Effect of Harvest Date on Maturity, Maturity Distribution, and Flavor of Florunner Peanuts[1]

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ABSTRACT

In 1988 and 1990, irrigated plots of Florunner peanuts were harvested at weekly intervals to examine the progression of crop maturity profile, maturity distribution in commercial sizes, single seed roast color distribution, and descriptive flavor. Samples were collected 3 wk before through 2 wk after the optimum harvest date predicted by the hull scrape maturity method. Data from these samples indicated consisent pod maturity progression as well as increasingly higher percentages of mature peanuts in each commercial size through optimum harvest date. In 1990, the total percentage of seed from black and brown hull scrape classified pods in the medium commercial size progressed from *ca.* 48% at 3 wk before optimum to *ca.* 89% at the optimum harvest date. Distributions of roasted colors of 100 single, medium grade size seed contained fewer dark colored seed with progressive harvest date, and earlier harvests produced darker roasted peanut paste. Mean color of single seed roast color distributions increased (became lighter) in progressive harvest dates and were 3 to 6 Hunter L units higher than the corresponding paste colors. Descriptive roast flavor analysis of paste made from medium-size peanuts harvested in 1990 indicated that, in the earlier harvests, intensities of the descriptors roasted peanutty and sweet aromatic were significantly lower and intensities of dark roast and bitter taste were higher.

Key Words: Sensory, roast color, harvest, quality.

Harvesting peanuts at optimum harvest date results in highest yields and grades (9,15,16,18). Further, use of the hull scrape maturity method (18), while contributing to optimum harvest, has demonstrated that the greatest percentage of mature pods are generally harvested at the optimum harvest date. Mature pods are not prevalent at early harvest dates and, at late harvest dates, mature pods begin to fall off the plant. Even though there are always some immature pods at any harvest time, ample financial incentive exists within the peanut industry to harvest at the optimum time. However, there are conditions of weather, disease, acreage, equipment, and personnel

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that may interfere with normal maturation and/or harvest at the optimum time. Thus, harvested peanuts do not always contain high percentages of mature peanuts.

Sanders *et al.* (14) evaluated flavor of medium-size peanuts from hull scrape classified pods and demonstrated that medium grade size peanuts from mature pods have greater potential for full flavor than peanuts from immature pods. Sanders *et al.* (13) reported that peanuts from immature classes developed more fruity fermented off-flavor and less roasted peanutty flavor than mature peanuts of the same size when all samples were cured in-shell at 16.8 C above ambient temperature. Examination of high-temperature-cured, grade-sized peanuts indicated that immature peanuts in each size were responsible for the off-flavor caused by improper curing (11). Williams *et al.* (19) and Sanders (10), using an array of different types of samples, demonstrated that maturity distributions (percentage of seed of each maturity class in a grade size) are related to environmental and cultural practices including harvest date. Thus, as the hull scrape maturity profile moves toward higher percentages of mature pods with increased time after planting, the percentage of mature seed in each shelled grade size also increases with time (10). The logical coordinated interaction and application of these collective research data suggest higher flavor quality at optimum harvest; however, reports were not found which verified that maturity distributions and possible physiological differences related to progressive harvest dates actually result in flavor quality differences.

The objectives of this study were to (a) determine the effect of harvest date on roast flavor quality of Florunner peanuts, (b) evaluate the changes in crop maturity profile and maturity distributions in medium grade size peanuts at progressive harvest dates, and (c) determine single seed roast color distributions and relationships to paste color from each harvest date. These data were obtained to further demonstrate the strong relationship between harvest date, maturity distributions and roast color variation (10,11,14) as well as to document the effect of harvest date on flavor. This data should provide added incentive for industry encouragement and implementation of practices resulting in optimum harvest and highest quality.

Materials and Methods

Peanuts (*Arachis hypogaea* L. cv. Florunner) from the 1988 and 1990 crop years were evaluated. Peanuts were planted on 29 April 1988 and 27 April 1990, respectively, in plots which contained 24 rows of approximately 50 m length. Using the hull scrape method (18) to predict optimum harvest date, samples were collected at -3, -2, -1, 0, +1, and +2 wk from the optimum predicted date. Optimum predicted harvest date in 1988 was 16 September at 140 days after planting (DAP) and optimum date in 1990 was 14 September at 142 DAP. On each harvest date, three randomly selected 12.2-m row sections in the plots were hand dug and placed into windrows. After 3 d, peanuts in each windrow were harvested with a small combine and pods were dried to between 7 and 8% moisture with controlled drying temperature between 26.7 C and 35 C. Peanuts were shelled, sized into commercial grades, and held at 5 C until roasting. When peanuts were combined, *ca.* 2-kg pod samples also were taken from each row section, subjected to hull scrape classification (yellow 2, orange A, orange B, brown, and black), counted, dried with ambient air, and shelled. Seed were sized over slotted hole screens as previously described (10), and weights of seed from each maturity class riding each screen were determined. These data were used to calculate maturity distributions in each grade size for that harvest date (10). The medium grade size was utilized in these studies because it constitutes, by far, the largest fraction upon shelling.

Medium grade size peanuts from each harvest date sample were roasted as previously described (14) using a modified Farberware roaster, model 355. Initial and final roaster temperatures were 36.6 ± 1.5 C and 176.0 ± 5.0 C, respectively. Peanuts were blanched with a laboratory blancher, and lot roast color was then determined with a HunterLab, model D25-PC2 colorimeter with a 5-cm sample opening. One hundred roasted seed were randomly divided from each lot and color of each seed was measured using a Minolta Chroma Meter, model CR-300, with a plastic petri dish cover plate to standardize seed distance from the light source. The 100 seed were returned to the lot and paste was prepared in a Cuisinart food processor using a precise grind-cool protocol to maintain temperature below 32 C (14). Peanut paste color was determined with the HunterLab colorimeter and samples were immediately frozen until sensory analysis. Pastes were presented to a 12-member panel trained in descriptive sensory analysis as previously described (6). The panel had been trained over a period of 6 mo and analyzed peanut samples for over 5 yr. Peanut paste samples were presented randomly in white transparent cups with three-digit random numbers. Each panelist evaluated the samples independently under red lights. Samples were assigned intensity ratings (0 to 15) for descriptive terms reported by Johnsen *et al.* (5) and Sanders *et al.* (14). Data are the means of three panel presentations. Data were analyzed using a Statistical Analysis System (17) program package and significant differences among means were determined by the Waller Duncan Test.

Results and Discussion

The hull scrape maturity method (18) was used to determine the -3 wk sample date and predict optimum harvest date. Maturity profiles from -3 wk and 0 wk were used to make and validate predictions are summarized in Fig. 1 for 1988 and Fig. 2 for 1990 as the percentage of yellow 2, orange, brown, and black pods. In 1988, the initial prediction missed the optimum harvest profile by about 4 d (Fig. 1). However, a delay in harvest of a week would have been after the optimum harvest profile and, thus for the purpose of this study, the initial prediction was appropriate. In 1990, the initial prediction correctly estimated the optimum maturity profile (Fig. 2). Although some differences were noted between the 1988 and 1990 percentages of orange, brown, and black hull scrape classes at 0 wk (Figs. 1 and 2), data from all sample dates indicated the consistent pattern of maturation occurring during each year.

The consistent pattern of maturation also was obvious in the changes that occurred in maturity distributions from consecutive harvest dates (Fig. 3). Maturity distributions change in relation to several cultural and envi-

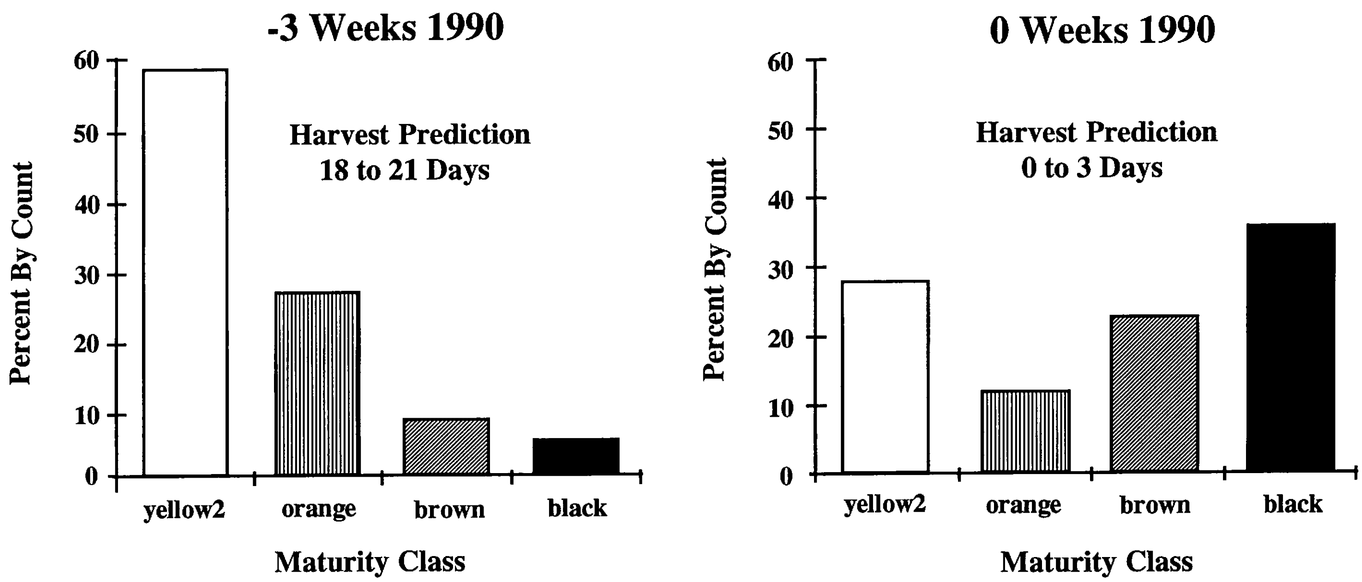

Fig. 1. Hull scrape profile class percentages and predicted harvest dates at -3 and 0 wk sample dates in 1988. White and yellow 1 classes were not considered.

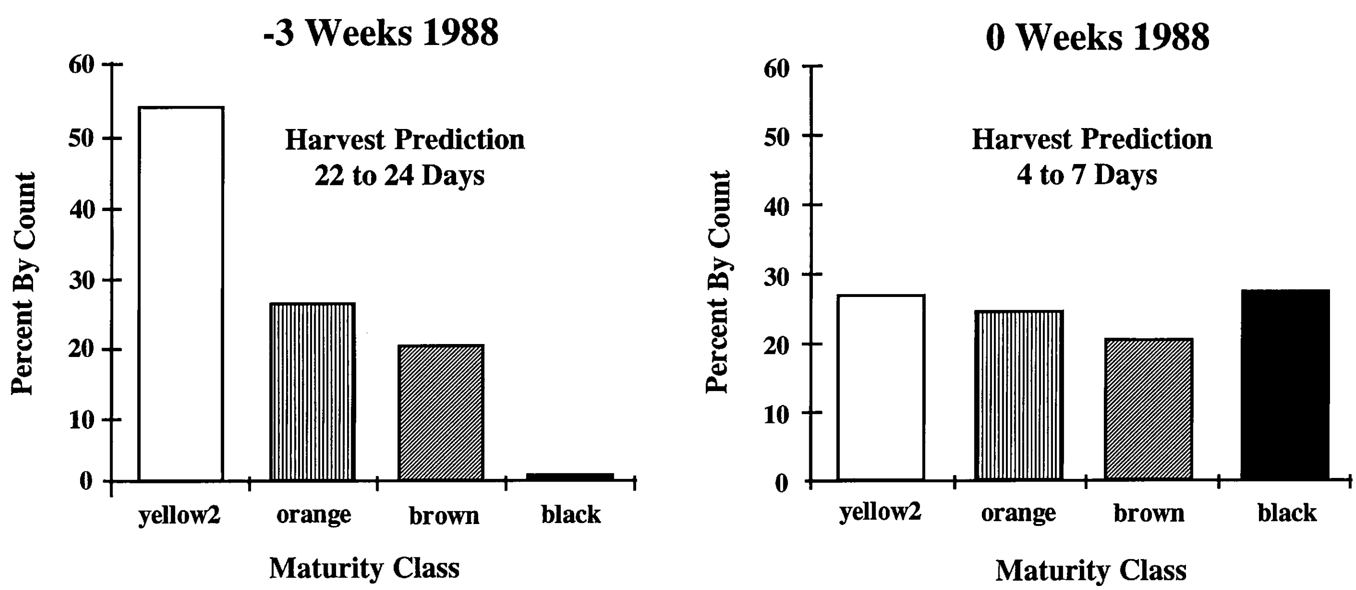

Fig. 2. Hull scrape profile class percentages and predicted harvest dates at -3 and 0 wk sample dates in 1990. White and yellow 1 classes were not considered.

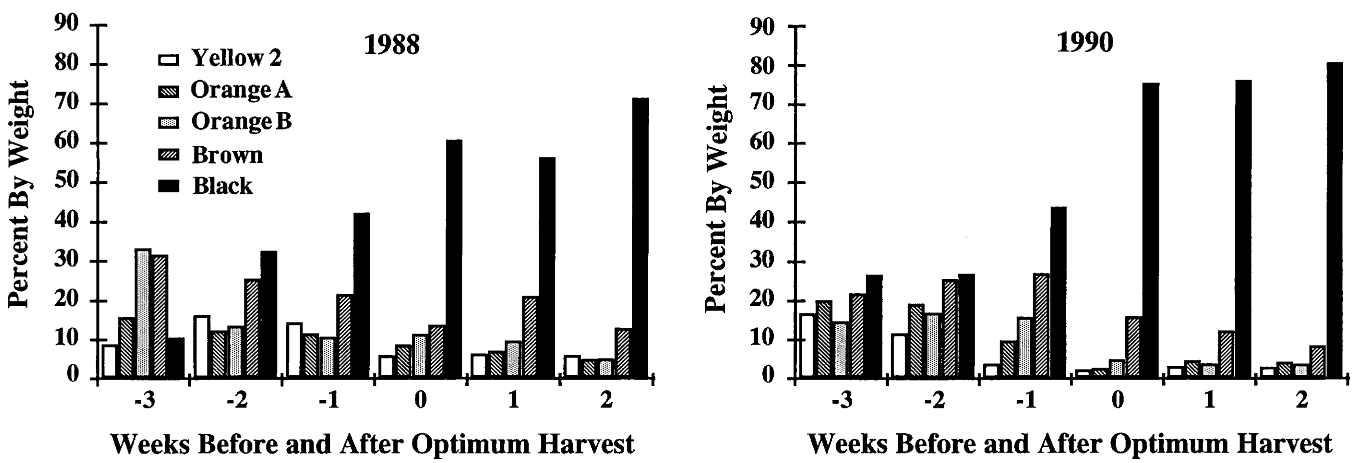

Fig. 3. Maturity distributions in medium-size peanuts from different harvest dates in 1988 and 1990.

ronmental factors which are related to the pattern of crop maturation (10,19). Percentage of seed from black pods increased from -3 wk through 0 wk in the maturity distributions of medium-size peanuts in both years (Fig. 3). Percentages of seed from black pods were higher in 0 through 2 wk samples in 1990 than in 1988. This difference resulted from black hull scrape class percentages for the 0 wk samples (Figs. 1 and 2) being about 10% higher in 1990 than in 1988. Maturity class percentages data (not presented) for 1 and 2 wk were similarly different and resulted from varying environmental conditions between the 2 yr (4). The difference in maturity distributions for harvest dates -3, -2, and -1 and the distributions in 0, 1, and 2 are distinct and suggest a significant quality potential difference. This potential is based on published information on seed from maturity classes indicating composition differences (1,2,8,12) and research indicating that immature peanuts have inferior flavor quality (13,14).

The lot color of whole roasted medium peanuts as determined with the HunterLab colorimeter was generally lighter (higher Hunter L value) with increasing harvest date (Table 1). Paste colors were generally darker than the corresponding lot seed colors. Sanders *et al.* (14) reported that Hunter L values increased with maturity when medium-size peanuts from individual maturity classes were roasted for the same time and temperature. Thus, the color of harvest date samples changed because of the maturity/roast color relationship and because maturity distributions contained progressively more mature peanuts. The color distribution of 100 individual roasted seed from -3, -2, and 0 wk samples from 1988 and 1990, presented respectively in Figs. 4 and 5, also indicate the progression of maturity distribution in sequential harvest dates. The average Hunter L calculated from the individual 100-seed distributions of all harvest dates are presented in Fig. 6 and show the same increasing trend in color. The average Hunter L values of the 100-seed distributions (Fig. 6) were higher than the L values of the corresponding lot seed colors and pastes (Table 1).

Lot roast colors of seed for early harvest dates in 1990 were as much as 8 Hunter L units darker than colors for later harvests; however, in 1988 the difference was less than 3 (Table 1). These roast color differences over harvest dates for both years are explained by the differ-

Table 1. Roasted peanut seed color and paste color (Hunter L) for peanuts harvested at weekly intervals in 1988 and 1990.

Harvest	Seed color		Paste color	
wk	1988	1990	1988	1990
	Hunter L			
-3	47.7	42.7	47.7	41.2
-2	48.5	45.9	48.4	44.3
-1	48.2	48.9	49.5	48.3
0	50.0	50.7	49.8	50.6
+1	48.7	50.7	49.1	50.7
+2	48.9	50.1	49.6	49.9

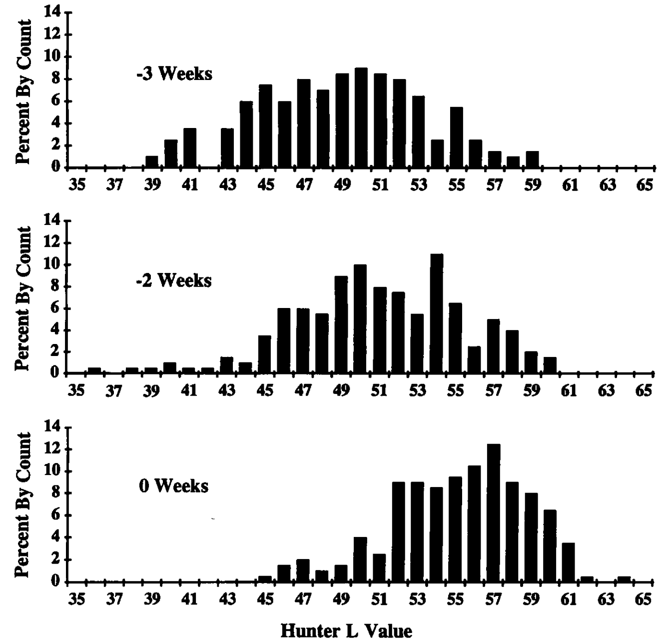

Fig. 4. Roasted seed color distribution in medium-size peanuts from -3, -2, and 0 wk harvest dates in 1988.

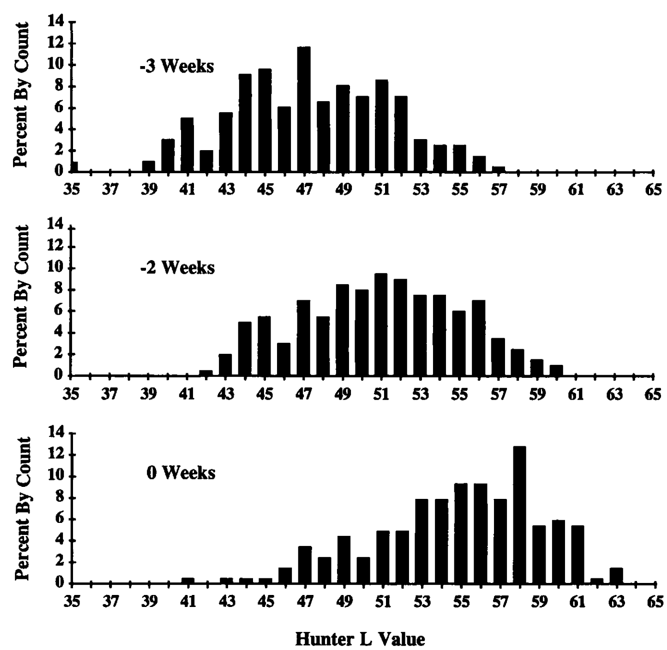

Fig. 5. Roasted seed color distribution in medium-size peanuts from -3, -2, and 0 wk harvest dates in 1990.

ent maturity distributions among harvest dates (Fig. 3). However, we have no explanation for the roast color differences between years for the -3 and -2 wk harvests (Table 1) because similar maturity distributions occurred at early harvest from both years (Fig. 3). Differences in roast color for peanuts of similar maturity from different years have been previously reported (14). Free amino acid and sugar content (which are constituents of the

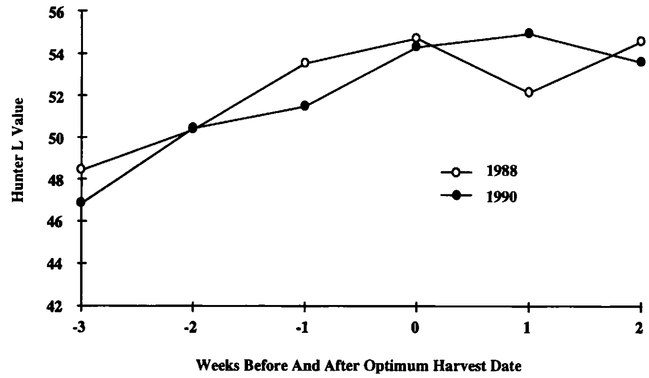

Fig. 6. Mean color of 100 individual roasted seeds from harvest dates in 1988 and 1990.

browning reaction) in peanuts of similar maturity from these studies in both years were not meaningfully different (D. Grimm, personal commun.).

Descriptive sensory analysis of harvest date samples in 1988 did not indicate any meaningful significant differences for any flavor descriptor. These data were contrasted by significant differences for three important descriptors and one taste characteristic in the 1990 samples (Table 2). In 1990, the intensity of roasted peanutty, the predominant descriptor for peanut flavor, was significantly lower at the -3 wk harvest. Sweet aromatic also was significantly lower, but only at the two earliest harvest dates. Dark roast, the descriptor most related to roast color, was significantly different at the two earliest harvest dates.

Table 2. Intensity of sensory descriptors for peanuts harvested at weekly intervals in 1990.

Harvest wk	Roasted peanutty	Sweet aromatic	Dark roast	Bitter
	Intensity[a]			
-3	4.09 b	1.87 b	4.04 a	2.19 a
-2	4.55 ab	1.90 b	3.59 ab	2.08 ab
-1	4.63 a	2.43 a	2.81 bc	1.66 abc
0	4.89 a	2.34 a	2.43 bc	1.59 bc
+1	4.98 a	2.43 a	2.35 c	1.38 c
+2	4.72 a	2.37 a	2.56 bc	1.50 c

[a]Means in a column followed by the same letter are not significantly different ($P \leq 0.05$).

Maturity distribution differences within the medium size between the 2 yr were apparently sufficient to influence panel results. In 1990, total percentages of classes considered to be "mature" (black, brown, and orange B) were *ca.* 25-30% higher in later harvests (0, 1, 2 wk) than in early harvests (-3, -2 wk). These large differences in harvest dates correspond to the significant differences found in sensory descriptors. However, in 1988 the difference in total percentage of "mature" between late and early harvests was only 10-14% and resulted in sensory differences that were not obvious to the panel.

Previous studies (10,11,13) documented that improper high temperature curing has a greater effect on immature peanuts than on mature peanuts. The result of high temperature curing is increased intensity of the fruity fermented off flavor and reduction of roast peanutty intensity. Extreme care was exercised in the curing and handling of peanuts from all harvest dates but any deviation from optimum conditions, as often occurs in actual practice, would have dramatically increased the potential for wide differences in panel response to samples from the early and late harvest dates.

The sensory differences corresponded well with the differences in roast color data for harvest dates presented in Table 1. Pattee *et al.* (7) and Crippen *et al.* (3) demonstrated relationships of roast color to various descriptive sensory terms. However, the roast color-sensory response relationship was not a complication in this study because it also exists in commercial operations. Harvested peanuts, whether at optimum harvest date or not, constitute the raw materials that the processing industry must utilize, and processing of a lot is usually accomplished in a single time/temperature roast operation. In commercial operations, peanuts from different harvest dates and different farms are mixed in a single warehouse, mixed during shelling, and processed together. Such processing would be singular in protocol, and the colors and sensory attributes of peanuts represented by the samples in this study would all be mixed. There is difficulty in prediction of sensory quality of such a mix; however, the mix would contain some peanuts of lesser flavor quality because of early harvest dates.

Summary

This study indicated that harvest date is responsible for variations in flavor and roast color occurring during processing. Although currently used cultivars and cultural practices provide only limited opportunity to impact maturity factors, knowledge of interactions of interactions of maturity, harvest date, and environment should provide further incentive for scientific and industry focus to deliver peanuts with a limited or more precisely defined maturity composition.

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