Dry matter production of tropical grasses and legumes in Thailand

A total of fifty species or strains of tropical grasses and legumes was introduced and annual dry matter yields as well as seasonal distribution of yields were determined in 1973 and 1974 at the Forage Crop Station, Pakchong, in Thailand.

The species and strains tested in 1974 are listed in Table 1, together with information of source of seeds, amount of fertilizer applied, and number of cuttings practiced. In Table 2 annual dry matter yields in 1973 and 1974 are shown.

There are twenty species which yielded more than 20 ton/ha in 1974. Maximum dry matter yields were recorded with Napier grass in 1973 and 1974. At a high level of fertilizer application the yield of this species reached 75.6 ton/ha in 1974. Though this figure is slightly lower than the figures recorded in Puerto Rico and El Salvador[1], this is one of the highest record of dry matter yields in the tropical grassland throughout the world. Although the yield of Hybrid Napier grass was lower than that of Napier grass, it was ranked second and third highest producer in 1974 and 1973, respectively.

As a tall, erect type grass, Jaragua grass showed rather high yield. Among the group of bunch or semi-bunch type, species or strains which showed high yields were Buffel grass (Molopo), Guinea grass (Gatton panic), Blue panic grass, Colored Guinea grass (Komatipoot), Buffel grass (Common type), Rhodes grass (Gunson), Green panic grass, Colored Guinea grass (Kravirond) and Rhodes grass (Pioneer).

It is apparent that *Panicum* species including Guinea grass is one of high producers in the tropical grasses. Several *Panicum* species have been grown in the tropical and subtropical regions of the world, and the popularity of the species has been increasing in recent years, replacing some unpalatable species such as Rhodes grass. At Pakchong, Yoshiyama[2] and Ono[3] found that all *Panicum* species tested showed high dry matter production. It can be said that as a bunch or semi-bunch type of grasses, *Panicum* species are one of the most hopeful grasses in Thailand.

As to decumbent type of grasses, Signal grass (decumbent type) showed a good record of yield, although Signal grass (erect type) also gave a high yield, 42.9 ton/ha. Other decumbent grasses, Para grass and Alabang X, also exceeded 20 ton/ha. These decumbent grasses form a dense ground cover which protects soil from erosion, invasion of weeds and are resistant to frequent grazing. Once pasture of decumbent grasses is established, there will be a productive, persistent and easy-to-manage grassland. Although the maximum yield of dry matter was obtained by a tall, erect type of grass such as Napier grass, it is rather doubtful to grow such type of grass for animal grazing. When pastures for beef cattle grazing are considered, these decumbent grasses will be important in tropical regions.

All legumes showed rather low dry matter yield. None of them but Glycine exceeds 10 ton/ha. Further studies are needed to find high yielding species or strains and better management.

In general, high yielding species respond to high level of fertilizer. There are some species showing less or no response to fertilizer. Even in the high yielding species, some ones such as Buffel grass (Molopo) and Buffel grass (common type) showed less or sometimes negative response to high fertilizer application. Wilson, J. R.[4] stated that "the tropical grasses grow better than the temperate grasses at low nutrient combinations but the reverse was true for the high nutrient combination". Some important physiological differences between tropical and temperate grasses may exist. More work on this point is required.

The seasonal distribution of dry matter yield is shown in Fig. 1. There are two

Table 1. Species and strains tested

Plant materials	Obtained from	Fertilizer application (kg/ha)	Cuttings in 1974
Signal, Erect (*Brachiaria brizantha*)	P	240	6
Signal, Decumbent (*B. decumbens*)	P	240	6
Para grass (*B. mutica*)	P	240	6
Buffel grass; Molopo (*Cenchrus ciliaris*)	J	240	6
Buffel grass (*C. ciliaria*)	P	240	6
Rhodes grass, Gunson (*Chloris gayana*)	J	240	6
Rhodes grass, Pioneer (*C. gayana*)	J	240	6
Ribbed paspalum (*Paspalum malacophllum*)	J	240	6
Star grass (*Cynodon plectochyus*)	P	240	6
Alabang X (*Dichanthium aristatum*)	P	240	6
Pangola grass (*Digitaria decumbens*)	P	240	6
Weeping lovegrass, Ermelo (*Eragrostis curvula*)	J	240	6
Wilman's lovegrass (*E. superba*)	P	240	6
Jaragua grass (*Hyparrhenia rufa*)	P	240	6
Blue panic grass (*Panicum antidatale*)	J	240	6
Blue panic grass (*Panicum antidotale*)	P	240	6
Colord Guinea grass, Komatipoot (*Panicum coloratum*)	J	240	6
Colord Guinea grass, Kravirond Uganda (*P. coloratum*)	J	240	6
Dallis grass, Kyushu No. 4 (*Paspalum dilatatum*)	J	240	6
Browntop millet (*Paspalum plicatuium*)	J	240	6
Guinea grass, Gatton panic (*Panicum maximum*)	J	240	6
Guinea grass, Gatton panic (*P. maximum*)	P	240	6
Green panic (*Panicum maximum var. trichoglum*)	J	240	6
Scrobic grass (*Paspalum commersonii*)	P	240	6
Dallis grass, La B-230 (*Paspalum dilatatum*)	J	240	6
Brunswick grass (*Paspalum nicorae*)	J	240	6
Bahia grass, Nanpu (*Paspalum notatum*)	J	240	6
Biscuit grass (*Paspalum vaginatum*)	J	240	6
Hybrid Napier grass (*Pennisetum purpurcophoides*)	P	240	6
Napier grass (*Pennisetum purpureum*)	P	240	6
Nandi setaria (*Setaria sphacelata*)	J	240	6
Guatemala grass (*Tripsacum laxum*)	P	240	6
Centrosima (*Centrosima pubecens*)	J	240	6
Centrosima (*C. pubecens*)	P	240	6
Silver leaf desmodium (*Desmodium uncinatum*)	J	200	5
Dolichos lablab (*Dolichos lablab*)	P	200	5
Glycine (*Glycine wightii*)	P	240	6
Vasey grass (*Paspalum unvillei*)	J	240	6
Stylo (*Stylosanthes guyanensis*)	P	200	5
Siratro (*Phaseolus atropurpurreus*)	J	240	6
Siratro (*P. atropurpureus*)	P	240	6

Note: Seed source P: Pakchong
J: Japan
A: Australia

Fertilizer applied at high rate is indicated. Application at low level was also practiced (1/2 of high rate), but not shown in the Table.

Table 2. Annual dry matter yields in 1973 and 1974

	1973 ton/ha			1974 ton/ha		
	H	L	Av.	H	L	Av.
Napier grass	56.3	39.5	47.9	75.6	38.2	56.9
Hybrid Napier grass	34.3	31.1	32.7	47.9	38.6	43.2
Signal grass, Erect	23.1	13.0	18.1	51.5	34.4	42.9
Buffel grass, Molopo	14.4	17.6	16.0	38.9	36.5	37.7
Cuinea grass, Gatton panic P	20.8	12.5	16.7	36.9	29.3	33.1
Guinea grass, Gatton panic J	14.9	12.5	13.7	36.1	25.2	30.6
Blue panic grass P	12.9	6.7	9.8	41.2	19.7	30.5
Colored Guinea, Komatipoot	15.2	13.2	14.2	33.5	24.8	29.1
Buffel grass	9.0	7.0	8.0	30.7	27.2	28.9
Rhodes grass, Gunson	12.8	9.6	11.2	27.0	28.9	27.9
Green panic	14.6	8.4	11.5	33.2	21.7	27.5
Rhodes grass, Pioneer	13.9	8.7	11.3	26.0	27.1	26.6
Colored Guinea, Kravirond	13.0	11.2	12.1	27.5	23.7	25.6
Signal grass, Decumbent	24.0	21.7	22.9	27.9	22.6	25.2
Jaragua grass	10.6	10.5	10.6	24.9	23.2	24.0
Para grass	20.8	15.1	18.0	27.7	19.6	23.6
Alabang X	21.6	17.0	19.3	24.7	20.7	22.7
Willman's love grass	8.2	7.4	7.8	24.6	20.0	22.3
Brown top millet	18.4	11.3	14.9	24.8	17.1	21.0
Blue panic grass J	13.9	7.9	10.9	26.2	15.5	20.8
Vasey grass	8.3	4.5	6.4	22.7	14.3	18.5
Weeping love grass	6.1	5.7	5.9	17.4	16.3	16.9
Ribbed paspalum	12.9	7.0	10.0	18.1	13.1	15.6
Dallis grass, Kyushu No. 4	8.0	9.6	8.8	16.0	14.2	15.1
Dallis grass, La B-230	11.9	8.4	10.2	19.2	10.9	15.1
Guatemala grass	41.0	41.2	41.1	15.3	14.1	14.9
Star grass	8.7	12.9	10.8	16.1	12.0	14.0
Biscuit grass	11.6	7.7	9.7	15.6	11.1	13.4
Nandi setaria	8.1	11.3	9.7	10.3	13.9	12.1
*Glycine	7.7	8.5	8.1	11.4	9.9	10.7
Brunswick grass	4.5	4.1	4.3	14.1	7.0	10.6
Scrobic grass	12.9	15.1	14.0	8.0	11.1	9.5
Pangola grass	14.7	10.1	12.4	7.1	8.9	8.0
*Dolichos Lab lab	11.3	11.0	11.2	5.4	10.7	8.0
*Centrosima P	6.5	6.1	6.3	6.6	7.6	7.1
*Siratro P	8.1	6.9	7.5	6.0	7.2	6.6
*Siratro J	8.2	7.0	7.6	6.8	5.8	6.3
*Centrosima J	5.9	6.4	6.2	5.2	6.9	6.0
*Silver leaf desmodium	2.0	1.9	2.0	4.0	5.9	4.9
Bahia grass, Nanpu	2.5	2.5	2.5	4.4	4.1	4.3
*Stylo	7.8	7.2	7.5	3.8	3.9	3.9

Note: * indicates legume, H and L indicate high and low level of fertilizer application
Data of crops newly sown in 1974 are not included.

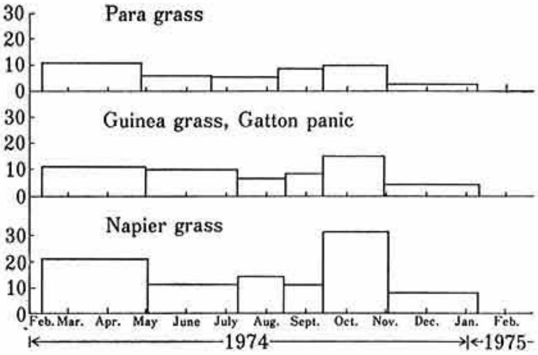

Fig. 1 Seasonal distribution of dry matter yield ($g/m^2/day$)

peaks in the dry matter yield in a year, namely March–April and September–October. As a typical example, data of Para grass, Guinea grass (Gatton panic) and Napier grass are shown in Fig. 1. Except few instances, the general pattern is similar for other species, and seems to be closely related to seasonal distribution of rainfall, suggesting an importance of irrigation to tropical grassland in developing animal industry.

In 1974, six times of cutting were carried out with majority of grasses. Except only few species such as *Dolichos lablab*, the regrowth of grasses and legumes were all fairly well showing no retarded regrowth by frequent cuttings. Apparently if water supply is enough, tropical grasses and legumes can fairly tolerate frequent cuttings.

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Flowering season and seed storage of dipterocarps

It is urgently needed to solve seed problems of tropical tree species for the regeneration of existing forests as well as rehabilitation of forests recklessly harvested after the World War II. Dipterocarps are the main commercial tree species of the tropical rain forests in Southeast Asia, and their seeds are notorious for an extremely short life. The authors carried out a series of experiments to solve some of the basic problems of dipterocarp seeds at the Forest Research Institute (FRI), Kepong, in West Malaysia for a period of three and half years since November 1971 under a cooperative research program between FRI and TARC.

Some works have already been done on the phenology of dipterocarps, but its flowering and fruiting behaviour are still left obscure. It was suggested by several authors that a prolonged dry period followed by warm soaking prolonged rains will induce the flowering on a large number of trees, resulting in a "gregarious flowering season". However, according to the thirty-eight flowering records obtained during the present experiment with the lowland forests, surrounding Kuala Lumpur, it was found that there were two flowering seasons every year that coincided with the pronounced rainy season (Fig. 1), and the flowering-to-fruiting period was between two and five months.

The loss of the flowers and young fruits during the seed maturation process was over 90% of the total flowers produced, including many cases of no fruit setting. Although the seed dry weight is a possible indicator of timing of the seed collection, it is recommended that preparation for the collection be made as soon as the seed-wing begin to turn brown, without waiting for the seeds themselves to turn brown.

Garrard (1955) suggested that the tropical climate is not suitable for the seeds which may require a period of 'after-ripening' before germination can occur, although the after-ripening of tropical tree seeds in general seems to be not clearly identified so far. Tang (1971) observed that the seeds of more important dipterocarps e.g. *Shorea leprosula, S. curtisii, S. platyclados* exhibited

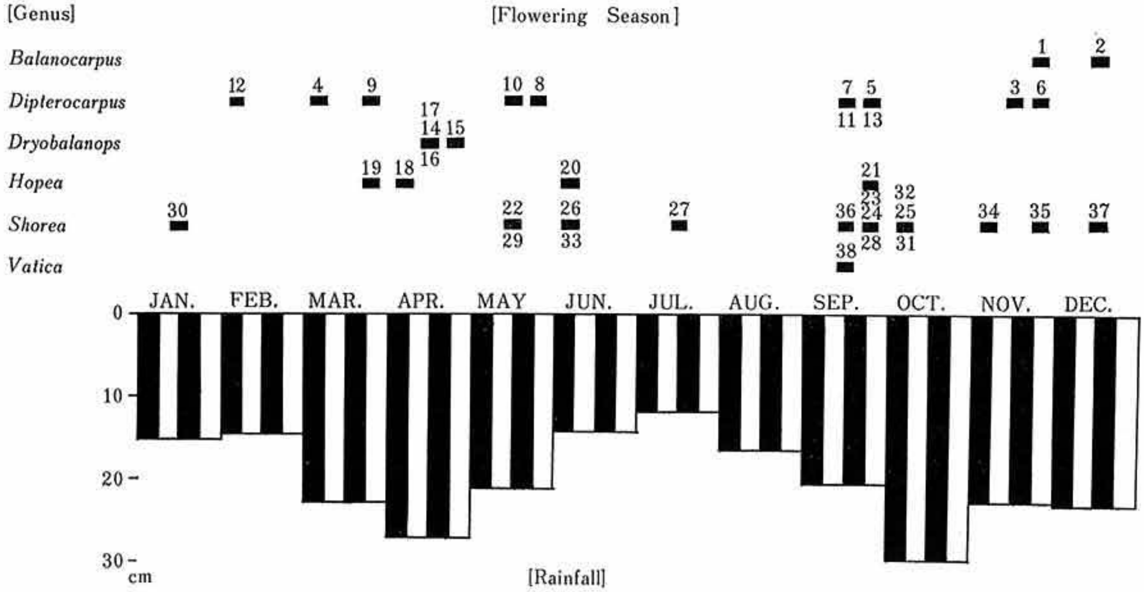

Fig. 1 Flowering season of dipterocarps and rain chart in kuala Lumpur and its surrounding areas

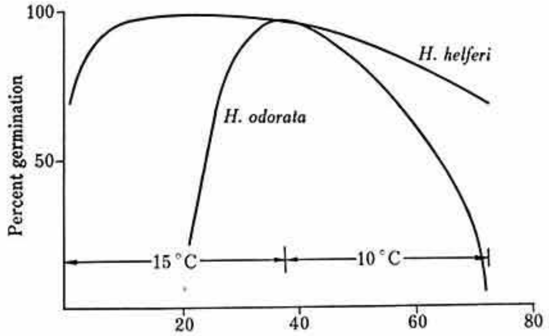

Fig. 2 Germination percentage of *H. helferi* and *H. odorata* seeds as effected by low temperature treatment

very little or no normal dormancy. As a matter of fact, the 'after-ripening' or 'a resting period' of most tropical tree seeds is generally almost unknown. However, it was found in the present study that the germination of *Hopea* seeds was apparently effected by the prechilling treatment (Fig. 2), despite of many observations of germinated seeds on branches ahead of seed collection.

Seeds of *Quercus* and others in the temperate zone lose their viability very easily by drying seeds. Similarly, a simple drying treatment can not be applied to dipterocarps seeds. Namely, they showed over 60% of moisture content at the time when the seeds were collected, but they dry up rapidly in a few days after collection, and which resulted in a loss of viability in two to three weeks under normal conditions. The critical moisture content of dipterocarp seeds for a serious deterioration was estimated about 35% on a fresh weight basis (Fig. 3). This level of moisture content is similar to a critical level of 30 to 34% for seeds of *Acer saccharinum* in the temperate zone (Johns, 1920).

In the tropics with high and uniform temperature and humidity throughout the year, the application of stratification without accompanying low temperature treatment can not be expected to be effective for storage of the seeds, based on the result of this

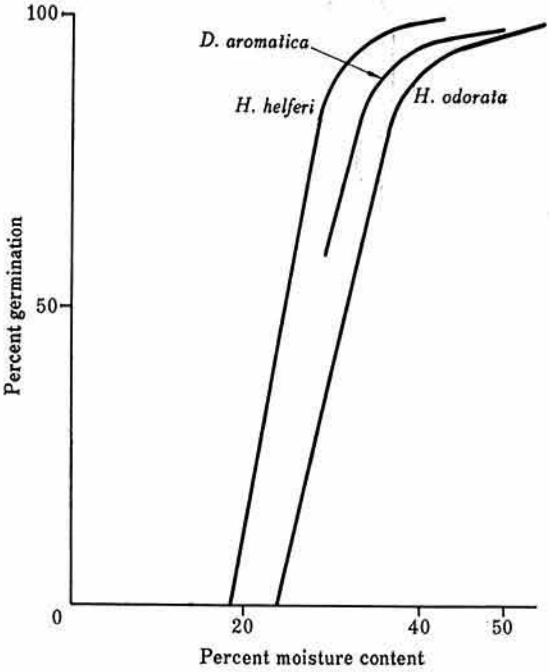

Fig. 3 Germination of *H. helferi*, *H. odorata* and *Dryobalanops aromatica* seeds at different moisture-content levels

study, similar to Barnard's result (1950). However, the low temperature storage of seeds, sealed in polyethylene bags after gradual desiccation to a level just above the critical moisture content was found to be effective in keeping the seed viability for a prolonged period. In this study, *Hopea helferi* seeds could be stored for about two months at a temperature of 15°C for an initial period and 10°C for a later period, (Fig. 2), and *H. odorata* seeds for about three weeks at 4°C after the above-mentioned treatments without serious damage to the seeds. The polyethylene bags were placed under water of 4°C in order to avoid rapid temperature fluctuations. On the other hand, the optimum temperature for testing their germinability was 10°C or 25°C.

Anatomical investigations on reproductive process and more studies on the response of seeds to low temperature are needed.

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