Diversity of pod weight of Indonesian local groundnut (*Arachis hypogaea* L.) varieties at different harvesting time

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Abstract. Groundnut, a self-pollinated legume, is an important cash crop which has high oil seed content and provides nutritious fodder to livestock. Harvesting time is very critical to the groundnut production, because their maturity determines the pod weight. This study aimed to observe the pod weight of local groundnut varieties of Indonesia at different harvesting time. A total of 50 local varieties groundnut were grown at ICABIOGRAD Experimental Station from May–September 2015. The pods were harvested at 75, 85 and 95 days after planting (DAP) and weighed. The results showed that the accessions reached its physiological maturity at 85 DAP, where the plants reached the highest maturity index (2.28). The average maturity index at 75 and 95 DAP was 1.64 and 1.84, respectively. The pod weightat 75, 85 and 95 DAP ranged from 1.0 to 31.4 g, 4.2 to 35.2 g and 2.0 to 31.6 g, respectively, whereas the seed weight ranged from 1.0 to 20.8 g, 2.2 to 26.4 g and 1.4 to 24 g, respectively. A relatively high seed and hull weight ratio at 85 DAP was found in MLG 1629 Jombang, MLG 7552 Gresik, Hoi Ambon, Lanbau and AH 842Si varieties. The harvesting time should be done at physiological maturity to identify the maturity type among local varieties. It is recommended that the Indonesian local varieties of groundnuts should be harvested at 85 DAP.

Keywords: groudnut, harvesting time, pod weight, seed.

1. Introduction

Groundnut (*Arachis hypogaea* L.) is an essential crop in Indonesia because of its high oil seed content. The crop is grown both as a cash and food crop. Some significant constraints of groundnut production and productivity include the lack of improved varieties, poor cultural practices, insect pests, diseases, weeds, drought, and the non-timely execution of agronomic practices [1,2]. The goal of most groundnut breeding program is to increase yield. Characterization of harvesting time or maturity stage of the crop is an important step in obtaining promising breeding materials.

The time of harvest can contribute significantly on yield and productivity, but most farmers are not aware of groundnut maturity time for harvesting. Generally, local groundnut varieties are harvested at 80–85 days after planting (DAP) for the food industry, whereas the harvesting time is delayed up to 90–100 DAP for industrial seed. Several released variety, such as Domba and Panther, were harvested at 100 DAP, while Badak variety could be harvested at 105 DAP [12].

The impact of late harvesting time are less water content and high percentage of mid-mature kernels [3]. The physiological maturity stage is a recommended measure for determining the harvesting time to obtain high pod yield and kernels quality [4]. Therefore, determination of harvest time is essential as it contributes to yield and productivity. The differences in maturity time were at two levels: between the maturity group of genotypes and between the genotypes within each maturity group [13].

Early harvesting time of groundnut could reduce yield by 15% and economic value by 21% [5]. Harvesting groundnuts too early resulted in immature nuts, low yields, and off-flavors [6] with many immature seeds [3]. Groundnut plant can sustain and develop pods with less than 15% to 20% of flowers produced mature pods. On the other hand, late harvest affects the pod and other yield components. Delaying harvesting time could increase yield, mature kernels, shelling percentage, pod number and pod yield per plant, 100-seed weight, oil and protein contents, and O/L ratio [7–9]. In contrast, delaying harvesting time may also increase yield loss. Premature harvesting reduced yield and kernel quality by 16–25% and delayed harvesting resulted in 30–40% yield losses [4]. Genotype with the highest harvest index is characterized by high yield, performances morphology, weight per pod and number of pod per m^2 [13].

Optimal harvesting time is critical for obtaining high yield of local groundnut varieties as it can reduce yield losses. The late-maturing group tended to have a slightly higher pod weight than the early- and the medium-maturing groups [13]. Information on maturity traits responsible for differences in yield performance among local groundnut genotypes is still lacking. This data can be used to develop appropriate strategies for varietal selection that could improve groundnut yield. Therefore, this study aimed to observe the pod weight performance of Indonesian local groundnut varieties at various harvesting time.

2. Materials and methods

A total of 50 accessions of local groundnut varieties and lines were grown at the Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development (ICABIOGRAD) Experimental Station during the dry season of May–September 2015. One seed of each cultivar was sown in 4 rows within 2 m × 3 m plots at a planting distance of 40 cm ×20 cm. The land was disked and harrowed before planting following the procedures for yield trials land preparation. Fertilizers were applied at a dose of 50 kg/ha of urea, 100 kg/ha of P_2O_5 and 75 kg/ha of KCl. Pesticides and fungicides were applied as necessary following the recommended procedures. The standard cultural practices were carried out during the whole growing period [10]. The experiment was well managed in order to avoid drought, nutrient and other stresses. Plants were uprooted at 75, 85 and 95 days after planting (DAP) and observed for yield components, such as pod weight, seed weight, pod number and maturity index. Maturity index is the ratio of seed weight to hull weight.

3. Results and discussion

Harvesting time at physiological maturity resulted in higher groundnut pod and kernel yield compared toharvesting at 75 and 95 DAP, indicating that different harvesting time could affect pod and kernel yield. An early harvesting time can reduce the number of pods per plant which lead to low pod and kernel yields. Pod yield of grondnut varieties directly related to kernel yield [4]. On the other hand, pod maturity can be determined by measuring changes in kernel weight and hull weight during maturity, chlorophyll content, amino acid content and maturity index [3].

In this study, groundnut accessions showed different maturity index at different time of harvest.The maturity index for each accession showed maximum and minimum rates, where the maximum value determines the harvesting time. At 75 DAP, several local varieties had a range of maturity index of 0.50 to 2.78 with an average of 1.6. The other varieties showed a range of maturity index of 0.78 to 3.85 with an average of 2.28 at 85 and 0.35 to 3.16 with an average of 1.84 at 95 DAP (Figure 1 and 2).

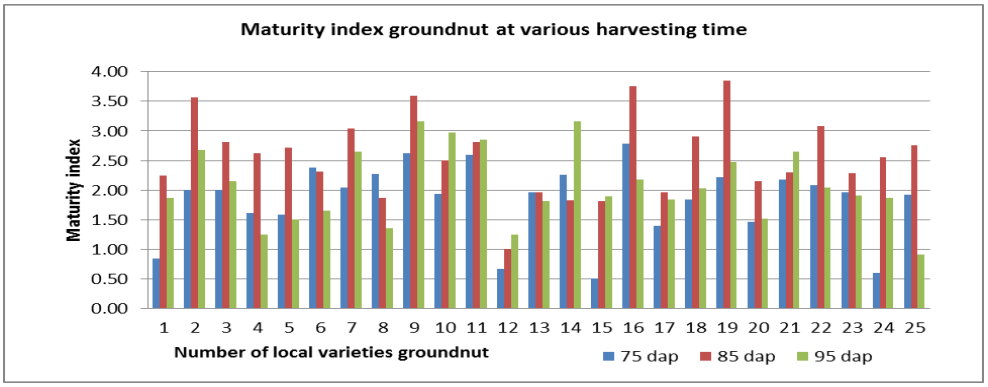

Figure 1. The maturity index of local groundnut varieties number 1–25 at 75, 85 and 95 days after planting (DAP).

Harvesting time determines groundnut pod and kernel yield. Harvesting time at physiological maturity resulted in higher groundnut pod and kernel yield compared to harvesting at early and late physiological maturity. An early harvesting time reduced the number of pods per plant which lead to low pod and kernel yields. On the other hand, delayed harvesting resulted in lower maturity index in some accessions, such as AH 1643 Si (number 10) Banjar, AH 1647 Si (number 11) Karangasem, AH 1656 Si (number 12) Tampaksiring Bali, AH 1681 Si (number 14) Magetan, and lines such as AH 1033 Si (number 47) and AH 1044 Si (number 49) (Figure 1 and 2). All local varieties and lines may show physiological maturity at 80–85 DAP, where they showed 75% mature pod brown and black pod color and maximum seed hull maturity index (2.0–3.4) [3].

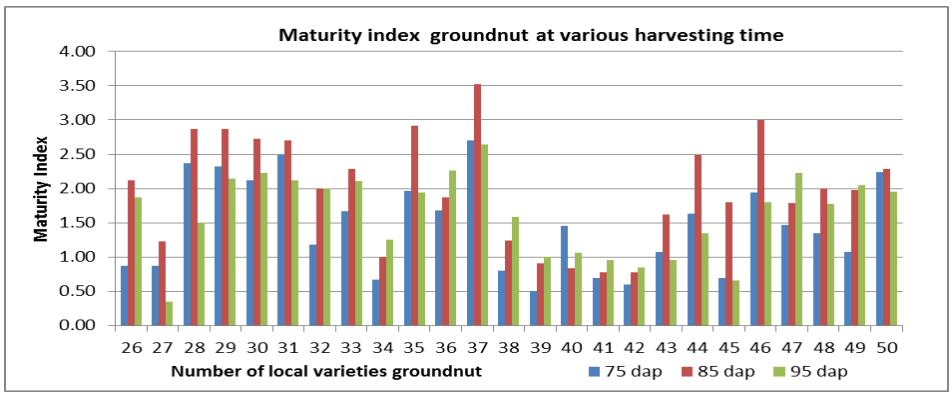

Figure 2. The maturity index of local groundnut varieties number 26–50 at 75, 85 and 95 DAP.

Groundnut is mature when 70–80% of the inner layer of the pods shells turn dark, and the kernels are plump. As reported previously, significant reductions in groundnut yields could occur as a result of premature or delayed harvest [11]. The same result of lower pod yield occurred on other groundnut varieties in Africa when harvested beyond its physiological maturity [4]. Also, harvesting time affect the kernel quality [7,9].

Pod yield of groundnut varieties were positively correlated with kernel yield [4]. The kernel weight harvested at 85 DAP were higher than the kernel that was harvested at 75 and 95 DAP (Table 1). Thus, the kernel weight of local varieties tended to reduce at either early or late harvesting time.

Table 1. The average and range of pod, kernel and hull weight of 50 local groundnut varieties at three harvesting time.

Yield component	75 DAP	85 DAP	95 DAP
Pod weight (g)	14.06 (1.00–3 1.40)	18.15 (4.20–35.20)	18.50 (2.00–31.60)
Kernel weight (g)	9.17 (0.40–20.80)	12.97 (2.20–26.40)	12.32 (1.40–24.00)
Hull weight (g)	4.89 (0.60–10.60)	5.18 (1.60–9.40)	6.18 (0.60–11.40)

DAP = days after planting.

The average kernel weight of local varieties was 9.2, 13.0 and 12.3 g at 75, 85 and 95 DAP, respectively, which suggested lower kernel production at the early harvesting time (Figure 3). However, several accessions produced the highest kernel weight at early harvesting time. The highest kernel weight at 75 DAP was observed on Mlg 7641 Lamongan and Mlg 7548 Tuban lines, whereas at 85 DAP was on Mlg 7579 Probolinggo and AH 1029 Si lines, and at 95 DAP was on Mlg 7579 Probolinggo and AH 1037 Si lines. The highest kernel weight was obtained when pods were fully filled and reached maturity. Early harvested pods were characterized by immature, shrink and small kernels, whereas the late harvested ones sprouted and had high incidence of insect attack on both kernel and pod [4]. Also, the impact of late maturity are less water content, high percentage of mid-mature pods and potential contaminant of *Aspergillus flavus* [3].

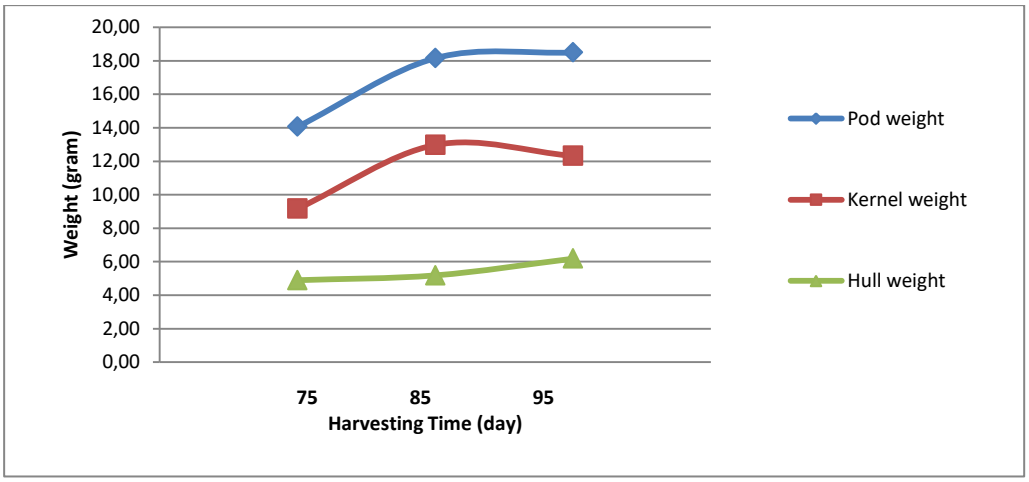

Figure 3. The average pod, kernel and hull weight of 50 local groundnut varieties at three harvesting time.

Harvesting time of groundnut varieties at physiological maturity produced high pod yield. In this study, pod, kernel and hull weight at 85 DAP were higher than those at 75 and 95 DAP (Figure 3). The pod weight harvested at 75, 85 and 95 DAP ranged from 1.0 to 31.4 g, 4.2 to 35.2 g and 2.0 to 31.6 g, respectively. The local varieties Mlg 7641 Lamongan and Mlg 7548 Tuban had high pod weight at 75 DAP, and Mlg 7579 Probolinggo and AH 1029 Si lines at 85 DAP. Mlg 7548 Tuban and Mlg 7579 Probolinggo still showed high pod weight when harvested at 95 DAP. This results affirmed the previous study that high pod weight were mainly recorded at physiological maturity for all local groundnut varieties [4]. The studied groundnut lines have less number of days to 50% flowering and had more number of mature pods at maturity. However, the local varieties with the highest pod weight showed longer period of seed filling duration or still developing pod. Thus, differential pod weight per plant were attributed by genotypes [9].The genotypes with the highest harvest index was those with the highest yield because of the ability to maintain a relatively greater number of pods than the other genotypes [13].

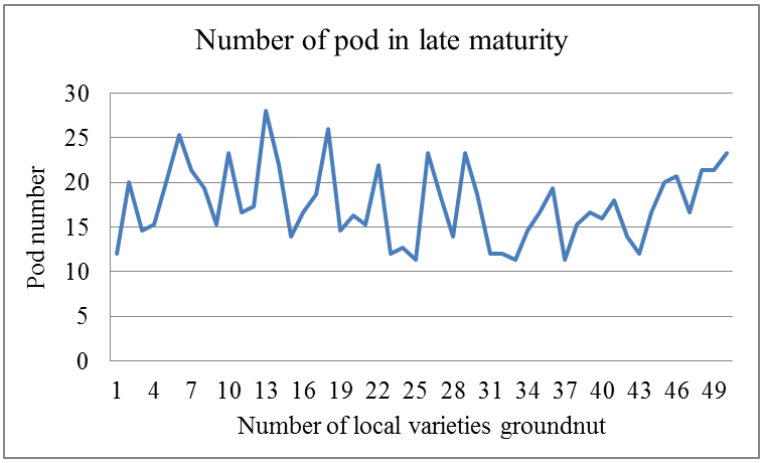

Figure 4. The number of pod of 50 local groundnut varieties at three harvesting time.

The number of pods per m^2 and weight per pod were the two primary components of groundnut yield [13]. The number of pod of local varieties tended to be stable at medium until late harvesting time, i.e. 11 to 28 pods at 95 DAP (Figure 4). The highest pod number was obtained from Mlg 7579 Probolinggo and Kacang Allu (South Sulawesi), whereas the lowest was from Lambuya (North Sulawesi) and line AH 842 Si. Early harvesting time resulted in immature nuts, low yields and off-flavors [6], and consequently reduce the yield, oil content and seeds quality [4]. The effects of pod number per plant on pod yield were influential under different environmental conditions and management. The limitations in assimilate supply during this period, as imposed by drought, reduced flower production, increased flower abortion and pod abscission [13].

The relatively high seed and hull ratio or optimal maturity were found in MLG 1629 Jombang, MLG 7552 Gresik, Hoi Ambon, Lanbau and AH 842 Si, indicating that these varieties had stable maturity index. On the other hand, the local varieties Mlg 7641 Lamongan, Mlg 7548 Tuban, Mlg 7579 Probolinggo, and also the lines AH 1029 Si and AH 1037 Si remained showing high pod weight at maturity time. Therefore, harvesting time groundnut crop is advisable at physiological maturity to identify the different maturity type. For the Indonesia local groundnut varieties the harvesting time will be the best at 85 DAP.

4. Conclusions

The optimaltime to harvest local groundnut varieties of Indonesia was at 85 DAP, as the pod weight, seed weight and maturity index were the highest at this harvesting time. Several varieties with stable seed-hull weight ratio suggested their potential genetic materials for breeding scheme. Different maturity index of the local varieties in this study reflected pod and kernel yield losses in each groundnut variety.

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6. Authors contribution

All authors contributed equally to the manuscript. TZ designed, performed the data collection, and drafted the manuscript. NH prepared the plant materials. ND assisted the drafting, revised and finalized the manuscript during publication.

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