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Determination of pod and crop maturity for peanuts using percent pod-fill

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Hinds, Margaret J., Singh, Bharat and Anderson, John C. 1992. **Determination of pod and crop maturity for peanuts using percent pod-fill.** Can. J. Plant Sci. 72: 1057–1065. A simple method for determining pod and crop maturity for peanuts (*Arachis hypogaea* L.) was developed using percent pod-fill (PF) — the percentage of green-pod volume that is seed. Peanut samples were collected 99–141 days after planting (DAP) for 3 yr from two soil types in the eastern Caribbean. PF of the composite pods and of the individual maturity classes from each treatment was determined. ANOVA, significance of means separation and correlation coefficients were computed. The results from the composite samples were correlated with optimum reaping time (ORT) established from the shellout method. ORT occurred 117–141 DAP. PF rate varied with season and soil type, but PF values for mature pods and for composite pods at ORT were independent of pod size, season and soil type. PF of mature pods was 41.5 ±1.3% and was significantly different from that of other maturity classes. PF for composite pods at ORT was 38.2 ± 2.2% and was significantly different from PF values before ORT. The results indicated that percent pod-fill could be a reliable indicator of pod and crop maturity for peanuts.

Key words: *Arachis hypogaea*, peanut maturity, pod-fill, maturity index

Hinds, Margaret J., Singh, Bharat et Anderson, John C. 1992. **Détermination de la maturité de la plante et de la gousse de l'arachide à partir de l'indice de remplissage des gousses.** Can. J. Plant Sci. 72: 1057–1065. Une méthode simple pour déterminer la maturité de la gousse et de la plante de l'arachide (*Arachis hypogaea* L.) a été élaborée à partir des données sur le remplissage de la gousse. On définit l'indice de remplissage de la gousse (IRG) comme étant le pourcentage du volume de la gousse verte occupé par les graines. Des échantillons d'arachides ont été prélevés pendant 3 ans entre 99 et 141 j après la mise en terre sur deux types de sol des Caraïbes orientales. Le IRG de lots composites de gousses et de chaque classe de maturité pour chaque traitement a été déterminé. On a calculé l'analyse de la variance, le degré de signification des écarts entre les moyennes et les coefficients de corrélation. Les résultats obtenus sur les échantillons composites étaient c[illegible] avec les temps de récolte optimum (TRO) établi par la méthode de l'égrenage manuel. Le TRO se situait entre 117 et 141 j après le semis. Le taux de remplissage de la gousse variait selon l'année de culture et le type de sol, mais les valeurs de remplissage des gousses mûres et des gousses composites récoltées au TRO étaient indépendantes de la taille des gousses, de la saison et du type de sol. Le IRG des gousses mûres était de 41,5 ± 1,3%, valeur significativement différente de celle obtenue pour les autres classes de maturité. Le IRG des gousses composites récoltées à TRO était de 38,2 ± 2,2%, ce qui est significativement différent des valeurs obtenues pour les gousses récoltées avant TRO. Les résultats portent à conclure que le IRG pourrait être un indicateur sûr du degré de maturité des gousses et de la culture de l'arachide.

Mots clés: *Arachis hypogaea*, maturité de l'arachide, remplissage de la gousse, indice de maturité

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Optimum quality in peanuts (*Arachis hypogaea* L.) is important at all levels of production and utilization. Size and weight relationships of pod components have been investigated for determining harvest date and maturity of peanuts. Some of the methods that have been used include near-infrared spectroscopy to classify seeds according to size (Whitaker et al. 1987); seed density to distinguish between mature and immature samples (Kramer et al. 1963; Miller and Burns 1971); mean individual weight of oven-dried seeds to estimate crop maturity (Barrs 1962); and seed/hull ratio of oven-dried pods to determine harvest date (Pattee et al. 1980).

The peanut cultivar NC2 is grown extensively in the eastern Caribbean. It is a two-seeded Virginia-type peanut developed from a cross between cultivars GA 207-2 and Whites runner. This cultivar is noted for its excellent shelling percentage (Gregory 1970). However, in the Caribbean there is a high incidence of immature and over-mature pods, improperly cured or dried pods, and moldy pods among the harvested and marketed nuts (Singh 1985). This is because (*i*) there are no established standards for maturity of pods; and (*ii*) date (120 d after planting (DAP)) and/or foliage color are the chief determinants of harvest time. Thus, farmers not only harvest too early but also sell immature pods that are insufficiently cured or dried. These pods subsequently become moldy, and their nuts, which have off-flavors, result in unstable products. Therefore there is a need for reliable, objective and inexpensive methods to distinguish mature pods from others and to determine when crops should be harvested. Fulfillment of this need would enable (*i*) harvested pods to contain the maximum percentage of sound, mature pods; and (*ii*) marketed pods to consist of predominantly mature pods, thereby improving the processing quality of peanuts (separation of testa, adequate fat content, and increased uniformity, consistency and stability of products).

Among the size and weight relationships that have been investigated as maturity indices, the seed/hull ratio has shown the most potential. However, the major constraint of this method is that ratios vary between similar seasons for the same cultivar (Pattee et al. 1980). In this study, percent pod-fill (PF) — the percentage of green-pod volume that is seed — was investigated as a potential maturity and reaping index, since there is a need in peanut-growing areas worldwide for reliable and objective indices that can be determined rapidly. It was hypothesized that (*i*) mature pods of the same cultivar should contain similar degrees of pod-fill; and (*ii*) pod-fill, being a volume ratio, should be a more reliable method than those relying only on measurements of weight or size of pod components. In this context, a maturity index is one that clearly distinguishes between mature and immature pods, while a reaping index is one that reliably denotes crop maturity.

The objectives of this study were to investigate if pod-fill could indicate (*i*) pod maturity, that is, if pod-fills of all mature pods were similar to each other but were significantly different from pod-fills of immature and over-mature pods; and (*ii*) crop maturity, namely, if PF (*a*) changed significantly with DAP, (*b*) displayed fairly consistent values at optimum reaping time (ORT) for all year–soil combinations, and (*iii*) at ORT was significantly different from PF before ORT.

MATERIALS AND METHODS

Collection of Samples

Peanuts (cultivar NC2) were collected from 1985 to 1987 from two soil types (volcanic clay (VC) and volcanic sandy (VS) loams) in St. Vincent at 3-, 4- or 7-d intervals 99–141 DAP. The farms were prepared, planted and maintained by peanut farmers using standard cultural practices (Caribbean Agricultural Research and Development Institute (CARDI) 1983). Lands were prepared by ploughing and harrowing to destroy weeds and obtain a good tilth of 22-cm depth. For weed control, Alachor (2-chloro-2′,6′ diethyl N-(methoxymethyl) acetanilide) was applied at 1.5–3.0 kg ha^{-1} as a pre-emergence treatment, and inter-row manual weeding was done during the first 30 d after sowing. At least 2 wk before sowing, fertilizer (12:12:17) and lime (CaO) were broadcast in quantities of 200 and 2000 kg ha^{-1}, respectively. Seeds were sown during the wet season at a depth of 2.5–5.0 cm, with spacing of approximately 10 cm between plants and 40–45 cm between rows. Soils were not irrigated. Plots were laid out in a randomized complete block design. Three replicates of 100 plants each were harvested per farm on each sampling day. All the pods were collected. In this context, these pods were called composite samples, since they consisted of pods at all maturity stages. The composite samples obtained on each digging day were cleaned with tap water, blotted dry with paper towels, double-wrapped in polyethene bags and stored at −10°C.

Classification of Pods

Each composite sample was thoroughly mixed and subdivided. One subdivision was categorized into maturity stages by matching the internal characteristics of the stages used by Pattee et al. (1974) with the following external features: *intermediate* — thick and soft shell, lines present but not clearly defined (stages 9 and 10); *nearly-mature* — firm shell with reticulations on majority of external surface except for near beak, which was either slightly soft or smooth (stages 11 and 12); *mature* — very firm shell with reticulations clearly defined all over external surface (stage 13); and *over-mature* — very firm and dry shell with pinholes, or shell starting to deteriorate (stage 15). In this context, the subdivisions (of composite samples) that were categorized into maturity stages are called maturity-class samples.

Determination of Percent Pod-fill

Three subsamples of 35 pods were randomly selected from each subdivision of intermediate, nearly mature, mature and composite pods. Each subsample was dropped into a 1-L graduated cylinder (Nalgene TD/TC, graduated in 10 mL) fitted with a funnel, the bore of which allowed the pods to fall singly into the cylinder. The mean volume of the pods was determined by AOAC method #227.001 (Association of Official Analytical Chemists 1980). The pods were then removed from the cylinder and shelled manually. The seeds obtained were blotted dry and added to a 100-mL cylinder (Gradplex, graduated in 1 mL), and their mean volume was determined. Owing to their small numbers, over-mature pods from all treatments were grouped for measuring their percent pod-fill.

Determination of Optimum Reaping Time

The shellout method (Sanders et al. 1982) was used on the subdivision of composite samples from each digging day. ORT for each crop was taken as the digging day on which the maximum percentage of sound, mature pods was obtained.

Climatological Parameters

Records from the Arnos Vale Meteorological Office and Department of Agriculture (St. Vincent) for the period Oct. 1985 to Nov. 1987 were used to derive various climatological factors. These factors provided information on environmental conditions during pod-fill.

Daily rainfall per se was not considered an informative enough factor because of differences in infiltration rates and water-holding capacities of the two soil types, VC and VS loams. Alternatively, SR, the sufficient rain index, was derived. SR represented the percentage of days from onset of flowering to end of season with at least 4.2 mm of moisture in the top 30 cm of soil. The value of 4.2 mm was selected as the standard based on recommendations of CARDI (1983) for Caribbean-grown peanuts.

The mean daytime air temperature, TMN, was obtained from the mean of hourly air temperatures between 6 A.M. and 6 P.M. Skies were cloudy during wet seasons but relatively clear during dry seasons. Thus a solar irradiance factor, IR, related to clearness of skies between 6 A.M. and 6 P.M., was derived: the larger the IR (on an eight-point scale), the clearer the sky. A cumulative heat factor, TIR, related to the interactive heating effect between daytime temperature and solar irradiance, was also derived.

Statistical Analysis

Data from composite samples were analysed separately from those of maturity classes. The Statistical Analysis System (SAS) Institute, Inc. computer package was used for all statistical analyses (SAS 1985).

MATURITY CLASSES. A factorial arrangement of treatments (maturity stages) and replicates per treatment was used to evaluate their effects on percent PF. Year and soil type were nested within each treatment. The effects of location within farm were not considered because (*i*) preliminary experiments conducted in 1985 did not show significant differences among samples in a particular maturity class due to locations within farm; and (*ii*) the numbers of intermediate pods were too small. ANOVA was obtained by the general linear models (GLM) procedure. Significant differences between means ($P = 0.05$) were determined by the Tukey's studentized range (HSD) test. Correlation coefficients were calculated by the method of Pearson product-moment correlation.

COMPOSITE SAMPLES. A factorial arrangement of treatments (harvest dates), locations within farm, and replicates per treatment was used. Year and soil type were nested within each treatment. ANOVA, significance of means separation, and correlation coefficients were computed using the procedures previously outlined.

RESULTS AND DISCUSSION

Maturity-Class Samples

Mean percent PF of mature pods from all the harvest dates per year–soil combination ranged from 40.1 to 43.0 (Table 1). There were no significant differences in overall PF due to soil type. There was progressive increase in PF with advance in maturity stage (Table 1). The ranges of PF for mature (MAT), nearly mature (NM) and intermediate (INT) samples were 40.1–43.0, 34.3–39.3 and 23.8–37.0, respectively. In addition, for individual year–soil combinations, the degree of PF was significantly different between successive maturity stages. There were insufficient over-mature (OM) pods for them to be included in the statistical analysis. However, their PF ranged between 44.5 and 48.6. It was observed that after maturity, the shells became thinner (as they dried out) and started to deteriorate.

The pattern of increase in PF was not consistent but varied among seasons for the same soil type. For example, in 1985, when the VC loam appeared to be hottest and driest (Table 2), rate of PF was very rapid in the younger stages, with the result that the INT samples had a PF of 37.0 ± 2.0% (Table 1).

Table 1. Percent pod-fill of green peanuts (cultivar NC2) at various maturity stages grown in St. Vincent from 1985 to 1987

Maturity stage[z]	Pod-fill of green peanut pods (%)[y]					
	1985		1986		1987	
	VC[x]	VS[x]	VC[x]	VS[x]	VC[x]	VS[x]
MAT	41.87 ± 1.15 *abc*	40.07 ± 0.12 *abcd*	40.87 ± 1.10 *abcd*	40.53 ± 0.55 *abcd*	43.00 ± 0.36 *a*	42.77 ± 0.95 *ab*
NM	39.33 ± 0.32 *abcde*	34.30 ± 0.10 *f*	34.33 ± 1.72 *f*	35.73 ± 2.06 *ef*	38.77 ± 0.42 *bcde*	37.83 ± 2.08 *cdef*
INT	37.00 ± 2.00 *def*	23.83 ± 2.11 *g*	25.57 ± 0.99 *g*	26.10 ± 0.50 *g*	25.17 ± 2.45 *g*	26.77 ± 1.65 *g*

[z]MAT, mature; NM, nearly mature; INT, intermediate.
[y]Means of triplicate determinations × three locations in farm representing averages for harvest dates.
[x]Soils: VC = volcanic clay loam; VS = volcanic sandy loam.
a–g Means with different letters across rows and down columns are significantly different (Tukey's HSD test, $P = 0.05$).

Table 2. Average values[z] of climatological parameters in St. Vincent from Oct. 1985 to Nov. 1987

Climatological parameter[y]	1985		1986		1987	
	VC[x]	VS[x]	VC[x]	VS[x]	VC[x]	VS[x]
SR	42.00	78.00	87.00	74.00	71.00	55.00
TMN	26.20	27.00	27.90	28.40	28.70	28.80
IR	04.49	04.10	03.31	03.25	03.24	03.26
TIR	117.64	110.70	92.35	92.30	92.99	93.89

[z]Average daily values from onset of flowering to end of sample collection for all parameters except SR.
[y]SR = percentage number of days from onset of flowering to end of sample collection with ≥4.2 mm of moisture in top 30 cm of soil; TMN = mean day air temperature (°C); IR = solar irradiance factor; and TIR = cumulative heat factor = TMN × IR.
[x]Soils: VC = volcanic clay loam; VS = volcanic sandy loam.

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The MAT pods in this season attained a PF of 41.9 ± 1.1%. On the other hand, in 1987, when the VC Loam appeared to be cool and damp (Table 2), the increase in PF was remarkably high between the INT (25.2 ± 2.4%) and NM (38.8 ± 0.4%) stages (Table 1). During this season the maximum PF (43.0 ± 0.3%) for mature pods on this soil type was obtained. A slightly different trend was observed for those peanuts grown on VS loam. For example, in 1987, when soil conditions seemed to be driest and warmest (Table 2), the most PF still occurred between INT (26.8 ± 1.6%) and NM (37.8 ± 2.1%) stages (Table 1). Maximum PF of MAT pods (42.8 ± 0.9%) grown on this soil type was attained in this season. However, in 1985, when the VS loam was very wet and cool (Table 2), the degree of PF for the three maturity stages was the least.

PF values of MAT peanuts (cultivar NC2) obtained in this experiment cannot be compared with those of other cultivars, since reports on actual PF measurements were not found in the literature. However, the higher rate of PF that occurred in the warmer VC loam seemed to show similar trends to the findings of Sanders and Blankenship (1984) in which maturation was delayed in cooled (21.8°C) soil but accelerated in heated (28.9°C) soil.

Although rate of PF was influenced by season and soil types, the actual values of PF of MAT pods were significantly greater than those of NM pods (Table 1). Also, even when degree of PF at the immature stages was vastly different (e.g., for the VC loam in 1985 and 1987, Table 1), the PF values of the MAT pods were not significantly different from each other. In addition, PF values of the MAT peanuts was consistently similar irrespective of pod size, soil type and soil conditions (Tables 1–3). Preliminary work on dimensions of pods from 1985 showed that diameters of mature pods from VS loam were significantly larger than those from VC loam (Table 3). Yet the PF values of these pods were not significantly different from each other (Table 1). These findings indicate that a PF of 41.5 ± 1.3% could be used as a maturity index for the peanut cultivar NC2 grown in St. Vincent. These results also suggest that percent PF may have potential as a quick, objective indicator of maturity for NC2 and other peanut cultivars grown worldwide. PF of mature peanuts would have to be established for each cultivar and growing location.

Composite Samples

The results of the shellout method (Table 4) indicated that ORT occurred at the following times for the VC loam: 117 DAP (1985), 127 DAP (1986) and 134 DAP (1987); and for the VS loam: 131 DAP (1986) and

Table 3. Dimensions of green peanuts (cultivar NC2), at various maturity stages grown in St. Vincent in 1985

Maturity stage[z]	Dimension (cm)			
	Pod length[y]		Pod diameter[y]	
	VC[x]	VS[x]	VC[x]	VS[x]
MAT	3.51 ± 0.35 *ab*	4.26 ± 0.18 *a*	1.45 ± 0.09 *b*	1.70 ± 0.08 *a*
NM	3.37 ± 0.47 *b*	3.91 ± 0.08 *ab*	1.39 ± 0.11 *b*	1.45 ± 0.04 *b*
INT	3.29 ± 0.39 *b*	3.47 ± 0.11 *ab*	1.39 ± 0.10 *b*	1.42 ± 0.05 *b*

[z] MAT, mature; NM, nearly mature; INT, intermediate.
[y] Means of triplicate determinations × three locations in farm representing averages for harvest dates.
[x] Soils: VC = volcanic clay loam; VS = volcanic sandy loam.
a,b Means with different letters across rows and down columns are significantly different (Tukey's HSD test, $P = 0.05$).

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Table 4. Percent mature pods among composite samples of pods from St. Vincent 1985–1987 NC2 peanut crops

	Mature pods (%)[y]					
	1985		1986		1987	
DAP[z]	VC[x]	VS[x]	VC[x]	VS[x]	VC[x]	VS[x]
99	5.52 ± 0.43 *p*					
106	17.54 ± 0.50 *n*	10.69 ± 0.41 *o*	57.72 ± 0.44 *de*	56.37 ± 2.08 *e*		
113	45.14 ± 0.60 *l*	17.72 ± 0.44 *n*	62.81 ± 0.36 *bc*	52.76 ± 0.42 *g*	55.90 ± 2.06 *ef*	58.76 ± 0.30 *de*
117	63.48 ± 0.33[w] *b*					
120	59.97 ± 0.45 *cd*	18.83 ± 0.68 *n*	63.22 ± 1.00 *b*	55.90 ± 0.27 *ef*	46.29 ± 0.44 *kl*	49.60 ± 0.38 *ijk*
123					46.89 ± 7.27 *jkl*	51.13 ± 0.14 *ghi*
127	53.38 ± 1.58 *fg*	36.83 ± 0.54 *m*	67.64 ± 1.89[w] *a*	64.56 ± 0.27 *b*	35.26 ± 0.86 *m*	64.07 ± 0.87[w] *b*
130					48.81 ± 0.50 *ijk*	56.49 ± 0.36 *e*
131				69.07 ± 0.42[w] *a*		
134		46.96 ± 3.62 *jkl*	62.39 ± 0.93 *bc*	64.01 ± 0.12 *b*	63.93 ± 0.51[w] *b*	45.94 ± 2.47 *kl*
137					51.90 ± 0.67 *gh*	35.89 ± 0.47 *m*
141					48.61 ± 0.35 *ijk*	34.17 ± 1.54 *m*

[z] Days after planting.
[y] Means of triplicate determinations × three locations in farm.
[x] Soils: VC = volcanic clay loam; VS = volcanic sandy loam.
[w] Optimum reaping time (ORT). For VS 1985, digging was completed before ORT.
a–p Means with different letters across rows and down columns are significantly different (Tukey's HSD test, $P = 0.05$).

127 DAP (1987). In the case of the VS loam in 1985, digging was completed before ORT. However, extrapolation using regression analysis indicated that ORT should have occurred at approximately 141 DAP. ORT obtained from the shellout method was compared with the dates on which the farmers actually harvested other peanut crops that they had planted on the same day as the plots in this study. The results showed that the farmers' use of 120 DAP and/or foliage color to determine harvest date caused them to reap too early in all cases (Table 5). Thus the farmers did not obtain maximum yield from their crops. In addition, their harvests would have contained a higher percentage of immature pods, since it is customary for all harvested pods (except "pops") to be dried and stored together. Hence, the presence of more immature pods among the farmers' stocks would have facilitated the incidence of molds and production of off-flavors during the drying and storage periods.

The percent PF of the green composite pods increased as the seasons progressed up to ORT, when the mean value was 38.2 ± 2.2% (Table 6). PF values of corresponding MAT and NM pods were 41.5 ± 1.2 and 36.7 ± 2.2%, respectively (Table 1). At ORT the PF values from the various year–soil combinations and locations within farms were not

Table 5. Features of composite samples of pods at estimated optimum reaping time (ORT) versus farmers' harvest day from the St. Vincent 1985-1987 NC2 peanut crops

	1985		1986		1987	
	VC[z]	VS[z]	VC[z]	VS[z]	VC[z]	VS[z]
			At estimated ORT			
DAP[y]	117	141[x]	127	131	134	127
Mature pods (%)	63.48	—	67.64	69.07	63.93	64.07
Pod-fill (%)	38.51	—	38.01	38.41	38.16	38.14
			At farmers' harvest day			
DAP[y]	106	120	120	120	127	120
Mature pods (%)	17.54	18.83	62.81	52.76	48.81	49
Pod-fill (%)	28.47	33.16	36.83	36.61	37.37	34.07

[z]Soil types: VC, volcanic clay loam; VS, volcanic sandy loam.
[y]Days after planting.
[x]ORT was obtained by extrapolation.

significantly different from each other. However, in some cases (viz., VC loam in 1986, and VS loam in 1986 and 1987), PF values at ORT were not significantly different from those of up to 2 wk before ORT (Table 6). This is because rates of increase in PF were different between soil types and also between seasons for the same soil type. However, irrespective of the different rates of increase in PF before ORT among the various year-soil combinations, PF of the composite pods at ORT fell within a narrow range.

It would appear that some environmental factors influenced PF rates. Warmer daytime air temperatures (27.8-29.3°C) seemed to promote pod-filling earlier in the season. For example, in (cooler) 1986 at 106 DAP, composite samples from the VC loam had a mean PF of 33.02 ± 1.19%, whereas in (warmer) 1985 composite samples from plants of similar age and same soil type had a lower PF of 28.47 ± 0.76% (Tables 2 and 6). Azu (1979) also observed faster rates of pod-fill during warmer years in Ontario. However, when the St. Vincent soils were damp and cool, the apparently slower rate of the final stages in pod maturity caused ORT to occur at a greater number of DAP and also to extend over a longer period (Table 6). This longer duration of ORT would explain why in 1986 PF values of the composite pods at about 120 DAP were not significantly different from the values on the lone day (viz., 127 DAP for VC and 131 DAP for VS crops) that was considered ORT in this study.

After ORT, the changes in PF of the composite pods were also influenced by environmental factors. Increases were observed in PF for the VC loam (1985) and the VS loam (1986 and 1987) samples, whereas PF for the VC soil samples in 1986 decreased. On the other hand, after ORT, PF for the VC loam samples in 1987 increased, then decreased. After ORT, PF values reflected the proportions of OM to young pods present. In some instances, new pods continued to be formed to the end of the season, while in other instances no new pods developed after about 1 wk after ORT. For example, in 1987 on the VS loam, there were up to 63% OM pods but no young pods at 14 d after ORT (or 141 DAP), hence the high PF of 42.9 ± 3.5% (Table 6). On the other hand, in 1986, at 7 d after ORT there were 4-8% OM pods, but up to 26% young pods were observed among the composite samples from the VC loam, thereby resulting in an overall decrease in PF. The above observations indicated that after ORT, new pods were formed when the soils were relatively moist and cool, thereby causing a reduction in the average PF of the composite samples. On the other hand, if soils were relatively dry and warm after ORT, no new pods were formed but mature pods

Table 6. Percent pod-fill of green composite samples of peanuts (cultivar NC2) grown in St. Vincent from 1985 to 1987

	Pod-fill of green pods (%)[y]					
	1985		1986		1987	
DAP[z]	VC[x]	VS[x]	VC[x]	VS[x]	VC[x]	VS[x]
99	24.40 ± 0.69 *pq*					
106	28.47 ± 0.76 *no*	22.12 ± 3.48 *q*	33.02 ± 1.19 *klm*	31.27 ± 2.69 *mn*		
113	34.10 ± 1.51 *hijklm*	26.06 ± 1.78 *op*	36.47 ± 2.39 *defghij*	35.03 ± 1.21 *fghijkl*	33.36 ± 2.11 *ijklm*	32.92 ± 0.39 *klm*
117	38.51 ± 0.19[w] *bcde*					
120	37.52 ± 1.01 *defg*	33.16 ± 1.23 *jklm*	36.83 ± 2.70 *defgh*	36.61 ± 1.05 *defghi*	34.48 ± 0.56 *ghijklm*	34.07 ± 0.33 *hijklm*
123					37.56 ± 1.02 *defg*	36.28 ± 1.87 *efghijk*
127	39.86 ± 0.49 *abcd*	32.22 ± 1.69 *lm*	38.01 ± 3.61[w] *def*	36.59 ± 2.37 *defghi*	37.37 ± 1.32 *defgh*	38.14 ± 2.11[w] *cdef*
130					32.86 ± 2.23 *lm*	37.52 ± 2.18 *defg*
131				38.41 ± 0.12[w] *bcdef*		
134		35.08 ± 1.76 *fghijkl*	37.66 ± 1.72 *defg*	39.56 ± 1.75 *abcde*	38.16 ± 3.04[w] *cdef*	39.79 ± 1.83 *abcd*
137					41.51 ± 2.15 *abc*	41.58 ± 2.37 *ab*
141					36.58 ± 1.67 *defghi*	42.90 ± 3.46 *a*

[z] Days after planting.
[y] Means of triplicate determinations × three locations in farm.
[x] Soils: VC = volcanic clay loam; VS = volcanic sandy loam.
[w] Optimum reaping time (ORT). For VS (1985), digging was completed before ORT.
a–q Means with different letters in both rows and down columns are significantly different (Tukey's HSD test, $P = 0.05$).

continued to age. This aging process was accompanied by deterioration of the shells, hence the increase in average PF of the composite samples.

Percentage PF of the green composite pods (*i*) showed definite increases as all the seasons progressed and (*ii*) was within the narrow range of 38.2 ± 2.2% at ORT for all year–soil combinations. PF values at ORT for the individual year–soil combinations were not significantly different from each other and were larger than PF before ORT. Thus, by using the PF method and harvesting their crops as soon as the PF of composite samples reaches 38.2 ± 2.2%, the farmers would obtain harvests with a maximum percentage of mature pods. Such harvests would have potentially greater marketable value because of their higher PF and improved processing quality. The indices used by the farmers to determine crop maturity resulted in lower yields, since they led them to harvest crops before the majority of pods had matured (Table 5). On the other hand, if farmers had harvested too late, they would have obtained either a large proportion of immature pods or a large proportion of over-mature pods. Thus, harvesting crops as soon as PF of composite samples reaches 38.2 ± 2.2% would also minimize the chance of farmers obtaining harvests of these kinds.

Percent pod-fill has provided a reliable means of determining crop and pod maturity for Caribbean-grown peanuts (cultivar NC2). Harvesting when composite samples first attain 38.2 ± 2.2% pod-fill would ensure a maximum percentage of mature pods in the crop. This would lead to improved quality of the farmers' stock. In addition, wholesalers and processors could use the PF value of 41.5 ± 1.3% to determine if pods are mature. The pod-fill method has the following features: it is an objective test; it requires simple, inexpensive apparatus; little training is required, making it suitable for use by farmers with limited skills; tests can be performed on the farm; and results are obtained rapidly. Thus percent pod-fill could be investigated as a potential maturity and reaping index for peanut cultivars grown worldwide.

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