Characteristics of Seed and Germination of Wild-Type Sago
“Manno” (Metroxylon sago Rottb.) Collected from Sago Palm Field
around Lake Sentani near Jayapura, Indonesia

Fransiscus Suramas Rembon*1, Yulius Barra Pasolon1 and Yoshinori Yamamoto2

1 Faculty of Agriculture, Haluoleo University, Kendari, Southeast Sulawesi 93232, Indonesia
2 Faculty of Agriculture, Kochi University, Nankoku, Kochi 783-8502, Japan

Abstract: Seeds of folk varieties, Manno Kecil (Small Manno; MK) and both Manno Besar (Big Manno; MB) and MK were respectively collected in September 2005 (Exp. 1) in Yabaso village and in September 2006 (Exp. 2) in Yabaso and Kehiran villages, District of Sentani, Jayapura, Papua Province, Indonesia. The collected fruit weight of MK and MB ranged from 7.4 g to 44.6 g and 31.8 g to 46.2 g, with an average of 28.2 g and 37.6 g, respectively. The seed weight of MK and MB ranged from 5.8 g to 31.9 g and 21.7 g to 32.9 g, with an average of 20.4 g and 28.0 g, respectively. Fruit weight of both MK and MB was lower than that of the reported cultivated type of sago palms. The germination percentage of MK and MB was 70.1% and 77.3%, respectively, showing a slightly higher percentage in MB than in MK. These percentages were higher than those of the reported cultivated type of sago palms (40-60%). The seed germination of MK occurred from 6 to 69 days after sowing (DAS), showing a rapid increase (ca. 68%) from 20-34 DAS. These results suggested earlier and higher germination percentages during the rapid increase period of the wild-type Manno than in the cultivated type of sago palms. Further studies should be performed to clarify the effects of seed maturity and seed size or weight in Manno on the germination percentage and rate, using the collected fruits (seeds) from the plant.

Key words: Folk variety, Manno, Sago palm, Seed germination, Seed weight
Introduction

Sago palm (*Metroxylon sagu* Rottb.) is able to produce many seeds at the top of the stem at the end of life and propagates through seeds (Akuba 2003). According to Flach (1997), a well-developed inflorescence may carry up to 850,000 fruit. On the other hand, Kiew (1977) estimated that the palm can produce 120,960-376,320 flowers on its inflorescence with about 2,500 fruit within the seeds inside. Moreover, according to Jong (1995) sago palms with heavy fruiting can produce about 276,000-864,000 mature flower buds and 2,174-6,675 mature fruit of about 4-5 cm in diameter. The duration of fruit growth from anthesis to last fruit drop is from 19 to 23 months.

In spite of these facts, sago palm is usually propagated by sucker. One of the reasons farmers use the suckers as the propagating material is the shorter duration from planting to harvesting (around the flowering stage) compared with the seedlings. However, as it is very difficult to collect the huge amount of evenly grown and good-quality suckers for a large-scale planting, using seedlings as the propagating material should be considered in such a case. Due to earlier harvesting before seed maturation in sago palms, few reports are available on the characteristics of seed germination (Jong 1991, Ehara et al. 1998, 2001) because of the difficulty of collecting the seeds. It might be very important to clarify the characteristics of seed germination of the sago palm when using seeds as the propagating material in large-scale planting.

The authors have recognized many types of sago palms (folk varieties, i.e., varieties classified by local people) around Lake Sentani near Jayapura, Papua Province, Indonesia, and have been conducting research on the differences in the growth characteristics and the starch productivity of these sago palms (Yamamoto et al. 2006). During this research, it became clear that the local people recognized the wild-type sago palm (“sago hutan”), *Manno*, as characterized by low starch productivity, and therefore usually not harvested by the people. *Manno* was classified into two types by the plant size, i.e., big *Manno* (“Manno besar”) and small *Manno* (“Manno kecil”). Around the bolting stage, large and small *Manno* showed respective trunk weights of about 1230 kg and 440 kg (Yanagidate et al. 2007). It is easy to collect the seeds of these sago palms due to less frequent harvesting.

This research was performed to study the germination characteristics of the sago palm using the seeds of *Manno* which are easy to collect, in order to gain the basic data for the establishment of the propagation method in large-scale planting.

Materials and Methods

Two experiments were performed in two consecutive years, experiment 1 in 2005 and experiment 2 in 2006.

Experiment 1

Fifty-eight fallen mature sago fruit with good appearance were randomly collected in September 2005 under the fruiting sago palm tree of small *Manno* (MK, spiny-type) in Yabaso village around Lake Sentani, District of Sentani, Jayapura. After each fruit was weighed using an electronic balance, the husk (exocarp and mesocarp) and sarcotesta were removed by washing with tap water (Fig. 1), and the seeds were weighed following the same method for the fruit weight. The treated seeds were then sown at 1 cm depth
from the surface of the seed bed (44 cm x 34 cm x 20 cm) which was filled with the mixture of an organic fertilizer called Multi Organic Fermented Fertilizer (MOF) and sand 1 : 1 (v/v). The MOF was a compost of wasted sago extract: mineral soil : sawdust : chicken manure, 6:1:2:2 (v/v), respectively. The germination medium was 10 cm in depth and was watered daily in order to maintain a humidity close to the natural environmental condition in the field. The reason of using a mixture of MOF and sand is to increase water holding capacity of the seed bed medium.

Germination counts were made during the experiment up to three months after seeding. The seed is considered as germinated when the epiblast or shoot and the primary root have emerged (Ehara et al. 1998). Accumulated percentage of seed germination was calculated by dividing the number of germinated seeds on the observed day by the total germinated seeds until the final observed day.

Experiment 2

The fallen mature sago fruit with good appearance of small Manno (MK) and big Manno (MB, spiny-type) were randomly collected in Kehiran and Yabaso villages, respectively. Among the collected fruit, 29 and 46 were measured for the fruit and seed weight, respectively, following the same method as in experiment 1. The fruit sizes were also measured for diameter and longitudinal length using a caliper.

Germination counts were made until 3 months after sowing when no more germinated seeds appeared, following the same method as in experiment 1, although no record of the germinated number of seeds was made on each observed day. Percentage of germination was calculated by dividing the final number of germinated seeds by the total sown seeds.

Results

Experiment 1

The collected fruit weight of MK ranged from 7.4 to 44.6 g with an average of 25.4 g (Table 1). The seed weight ranged from 5.8 to 31.9 g with an average of

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<th>Table 1. The average seed, husk (exocarp and mesocarp) + sarcotesta and fruit weights of small and big Manno, experiments 1 and 2.</th>
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<td><strong>Fruit variety</strong></td>
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Data followed by ± indicated the value of standard error. CV = coefficient of variation. 1) Husk indicates exocarp and mesocarp of fruit.
19.2 g. The highest frequency of seed weight was observed at 25-26 g, followed by 18-19 and 19-20 g (Fig. 2). The frequencies of seed weight 11 g > and 26 g < were few. The calculated seed/fruit weight percentage was 75.6%. The coefficients of variance (CVs) (%) of the fruit and seeds were almost the same, 29% and 27%, respectively, and these CV values were lower than that of the husk + sarcotesta (36.5%).

Fig. 2. Distribution of the seed weights of small Manno (Experiment 1)

The accumulated percentage of seed germination is shown in Fig. 3. The seed germination occurred from 6 to 69 days after sowing (DAS) and showed a remarkable increase from 20 to 34 DAS (ca. 68.3%). Before and after this period, the germination rate was not as high. The final germination percentage was 70.7%.

Fig. 3. Accumulated percentage of seed germination of small Manno (Experiment 1). Numerals in the figure indicate days after sowing (accumulated germination %).

Two types of seedlings, spiny and non-spiny types, were observed from the seeds collected simultaneously (Fig. 4), although these seeds were collected under spiny mother palms. The ratio of spiny- and non-spiny-type seedlings was 43.9% : 56.1%.

Experiment 2

The collected fruit weights of MK and MB ranged from 21.8 to 37.3 g, and from 31.8 to 46.2 g, with an average of 30.9 and 37.6 g, respectively (Table 1). The average fruit diameter and longitudinal length were 3.54 and 3.37 cm for MK and 3.70 and 3.62 cm for MB, respectively. The seed weights of MK and MB ranged from 13.7 to 27.6 g, and from 21.7 to 32.9 g, with an average of 21.5 and 28.0 g, respectively. The average weights of fruit and seeds were 18% and 24% higher in MB than in MK, respectively. The CVs (%) of fruit and seeds were 15.6% and 14.9% for MK and 10.1% and 11.8% for MB, respectively. These CV values were smaller than those of the husk + sarcotesta (50-57%). The calculated seed/fruit weight percentages of MK and MB were 70 and 75%, respectively.

The germination percentages of MK and MB were 69.4% and 77.3%, respectively, showing a slightly higher percentage in MB compared with MK.

Discussion

The average weights of fruit and seeds of MK in experiments 1 and 2 were 28.2 g and 20.4 g, respectively, and these values were 25% and 27% lower than those of MB in experiment 2 (fruit wt: 37.6 g; seed wt: 28.0 g), respectively. The fruit weight of wild-type Manno was lower than that of the
sowing in MK indicated that the germination occurred from 6 to 69 DAS, showing a rapid increase (ca. 68%) from 20 to 34 DAS. Ehara et al. (2001) reported that the germination of cultivated sago palm seeds, treated in the same way as in this research, under 30°C water condition occurred from 32 to 80 DAS, showing a rapid increase (ca. 50%) from 32 to 48 DAS. Comparing the results, it was suggested that earlier germination and higher germination percentages occurred during the rapid increase period of the wild-type Manno than in the cultivated type of sago palm. The differences might be based on the different methods of fruit (seed) collection and the germination test, as well as genetic differences.

The results mentioned above revealed that in two types of wild sago palm, growing around Lake Sentani near Jayapura, Papua, Indonesia, the fruit and seed weights were greater in MB with larger plant size compared with MK with smaller plant size, and the germination percentage of Manno was higher than that of the cultivated type in Malaysia, although the fruit weight was less in Manno.

Using the fallen fruit (seeds) for the experimental material in this research might have influenced the germination rate and percentage as well as the fruit and seed weights of Manno through the period from the falling to the collecting of fruit and the environmental conditions on the ground where the fruit fell. For example, the germination inhibitors contained in the pericarp (exocarp and mesocarp) of fruit (Ehara et al. 2001) may leach out during rain. Further studies should be performed to clarify the effects of seed maturity and seed size or weight in Manno on the germination percentage and rate, using the collected fruit (seeds) from the plant. Comparison of the germination inhibitors between the sago fruit belonging to different folk varieties is also necessary.

References


Flach, M. 1997 Promoting the conservation and use of underutilized and neglected crops. 13. Sago Palm (Metroxylon sagu Rottb.). International Plant Genetic Resources Institute, Rome, Italy, pp. 76.
