THE EFFECT OF LIGHT, TEMPERATURE, AND TIME OF PLANTING AND HARVESTING ON THE YIELD, GRADE, AND MATURATION OF THE SPANISH PEANUT

By

WILLIAM BOYD DAVIS

Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

1966

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
July, 1968

THE EFFECT OF LIGHT, TEMPERATURE, AND TIME
OF PLANTING AND HARVESTING ON THE YIELD,
GRADE, AND MATURATION OF THE
SPANISH PEANUT

Thesis Approved:

Ralph S. Matlock
Thesis Adviser

Robert D Morrison

Lester W. Reed

David A. Sander

D. D. Durham
Dean of the Graduate College

ACKNOWLEDGMENTS

The author would like to take this opportunity to express his sincere appreciation to Dr. Ralph Matlock, his major advisor, for the guidance, advice and helpful criticism during this course of study.

Appreciation is expressed to Dr. Robert D. Morrison and the staff of the computer center for processing most of the data in this study and for giving me helpful advice. Gratitude is extended to Drs. Lester W. Reed and David A. Sander for their helpful criticisms while preparing the final manuscript of this thesis.

Thanks are given to the Agronomy Department of Oklahoma State University for making this study possible and their financial help through a teaching assistantship. The author appreciated working with Dr. David A. Sander.

Special thanks are given to my parents, Mr. and Mrs. Theo Davis for their many sacrifices while making my higher education possible.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

A high yield of good quality mature peanuts is of major concern in peanut production. Precise information is needed for determining optimum planting and harvesting dates for peanuts.

Digging a week early or a week past the optimum maturity date may reduce the amount of salable peanuts up to 300 to 500 pounds per acre. Both immature and overmature kernels have been associated with off-flavor.

Several methods have been used to correlate kernel and plant characteristics with maturity, but many are unreliable and time consuming. A precise and simple means of predicting maturity is needed for determining the optimum maturity or harvest date. An accurate prediction of the best time to harvest is difficult because of the indeterminate growth habit of the peanut.

The object of these studies was to examine the processes of maturation in growth chamber and field studies in order to determine the most suitable method of expressing peanut maturity.

CHAPTER II

REVIEW OF LITERATURE

Smith (19) reported that peanuts are cultivated in temperate regions like an annual crop, but they possess indeterminate growth and survive like perennials in frost-free zones.

The flowering cycle extends from approximately five weeks after planting until the first frost (19). Commencement of flowering depends greatly on temperature (18, 19). Shear and Miller (18) reported that 24 to 31 days were needed for initiation of flowering for the Jumbo Runner peanut with the maximum daily temperature reaching 80° F. or above.

Smith (19) reported that Improved Spanish 2B began flowering four weeks after planting, and they showed a marked acceleration in flowering frequency two weeks later under field conditions at Raleigh, North Carolina. Most of the flowers were produced in the next 31-day period with the peak flowering occurring 57 days after planting. The seasonal flowering cycle formed a frequency curve similar to a normal distribution (19).

Arachis hypogaea L. was shown to have a cyclic flowering with abrupt alternation of high and low frequencies occurring during the major portion of the flowering period.

Cyclic flowering was not directly controlled by variations in factors of the external environment (2, 19).

The interval between the flowering and the appearance of gynophores (pegs) was at least five days. The growth of the gynophore began immediately after fertilization and the time required for it to reach the soil was determined by its initial distance from the ground (9). Pickett (15) estimated that the time between the appearances of the flowers and the entrance of the gynophores into the soil was about 14 days. Gynophores which were initiated more than 15 cm. above the soil surface usually failed to reach the ground, and the gynophore tips usually died.

Gregory (9) reported that the gynophore was positively geotropic; and upon penetrating the soil, the gynophore grew to a depth of 2 to 7 cm. When the gynophore reached its maximum penetration of the soil, it lost its geotropism; the tip turned to a horizontal position as the fruit began to enlarge, and development rapidly ensued.

According to Smith (19), the period of time from flowering to fruit development was from 50 to 60 days.

Patel and Seshadri (14) tagged flowers and reported that the Spanish type locally known in India (Gudiyathum) required 95 days from planting or 60 days after flowering to produce mature fruit. Although tagging the flowers was of distinct value in evaluating the age of the fruit, the authors indicated that the seeds from flowers which opened on the same day did not develop at the same rate. The gynophores from the flowers near the soil surface entered the soil and produced seeds earlier than those at a greater distance from the soil surface.

Collins (5) obtained a yield increase for the Dixie Spanish variety as the time of harvest was delayed. The time of harvesting ranged from 111 to 146 days from planting with harvesting being done at weekly intervals. The plots harvested 146 days from planting produced significantly more peanuts than any of the earlier harvest dates. Mean yield, dry matter content, numbers and weights of kernels increased through the last harvest date which suggested that maximum yield may not have been reached.

Collins (5) reported an increase in the mean number of intermediate fruit as harvest was delayed. The mean numbers of mature and immature fruits among the six harvest dates were not significantly different (5).

Planting dates before May 1 and after June 20 to June 30 resulted in marked reductions of yield for Spanette peanuts at Stratford, Oklahoma (11). The highest yields were obtained for planting dates occurring after May 10 and before June 10 (11).

Shear and Miller (17) reported that in North Carolina the range for time of planting (April 22 to May 22) or time of digging (September 26 to October 30) had very little influence on the yield of Jumbo Runner peanuts. The early-planted peanuts required more time between planting and digging in order to reach their maximum levels of shelling percentage and their percentage of extra large kernels than the later planted ones did (18). The minimum time necessary for Jumbo Runner peanuts to reach maximum levels of both shelling percentage and percentage of extra large kernels was 148 days for peanuts planted May 22 and 171 days for peanuts planted April 22 (18).

Rossen and Bolhuis (16) found that the first flower developed from the axillary buds of the first lateral stalks in the Spanish variety Schwarz 21.

Gupton (10) stated that from a careful study of the flowering and pegging patterns at previously identified reproductive positions on the cotyledon laterals, peg placement and branching pattern were highly correlated for the Virginia type peanut. The first pegs to enter the ground were found to arise from nine specific positions on the lateral (6). Hexem (6) in 1965 used tranverse cuttings of kernels to follow the maturation patterns of NC 2 from the nine positions. Field maturity was determined by calculating the percentage of the kernel diameter in relation to fruit diameter.

Barrs (1) and Collins (5) used the mean individual kernel weight (MIKW) to express maturity in the peanut. The MIKW reached a constant value for any given variety of mature peanuts regardless of environmental conditions (1). Collins (5) found the MIKW remained constant at 0.34 gram per kernel for the first three harvest dates (111, 118, and

125 days from planting), and increased to 0.37 to 0.38 gram per kernel on the 132, 139, and 146 days from planting.

Maturity may be determined by pigmentation of the interior pericarp. Researchers (5, 11, 13, 19) found the inside of the shell had become a mottled brown to black upon reaching maturity. The brown coloration causing the splotching on the inner surface diffuses inward from the mechanical layer of the shell. The common source of the brown coloration is the oxidation and the polymerization of tannins or polyphenol of the catechol type (17).

Matlock (11), Smith (18), and Collins (5) classified the fruit as mature when the interior pericarp was dark, immature when the interior pericarp was white, and intermediate when the interior pericarp was between the two extremes.

Yellowing of the foliage, spotting of the leaves, and leaf drop are indications of time to dig (21). Cerocospora leafspot disease and fruit dropping are positively correlated; and by controlling leafspot, the growing season of Jumbo Runner peanut was extended. This resulted in a higher quality fruit and higher yields (12).

Pickett (15) reported that a combination of factors which indicate maturity include the texture of the seed, the color of testa, the tightness with which the seed is held by the shell, the absence of fleshy material, a change of color on the inner pericarp, and the appearance of the outer pericarp.

Toole et al. (22) used seed size, seedcoat color and conditions of the outer layer of the seed coat to derive eight classes of maturity. Seed size ranged from one-half mature size (most immature) to full size (mature) while seed color ranged from a white with faint tinge of pink (most immature) to brown (mature). The condition of the outer layer of the seedcoat ranged from very thick and turgid (most immature) to papery thin (mature).

The duration and quality of light during the growth period was reported to be more important than its intensity (7). Photoperiods longer than twelve hours resulted in more flowers but fewer fruit.

Fortanier (7) found that comparatively high temperatures were necessary for good growth. Temperatures below 68° F. caused a marked reduction of all life processes, while temperatures above 95° F. were detrimental depending on the relative humidity of the soil and atmosphere. A mean temperature of 86° F. resulted in maximum growth. The distribution of the optimum temperature during the day or night had an insignificant influence provided the differences did not exceed 18° F.

Mills (13) estimated the lower and optimum cardinal temperatures for germinating seedlings by measuring the growth of the seedlings up to 172 hours for temperatures ranging from 55° to 105° F. The lower cardinal temperatures for peanut seedlings was between 55° and 65° F. in germination tests using the NC 2 variety.

The optimum cardinal temperature for peanut plants grown over a 5-month period is in the lower part of the 80° to 100° F. range, with many variables involved (13). Three years of field data using a combination of 56° F. as the lower cardinal temperature and 76° F. as the optimum cardinal temperature gave the lowest coefficients of variation for effective heat units (13).

Valli (24) used five biometeorological factors to predict the maturity for each of five varieties of peanuts. These included growing degree days above a base of 65° F., effective heat units, effective radiation, actual langleys, and effective langleys. Based on the standard deviations in days and coefficients of variation, the effective langleys were considered to be the best single predictor of peanut maturity. Effective langleys consist of a combination of the two bioclimatic factors, temperature and light, which most affect photosynthesis.

Gilmore and Rogers (8) suggested that in order to eliminate negative heat units, all temperatures below 50° F. would be considered as 50° F. when determining the number of heat units needed for the maturity of corn. Temperatures which were above the optimum temperature level retarded growth, and corrections were needed in the calculation of heat units for excessive temperatures.

Heat units do not take into account the shift in optimal temperatures during the development of the plant, or that the optimal day and night temperatures were strongly dependent upon the light intensity (25). Lower light intensities decreased the optimal temperature (25).

Wang (26) summarized the disadvantages of the heat unit approach to plant responses. He concluded: (A) plants respond differently to the same environmental factor during various stages of their life cycle; (B) the threshold temperature values employed as a constant throughout the entire life cycle of a plant change with the advancing age of the plant; (C) no improvement was made by varying the upper and lower threshold temperatures in the heat unit system; (D) the heat unit requirement of a given process remained constant only for that range within which a direct proportionality existed between growth rate and temperature, with the lack of proportionality usually found near the upper and lower threshold temperatures; and (E) many factors which influence plant growth and development, such as soil moisture and vapor pressure deficit, were not taken into account by the heat unit system.

CHAPTER III

MATERIALS AND METHODS

Growth chamber experiments I and II were conducted at the Agronomy Research Station near Stillwater, Oklahoma. Field experiment III was conducted at the Caddo Peanut Research Station near Ft. Cobb, Oklahoma.

Growth Chamber Experiment I

A 12-hour day from 6 A.M. to 6 P.M. and an average of 2100 foot candles of light were used in the first growth chamber study. The temperature was set for 82° F. but ranged from 78° to 88° F. The relative humidity ranged from 40 to 99 per cent.

Two Argentine peanut seeds were planted March 4, 1966, in each of twenty-one ten-inch pots in a sandy loam soil. The pots were placed on the growth chamber bench in a completely randomized design.

Analysis of the soil gave a pH of 6.2, 0.68 per cent organic matter, 0.034 per cent nitrogen, 120 pounds per acre of available potassium and 57 pounds per acre of available phosphorous. No fertilizer was applied to the soil during the experiment.

Daily bloom counts were recorded. Approximately eight to twelve days after blooming, gynophores appeared which were then tagged and dated. At harvest, the tagged fruits revealed the period from pegging to maturity. Six plants were harvested at weekly intervals from 90 to 132 days from planting. On each of the seven harvest dates, any fruits possessing some kernel development were removed from the plant. The oven-dry weights of plants and roots were determined for each of the six plants on each harvest date. The plants and roots were dried 48 hours in a forced draft hot air oven set at 90° C. Dry matter data for fruits and kernels were not determined since the kernels were used for biochemical studies.

Maturity data were obtained from the fruits cured at 90° F. in a controlled curing box by classifying individual fruits as mature, intermediate, or immature according to their interior pericarp color. Fruits with dark pigmentation of the interior pericarp were considered mature, those with white interior pericarp as immature, and those between the two extremes as intermediate. The fruits were hand shelled, classified, counted and weighed for each harvest date.

Growth Chamber Experiment II

The conditions in the second growth chamber experiment were similar to the first except that the photoperiod was from midnight to noon, and the temperature was set for 85° F. but ranged from 82° to 92° F.

One seed each of the Argentine peanuts was planted June 9, 1967, in twelve eight-inch pots filled with the same sandy loam soil used in experiment I. The pots were placed on the growth chamber bench in a completely randomized design.

Blooms were counted, recorded, tagged and dated daily. Eight to twelve days later the tag was moved from the bloom to the gynophore.

Three plants were harvested at 10-day intervals from 110 to 140 days from planting.

Field Experiment III

The field experiment at the Caddo Peanut Research Station near Ft. Cobb, Oklahoma, consisted of ten planting dates which ranged from May 2 to July 4 at weekly intervals. Each treatment contained a four row plot replicated three times in a randomized complete block design.

The center two rows of treatments planted May 2, May 9, May 16, and May 23 were dug October 20, and those planted May 30, June 6, June 13, June 20, June 27, and July 4 were dug October 31. Yield and grade data were obtained for all planting dates.

Representative 1-pound samples of clean air-dried peanuts from each plot in the test was used for grade determination. The percentages of sound mature (SMK), sound splits

(SS), other kernels (OK), and damaged kernels were determined by personnel of the State-Federal Inspection Service at Durant, Oklahoma. The total percentage of sound mature kernels consisted of sound kernels held on the 15/64 x 3/4-inch slotted sieve plus sound split kernels.

Individual plants were harvested from the border rows at weekly intervals for periods of 116 to 151 days from planting. The last harvesting intervals for the June 13, June 20, June 27, and July 4 planting dates were terminated due to a killing freeze. On each respective harvest date, six plants were pulled at random from the border rows of each plot to obtain a total of eighteen plants from each treatment. Nine of the eighteen plants from each treatment were used for determining the individual plant and fruit weights. The other nine plants from each treatment were used to determine the number of pegs, pops, mature, intermediate, and immature fruits. The percentages for the numbers and weights of mature, intermediate, and immature large and small kernels were determined.

The fruits for each harvest date were cured in an oven set at 90° F. and then classified as mature, intermediate, or immature based on interior pericarp color. After the fruits had been classified, the kernels were sized using a 15/64 x 3/4-inch slotted sieve. Kernels riding the sieve were classed as large and those that fell through were classed as small. Kernel weight was then taken for each maturity and size group for material from each plant in each treatment.

Three biometerological factors (effective heat units, langleys, and effective energy) were calculated from planting to harvesting date for the purpose of predicting the optimum maturity date. Effective heat units were based on daily readings of 70° F., 73° F., 76° F., 82° F. and 85° F. as the optimum temperature and a lower cardinal temperature of 56° F. Daily totals of langleys (cal./cm^2/min.) were obtained from National Climatological Data for Will Rogers Air Field, Oklahoma City, Oklahoma. Daily effective energy units were calculated by multiplying the daily total langleys by the daily mean temperature for each day. The number of days from April 1 to planting and from April 1 to harvesting were calculated to obtain the planting-harvesting index.

The analyses of variance and regression coefficients for the data in Experiment III were calculated by using the IBM computer at Oklahoma State University Computer Center. The coefficients of variation and the least significant differences were determined on a desk calculator.

CHAPTER IV

RESULTS AND DISCUSSION

Blooming Cycles

The mean number of days from planting to emergence in growth chamber experiment I was five days and the time from planting to the first flower was 27 days (Figure 1). The flowering cycle steadily increased until a high point of flowering, 3.0 flowers per plant, occurred 37 days after planting. The highest mean number of flowers per plant (3.1) occurred 42 days after planting. The flowering frequency was cyclic with alternating high and low peaks occurring every three to four days. The last flower occurred 84 days after planting in experiment I.

The mean number of days from planting to emergence in growth chamber experiment II was five days and from planting to the first flower was 24 days (Figure 2). The bloom frequency abruptly reached its highest peak of 5.1 flowers per plant in 28 days after planting. Blooming frequency decreased sharply 36 days after planting when a secondary bloom frequency of 3.25 flowers per plant occurred.

Temperatures rose to 105° F. because of an electric power failure on July 11 and July 12, or 32 and 33 days from planting. The blooming frequency decreased sharply on

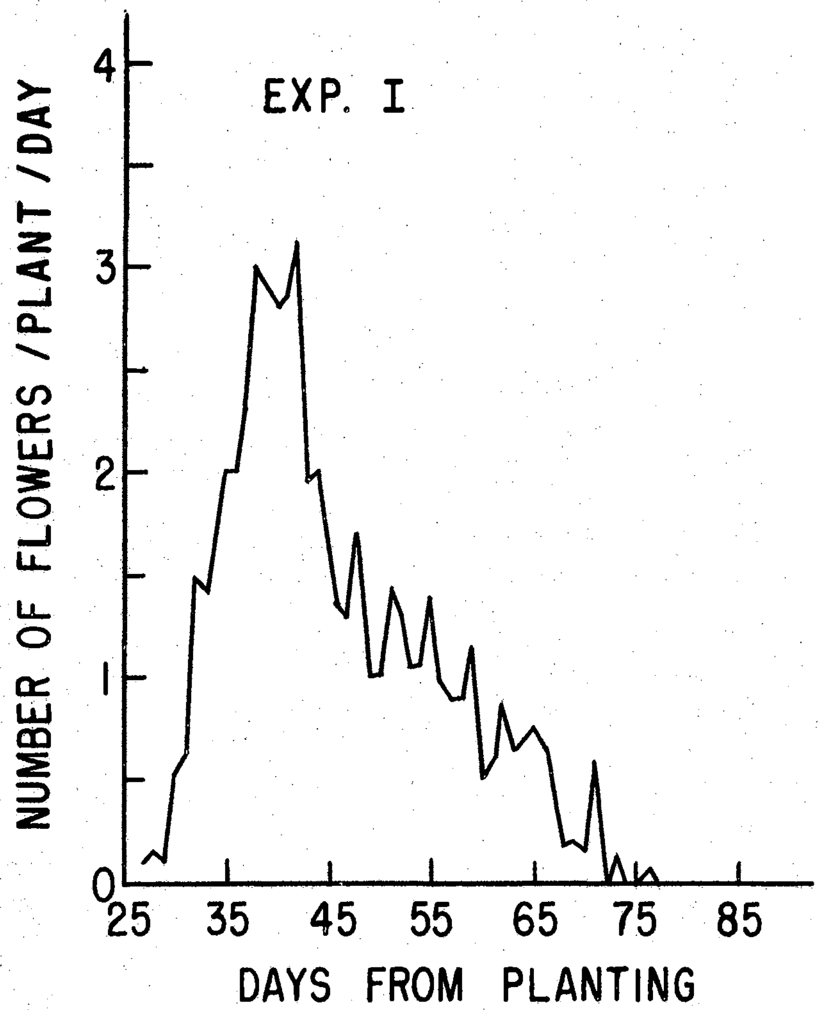

Figure 1. Mean Number of Flowers per Plant per Day for Argentine Peanuts Recorded Daily in Growth Chamber Experiment I, 1966

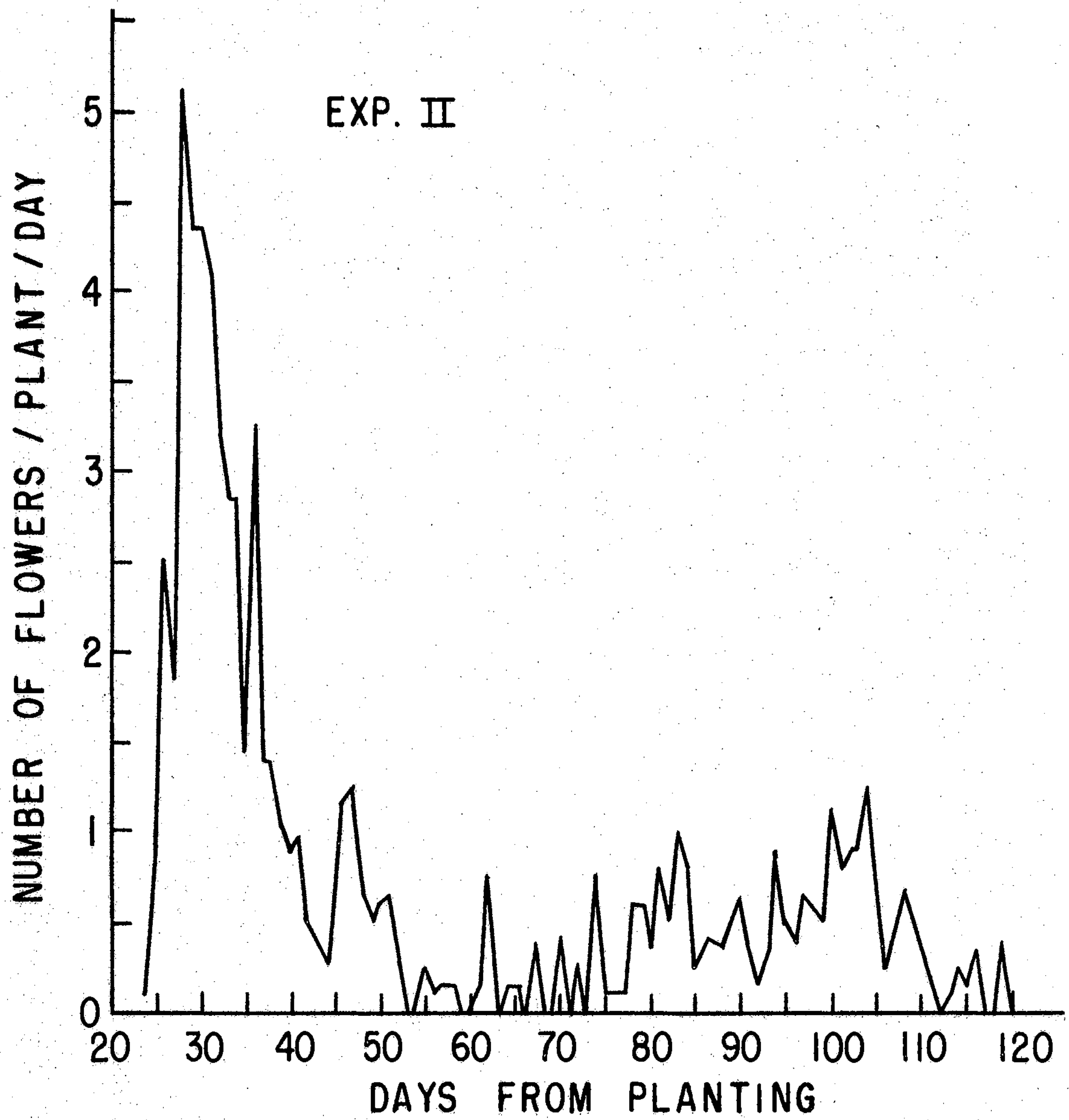

Figure 2. Mean Number of Flowers per Plant per Day for Argentine Peanuts Recorded Daily in Growth Chamber Experiment II, 1967

July 13 and remained at a relatively low level with alternating high and low peaks occurring during the remainder of the blooming period. The last flower was recorded 120 days from planting.

Maturity Patterns

The maturity pattern from pegging to maturity for growth chamber experiment I is shown in Table I. The earliest peg was tagged on April 8. Forty-nine per cent of the mature and intermediate kernels were produced from pegs tagged during the first 11-day interval of pegging from April 8 to April 18 (34 to 44 days after planting). Forty-seven per cent of the mature and intermediate kernels were produced from pegs tagged during the second 11-day interval of pegging from April 19 to April 29 (45 to 55 days after planting). Thus ninety-six per cent of the mature and intermediate kernels resulted from pegs produced during the first 22 days of pegging.

The maturity pattern from blooming to maturity for growth chamber experiment II is shown in Table II. July 4 was the date on which the earliest bloom was tagged. During the first 11-day interval of blooming from July 4 to July 14 (25 to 35 days after planting) 87 per cent of the mature and intermediate kernels were produced. During the second 11-day interval of blooming, from July 15 to July 25 (36 to 46 days after planting), 10 per cent of the mature and intermediate kernels resulted from blooms in this interval. Thus,

TABLE I

TOTAL NUMBERS OF MATURE AND INTERMEDIATE KERNELS PER SIX PLANTS IN GROWTH CHAMBER EXPERIMENT I, 1966

Pegging Dates	Days from Planting to Harvest							Percentage of Kernels
	90	97	104	111	118	125	132	
April 8 to 18	1	9	16	22	16	16	16	49
April 19 to 29	0	4	6	11	21	27	24	47
After April 29	0	0	0	0	1	1	6	4

Planted March 4, 1966; harvested May 28 to July 9.

TABLE II

TOTAL NUMBERS OF MATURE AND INTERMEDIATE KERNELS PER THREE PLANTS IN GROWTH CHAMBER EXPERIMENT II, 1967

Blooming Dates	Days from Planting to Harvest				Percentage of Kernels
	110	120	130	140	
July 4 to 14	32	33	29	32	87
July 15 to 25	2	5	2	6	10
After July 25	0	1	3	0	3

Planted June 9, 1967; harvested Sept. 27 to Oct. 27.

97 per cent of the mature and intermediate kernels resulted from flowers produced during the first 22 days of blooming, and three per cent resulted thereafter.

Very few mature and intermediate kernels resulted from blooms produced beyond 55 and 46 days after planting in experiment I and II, even when the plants were allowed to remain 132 to 140 days before digging. It would appear that any practice that would tend to increase early blooming should increase the proportion of mature kernels.

Harvest Data in Growth Chamber Experiment I

Highly significant differences occurred among harvest dates for plant weights (Table III). Mean weights ranged from 9.41 to 14.95 grams per plant. Mean plant weight increased significantly from 9.41 grams per plant for the May 28 harvest to 14.95 grams per plant for the June 4 harvest, but remained fairly constant for the harvest dates after June 4. The coefficient of variation was 14 per cent.

The mean numbers of mature and intermediate kernels per plant were highly significant among harvest dates (Table III). The mean number of kernels per plant ranged from 0.33 to 30.33. The mean number of mature and intermediate kernels increased significantly from May 28 to June 4, from June 4 to June 11, and June 11 to June 25. There were no significant increases in the number of mature and intermediate kernels 111 days after planting. The coefficient of variation was 31 per cent.

TABLE III

MEAN PLANT WEIGHT, NUMBER OF MATURE AND INTERMEDIATE AND IMMATURE KERNELS PER PLANT, AND WEIGHT OF MATURE AND INTERMEDIATE AND IMMATURE KERNELS PER PLANT FOR EACH OF SEVEN HARVEST DATES IN GROWTH CHAMBER EXPERIMENT I, 1966

Harvest Date	Number of Days from Planting to Harvest	Plant Weight (gms.)	Number of Mat. + Inter. Kernels	Number of Immature Kernels	Weight of Mat. + Inter. Kernels	Weight of Immature Kernels
May 28	90	9.41	0.33	20.83	0.11	7.17
June 4	97	14.95	9.00	14.00	4.17	4.44
June 11	104	14.87	16.50	14.00	7.35	2.68
June 18	111	13.11	21.67	12.00	10.75	1.80
June 25	118	14.63	24.33	9.17	11.53	0.65
July 2	125	12.91	26.67	16.50	12.43	2.01
July 9	132	12.56	30.33	5.50	13.17	0.80
Grand Mean		13.21	18.41	13.14	8.38	2.79
LSD.05		3.14	7.07	N.S.	10.71	3.75
CV (%)		14	31	68	27	77

There were no significant differences for numbers of immature kernels among the harvest dates (Table III). The coefficient of variation of 68 per cent was very high. There was a tendency for immature kernels to decrease and for intermediate and mature kernels per plant to increase as harvest date was delayed.

Highly significant differences for weight of mature and intermediate kernels per plant occurred among the harvest dates (Table III). The value for the first harvest date, made 90 days after planting (May 28), was very low with a mean of 0.11 grams, and weights increased sharply for the June 4, June 11, and June 18 harvests to 4.17, 7.35, and 10.75 grams per plant, respectively. Further increases recorded for the June 25, July 2, and July 9 harvest dates were 11.53, 12.43, and 13.17 grams per plant, respectively. The May 28 harvest date had significantly less kernel weight than did the June 25, July 2, and July 9 harvest dates. The coefficient of variation was 27 per cent.

The mean weights of immature kernels were significantly different among the harvest dates and ranged from 0.80 to 7.17 grams per plant (Table III). Immature kernel weights per plant significantly decreased by 38 per cent from the May 28 (7.17 grams) to June 4 harvest (4.44 grams). Mean immature kernel weights decreased by 40, 33, and 64 per cent from the June 4 to June 11, from the June 11 to June 18 and from June 18 to June 25 harvest dates, respectively. The July 2 harvest increased 309 per cent for immature kernel weights per plant, while the July 9 harvest decreased 60 per cent. The May 28 harvest date produced significantly more immature kernels by weight than any of the other harvest dates except June 4. The coefficient of variation of 77 per cent was high.

Harvest Data in Growth Chamber Experiment II

There were no significant differences among the harvest dates for plant weights, numbers and weights of mature and intermediate kernels, and numbers and weights of immature kernels in growth chamber experiment II (Table IV). This experiment used one plant for each of three replications in each of the four harvest dates, and the spread in harvest dates was not as great in experiment II as compared with experiment I.

These data show that plants and kernel weights did not change materially between 110 and 140 days after planting. This agrees with the data in experiment I where there was little change between 111 and 132 days after planting.

Field Experiment

Time of Planting

Peanut Flowering. The number of days from planting to flowering decreased from 35 to 24 days as the planting date was delayed from May 2 to June 6 (Table V). The May 2, May 9, May 16, May 23, and May 30 planting dates had 27, 28, 30, 26, and 28 days, respectively, of temperature 80° F. or above. Planting dates from June 6 through July 4 had from

TABLE IV

MEAN PLANT WEIGHT, NUMBER OF MATURE AND INTERMEDIATE AND IMMATURE KERNELS PER PLANT, AND WEIGHT OF MATURE AND INTERMEDIATE AND IMMATURE KERNELS PER PLANT FOR EACH OF FOUR HARVEST DATES IN GROWTH CHAMBER EXPERIMENT II, 1967

Harvest Date	Number of Days from Planting to Harvest	Plant Weight (gms.)	Number of		Weight of	
			Mat. + Inter. Kernels	Immature Kernels	Mat. + Inter. Kernels	Immature Kernels
Sept. 27	110	11.90	14.67	5.33	5.57	0.85
Oct. 7	120	10.27	15.33	4.67	6.32	0.72
Oct. 17	130	10.07	14.33	3.33	4.68	0.56
Oct. 27	140	12.67	17.33	6.00	6.80	0.76
Grand Mean		11.23	15.42	4.83	5.84	0.52
LSD.05		N.S.	N.S.	N.S.	N.S.	N.S.
CV (%)		36	24	55	25	121

TABLE V

FLOWERING DATA FOR EACH OF TEN PLANTING DATES ON THE CADDO PEANUT RESEARCH STATION, 1966

Planting Date	Flowering Date	Days from Planting to Flowering	Days of 80° F. or Above
May 2	June 6	35	27
May 9	June 11	34	28
May 16	June 18	33	30
May 23	June 21	30	26
May 30	June 30	31	28
June 6	July 3	28	24
June 13	July 8	25	23
June 20	July 14	24	24
June 27	July 22	25	25
July 4	July 28	24	24

23 to 25 days of temperature 80° F. or above, and the days for flowering were 23 to 25 days from planting.

The earlier planting dates (May 2 through June 13) had two to eight days difference in the days from planting to flowering and days of temperature 80° F. or above.

Yield. Mean yields and numbers of plants per plot for planting dates from May 2 through July 4 are shown in Figure 3. Mean yields per plot ranged from 441 to 3,445 pounds per acre with a mean yield for the experiment of 2,039 pounds per acre.

Plots for the May 2 through May 23 planting dates were dug October 20 and those for the May 30 through July 4 planting dates were dug October 31. The interval from planting to harvest for the May 2, May 9, May 16, May 23, May 30, June 6, June 13, June 20, June 27 and July 4 planting dates were dug 171, 164, 157, 150, 154, 147, 140, 133, 126 and 119 days, respectively. The yields of the plots planted May 2 and May 9 may have been significantly reduced by delaying harvest past the optimum maturity.

Highly significant differences occurred among the planting dates for yield. Mean yields were not significantly different between each of the following planting dates: (A) May 23 and May 16, (B) May 2, May 9, May 16, and June 13, (C) May 2, May 9, June 6, June 13 and June 20, (D) May 2, May 9, May 30, June 6, June 20 and June 27, and (E) June 27 and July 4. The May 23 planting date was significantly higher in yield than any of the other planting dates except

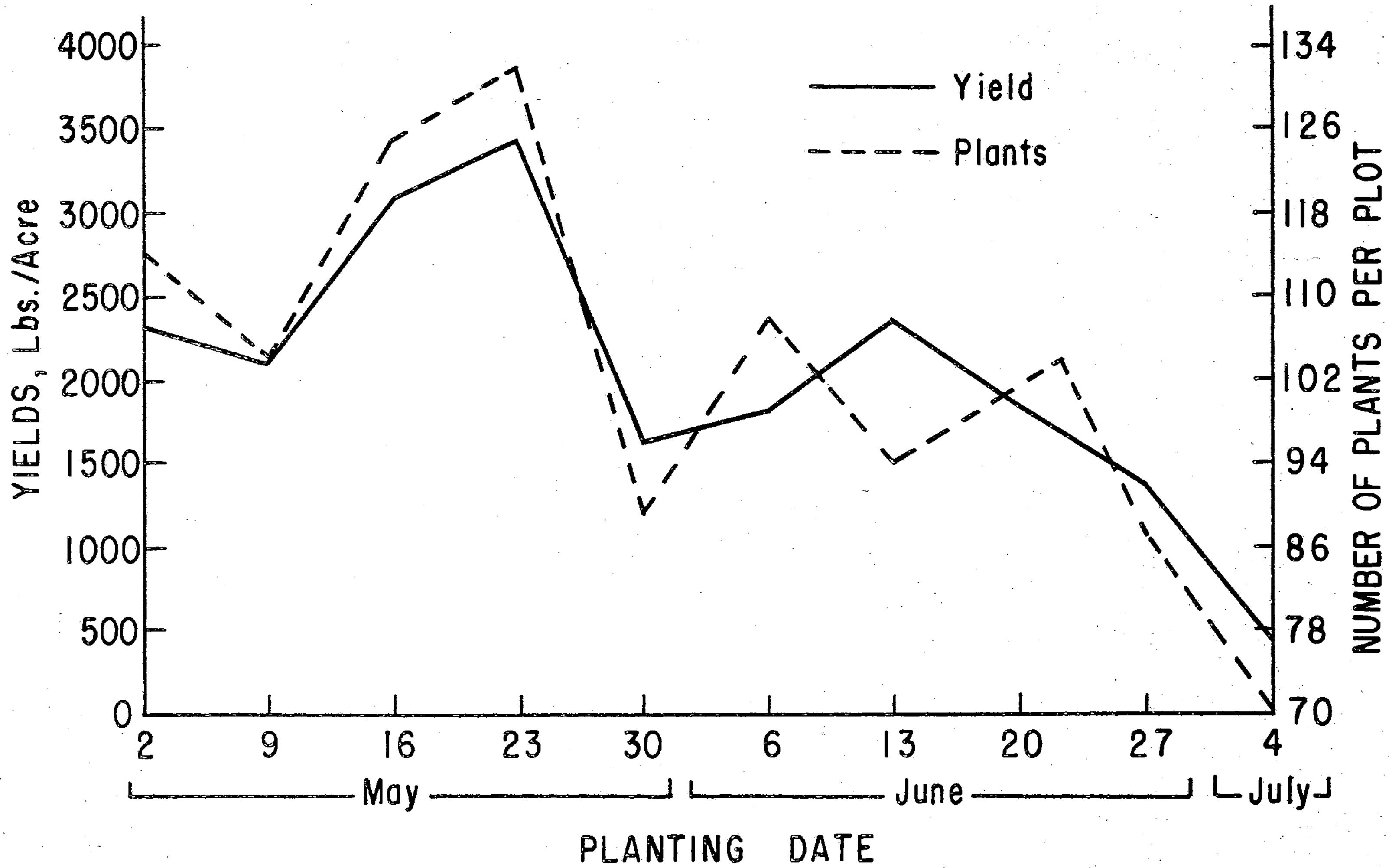

Figure 3. Mean Yield and Number of Plants per Plot for Ten Planting Dates on the Caddo Peanut Research Station, 1966

May 16. A mean yield difference of 944 pounds per acre between any two of the means was required for significance at the 5 per cent level. The coefficient of variation for yield was 28 per cent.

There were no significant differences in the numbers of plants per plot among the planting dates. The coefficient of variation was 21 per cent.

Grade. The grades were determined for samples from each planting date treatment and are shown in Figure 4. The factors determined in grading included the percentages of total sound mature kernels, sound splits, other kernels and damaged kernels.

There were no significant differences among the planting dates for the percentages of the total sound mature kernels. The coefficient of variation was 3 per cent.

The mean percentages of sound splits were highly significant among planting dates. Sound splits for May 2, May 9, May 16 and May 23 planting dates were significantly higher than any of the later planting dates. Sound splits for the planting dates from May 30 through July 4 ranged from 4 to 7 per cent. The mean percentages of sound splits for the July 4 planting date were significantly higher than those for the June 20 planting date.

Mean percentages of other kernels were significantly different among planting dates, ranging from 2 to 6 per cent with a mean of 3.3 per cent. The June 27 planting date was significantly higher by 2 per cent than the May 23 planting

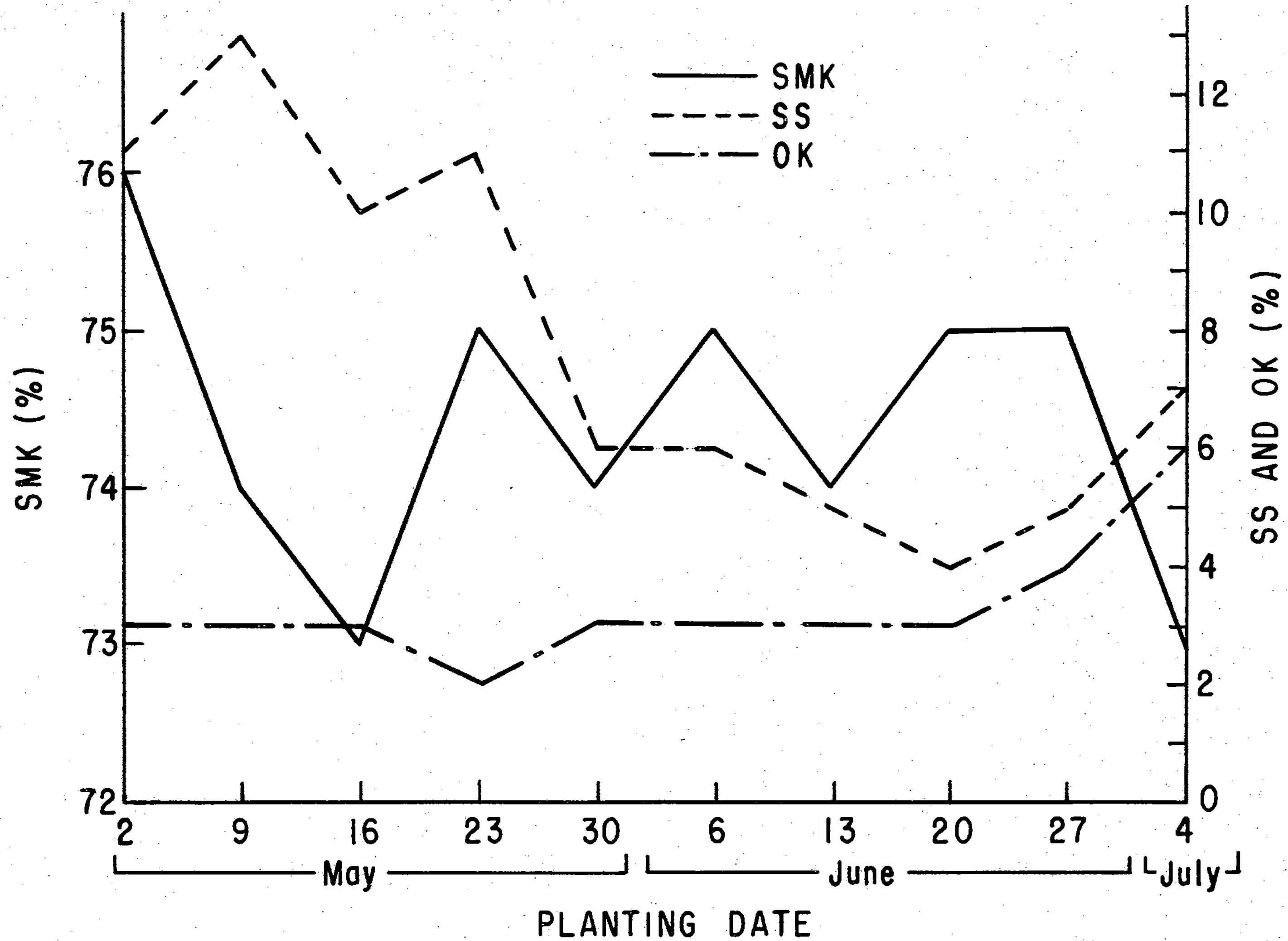

Figure 4. Mean Percentages of SMK, SS, and OK for Ten Planting Dates on the Caddo Peanut Research Station, 1966

date, and the July 4 planting date was significantly higher by 2 to 4 per cent than any of the earlier planting dates.

There were no damaged kernels noted for any of the treatments.

Time of Harvesting

Mean Dry Plant Weight. Highly significant differences occurred among the harvest dates for each of the ten planting dates for the mean dry plant weight per plant and ranged from 12 to 122 grams per plant (Table VI). May 2, May 9 and May 16 planting dates reached their maximum dry plant weights in 130, 116 and 130 days from planting, respectively. The mean dry plant weights per plant did not significantly increase after 116 days from planting for any planting date after May 16 and through July 4. The mean dry plant weight generally decreased as the harvest and planting dates (after May 9) were delayed.

Mean Dry Fruit Weight. There were significant differences among the harvest dates for May 2, May 9, May 16, May 30, June 13 and June 20 planting dates for the mean dry fruit weight per plant (Table VII), values for which ranged from 6 to 62 grams per plant. Mean dry fruit weight increased sharply from May 2 to May 9 (from 31.0 to 37.0), increased slightly through May 30 and again increased sharply up to 49 grams per plant on June 6. Marked decreases occurred from June 6 to June 13 (from 49 to 37.3 grams), from June 13 to June 20 (from 37.3 to 29.1), and from June 27 to July 4 planting dates (from 27.6 to 10.2 grams).

TABLE VI

MEAN GRAMS PER PLANT OF DRY PLANT WEIGHT FOR EACH OF TEN PLANTING DATES AND FOR SEVERAL HARVEST DATES ON THE CADDO PEANUT RESEARCH STATION, 1966

Planting Date	Days from Planting to Harvest 116	123	130	137	144	151	Mean	Harvest Date LSD.05	CV (%)
May 2	74	70	94	88	84	73	80.6	18.8	34
May 9	122	66	78	88	59	67	80.2	23.3	30
May 16	75	94	103	73	55	35	72.3	23.6	34
May 23	86	91	60	43	44	34	59.7	27.0	47
May 30	86	82	47	46	41	29	55.2	23.1	44
June 6	90	54	69	46	34	27	53.4	27.0	53
June 13	49	44	35	28	17		34.7	13.3	40
June 20	42	54	24	21	48		31.1	16.3	54
June 27	50	29	22	19			29.9	15.9	54
July 4	32	24	12				22.7	11.4	50

TABLE VII

MEAN GRAMS PER PLANT OF DRY FRUIT WEIGHT FOR EACH OF TEN PLANTING DATES AND FOR SEVERAL HARVEST DATES ON THE CADDO PEANUT RESEARCH STATION, 1966

Planting Date	Days from Planting to Harvest 116	123	130	137	144	151	Mean	Harvest Date LSD.05	CV (%)
May 2	18	17	33	44	35	39	31.0	11.4	38
May 9	40	25	33	38	35	51	37.0	14.6	41
May 16	22	41	62	43	40	26	39.1	17.5	47
May 23	39	44	38	32	42	41	39.3	N.S.	51
May 30	39	51	34	45	44	26	39.9	15.3	40
June 6	55	41	65	54	42	37	49.0	N.S.	53
June 13	47	39	40	34	27		37.3	12.4	34
June 20	33	42	24	25	20		29.1	12.7	45
June 27	31	27	26	27			27.6	N.S.	35
July 4	14	9	6				10.2	N.S.	89

Optimum harvest dates based on the highest mean dry fruit weights per plant occurred from 130 to 137 days from planting for the May 2, May 9 and May 16 planting dates and occurred from 116 to 123 days from planting for the May 30, June 13 and June 20 planting dates.

Mean Percentages of Oven Dry Plant Weight. The mean percentages of dry plant weight were significantly different among harvest dates for each planting date and ranged from 19 to 83 per cent (Table VIII). Mean percentages of plant weight in general increased as harvest and planting dates were delayed. Each planting date usually reached the same mean percentage of dry plant weight about the same time.

Mean Percentages of Oven Dry Fruit Weight. Significant differences occurred among harvest dates for each planting date except July 4 for the mean percentages of oven dry fruit weight (Table IX). The range was from 33 to 71 per cent. Percentages of oven dry fruit weight increased as the harvesting and planting dates were delayed. The fruit for each planting date generally reached the same stage of maturity or mean percentage of oven dry fruit weight on the same date.

Mean Percentages of Numbers of Fruit. Percentages of mature, intermediate and immature fruits were calculated as a percentage of total number of fruits for each planting and harvest date as shown in Table X.

Significant differences occurred among the harvest dates for May 2 through the June 13 planting dates. Mean

TABLE VIII

MEAN PERCENTAGES OF DRY PLANT WEIGHT FOR EACH OF TEN PLANTING DATES AND FOR SEVERAL HARVEST DATES ON THE CADDO PEANUT RESEARCH STATION, 1966

Planting Date	Days from Planting to Harvest 116	123	130	137	144	151	Mean	Harvest Date LSD.05	CV (%)
May 2	29	22	25	18	36	28	26.41	4.50	18
May 9	22	26	19	44	26	33	28.46	11.56	42
May 16	23	19	32	38	43	51	34.37	9.08	28
May 23	19	42	37	44	53	63	42.74	5.00	12
May 30	35	32	46	47	58	75	48.74	6.34	14
June 6	27	42	46	55	70	77	52.96	6.37	13
June 13	44	50	54	83	76		61.49	14.36	24
June 20	37	45	70	74	82		61.64	4.89	8
June 27	47	70	72	77			66.56	5.19	8
July 4	59	63	73				64.96	5.97	9

TABLE IX

MEAN PERCENTAGES OF DRY FRUIT WEIGHT FOR EACH OF TEN PLANTING DATES AND FOR SEVERAL HARVEST DATES ON THE CADDO PEANUT RESEARCH STATION, 1966

Planting Date	Days from Planting to Harvest						Mean	Harvest Date LSD.05	CV (%)
	116	123	130	137	144	151			
May 2	36	33	35	40	55	53	42.00	6.45	16
May 9	35	43	40	51	49	61	46.46	4.48	10
May 16	39	37	53	55	59	67	51.48	4.13	8
May 23	37	55	57	62	66	69	57.72	3.88	7
May 30	57	55	63	66	66	69	62.63	3.34	6
June 6	52	63	65	68	69	70	64.48	2.53	4
June 13	64	68	67	71	71		68.16	2.87	4
June 20	63	62	69	68	75		67.18	3.14	5
June 27	63	72	69	68			68.17	5.05	8
July 4	62	55	65				60.52	N.S.	21

TABLE X

MEAN PERCENTAGES OF MATURE, INTERMEDIATE, AND IMMATURE FRUIT FOR EACH OF TEN PLANTING DATES AND FOR SEVERAL HARVEST DATES ON THE CADDO PEANUT RESEARCH STATION, 1966.

Planting Date	Maturity Group	Days from Planting to Harvest						Grand Mean	LSD (.05)	CV (%)
		116	123	130	137	144	151			
	Mature	3	9	14	19	36	43	20.71	10.38	52
May 2	Intermediate	4	7	16	30	17	23	16.00	7.59	50
	Immature	92	84	71	51	47	34	63.23	10.61	18
	Mature	1	4	19	40	45	55	27.14	8.18	31
May 9	Intermediate	5	21	19	16	22	22	17.57	5.71	34
	Immature	94	75	62	44	33	23	55.36	9.60	18
	Mature	3	10	33	38	49	39	28.71	12.37	45
May 16	Intermediate	16	24	20	22	21	27	21.70	N.S.	44
	Immature	81	66	47	40	30	34	49.65	12.66	27
	Mature	18	33	32	44	44	43	35.50	11.47	34
May 23	Intermediate	15	21	29	18	26	24	22.22	N.S.	45
	Immature	67	46	39	38	30	33	42.31	11.95	29
	Mature	25	36	47	30	48	46	38.75	14.19	38
May 30	Intermediate	25	23	17	25	20	24	22.13	N.S.	46
	Immature	50	41	36	45	32	30	39.18	13.48	36
	Mature	42	21	42	40	41	56	40.34	12.72	37
June 6	Intermediate	20	23	22	17	23	17	20.43	N.S.	50
	Immature	38	56	36	43	36	28	39.23	14.27	44
	Mature	44	38	52	51	59		48.64	7.04	15
June 13	Intermediate	22	17	19	23	23		20.60	N.S.	36
	Immature	34	45	30	27	18		30.73	7.47	25
	Mature	35	35	44	50	46		41.84	N.S.	39
June 20	Intermediate	34	19	26	30	34		28.51	N.S.	43
	Immature	31	47	30	20	20		29.64	17.27	60
	Mature	34	39	30	36			34.87	N.S.	58
June 27	Intermediate	34	24	28	33			29.64	N.S.	47
	Immature	32	37	42	31			35.50	N.S.	44
	Mature	6	8	9				7.56	N.S.	192
July 4	Intermediate	23	18	54				31.44	18.53	59
	Immature	71	75	37				61.03	21.05	35

percentages of mature fruit ranged from 3 to 59 per cent among the harvest dates, and they increased as the harvest date was delayed and as the planting date was delayed through June 13. Values decreased after the June 13 planting date and dropped sharply to 8 per cent on the July 4 planting date.

The mean percentages of intermediate maturity fruits were significant among the harvest dates for May 2, May 9, and the July 4 planting dates ranging from 4 to 54 per cent among the harvest dates and generally increasing as the planting date was delayed. June 20, June 27 and July 4 planting dates had 6 to 15 per cent more intermediate fruit than the earlier planting dates.

Significant differences occurred among the harvest dates for each planting date except June 27 for mean percentages of immature fruit. The range was from 20 to 94 per cent among the harvest dates. The immature fruit generally decreased as the harvest date was delayed and as the planting date was delayed through June 20, increasing slightly on June 27, and abruptly on July 4 planting date.

Mean Percentages of Large Kernels. Percentages of large mature, intermediate and immature kernels were calculated as a percentage of the total number of large kernels for each planting and harvesting date as shown in Table XI.

Significant differences occurred among harvest dates for May 2, May 9, May 16, June 6 and June 13 planting dates for mean percentages of large mature kernels. The results

TABLE XI

MEAN PERCENTAGES OF LARGE MATURE, INTERMEDIATE, AND IMMATURE KERNELS FOR EACH OF TEN PLANTING DATES AND FOR SEVERAL HARVEST DATES ON THE CADDO PEANUT RESEARCH STATION, 1966.

Planting Date	Maturity Group	Days from Planting to Harvest 116	123	130	137	144	151	Grand Mean	LSD (.05)	CV (%)
	Mature	16	14	30	28	48	54	31.69	15.84	52
May 2	Intermediate	20	12	36	45	25	28	27.56	13.53	51
	Immature	64	64	35	27	27	18	38.90	18.29	49
	Mature	3	7	28	52	53	63	34.56	10.86	33
May 9	Intermediate	10	38	37	23	29	24	26.94	9.37	36
	Immature	86	54	35	25	18	12	38.50	11.73	32
	Mature	5	17	47	47	56	42	35.76	15.24	45
May 16	Intermediate	31	38	25	28	26	38	30.80	N.S.	44
	Immature	65	45	29	25	18	20	33.56	11.67	36
	Mature	31	45	37	51	47	43	42.39	N.S.	35
May 23	Intermediate	24	26	34	25	31	31	28.39	N.S.	40
	Immature	45	29	29	24	22	26	29.38	9.59	34
	Mature	37	45	53	34	50	48	44.56	N.S.	38
May 30	Intermediate	32	29	26	31	22	28	28.13	N.S.	35
	Immature	32	26	21	34	27	24	27.35	N.S.	51
	Mature	50	30	44	45	46	59	45.70	15.12	36
June 6	Intermediate	25	30	26	22	26	19	24.65	N.S.	40
	Immature	25	40	30	33	27	22	29.64	N.S.	58
	Mature	53	45	55	54	63		53.73	8.08	16
June 13	Intermediate	27	22	23	25	23		23.96	N.S.	34
	Immature	21	33	22	21	14		22.32	7.25	34
	Mature	42	41	48	52	52		46.98	N.S.	40
June 20	Intermediate	35	24	28	28	34		29.80	N.S.	39
	Immature	23	35	24	20	13		23.26	N.S.	79
	Mature	40	44	33	40			39.28	N.S.	52
June 27	Intermediate	37	26	33	41			34.06	N.S.	44
	Immature	22	31	34	20			26.75	N.S.	57
	Mature	1	6	12				6.48	N.S.	247
July 4	Intermediate	6	26	47				25.93	24.13	93
	Immature	93	68	42				67.53	30.48	45

ranged from 16 to 63 per cent among the harvest dates and increased as harvest dates and planting dates (through June 13) were delayed.

Mean percentages of large intermediate kernels were highly significant among the harvest dates for May 2, May 9 and July 4 planting dates, and ranged from 12 to 47 per cent among the harvest dates.

Highly significant differences occurred among the harvest dates for May 2, May 9, May 16, May 23, June 13 and July 4 planting dates for mean percentages of large immature kernels. Decreases occurred as harvest dates and planting dates (through June 13) were delayed. Slight increases were obtained for the June 20 and June 27 planting dates, with a sharp rise to 68 per cent on the July 4 planting date.

Mean Percentages of Small Kernels. Mean percentages of small mature, intermediate and immature kernels were calculated as a percentage of the total number of small kernels for each planting and harvest date as shown in Table XII.

There were significant differences among the harvest dates for May 2, May 9, and May 16 planting dates. Results ranged from 0 to 12 per cent among harvest dates, and were very erratic, generally increasing as harvest date was delayed and decreasing as planting date was delayed.

Mean percentages of small intermediate kernels were significant among the harvest dates for May 9 and June 27 planting dates, and ranged from 0 to 15 per cent among the harvest dates and were very erratic but generally increased as harvest date was delayed.

TABLE XII

MEAN PERCENTAGES OF SMALL MATURE, INTERMEDIATE, AND IMMATURE KERNELS FOR EACH OF TEN PLANTING DATES AND FOR SEVERAL HARVEST DATES ON THE CADDO PEANUT RESEARCH STATION, 1966.

Planting Date	Maturity Group	Days from Planting to Harvest						Grand Mean	LSD (.05)	CV (%)
		116	123	130	137	144	151			
May 2	Mature	0	7	4	1	6	6	3.99	5.25	137
	Intermediate	1	3	6	1	4	9	4.02	N.S.	184
	Immature	99	90	90	98	90	84	91.97	N.S.	14
May 9	Mature	0	0	2	4	4	12	3.44	6.62	201
	Intermediate	1	1	2	4	5	15	4.56	7.60	174
	Immature	99	98	97	93	92	74	92.01	13.40	15
May 16	Mature	0	0	2	5	1	4	2.03	3.52	176
	Intermediate	1	0	4	3	4	8	3.39	N.S.	164
	Immature	99	99	94	92	94	88	94.59	6.79	7
May 23	Mature	0	1	1	3	8	1	2.57	N.S.	251
	Intermediate	0	2	2	6	9	3	3.72	N.S.	200
	Immature	100	97	96	91	83	96	93.68	N.S.	12
May 30	Mature	0	0	4	3	0	12	3.17	N.S.	509
	Intermediate	3	0	2	5	7	7	4.00	N.S.	203
	Immature	97	99	93	92	93	82	92.67	N.S.	27
June 6	Mature	1	0	1	4	1	1	1.33	N.S.	316
	Intermediate	2	0	3	6	3	4	3.00	N.S.	239
	Immature	97	100	96	90	96	94	95.50	N.S.	21
June 13	Mature	1	1	1	4	3		2.00	N.S.	236
	Intermediate	5	1	2	8	13		5.80	N.S.	150
	Immature	95	97	96	88	85		92.20	N.S.	20
June 20	Mature	0	1	3	6	7		3.40	N.S.	233
	Intermediate	4	2	7	7	15		7.00	N.S.	146
	Immature	96	98	90	87	78		89.80	17.23	20
June 27	Mature	1	1	0	3			1.34	N.S.	312
	Intermediate	9	2	2	15			7.08	8.75	126
	Immature	90	97	98	82			91.56	10.34	12
July 4	Mature	0	1	3				1.14	N.S.	415
	Intermediate	0	3	9				4.00	N.S.	218
	Immature	100	96	89				94.89	N.S.	13

There were significant differences among the harvest dates for May 9, May 16, June 20 and June 27 planting dates for mean percentages of small immature kernels. The values ranged from 74 to 100 per cent among the harvest dates and generally decreased as harvest was delayed.

Mean Percentages of Large Kernel Weights. The weights of large mature, intermediate and immature kernels were calculated as a percentage of the total weight of large kernels for each planting and harvesting date as shown in Table XIII.

The mean percentages for large kernel weights were highly significant among the harvest dates for May 2, May 9, May 16, June 6 and June 13 planting treatments, ranging from 1 to 63 per cent among harvest dates and generally increasing as harvest and planting dates (through June 13) were delayed, but decreasing down to a mean 6 per cent on July 4 planting date.

Significant differences occurred among the harvest dates for May 2, May 9, May 16, June 6 and July 4 planting treatments for the mean percentages of large intermediate kernel weight. The range was from 6 to 47 per cent among the harvest dates.

The mean percentages of large immature kernel weights were significant among the harvest dates for May 2, May 9, May 16, May 23, June 13, and July 4 planting dates. The results ranged from 12 to 93 per cent and generally decreased as harvesting dates and planting dates (through June 13) were delayed. The mean percentages increased slightly on the

TABLE XIII

MEAN PERCENTAGES OF LARGE MATURE, INTERMEDIATE, AND IMMATURE KERNEL WEIGHT FOR EACH OF TEN PLANTING DATES AND FOR SEVERAL HARVEST DATES ON THE CADDO PEANUT RESEARCH STATION, 1966.

Planting Date	Maturity Group	Days from Planting to Harvest 116	123	130	137	144	151	Grand Mean	LSD (.05)	CV (%)
May 2	Mature	18	18	28	27	49	57	32.91	17.27	55
	Intermediate	19	18	37	48	25	29	29.39	16.83	60
	Immature	63	64	35	25	26	14	37.79	17.90	49
May 9	Mature	3	7	30	56	57	66	36.63	11.32	32
	Intermediate	10	39	40	24	29	25	27.70	9.52	36
	Immature	86	54	30	20	14	9	35.65	11.94	35
May 16	Mature	4	20	48	50	59	45	37.80	16.73	46
	Intermediate	32	47	26	28	27	38	32.98	14.01	44
	Immature	63	34	26	22	14	17	29.28	12.22	44
May 23	Mature	35	49	40	53	50	45	45.41	N.S.	33
	Intermediate	27	26	35	24	31	29	28.70	N.S.	41
	Immature	38	26	24	23	19	25	25.84	9.62	39
May 30	Mature	41	49	55	37	53	51	47.57	N.S.	36
	Intermediate	33	29	28	33	24	29	29.20	N.S.	37
	Immature	27	21	18	30	23	21	23.26	N.S.	63
June 6	Mature	55	31	46	50	49	62	48.80	15.35	38
	Intermediate	25	33	28	22	27	20	25.83	8.47	37
	Immature	20	36	26	29	23	18	25.31	N.S.	63
June 13	Mature	57	49	59	58	66		57.56	8.41	15
	Intermediate	26	23	23	24	23		23.82	N.S.	37
	Immature	17	28	18	18	11		18.62	6.05	34
June 20	Mature	44	45	50	55	55		50.07	N.S.	37
	Intermediate	38	26	28	27	33		30.42	N.S.	41
	Immature	18	29	22	17	12		19.58	N.S.	86
June 27	Mature	46	46	35	42			42.58	N.S.	50
	Intermediate	36	27	35	40			34.61	N.S.	46
	Immature	17	27	29	18			22.66	N.S.	61
July 4	Mature	1	7	12				6.85	N.S.	247
	Intermediate	7	23	45				24.93	23.24	93
	Immature	92	70	43				68.28	30.14	44

June 20 and June 27 planting dates, and increased sharply (up to 68 per cent) on the July 4 planting date.

The mean percentages for the numbers and weights of large kernels corresponded closely as was expected and when either variable (number or weight) was significant, the other variable was also significant. Weights of the large kernels had a slightly higher coefficient of variation. Either numbers or weights of large kernels could be used in a maturity study.

Mean Percentages of Small Kernel Weights. The percentages of small mature, intermediate and immature kernel weights were calculated as a percentage of the total large kernel weight for each planting and harvesting date as shown in Table XIV.

Significant differences occurred among the harvest dates for May 2, May 9 and May 16 planting dates for the mean percentages of small mature kernel weights. Values ranged from 0 to 14 per cent and generally increased as harvest was delayed.

The mean percentages of small intermediate kernel weights were significantly different among the harvest dates for May 2, May 9, and June 27 planting dates. The range was from 0 to 21 per cent and generally increased as harvest was delayed. The June 13, June 20, June 26 and July 4 planting dates showed higher weights, being 2 to 5 per cent higher than those for the earlier planting dates.

TABLE XIV

MEAN PERCENTAGES OF SMALL MATURE, INTERMEDIATE, AND IMMATURE KERNEL WEIGHT FOR EACH OF TEN PLANTING DATES AND FOR SEVERAL HARVEST DATES ON THE CADDO PEANUT RESEARCH STATION, 1966.

Planting Date	Maturity Group	Days from Planting to Harvest 116	123	130	137	144	151	Grand Mean	LSD (.05)	CV (%)
	Mature	0	11	5	1	8	7	5.31	6.51	131
May 2	Intermediate	1	7	3	1	4	11	4.54	6.43	148
	Immature	99	83	91	98	88	82	89.94	7.08	12
	Mature	0	1	3	5	5	14	4.50	7.92	184
May 9	Intermediate	1	2	3	5	5	15	5.22	7.50	150
	Immature	98	97	94	90	90	70	90.04	14.16	16
	Mature	0	1	2	7	1	3	2.22	2.94	138
May 16	Intermediate	1	0	5	3	3	7	3.22	N.S.	144
	Immature	99	99	92	89	97	90	94.37	5.82	6
	Mature	0	2	2	3	9	1	2.87	N.S.	239
May 23	Intermediate	0	4	1	8	10	4	4.20	N.S.	205
	Immature	100	94	97	89	81	95	92.74	12.09	14
	Mature	0	1	21	4	0	12	3.15	N.S.	544
May 30	Intermediate	4	1	4	5	9	12	5.15	N.S.	229
	Immature	96	99	75	90	91	76	87.78	N.S.	36
	Mature	2	0	1	5	1	1	1.70	N.S.	245
June 6	Intermediate	3	1	5	7	4	9	4.81	N.S.	243
	Immature	95	99	94	88	95	91	93.67	N.S.	24
	Mature	1	2	3	6	4		3.20	N.S.	247
June 13	Intermediate	9	3	4	9	16		8.20	N.S.	141
	Immature	89	95	93	85	79		88.20	N.S.	22
	Mature	0	1	4	9	12		5.20	N.S.	250
June 20	Intermediate	7	3	11	9	21		10.20	N.S.	145
	Immature	93	96	86	81	67		84.60	19.80	25
	Mature	2	1	0	5			2.17	N.S.	293
June 27	Intermediate	10	3	3	18			8.58	10.01	119
	Immature	87	96	97	77			89.08	12.75	15
	Mature	0	1	3				1.30	N.S.	425
July 4	Intermediate	0	10	12				7.33	N.S.	220
	Immature	100	89	85				91.19	N.S.	21

Significant differences occurred among the harvest dates for May 2, May 9, May 16, May 23, June 20 and June 27 planting dates for mean percentages of small immature kernel weights. The range was from 67 to 100 per cent and decreased as harvest date was delayed.

The mean percentages for the numbers and weights of small mature and intermediate kernels corresponded fairly closely, but numbers and weights of immature kernels did not correspond. Data in Tables XII and XIV show that small kernel weights exhibited significant differences more often than did numbers of small kernels. Small kernel weights had slightly higher coefficients of variation; but to avoid duplication of data, it would appear desirable to use small kernel weights.

There were no methods used in this study to determine how large and small kernels varied in proportion to each other.

Maturity Predictors

Three maturity indices and a planting-harvest index were evaluated in this study to determine how precise they were in determining optimum maturity or harvest date.

The model used to predict maturity was

$$Y = \mu + R_i + H_j + P_k + (HP)_{jk} + B_1X + B_2X^2 + E,$$

where μ = overall mean.

R_i = effect due to the ith replication

H_j = effect due to the jth planting date

P_k = effect due to the kth harvest date

$(HP)_{jk}$ = interaction due to the jth planting date and kth harvest date

X = E.H.U. or Effective Energy or Langleys

B_1 = partial regression coefficient associated with X

B_2 = partial regression coefficient associated with X^2

R^2 = square of the multiple correlation coefficient.

$$R^2 = \frac{\text{sum of squares removed by the model, excluding } \mu}{\text{total corrected sum of squares corrected for the mean, } \mu}$$

The multiple correlation coefficient, R, for each maturity index on the number of mature and intermediate kernels was 0.66. Multiple correlation coefficient for each maturity index on the weight of mature and intermediate kernels was 0.69. These values did not change from one maturity predictor to another, since the sum of squares removed by E.H.U. or Effective Energy or Langleys was almost zero after adjusting for other effects (Table XV).

If the effects of replicates, planting dates and harvest dates are ignored and either E.H.U., or Effective Energy or Langleys is used for X, it is seen in Table XVI that the multiple correlation coefficient changes for different optimum cardinal temperatures and for the different maturity predictors. Temperatures of 76° F., 79° F. and 82° F. gave the most precise predictions of maturity based on number of mature and intermediate kernels. Based on the multiple

TABLE XV

MULTIPLE CORRELATION COEFFICIENTS FOR PREDICTING THE NUMBER OR WEIGHT OF MATURE AND INTERMEDIATE KERNELS WHEN REPLICATIONS, PLANTING DATES, HARVEST DATES AND EITHER E.H.U. OR EFFECTIVE ENERGY OR LANGLEYS ARE USED

X	Optimum Cardinal Temperature	Number of Mat. & Inter. Kernels	Weight of Mat. & Inter. Kernels
E.H.U.	70° F.	0.66	0.69
E.H.U.	73° F.	0.66	0.69
E.H.U.	76° F.	0.66	0.69
E.H.U.	79° F.	0.66	0.69
E.H.U.	82° F.	0.66	0.69
E.H.U.	85° F.	0.66	0.69
Effective Energy		0.66	0.69
Langleys		0.66	0.69

TABLE XVI

MULTIPLE CORRELATION COEFFICIENTS FOR PREDICTING THE NUMBER OR WEIGHT OF MATURE AND INTERMEDIATE KERNELS WHEN EITHER E.H.U. OR EFFECTIVE ENERGY OR LANGLEYS ARE USED

X	Optimum Cardinal Temperature	Number of Mat. & Inter. Kernels	Weight of Mat. & Inter. Kernels
E.H.U.	70° F.	0.795	0.421
E.H.U.	73° F.	0.789	0.418
E.H.U.	76° F.	0.822	0.459
E.H.U.	79° F.	0.824	0.454
E.H.U.	82° F.	0.822	0.443
E.H.U.	85° F.	0.806	0.414
Effective Energy		0.715	0.676
Langleys		0.660	0.593

correlation coefficient for weights of mature and intermediate kernels, effective energy was the most precise (highest multiple correlation coefficient) predictor of maturity. In this study either numbers or weights of mature and intermediate kernels could be used to predict maturity since the maturity predictors were all based on the same units, but since peanuts are sold by weight, effective energy would appear to be more practical.

These data indicate that effective energy was the best maturity predictor based on the weights of mature and intermediate kernels, since it measures the two biometeorological factors (temperature and light) that affect photosynthesis the most.

Multiple correlation coefficients were obtained for the model

$$Y = B_0 + B_1X + B_2X^2 + B_3Z + B_4Z^2 + B_5XZ + B_6XZ^2 + B_7X^2Z + B_8X^2Z^2 + E$$

where X = number of days to plant from April 1

Z = number of days to harvest from April 1

Y = response of number or weight of mature and intermediate kernels

E = random error.

Multiple correlation coefficients for the six variables were based on the number of days from April 1, reference date, to planting and harvesting dates (Table XVII). The multiple correlation coefficient of 0.59 for weights of mature and intermediate kernels would be most useful to

TABLE XVII

MULTIPLE CORRELATION (R) COEFFICIENTS FOR SIX VARIABLES BASED ON THE NUMBER OF DAYS FROM APRIL 1 TO PLANTING AND HARVEST DATES, CADDO PEANUT RESEARCH STATION, 1966

Variables	R Values
Number of Large Mature and Intermediate Kernels	0.561
Number of Small Mature and Intermediate Kernels	0.759
Number of Mature and Intermediate Kernels	0.552
Weight of Large Mature and Intermediate Kernels	0.596
Weight of Small Mature and Intermediate Kernels	0.728
Weight of Mature and Intermediate Kernels	0.594

predict the optimum harvest date or maturity since peanuts are sold by weight.

CHAPTER V

SUMMARY AND CONCLUSIONS

The Argentine variety of Spanish peanuts were grown in growth chamber experiments I and II during 1966 and 1967, respectively. Blooming cycles, maturity patterns, plant weights, and numbers and weights of mature plus intermediate and immature kernels were determined.

Initiation of flowering occurred after 27 days of 82° F. day temperature in growth chamber experiment I. The highest frequency of blooms per day was 3.1 blooms per plant which occurred 42 days after planting and the blooming period lasted 42 more days for a total of 84 days after planting. Improved Spanish 2B peanuts reached highest frequency of blooming 57 days after planting under field conditions according to Smith (19). Collins (5) reported that the highest frequency of blooms for the Argentine variety occurred 55 days after planting in a growth chamber study using 85° F. day temperature, 70° F. night temperature, and a thirteen-hour daylight period at 3,500 foot candles.

Initiation of flowering occurred after 24 days of 85° F. day temperatures in growth chamber experiment II. The highest frequency of blooms was 5.1 blooms per plant which occurred 28 days after planting and the blooming period lasted 96 days.

Plant and kernel weights did not change materially between 110 and 140 days after planting in growth chamber experiments I and II.

The number of mature plus intermediate kernels increased significantly as the harvest date was delayed in growth chamber experiment I.

Forty-nine and forty-seven per cent of the mature plus intermediate kernels formed pegs in the first and second 11-day intervals of pegging in growth chamber experiment I.

Eighty-seven and ten per cent of the mature plus intermediate kernels formed from blooms occurring in the first and second 11-day intervals of blooming in growth chamber experiment II.

Twenty-three to 30 days of 80° F. or above temperatures were needed for initiation of flowering for the Argentine variety of Spanish peanuts in the 1966 field test near Ft. Cobb, Oklahoma. The earlier planting dates required a longer period of time from planting to blooming and hence more days with temperatures of 80° F. or above for initiation of flowering.

Highly significant differences occurred among the planting dates for yield in field experiment III. May 23 planting date had the highest mean yield of 3,445 pounds per acre but was not significantly different from the 3,089 pounds per acre yield of May 16 planting date. Planting dates before May 16 and after May 23 were significantly lower in yield than the May 23 planting date.

Sound splits were significantly higher (3 to 9 per cent) for the first four planting dates of May 2, May 9, May 16, and May 23 than any of the later planting dates.

Highly significant differences occurred among the harvest dates for each of the ten planting dates for the mean dry weight per plant. Mean dry weights per plant did not significantly increase after 116 days from planting for any planting date after May 16 and through July 4. Mean dry plant weights generally decreased as harvest and planting dates were delayed.

The mean dry fruit weights per plant were significantly different among the harvest dates May 2, May 9, May 16, May 30, June 13, and June 20 planting dates. Optimum harvest dates based on the highest mean dry fruit weights per plant occurred from 130 to 137 days from planting for the May 2, May 9, and May 16 planting dates. Optimum harvest dates for the May 30, June 13, and June 20 planting dates occurred from 116 to 123 days from planting.

Significant differences occurred among the harvest dates for May 2 through June 13 planting dates for the mean percentages of mature fruit. Mean percentages increased as harvest dates and planting dates (through June 13) were delayed.

The June 20, June 27, and July 4 planting dates had from 6 to 15 per cent more intermediate fruit than the earlier planting dates.

Significant differences occurred among the harvest dates for May 2, May 9, May 16, June 6, and June 13 planting dates for the mean percentages of large mature kernels, and their weights increased as harvest and planting dates (through June 13) were delayed.

The mean percentages of large immature kernels and their weights were highly significant among the harvest dates for May 2, May 9, May 16, May 23, June 13, and July 4 planting dates, and decreased as harvesting dates and planting dates (through June 13) were delayed.

Significant differences occurred among the harvest dates for May 2, May 9, May 16, May 23, and June 20 planting dates for the mean percentages of small immature kernel weight. Sixty-seven to one hundred per cent of the small kernel weights were due to immature kernels.

Effective energy was the most precise predictor of maturity for those indices examined, based on the highest multiple correlation coefficient using the weights of mature plus intermediate kernels.

This study was not adequate to understand fully the relationship between maturity of peanuts and maturity predictors. More research is needed to understand the relationship between biometeorological factors and maturity of the peanut, to determine optimum maturity or harvest dates, and to develop a simpler, more reliable maturity index.

LITERATURE CITED

LITERATURE CITED

(1) Barrs, H. D. 1962. The relation between kernel development and time of harvesting of peanuts at Katherine, N. T. Australian. Jour. Exp. Agr. and Animal Husbandry. 2:54-60.

(2) Bolhuis, G. G. 1958. Observations of the flowering and fructification of the groundnut, *Arachis hypogaea*. Netherlands Jour. Agr. Sci. 6:18-23.

(3) ________. 1959. Observations on the flowering and fructification of the groundnut, *Arachis hypogaea* III. Netherlands Jour. Agr. Sci. 7:51-52.

(4) ________, and W. DeGroot. 1959. Observation on the effect of varying temperatures on the flowering and fruit set in three varieties of groundnut. Netherlands Jour. Agr. Sci. 7:317-326.

(5) Collins, John Jerry. 1966. The influence of time of harvesting Dixie Spanish peanuts on maturity, yield, and grade. Unpubl. Master's Thesis, Oklahoma State University, pp. 1-47.

(6) Emery, D. A., C. L. Gupton and R. O. Hexem. 1966. Indexing the maturation of varietal and segregating populations of Virginia type peanuts. 1966 Proc. Peanut Res. Conference, pp. 25-30.

(7) Fortanier, E. J. 1958. Control of flowering in *Arachis hypogaea* L. Netherlands Agr. Sci. Jour. 6:69-70.

(8) Gilmore, E. C. and J. S. Rogers. 1958. Heat units as a method of measuring maturity of corn. Agron. Jour. 50:611-615.

(9) Gregory, Walton C., Ben W. Smith, and John A. Yarbrough. 1951. Morphology, genetics, and breeding. The peanut--the unpredictable legume--a symposium. The National Fertilizer Association, Washington, D. C. pp. 28-86.

(10) Gupton, C. L. 1967. The heritability of maturation indices associated with specific growth periods in Virginia type peanuts. Unpubl. Ph.D. Dissertation, North Carolina State University, pp. 1-111.

(11) Matlock, Ralph S., W. N. Stokes, and Roy M. Oswalt. 1963. The influence of time of planting Spanish peanuts on yield and quality. 1963 Proc. Peanut Improvement Working Group. pp. 93-106.

(12) Miller, L. I. 1946. Peanut leafspot control. Virginia Agr. Exp. Sta. Tech. Bul. 104.

(13) Mills, W. T. 1961. Heat unit system as a system for predicting optimum time of harvest peanut. Amer. Soc. Agr. Engr. pp. 1-18.

(14) Patel, J. S., and C. R. Seshadri. 1935. Oil formation in groundnut with reference to quality. Indian Jour. Agr. Sci. 5:165-185.

(15) Pickett, T. A. 1950. Composition of developing peanut seed. Plant Physiology 25:210-224.

(16) Rossem, A. Van, and G. G. Bolhuis. 1954. Some observations on the generative development of the peanut. Netherlands Jour. Agr. Sci. 2:302-303.

(17) Schenk, Roy V. 1960. Source of the inner brown color of the peanut shell. Bot. Gaz. 12:191-192.

(18) Shear, G. M., and L. I. Miller. 1959. Influence of time of planting in the Jumbo Runner peanut. Agron. Jour. 51:30-32.

(19) Smith, Ben W. 1954. *Arachis hypogaea*. Reproductive efficiency. Amer. Jour. Bot. 41:607-616.

(20) Steel, R. G. D., and James H. Torrie. 1960. Principles and procedures of statistics. McGraw-Hill Book Company, Inc., New York.

(21) Sturkie, D. G., and J. T. Williamson. 1951. Cultural practices. The peanut--the unpredictable legume--a symposium. The National Fertilizer Association, Washington, D. C. pp. 173-209.

(22) Toole, V. K., W. K. Bailey, and E. H. Toole. Factors influencing dormancy of peanut seeds. Plant Physiol. 39:822-832.

(23) U. S. Weather Bureau climatological data, national summary. U. S. Dept. of Commerce, Environmental Science Services Administration. Vol. 17, 1966.

(24) Valli, V. J. 1965. Biometeorological factors as predictors of agronomic maturity of peanuts. Tech. Note 6, Agric. Meteorology Report No. 11. U. S. Dept. of Commerce, Washington, D. C.

(25) Wang, J. Y. 1960. A critique of the heat unit approach to plant response studies. Ecology 41:785-790.

(26) Went, F. W. 1953. The effect of temperature on plant growth. An. Rev. of Plant Physiology. 4:347-362.

APPENDIX

APPENDIX TABLE I

MEAN SQUARES FOR PLANT WEIGHT, NUMBER OF MATURE AND INTERMEDIATE AND IMMATURE KERNELS PER PLANT, AND WEIGHT OF MATURE AND INTERMEDIATE AND IMMATURE KERNELS PER PLANT IN GROWTH CHAMBER EXPERIMENT I, 1966

Source of Variation	df	Plant Weight	Number of		Weight of	
			Mat. & Inter. Kernels	Immature Kernels	Mat. & Inter. Kernels	Immature Kernels
Total	41					
Harvest Date	6	22.78**	674.99**	147.41	139.55**	32.13*
Sampling Error	21	11.08*	36.36	24.57	6.48	2.14
Error	14	3.23	32.62	81.19	4.85	4.61
Grand Mean		13.21	18.41	13.14	8.38	2.79
LSD (.05)		3.14	7.07	N.S.	10.71	3.75
CV (%)		14	31	68	27	77

* Exceeds 5% Level of Significance
** Exceeds 1% Level of Significance

APPENDIX TABLE II

MEAN SQUARES FOR PLANT WEIGHT, NUMBER OF MATURE AND INTERMEDIATE AND IMMATURE KERNELS PER PLANT, AND WEIGHT OF MATURE AND INTERMEDIATE AND IMMATURE KERNELS PER PLANT IN GROWTH CHAMBER EXPERIMENT II, 1967

Source of Variation	df	Plant Weight	Number of Mat. & Inter. Kernels	Number of Immature Kernels	Weight of Mat. & Inter. Kernels	Weight of Immature Kernels
Total	11					
Harvest Date	3	49.69	5.42	3.89	2.58	0.04
Error	8	15.91	13.33	7.00	2.10	0.40
Grand Mean		11.23	15.42	4.83	5.84	0.52
LSD (.05)		N.S.	N.S.	N.S.	N.S.	N.S.
CV (%)		36	24	55	25	121

* Exceeds 5% Level of Significance
** Exceeds 1% Level of Significance

APPENDIX TABLE III

MEAN SQUARES FOR YIELD, NUMBER OF PLANTS PER PLOT, AND GRADE FACTORS FOR TEN PLANTING DATES ON THE CADDO PEANUT RESEARCH STATION, 1966

Source of Variation	df	Yield lbs/acre	No. of plants per plot	Total SMK (%)	SS (%)	OK (%)
Total	29					
Replication	2	427516.42	254.70	17.63	4.43	1.03
Dates	9	2165188.34**	1029.42	2.30	31.27**	3.91*
Error	18	302935.09	481.92	4.41	3.73	1.14
Grand Mean		2038.53	102.80	74.43	7.87	38.08
LSD (.05)		943.70	N.S.	N.S.	3.15	1.60
CV (%)		28	21	3	25	33

* Exceeds 5% Level of Significance
** Exceeds 1% Level of Significance

VITA

William Boyd Davis

Candidate for the Degree of

Master of Science

Thesis: THE EFFECT OF LIGHT, TEMPERATURE, AND TIME OF PLANTING AND HARVESTING ON THE YIELD, GRADE, AND MATURATION OF THE SPANISH PEANUT

Major Field: Agronomy

Biographical:

Personal Data: Born at Marlow, Oklahoma, October 2, 1944, the son of Theo and Mary Francis Davis.

Education: Attended grade and high school at Bray, Oklahoma; graduated from Bray High School in May, 1962; received an Associate in Arts degree from Cameron State Agricultural College in 1964; received a Bachelor of Science degree from Oklahoma State University in 1966.

Experience: Born and reared on a farm; employed during the summers of 1966 and 1967 as a research assistant on peanut and soybean research for Oklahoma State University; Graduate Teaching Assistant of the Agronomy Department, Oklahoma State University, 1966-1968.

Organizations: Alpha Zeta, Agronomy Club, and the Student Branch of the Soil Conservation Society of America.