

# DEMONSTRATION TRIALS ON UTILISATION OF FODDER TREES AND SHRUBS, CROP RESIDUES AND BY-PRODUCTS FOR SMALL DAIRY FARMS

S.Udchachon and W. Boonpuckdee<sup>1</sup>,

## SUMMARY

Ten demonstration farms were set up in each of the two provinces, Khon Kaen and Udomthani. The main objective was to demonstrate to farmers how to solve the problem of feed shortage in the dry season through the use of crop residues and fodder trees. There were five major activities such as demonstration on utilisation of crop residues, utilisation of fodder trees, introduction of new forage species, irrigation of pasture species in dry season and field days. Locally available crop residues such as corn stover, cassava leaves, soybean pod husks, sugar cane tops and molasses were tested for adoption by farmers. Five species of fodder trees such as *Leucaena leucocephala*, *Erythrina subumbrans*, *Cajanus cajan*, *Desmanthus virgatus* and *Gliricidia sepium* were investigated for establishment, yield and utilisation. Development of a small irrigation system was undertaken to overcome water stress in the dry season. Impacts on other farmers and the policy of Livestock Development Department on dairy extension were discussed.

## INTRODUCTION

Dairy farming has become an important career for Thai farmers in the northern part of the Northeast Thailand since 1991 when a pilot project on dairying was established. More than 3,000 pregnant heifers were imported and provided to farmers under a loan scheme. The project is going well and, at present, expanding. A large milk processing plant will be constructed at Khon Kaen to handle the rapidly increasing raw milk production in the near future.

Dairy areas may be classified into two zones, upland rainfed area and lowland irrigated area. The major constraint in both zones is feed shortage in the dry season from November to May. The problem is more critical to farmers in upland rainfed areas than farmers in irrigated areas. Dairy cattle are fed on rice straw and heavily supplemented with concentrate. This has resulted in a high cost of milk production. In the long term some very poor farmers may not survive in such a system. Although there are some crop residues available, a number of farmers are unaware that they can be used as animal feeds and do not know how to use it effectively. Available crop residues from upland areas are rice straw, cassava leaves, sugar cane tops and molasses. In the lowland area, rice straw, corn stover and soybean pod husks are available. This project was to demonstrate to the farmers on the use of available resources in their areas for animal production. The project also continued the incompleting trials carried

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<sup>1</sup> Khon Kaen Animal Nutrition Research Center, Tha pra, Khon Kaen, 40260, Thailand

out during 1991-1992 under the project "Demonstration trial on suitable backyard pasture utilisation for small dairy farm in Khon Kaen." supported by FAO under the Plant Production and Protection Division.

**Main objective:** To demonstrate to the farmers on how to solve the problem of feed shortage in dry season.

**Location:** Khon Kaen and Udonthani province.

**Duration:** September 1992 - August 1994.

**Target farm:** 10 farms in each province.

**Methodology** 1. Training.  
2. Regular individual farm visits.

## RESULTS

More than 100 farms were surveyed but only 20 farms were selected as demonstration farms.

There were five major activities which include: (a) Demonstration on utilisation of crop residues.

- (b) Demonstration on utilisation of fodder trees.
- (c) Introduction of new pasture species.
- (d) Irrigation of pasture in dry season.
- (e) Field days.

### (a) *Demonstration on utilisation of crop residues*

Available crop residues are corn stove, cassava leaves, soybean pod husks, molasses and sugar cane tops.

From 1993 to 1994, more than 400 farmers received training on feeds and feeding for dairy cattle under the cooperation of the provincial livestock office and provincial cooperative office in both Khon Kaen and Udonthani provinces. The utilisation of crop residues was one of the topics. After the training courses, follow up farm visits was carried out by regularly. After a few months of visiting and advice, it was found that corn stove, soybean pod husks, cassava leaves and molasses were well adopted whereas sugar cane tops had not been adopted yet. The main reason for low adoption was the lack of labour to collect and chop the sugar tops. Also collection of sugar cane tops was hard work compared to collection of crop residues.

### (b) *Demonstration on Utilisation of Fodder Trees*

Five species tested were *Erythrina subumbrans*, *Leucaena leucocephala*, *Cajanus cajan*, *Gliricidia septum* and *Desmanthus virgatus*

There were two stages of work:

**Stage I.** - Establishment of fodder trees.

**Stage II.** - Utilisation of fodder trees.

### Stage: I. Establishment of fodder trees

Since the project period was short, most of the work was in stage I.

#### ***Erythrina subumbrans***

##### On farm activity

In 1993, 1,403 stem cuttings were provided to 7 farms in Khon Kaen and 6 farms in Udonthani (Append II.). Survival rate after one year was 54.81 %. The high mortality of the cuttings was attributed to drought and grazing by animals as annual rainfall was only 946 mm compared to the average of 1,182 mm. Survival of cuttings in field planting was higher if they were planted in well prepared beds and early in the rainy season. Good establishment was achieved by incorporation of cow manure into the seed beds at a rate of 2-3 kg/plant (fresh weight) and watering every 10-15 days during the critical dry periods. For the well established plants, leaves of *Erythrina* were sampled from 30 plants. Average leaf yield for the first harvest was 1.74 kg/ plant as fresh weight or 0.65 kg/plant as dry weight. Farmers fed fresh *Erythrina* leaves to animal by picking the leaves from the trees manually or let the animal graze freely. Leaf of *Erythrina* is very palatable to the animal. In 1994, 1,340 stem cuttings were provided to 21 farmers.

##### On station activity

Due to the poor establishment, an experiment was conducted to study the establishment constraints in *Erythrina*. Effect of hormone NAA on *Erythrina subumbrans* cutting growth. The experiment was carried out in cooperation with the Chaing Yuen Animal Nutrition Station. There were 4 treatments with 4 replications.

T1 = Control

T2 = Dipping *Erythrina's* branches into NAA solution (L-naphthylacetic acid) at a concentration of 1,000 mg/L. for 30 seconds before planting in plastic bags filled with soil.

T3 = Dipping *Erythrina's* branches into NAA solution (L-naphthylacetic acid) at a concentration of 5,000 mg/L. for 30 seconds before planting in plastic bags filled with soil.

T4 = Dipping *Erythrina's* branches into NAA solution (L-naphthylacetic acid) at a concentration of 10,000 mg/L. for 30 seconds before planting in plastic bags filled with soil.

Branches of *Erythrina subumbrans* were cut into 30 cm. lengths and dipped into NAA solution of various concentrations, depending on the treatments.

The following data was collected.

- Date of leaf appearance.
- Leaf and branch number.
- Plant height.
- Root weight.

In every treatment new shoots started to appear 17-18 days after planting in plastic bags. There were about 34 shoots appearing almost simultaneously but development was slow. Number of branches were similar in every treatment. There were 4-5 branches per plant until

*Utilization of fodder trees and shrubs, crop residues and by products for small dairy farmers*

the end of the experiment. Young leaves appeared in the fifth week after planting. Pattern of leaf growth is shown in Figure 1. After four months, average plant height was 94 cm and average root dry weight was 1.93 g per plants (Figure 2). No significant difference was found in terms of those parameters mentioned above.

#### Selection of *Erythrina subumbrans* variety

It was observed in a survey that plants from different locations were different in growth performance. The most obvious was the amount of thorns on branches and stem. *Erythrina* plants collected from Udomthani, Khon Kaen and Mahasarakham provinces had the lowest, medium and the highest amount of thorns, respectively. The number of thorns on a young branch 30 cm. in length, less than two months of age, were 18.61, 23.44 and 50.98 for the varieties collected from Udomthani, Khon Kaen and Mahasarakham provinces, respectively. A comparison on plant growth was carried out at Khon Kaen Animal Nutrition Research Center on soil of high fertility. Locations were used as treatments with 4 replications. Plants were grown from branches of size 6 cm. in diameter and 1 m in length. Leaf and branch number were recorded weekly. At 108 days after planting leaves were harvested by hand picking. Leaf number and leaf yield are shown in Table 1. Leaves were harvested every two months after the first harvest. The varieties collected from Khon Kaen and Udomthani province grew faster than the variety collected from Mahasarakham province.

#### Parental stock plot

The varieties which are medium and/or low in thorns (Khon Kaen and Udonthani) were used as parental stocks at Khon Kaen Animal Nutrition Research Center. Branches were cut at 1 meter in length and planted into soil with a well prepared seed bed. A total of 192 branches were planted at the beginning of the rainy season in 1993. Weeding was done when necessary. About 84 % of the total were successfully established. Three harvests were carried out. Average dry matter yields per plant for the first, second and third harvests were 314,565 and 879 am. respectively (Table 2). Dry matter yield increased with plant age.

#### ***Leucaena leucocephala***

From field experiences in 1991 and 1992, establishment of *Leucaena* was unsuccessful in upland rainfed areas. In 1993, only one farmer was provided with *Leucaena* seedlings. The seed bed was very well prepared. Soil was ploughed to a 30 cm depth. Cow manure was applied before seedling transplanting. During very dry periods, watering was required. After one year, it was found that most of the 2,000 plants were successfully established.

#### ***Cajanus cajan.* (Pigeon pea).**

From field work experience in 1992 under the project "Demonstration trail on suitable backyard pasture utilisation for small dairy farm in Khon Kaen" supported by FAO, it was found that pigeon pea could be established easily from seed by direct seeding. Pigeon pea was the easiest species to establish compared to the other fodder species.

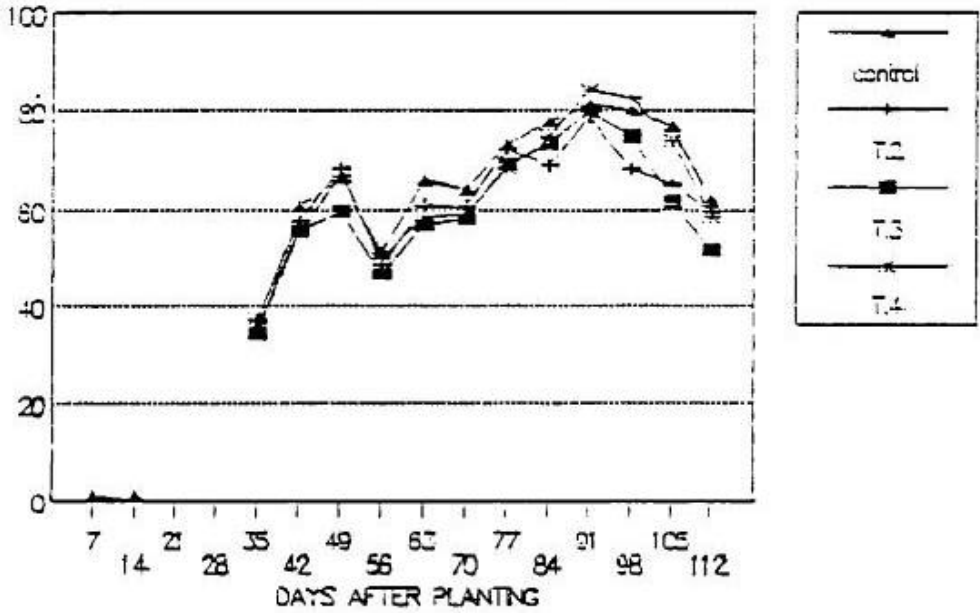


Fig. 1 Leaf number of *Erythrina* seedling

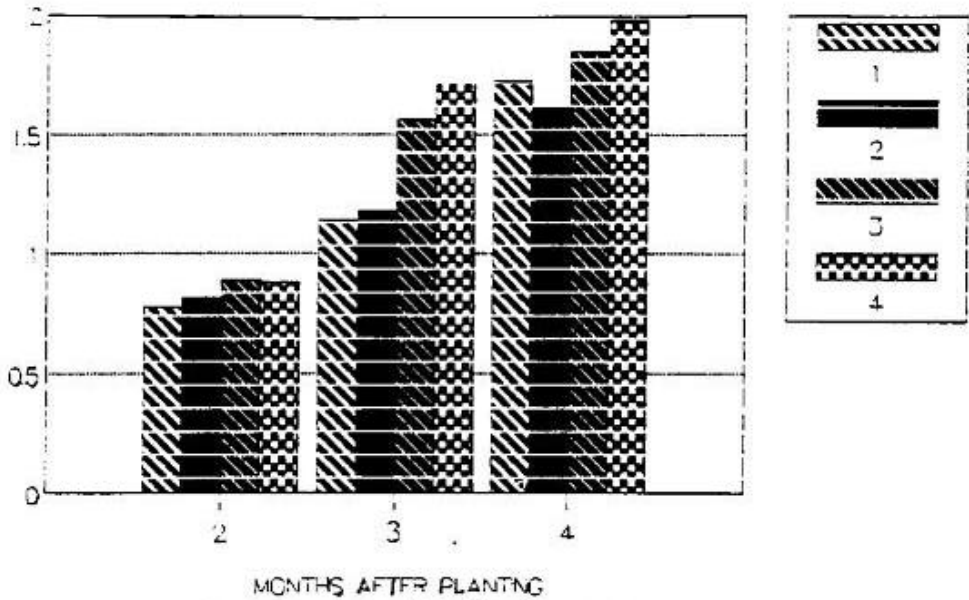


Fig. 2 Dry matter yield of *Erythrina* roots

Table 1. Number of leaves and leaf dry matter yield.

Location	Number of thorns	At 108 days after planting		Total leaf dry matter yield (gm/p, or 5 harvest.)
		Leaf number	DM(gm/p)	
1. Udornthani	18.61	240.41	0.295	1.96
2. Khon Kaen	23.44	246.71	0.355	2.12
3. Mahasarakham	50.98	165.27	0.196	1.47
CV (%)	10.06	16.08	23.31	22.04
LSD <sub>.01</sub>	**	ns.	ns.	ns.

Table 2. Dry matter yield of *Erythrina*

	Days after planting.	Dry matter yield. (gm/plant.)
First harvest	236	314
Second harvest	365	565
Total for the first year	-	879
Third harvest	455	827

In 1993, farmers were recommended to grow pigeon pea in rows of spacing 2-3 meters, in a mixed ruzi grass and Graham stylo pasture. In the rainy season, cut ruzi grass and Graham stylo were fed to animals whereas pigeon pea was fed to animals in the dry season. Farmers were satisfied with the system. In 1994, they increased the area of pigeon pea / ruzi grass / Graham stylo mixed pasture.

For an existing mixed pasture, 4 methods of introducing pigeon pea into the pasture were tested.

1. Broadcasting of pigeon pea seeds into the mixed pasture with no tillage.
2. Sowing pigeon pea seeds in rows with 25 cm. spacing, into the mixed pasture with no tillage.
3. Direct seed of pigeon pea seeds into small holes of 2-3 cm. depth and 25 cm. spacing.
4. Sowing pigeon pea seed in rows with spacing of 25 cm. on tillage pasture.

It was found that pigeon pea failed to establish using the first two methods. With the third method, pigeon pea established successfully but seedling growth rate was too poor. Plant height after five and a half months was only 1 ft. Dry matter yield was too low to harvest. For the last method of establishment, pigeon pea grew very well and competed successfully with the companion grass and legume. Dry matter yield after five and a half months, by cutting at ground level, was 0.43 kg per one meter row.

### ***Desmanthus virgatus* (Hedge lucerne.)**

Seeds of *Desmanthus virgatus* were provided to 11 farmers in 1993. The seed germinated well and seedlings established successfully in three farms where the seed beds had been well prepared; a lot of cow manure was applied and weeding was regular. Seedling growth rate was very slow. However seedlings grew well under sprinkle irrigation even when companion crop with maize. Herbage yield at 3 months after planting was 2,000 kg/rai as fresh weight or 600 kg/rai as dry weight. Crude protein content was 12.73 - 15.20 %. In dry season with no irrigation, herbage yield was very low, but the plants still survived through the drought.

Hedge lucerne was very palatable to animals. However, a disadvantage of this species was the difficulty in establishment. In 1994, 44 kg of hedge lucerne seed were provided to 31 farmers.

### ***Gliricidia sepium***

In 1993, both seeds and seedlings of *Gliricidia sepium* were provided to farmers. It was grown along fence line. The seed germinated well but later most plants perished during the dry season. In contrast, plants grown from seedlings had a better chance of survival. After one year, survival rate of the 1,982 plants grown from seedlings in 15 farms was 56.17 % but they were still too small to harvest. The slow seedling growth rate and low palatability were the weak characteristics of this species in comparison to other fodder tree species.

In 1994, 770 seedlings were provided to 12 farmers and 559 seedlings were grown for seed production in Khon Kaen Animal Nutrition Research Center.

## **Stage II. Utilisation of fodder trees**

The five fodder tree species were fed to animal as supplementary feed. Fresh leaves were mixed with fresh grass or rice straw and fed to animals. The most palatable fodder trees, in order of preference, were *Erythrina subumbrans*, *Desmanthus virgatus*, *Leucaena leucocephala*, *Cajanus cajan* and *Gliricidia sepium*. Some farmers who supplemented their dairy cows with *Erythrina subumbrans* and *Desmanthus virgatus* observed that milk yield per day was increased.

Chemical analysis was carried out in the laboratory while degradability was tested by Nylon bag technique at Khon Kaen Animal Nutrition Research Center (Pimpapom Polsen, personal contact). Nutritive value of the fodder tree species are shown in Table 3. There is no doubt that they can be a good alternative feed resource to replace the utilisation of concentrates. The exception was pigeon pea which had relatively low degradability percentage.

### **(c) Introduction of new pasture species**

Information obtained from the project "Demonstration trial on suitable backyard pasture utilisation for small dairy farm in Khon Kaen" shown that *Panicum maximum* TD58 was the most promising species. Therefore, in 1993 seed was provided to almost 200 farmers in both Khon Kaen and Udonthani provinces. Farmers preferred this species to ruzi grass (*Brachiaria ruziziensis*) and a number of farmers requested for more seeds. Farmers said that regrowth of *Panicum maximum* TD58 was faster and it was easier to cut than ruzi grass. The positive response of farmers to *Panicum maximum* TD58 was one of the reasons DLD

produced more seed replacing ruzi grass seed production. The 1994 target for seed production of *P. maximum* is 183,000 kg.

Table 3. Crude protein content and potential degradability percentage (% DMD) of young leaves.

Fodder tree species.	Crude Protein Content (%).	Degradability (%).
1. <i>Erythrina subumbrans</i>	22.66	74.79
2. <i>Leucaena leucocephala</i>	27.05	78.74
3. <i>Desmanthus virgatus</i>	26.46	74.59
4. <i>Cajanus cajan</i>	19.63	36.79
5. <i>Gliricidia septum</i>	19.24	71.76

#### (d) Irrigation of pasture in dry season

The project had set up 6 farms in Khon Kaen and 6 farms in Udonrthani province as demonstration farms for pasture irrigation in the dry season. The farms used water from different sources such as underground water, water from pond and water from irrigation canals. A small irrigation system was set up to cover 2-5 rai of pasture. Cost for materials of the system was approximately 6,420 baht, comprising of pipe system (3,700 baht) and electric water pump (2,720 baht). A diagram of the pipe system is shown in Appendix III and IV. Forage crop species suited for irrigation and herbage production costs were examined. The tested species were *P. maximum* TD 58, Hybrid sorghum (Jumbo), sweet sorghum (Utong 203) and maize (Suwan 2). Testing will be completed in April 1995.

Irrigation of pasture in dry season has shown that it can solve the problem of feed shortage to some degree. It is realised that an available water supply is an important factor in dairy farming. It has become a policy for DLD that farmers who are going to raise dairy cow must be able to have access a water source. The government is going to support or provide loans to farmers to build up a water source in order to supply sufficient water for use on their farms.

#### (e) Field days

The project had supported and arranged field days for those members to visit each other. They discussed among themselves and exchanged ideas. After visiting some farmers had improved their farm conditions and animal performance.

Field days had been held many times with the cooperation of many provincial livestock officers. Almost 1,000 farmers and field officers visited these demonstration farms. In addition, 6 short stories on dairying and forage crop had been produced through VDO tapes by using these demonstration farms as information base. The documents have been broadcast on television and are being used as training material.

## **CONCLUSION AND RECOMMENDATIONS**

1. This kind of demonstration farm is a good method for transferring technology to small farmers.
2. Utilisation of crop residues which do not require too much labour, such as corn stover, cassava leaves, soybean pod husks and molasses can be easily adopted by farmers.
3. Utilisation of fodder trees still has the problem of establishment. Establishment technique needs further investigation, with the exception of pigeon pea which can be established easily by direct seeding. Although digestibility of pigeon pea is low it is still better than having nothing to feed animal during dry periods.
4. Introduction of new forage species such as *P. maximum* TD58 was successful. A further investigation for new species, especially legume species needs to be conducted. Pasture species for waterlogging conditions also should be examined.
5. For the farmers who can access to a water source, small irrigation systems can solve the problem of feed shortage in dry season to some degree. In the case of dry spells during rainy season, the irrigation system can also help the young seedlings to survive. However, poor small farmers need loans to set up the irrigation systems.
6. Present demonstration farms should be carry on continued with financial support from DLD or FAO.

## **ACKNOWLEDGEMENTS**

The authors wish to thank the Animal Production and Health Division of FAO for funding this project and also thank to Dr. P.L. Pugliese for his guidance and support.

**Appendix I****List of demonstration farms**Khon Kaen province

1. Mr. Somboon Oracha
2. Mr. Uthom Tongphu
3. Mr. Boulai Seankulung
4. Mr. Kongdet Pearchun
5. Mr. Sao Simachun
6. Mr. John Simachun
7. Mr. Phun Nuanbutdee
8. Mr. Sorn Hongwanna
9. Ms. Tongbai Kongchom
10. Mr. Tee Nammongkul

Udomthani province

1. Mr. Wattana Sriboonruang
2. Mr. Chunsri Chaimanee
3. Mr. Jeim Boonkhong
4. Mr. Pradist Eamsriri
5. Mr. Urai Phalino
6. Mr. Tong Kanawapee
7. Mr. Vichai Kaewgeot
8. Mr. Sombat Deelord
9. Mr. Tawee Buasai
10. Mr. Sompong Phasook

## Appendix II

List of members who received *Erythrina subumbrans* seedlings in 1993.

Province	Number of plants received	Number of plants survived after one year
<u>Khon Kaenrovince.</u>		
1. Mr. Somboon Oracha.	217	190
2. Mr. SaoSimachun	63	27
3. Mr. John Simachun	69	10
4. Mr. Phun Nuanbutdee	50	12
5. Mr. Som Hongwanna	50	45
6. Ms. Tongbai Kongchun	50	20
7. Mr. Tee Nammongkul	200	20
Sub total	699	324
<u>Udomthani province.</u>		
1. Mr. Wattana Sriboonruang	208	195
2. Mr. Pradist Eamsriri	105	10
3. Mr. Urai Phalino	185	180
4. Mr. Tong Kanawapee	100	30
5. Mr. Vichai Kaewgeot	56	10
6. Mr. Buahong Titum	50	20
Sub total	704	445
<b>Total</b>	<b>1,403</b>	<b>769</b>
	<b>100</b>	<b>54.81</b>

Appendix III

Tapped Head

Outlet for Sprinkler

เปิดหัวจากออก แล้วเชื่อมต่อ  
ด้วย ⑤ เมื่อจะใช้รดแปลงหญ้า

3/4" Hose for connection

with sprinkler head.

สายยาง 3/4"  
ยาว 20 ม. ต่อเข้าหัวสปริงเกอร์

แป๊ปบริด 3/4"  
ข้อลดเหลี่ยม 3/4/1"  
PVC เกลียวใน Female fitting

สายยาง 3/4" ยาว 10 ม.  
ต่อเข้าหัวสปริงเกอร์

3/4" Hose for connection  
sprinkler head.

1" Hose สายยาง 1"  
Electric motor  
ปั้ม 0.5 แรงม้า

Tapped Head

หัวจาก PVC 1" ล้อมปิดแล้วรัดด้วยยาง  
ในรถจักรยานยนต์ เมื่อต้องการใช้  
น้ำ เปิดหัวจากออกแล้วต่อด้วย ⑤

Water

น้ำ

หัวกรรไกรเหล็ก 1" Filter

ท่อ PVC 1" หรือสายยาง  
1" PVC pipe or hose.  
One way valve.  
ความยาวขึ้นกับสภาพพื้นที่

3/4" Hose for connection

with sprinkler head.

สายยาง 3/4" ยาว 20 ม.  
ต่อเข้าหัวสปริงเกอร์

3/4" Hose for connection

with sprinkler head.

สายยาง 3/4" ยาว 10 ม.  
ต่อหัวสปริงเกอร์

Screw-in hose fitting  
Diameter reducing fitting

ท่อ PVC 1" หรือสายยาง  
1" PVC pipe or hose.  
One way valve.  
ความยาวขึ้นกับสภาพพื้นที่

Appendix IV

