UDC 575.630
https://doi.org/10.2298/GENSR1901179W
Original scientific paper

AGRO-MORPHOLOGICAL AND CHEMICAL CHARACTERIZATION OF TRADITIONAL INDONESIAN PEANUT (*ARACHIS HYPOGAEA* L.) CULTIVARS

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Wanget S. A., M. R. Morales-Corts, R. Pérez-Sánchez, N. Rostini, M. Á. Gómez-Sánchez, A. Karuniawan (2019): *Agro-morphological and chemical characterization of traditional Indonesian peanut (Arachis hypogaea L.) cultivars.*- Genetika, Vol 51, No.1, 179-198.

In order to improve the knowledge of the peanut species, thirty five cultivars from several different regions in Indonesia were collected and characterized agro-morphologically and chemically. A total of 25 descriptors, mainly defined by the International Plant Genetic Resources Institute and the International Crops Research Institute for the Semi-Arid Tropics were used to describe the flowers, leaves and fruits obtained over 5 planting seasons (October 2010-February 2013). The study indicates that different growth seasons strongly affect the quantitative peanut parameters measured. A dendrogram, produced using the Furthest Neighbor Method (Euclidean) from agro-morphological and chemical parameters, afforded a clear separation between the peanut cultivars and revealed existing synonymies such as Gorontalo B and C and homonymies such as Kinali Merah and Putih. Some cultivars, such as Baturaja B, Rancabuaya, and Sumenep, exhibited an interesting combination of the high-yield (950 kg/ha), high content of omega-3 (3.42 g/100g) and omega-9 (38.11 g/100g) fatty acids, and resistance to *Ralstonia solanacearum* characters. Another two relevant cultivars related to chemical composition were Binjai and Sumedang. All these traditional cultivars can be used as a potential source of genetic

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variation for future peanut improvement programs. This work is an important step in the conservation of genetic peanut resources in Indonesia, which show distinctive and interesting agronomic and chemical characters, such as yield components, maturing time and oil composition.

Keywords: conservation, genetic resources, peanut descriptors, pod, unsaturated fatty acids

INTRODUCTION

Peanut (*Arachis hypogaea* L.), also known as groundnut, is an annual allotetraploid legume (2n=4x=40) used as a source of vegetable protein and oil. It is grown over a diverse range of environmental conditions, with the main commercial production occurring in the northern hemisphere (India, China, West Africa and the south of the U.S.A.). Concretely, it is cultivated in 118 countries of world, with an annual production of 47.09 million tons, grown on an extension of 27.94 million ha. In 2017, Indonesian peanut production was 480,000 tons of dry peanuts, with a crop area of 364,000 ha and a yield of 13.18 quintal/ha (FAOSTAT, 2017). Peanuts can be found in almost all regions of Indonesia and they were first introduced there by Spanish traders from South of America in the 1500s (SMITH, 2002).

In Indonesia peanuts are widely used as a complement to traditional foods, such as "gado-gado", "satay", "rempeyek" (fried snacks) and many other foods. In industry, peanuts are used as an ingredient for making cheese, butter, and cooking oil. They are also widely used as food in animal production. Peanut generally has a high content in total oil and its composition is very important from a nutritional point of view. Fatty acids, and specifically unsaturated fatty acids (omega-3, omega-6 and omega-9), are essential compounds that must be present in our diet. Some studies have indicated the beneficial role of fatty acid, especially omega-3 fatty acid, in preventing cardiovascular disease and protecting mental health (SIMOPOULUS, 1991). According to the studies of RAHIMI *et al.* (2011) by adding omega-3 vegetable sources to animal diets (chickens), the omega-3 fatty acid content can be increased in their meat, which may have beneficial effects on human health. A high omega-3/omega-6 ratio is important as regards cardiovascular disease such as hypertension or ischemia (CORONADO *et al.*, 2006). Oleic acid, a monounsaturated omega-9 fatty acid, is an important component determining seed quality in peanuts because it enhance fatty acid composition, a beneficial effect on human health, improved flavour, and increase shelf-life of stored food products by delaying rancidity (BARKLEY *et al.*, 2011). Consequently, peanut varieties with high omega-9/omega-6 acid ratios are now preferred by the peanut industry owing to the stability of their oil, increased shelf life, and more health benefits. Many peanut improvement programs are now attempting to incorporate the high oleic (omega-9) trait into new and improved varieties (CHAMBERLIN *et al.*, 2011).

Many studies addressing the agro-morphological, chemical and molecular characterization of peanuts have been reported (KOCHERT *et al.*, 1991; MALLIKARJUNA-SWAMY *et al.*, 2003; UPADHYAYA, 2003; UPADHYAYA *et al.*, 2003, 2006; RAJGOPAL *et al.*, 2004; FRIMPONG, 2004; HOLBROOK and DONG, 2005; KOTTAPALLI *et al.*, 2007; ISLAM *et al.*, 2008; YU *et al.*, 2010; SHAHZAD *et al.*, 2011; BARKLEY *et al.*, 2011; CHAMBERLIN *et al.*, 2011; DEAN *et al.*, 2013; RAO *et al.*, 2013; YOL *et al.*, 2018, among others). However, no detailed studies on Indonesian peanuts cultivars have been found in the literature.

This study aimed to collate agro-morphological and chemical information about peanut cultivars and about the genetic relationships among the collection of peanut cultivars spread across different regions in Indonesia.

MATERIALS AND METHODS

Plant material and plant establishment

Thirty-five peanut cultivars (32 traditional and 3 improved genotypes) originating from all regions of Indonesia and held in the collection of Padjadjaran University (Bandung, West Java, Indonesia) were studied. A list of all the cultivars studied and their sources are shown in Table 1.

Table 1. Origin of the 35 peanut cultivars

Cultivar	Origin
Atambua	Nusa Tenggara Timur
Batu	Java
Baturaja B	Sumatera
Binjai	Sumatera
Ciamis	Java
Citayam	Java
Garut	Java
Gorontalo A	Sulawesi
Gorontalo B	Sulawesi
Gorontalo C	Sulawesi
Jatim	Java
Kanonang Merah	Sulawesi
Kanonang Putih	Sulawesi
Karo	Sumatera
Kefa Timor	Nusa Tenggara Timur
Kinali Merah	Sulawesi
Kinali Putih	Sulawesi
Larantuka	Nusa Tenggara Timur
Madura	Java
Rancabuaya	Java
Siantar Merah	Sumatera
Siantar Putih	Sumatera
Siborongborong	Sumatera
Soe Timor	Nusa Tenggara Timur
Sultra	Sulawesi
Sumba Timor	Nusa Tenggara Timur
Sumedang	Java
Sumenep	Java
Sungai Liat B	Sumatera
Tondegesan Merah	Sulawesi
Tondegesan Putih	Sulawesi
Tuban	Java
Gajah	Control cultivar
Kelinci	Control cultivar
Landak	Control cultivar

Plants were sown in rows on a plot, with two replicas, and were planted during five different seasons at the experimental garden at Ciparanje, West Java, Indonesia (Agriculture Faculty of Padjadjaran). The area lies at an altitude of 753 m above sea level and has a type-C rainfall pattern (SCHMIDT and FERGUSON, 1951). Each cultivar was sown on a 4-m long row on a ridge. The distance between rows was 60 cm, with 20 cm between the plants in a row. To record data, ten representative plants were randomly selected from each cultivar. The entire plot was harvested and the pods were stripped off and dried to determine total plot yield.

The first season planted was October 2010-February 2011; the second season planted was April 2011-August 2011; the third season planted was November 2011-March 2012; the fourth season planted was May 2012-September 2012, and the fifth season planted was October 2012-February 2013. The meteorological conditions for the plant development period during the five seasons are shown in Table 2.

Table 2. Growth season and meteorological conditions for the development of peanuts during the research period in West Java, Indonesia

Season	Period	Total rainfall (mm)	Average temperature (ºC)
Season 1	0ctober 2010 – February 2011	214.16	23.2
Season 2	April 2011 – August 2011	85.88	23.22
Season 3	November 2011 – March 2012	224.5	23.42
Season 4	May 2012 – September 2012	75.76	23.26
Season 5	October 2012 – February 2013	353.18	23.52

Data provided by Java Barat dalam angka tahun 2011, 2012 and 2013. Badan Pusat Statistik Java Barat incorporated with BAPEDA Provinsi Java Barat, Indonesia

Agro-morphological descriptors

Agro-morphological descriptors were recorded according to a descriptor list of peanut varieties (*Arachis hypogaea*) (IBPGR and ICRISAT, 1992). The physical parameters studied were viability (plant emergence ten days after planting, %), plant height, leaflet length and width, flowering (days after planting), harvesting (days after planting), canopy width, pods per plant, 100-seed weight and yield. Size parameters were determined using a digital caliper with a sensitivity of 0.01 mm. Pod and seed mass was measured on an electronic balance with a sensitivity of ±0.01 g. Leaflet length and width (mm) at 60 days after planting, plant height (cm) and yield (kg/ha) at harvest, flowering (days from emergence to the stage when 50% plants had begun to flower), growth habit, hairiness of the stem surface, leaflet shape and hairiness of the leaflet surface, pod beak, pod constriction, pod surface, seed shape and seeds per pod were recorded on a plot basis. The color descriptor parameter measurements performed on petal color, leaf color and seed coat color used the Munsell color chart, according to a standard description of peanuts of the U.S. Department of Agriculture.

Pest attack [*Ralstonia solanacearum* (Smith) Yabuuchi] was also evaluated in each peanut plant since the growing location is known to be endemic wilt area. Observation of plants showing bacterial wilt symptoms was recorded weekly, since one week through 10 days to harvest time. Wild disease incidence was calculated as a percentage of healhty plants to total plants and was used in classifying resistance degree. According to MACHMUD and RAIS (1994), bacterial wilt reactions of the tested cultivars were categorized as: resistant (<15% wilted plants), moderately resistant (15-25%), moderately susceptible (25-35%) and susceptible (>35%).

Seed chemical composition

The total oil content was analyzed using the Soxhlet method according to standard AOAC (1990) and it is shown as a percentage of peanut weight. The content of unsaturated fatty acids (omega-3, omega-6 and omega-9) was determined on a 0.2 g oil sample using a gas chromatography (GC) method (MCNAIR and BONELLI, 1988). The results are shown as g per 100g of total oil. The omega-3/omega-6 and omega-9/omega-6 ratios were determined in order to evaluate the quality of the oil. All analyses were performed at the Post-harvest Crop Laboratory of the Indonesian Ministry of Agriculture in Bogor, West Java, Indonesia.

Statistical analyses

Means and standard deviations were calculated for each of the quantitative parameters studied over the five plant seasons for the 35 peanut cultivars. The unit of measurement of each of the parameters studied was taken from an individual value of each of ten plants sampled per cultivar. An ANOVA analysis for the quantitative agromorphological and chemical parameters of peanuts was implemented in order to investigate significant differences among cultivars and as regards the 5 planting seasons. Differences between means were investigated using Duncan's multiple range test. Finally, a dendrogram of genetic similarities among the peanut cultivars was compiled using the Furthest Neighbor Method. All statistical analyses were carried out using Statgraphics Plus 5.3.

RESULTS AND DISCUSSION

Agro-morphological descriptors

The means, standard deviations and ANOVA analyses for the quantitative agro-morphological parameters analyzed in the peanut cultivars are shown in Table 3. With respect to the viability parameter the highest value was recorded for Sungai Liat B (91.25 ± 6.85), and the lowest value was obtained for Siborong-borong (53.75 ± 25.16). Twenty cultivars had values higher than 75%, which can be considered a very good viability. Most of the traditional Indonesian cultivars had higher viability values than the reference cultivars. Regarding the phenological parameters, flowering time ranged between 30 and 35 days after planting, and harvesting time ranged between 99 and 111 days after planting. Significant differences at 95% of confidence level were found for this last parameter among Sumba Timor and Atambua (longer-cycle genotypes) and the rest of cultivars. In this sense, LIU *et al.* (2013) observed that premature harvesting causes a loss of 20-50% of the peanut yield and reduces seed quality. In relation with plant height, the mean value was around 32 cm. These results agree with those obtained by FRIMPONG (2004) for traditional peanut cultivars from Northern Ghana (35 cm). However, YOL *et al.* (2018) found taller plants (60.4 cm) when they evaluated 256 peanut genotypes representing over 25 countries across Asia, America and Africa. It could be said that many of them have been improved in the cultivation countries. Canopy width ranged from 29 to 41 cm, being Kinali Merah and Kinali Putih the widest genotypes. Leaflet length and width varied from 4.19 to 5.45 and from 2.36 to 2.86 cm, respectively. Similar results for these last two parameters were recorded by UPADHYAYA *et al.* (2003). The number of pods on a single plant ranged from 11 to 27. Other researchers that recorded important variations in the number of pots per plant of the different cultivars were YOL *et al.* (2018), FRIMPONG (2004) and MALLIKARJUNA-SWAMY *et al.* (2003).

Table 3a. Means, standard deviations and ANOVA analyses for quantitative agromorphological parameters in Indonesian peanut cultivar

Cultivar	Viability (%)	Plant Height (cm)	Flowering (Day after planting)	Harvesting (Day after planting)
Atambua	81.25 ±28.87bcd	46.80 ±2.32j	32.60 ±2.68ab	110.80 ±4.67fg
Batu	72.50 ±13.79abcd	29.43±4.36bcde	31.40 ±2.21a	99.60 ±2.13a
Baturaja B	67.50 ±13.69abcd	31.54 ±8.07cdef	31.80 ±3.18a	99.40 ±1.10a
Binjai	67.50 ±9.82abcd	32.02±4.08defg	32.20 ±4.26a	99.40 ±1.10a
Ciamis	80.00 ±23.77bcd	30.89 ±9.64cdef	31.40 ±3.44a	99.40 ±1.10a
Citayam	71.25 ±27.39abcd	43.02 ±3.33ij	31.60 ±3.86a	101.60 ±2.49bc
Gajah	71.25 ±19.96abcd	30.10±5.11bcde	32.20 ±3.85ab	100.20 ±0.37ab
Garut	86.25 ±9.82bcd	22.40 ±4.67ab	30.80 ±1.77a	99.00 ±1.63a
Gorontalo A	75.00 ±23.94abcd	23.49±3.14abc	31.60 ±3.30a	99.80 ±0.89a
Gorontalo B	67.50 ±25.87abcd	22.62±2.96ab	32.60 ±3.98ab	99.80 ±0.89a
Gorontalo C	71.25 ±12.81abcd	30.37±4.64bcde	32.20 ±3.39ab	99.40 ±2.28a
Jatim	85.00 ±13.79bcd	32.87±6.23defg	31.20 ±1.34a	99.40 ±1.10a
Kanonang Merah	86.25 ±12.18bcd	39.22±5.64fghij	31.00 ±1.53a	100.80 ±0.68ab
Kanonang Putih	81.25 ±21.04bcd	41.52 ±8.05hij	31.20 ±1.46a	101.00 ±1.41bc
Karo	73.75 ±19.57abcd	28.91 ±6.50abcde	31.00 ±1.73a	99.60 ±1.24a
Kefa Timor	81.25 ±19.09bcd	30.53 ±9.22bcde	33.20 ±2.67ab	109.00 ±3.61ef
Kelinci	65.00 ±16.77ab	32.39±5.71defg	32.20 ±2.85ab	99.60 ±1.88a
Kinali Merah	63.75 ±24.84ab	37.74 ±6.25efghi	31.60 ±1.97a	102.20 ±0.89c
Kinali Putih	80.00 ±17.08abcd	42.56 ±6.71ij	31.00 ±1.53a	101.20 ±1.95bc
Landak	65.00 ±12.81ab	25.73 ±3.60abcd	33.20 ±3.58ab	100.40 ±0.73ab
Larantuka	85.00 ±14.70bcd	33.08 ±8.70defgh	33.00 ±2.77ab	104.40 ±2.62d
Madura	86.25 ±5.59bcd	30.50 ±9.00bcde	30.20 ±2.11a	99.40 ±1.10a
Rancabuaya	80.00 ±14.61bcd	21.93 ±1.98a	31.20 ±1.46a	100.40 ±0.73ab
Siantar Merah	81.25 ±10.21bcd	30.12 ±7.75bcde	30.40 ±2.05a	99.40 ±1.10a
Siantar Putih	70.00 ±15.05bcd	33.75 ±9.61defgh	32.60 ±3.03ab	100.80 ±1.46ab
Siborongborong	53.75 ±25.16a	32.05 ±9.68 defg	33.00 ±3.65ab	99.40 ±1.10a
Soe Timor	75.00 ±25.26abcd	43.43 ±7.23ij	35.00 ±2.89b	108.40 ±4.38e
Sultra	77.50 ±15.98abcd	26.62 ±9.75abcd	30.60 ±2.05a	99.80 ±0.89a
Sumba Timor	90.00 ±7.74cd	40.52 ±9.32ghij	32.80 ±1.77ab	111.20 ±4.60g
Sumedang	75.00 ±17.31abcd	26.32 ±6.70abcd	30.60 ±1.88a	99.00 ±1.15a
Sumenep	66.25 ±20.28abc	27.94 ±8.34abcd	30.80 ±1.77a	99.40 ±1.10a
Sungai Liat B	91.25 ±6.85d	32.50±4.31 defg	32.00 ±3.11ab	99.20 ±2.41a
Tondegesan	78.75 ±16.38bcd	29.32±3.94abcde	31.60 ±1.88a	99.80 ±1.67a
Tondegesan Putih	87.50 ±11.97abcd	29.78±3.82abcde	31.40 ±1.24a	99.20 ±1.95a
Tuban	73.75 ±9.82abcd	31.24 ±7.77cdef	35.20 ±2.67b	99.40 ±1.10a

ANOVA, Analysis of Variance - Different letters in the same column indicate significant differences LSD *($P<0.05$)*

Table 3b. Means, standard deviations and ANOVA analyses for quantitative agromorphological parameters in Indonesian peanut cultivar

Cultivar	Canopy width (cm)	Leaflet Length (cm)	Leaflet Width (cm)	Pod per plant
Atambua	30.10 ±3.18ab	4.19 ±0.35a	2.73 ±0.30efghij	18.40 ±4.99fghij
Batu	36.22 ±7.35 defgh	5.22 ±0.42ghi	2.54 ±0.18abcdef	17.80 ±8.96defgh
Baturaja B	37.37 ±1.99efghi	5.23 ±0.25ghi	2.61 ±0.04bcdefghi	20.00 ±6.76hijk
Binjai	30.79 ±3.20ab	4.28 ±0.67a	2.48 ±0.20abcd	17.65 ±4.79defgh
Ciamis	36.90 ±4.20defgh	5.45 ±0.34i	2.83 ±0.12ij	11.90 ±2.60ab
Citayam	35.25 ±6.85cdefg	4.72 ±0.29bcde	2.80 ±0.33ghij	16.36 ±1.04cdefg
Gajah	32.65 ±4.74abcd	4.87 ±0.55cdef	2.57 ±0.28abcdefgh	13.65 ±3.53abcd
Garut	40.05 ±6.48hi	4.81 ±0.31cdef	2.49 ±0.16abcde	13.45 ±6.46abcd
Gorontalo A	29.78 ±4.58a	4.86 ±0.09cdef	2.67 ±0.04defghij	13.40 ±2.14abcd
Gorontalo B	29.13 ±2.32a	4.75 ±0.26bcde	2.53 ±0.09abcdef	15.85 ±5.16bcdef
Gorontalo C	34.06 ±2.68bcdef	5.00 ±0.42efgh	2.50 ±0.14abcde	10.90 ±3.00a
Jatim	36.20 ±5.07defgh	5.01 ±0.27efgh	2.42 ±0.22abc	17.00 ±5.58defgh
Kanonang	33.86 ±7.02abcde	4.75 ±0.11bcde	2.65 ±0.05cdefghij	13.35 ±6.87abcd
Kanonang Putih	35.35 ±6.55cdefg	5.07 ±0.35efgh	2.81 ±0.24hij	11.90 ±4.57ab
Karo	33.40 ±4.76abcde	4.66 ±0.35bcd	2.60 ±0.11abcdefghi	17.90 ±4.12defgh
Kefa Timor	29.13 ±2.32a	4.56 ±0.50abc	2.56 ±0.21abcdefg	16.92 ±2.35cdefg
Kelinci	33.90 ±6.70abcde	5.39 ±0.09hi	2.67 ±0.08defghij	12.95 ±4.54abc
Kinali Merah	41.67 ±3.51i	4.71 ±0.57bcde	2.75 ±0.32fghij	22.18 ±2.24jk
Kinali Putih	41.50 ±3.17i	5.17 ±0.29fghi	2.80 ±0.21ghij	12.50 ±6.00abc
Landak	36.28 ±3.66defgh	5.19 ±0.79fghi	2.82 ±0.19ij	24.80 ±2.64kl
Larantuka	29.78 ±4.58a	4.88 ±0.53cdef	2.63 ±0.32cdefghij	27.11 ±3.46l
Madura	36.08 ±3.05defgh	4.78 ±0.34bcde	2.69 ±0.14defghij	15.15 ±2.56bcdef
Rancabuaya	40.43 ±1.86hi	5.38 ±0.24hi	2.86 ±0.18j	12.25 ±5.50abc
Siantar Merah	35.85 ±0.80cdefg	4.68 ±0.36bcd	2.50 ±0.19abcde	14.50 ±4.40abcde
Siantar Putih	33.20 ±2.91abcde	5.09 ±0.27efgh	2.59 ±0.17abcdefghi	13.50 ±1.76abcd
Siborongborong	31.34 ±3.37abc	4.72 ±0.71bcde	2.38 ±0.36 ab	12.95 ±2.44abc
Soe Timor	34.06 ±2.68bcdef	4.42 ±0.66ab	2.36 ±0.23a	21.60 ±3.72ijk
Sultra	34.40 ±3.33bcdef	5.15 ±0.37fghi	2.69 ±0.13defghij	19.65 ±1.36ghij
Sumba Timor	29.31 ±2.39a	4.71 ±0.41bcde	2.42 ±0.25abc	18.89 ±2.40fghij
Sumedang	39.08 ±1.11ghi	5.00 ±0.70efgh	2.60 ±0.27abcdefghi	19.55 ±4.52ghij
Sumenep	37.73 ±4.75efghi	4.96 ±0.91defg	2.53 ±0.44abcdef	24.25 ±9.53kl
Sungai Liat B	34.85 ±7.06bcdef	5.04 ±0.13efgh	2.56 ±0.09abcdefg	15.60 ±3.18bcdef
Tondegesan	35.87 ±2.61cdefg	5.25 ±0.70ghi	2.57 ±0.24abcdefgh	13.50 ±6.32abcd
Tondegesan	38.75 ±5.23fghi	5.01 ±0.19efgh	2.43 ±0.17abcde	15.75 ±8.01bcdef
Tuban	34.83 ±5.10bcdef	5.05 ±0.13efgh	2.71 ±0.16defghij	12.03 ±3.24abc

ANOVA, Analysis of Variance - Different letters in the same column indicate significant differences LSD *($P<0.05$)*

Table 3c. Means, standard deviations and ANOVA analyses for quantitative agromorphological parameters in Indonesian peanut cultivar

Cultivar	100-Seed (g)	Yield (kg/ha)	Pest Attack (%)
Atambua	39.65 ±4.95abcd	241.81±10.34a	0.00a
Batu	40.19 ±5.21abcde	659.03±15.16hi	11.11±2.24e
Baturaja B	52.13 ±4.70ghi	950.73±42.91qr	0.00a
Binjai	41.98 ±4.60abcde	589.13 ±44.95fg	11.11±1.86e
Ciamis	46.98 ±3.16efg	596.15±24.24fg	8.89±0.76d
Citayam	43.94 ±1.59cdef	504.88 ±2.44de	4.44±0.84c
Gajah	54.02 ±8.80hi	691.94 ±32.31ij	0.00a
Garut	46.76 ±4.16efg	916.45 ±48.61opq	4.44±0.47c
Gorontalo A	36.14 ±5.16ab	349.69 ±22.73b	0.00a
Gorontalo B	38.44 ±9.77abcd	355.94 ±39.05b	11.11±1.53e
Gorontalo C	39.65 ±4.95abcd	271.78 ±27.46 a	11.11±2.03e
Jatim	44.37 ±4.95def	752.55 ±50.09kl	4.45±0.71c
Kanonang Merah	48.46 ±2.17fgh	817.09 ±22.66n	4.45±0.62c
Kanonang Putih	42.80 ±2.17bcdef	811.70 ±51.54mn	4.44±0.96c
Karo	42.62 ±4.62bcdef	539.46 ±37.02de	14.45±2.74f
Kefa Timor	40.63 ±1.21abcde	591.18 ±46.47fg	2.22±0.35b
Kelinci	37.88 ±9.01abc	428.59 ±62.29c	0.00a
Kinali Merah	40.63 ±1.21abcde	712.17 ±45.71jk	0.00a
Kinali Putih	37.29 ±3.29abc	512.97 ±48.53d	0.00a
Landak	54.51 ±7.46hi	880.47 ±61.95o	0.00a
Larantuka	38.44 ±9.77abcd	684.17 ±71.47ij	0.00a
Madura	46.82 ±2.99efg	771.44 ±40.38lmn	0.00a
Rancabuaya	46.24 ±3.91efg	931.65 ±62.07pqr	0.00a
Siantar Merah	46.02 ±5.24efg	655.73 ±32.33 hi	0.00a
Siantar Putih	41.41 ±4.03abcde	630.86 ±44.52gh	0.00a
Siborongborong	42.85 ±8.78bcdef	327.16 ±44.13b	13.33±1.99f
Soe Timor	39.18 ±5.35abcd	799.75 ±58.12mn	0.00a
Sultra	44.18 ±3.57def	902.92 ±29.61opq	0.00a
Sumba Timor	36.14 ±5.16ab	633.40 ±37.76gh	0.00a
Sumedang	42.46 ±6.69bcdef	767.43±39.02lm	0.00a
Sumenep	43.94 ±5.62cdef	969.47 ±42.81r	0.00a
Sungai Liat B	35.64 ±3.44a	411.42 ±30.97c	11.11±1.74e
Tondegesan Merah	55.74 ±5.39i	660.10 ±33.21 hi	7.78±1.28d
Tondegesan Putih	39.18 ±5.35abcd	885.00±88.97op	4.44±0.75c
Tuban	40.59 ±7.24abcde	575.45±24.33ef	13.34±2.34f

ANOVA, Analysis of Variance - Different letters in the same column indicate significant differences LSD *(P<0.05)*

The weight of 100 seeds ranged from 35.64 g (Sungai Liat B) to 55.74 g (Tondegesan Merah). MALLIKARJUNA-SWAMY *et al.* (2003), HOLBROOK and DONG (2005), UPADHYAYA *et al.* (2003) and YOL *et al.* (2018) also recorded similar values for the 100-seed weight parameter. With respect to yield parameter, the mean value was around 650 kg/ha. These results agree with those obtained by FRIMPONG (2004): 681 kg/ha. The highest yields were found in the Baturaja B, Rancabuaya, and Sumenep accessions, for which values higher than those seen for the control cultivars were obtained. There was no correlation between yield and plant height, canopy width, pods per plant and 100-seed weight. Although the presence of *Ralstonia solanacearum* was detected at the trial plot, the wilt incidence levels were less than 15% in all the cases. Following MACHMUD and RAIS (1994), it could be said that all studied cultivars are considered as resistant genotypes. This high level of resistence to wilt disease is the main reason of farmers in wilt endemic areas for not planting new cultivars (NUGRAHAENI *et al.*, 2017). The strongest attack by pests (*Ralstonia solanacearum*) was found in the Karo cultivar (14.45%). On the other hand, the accessions resistant to the disease were Gajah, Landak, Kelinci (reference cultivars), Atambua, Baturaja B, Gorontalo A, Kinali Merah, Kinali Putih, Larantuka, Madura, Rancabuaya, Siantar Merah, Siantar Putih, Soe, Sultra, Sumba, Sumedang, and Sumenep (traditional cultivars). It can be seen that the three most productive cultivars (Baturaja B, Rancabuaya, and Sumenep) were not subject to *Ralstonia solanacearum* attack. Similar wilt incidence levels were recorded by NUGRAHAENI and RAHAYU (2017) for Indonesian peanut cultivars.

Qualitative agromorphological parameters are shown in Table 4. Since there are six growth habits based on the angle of the primary branches during the podding stage (IBPGR and ICRISAT, 1992), the growth habit of all the cultivars in the present research was erect. “Erect” was also the most predominant growth habit observed by UPADHYAYA *et al.* (2003) in the ICRISAT core peanut collection. Four leaflet shapes were observed in this study. Obcuneate was the most frequent (19 cultivars), followed by elliptic in 7 cultivars, lanceolate in 6, and cuneate in 3 (Figure 1).

Figure 1. Leaflet shape

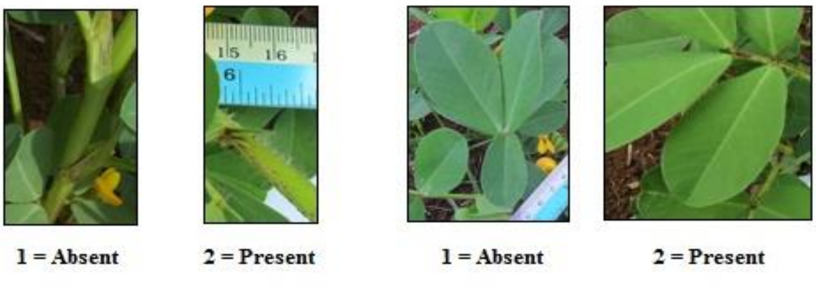

Figure 2. Stem and leaflet hairiness of peanuts

Stem hairiness was detected in 27 cultivars and was absent in 8 cultivars. Leaflet hairiness was only found in five cultivars and was absent in 30 cultivars (Figure 2).

Table 4a. Qualitative agromorphological parameters in Indonesian peanut cultivars

Cultivar	Vegetative habit	Leaflet Shape	Stem Hairiness	Leaflet Hairiness
Atambua	Erect	Obcuneate	Present	Absent
Batu	Erect	Elliptic	Present	Absent
Baturaja B	Erect	Elliptic	Present	Absent
Binjai	Erect	Obcuneate	Absent	Absent
Ciamis	Erect	Elliptic	Present	Absent
Citayam	Erect	lanceolate	Present	Absent
Gajah	Erect	Cuneate	Present	Absent
Garut	Erect	Obcuneate	Present	Absent
Gorontalo A	Erect	Elliptic	Absent	Absent
Gorontalo B	Erect	Elliptic	Absent	Absent
Gorontalo C	Erect	Obcuneate	Absent	Absent
Jatim	Erect	Obcuneate	Present	Present
Kanonang Merah	Erect	Obcuneate	Present	Absent
Kanonang Putih	Erect	Obcuneate	Present	Absent
Karo	Erect	Obcuneate	Present	Absent
Kefa Timor	Erect	Obcuneate	Absent	Absent
Kelinci	Erect	Elliptic	Present	Absent
Kinali Merah	Erect	Obcuneate	Present	Absent
Kinali Putih	Erect	Obcuneate	Present	Present
Landak	Erect	Obcuneate	Absent	Absent
Larantuka	Erect	Obcuneate	Absent	Absent
Madura	Erect	Obcuneate	Present	Absent
Rancabuaya	Erect	Obcuneate	Present	Absent
Siantar Merah	Erect	Cuneate	Present	Absent
Siantar Putih	Erect	Obcuneate	Present	Present
Siborongborong	Erect	Obcuneate	Present	Absent
Soe Timor	Erect	Lanceolate	Present	Absent
Sultra	Erect	Obcuneate	Present	Absent
Sumba Timor	Erect	Cuneate	Present	Absent
Sumedang	Erect	Lanceolate	Present	Absent
Sumenep	Erect	Lanceolate	Present	Absent
Sungai Liat B	Erect	Obcuneate	Present	Present
Tondegesan Merah	Erect	Lanceolate	Present	Absent
Tondegesan Putih	Erect	Lanceolate	Present	Present
Tuban	Erect	Elliptic	Absent	Absent

Table 4b. Qualitative agromorphological parameters in Indonesian peanut cultivars

Cultivar	Pod surface	Pod constriction	Pod beak	Seed shape
Atambua	Pubescent	Deep	Inconspicuous	Elongated-Slender
Batu	Pubescent	Shallow	Inconspicuous	Short broad
Baturaja B	Glabrous	Medium	Inconspicuous	Cylindrical-Tapered
Binjai	Glabrous	Shallow	Absent	Spheroidal
Ciamis	Glabrous	Shallow	Inconspicuous	Cylindrical-Tapered
Citayam	Glabrous	Shallow	Inconspicuous	Elongated-Slender
Gajah	Glabrous	Deep	Pronounced	Cylindrical blunt ends
Garut	Glabrous	Medium	Inconspicuous	Elongated-Slender
Gorontalo A	Pubescent	Deep	Inconspicuous	Spheroidal
Gorontalo B	Pubescent	Medium	Inconspicuous	Elongated-Slender
Gorontalo C	Pubescent	Medium	Inconspicuous	Short broad
Jatim	Pubescent	Medium	Inconspicuous	Elongated-Slender
Kanonang Merah	Glabrous	Deep	Pronounced	Cylindrical-Tapered
Kanonang Putih	Pubescent	Medium	Pronounced	Short broad
Karo	Glabrous	Shallow	Inconspicuous	Spheroidal
Kefa Timor	Glabrous	Deep	Pronounced	Elongated-Slender
Kelinci	Pubescent	Shallow	Inconspicuous	Cylindrical-Tapered
Kinali Merah	Glabrous	Deep	Pronounced	Elongated-Slender
Kinali Putih	Glabrous	Medium	Absent	Short broad
Landak	Pubescent	Deep	Inconspicuous	Elongated-Slender
Larantuka	Glabrous	Deep	Pronounced	Cylindrical-Tapered
Madura	Glabrous	Deep	Pronounced	Elongated-Slender
Rancabuaya	Pubescent	Medium	Inconspicuous	Cylindrical-Tapered
Siantar Merah	Pubescent	Medium	Inconspicuous	Cylindrical-Tapered
Siantar Putih	Pubescent	Deep	Inconspicuous	Cylindrical-Tapered
Siborongborong	Pubescent	Medium	Pronounced	Spheroidal
Soe Timor	Glabrous	Deep	Pronounced	Elongated-Slender
Sultra	Pubescent	Deep	Inconspicuous	Spheroidal
Sumba Timor	Glabrous	Deep	Pronounced	Elongated-Slender
Sumedang	Glabrous	Medium	Inconspicuous	Spheroidal
Sumenep	Glabrous	Medium	Absent	Cylindrical-Tapered
Sungai Liat B	Pubescent	Shallow	Inconspicuous	Cylindrical-Tapered
Tondegesan Merah	Pubescent	Medium	Pronounced	Spheroidal
Tondegesan Putih	Pubescent	Medium	Pronounced	Spheroidal
Tuban	Glabrous	Medium	Absent	Elongated-Slender

Table 4c. Qualitative agromorphological parameters in Indonesian peanut cultivars

Cultivar	Petal Color	Leave Color	Coat color	Seed/ pod
Atambua	Orange	Dark green	Cream	3-2-1-4
Batu	Orange-Yellow	Dark green	Tan	3-1-2
Baturaja B	Orange	Medium green	Cream	2-1-3
Binjai	Brick red	Dark green	Cream	2-1
Ciamis	Lemon yellow	Medium green	Dark purple	2-1
Citayam	Orange-Yellow	Medium green	Cream	2-3-1
Gajah	Brick red	Dark green	Light pink	2-1-3
Garut	Orange	Medium green	Dark purple	2-3-1-4
Gorontalo A	Lemon yellow	Light green	Pink	2-1
Gorontalo B	Orange	Medium green	Pink	2-1
Gorontalo C	Orange	Medium green	Light pink	2-1
Jatim	Orange-Yellow	Dark green	Cream	3-2-4-1
Kanonang Merah	Brick red	Light green	Wine	2-3-4-1
Kanonang Putih	Orange-Yellow	Medium green	Light pink	3-4-2-1
Karo	Orange-Yellow	Medium green	Cream	2-1
Kefa Timor	Orange	Light green	Pink	2-1-3
Kelinci	Orange-Yellow	Medium green	Cream	3-2-1-4
Kinali Merah	Yellow	Light green	Red	2-3-1-4
Kinali Putih	Orange-Yellow	Medium green	Light pink	3-2-4-1
Landak	Orange	Medium green	Wine	2-1
Larantuka	Orange	Medium green	Pink	3-2-1-4
Madura	Orange	Medium green	Pink	2-1-3
Rancabuaya	Orange	Dark green	Dark purple	3-2-4-1
Siantar Merah	Orange	Medium green	Wine	2-3-1-4
Siantar Putih	Orange-Yellow	Medium green	Cream	3-4-2-1
Siborongborong	Yellow	Medium green	White	2-1-3
Soe Timor	Orange-Yellow	Light green	Pink	3-2-1-4
Sultra	Orange	Medium green	Cream	2-1-3
Sumba Timor	Orange	Medium green	Pink	2-3-1-4
Sumedang	Lemon yellow	Light green	Cream	2-1-3
Sumenep	Lemon yellow	Medium green	Tan	2-1-3
Sungai Liat B	Yellow	Light green	Cream	3-2-1-4
Tondegesan Merah	Orange	Medium green	Red	2-3-4-1
Tondegesan Putih	Orange-Yellow	Medium green	Pink	3-4-2-1
Tuban	Orange	Medium green	Light pink	2-1

UPADHYAYA (2003) and UPADHYAYA *et al.* (2003) also observed hairy stems and almost glabrous leaflets with mostly elliptic and obcuneate shapes. Glabrous (18 cultivars) and pubescent (17 cultivars) pod surfaces were observed. A medium degree of constriction in mature pods was present in 15 cultivars, followed by deep constriction in 13 cultivars, and shallow constriction in 7 cultivars. Other researchers that observed important pod constrictions were HOLBROOK and DONG (2005). In mature pods, the beak was absent in 4 cultivars, inconspicuous in 19 cultivars, and pronounced in 12. Different pod shapes (surface, constriction and beak) are shown in Figure 3. The spheroidal shape in mature seeds was present in 8 cultivars, the short-broad form in 4, elongated-slender in 12, cylindrical-tapered end in 10 cultivars, and only one cultivar was cylindrical-blunt ended (Figure 4). Most cultivars with seeded pods had 2-1 seeds (2-seed pods most frequent, 1-seed pods less frequent) (IBPGR and ICRISAT, 1992). These results are in agreement with those of UPADHYAYA (2003). A negative correlation between seeds per pod (R2=0.85) and 100-seed weight was noted. In general, cultivars with a low number of seeds per pod had large seeds. It can be observed that some of the most productive cultivars had only 2-1 seeds per pods (Sumeped, Baturaja B and Rancabuaya).

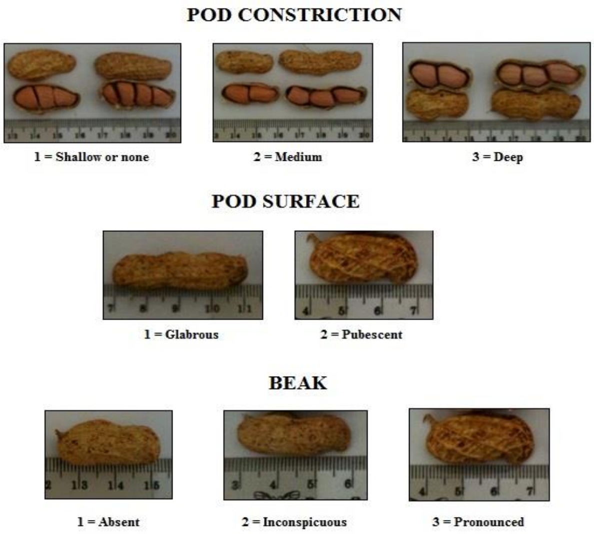

Figure 3. Pod shape of peanut

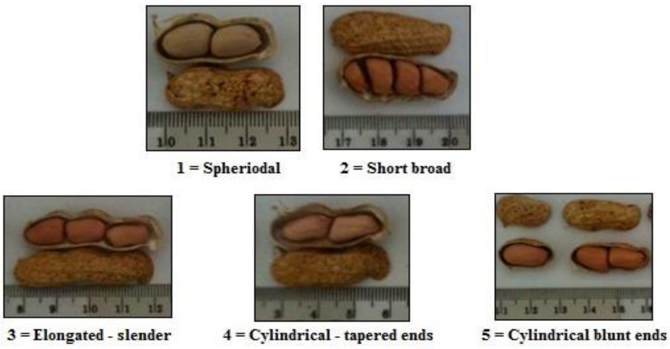

Figure 4. Seed shape of peanut

Only five out of seven types of petal color were observed. The orange petal was the one most commonly represented (15 cultivars) followed by orange-yellow (10 cultivars), lemon yellow in 4 cultivars, yellow in 3 cultivars, and brick-red petals in 3 cultivars. UPADHYAYA *et al.* (2003) observed orange, garnet or brick red, and orange-yellow petals, but, lemon yellow and yellow were not observed in any of the peanut cultivars. Three leaf colors were observed in the cultivars. Medium green was the most frequent (22 cultivars), followed by light green (7 cultivars) and dark green in 6 cultivars. Seven classes of seed color were observed: cream was the most commonly represented (11 cultivars) followed by pink (8 cultivars). White was only seen in the Siborongborong cultivar.

Chemical composition of seeds

The means, standard deviations and ANOVA analyses for the chemical parameters analyzed in the peanut fruits are shown in Table 5. Oil or fatty acid in peanuts is influenced by many different components, including the oil concentration, seed mass, and the mean oil produced per seed. All of these traits can potentially be improved through selection as long as there is sufficient genetic variation (WILSON *et al.*, 2013). The highest oil content was found in the Sumedang cultivar (45.24%) and the lowest was recorded for the Siantar Merah cultivar (17.68%). With respect to the unsaturated omega-3 fatty acid (linolenic acid), the highest value was also found in the Sumedang cultivar (5.17 g/100g). This value was higher than that of the Landak control cultivar (4.39 g/100g). Other cultivars with high omega-3 contents were Karo, Sumenep, Binjai and Sumba Timor (4.25-4.16 g/100g). The highest value of unsaturated omega-6 fatty acid (linoleic acid) was recorded for the Sumedang cultivar (46.84 g/100g), and the lowest for the Kinali Putih cultivar (27.07 g/100g). High omega-6 contents were also found in the Jatim, Karo, Baturaja B, Sultra, Rancabuaya, Larantuka, Garut, and Citayam accessions (43.12-40.06 g/100g). The highest unsaturated omega-9 fatty acid (oleic acid) content was found in the Siantar Merah cultivar (47.61 g/100g) and the lowest was detected in the Soe Timur cultivar (29.56 g/100g). High omega-9 contents were observed in the Ciamis, Sungai Liat B, Binjai, Citayam, Sultra, Jatim, Garut, Sumenep, Siantar Putih and Karo traditional cultivars (>40 g/100g). The highest omega-3/omega-6 ratios were found in the Landak control cultivar (0.12), followed by the Binjai, Madura, Sumenep, Sumba Timor and Sumenang traditional Indonesian cultivars (0.11 omega-3/omega-6 ratio). According to CORONADO *et al.* (2006) this ratio significantly improves the nutritional attributes of the crop and is therefore important parameter to consider as regards a healthy diet. As indicated by LÓPEZ *et al.* (2001), a high omega-9/omega-6 ratio is related to the stability of peanut oil and, in addition, a high oleic/linoleic ratio also appears to have health benefits. The highest ratios were observed for some traditional Indonesian cultivars: Kinali Putih (1.34), Siantar Merah (1.3), and Gorontolo C (1.25). These ratios were higher than the values found for the control cultivars (Table 5). According to LÓPEZ *et al.* (2001), in current cultivars the oleic/linoleic ratio ranges from 0.8 to 2, indicating that in general Indonesian cultivars have intermediate values of this ratio.

The traditional Binjai and Sumenep cultivars had good omega-3/omega-6 (0.11) and omega-9/omega-6 (about 1.12) ratios, these values being similar to those seen for the Landak control cultivar (0.12 and 1.17 respectively). It was also found that the most productive cultivars (Baturaja B, Rancabuaya and Sumenep) had an interesting combination of the high-yield, high content of unsaturated fatty acids and resistance to *Ralstonia solanacearum* characters.

Table 5. Means, standard deviations and ANOVA analyses for chemical parameters in Indonesian peanuts

Cultivar	Total Oil (%)	Omega3 (g/100g)	Omega6 (g/100g)	Omega9 (g/100g)	Omega3/ Omega6	Omega9/ Omega6
Atambua	38.40±3.98gi	2.16±0.32gh	35.03±3.42defg	35.58±3.54cdef	0.06±0.01bc	1.02±0.11ij
Batu	31.79±3.02cde	2.69±0.30k	38.93±3.36ghij	36.03±3.52defg	0.07±0.01cd	0.93±0.19def
Baturaja B	32.77±3.64def	3.11±0.35q	42.49±3.97jkl	38.27±3.79fghi	0.07±0.01cd	0.90±0.14cd
Binjai	35.75±3.81efg	4.17±0.40v	37.98±3.52fghi	44.33±4.36jk	0.11±0.02gh	1.17±0.17p
Ciamis	43.43±4.02jk	2.96±0.30n	39.25±3.84ghijk	44.95±4.71jk	0.08±0.01de	1.15±0.16op
Citayam	29.27±2.86bcd	3.01±0.32no	40.06±3.59hijk	43.73±4.34jk	0.08±0.01de	1.09±0.14lm
Gajah	38.04±3.49ghi	2.87±0.29m	32.69±3.26bcde	33.17±3.96abcde	0.09±0.02ef	1.01±0.13hi
Garut	42.15±4.11ijk	3.57±0.34s	40.11±3.89hijk	42.19±4.08ij	0.09±0.01ef	1.05±0.18jk
Gorontalo A	38.87±3.47ghi	2.37±0.27i	33.95±3.72cdef	38.21±3.83fghi	0.07±0.01cd	1.13±0.12no
Gorontalo B	38.53±3.19ghi	2.21±0.29h	32.16±3.64bcde	32.73±3.13abcd	0.07±0.01cd	1.02±0.11ij
Gorontalo C	42.50±4.00ijk	1.92±0.21d	28.70±2.99ab	35.81±3.72cdef	0.07±0.01cd	1.25±0.14q
Jatim	41.88±3.88ijk	2.87±0.32lm	43.12±4.02kl	42.53±4.31ij	0.07±0.01cd	0.99±0.10hi
Kanonang Merah	39.03±3.73ghij	2.02±0.28e	27.53±3.16a	31.21±3.73abc	0.07±0.01cd	1.13±0.12no
Kanonang Putih	43.50±4.20jk	2.82±0.27l	37.69±3.47fghi	38.08±3.64fghi	0.07±0.01cd	1.01±0.10 hi
Karo	36.61±3.47fgh	4.25±0.39w	43.03±4.33kl	40.26±3.99ghij	0.10±0.02jg	0.94±0.09ef
Kefa Timor	39.62±3.94ghij	2.06±0.31ef	33.51±3.73cdef	30.08±2.95ab	0.06±0.01bc	0.90±0.09cd
Kelinci	28.77±2.46bcd	3.88±0.37t	38.36±3.91ghij	43.23±3.98jk	0.10±0.02fg	1.13±0.11no
Kinali Merah	38.47±3.63ghi	2.45±0.28j	31.13±3.00abcd	32.81±3.14abcd	0.08±0.01de	1.05±0.12jk
Kinali Putih	38.45±3.94ghi	1.90±0.20d	27.07±2.94a	36.30±3.82defg	0.07±0.01cd	1.34±0.14s
Landak	18.86±2.03a	4.39±0.42y	37.57±3.71fghi	44.13±4.37jk	0.12±0.02h	1.17±0.11p
Larantuka	35.68±3.83efg	3.32±0.34r	40.47±3.78hijk	35.56±3.46cdef	0.08±0.01de	0.88±0.09c
Madura	36.50±3.18fgh	4.06±4.01u	37.68±3.19fghi	37.15±3.28efgh	0.11±0.02gh	0.99±0.09hi
Rancabuaya	26.84±2.99b	2.99±0.30no	41.35±3.92ijk	34.46±3.64bcdef	0.07±0.01cd	0.83±0.09b
Siantar Merah	17.68±2.37a	3.04±0.34op	36.51±3.67efgh	47.61±4.32k	0.08±0.01de	1.30±0.18r
Siantar Putih	32.81±3.52def	3.35±0.32r	39.88±3.71ghijk	40.55±4.12ghij	0.08±0.01de	1.02±0.14ij
Siborongborong	39.07±3.64ghij	1.34±0.18 a	30.67±2.82abc	33.97±3.71abcde	0.04±0.01a	1.11±0.12mn
Soe Timor	35.63±3.91efg	1.55±0.19b	30.24±3.06abc	29.56±2.93a	0.05±0.01ab	0.98±0.09gh
Sultra	38.28±3.73ghi	2.10±0.23fg	42.07±4.07jkl	42.54±3.96ij	0.05±0.01ab	1.01±0.09hi
Sumba Timor	41.21±4.11ijk	4.16±0.39v	36.37±3.73efgh	32.97±3.24abcd	0.11±0.02gh	0.91±0.09cde
Sumedang	45.24±4.30k	5.17±0.45z	46.84±4.51l	30.40±2.64ab	0.11±0.02gh	0.65±0.09 a
Sumenep	27.46±2.96bc	4.17±0.37v	39.32±3.94ghijk	41.60±4.01hij	0.11±0.02gh	1.06±0.16kl
Sungai Liat B	31.06±3.47cde	2.41±0.29ij	39.97±3.73ghijk	44.88±4.23jk	0.06±0.01bc	1.12±0.15mno
Tondegesan Merah	40.27±3.61hij	3.10±0.32pq	37.24±3.49fghi	35.41±3.71cdef	0.08±0.01de	0.95±0.09fg
Tondegesan Putih	43.65±4.30jk	1.69±0.23c	32.45±3.26bcde	35.28±3.11cdef	0.05±0.01ab	1.09±0.14lm
Tuban	40.70±3.99hij	2.36±0.29i	31.47±3.22abcd	33.18±3.35abcde	0.07±0.01 cd	1.05±0.11jk

ANOVA, Analysis of Variance - Different letters in the same column indicate significant differences LSD *($P<0.05$)*

Statistical analyses

The ANOVA analyses for the quantitative agro-morphological and chemical fruit parameters of peanut cultivars with respect to the 5 planting seasons are showed in Table 6. Significant differences were observed for all the characters of all cultivars with respect to the different planting seasons, except for the harvest-time parameter, in only four cultivars. The main variable in the 5 planting seasons is rainfall, which clearly modifies the agro-morphological and chemical parameters of peanuts. Regarding harvesting time, no differences between planting seasons were found for the Gajah, Landak, Rancabuaya, and Siantar B accessions, which were harvested at 100 days after planting during all 5 seasons. Gajak and Landak are two of the control cultivars which had a very stable crop cycle. UPADHYAYA *et al.* (2003) also evaluated morphological characteristics in a rainy season and in a post-rainy season, observing significant differences for all the parameters in the two peanut groups of the core collection, except for leaflet surface. Thus, our results are in agreement with those of UPADHYAYA *et al.* (2003) who indicated that quantitative morphological peanut descriptors are modified by the growth season.

Table 6. ANOVA analyses for peanut parameters with respect to the 5 planting seasons of the study

ACCESSION	Quantitative agro-morphological parameters								Chemical fruit parameters			
	Vi	Hp	Fl	Hv	C	Pp	Sw	Y	Ot	O3	O6	O9
Atambua	**	**	**	**	**	**	**	**	**	**	**	**
Batu	**	**	**	**	**	**	**	**	**	**	**	**
Baturaja B	**	**	**	**	**	**	**	**	**	**	**	**
Binjai A	**	**	**	**	**	**	**	**	**	**	**	**
Ciamis	**	**	**	**	**	**	**	**	**	**	**	**
Citayam	**	**	**	**	**	**	**	**	**	**	**	**
Gajah	**	**	**	ND	**	**	**	**	**	**	**	**
Garut	**	**	**	**	**	**	**	**	**	**	**	**
Gorontalo A	**	**	**	**	**	**	**	**	**	**	**	**
Gorontalo B	**	**	**	**	**	**	**	**	**	**	**	**
Gorontalo C	**	**	**	**	**	**	**	**	**	**	**	**
Jatim	**	**	**	**	**	**	**	**	**	**	**	**
Kanonang Merah	**	**	**	**	**	**	**	**	**	**	**	**
Kanonang Putih	**	**	**	**	**	**	**	**	**	**	**	**
Karo	**	**	**	**	**	**	**	**	**	**	**	**
Kefa Timor	**	**	**	**	**	**	**	**	**	**	**	**
Kelinci	**	**	**	**	**	**	**	**	**	**	**	**
Kinali Merah	**	**	**	**	**	**	**	**	**	**	**	**
Kinali Putih	**	**	**	**	**	**	**	**	**	**	**	**
Landak	**	**	**	ND	**	**	**	**	**	**	**	**
Larantuka	**	**	**	**	**	**	**	**	**	**	**	**
Madura	**	**	**	**	**	**	**	**	**	**	**	**
Rancabuaya	**	**	**	ND	**	**	**	**	**	**	**	**
Siantar A	**	**	**	**	**	**	**	**	**	**	**	**
Siantar B	**	**	**	ND	**	**	**	**	**	**	**	**
Siborongborong	**	**	**	**	**	**	**	**	**	**	**	**
Soe Timor	**	**	**	**	**	**	**	**	**	**	**	**
Sultra 1	**	**	**	**	**	**	**	**	**	**	**	**
Sumba Timor	**	**	**	**	**	**	**	**	**	**	**	**
Sumedang	**	**	**	**	**	**	**	**	**	**	**	**
Sumenep	**	**	**	**	**	**	**	**	**	**	**	**
Sungai Liat B	**	**	**	**	**	**	**	**	**	**	**	**
Tondegesan Merah	**	**	**	**	**	**	**	**	**	**	**	**
Tondegesan Putih	**	**	**	**	**	**	**	**	**	**	**	**
Tuban	**	**	**	**	**	**	**	**	**	**	**	**

**Significant differences LSD ($P<0.05$). ND, no significant differences LSD ($P<0.05$).

C, canopy; Vi, viability; Hp, plant height; Fl, flowering; Hv, Harvesting; Pp, pod per plant; Sw, 100-seed weight; Y, yield (Kg); Ot, total oil in seed; O3, omega-3; O6, omega-6 in seed; O9, omega-9 in seed

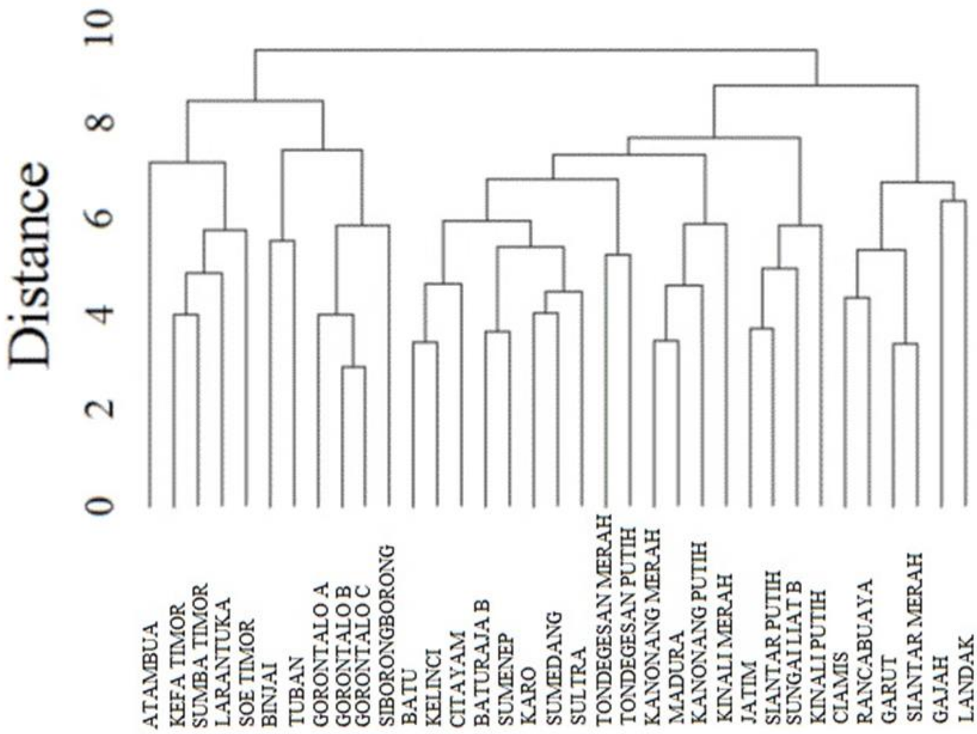

Figure 5. Dendrogram produced using the Furthest Neighbour Method (Euclidean) from agro-morphological and chemical characters of the 35 peanuts cultivars

Figure 5 shows a dendrogram of the relationships among the cultivars obtained on analyzing all the parameters studied. In the dendrogram, there are two major groups clearly clustered by all the parameters measured. Grouping occurs because there are similarities between some of the characters of each cultivar. The dendrogram shows a clear separate grouping that includes Atambua, Kefa Timor, Sumba Timor, Lanrantuka, Soe Timor, Binjai, Tuban, Siborongborong and the three Gorontalo accessions. The Atambua accession had important differences with respect to the rest of accessions originating from the same area, East Nusa Tenggara. Clear synonymies were found with Gorontalo B and C (North Sulawesi), Kanonang Merah (North Sulawesi) with Madura (East Java), Garut (West Java) with Siantar Merah (North Sumatera) and probably Batu with Kelinci (control cultivar). It is possible that the Batu cultivar could be an adaptation from the Kelinci variety, which is a very old cultivar introduced into the Indonesian islands. We observed that Kelinci was the variety that differed the most with respect to the control varieties, whereas Gajah (elephant) and Landak (hedgehog) control cultivars were both in the same group, clearly separated from the traditional Indonesian cultivars. It can also be observed that two of the most interesting cultivars (Baturaja B and Sumeped) are close together in the dendrogram. It can be observed some synonymous accessions were from different Indonesian islands, which indicates an important exchange of genetic material between such islands. Some clear cases of homonymy occur with the Merah and Putih Tondegesan cultivars, with Kinali merah and Kinali Putih, and with Siantar Putih and Merah. Instead of presenting common characteristics, their differences allow them to be separated into two cultivars.

CONCLUSIONS

Thirty-five Indonesian peanut cultivars have been characterized agro-morphologically and chemically. The results of this study clearly indicate that different growth seasons strongly affect the character of the quantitative peanut parameters measured. The dendrogram generated reveals a clear separation between the peanut cultivars and uncovers existing synonymies and homonymies. The most productive cultivars (Baturaja B, Rancabuaya and Sumenep) have an interesting combination of the high-yield, high content of unsaturated fatty acids and resistance to *Ralstonia solanacearum* characters. The highest content of total oil and omega-3 (linolenic acid) was found for the Sumedang cultivar. All these traditional cultivars can be used as potential sources of genetic variation for future peanut improvement programs.

ACKNOWLEDGEMENTS

Our appreciation and acknowledgement are due to 'Hibah PUPTN UNPAD 2013' for research funding; Hawan Mugni for assistantships during early-season field planting trials, and the Indonesian Ministry of Education and Culture for support from the Sandwich program.

Received, July 21th, 2018
Accepted February 18th, 2019

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AGROMORFOLOŠKA I HEMIJSKA KARAKTERIZACIJA TRADICIONALNIH SORATA KIKIRIKIJA U INDONEZIJI

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Izvod

Da bi se poboljšalo znanje o vrstama kikirikija, sakupljeno je trideset pet sorata iz nekoliko različitih regiona u Indoneziji, koje su okarakterisane agromorfološki i hemijski. Ukupno 25 deskriptora, uglavnom definisanih od strane Međunarodnog instituta za biljne genetičke resurse i Međunarodnog instituta za istraživanje useva za polusušne tropske uslove, korišćeni su za opis cvetova, listova i plodova dobijenih tokom 5 vegetacionih sezona (oktobar 2010 - februar 2013). Istraživanje pokazuje da različita godišnja doba snažno utiču na kvantitativne osobine kikirikija. Dendrogram, proizveden korišćenjem metode Euklidianove distance na osnovu agromorfoloških i hemijskih osobina, omogućio je jasno razdvajanje sorata kikirikija i otkrio postojeće sinonime kao što su Gorontalo B i C i homonime, kao što su Kinali Merah i Putih. Neke sorte, kao što su Baturaja B, Rancabuaia i Sumenep, pokazale su zanimljivu kombinaciju visokoprinosnog (950 kg/ha), visokog sadržaja omega-3 (3.42 g/100g) i omega-9 (38.11 g/100 g).) masnih kiselina i otpornost na *Ralstonia solanacearum*. Još dve sorte vezane za hemijski sastav bile su Binjai i Sumedang. Sve ove tradicionalne sorte mogu se koristiti kao potencijalni izvor genetičkih varijacija za buduće programe za poboljšanje kikirikija. Ovaj rad je važan korak u očuvanju genetičkih resursa kikirikija u Indoneziji, koji pokazuju karakteristične i zanimljive agronomske i hemijske karakteristike, kao što su komponente prinosa, vreme sazrevanja i sastav ulja.

Primljeno 21.VII.2018.
Odobreno 18. II. 2019.