

Impact of tropical forage seed development in villages in Thailand and Laos: Research to village farmer production to seed export

MICHAEL D. HARE¹, SUPHAPHAN PHENGPHET¹, THEERACHAI SONGSIRI¹, NADDAKORN SUTIN¹, EDWARD S.F. VERNON² AND EDUARDO STERN³

¹*Ubon Forage Seeds, Faculty of Agriculture, Ubon Ratchathani University, Ubon Ratchathani, Thailand.*

www.ubuenglish.ubu.ac.th

²*FoodWorks Co Ltd., Wanchai, Hong Kong, China.* www.foodworks.ag

³*Tropical Seeds, LLC, Coral Springs, FL, USA.* www.tropseeds.com

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Abstract

Seed of 6 forage varieties, Mulato II hybrid brachiaria, Cayman hybrid brachiaria, Mombasa guinea, Tanzania guinea, Ubon stylo and Ubon paspalum, are currently being produced by more than 1000 smallholder farmers in villages in north-east Thailand and northern Laos, under contract to Ubon Forage Seeds, Faculty of Agriculture, Ubon Ratchathani University, Thailand. The seed is mainly exported overseas (95%) and the remainder is sold within Thailand. Tropical Seeds LLC, a subsidiary of the Mexican seed company, Grupo Papalotla, employs the seed producing and seed research group, Ubon Forage Seeds, to manage seed production, seed sales and export, and to conduct research on new forage species. This paper discusses in detail how the development in villages of a smallholder farmer seed production program has had positive social and economic outcomes for the village seed growers and enabled farmers in other countries to receive high quality forage seeds. The strong emphasis on seed quality, high purity, high vigor and high germination, has had a large impact on tropical pastures in more than 20 tropical countries in Asia, Africa, the Pacific and Central and South America.

Resumen

En el noreste de Tailandia y en el norte de Laos, aproximadamente 1000 pequeños productores, en contrato con Ubon Forage Seeds, Faculty of Agriculture, Ubon Ratchathani University, Tailandia, producen semillas de *Brachiaria* híbridos cvs. Mulato II y Cayman; de guinea (*Panicum maximum*) cvs. Mombasa y Tanzania; de stylo (*Stylosanthes guianensis*) cv. Ubon stylo; y de paspalum (*Paspalum atratum*) cv. Ubon paspalum. Estas semillas se exportan principalmente a otros países (95%); el resto se vende en Tailandia. Tropical Seeds LLC, subsidiaria de la compañía mexicana de semillas Grupo Papalotla, emplea el grupo de producción e investigación Ubon Forage Seeds para manejar, vender y exportar la producción de semilla y conducir la investigación en nuevas variedades de forrajeras. En este documento se discute en detalle cómo un programa de producción de semillas ha contribuido positivamente al desarrollo social y económico de comunidades de pequeños productores de semilla y ha hecho posible que productores de otros países se beneficien por el uso de semillas de buena calidad. El fuerte énfasis en la calidad, alta pureza, alto vigor y alta germinación de las semillas ha tenido un gran impacto en pasturas tropicales de más de 20 países de Asia, Africa, la región del Pacífico, Centro y Sur América.

Introduction

Seed of 6 forage varieties, Mulato II hybrid brachiaria (*Brachiaria ruziziensis* x *B. decumbens* x *B. brizantha*), Cayman hybrid brachiaria (*B. ruziziensis* x *B. decumbens* x

B. brizantha), Mombasa guinea (*Panicum maximum*), Tanzania guinea (*P. maximum*), Ubon stylo (*Stylosanthes guianensis*) and Ubon paspalum (*Paspalum atratum*), is currently being produced by more than 1000 smallholder farmers in villages in northeast Thailand and northern Laos. The seed, 150 t in 2013, is mainly exported overseas (95%) and the remainder is sold within Thailand.

Tropical Seeds LLC, a subsidiary of the Mexican seed company, Grupo Papalotla, employs a seed producing and seed research group, Ubon Forage Seeds in the Faculty of

Correspondence: Michael D. Hare, Ubon Forage Seeds, Faculty of Agriculture, Ubon Ratchathani University, Ubon Ratchathani 34190, Thailand.

Email: michaelhareubon@gmail.com

Agriculture, Ubon Ratchathani University, to manage seed production, seed sales and export, and to conduct research on existing and new forage species. The decision to produce seed in Thailand was because of forage seed quality, smallholder experience and professionalism (Hare 1993) and Ubon Ratchathani University's involvement in forage seed production (Hare and Horne 2004; Hare 2007).

This paper discusses in detail the seed production of the 6 varieties and how the development in villages of a smallholder farmer seed production program has had positive social and economic outcomes for the village seed growers and enabled many smallholder farmers in other countries to receive high quality forage seeds.

Mulato II and Cayman hybrid brachiaria

Seed research

Producing good seed yields of Mulato II and Cayman has been very difficult to achieve. Both produce sufficient inflorescences, racemes and spikelets to indicate a potential for useful seed yields. However, by seed harvest, there is usually a massive failure of seed set, caryopsis maturation or both, with the cleaned seed containing less than 9% of the spikelets formed by the crops. The subsequent failure of seed set is probably due to pollen sterility (Risso-Pascotto et al. 2005) and this sterility is genetic.

A series of field trials have been conducted in an endeavor to increase seed yields through agronomic management. The trials have been mainly with Mulato II but the results can be applied to Cayman (Pizarro et al. 2013). Field trials have been on time of planting (Hare et al. 2007a), closing date (Hare et al. 2007b) and methods of seed harvesting (Hare et al. 2007c). Through this research, seed yields have increased from 250 to over 600 kg/ha.

Farmer seed production

Seed production of Mulato II and Cayman in Thailand is managed by Ubon Forage Seeds and in Laos by Happy Farmers Co. Ltd. Thailand seed is produced in Nong Saeng village, Roiet province (130 masl, 16° N) and in Laos in several villages in Nga district, Oudomxay province (500 masl, 23° N). In Thailand, the seed is swept from the ground but in Laos the seeds are knocked from seedheads tied together. Farmers in Thailand treat Mulato II as an annual crop, replanting each year. This is because Mulato II seed crops, grown on very poor soils in Thailand, produce uneconomic seed yields in the second and subsequent years, even with fertilizer. In Laos, on richer soils without fertilizer, many farmers have been producing consistently good yields (300 kg/ha) for over 5 years.

At Ubon Ratchathani University all Mulato II and

Cayman seed is treated with sulphuric acid to remove the lemma and palea husks to improve seed germination, and is washed, dried and recleaned before packaging for sale and export. After acid-scarification, Mulato II and Cayman seeds average 88–91% viability (tetrazolium test), 70–90% germination and over 99.5% purity. Without acid-scarification, the seed never exceeds 30% germination. Even long-term storage will not increase germination, due to the physical dormancy imposed by the tightly bound lemma and palea husks (Hare et al. 2008).

Yields from ground-harvested Mulato II seed in Thailand have averaged 400 kg/ha since 2009 and many farmers are now harvesting over 630 kg/ha. Thailand production has increased from just under 10 000 kg in 2009/10, produced by 45 farmers, to 41 000 kg in 2012/13, produced by 107 farmers.

In Laos, seed production has increased from 155 farmers in 9 villages producing 2205 kg in 2007/08, to 600 farmers in 30 villages producing 28 000 kg in 2012/13.

Mombasa and Tanzania guinea grasses

Farmer seed production

In 2008, Ubon Forage Seeds first started producing Mombasa guinea seed for Tropical Seeds, mainly for export back to Mexico. Because Mombasa is a large, leafy and very productive grass, a strong market has recently developed for Mombasa in Asia. In 2010, Tropical Seeds asked Ubon Forage Seeds to start producing Tanzania guinea seed for export to Central America, because they wanted seed of pure true-to-type Tanzania guinea, without contamination by common varieties.

We have relied on farmer experience in producing Tanzania seed for several years (Phaikaew et al. 1995) to use the same methods to produce Mombasa seed.

Strong winds in October can be a major problem, blowing a lot of good seed to the ground. In the case of guinea grass seed, farmers do not sweep fallen seed from the ground. Seed yields of Mombasa guinea have ranged from 318 kg/ha in 2008 to 492 kg/ha in 2012.

In the past there has been too much light and empty seed in the farmers' guinea seed we purchased and it had to be cleaned again at the university, losing over 20% in weight in some instances. To overcome this problem, starting in 2010, small seed cleaners with a strong air blast were manufactured and given free to the seed growers. These cleaners have been very successful, as the farmers are able to clean their seed to over 99.5% purity, with seed of a high thousand seed weight (Mombasa 1.54 g; Tanzania 1.20 g). No further cleaning needs to be done at the university for sale and export.

Ubon stylo

Seed research

Ubon stylo produced 2.6 times the seed yield of Tha Phra stylo (*Stylosanthes guianensis*) (959 vs. 365 kg/ha) in a field trial at Ubon Ratchathani University. Closing stylo seed crops in September doubled seed yield over closing in October (Hare et al. 2007d). Germination tests on 1-year-old stored Ubon stylo seed (Hare 2007) showed that hot water and machine-scarification significantly increased germination and reduced hard and dead seed. Without scarification, seed germination was less than 10%. These days, we acid-scarify the stylo seed because it is relatively easy to do, and very high germination (99%) can be achieved.

Farmer seed production

All Ubon stylo seed is swept from the ground in January–February. Then it is acid-scarified at the university to remove soil and the thin pod integuments, and to soften the seed coat for maximum germination. The farmers' yields currently average more than 1000 kg/ha.

Ubon paspalum

Seed research

Field trials have been conducted on method and time of planting (Hare et al. 2001a), method of harvesting and closing date (Hare et al. 1999). A growth room study confirmed Ubon paspalum as a long-short day plant exhibiting

a quantitative response to long days followed by a qualitative response to short days (Hare et al. 2001b).

Farmer seed production

Ubon paspalum seed is currently produced in only one village in Thailand because the market demand for seed is very small. Flowering is well synchronized and it is the first seed crop harvested each year with harvesting taking place in late September–early October.

Profitability of smallholder forage seed production in Thailand and Laos

Forage seed crops are far more profitable than rice in Thailand (Table 1), but forage seed crops cannot be planted on the low-lying, waterlogged paddies, where only rice can be grown. Mulato II is the most profitable forage seed crop, because yields from ground-swept seed are now consistently between 500 and 650 kg/ha.

Cassava is the main competitor with forage seeds for land in Thailand, particularly seed crops of Mombasa, Tanzania and Mulato II. Cassava is a relatively easy crop to grow and with the tubers in the soil, there is no risk of losing seed from climate variations as with grass seed crops. If cassava prices increase to more than US\$ 0.10/kg, many farmers would prefer to grow cassava. If the cassava price drops to US\$ 0.08/kg, farmers will plant more forage seed crops.

Farmers in Nga district, Laos, do not hire any outside labor for their agricultural production. Crops are sown by hand, seed is free, no fertilizer, insecticides and herbicides are used, cultivation is by hand and no machinery is hired

Table 1. Estimated costs and gross and net income (US\$/ha) from rice, cassava and forage seeds in northeast Thailand.

	Rice	Cassava	Ubon paspalum	Mulato II	Ubon stylo	Mombasa
Direct Costs						
Cultivation	125	125	125	125	125	125
Raising furrows		125			125	
Fertilizer	375	415	210	210	210	210
Labor for weeding		125	65	125	125	65
Labor for harvesting	125	210	125	335	335	125
Hire digger to dig up tubers		125				
Labor for cleaning/threshing	125	125	65	335	335	65
Transport	80	105				
Total Direct Costs	830	1355	590	1130	1255	590
Sale price (US\$/kg)	0.50	0.09	3.00	6.00	3.35	3.35
Yield (kg/ha)	2500	25 000	565	500	810	500
Gross Income	1250	2250	1695	3000	2714	1675
Net Income	420	895	1105	1870	1459	1085

Table 2. Estimated yield and net income (US\$/ha) from rice and Mulato II seed in Nga district, Oudomxay province, Laos.

	Rice	Cassava	Maize + Soybean		Mulato II
			Maize	Soybean	
Sale price (US\$/kg)	0.25	0.05	0.08	0.30	4.00
Yield (kg/ha)	1500	25 000	3500	1500	278
Net Income	375	1250	280	450	1112

or used. No costs are incurred except for family labor and time, which are common to all these crops. Mulato II seed production is very profitable compared with upland glutinous rice grown on steep hillsides, producing 6 times the income (Table 2).

The major advantage of Mulato II seed is its relatively high value per kg and less bulk, which helps offset high transport costs from remote areas like Nga district to Thailand. In Laos, Mulato II is also proving to be a sustainable and environmentally friendly agricultural crop in Nga district, because it prevents erosion by providing a dense vegetative cover on the hill slopes and growing for many years, unlike upland rice and maize, which die after seed harvest and do not provide a ground cover.

Export

Ubon Forage Seeds has achieved an international reputation for very high quality tropical forage seed, emphasizing high purity, high vigor and high germination. The seeds from ground-harvested Mulato II and Ubon stylo are acid-scarified to remove soil particles and increase seed germination.

Mombasa, Tanzania and Ubon paspalum seed are all cleaned by the farmers to over 99% purity and dried to 10% seed moisture. Farmer groups are supplied with free seed cleaners to help them reach the required purity and seed-weight standards we set. We also supply the farmer groups with small scales and measuring jugs and they are instructed carefully on how to sample to test seed weight against volume. During the past 3 years, nearly 140 000 kg of seed have been exported to 22 countries and 6000 kg have been sold within Thailand. The main markets have been in Central America (84 000 kg), Asia (32 000 kg) and the Pacific region (23 000 kg). Africa is becoming an emerging market.

Conclusion

Forage seed production in northeast Thailand and northern Laos has become an economically viable and sustainable cash crop for more than 1000 smallholder village farmers. The seed is predominantly exported to dairy and beef cattle smallholder farmers in other tropical countries in Asia, Africa, the Pacific and Central and South America.

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