Maturity Distribution in Commercially Sized Florunner Peanuts

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ABSTRACT

Quality, as measured by roast color, flavor and storability, is variable within and among peanut (*Arachis hypogaea* L.) lots of the same commercial size. Because maturity is significantly related to many quality characteristics, the variability in maturity distributions (percentage of various maturity classes) was examined within sized peanut lots from twenty random samples, an irrigation study, a harvest date study, and a soil temperature study. Pods from each source were separated into hull scrape maturity classes, dried, shelled, and screened to obtain seed size distributions. Using the weight of each maturity class in each commercial size, the percentage weight contribution of each maturity class in each commercial size category was calculated. Seed size distribution for maturity classes from different treatments in each study varied widely. The data indicated that each commercial size category contained peanuts from each maturity class. Treatments within the studies generally produced significant differences among percentages of individual maturity classes in each size. Large standard deviations and coefficients of variation in all studies indicated the wide variability potential in sized lots. The distributions of maturity within commercial sizes were sufficiently different to suggest that flavor, roast color, storability, and other quality estimators would be affected in final roast products from some of the lots.

Key Words: *Arachis hypogaea* L., hull scrape, quality, seed size, groundnut.

The indeterminant fruiting pattern of peanuts (*Arachis hypogaea* L.) dictates that at any harvest date fruit of a wide range of maturity are harvested. Normal peanut shelling operations result in separation of peanuts based on size without regard to maturity. Although a size-maturity relationship exists, it is not absolute, and peanuts of different maturity are sized together. Runner-type peanuts are presently marketed on the basis of seed size and/or count per unit weight. Variability in quality is common from lot to lot.

Examination of products containing sized, whole, roasted peanuts provides evidence of the variability that exists in flavor, roast color, storability, and other quality characters within and among commercial sized peanut lots. Sanders *et al.* (13) found significant variations in roast color and flavor potential of medium size peanuts from different maturity classes. Immature peanuts roasted darker and had less total flavor potential. Sanders *et al.* (12) 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 were cured in-shell at 16.8 C above ambient temperature. Whole, edible, runner-type peanuts are marketed in jumbo, medium, and No. 1 commercial size categories. The category other edible was recently eliminated as an individual market size; however, this category is still of importance due to various tolerances of small seed in other sizes.

Peanut seed size distributions in harvested lots are important because of the economics associated with different commercial size categories. Davidson *et al.* (3) suggested that seed size distributions may be affected by such variables as variety, agronomic practices, climate, soil moisture, and harvest dates. Pattee *et al.* (6) presented data which showed a general increase in seed size distribution in increasing physiological maturity stages of Florigiant peanuts. More recently, Williams *et al.* (17) explored the relationship of hull-scrape peanut maturity and plant development to seed size. Coffelt *et al.* (2), Pattee *et al.* (6), and Williams *et al.* (17) in various ways suggested that the proportion of immature kernels vs mature kernels in a sized lot could affect lot composition and response to handling conditions during the marketing process. The range and variability of the proportions were not estimated in those reports.

This report is intended to document the variation in maturity proportions in sized peanuts in order to provide information relevant to the variability in flavor, roast color and storability commonly found in commercial lots.

Materials and Methods

Florunner peanut samples used were obtained from four separate sources: 1) random samples from research plots and farms (1985-1988), 2) an irrigation study, 1986, 3) a harvest date study, 1987 and 4) a soil temperature study, 1987.

Twenty individual samples from various plot and field studies conducted from 1985-1988 were utilized. Although the samples were collected in a nonreplicated manner, they were consistently 10 kg or larger and served to formulate the initial observations on maturity distribution variability.

The irrigation study consisted of six treatments of progressive water stress in four replications in a randomized complete block design. Irrigation scheduling was based on cumulative degree differences between canopy and ambient air temperatures (14). Samples (0.5 kg) were from replicate lots after windrow drying of plants harvested at 137 days after planting (DAP).

The harvest date study was conducted on a large, irrigated uniform field in Colquitt County, Georgia. Using the hull scrape method to predict optimum harvest date, samples were collected at -3, -2, -1, +1 and +2 weeks from optimum. The optimum harvest date was complicated by rain and the sample was not collected. For each harvest date, random windrows were harvested to fill three drying wagons and approximately 20 kg were removed from each wagon by pneumatic probe. Samples of ca 4.5 kg were divided from the 20 kg lots for hull scrape classification.

In the soil temperature studies, geocarposphere temperatures were

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modified with thermostatically controlled heating cables or cooling coils as described for other studies (9) and plants were irrigated when the 5 cm under row soil moisture tension was ca. -0.3 bars. Mean 5 cm depth soil temperatures were ca. 28 C, 25 C and 22 C. Plants were harvested at 124 DAP, 134 DAP and 145 DAP, respectively, due to variation in maturation rate. Allowing for border rows and row ends, all peanuts in each 5.5 x 12.3 m plot were utilized by random selection of rows to obtain three 18.3 m row lots.

Pods of all samples were subjected to gentle abrasion with a slurry of small glass beads in water (16) to remove the exocarp and expose the mesocarp color which was used in hull scrape maturity class determination. Pods were visually sorted into increasing maturity classes based on mesocarp colors designated as yellow 2, orange A, Orange B (orange classes were combined in the irrigation study), brown, and black. Color class designations corresponded to numbered classes 3-7 described by Williams and Drexler (15). Orange A and orange B both corresponded to class 5, and separation was based on orange in orange A and brownish orange in orange B.

Maintaining maturity class integrity, pods were dried with ambient air until mean seed moisture was 7-8%. Each maturity class was hand-shelled and seed were sized according to thickness over a series of slotted hole screens having length of 25.4 mm and widths of 10.3 mm (Screen No. 26), 9.5 mm (Screen No. 24), 8.7 mm (Screen No. 22), 8.3 mm (Screen No. 21), 7.9 mm (Screen No. 20), 7.1 mm (Screen No. 18), 6.4 mm (Screen No. 16), 5.6 mm (Screen No. 14), and 4.8 mm (Screen No. 12). Seed sizes are presented in units of commercial screen number (size in mm = screen no. x 0.397). The percentage of seed by weight that rode each screen and fell through screen No. 12 was calculated to provide the seed size distribution. Commercial sizes were considered as follows: jumbo ≥8.3 mm, medium < 8.3 mm - ≥7.1 mm, No. 1 <7.1 mm - ≥6.4 mm, and other edible <6.4 mm - ≥5.6 mm. After seed in each maturity class were sized, the total weight from each maturity class in each commercial size was determined. These weights were totaled and the percentage weight contribution of each maturity class in each commercial size was calculated.

For each study differences in percentages of maturity classes in each size were subjected to an analysis of variance and significant differences among means were determined by Duncan's New Multiple Range Test at the 5% level of probability. Data from all sources were reduced to the mean of all treatments, standard deviations, and coefficients of variation. Data from the soil temperature study is presented as a detailed example of seed size and maturity distribution variation.

Results and Discussion

For specific maturity classes, peanuts produced in the cooler soil generally had distributions with larger mean seed size than those produced in the warmer soils (Fig. 1). Davidson *et al.* (3) reported that experimental seed size distributions fit the logistic distribution very well and that mean seed size for Florunner peanuts varied from year to year. The data in Fig. 1 indicate that soil temperature, as one aspect of the environment, may cause shifts in the size distribution of specific maturity classes. It further suggests that size distribution should not be used exclusively as an indicator of crop maturity. Williams *et al.* (17) used the cumulative function for the logistic distribution to make estimates of mean seed size in individual maturity classes at progressive plant ages. The estimate of mean seed size showed a positive relationship with maturity.

The data from this study exemplify the potential of size distributions that may be found in individual peanut maturity classes and provide information relative to maturity

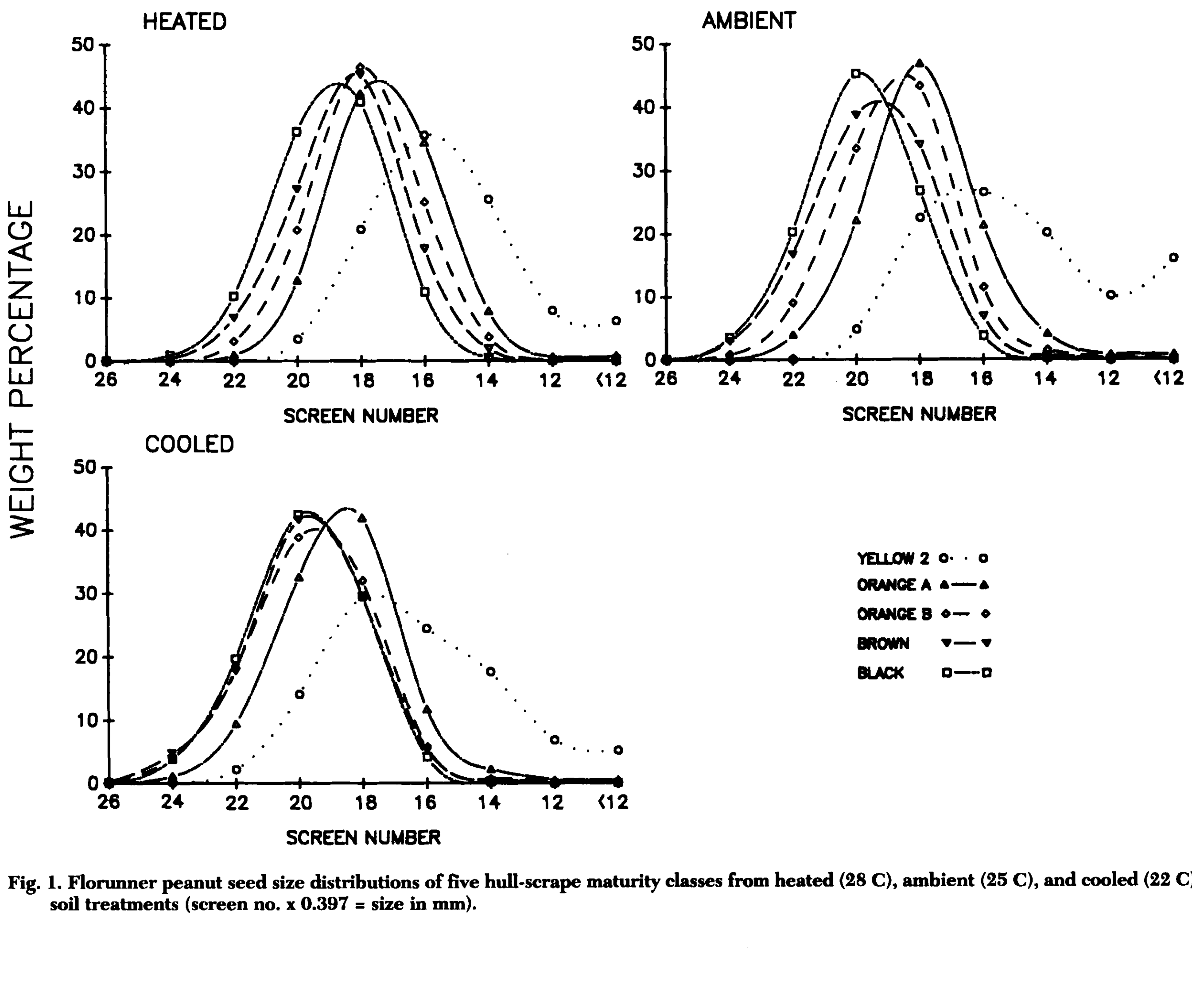

Fig. 1. Florunner peanut seed size distributions of five hull-scrape maturity classes from heated (28 C), ambient (25 C), and cooled (22 C) soil treatments (screen no. x 0.397 = size in mm).

composition of commercially available peanuts which are marketed on a size basis (Fig. 1). The size distribution and relative weight percentage of each maturity class present determines the quantity of peanuts of a particular maturity class in each size category. Although a general mean seed size-maturity relationship is evident in the distributions, in most cases some seed of each maturity class ride each screen. This indicates that each commercial size classification (jumbo, medium, No. 1, and other edible) may contain peanuts of each maturity class. Confirmation of this observation may be found in tabulated maturity-size data on virginia- and runner-type peanuts presented by Pattee *et al.* (6) and Williams *et al.* (17), respectively.

Because compositions and quality potentials differ, the relative percentages of peanuts of each maturity class in a given commercial size influence lot characteristics such as storability, roast color variation, flavor/off-flavor potential, and other quality characteristics related to maturity. Lipids, proteins, and sugars in immature peanuts are not compositionally or structurally at the state of metabolic quiescence indicative of maturity (1,5,10). The unstable nature of these fractions in immature peanuts increases the potential for reduced quality when they are present in high percentages in any given lot.

The maturity distribution of peanuts in each commercial size category (Fig. 2) demonstrates the general relationship between size and maturity in that categories of the largest seed size contain higher percentages of mature peanuts (brown and black), and the categories with small seed contain higher percentages of immature peanuts (orange A, yellow 2, and yellow 1). However, the larger commercial size categories may also contain substantial quantities of very immature peanuts. Peanuts from heated soil contained generally higher percentages of mature peanuts in each size category than those from the cooled soil. Heated soil peanuts also had the smaller mean seed size in individual maturity classes (Fig. 1).

Sanders and Blankenship (8) reported that peanuts produced in cooler soils generally have seed size distributions containing higher percentages of large seed but with a delayed crop maturation rate. Significant differences in the percentage of peanuts from each maturity class in each size were more consistent between the heated and cooled soil treatments. In larger sizes, ambient and heated treatment

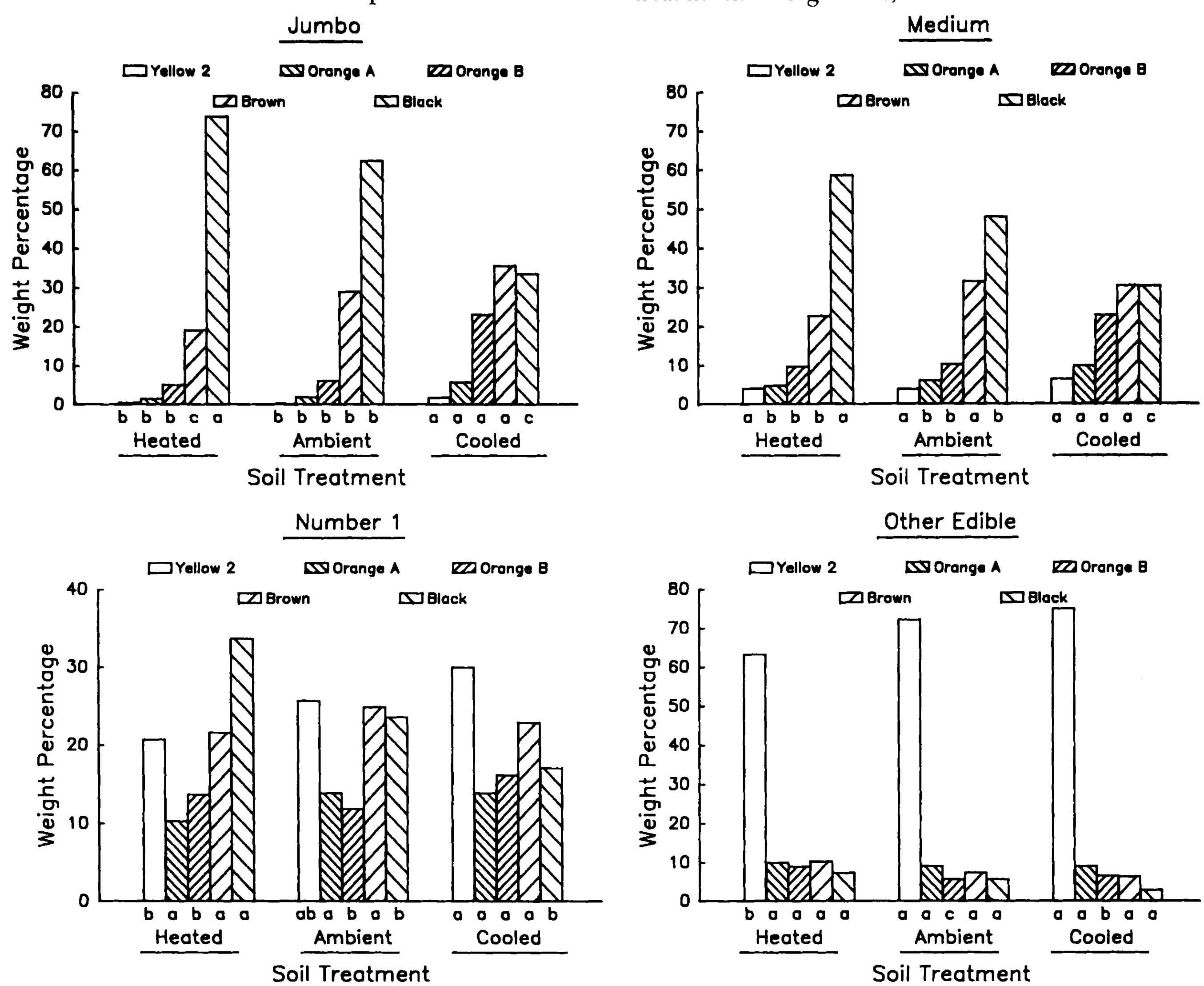

Fig. 2. Maturity distributions within four commercial sizes of Florunner peanuts from heated (28 C), ambient (25 C), and cooled (22 C) soil treatments. Means for the same maturity class from each treatment not having a common letter are significantly different (P = 0.05, Duncan's New Multiple Range Test).

percentages for the more immature classes were usually not significantly different. In the medium size, which usually constitutes the largest part of shelled Florunner lots, the variation in maturity composition is evident in that the total of black and brown classes in the ambient and heated treatment was ca. 80% while in the cooled treatment the total was ca. 60%. Thus, medium sized peanuts from the cooled treatment contained 40% Orange B and less mature classes compared to 20% in the ambient and heated treatments. In the No. 1 size, the two most immature classes totaled 31.0, 39.6, and 43.9% for heated, ambient, and cooled treatments, respectively. The percentage of immature seed needed to produce a negative quality effect in any given size has not been determined; however, the potential for a negative effect increases as the percentage of immature seed increases. Small peanuts have for some time been identified as those most likely to be associated with flavor, curing, moisture, blanching, storing, and other quality problems (4,6,7,11). The data for the other edible size category for all samples indicate that this commercial size is composed mainly of very immature peanuts.

Maturity distribution data from the soil temperature study indicating variation in maturity composition were substantiated by data from the random samples, irrigation study, and harvest date study (Table 1). Analysis of variance for the harvest date and irrigation studies indicated, as for the soil temperature study, that significant differences usually existed among treatment mean percentages of individual maturity classes in each size. The large standard deviations and coefficients of variation indicate the wide variability associated with the percentage of individual maturity classes composing commercial sizes. The wide variation in mean percentages among the four sources of samples provides further indication of potential maturity variation in sized lots.

Summary

Data presented in this manuscript indicate that commercially sized Florunner peanuts may contain widely varying maturity distributions. Published information on maturity classes suggests that the classes are compositionally different enough in free amino acids, proteins, carbohydrates, and lipids to expect them to react differently to the many processes from curing to manufactured product (1,2,5,10). Further, Sanders *et al.* (12,13) demonstrated the inferior flavor quality potential of immature vs mature peanuts of the same size when subjected to less than optimum handling practices. The relative percentage of immature seed in a lot of any size thus impacts the quality of that lot. The larger the percentage of immature seed the greater potential for negative quality impact. Various environmental and cultural conditions have significant effects on seed size distribution of maturity classes and thus the maturity distribution within sized peanut lots.

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Table 1. Means (x), standard deviations (sd), and coefficients of variation (cv) for percentages of peanut maturity classes in commercial sizes from treatments/samples within four data sources.

Commercial Size / Data Source	Yellow 2			Orange A			Orange B			Brown			Black		
	$\bar{x}$	sd	cv	$\bar{x}$	sd	cv	$\bar{x}$	sd	cv	$\bar{x}$	sd	cv	$\bar{x}$	sd	cv
Jumbo															
Random	2.1	2.3	113.1	7.9	9.4	118.7	17.4	18.3	105.0	27.5	13.1	47.6	45.1	28.2	62.4
Irrigation #	8.6	3.7	43.4				9.5	3.6	38.5	45.9*	17.3	37.8	37.1*	15.4	41.4
Harvest Date	0.7*	1.0	139.4	1.4*	1.0	67.0	4.4*	2.8	62.7	18.1*	9.5	52.4	75.3*	13.1	17.4
Soil Temperature	0.9*	0.7	87.2	3.1*	2.1	67.2	11.5*	8.7	75.2	27.9*	6.8	24.5	56.7*	17.2	30.4
Medium															
Random	13.1	10.7	81.7	13.7	11.7	85.5	15.3	9.3	60.8	25.3	12.0	47.3	32.5	23.6	72.6
Irrigation #	13.4*	8.7	65.3				20.7*	10.9	52.8	42.0*	10.7	25.4	23.5*	15.0	63.9
Harvest Date	5.7*	3.7	65.2	5.4*	2.3	42.2	6.8	2.1	30.6	18.6*	6.1	32.6	63.6*	11.8	18.5
Soil Temperature	4.9	1.6	31.9	7.0*	2.5	35.5	14.3*	6.3	44.0	28.2*	4.0	14.2	45.7*	12.2	26.6
Number 1															
Random	46.6	19.8	42.4	17.2	10.1	58.6	9.8	4.5	46.0	14.1	9.9	70.7	12.6	13.3	105.4
Irrigation #	38.9*	13.9	35.9				23.3*	8.7	37.5	24.6*	9.9	40.2	10.5*	7.4	70.4
Harvest Date	29.5*	9.9	33.5	15.1*	6.1	40.6	10.2*	3.2	31.5	16.3	3.5	21.8	28.9*	8.2	28.3
Soil Temperature	25.5*	4.6	18.0	12.7	2.7	21.4	13.9*	2.5	17.9	23.1	2.5	10.7	24.8*	7.6	30.6
Other Edible															
Random	76.7	12.5	16.3	10.9	9.8	90.0	4.5	2.5	55.8	6.2	4.6	73.9	3.4	3.6	105.9
Irrigation #	66.1*	13.6	20.6				11.3	6.5	57.4	10.4*	6.9	66.0	3.1*	2.3	74.8
Harvest Date	62.9*	19.2	30.5	16.8*	12.9	76.5	6.4*	3.7	57.8	6.0	3.5	57.7	7.9*	4.4	54.9
Soil Temperature	70.2*	6.0	8.5	9.4	3.0	31.5	7.1*	1.7	23.7	8.0	2.4	29.6	5.3	2.4	44.5

* Significant differences among treatment means at the 5 % level of probability.

Orange A and B included as Orange B.

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