atratum* has just been fed to ruminants in a few years and it

appeared to be well suited for smallholder dairy farmers. From this point, the second experiment was done for evaluation of plant spacing on *Paspalum atratum* production in waterlogged condition (Table 2).

There were influences of spacing on the first and second harvest but no changes in the third and fourth cutting among treatments. In the first two harvests, biomass from spacing treatment of 20 x 50 cm was higher compared to others, particularly that of treatment 50 x 50 cm. This could be explained by the difference in density or number of plants per size as narrower spacing had more plants at the same plot in comparison with wider space. Nevertheless, this tendency has changed in the third and fourth harvest, when high density of grass required more fertilization leading to nitrogen deficiency and this phenomenon affected Paspalum production in the following years (Phaikaew et al., 2001). In addition, Hare et al. (2004) showed that Jarra digit (*Digitaria milanjiana cv.*) swards planted in narrow rows produced more DM twice as dense and had fewer weeds than swards planted in wide rows but at the second cut (6 months after planting), row spacing had no influence on DM yield of Jarra digit.

Table 2. **Biomass of *Paspalum atratum* grass at different spacings**

Harvest time	Spacing (cm)				SE	P
	20 x 50	30 x 50	40 x 50	50 x 50		
Fresh biomass, tonnes /ha						
1st	26.58[a]	21.13[ab]	16.64[b]	17.54[b]	1.85	0.01
2nd	25.86[a]	24.6[a]	22.83[ab]	20.70[b]	0.77	0.003
3rd	26.11	25.66	24.91	22.07	1.33	0.19
4th	24.97	23.80	24.21	23.71	0.45	0.23
DM biomass, tonnes/ha						
1st	6.29[a]	5.00[ab]	4.05[ab]	4.50[b]	0.44	0.02
2nd	5.36[ab]	5.53[a]	4.77[b]	4.73[b]	0.17	0.01
3rd	5.18	5.64	5.20	4.61	0.27	0.12
4th	4.94	4.73	4.86	4.74	0.09	0.31
CP biomass, tonnes/ha						
1st	0.574[a]	0.461[ab]	0.322[b]	0.364[b]	0.04	0.003
2nd	0.584[ab]	0.650[a]	0.531[b]	0.538[b]	0.02	0.03
3rd	0.562	0.574	0.567	0.480	0.03	0.13
4th	0.454	0.459	0.458	0.438	0.09	0.30

In trial 3, DM intake was similar in all diets and tended to be higher in control treatment (Table 3). Similarly, there were no influences on milk yield, milk composition and FCR among treatments (Table 3). However, PCT treatment had higher profit compared to control and did not differ from that of PC. This difference was partly due to the replacement of protein sources from Trichanthera foliage.

Table 3. Effects of different treatments on DM intake and milk parameters

Parameters	Treatments			SE	P
	Control	PC	PCT		
Dry matter intake, kg/d	11.10	10.95	10.55	0.18	0.11
Milk parameters*					
Milk yield, kg/d	10.88	10.85	10.19	0.21	0.06
Fat, %	4.30	4.31	4.06	0.09	0.13
Protein, %	3.68	3.42	3.34	0.13	0.21
Lactose, %	4.92	4.74	4.55	0.15	0.28
FCR, kg milk	1.03	1.01	1.04	0.02	0.62
Profit, VND/kg milk**	2900[a]	3300[b]	3400[b]	77.1	0.003

[a,b]*Means without common superscript along rows are significantly different at P<0.05*

[*]*Covariance analysis were applied using initial milk yield on standard diet as the covariant*

[**]1USD is equivalent to 21,180 VND

PC: Paspalum grass *ad lib* + 4 kg/day cottonseed cake.

PCT: Paspalum grass *ad lib* + 1 kg/day cottonseed cake + 1 kg Trichanthera (DM basis).

Normally, plant protein is available in wide nature and transportation fee was free or only small amount of money was needed. Thus, lower investment per kg milk as well as the increased benefit from buying their milk was attained. It was also concluded by Topps (1997) that the most effective way to enhance energy intake and performance of animals fed on crop residues was to provide them with good quality forages, including forage legumes.

4. Conclusions

Paspalum atratum and *Hymenachne acutigluma* were well-adapted in waterlogged condition and produced similar production and plant spacing had no influence on *Paspalum atratum* production by cutting time.

Dairy cattle consuming *Paspalum atratum* solely supplemented with cottonseed cake or combined with Trichanthera as a replacement of concentrate had similar milk production.

Acknowledgments

The authors would like to express sincere appreciation to the Swedish International Development Agency (Sida), Department for Research Cooperation with Developing Countries (SAREC), through the MEKARN regional project for funding this work and farmers of the Evergrowth dairy cooperative for their support.

5. References

AOAC (1990). Official methods of analysis. 15th ed. Association of Official Analytical Chemists, Arlington, VA.

Phaikaew, C., Khemsawat, C., Tudsri, S., Ishii, Y., Numaguchi, H. and Tsuzuki, E. (2001). Effects of plant spacing and sowing time on seed yield and seed quality of *Paspalum atratum* in Thailand. *Tropical Grasslands*, 35: 129–138.

Hare, M.D., Booncharern, P., Tatsapong, P., Wongpichet, K., Kaewkunya, C. and Thummasaeng, K. (1999). Performance of *Para* grass (*Brachiaria mutica*) and Ubon paspalum (*Paspalum atratum*) on seasonally wet soils in Thailand. *Tropical Grassland*, 33: 75–81.

Hare, M.D., Tatsapong, P., Lunpha, A. and Wongpichet, K. (2004). Effect of plant spacing, cutting and nitrogen on establishment and production of *Digitaria milanjiana* cv. Jarra in north-east Thailand. *Tropical Grasslands*, 38: 217 –226.

Ha, N.N. and Phan, P.T. (1995). Vegetative propagation capacities and effect of fertilization on biomass production of Trichanthera gigantea. *Livestock Research for Rural Development*, 7(1).

Duyen, N.T., Bien, L.T., Mui, N.T., Binh, D.V. and Preston, T.R. (1996). Foliage of *Trichanthera gigantea*, Jackfruit (*Artocarpus heterophyllus*) banana (*Musa* sp) as protein resources for lactating goats fed a basal diet of rice straw and sugar cane tops. *Livestock Research for Rural Development*, 8(3): http://cipav.org.co/lrrd.

Nhan, N.T.H., Man, N.V. and Preston, T.R. (2009). Biomass yield of *Hymenachne acutigluma* and *Paspalum atratum* in association with *Sesbania sesban* on seasonally waterlogged soils and their use as feeds for cattle in the Mekong Delta, Vietnam. *Livestock Research for Rural Development* 21(8), http://www.lrrd.org/lrrd21/8/nhan21121.htm.

Nhan, N.T.H., Hon, N.V., Son, V.V., Preston, T.R. and Dolberg, F. (1996). Effect of shade on biomass production and composition of the forage tree *Trichanthera gigantea*. *Livestock Research for Rural Development*, 8(2).

Nhan, N.T.H., Preston, T.R. and Dolberg, F. (1997). Use of *Trichanthera gigantea* leaf meal and fresh leaves as livestock feed. *Livestock Research for Rural Development*, 9(1), http://www.cipav.org.co/lrrd/lrrd9/1/nhan91.htm.

Nhan, N.T.H., Son,V.V., Preston , T.R. and Leng, R.A. (2005). Effect of an oil drench on growth rate of cattle fattened on grass, supplemented with molasses, rice bran or rice straw. Livestock – based sustainable farming systems in the lower Mekong basin, 65-69.

Rogers, G.M. and Matthew, H.P. (1995). Optimal feeding management of Gossypol-containing diets for beef cattle. *Journal of Veterinary Medicine*: 90:994, 996-1005.

Topps, J.H. (1997). Forage legumes as protein supplements to poor quality diets in the semi-arid tropics. In: Wallace, R.J and Lahloukassi, A. (Eds.), Rumen Ecology Research Planning. Proceedings of workshop held at ILRI, 13-18 March 1995, Addis Ababa, Ethiopia.

Williams, J.H., Anderson, D.C. and Kress, D.D. (1979). Milk production in Hereford cattle. 1. Effects of separation interval on weigh-suckle-weigh milk production estimates. *Journal of Animal Science*, 49(6): 1438-1442.