SCREENING FOR GENETIC TOLERANCE TO COLD TEMPERATURE DURING GERMINATION IN PEANUTS (*ARACHIS HYPOGAEA* L.)

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CHAPTER I

INTRODUCTION

Little information is recorded concerning the influence of unfavorably low temperatures upon germination and growth of a subtropical heat-loving species, such as peanuts (Arachis hypogaea L.) (3). Injury induced by low temperatures above freezing, commonly called chilling injury, occurs in many species.

Many spring-planted crops in Oklahoma, including peanuts, suffer chilling injury soon after planting. Tolerance to cold soils should enhance early growth and thus extend the growing season by permitting earlier planting. The earlier planting date would allow a later-maturing variety to be planted to maximize yields or would allow earlier-maturing varieties to be harvested earlier, thus escaping the dangers of freezing temperatures in the fall.

It is not known whether genetic differences exist in the peanut germplasm for tolerance to cold temperatures during germination. If such differences do exist, they could possibly be found between peanut accessions or between individual plants (seeds) within an accession. Possible genetic variability within an accession could be due to the manner in which many accessions have been collected and introduced.

Some collectors attempt to collect a wide sample of the peanuts in a given area. Since peanuts are highly self-pollinated, each seed collected has a high probability of being homozygous, but the seeds in a sample may each be homozygous for different genes or alleles if no selection pressure has been applied for a given gene. Thus plants in a given accession may be homozygous but not homogeneous.

The first objective of this study was to develop a procedure for identifying sources of resistance or tolerance in peanuts to cold temperatures during germination. Once this technique was developed, peanut germplasm was screened to identify the best levels of cold tolerance available.

Emergence counts and classification of seedlings were made at the end of each three-week trial run. Plant selections were made during classification of the seedlings exposed to the cold temperature during germination. Exceptionally vigorous, normal seedlings were selected from different accessions. Selections were not made within accessions that had uniformly good or poor seedlings. However, if one seedling appeared to be exceptionally more tolerant in an otherwise poorly performing accession, then it was selected. The majority of the selections were made within accessions which showed considerable variability in seedling responses to the chill stress. These selections could possibly differ genetically for genes or alleles determining chill tolerances. Once apparent differences in

tolerance were identified, crosses were made to determine the inheritance of the chill tolerance.

CHAPTER II

LITERATURE REVIEW

Peanut Classification and Origin

Peanuts (Arachis hypogaea L.) are annual herbaceous plants belonging to the Papilionaceae family, a suborder of the larger order Leguminoseae (14). Peanuts have been reported as being a "diploidized" allotetraploid with a chromosome number of 2n = 40 (25).

The plants of the genus Arachis may be grouped at present into 30-50 different species (22). Natural variability in the cultivated peanut is substantial and has provided valuable resources for the development by selection and hybridization of cultivars adapted to different environments (25).

Many peanut cultivars have been described and several attempts made to organize these into taxonomic classifications. Krapovickas (32) classified the cultivated species, Arachis hypogaea L., into two subspecies, each containing two botanical varieties: (a) subspecies hypogaea, variety hypogaea (the Virginia group) and variety hirsuta Kohler and (b) subspecies fastigiata Waldron, variety fastigiata (the Valencia group) and variety vulgaris Harz (the Spanish group).

The four U.S. market types (Spanish, Valencia, Runner, and Virginia) consist of two botanical types. The Spanish botanical type includes the Spanish and Valencia market types, whereas the Virginia botanical type includes the Runner and Virginia market types. Distinctions can be made between the two botanical types based on the presence or absence of inflorescences on the main stem leaf axils. Virginia types lack inflorescences in the main stem leaf axils, while the Spanish types have inflorescences in the main stem leaf axils (25).

The exact origin of the peanut is unknown and will probably continue to be a source of inquiry for some time to come. Current evidence seems to favor the upper Plata basin of Bolivia as the home of the peanut. Independent origin in Brazil is less likely (26).

Krapovickas (32) recognized the following five geno-centers: (a) the Guarani Region--basins of the Paraguay and Parana Rivers, (b) Goias and Minas Gerais (Brazil), (c) Rondonia and northwest Mato Grosso (Brazil), (d) the eastern foothills of the Andes in Bolivia, and (e) Peru. An important secondary center of variation is Africa.

The Andean area was a center of post-Columbian dispersal (26). According to Darlington, the peanut was taken from Brazil to Peru, Africa, and India by the Portuguese and to the Phillipines by the Spaniards (16).

The peanut was introduced into North America during colonial days by slave traders bringing slaves from Africa

(55). The peanut was not extensively grown in North America until after the Civil War in 1865, and then was confined to Virginia and North Carolina (27).

The peanut is now grown in the warmer parts of the six major continents. Seventy-five percent of all peanuts grown in the world are produced by India, mainland China, Nigeria, the United States, and Senegal. Peanuts are well adapted to tropical and sub-tropical regions of the world (37).

Peanut Germination

The initial water uptake at the start of germination causes the entire peanut seed to swell. Swelling is due mainly to imbibition by the protein, which comprises 20-30 percent of a peanut seed (38). The awakening step from a dry, dormant seed to an active metabolic state usually lasts from minutes to several hours at an optimum temperature with ample moisture in the presence of oxygen (31). Temperature does not affect the amount of water taken up by am imbibant, but has a definite effect on the rate of imbibition. A decrease in temperature decreases the rate of imbibition (18).

During the germination of peanut seed, over 60 percent of the dry weight of the cotyledon and 70 percent of the protein is depleted. As peanut seeds germinate and deplete their storage materials, there is an increase in enzyme and mitochondrial activity to about eight days, followed by a reduction in activity. This pattern of enzymic change closely resembles the levels of RNA during germination (6).

One of the spectacular changes which occurs when a seed is planted under conditions favorable for germination is a rapid increase in the respiration rate. Under aerobic conditions the pyruvic acid produced in glycolysis undergoes oxidation to carbon dioxide and water via the Kreb cycle. The enzymes involved not only in the tricarboxylic acid cycle (TCA) but also for electron transport to oxygen can be found in the mitochondria (54).

Most seed lipids are comprised of triglycerides. This seed lipid reserve, triglyceride, is first hydrolyzed to glycerol and fatty acids by the enzyme action of lipases (31). Both soluble and insoluble lipolytic and catalase enzymes are found in peanuts (55). The glyoxylate cycle converts acetyl residues derived from the fatty acids of storage triacylglycerols into carbohydrates via succinic acid. The glyoxylate cycle provides both energy and four-carbon intermediates for the biosynthetic pathways of the cell. The enzymes of the glyoxylate cycle, particularly isocitratase and malate synthetase, are found in cytoplasmic organelles called glyoxysomes (2).

During germination, seed proteins are hydrolyzed into peptides and amino acids which are translocated to the growing portions of the embryo. In germination of the peanut, the protein bodies swell and develop cavities, fragments, and disappear. These changes occur between four and nine days of germination and coincide with the most rapid disappearance of acid-insoluble protein (2).

Seed germination requires a tremendous amount of biological energy (adenosine triphosphate) not only for biogenesis of new cellular constituents in seedlings, but also for the formation of protein-synthesizing machinery in producing enzymes for degradation and conversion of storage compounds. Usually the ATP supply does not appear to be limiting during germination in a favorable temperature range and with normal oxygen supply. If the environmental conditions are changed to adverse ones, such as very low temperatures and anaerobic conditions, ATP would be limiting and germination arrested (31).

Vigor Test

The Association of Official Seed Analysts (AOSA)'s definition of seed germination is: "In seed laboratory practice, germination is the emergence and development from the seed embryo of those essential structures which, for the kind of seed in question, are indicative of the ability to produce a normal plant under favorable conditions" (20).

Isely (30) defined vigor as: "The sum total of all seed attributes which favor stand establishment under favorable conditions." Vigor tests can be categorized into two types: (a) direct tests which simulate pertinent unfavorable field conditions on a laboratory scale and (b) indirect tests which measure certain physiological attributes of seeds. Several methods of the indirect and direct type have been developed or proposed (17).

Indirect tests can be classified into four general groups: biochemical, growth rate, stress, and physical measurement tests. Biochemical testing involves the use of the tetrazolium test as a means of evaluating vigor. Moore and Smith (41) have stated that careful examination of tetrazolium staining patterns reveals seed weaknesses not detectable in the standard germination test and that both mechanical injuries and physiological aging are detectable. Speed of germination tests, growth rate of seedlings, and related tests such as dry weight of seedlings have been used to evaluate vigor (17).

Stress conditions which have been used are unfavorable temperature and moisture levels, exposure under vacuum, seed soaked in sodium hydroxide and ammonia chloride (53), and mechanical barriers such as brick gravel. Vigor tests have been reported for cotton based on permeability changes associated with deterioration (17).

The methods, direct or indirect, of evaluating vigor are of small consequence as long as good differentiation of vigor differences between seed lots is obtained. However, from a practical standpoint, the test used should be reproducible and fairly simple to conduct (17).

The cold test for corn is the only direct vigor test in widespread use today (17). Corn "cold tests" are germination tests conducted in soil that is kept cold during the early stage of the germination period. The test is not one actually against cold in itself, but rather against seed-rotting

molds or fungi which inhabit nearly all soils and attack slowly-germinating kernels in these environments. Species of Pythium are the principal fungi involved. A temperature of 8 to 10 C is ideal for disease development in corn "cold tests." In this temperature range, the most susceptible kernels are rotted by Pythium after about five days of exposure (28, 29, 48).

A means of demonstrating weaknesses in seed lots can be furnished by cold tests which are not detectable by official favorable germination tests. Cold tests have the capability of rating or indexing seed lots in terms of their resistance to unfavorable conditions (29).

Cold test methods can be applied to many kinds of crop seeds other than corn. Isely (29) suggested that, possibly, the measurement of the agricultural value of seeds in terms of germination would carry more weight if both the maximum potential value (germination test under favorable conditions) and the minimum value (the cold test or its equivalent) of seed were established.

Chilling Effects

Tropical and subtropical plants exhibit a marked abnormal physiological function when exposed to nonfreezing temperatures below about 10 to 12 C. This dysfunction is referred to as chilling injury. Chilling injury is the preferable term because it is not easily confused with freezing

injury or with phenomena related to cold or winter hardiness (34).

Species vary somewhat in tolerance with their region of origin. Plants that are most sensitive to chilling are the staple crops of the subtropics, such as rice, velvet beans, cotton, and peanuts. The hardier plants are extensively grown in temperate regions, for example, maize, sorghums, watermelons, and pumpkins. The most hardy have a very wide distribution, but are essentially northern annuals, such as soybeans, buckwheat, flax, and sunflowers (49).

Spanish peanuts from Georgia were chilled at 0.5 to 5 C for various lengths of time. At the time of chilling, the peanut seedlings were three weeks old. No obvious effects immediately after chilling were shown. The tops, in general, were uninjured. However, injuries to the root systems were sufficient to stunt growth and, in some cases, to cause the death of the plants (49).

Differences were exhibited between botanical types of peanuts. Valencia and Spanish types were very sensitive, while Virginia Bunch was exceptionally hardy. Spanish and Valencia peanuts showed injury from exposure to temperatures from 0.5 to 5 C for 60 hours, but with favorable conditions they recovered. However, Virginia Bunch peanuts, maize, sorghum, watermelons, and pumpkins are not likely to suffer serious injury by such specified conditions (49).

Trice cotton, which is grown near the northern limit of the Cotton Belt in North Carolina, proved more hardy than

Delfos from Mississippi. Westex, a variety specially bred for Texas conditions, was considerably more susceptible than either Trice or Delfos (49).

Germination and subsequent seedling growth of cotton are inhibited or adversely influenced by low temperatures of 5 or 10 C. Christiansen (8) studied two temperature regimes. A cold-warm regime caused radicle meristem abortion and an initial growth lag prior to normal subsequent development. A warm-cold-warm regime caused drastic reductions in growth rate and death or inactivation of cortex tissue. Sloughing of the cortex cells was also noted. The warm-cold-warm regime injury is apt to have more serious consequences in terms of inhibition of subsequent seedling development and survival potential. The 5 C caused greater inhibition than the 10 C.

Laboratory and greenhouse growth studies of the influence of chilling (10 C) upon germinating cottonseed showed that length of cold period is additive in inhibiting seedling growth at favorable temperatures. Seedling development in terms of dry weight accumulation, width, and height of the first true leaf was reduced by early chilling. First true leaf morphology, hypocotyl elongation and root development were adversely influenced (9).

The sorghum hybrid R.S. 610 was superior to the varieties D.D. Yellow Sooner and Martin in germination and seedling emergence at low temperatures. Between 8 and 10 C is apparently the minimum temperature required for germination

of sorghum seed. However, somewhat higher temperatures seem to be required for seedling emergence from the soil. Seed treated with the fungicide Captan resulted in satisfactory seedling stands in early-planted field studies of grain sorghum (46).

A cotton seedling study showed that sensitivity to chilling varies with stage of seedling development and level of temperatures. A 5 C treatment for 96 hours when applied at the initiation of germination killed all the seed. The same temperature caused only a moderate amount of growth inhibition when applied for a period of 96 hours after 12 hours of germination at 31 C. A second period of chilling hypersensitivity occurs after about 18 to 30 hours of germination at 31 C. This coincides with the period of rapid radicle elongation and ends with initiation of rapid hypocotyl elongation (10).

Christiansen (11) studied preconditioning treatments to cottonseed to reduce sensitivity to chilling during imbibition. He found that seeds hydrated for as little as one hour were less sensitive to chilling injury. Those seed hydrated for four hours at 31 C were insensitive to 5 C chilling for 96 hours. The preconditioning hydration effect persisted even if the seeds were redried. By contrast, a hot water treatment was not as effective in reducing cold sensitivity. The hot water treatment resulted in a rapid partial hydration of the seed.

Tests have shown that sub-favorable temperatures during germination can have far-reaching effects on cotton. Chilling can alter growth and fruiting patterns throughout the growing season. Plant height at the end of the season was reduced significantly in relation to the amount of chilling applied. The date of first flower was delayed in a linear relation to the quantity of chilling (13).

Chilling delayed maturity whether applied to good or low quality cottonseed. Lower yields were reported from a chilling treatment applied to imbibing cottonseed. The reduced yield was attributed to delayed maturity and a reduced number of normal plants in the stand after thinning (52).

When lima bean seed (Phaseolus lunatus L.) were imbibed at a moderately low temperature of 15 C, and then allowed to germinate and grow at 25 C, seedling survival and size of seedlings were greatly reduced. However, when the low temperature imbibition period, even at 5 C, was preceded by a short interval of imbibition at 25 C, injury was very much less or avoided completely. Once imbibition had begun, low temperature and high osmotic concentration reduced the rate of water uptake (47).

Low-moisture soybean seed (Glycine max L. Merr.) are more sensitive than high moisture seed to cold temperatures above freezing during imbibition. Imbibition at 5 C caused a reduction in survival of low (6 percent) moisture seed but no reduction in survival of high (16 percent) moisture seed. Water uptake by seed was slower during imbibition at 5 C than

25 C for both Hawkeye and Acme soybeans. However, the rate of water uptake for low-moisture seed paralleled that of high moisture seed at both temperatures (43).

Mechanism of Chilling Injury

The mechanism of chilling injury during imbibition of certain seed has been suggested as a physical injury to membranes (47), as a block in a metabolic system (11), and as a physical disruption of a metabolic system (43). Proteins are the principal water-binding substances during imbibition, and the physical and physiological states of these proteins are probably related to temperature sensitivity at this time. A combination of rapid hydration of low-moisture proteins and cold temperature could result in disruption of membranes, increased exudation by root tissue, and possibly disruption of protein structure involved in metabolic functions. These disruptive effects at low temperatures would be minimized by slow hydration with water vapor (43).

Levitt (33) suggested that RNA and protein metabolism relate closely to chilling injury and frost resistance of plants. Yang and Brown (56) suggested a higher percentage of nonchargeable glycine and leucine tRNAs in chilled soybean seedlings. They suggested that nonchilled soybean tRNAs contain higher percentages of active conformational forms than do chilled soybean tRNAs.

The response of castor seedlings (Ricinus communis L.) to low temperatures clearly shows their chilling sensitivity.

A 24-hour chilling treatment at 2 C was sufficient to impede transfer of dry matter and inhibit radicle elongation. Respiration of intact seedlings and oxidation of succinate by isolated mitochondria showed discontinuities in Arrhenius plots of their reaction velocities, characteristic of chilling species. However, glyoxysomal enzymes did not show such discontinuities, indicating that there is probably no functional relationship between these enzymes and the glyoxysomal membrane (4).

Sugar beet (Beta vulgaris L.), a chilling-resistant species, and field bean (Phaseolus vulgaris L.), a chilling-sensitive species, were used to study inhibition of translocation by localized chilling at 10 C. The results indicated that inhibition of translocation in chilling-sensitive plants was due to physical blockage of sieve plates rather than from direct inhibition of a metabolic process which drives translocation. It appears that chilling causes the lipid portion of the plasma membrane or perhaps the sieve tube reticulum to undergo a phase change. The chilling-resistant sugar beet has a lower threshold for damage of about -1 C (21).

Lyons et al. (36) reported on the relationship between the physical nature of mitochondrial membranes and chilling sensitivity in plants. They found that a substantial range in apparent membrane flexibility exists among the species tested. The tissues whose mitochondrial membrane showed very little ability to swell were chilling-sensitive sweet potato

root and tomato fruits. The chilling-resistant tissues (pea seedlings, turnip root, and cauliflower bud) all had mitochondria with a striking ability to swell. Mitochondria from bean and corn seedlings also had a good ability to swell, although these are chilling-sensitive species. Mitochondria from chilling-resistant species showed a higher content of unsaturated fatty acids than did mitochondria from sensitive species.

Lyons and Raison (35), in 1970, studied the oxidative activity of mitochondria isolated from plant tissues sensitive and resistant to chilling injury. Their results demonstrated that the respiration of mitochondria from chilling-sensitive plant tissue, in contrast to that of mitochondria from resistant tissue, is significantly reduced at temperatures below 10 C. This indicated that the immediate response of sensitive tissue to chilling is a depression of respiratory activity. Impairment of mitochondrial phosphorylation was not an immediate result of chilling, but probably follows after the tissues have been injured for some time period.

Chilling at 5 C caused cotton seedlings to wilt. Permeability of cotyledonary membranes did not increase until seedlings were chilled for at least three hours. Cold-hardened seedlings showed less visible injury and less leakage from cotyledons than control seedlings (23).

Lyons (34) postulated that cellular membranes in sensitive plants undergo a physical-phase transition from a normal flexible liquid-crystalline to a solid gel structure at the

temperature critical for chilling injury. As temperature is lowered in chilling-sensitive species, the membrane lipids solidify at a critical temperature. The change in state would be expected to bring about a contraction that causes cracks or channels, leading to increased permeability. The immediate effect on permeability would cause an upset in ion balance as well as account for the ion leakage that results from chilling in some tissues.

Without prior hardening, cotton plants were severely injured when chilled at 5 C. RNA, protein, and lipid-soluble phosphate decreased during exposure to hardening temperatures, but sugars and starch increased (24).

Adenosine triphosphate (ATP) content in imbibed seed has been correlated with seedling size in fatty, starchy, and proteinaceous seed. Thus ATP appears to be a useful biochemical index of seed vigor (7).

A continual decrease in ATP concentration with time of chilling has been observed in young cotton seedlings chilled at 5 C. Chilled plants returned to optimum conditions were not able to restore the initial ATP concentration when chilled for two days. Hardening the seedlings prevented the decrease in ATP with chilling (50).

Stewart and Guinn (51) determined the effects of chilling at 3 to 5 C on the nucleotide composition of leaves and roots of cotton. The concentration of nucleotides, especially di- and triphosphates, in both leaves and roots, decreased with chilling. Chilling also caused an increase in

free nucleosides. They interpreted the results to mean that general phosphorolytic activity is associated with chilling injury rather than damage to the phosphorylating mechanisms alone. Hardening at 10 to 20 C prior to chilling prevented nucleotide losses.

Genetics of Chill Tolerance

Seed of cotton genetic selection M-8 (Gossypium hirsutum L.) and 'Pima S-4' (G. barbadense L.) differed rather widely in response to chilling. Thus genetic differences probably exist among Gossypium species in response to seed-hydration chilling. Interaction of genetic variance with seed quality may also be involved, since poor quality seed are more seriously affected by adverse environment than high quality seed (15).

In a cold phytotron environment of 14 C, plants of a recently-introduced strain of hexaploid cotton, 6X-3, produced up to six true leaves after four months, whereas a number of common cultivars produced only one or two true leaves and then died. The differences observed in the phytotron would appear to be a good indicator of a form of cold tolerance (42).

Christiansen and Lewis (12) studied reciprocal differences in tolerance to seed-hydration chilling in F_1 progeny of cotton. Crosses were made between a doubled haploid selection considered chilling-tolerant and one considered chilling-susceptible. They found that the response to

chilling by seeds from reciprocal crosses was primarily dependent upon the maternal parent.

Germination properties of cotton lines have been associated with geographical area where developed. Generally, lines developed for low elevations had better germination properties at both 15 and 25 C than did lines developed for high elevations. Thus, potential exists for developing cotton lines with improved germination at low temperatures (5).

Bean lines (Phaseolus vulgaris L.) have been bred with the ability to germinate at 8 to 10 C with good pod and plant type. These lines grew faster than the cultivars with which they were compared at temperatures of 10 C day and 8 C night. The heritability was about 35 percent for germination at low temperatures. No specific segregation pattern was observed (19).

Pinnell (45) showed that the emergence of single crosses of corn (Zea mays L.) under low-temperature conditions is closely correlated to the cold tolerance of their maternal parent. According to Pinnell, the nature of the endosperm may be responsible for the portion of inheritance directly related to the maternal parent.

Pesev (44) stated that tolerance to low temperature is an inheritable and varietal plant characteristic in corn. The genetic mechanism of this inheritance is believed to be rather complex. He studied two-year average emergence ratings of 56 reciprocal single crosses and their parental

inbred lines after treatment at 6 and 8 C. The degree of tolerance to low temperatures was strongly dependent upon the emergence ability of the maternal parent. Complementary gene action in the seed embryo was used to explain higher stand density of single crosses over inbred lines.

Mock and Eberhart (40) concluded that improvement of cold tolerance by selection within adapted maize populations was possible. Good cold-tolerant inbreds could be developed without using unadapted, early-maturing genotypes as germplasm sources. Genes conditioning cold tolerance were independent of genes controlling stand and maturity under normal planting conditions. Predicted selection responses indicated field selection for cold tolerance would be more efficient.

Progress was evaluated for cold tolerance from several cycles of recurrent selection in two Iowa maize breeding populations, BSSS2 (SCT) and BSSS13 (SCT). Relatively more progress for improved cold tolerance was recognized from two cycles of recurrent selection in BSSS13 (SCT) than from three cycles in BSSS2 (SCT) (39). Mock and Eberhart (40) predicted that more progress would be made in BSSS13 (SCT) than in BSSS2 (SCT) due to a larger genotypic variability in BSSS13 (SCT).

CHAPTER III

MATERIALS AND METHODS

The peanut germplasm used in this study was taken from cold storage (7C) at the Agronomy Research Station, Stillwater, Oklahoma. Oklahoma peanut accessions were screened for chill tolerance at the Controlled Environmental Research Laboratory (CERL), Stillwater, in 1975 and 1976.

The 286 accessions screened for chill tolerance are listed in Table I, excluding the three cultivars used in the preliminary trial runs. Tamnut 74 was used as a check variety in all trial runs except for trial run #1.

Screening Procedure

Two Sherer Model W-200 chest-type growth chambers were used for this study. Air circulation was provided by four fans in each chamber. Each chamber contained incandescent and fluorescent lights which produced approximately 17,000 lux at the bottom of the chambers. Both chambers were illuminated for 12-hour photoperiods prior to seedling emergence.

One chamber was set with an optimum temperature (30 C) for peanut germination. This served as a check for the viability or seed quality of the specific seed lots being used

TABLE I

PEANUT GERMPLASM SCREENED FOR CHILL TOLERANCE DURING GERMINATION

Oklahoma P-No.[1]	Source of Seed Evaluated		50-Seed Weight	Testa Color
	Year	Location	(gms)	
0001	1965	Perkins	13.5	Flesh
0003	1969	Ft. Cobb	17.9	Flesh
0004	1969	Ft. Cobb	17.8	Flesh
0008	1962	Perkins	20.4	Flesh
0010	1969	Perkins	20.9	Flesh
0011	1967	Stratford	17.7	Flesh
0012	1972	Perkins	19.8	White
0015	1969	Perkins	20.4	Flesh
0016	1968	Ft. Cobb	26.8	Flesh
0017	1965	Ft. Cobb	17.4	Flesh
0018	1967	Perkins	20.3	Purple
0020	1963	Perkins	21.2	Flesh
0021	1969	Perkins	23.1	Flesh
0022	1967	Perkins	15.9	Flesh
0023	1969	Perkins	21.9	Flesh
0024	1969	Perkins	29.1	Flesh
0026	1969	Perkins	23.2	Flesh
0028	1969	Perkins	25.3	Flesh
0029	1971	Stratford	23.4	White
0030	1969	Perkins	22.2	Flesh & White
0031	1969	---	26.1	Flesh
0032	1969	Perkins	26.3	Flesh
0033	1967	Perkins	18.2	Flesh
0034	1969	Perkins	23.2	Flesh
0035	1969	Perkins	23.9	Flesh
0036	1969	Ft. Cobb	38.3	Flesh
0038	1971	Perkins	21.0	Flesh
0039	1967	Perkins	20.7	Flesh
0040	1966	Perkins	21.5	Flesh
0043	1971	Perkins	21.7	Flesh
0045	1971	Perkins	20.0	Flesh
0046	1971	Perkins	24.5	Flesh
0061	1969	Perkins	17.2	Flesh
0062	1969	Perkins	19.2	Flesh
0074	1972	Perkins	17.1	Flesh
0080	1969	Perkins	19.6	Flesh
0083	1966	Perkins	18.2	Flesh
0085	1968	Perkins	18.7	Flesh
0086	1969	Perkins	19.4	Flesh
0089	1969	Perkins	21.5	Flesh

TABLE I (CONTINUED)

Oklahoma P-No.	Source of Seed Evaluated		50-Seed Weight (gms)	Testa Color
	Year	Location		
0090	1969	Perkins	19.6	Flesh
0092	1969	Perkins	19.5	Flesh
0094	1969	Perkins	18.2	Flesh
0095	1969	Perkins	18.4	Flesh
0096	1969	Perkins	17.5	Flesh
0097	1969	Perkins	18.2	Flesh
0099	1969	Perkins	18.3	Flesh
0104	1969	Perkins	19.7	Flesh
0105	1970	Perkins	17.0	Flesh
0106	1968	---	17.8	Flesh
0109	1968	Perkins	17.5	Flesh
0114	1968	Perkins	17.4	Flesh
0115	1968	Perkins	13.9	Flesh
0116	1971	Perkins	19.6	Flesh
0117	1968	Perkins	16.8	Flesh
0118	1971	Perkins	20.8	Flesh
0119	1965	Ft. Cobb	20.8	Flesh
0144	1966	Perkins	22.5	Flesh
0146	1958	Perkins	22.1	Flesh
0147	1965	Perkins	19.2	Flesh
0152	1969	Perkins	19.7	Flesh
0153	1968	Perkins	30.3	Red Striped
0154	1967	Perkins	26.5	Flesh
0155	1969	Perkins	19.7	Flesh
0156	1969	Perkins	19.9	Flesh
0159	1967	Perkins	19.1	Flesh
0160	1968	Ft. Cobb	29.8	Flesh
0161	1972	Ft. Cobb	24.0	Flesh
0167	1969	Perkins	25.9	Purple
0174	1967	Perkins	20.5	Flesh
0175	1967	Perkins	19.8	Mixture
0176	1971	Perkins	23.3	Flesh
0185	1966	Perkins	17.7	Flesh
0186	1968	Perkins	14.9	Flesh
0188	1971	Perkins	26.6	Flesh
0189	1971	Perkins	25.1	Flesh
0190	1974	Perkins	22.7	Reddish
0200	1974	Perkins	19.1	Flesh
0207	1974	Perkins	15.4	Flesh
0214	1974	Perkins	18.5	Flesh
0216	1974	Perkins	20.8	Flesh
0289	1974	Perkins	32.5	Flesh
0295	1974	Perkins	21.5	Flesh
0296	1974	Perkins	23.5	Flesh

TABLE I (CONTINUED)

Oklahoma P-No.	Source of Seed Evaluated Year	Location	50-Seed Weight (gms)	Testa Color
0300	1974	Perkins	17.7	Flesh
0301	1974	Perkins	20.7	Flesh
0304	1974	Perkins	19.2	Flesh
0306	1974	Perkins	18.7	Flesh
0307	1974	Perkins	19.8	Flesh
0311	1974	Perkins	23.1	Flesh
0324	1974	Perkins	20.0	Flesh
0339	1974	Perkins	17.0	Flesh
0340	1974	Perkins	15.8	Dark Red
0342	1974	Perkins	19.1	Dark Red
0343	1974	Perkins	18.1	Flesh
0344	1974	Perkins	22.5	Red-Purple
0352	1974	Perkins	22.2	Red-Purple
0360	1974	Perkins	21.0	Flesh
0365	1974	Perkins	22.7	Flesh
0371	1974	Perkins	16.9	Flesh
0373	1974	Perkins	20.7	Flesh
0375	1974	Perkins	18.5	Flesh
0379	1974	Perkins	21.4	Flesh
0382	1974	Perkins	20.5	Red-Purple
0384	1974	Perkins	22.6	Flesh
0386	1974	Perkins	25.9	Flesh
0388	1974	Perkins	19.6	Flesh
0391	1974	Perkins	18.9	Flesh
0393	1974	Perkins	21.3	Flesh
0394	1974	Perkins	20.2	Flesh
0395	1974	Perkins	22.6	Flesh
0400	1974	Perkins	18.5	Flesh
0401	1974	Perkins	22.7	Flesh
0403	1974	Perkins	18.6	Flesh
0406	1974	Perkins	17.3	Flesh
0410	1974	Perkins	18.7	Flesh
0418	1974	Perkins	16.9	Flesh
0428	1974	Perkins	19.1	Flesh
0429	1974	Perkins	18.4	Flesh
0432	1974	Perkins	19.7	Flesh
0433	1974	Perkins	18.2	Flesh
0434	1974	Perkins	14.2	Flesh
0435	1974	Perkins	18.1	Flesh
0439	1974	Perkins	21.4	Flesh
0443	1974	Perkins	19.2	Flesh
0445	1974	Perkins	17.4	Flesh
0447	1974	Perkins	24.5	Flesh
0457	1974	Perkins	25.2	White

TABLE I (CONTINUED)

Oklahoma P-No.	Source of Seed Evaluated		50-Seed Weight (gms)	Testa Color
	Year	Location		
0458	1974	Perkins	22.2	Mixture
0460	1974	Perkins	23.1	Flesh
0461	1974	Perkins	19.4	Flesh
0462	1974	Perkins	18.2	Flesh
0465	1974	Perkins	21.6	Flesh
0467	1974	Perkins	20.9	Flesh
0468	1974	Perkins	24.9	Flesh
0471	1974	Perkins	18.6	Reddish
0474	1974	Perkins	19.6	Flesh
0475	1974	Perkins	19.3	Flesh
0477	1974	Perkins	19.7	Flesh
0478	1974	Perkins	21.8	Reddish
0479	1974	Perkins	20.7	Reddish
0480	1974	Perkins	21.8	Flesh
0482	1974	Perkins	18.7	Reddish
0485	1974	Perkins	20.5	Mixture
0487	1974	Perkins	21.6	Mixture
0489	1974	Perkins	21.1	Reddish
0490	1974	Perkins	20.2	Rusty Red
0491	1974	Perkins	21.2	Rusty Red
0493	1974	Perkins	22.5	Rusty Red
0495	1974	Perkins	23.7	Reddish
0496	1974	Perkins	21.6	Flesh
0563	1974	Perkins	22.1	Red
0565	1974	Perkins	22.9	Red
0567	1974	Perkins	22.1	Red
0568	1974	Perkins	19.7	Flesh
0574	1974	Perkins	20.8	Flesh
0577	1974	Perkins	20.7	Mixture
0580	1974	Perkins	21.3	Flesh
0584	1974	Perkins	20.3	Flesh
0589	1974	Perkins	16.5	Flesh
0591	1974	Perkins	18.2	Flesh
0592	1974	Perkins	17.4	Flesh
0594	1974	Perkins	18.9	Flesh
0599	1974	Perkins	17.5	Reddish
0602	1974	Perkins	16.4	Reddish
0606	1974	Perkins	17.4	Reddish
0608	1974	Perkins	21.3	Reddish
0609	1974	Perkins	20.7	White
0610	1974	Perkins	21.1	White
0612	1974	Perkins	23.3	Flesh
0623	1974	Perkins	22.1	Flesh
0624	1974	Perkins	20.3	Flesh

TABLE I (CONTINUED)

Oklahoma P-No.	Source of Seed Evaluated Year	Location	50-Seed Weight (gms)	Testa Color
0626	1974	Perkins	19.9	Flesh
0631	1974	Perkins	20.5	Flesh
0632	1974	Perkins	19.5	Flesh
0634	1974	Perkins	19.3	Flesh
0642	1974	Perkins	19.9	Flesh
0646	1974	Perkins	17.7	Flesh
0648	1974	Perkins	18.8	Flesh
0652	1974	Perkins	18.2	Flesh
0653	1974	Perkins	21.2	Flesh
0002	1974	Ft. Cobb	19.1	Flesh
0006	1974	Ft. Cobb	20.1	Flesh
3144	1974	Ft. Cobb	18.1	Flesh
0161	1972	Perkins	21.5	Red
3145	1972	Perkins	21.6	Red
1258	1974	Ft. Cobb	18.3	Flesh
1259	1974	Ft. Cobb	20.1	Flesh
1284	1974	Ft. Cobb	19.2	Flesh
2373	1974	Ft. Cobb	27.1	Flesh
3146	1974	Ft. Cobb	26.3	Flesh
3147	1974	Ft. Cobb	25.9	Flesh
3148	1974	Ft. Cobb	19.6	Flesh
3149	1974	Ft. Cobb	26.2	Flesh
2398A	1966 & 1968	Holland, Virginia	14.2	Russet
2398B	1975	Stratford	16.6	Flesh
0370	1974	Ft. Cobb	17.8	Flesh
0385	1974	Ft. Cobb	18.4	Flesh
0548	1974	Ft. Cobb	17.3	Flesh
3150	1974	Ft. Cobb	18.0	Flesh
0937	1968	Ft. Cobb	43.0	Reddish Brown
0939	1965	Perkins	20.6	Flesh
0971	1971	Perkins	16.8	Flesh
1439	1974	Ft. Cobb	17.0	Flesh
1615	1974	Ft. Cobb	17.0	Flesh
2374	1972	Perkins	38.3	Reddish Brown
2375	1974	Ft. Cobb	21.6	Flesh
2378	1974	Ft. Cobb	20.1	Flesh
2381	1974	Ft. Cobb	26.2	Flesh
2385	1974	Ft. Cobb	24.0	Flesh
2397	1974	Ft. Cobb	19.0	Flesh
0656	1974	Perkins	19.8	Flesh
0663	1974	Perkins	19.3	Flesh
0672	1974	Perkins	19.9	Flesh

TABLE I (CONTINUED)

Oklahoma P-No.	Source of Seed Evaluated Year	Location	50-Seed Weight (gms)	Testa Color
0686	1974	Perkins	20.8	Flesh
0690	1974	Perkins	19.7	Flesh
0691	1974	Perkins	20.0	Flesh
0695	1974	Perkins	17.3	Flesh
0698	1974	Perkins	22.0	Flesh
0706	1974	Perkins	21.6	Flesh
0712	1974	Perkins	19.7	Flesh
0714	1974	Perkins	20.9	Flesh
0723	1974	Perkins	21.2	Flesh
0735	1974	Perkins	18.3	Flesh
0746	1974	Perkins	17.8	Flesh
0748	1974	Perkins	19.5	Flesh
0761	1974	Perkins	27.6	Flesh
0765	1974	Perkins	18.3	Purple
0775	1974	Perkins	20.8	Flesh
0779	1974	Perkins	20.9	Flesh
0780	1974	Perkins	18.6	Flesh
0784	1974	Perkins	19.1	Flesh
0788	1974	Perkins	19.7	Flesh
2376	1975	Ft. Cobb	24.6	Flesh
2377	1975	Ft. Cobb	23.5	Flesh
2379	1975	Ft. Cobb	24.3	Flesh
2380	1975	Ft. Cobb	26.4	Flesh
2382	1975	Ft. Cobb	23.7	Flesh
2383	1975	Ft. Cobb	22.9	Flesh
2384	1975	Ft. Cobb	19.7	Flesh
2386	1975	Ft. Cobb	22.5	Flesh
0791	1974	Perkins	20.5	Flesh
0795	1974	Perkins	24.1	Flesh
0799	1974	Perkins	23.0	Purple
0800	1974	Perkins	24.0	Purple
0801	1974	Perkins	25.6	Purple
0802	1974	Perkins	25.4	Purple
0805	1974	Perkins	21.7	Flesh
0814	1974	Perkins	22.1	Pink
0822	1974	Perkins	24.3	Flesh
0824	1974	Perkins	26.1	Flesh
0825	1974	Perkins	23.7	Purple
0826	1974	Perkins	24.5	Flesh
0830	1974	Perkins	23.1	Pink
0835	1974	Perkins	23.5	Flesh
0836	1974	Perkins	25.5	Flesh
0837	1974	Perkins	20.7	Flesh
0838	1974	Perkins	27.0	Flesh

TABLE I (CONTINUED)

Oklahoma P-No.	Source of Seed Evaluated Year	Location	50-Seed Weight (gms)	Testa Color
0841	1974	Perkins	28.0	Flesh
0842	1974	Perkins	23.8	Flesh
0843	1974	Perkins	27.7	Reddish
0844	1974	Perkins	26.5	Flesh
0845	1974	Perkins	21.3	Flesh
0846	1974	Perkins	25.9	Flesh
0847	1974	Perkins	24.5	Flesh
0850	1974	Perkins	26.3	Flesh
0852	1974	Perkins	25.6	Flesh
0854	1974	Perkins	26.2	Flesh
0856	1974	Perkins	28.5	Flesh
0857	1974	Perkins	26.5	Flesh
0858	1974	Perkins	23.2	Flesh
0864	1974	Perkins	23.0	Flesh
0865	1974	Perkins	19.7	Flesh
0866	1974	Perkins	24.2	Flesh
0868	1974	Perkins	23.4	Flesh
0869	1974	Perkins	22.4	Flesh
0871	1974	Perkins	22.6	Flesh
0874	1974	Perkins	25.2	Flesh
0877	1974	Perkins	22.3	Flesh
0878	1974	Perkins	22.8	Flesh
0881	1974	Perkins	23.0	Flesh
0883	1974	Perkins	20.1	Purple
0884	1974	Perkins	20.6	Purple
0889	1974	Perkins	17.5	Reddish
0892	1974	Perkins	22.2	Flesh
0895	1974	Perkins	17.9	Flesh

1/ Numbers assigned to accessions in the peanut collection at the Oklahoma Agricultural Experiment Station. Plant introduction numbers and other identification are given in the Appendix tables.

for the accessions being evaluated in a particular trial run. The other chamber was set at various temperatures to give the duplicate seed samples a severe cold-stress treatment during germination.

To establish a temperature regime for screening, four pre-trial runs were conducted using different temperatures and time intervals. Four peanut cultivars (Florunner, Comet, Spanhoma, and Tamnut 74) were utilized in the pre-trial runs. Each cultivar was represented by 100 Captan-treated seed in each chamber. Both vermiculite and unsterilized sand were used in each pre-trial run as the germination media. The cultivar Comet was discarded from the analysis due to poor seed quality.

The first pre-trial run started with 41 hours at 20 C, then dropped to 0 C for 36 hours, and then raised to 20 C for 261 hours in the cold-stress chamber. The second pre-trial run consisted of 72 hours at 20 C, followed by 89 hours at 10 C, then raised to 20 C for 286 hours. The third run consisted of 72 hours at 20 C, then dropped to 5 C for 112 hours, followed by 365 hours at 20 C. The fourth pre-trial run started at 30 C for 14 hours, followed by 120 hours at 5 C, and then raised to 30 C days and 20 C nights for 362 hours. After trying the various temperatures over different periods of time, the fourth pre-trial run procedure was used to screen peanut germplasm for chill tolerance during germination.

A temperature recorder was placed in the center of each chamber. Five mercury thermometers were also placed throughout each chamber. All thermometer readings were recorded daily during every trial run.

Sixteen different peanut accessions were evaluated in each trial run. There were two replications per accession in each chamber. Each chamber had a capacity for eight plastic germinating flats. Each flat was planted with four equally-spaced rows, and each row received 25 Granox-treated seed of 1 of the 16 accessions at random. Vermiculite was used as the germinating media in the flats. The granular form of Terraclor Super X was mixed with the vermiculite to prevent fungi infection. Germination flats were watered when the vermiculite appeared dry during each trial run.

Emergence counts were made at the end of the three weeks. The seedlings were then classified into four categories: normal, intermediate, abnormal, and non-emerged.

Normal seedlings included those that had: (a) a primary root with a set of well-developed lateral roots, (b) a straight well-developed hypocotyl with no prominent breaks or deep lesions which might interfere with the conducting tissues, (c) an epicotyl with no chlorosis and an intact growing point, and (d) an overall vigorous appearance and not stunted.

Seedlings were classified intermediate if they had: (a) a primary root with short under-developed lateral roots, (b) a slight curvature in the hypocotyl which might interfere

with translocation, (c) an epicotyl with some chlorosis or necrotic lesions but otherwise normally developed, and (d) very immature or stunted.

Abnormal seedlings consisted of those that had: (a) multiple primary roots or no primary root and absence of secondary or lateral roots, (b) a malformed hypocotyl which was tightly curled or had severe breaks or deep lesions, (c) no epicotyl, or one without the growing point, with or without leaves, and (d) various combinations of the above.

Scatter diagrams of the seedling responses in the treatment and control chambers were plotted for each accession and classification category to help in determining susceptible and tolerant accessions. These diagrams for each trial run were used only as an aid, and they are not presented in this manuscript.

The analyses of the data obtained by the research were made by using the Statistical Analysis System (SAS) at the Oklahoma State University Computer Center (1). The data obtained from the emergence counts and classification were used to determine index differences between the control and chill treatment for each accession. Index differences were calculated as follows for each trial run separately:

INDEX DIFFERENCE = INDEX OF TREATMENT - INDEX OF CONTROL

INDEX = 1 (% NORMAL) + 2 (% INTERMEDIATE) + 3 (% ABNORMAL).

One, two, and three are arbitrary values assigned to the three categories to produce a wider spread in the calculated

index differences. Percentages were based upon the total number of emerged seedlings for that accession in that chamber. Negative and low index differences were considered to indicate very tolerant accessions, while high positive differences were associated with very susceptible accessions.

Selections

Plant selections were made during classification of the seedlings exposed to the cold temperature during germination. Single plant selections were chosen within accessions that appeared to have a greater variability to the chill treatment. Selections were not chosen from accessions with uniformly good or poor seedlings. However, within poor or susceptible accessions, a plant was chosen if it appeared to stand out as having tolerance. The normal category was the only category from which exceptionally vigorous seedlings were chosen.

These selections were grown to maturity in the summer months of 1975 and 1976 at the Agronomy Research Station, Perkins, Oklahoma. During the winter months, the selections were grown in a greenhouse at the CERL.

Seed produced by some of these selections were evaluated for chill tolerance to see if heritable differences existed in the material selected. Only selections from the first few runs had sufficient time to grow to maturity. To evaluate the progeny from these selections, a special run was set up which included 22 different peanut accessions.

Inheritance of Chill Tolerance

Hand crosses were initiated in the late summer and fall of 1976 to determine the inheritance of chill tolerance. A greenhouse and a growth chamber were utilized to facilitate crossing (D. J. Banks, Oklahoma State University, personal communication). Two tolerant (T) and two susceptible (S) accessions were crossed in the following combinations:

	Female		Male
a)	P-1284 (T)	X	P-2381 (T)
b)	P-1284 (T)	X	P-0012 (S)
c)	P-1284 (T)	X	P-0167 (S)
d)	P-2381 (T)	X	P-0167 (S)
e)	P-0012 (S)	X	P-2381 (T)
f)	P-0012 (S)	X	P-0167 (S)

All crosses were apparently successful, and seeds produced will be used in further studies to determine the inheritance of chill tolerance.

CHAPTER IV

RESULTS AND DISCUSSION

Preliminary Screening

Results of the four pre-trial runs were used to establish a procedure for screening peanut germplasm against cold temperature stress during germination. The responses of the four categories of seedling classification were apparently different as shown in Figure 1.

A peanut farmer will usually plant when there is a warm seedbeed, but, after planting, a cold front may lower the temperature and adversely affect growth and development. Thus, to simulate field planting, a procedure was needed that would initiate similar germination in both the chill-treatment and control chambers followed by a drop in temperature in the chill chamber.

A procedure also needs to produce a relatively moderate stress on the average accessions in the chill-treatment chamber. Potential differential responses between accessions would not be detectable if no stress were applied or if the stress were too severe.

The emergence percentages for the normal seedlings averaged over three cultivars and two germination media for the chill treatment of the first, second, third, and fourth

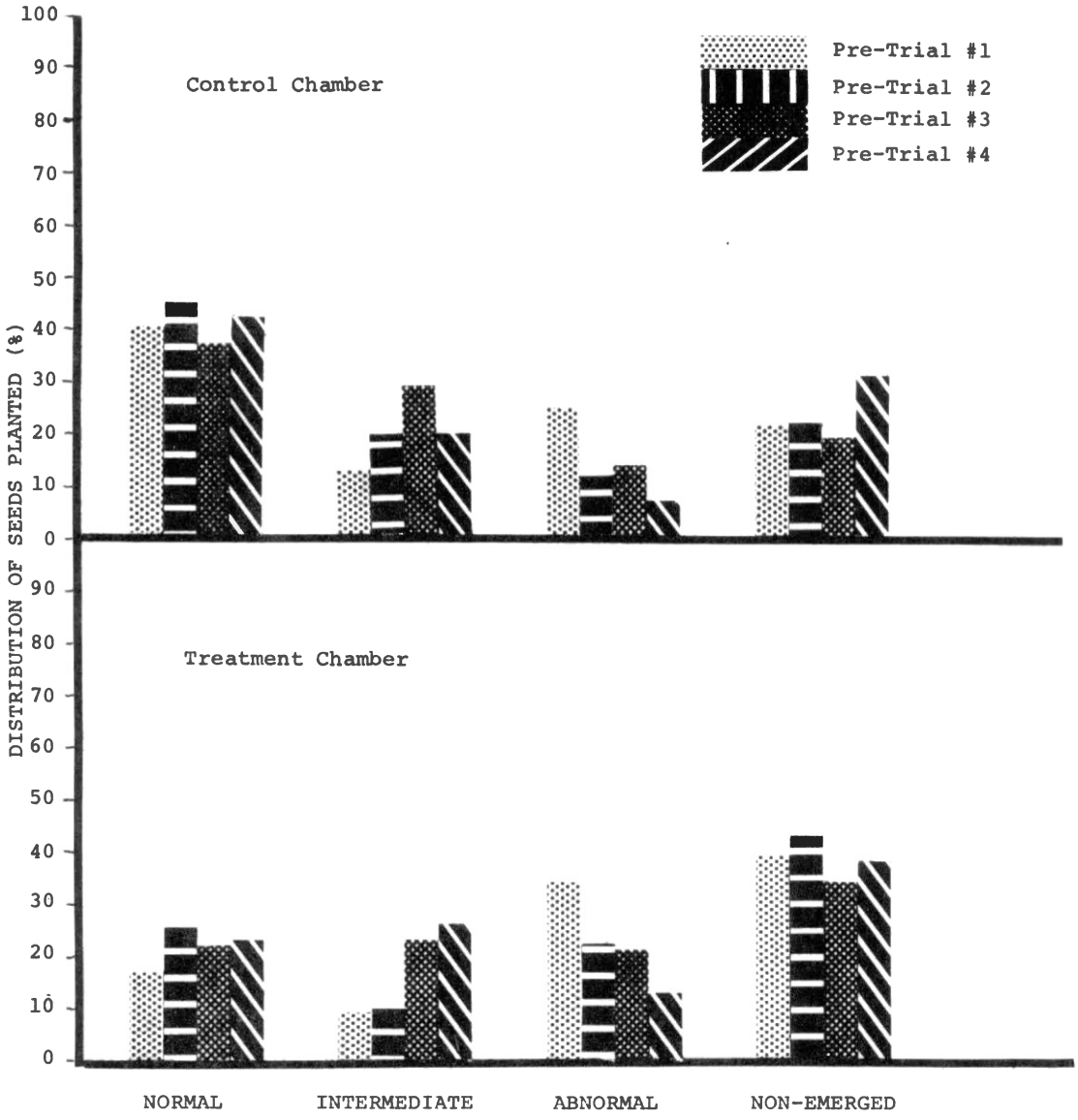

Figure 1. Results of Four Different Pre-Trial Runs on the Percentages for the Four Categories of Seedling Classification from 100 Seed Samples Averaged Over Three Cultivars and Two Germination Media per Cultivar

pre-trial runs were 17, 26, 22, and 23, respectively (Table II). Pre-trial run #1 showed a greater difference in normal seedlings between the control and treatment chambers than the other three pre-trial runs.

TABLE II

NUMBER OF NORMAL PEANUT SEEDLINGS EMERGING FROM SAMPLES OF 100 SEED PLANTED FOR EACH OF THREE PEANUT CULTIVARS IN THE PRE-TRIAL RUNS

		Pre-Trial #1		Pre-Trial #2		Pre-Trial #3		Pre-Trial #4	
Cultivar	Media	Control	Trt	Control	Trt	Control	Trt	Control	Trt
Tamnut 74	Sand	59	37	63	14	47	12	40	29
Tamnut 74	Verm	40	39	40	37	38	11	51	26
Florunner	Sand	34	02	49	34	24	46	33	23
Florunner	Verm	24	12	28	27	44	20	44	15
Spanhoma	Sand	55	00	51	21	49	20	55	16
Spanhoma	Verm	33	14	33	23	27	25	31	31
Mean		41	17	45	26	38	22	42	23

The averaged emergence percentages for the intermediate seedlings were 9, 10, 23, and 26 for the chill treatment of the first, second, third, and fourth pre-trial runs, respectively (Table III). The first pre-trial run had the least

difference between the chambers for the number of intermediate seedlings.

TABLE III

NUMBER OF INTERMEDIATE PEANUT SEEDLINGS EMERGING FROM SAMPLES OF 100 SEED PLANTED FOR EACH OF THREE PEANUT CULTIVARS IN THE PRE-TRIAL RUNS

		Pre-Trial #1		Pre-Trial #2		Pre-Trial #3		Pre-Trial #4	
Cultivar	Media	Control	Trt	Control	Trt	Control	Trt	Control	Trt
Tamnut 74	Sand	10	07	18	12	31	17	28	26
Tamnut 74	Verm	09	15	30	07	33	23	19	28
Florunner	Sand	10	08	24	08	21	08	10	18
Florunner	Verm	17	12	14	08	28	19	17	26
Spanhoma	Sand	13	03	14	17	21	36	23	28
Spanhoma	Verm	17	11	23	06	38	34	24	28
Mean		13	09	20	10	29	23	20	26

The averaged emergence percentages for the abnormal seedlings of the chill treatment for the first, second, third, and fourth pre-trial runs were 34, 22, 21, and 13, respectively (Table IV). Conditions of the second pre-trial run resulted in a greater difference in abnormal seedlings between the two chambers.

TABLE IV

NUMBER OF ABNORMAL PEANUT SEEDLINGS EMERGING FROM SAMPLES OF 100 SEED PLANTED FOR EACH OF THREE PEANUT CULTIVARS IN THE PRE-TRIAL RUNS

		Pre-Trial #1		Pre-Trial #2		Pre-Trial #3		Pre-Trial #4	
Cultivar	Media	Control	Trt	Control	Trt	Control	Trt	Control	Trt
Tamnut 74	Sand	19	18	05	12	12	08	04	14
Tamnut 74	Verm	37	33	17	34	19	41	05	20
Florunner	Sand	16	30	08	13	14	12	10	06
Florunner	Verm	34	47	15	14	05	30	08	27
Spanhoma	Sand	20	40	16	21	10	15	02	10
Spanhoma	Verm	24	36	14	35	23	18	10	03
Mean		25	34	12	22	14	21	07	13

The averaged percentages for the category of non-emerged seeds were 39, 43, 34, and 38 in the chill treatment of the first, second, third, and fourth pre-trial runs, respectively (Table V). The fourth pre-trial run resulted in the least difference in number of emerged seedlings between chambers. The temperature regime of the fourth pre-trial run was used to screen the peanut germplasm for chill tolerance because the difference in total emergence of the two chambers was smaller.

TABLE V

NUMBER OF PEANUT SEEDS FAILING TO EMERGE FROM SAMPLES OF 100 SEED PLANTED FOR EACH OF THREE PEANUT CULTIVARS IN THE PRE-TRIAL RUNS

Cultivar	Media	Pre-Trial #1		Pre-Trial #2		Pre-Trial #3		Pre-Trial #4	
		Control	Trt	Control	Trt	Control	Trt	Control	Trt
Tamnut 74	Sand	12	38	14	62	10	63	28	31
Tamnut 74	Verm	14	13	13	22	10	25	25	26
Florunner	Sand	40	60	19	45	41	34	47	53
Florunner	Verm	25	29	43	51	23	31	31	32
Spanhoma	Sand	12	57	19	41	20	29	20	46
Spanhoma	Verm	26	39	30	36	12	23	35	38
Mean		22	39	23	43	19	34	31	38

Screening Germplasm

Calculated index differences for the 259 peanut accessions screened in trial runs 1 through 19 are listed in Appendix Tables VII through XXV, respectively. Differences ranged from -52 in trial run #15 to 140 in trial run #5. Accessions having negative or low index difference values were considered the most tolerant. Susceptible accessions were those with high index differences.

Possible genetic tolerance was confounded with seed quality in many of the accessions screened. Other problems

were to differentiate between genetic differences within an accession or genotypic differences due to possible mechanical mixtures or differences in quality between seeds within a sample.

An additional 28 accessions had poor quality seed which resulted in less than 30 percent emergence in the chamber with optimum germinating temperature. Although the 30 percent emergence is an arbitrary point, in view of the confounding of seed quality with cold tolerance, it was felt that any seed lot with $\leq$ 30 percent emergence would not give a representative evaluation of the genetic potential of that accession. Thus, index values were not calculated for those accessions. Good quality seed from these accessions needs to be rescreened before any tolerance can be established.

The check cultivar, Tamnut 74, was used in each trial run except for the first run. Index differences for Tamnut 74 were very erratic across the trial runs (Figure 2). A general decline was noted toward the later trial runs. The irregularity in the index differences of Tamnut 74 was not anticipated and the causes have not been identified.

Seedling height measurements were not recorded; however, visual differences were apparent. The chill-treatment chamber resulted in shorter seedlings as compared to the control chamber.

The treatment chamber delayed emergence approximately eight days longer than the control chamber. First emergence

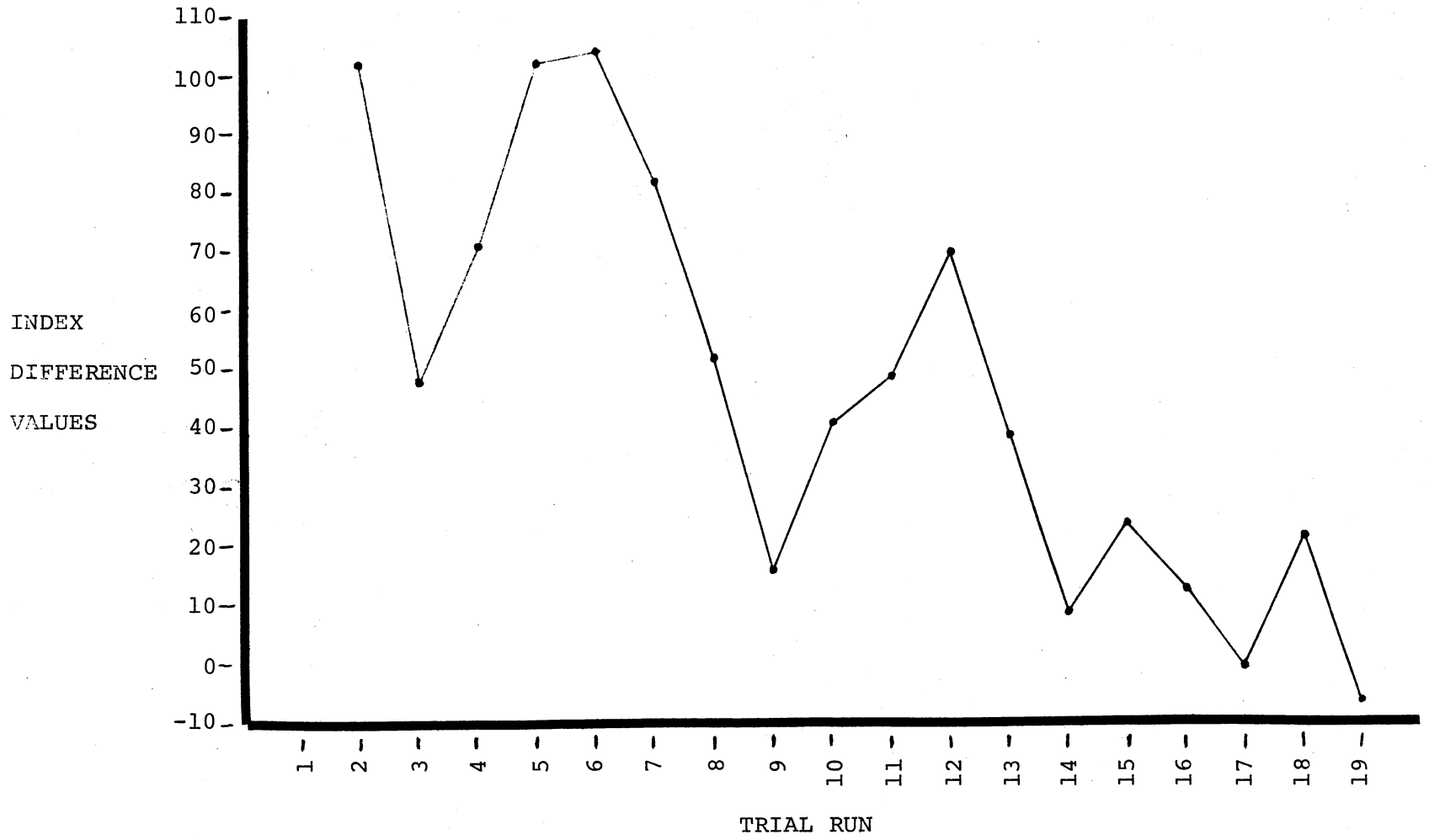

Figure 2. Index Difference Values for Tamnut 74 in Each Trial Run

in the control chamber was recorded on the average about four days after the start of each trial run.

Selection Evaluation

Selections made at the end of each three-week trial run are noted in the Appendix Tables by an asterisk. To evaluate the progeny from these selections, a special run was conducted (Table XXVI). Four cultivars (Comet, Florunner, Spanhoma, and Tamnut 74) were used to evaluate seed produced in 1975 by the selections versus random 1975 seed from the original populations (Table VI). Statistical analysis of selections versus the original populations for the number of normal seedlings resulted in a difference of 1.94 with the selections producing more normal seedlings. This difference was significant at the 0.07 observed significance level (OSL). There was also a difference between cultivars and a significant population by cultivar interaction at the 0.07 significance level. Highly significant differences occurred between the control and the chill treatment with approximately 2 1/2 times more normal seedlings in the control chamber. Significant differences for number of intermediate seedlings occurred between the control and the chill treatment, with the control chamber having fewer intermediate seedlings, and there was a significant cultivar by treatment interaction. Highly significant differences for the number of abnormal seedlings were found between the control and chill treatment, with the treatment chamber having more

TABLE VI

THE ANALYSES OF VARIANCE OF THE NUMBER OF SEEDLINGS IN NORMAL, INTERMEDIATE, ABNORMAL, AND NON-EMERGED CATEGORIES OF FOUR CULTIVARS COMPARING PROGENY FROM THE SELECTIONS TO THE ORIGINAL POPULATIONS

Source	d.f.	Mean Squares			
		Normal	Inter-mediate	Ab-normal	Non-emerged
Total	31	23.8	10.7	8.7	8.8
Rep (R)	1	26.3	2.5	0.1	15.1
Populations (P)	1	30.0	22.8	3.1	72.0**
Cultivars (C)	3	23.7	8.1	0.6	17.9**
P X C	3	23.4	9.1	4.4	15.8**
Error a R X P + R X C + R X C X P	7	6.5	8.2	4.3	1.4
Treatment (T)	1	399.0**	30.0	162.0**	3.1
P X T	1	0.0	22.8	15.1	1.1
C X T	3	11.0	24.9	6.8	8.4
P X C X T	3	3.5	2.9	1.7	6.2
Error b R X T in (C X P)	8	6.5	7.8	2.3	3.5

**Indicates significance at the 0.01 level of probability

abnormal seedlings. For abnormal seedlings, the population by treatment interaction was significant at the 0.03 OSL. The non-emerged category resulted in highly significant differences between selections and original populations, and among the four cultivars evaluated.

The seedling selections made within populations of the four cultivars Comet, Spanhoma, Tamnut 74, and Florunner were grown to maturity for a progeny seed increase in 1975. At the same time, random seed from each of the four cultivars was planted to get a fresh seed increase to represent the unselected cultivars. Attempts were made to determine whether progress was made from the selections. Index value differences calculated for the original population of each cultivar were compared with the respective differences calculated for the selections. A lower index value difference for a selection as compared to its original population would indicate that progress for cold tolerance had been made by selection, while similar differences would indicate no progress.

Lower index value differences were obtained for Comet, Spanhoma, and Florunner, but the difference for Tamnut 74 was relatively unchanged. Several possibilities exist for the explanation of these responses. First, the screening technique is not perfect, so exact reproducibility of the results is not known, and the differences obtained may not be real. Assuming that the technique is reasonably sound and reproducible, and that the differences obtained may be

real, some possible explanations are presented. The non-response to selection for Tamnut 74 is interesting in light of the fact that it is the most recently released cultivar (1974) of the four. Due to the nature of tetraploid inheritance, Tamnut 74 may be carrying more residual heterozygosity than the other three cultivars. According to one genetic hypothesis, heterozygosity per se is important in general "fitness" characters. It is felt that the response to cold stress during germination would fit well in the category of "fitness" characters.

Spanhoma and Comet were released in 1969 and 1970, respectively. It is likely that the additional generations of selfing have reduced the heterozygosity. However, since no conscious selection has been made for cold tolerance, gene frequency would not have changed, and these cultivars could well be homozygous but not homogeneous for any genes that might exist for cold tolerance or susceptibility. Proper selection of seedlings possessing gene(s) for cold tolerance should result in progress.

Florunner, released in 1969, is a cultivar made up by blending equal quantities of three sub-lines. The sub-lines are maintained separately by the originating breeder, and seed is blended as it is planted for Foundation Seed increase (personal communication, A. J. Norden, University of Florida). The discussion for Comet and Spanhoma above could also apply to each of the three sub-lines of Florunner. However, since the cold tolerance of each of the three sub-lines

is not known, the selection progress in Florunner may well be due to the selection of one of the sub-lines if differences do exist among them.

Eighteen other entries tested in the special run included 4 tolerant and 4 susceptible accessions from each of trial runs 1 and 3 plus 1 tolerant and 1 susceptible accession from trial run 2. Age of seed was a confounding factor since fresh seed produced in 1975 by the plants selected from the tolerant accessions were compared against "old" seed of the susceptible accessions. The "old" seed varied in age up to 11 years, but had been kept in cold storage.

Analysis of the accessions chosen from trial run 1 showed differences at the 0.08 significance level between tolerant selections and the original susceptible accessions for normal seedlings. The tolerant selections had considerably more normal seedlings than the susceptible accessions. Intermediate seedlings showed significant differences between tolerant selections and original susceptible accessions and between temperature treatments at a 0.03 OSL. The susceptible accessions again had fewer intermediate seedlings as compared to the tolerant selections. Highly significant accessions by treatment interactions were noted for the abnormal and the non-emerged categories.

Analysis of the entries chosen from trial run #2 indicated a difference between the tolerant selection and the original susceptible population at the 0.04 OSL for normal seedlings and for the non-emerged category. The tolerant

selection had more normal seedlings and a better germination than the susceptible accession. There was a difference between temperature treatments at a 0.09 OSL for abnormal seedlings.

Analysis of entries from the third trial run was based on percentages because the base numbers were very unequal. For the normal seedling category, differences resulted between tolerant selections and original susceptible populations at the 0.06 OSL. The percent normal seedlings in the tolerant selections was larger than in the susceptible populations. Highly significant differences occurred between temperature treatments. There were significantly higher percentages of intermediate seedlings in the tolerant selections than in the original susceptible populations at a 0.03 OSL. Tolerant selections versus original susceptible populations, accessions, and temperature treatments were each significant at a 0.02 OSL for the non-emerged category. The tolerant selections had substantially better emergence than the susceptible populations in all three sets of material.

Attempts were made to compare index differences for the 1975 progeny seed increase of the selections versus the older seed of the unselected accessions from three of the earlier trial runs. Lower index differences were expected if selection resulted in progress for cold tolerance during germination. Four tolerant selections and four susceptible unselected accessions were used from trial runs 1 and 3. In trial run 2, one tolerant selection and one susceptible unselected accession were compared.

Low germination was obtained in both control and chill chambers from the older seed of the unselected accessions due to the poor quality seed. The seed had been in cold storage for approximately one year at 7 C since the trial runs, and the large drop in percent germination was not anticipated.

The fresh seed of the selections had very good quality and resulted in extremely high germination. This extreme difference in seed quality prevented reliable comparisons for determining genetic progress from selection. Again the data emphasize the importance of having comparable good quality seed for future studies of this type.

Three tolerant and three susceptible accessions were chosen from trial run 14 to be reevaluated in the special run. The three tolerant accessions were P-1439, P-2381, and P-2385. The three susceptible accessions were P-0385, P-0937, and P-0971. Tamnut 74 was the check variety in both the trial and special runs. Only two of these accessions, P-0937 and P-0971, were reevaluated using the same seed lot as was used in the first evaluation. Seed lots for the other accessions differed by either location, year of harvest, or both (Figure 3). P-0937 and P-0971 again showed index difference values similar to those obtained in the first evaluation. Based on these two accessions, the screening procedure outlined previously would give reliable and reproducible data provided the same seed source and good quality seed were used.

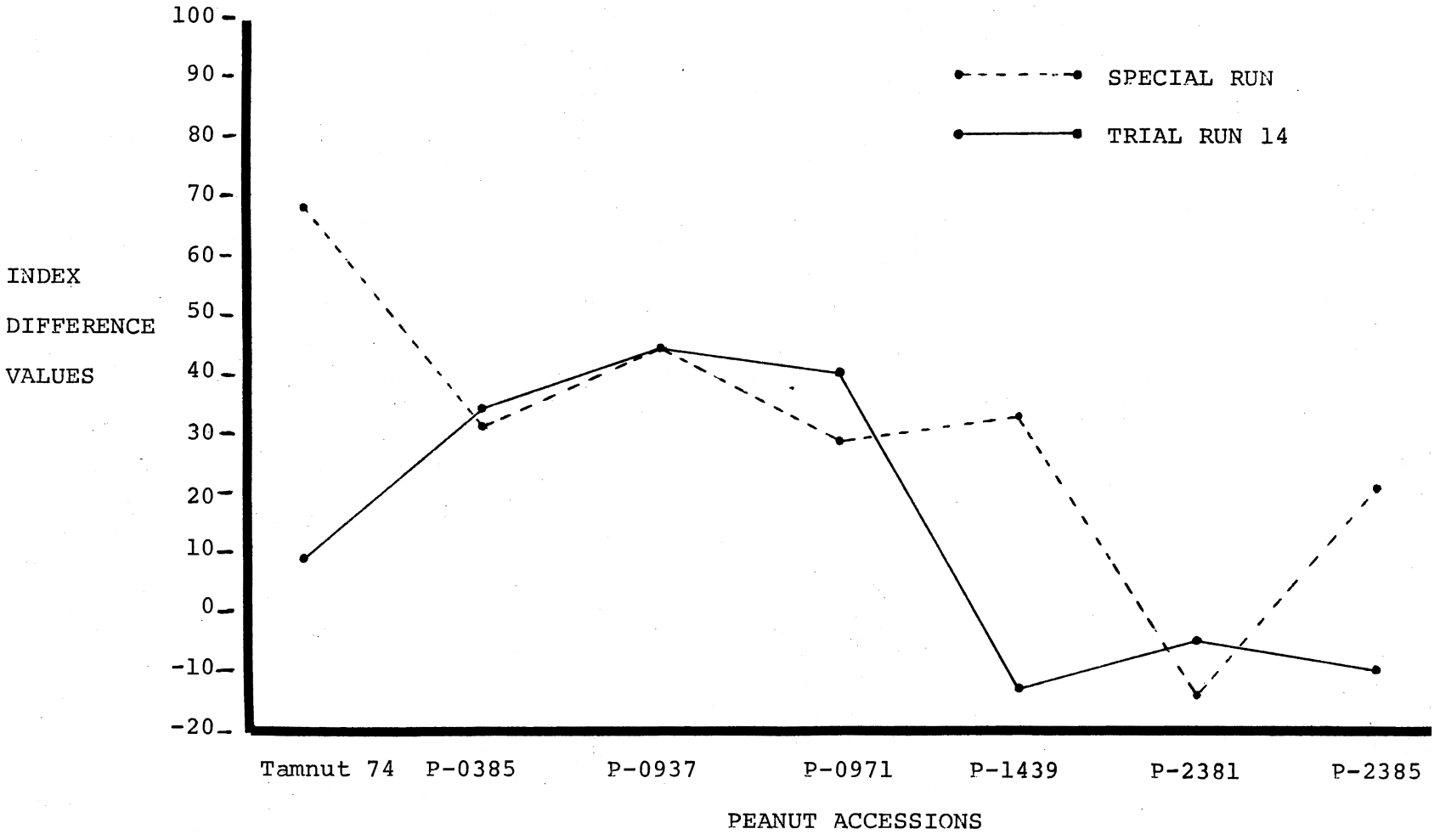

Figure 3. Index Difference Values for Seven Peanut Accessions Evaluated in Two Runs

High variances of means resulted from using only two replications per accession. The number of seed available per selection limited the use of more replications in order to keep the base number the same as that used previously during the screening procedure.

CHAPTER V

SUMMARY AND CONCLUSIONS

The first objective of this pioneer study was to develop a procedure for identifying sources of resistance or tolerance in cultivated peanuts to cold temperatures during germination. Various temperature regimes were tried before adopting a starting temperature of 30 C for 14 hours, followed by 5 days or 120 hours at 5 C, and then raised to 30 C days and 20 C nights for the remaining 362 hours, ending the three-week run.

After this technique was developed, peanut germplasm was screened for cold tolerance to identify the best levels available. Two hundred fifty-nine different accessions were screened for genetic differences in response to cold temperatures during germination.

Quality of seed for screening was a confounding factor in the results. However, considering all factors, genotypic differences probably do exist between the peanut accessions in response to a chill stress during germination. Improvement in this technique and use of good quality seed would undoubtedly be more efficient in detection of significant differences in chill tolerance between peanut accessions.

Plant selections were made of normal seedlings exposed to the cold temperature during germination. Progeny from these selections were evaluated. Analysis showed significantly more normal seedlings from the selections than from the original populations in the chill treatment chamber. Also, fewer abnormal seedlings were found in the selections than in the original populations. Possibly more cycles of plant selection or larger seed increases of the selection were needed for greater success.

The ability to repeat the results from this screening procedure was studied by seven accessions. However, only two accessions, P-0937 and P-0971, had the same seed source. These two and two other accessions, P-0385 and P-2381, had similar index difference values in both the trial and special run evaluations. Further replication with additional accessions should strengthen the reliability of duplicating the obtained results.

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APPENDIX

TABLE VII

SUMMARY OF DATA FROM TRIAL RUN 1

Okla. P-No.	Strain or P.I. No.	Origin≠	Control Chamber (C)							Chill Treatment Chamber (T)							Index		
			Total Emer.	Normal		Intermed.		Abnormal		Total Emer.	Normal		Intermed.		Abnormal				
				No.	%	No.	%	No.	%		No.	%	No.	%	No.	%	C	T	Difference
0008	Tex 314-4	USA	0	0	00	0	00	0	00	0	0	00	0	00	0	00	--	--	--
0011*	Strat. Sp.	USA	43	26	61	12	28	5	12	41	17	42	20	49	4	10	151	168	17
0004*	Spantex	USA	44	31	71	10	23	3	07	45	24	53	10	22	11	24	136	171	35
0021*	T-400-1	USA	43	29	67	10	23	4	09	38	16	42	12	32	10	26	142	184	42
0023*	226249	S AFR	35	15	43	17	49	3	09	30	9	30	9	30	12	40	166	210	44
0017*	161300	ARGN	49	35	71	11	23	3	06	50	19	38	21	42	10	20	135	182	47
0003*	Dix. Sp.	USA	35	22	62	11	31	2	06	43	17	40	13	30	13	30	143	191	48
0015*	161312	ARGN	37	29	78	6	16	2	05	44	19	43	15	34	10	23	127	180	53
0018*	162659	URUG	43	28	65	13	30	2	05	40	10	25	20	50	10	25	140	200	60
0016	162538	URUG	10	2	20	3	30	5	50	2	0	00	0	00	2	100	--	--	--
0010*	Tex 314-1	USA	39	22	56	13	33	4	10	39	8	21	9	23	22	56	154	236	82
0024	229656	MALGY	18	8	44	5	28	5	28	11	0	00	3	27	8	73	183	273	89
0022*	T-437	USA	37	22	60	12	32	3	08	27	1	04	12	44	14	52	149	248	99
0020	121070-1	PARA	3	1	33	1	33	1	33	1	0	00	0	00	1	100	--	--	--
0001	Argentine	USA	21	6	29	13	62	2	10	25	0	00	3	12	22	88	181	288	107
0012*	Pearl Peanut	USA	21	11	52	9	43	1	05	28	3	11	5	18	20	72	152	261	108

* = Selections were made within this accession.
≠ = Seed Catalog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp. A1-A79, 1974, was used where possible.
-- = Index values not calculated for accessions with < 30% emergence.

TABLE VIII

SUMMARY OF DATA FROM TRIAL RUN 2

Okla. P-No.	Strain or P.I. No.	Origin≠	Control Chamber (C) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Chill Treatment Chamber (T) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Index C	Index T	Index Difference
0032	234422	CH TI	35	31	89	2	06	2	06	40	18	45	17	43	5	13	117	167	50
0035*	242100	CH TI	35	21	60	8	23	6	17	35	12	34	8	23	15	43	157	208	51
0036	NC-2	USA	38	12	32	12	32	14	37	40	0	00	17	43	23	58	205	257	52
0040*	234420	CH TI	48	23	48	20	42	5	10	47	4	09	29	62	14	30	162	221	59
0031	234418	CH TI	39	32	82	3	08	4	10	46	15	33	21	46	10	22	128	189	61
0039	234419	CH TI	11	8	73	2	18	1	09	6	2	33	2	33	2	33	--	--	--
0038	219824	ARGN	10	5	50	3	30	2	20	10	2	20	2	20	6	60	--	--	--
0034*	242101	CH TI	36	24	67	4	11	8	22	35	9	26	8	23	18	51	156	226	70
0029*	White Seed Argintine	USA	34	22	65	7	21	5	15	46	5	11	24	52	17	37	150	226	76
0033*	237337	ISRL	36	22	61	11	31	3	08	29	4	14	14	48	11	38	147	224	77
0030*	234416	CH TI	42	34	81	6	14	2	05	42	11	26	18	43	13	31	124	205	81
0043	237507	ARGN	13	7	54	2	15	4	31	8	0	00	3	38	5	63	--	--	--
0028	234375	CH TI	11	4	36	4	36	3	27	6	0	00	1	17	5	83	--	--	--
0045*	237508	ARGN	35	25	71	10	29	0	00	27	7	26	6	22	14	52	129	226	97
2613	Tamnut 74	USA	42	33	79	9	21	0	00	43	10	23	13	30	20	47	121	223	102
0026	229658	MALGY	9	5	56	4	44	0	00	5	0	00	1	20	4	80	--	--	--

* = Selections were made within this accession.
≠ = Seed Catalog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp. A1-A79, 1974, was used where possible.
-- = Index values not calculated for accessions with < 30% emergence.

TABLE IX

SUMMARY OF DATA FROM TRIAL RUN 3

Okla. P-No.	Strain or P.I. No.	Origin≠	Control Chamber (C)							Chill Treatment Chamber (T)							Index		
			Total Emer.	Normal		Intermed.		Abnormal		Total Emer.	Normal		Intermed.		Abnormal		C	T	Difference
				No.	%	No.	%	No.	%		No.	%	No.	%	No.	%			
0046*	237510	ARGN	41	31	76	7	17	3	07	39	20	51	8	21	11	28	132	177	45
2613	Tamnut 74	USA	44	29	66	14	32	1	02	32	16	50	5	16	11	34	136	184	48
0080*	OAEP 58-22	USA	49	36	74	8	16	5	10	48	16	33	21	44	11	23	137	190	53
0074*	OAEP 58-16	USA	41	33	81	5	12	3	07	47	20	42	12	26	15	32	127	190	63
0062*	OAEP 58-4	USA	44	28	64	15	34	1	02	42	14	33	11	26	17	41	138	207	69
0083*	OAEP 58-29	USA	46	21	46	19	41	6	13	45	8	18	11	24	26	58	167	240	73
0061*	OAEP 58-3	USA	46	38	83	5	11	3	07	31	11	35	10	32	10	32	124	197	73
0096	Tex 24	USA	40	10	25	25	63	5	13	34	3	09	7	21	24	71	188	262	74
0085*	Tex 20	USA	41	20	49	18	44	3	07	34	5	15	10	29	19	56	158	241	83
0095*	Spantex	USA	37	12	32	16	43	9	24	38	2	05	5	13	31	82	192	276	84
0097*	Tex 24	USA	46	16	35	25	54	5	11	41	2	05	6	15	33	81	176	276	100
0094	Spantex	USA	37	16	43	12	32	9	24	31	0	00	5	16	26	84	181	284	103
0089	Tex 20	USA	21	8	38	10	48	3	14	8	0	00	1	13	7	88	176	287	111
0086	Tex 20	USA	25	12	48	7	28	6	24	18	0	00	2	11	16	89	176	289	113
0092	Tex 20	USA	42	25	60	15	36	2	05	43	4	09	9	21	30	70	145	260	115
0090	Tex 20	USA	41	24	59	15	37	2	05	34	4	12	2	06	28	82	146	270	124

* = Selections were made within this accession.
≠ = Seed Catalog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp. A1-A79, 1974, was used where possible.

TABLE X

SUMMARY OF DATA FROM TRIAL RUN 4

Okla. P-No.	Strain or P.I. No.	Origin≠	Control Chamber (C) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Chill Treatment Chamber (T) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Index C	Index T	Index Difference
0146	Sp. 146-1-1-48-4	BOLI	0	0	00	0	00	0	00	0	0	00	0	00	0	00	--	--	--
0144*	234417	CH TI	35	22	63	12	34	1	03	27	11	41	7	26	9	33	140	193	53
0155	121070-3	PARA	15	2	13	10	67	3	20	8	0	00	3	38	5	63	207	263	56
0114	121070-3	PARA	32	9	28	17	53	6	19	21	2	10	6	29	13	62	190	252	62
0119*	121070-3	PARA	38	18	47	19	50	1	03	25	4	16	11	44	10	40	155	224	69
2613	Tamnut 74	USA	38	28	74	9	24	1	03	22	10	45	2	09	10	45	129	200	71
0147*	162403	BOLI	42	25	60	16	38	1	02	28	9	32	6	21	13	46	143	214	71
0118*	121070-3	PARA	34	17	50	14	41	3	09	26	6	23	5	19	15	58	159	235	76
0106	121070-1	PARA	30	14	47	15	50	1	03	21	2	10	9	43	10	48	157	238	81
0099*	Tex 24	USA	47	31	66	15	32	1	02	28	5	18	11	39	12	43	136	225	89
0109	121070-1	PARA	11	3	27	7	64	1	09	4	0	00	1	25	3	75	--	--	--
0105	Tex 26	USA	46	8	17	33	72	5	11	20	0	00	2	10	18	90	193	290	97
0104	Tex 26	USA	45	25	56	17	38	3	07	28	2	07	10	36	16	57	151	250	99
0152	162957	AFR	17	3	18	12	71	2	12	6	0	00	0	00	6	100	194	300	106
0116*	121070-3	PARA	35	22	63	11	31	2	06	16	2	13	3	19	11	69	143	256	113
0117	121070-3	PARA	16	8	50	8	50	0	00	18	1	06	3	17	14	78	150	272	122

* = Selections were made within this accession.
≠ = Seed Catalog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp. A1-A79, 1974, was used where possible.
-- = Index values not calculated for accessions with < 30% emergence.

TABLE XI

SUMMARY OF DATA FROM TRIAL RUN 5

Okla. P-No.	Strain or P.I. No.	Origin≠	Control Chamber (C) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Chill Treatment Chamber (T) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Index C	Index T	Index Difference
0153	162532	BOLI	0	0	00	0	00	0	00	0	0	00	0	00	0	00	--	--	--
0188	Valencia	USA	13	5	39	2	15	6	46	9	3	33	2	22	4	44	--	--	--
0189	Valencia	USA	26	6	23	10	38	10	38	13	1	08	5	39	7	54	215	246	31
0154	162541	ARGN	15	6	40	6	40	3	20	8	0	00	7	88	1	13	180	213	33
0160*	223683	——	27	18	67	6	22	3	11	33	9	27	16	49	8	24	144	197	53
0159	162421	——	32	13	41	16	50	3	09	17	1	06	7	41	9	53	169	247	78
0185	121070-3-1	PARA	44	23	52	18	41	3	07	39	6	15	11	28	22	56	155	241	86
0175	223684	——	32	18	56	13	41	1	03	15	2	13	5	33	8	53	147	240	93
0161	Tenn. Red	USA	48	42	88	6	13	0	00	40	12	30	12	30	16	40	112	210	98
0186	T-32-A-1-4	USA	7	1	14	5	71	1	14	1	0	00	0	00	1	100	--	--	--
2613	Tamnut 74	USA	44	21	48	19	43	4	09	19	3	16	1	05	15	79	161	263	102
0155	162522-B	ARGN	19	13	68	5	26	1	05	18	0	00	8	44	10	56	137	256	119
0156	163147	BRAZ	20	10	50	9	45	0	00	10	1	10	2	20	7	70	140	260	120
0167	162407-B	BOLI	31	10	32	20	65	1	03	14	0	00	1	07	13	93	171	293	122
0176	Tex 206-6-1	USA	18	7	39	8	44	3	17	5	0	00	0	00	5	100	178	300	122
0174	121298	——	25	12	48	11	44	2	08	4	0	00	0	00	4	100	160	300	140

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≠ = Seed Catalog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp. A1-A79, 1974, was used where possible.
-- = Index values not calculated for accessions with < 30% emergence.

TABLE XII

SUMMARY OF DATA FROM TRIAL RUN 6

Okla. P-No.	Strain or P.I. No.	Origin	Control Chamber (C) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Chill Treatment Chamber (T) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Index C	Index T	Index Difference
0296	259648	CUBA	24	11	46	7	29	6	25	13	3	23	5	39	5	39	179	215	36
0307	259800	NYASA	36	21	58	12	33	3	08	24	10	42	6	25	8	33	150	192	42
0304*	259814	NYASA	30	17	57	6	20	7	23	32	7	22	15	47	10	31	167	210	43
0301	259728	URUG	33	14	42	13	39	6	18	32	9	28	8	25	15	47	176	219	43
0300	259585	JAMA	24	12	50	9	38	3	13	15	5	33	4	27	6	40	163	207	44
0306*	259536	VENEZ	31	19	61	7	23	5	16	35	11	31	13	37	11	31	155	200	45
0216	Tex 32-B-1-2	USA	39	22	56	8	21	9	23	37	8	22	15	41	14	38	167	216	49
0324*	259597	URUG	23	13	57	8	35	2	09	26	6	23	9	35	11	42	152	219	67
0190	Valencia	USA	41	29	71	10	24	2	05	38	11	29	15	40	12	32	134	203	69
0200*	Argentine	USA	45	36	80	7	16	2	04	42	12	29	18	43	12	29	124	200	76
0214	242100-1	CH TI	38	25	66	10	26	3	08	32	5	16	16	50	11	34	142	219	77
0289	Va 61 R	USA	28	18	64	6	21	4	14	22	3	14	8	36	11	50	150	236	86
0295*	259662	CUBA	39	28	72	9	23	2	05	34	8	24	11	32	15	44	133	220	87
0207	Tex 484	USA	41	28	68	10	24	3	07	37	6	16	15	41	16	43	139	227	88
0311	259594	URUG	33	18	55	11	33	4	12	24	2	08	7	29	15	63	157	254	97
2613	Tamnut 74	USA	45	30	67	13	29	2	04	36	7	19	7	19	22	61	138	242	104

* = Selections were made within this accession.
≠ = Seed Catalog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp. A1-A79, 1974, was used where possible.

TABLE XIII

SUMMARY OF DATA FROM TRIAL RUN 7

Okla. P-No.	Strain or P.I. No.	Origin≠	Control Chamber (C) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Chill Treatment Chamber (T) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Index C	Index T	Index Difference
0375	268649	RHOD	30	17	57	6	20	7	23	35	14	40	15	43	6	17	167	177	10
0382	268663	RHOD	17	7	41	5	29	5	29	17	5	29	5	29	7	41	188	212	24
0379*	268654	RHOD	40	20	50	10	25	10	25	37	10	27	17	46	10	27	175	200	25
0365	268635	RHOD	21	11	52	7	33	3	14	13	4	31	6	46	3	23	162	192	30
0360	268616	RHOD	22	13	59	5	23	4	18	18	5	28	9	50	4	22	159	194	35
0384*	268680	RHOD	29	18	62	10	35	1	03	29	13	45	9	31	7	24	141	179	38
0386	268686	RHOD	22	10	45	7	32	5	23	26	5	19	11	42	10	39	177	219	42
0371	268644	RHOD	30	19	63	5	17	6	20	21	5	24	11	52	5	24	157	200	43
0339	259678	CUBA	37	21	57	8	22	8	22	31	7	23	14	45	10	32	165	210	45
0340	268516	RHOD	17	5	29	8	47	4	24	14	2	14	4	29	8	57	194	243	49
0352	268601	RHOD	41	26	63	8	20	7	17	35	13	37	7	20	15	43	154	206	52
0373	268647	RHOD	18	12	67	5	28	1	06	20	8	40	5	25	7	35	139	195	56
0344	268577	RHOD	9	5	56	2	22	2	22	8	1	13	4	50	3	38	--	--	--
0342	268564	RHOD	32	16	50	13	41	3	09	20	4	20	8	40	8	40	159	220	61
2613	Tamnut 74	USA	44	31	70	8	18	5	11	44	13	30	8	18	23	52	141	223	82
0343	268573	RHOD	30	18	60	8	27	4	13	32	5	16	7	22	20	63	153	247	94

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≠ = Seed Catalog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp. A1-A79, 1974, was used where possible.
-- = Index values not calculated for accessions with < 30% emergence.

TABLE XIV

SUMMARY OF DATA FROM TRIAL RUN 8

Okla. P-No.	Strain or P.I. No.	Origin≠	Control Chamber (C) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Chill Treatment Chamber (T) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Index C	Index T	Index Difference
0433	268789	RHOD	26	12	46	5	19	9	35	27	9	33	8	30	10	37	189	204	15
0401	268707	RHOD	22	7	32	4	18	11	50	22	4	18	5	23	13	59	218	241	23
0432	268787	RHOD	24	12	50	9	38	3	13	16	7	44	3	19	6	38	163	194	31
0394	268692	RHOD	10	1	10	4	40	5	50	7	0	00	2	29	5	71	--	--	--
0391	268690	RHOD	29	9	31	14	48	6	21	15	5	33	1	07	9	60	190	227	37
0400	268706	RHOD	32	16	50	12	38	4	13	27	8	30	9	33	10	37	162	207	45
2613	Tamnut 74	USA	36	24	67	5	14	7	19	40	13	33	12	30	15	38	153	205	52
0418	268740	RHOD	24	14	58	4	17	6	25	15	4	27	4	27	7	47	167	220	53
0406	268710	RHOD	29	21	72	3	10	5	17	24	9	38	6	25	9	38	145	200	55
0410	268716	RHOD	31	13	42	12	39	6	19	23	6	26	3	13	14	61	178	235	57
0388	268688	RHOD	36	18	50	9	25	8	22	30	5	17	11	37	14	47	167	230	63
0403	268708	RHOD	23	14	61	7	30	2	09	17	3	18	7	41	7	41	148	224	76
0393	268692	RHOD	29	8	28	16	55	5	17	16	1	06	3	19	12	75	190	269	79
0395	268701	RHOD	31	16	52	9	29	6	19	8	1	13	2	25	5	63	168	250	82
0429	268771	RHOD	40	24	60	13	33	3	08	24	3	13	9	38	12	50	148	238	90
0428	268769	RHOD	31	17	55	9	29	5	16	28	1	04	11	39	16	57	161	253	92

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≠ = Seed Catalog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp. A1-A79, 1974, was used where possible.
-- = Index values not calculated for accessions with < 30% emergence.

TABLE XV

SUMMARY OF DATA FROM TRIAL RUN 9

			Control Chamber (C)							Chill Treatment Chamber (T)								
				Normal		Intermed.		Abnormal			Normal		Intermed.		Abnormal		Index		
Okla. P-No.	Strain or P.I. No.	Origin≠	Total Emer.	No.	%	No.	%	No.	%	Total Emer.	No.	%	No.	%	No.	%	C	T	Difference
0457	270773	RHOD	15	3	20	4	27	8	53	5	1	20	2	40	2	40	233	220	-13
0435	268790	RHOD	33	9	27	13	39	11	33	30	9	30	10	33	11	37	206	207	01
0434	268789	RHOD	25	8	32	7	28	10	40	36	9	25	14	39	13	36	208	211	03
0439	268808	RHOD	27	8	30	4	15	15	56	18	2	11	8	44	8	44	226	233	07
0461	270804	RHOD	35	14	40	10	29	11	31	33	9	27	13	39	11	33	191	206	15
2613	Tamnut 74	USA	45	19	42	13	29	13	29	43	13	30	16	37	14	33	186	202	16
0468	274267	RHOD	26	17	65	4	15	5	19	25	10	40	9	36	6	24	154	184	30
0445*	268823	RHOD	34	18	53	6	18	10	29	31	9	29	10	32	12	39	177	210	33
0443*	268821	RHOD	33	21	64	10	30	2	06	34	14	41	12	35	8	24	142	182	40
0458	270784	RHOD	32	13	41	11	34	8	25	32	6	19	11	34	15	47	184	228	44
0471*	261997	PARA	36	21	58	10	28	5	14	41	12	29	15	37	14	34	156	205	49
2447	268826	RHOD	16	6	38	5	31	5	31	14	1	07	4	29	9	64	194	257	63
0462	270804	RHOD	28	14	50	7	25	7	25	20	2	10	7	35	11	55	175	245	70
0467	271022	——	33	20	61	7	21	6	18	29	7	24	7	24	15	52	158	228	70
0465	270849	RHOD	30	18	60	8	27	4	13	31	8	26	7	23	16	52	153	226	73
0460	270789	RHOD	21	14	67	4	19	3	14	14	1	07	7	50	6	43	148	236	88

* = Selections were made within this accession.
≠ = Seed Catalog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp. A1-A79, 1974, was used where possible.

TABLE XVI

SUMMARY OF DATA FROM TRIAL RUN 10

Okla. P-No.	Strain or P.I. No.	Origin≠	Control Chamber (C) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Chill Treatment Chamber (T) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Index C	Index T	Index Difference
0495*	262046	BRAZ	32	20	63	9	28	3	09	37	19	51	10	27	8	22	147	170	23
0474*	——	——	37	22	59	8	22	7	19	32	12	38	12	38	8	25	160	188	28
0491	262038	BRAZ	31	17	55	9	29	5	16	21	8	38	7	33	6	29	161	190	29
0482*	262019	PARA	39	29	74	7	18	3	08	28	15	54	8	29	5	18	133	164	31
0485	262105	BOLI	20	7	35	6	30	7	35	15	3	20	3	20	9	60	200	240	40
2613	Tamnut 74	USA	41	28	68	7	17	6	15	47	19	40	15	32	13	28	146	187	41
0496	262050	BRAZ	28	21	75	4	14	3	11	22	11	50	5	23	6	27	135	177	42
0480*	262016	PARA	33	21	64	6	18	6	18	33	13	39	8	24	12	36	155	197	42
0479	——	——	23	15	65	3	13	5	22	19	6	32	7	37	6	32	157	200	43
0477	262014	PARA	31	16	52	9	29	6	19	24	6	25	9	38	9	38	168	213	45
0487*	——	——	34	19	56	7	21	8	24	29	11	38	2	07	16	55	167	217	50
0489	262036	BRAZ	38	26	68	6	16	6	16	31	10	32	10	32	11	35	147	203	56
0493	262087	BRAZ	30	24	80	6	20	0	00	31	12	39	12	39	7	23	120	184	64
0490	262037	BRAZ	24	16	67	3	13	5	21	28	6	21	7	25	15	54	154	232	78
0495	——	——	18	12	67	4	22	2	11	16	3	19	6	38	7	44	144	225	81
0478	262088	BRAZ	28	18	64	7	25	3	11	29	3	10	12	41	14	48	146	238	92

* = Selections were made within this accession.
≠ = Seed Catalog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp. A1-A79, 1974, was used where possible.

TABLE XVII

SUMMARY OF DATA FROM TRIAL RUN 11

Okla. P-No.	Strain or P.I. No.	Origin≠	Control Chamber (C) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Chill Treatment Chamber (T) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Index C	Index T	Index Difference
0592	268647	RHOD	16	3	19	6	38	7	44	13	4	31	4	31	5	39	225	208	-17
0591	268646	RHOD	25	5	20	10	40	10	40	16	5	31	3	19	8	50	220	219	-01
0599	268667	RHOD	14	3	21	3	21	8	57	15	1	07	6	40	8	53	--	--	--
0563	240579	GHANA	28	13	46	6	21	9	32	15	6	40	3	20	6	40	186	200	14
0565	268597	RHOD	23	10	44	5	22	8	35	8	2	25	3	38	3	38	191	212	21
0584	268634	RHOD	31	13	42	5	16	13	42	15	4	27	3	20	8	53	200	227	27
0577	268626	RHOD	27	10	37	7	26	10	37	17	4	24	4	24	9	53	200	229	29
0580	268629	RHOD	25	7	28	10	40	8	32	21	3	14	6	29	12	57	204	243	39
0567*	268601	RHOD	39	21	54	9	23	9	23	32	10	31	9	28	13	41	169	209	40
0574	268623	RHOD	21	9	43	7	33	5	24	12	1	08	7	58	4	33	181	225	44
0568	268604	RHOD	32	18	56	4	13	10	31	20	4	20	8	40	8	40	175	220	45
0602	268669	RHOD	6	1	17	2	33	3	50	5	0	00	1	20	4	80	--	--	--
2613	Tamnut 74	USA	47	30	64	10	21	7	15	43	16	37	11	26	16	37	151	200	49
0589	268641	RHOD	30	17	57	3	10	10	33	15	3	20	3	20	9	60	177	240	63
0606	268674	RHOD	30	11	37	6	20	13	43	7	0	00	2	29	5	71	206	271	65
0594	268654	RHOD	22	15	68	4	18	3	14	11	0	00	3	27	8	73	146	273	127

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≠ = Seed Catalog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp A1-A79, 1974, was used where possible.
-- = Index values not calculated for accessions with < 30% emergence.

TABLE XVIII

SUMMARY OF DATA FROM TRIAL RUN 12

Okla. P-No.	Strain or P.I. No.	Origin≠	Control Chamber (C)							Chill Treatment Chamber (T)							Index		
			Total Emer.	Normal		Intermed.		Abnormal		Total Emer.	Normal		Intermed.		Abnormal				
				No.	%	No.	%	No.	%		No.	%	No.	%	No.	%	C	T	Difference
0652	268729	RHOD	30	18	60	8	27	4	13	39	11	28	10	26	8	21	153	141	-12
0653*	268730	RHOD	37	23	62	8	22	6	16	31	16	52	10	32	5	16	154	165	11
0624	268703	RHOD	36	15	42	14	39	7	19	30	12	40	9	30	9	30	178	190	12
0648*	268725	RHOD	37	27	73	6	16	4	11	32	17	53	11	34	4	13	138	159	21
0631*	268710	RHOD	33	20	61	4	12	9	27	34	15	44	8	24	11	32	167	189	22
0626	268704	RHOD	30	14	47	15	50	1	03	28	12	43	7	25	9	32	157	190	33
0610	268678	RHOD	14	1	07	6	43	7	50	5	0	00	1	20	4	80	--	--	--
0632	268711	RHOD	39	21	54	9	23	9	23	34	11	32	9	27	14	41	169	209	40
0634	268713	RHOD	43	26	61	8	19	9	21	42	10	24	21	50	11	26	160	202	42
0609	268677	RHOD	21	7	33	6	29	8	38	17	1	06	7	41	9	53	205	247	42
0623	268702	RHOD	31	19	61	7	23	5	16	28	7	25	12	43	9	32	155	207	52
0646	268723	RHOD	38	22	58	10	26	6	16	24	6	25	8	33	10	42	158	217	59
0608	268676	RHOD	26	9	35	14	54	3	12	13	2	15	3	23	8	62	177	246	69
2613	Tamnut 74	USA	46	33	72	9	20	4	09	43	15	35	10	23	18	42	137	207	70
0642	268721	RHOD	37	22	59	11	30	4	11	34	2	06	14	41	18	53	151	247	96
0612	268683	RHOD	19	15	79	3	16	1	05	17	3	18	5	29	9	53	126	235	109

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≠ = Seed Catalog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp. A1-A79, 1974, was used where possible.
-- = Index values not calculated for accessions with < 30% emergence.

TABLE XIX

SUMMARY OF DATA FROM TRIAL RUN 13

Okla. P-No.	Strain or P.I. No.	Origin≠	Control Chamber (C) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Chill Treatment Chamber (T) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Index C	Index T	Index Difference
2373*	Goldin I	USA	41	17	42	10	24	14	34	45	21	47	12	27	12	27	193	180	-13
3148*	GA 116	USA	45	34	76	4	09	7	16	45	31	69	10	22	4	09	140	140	00
1284*	268637-65-1	USA	42	23	55	12	29	7	17	48	29	60	8	17	11	23	162	163	01
3146*	GK-19	USA	43	27	63	10	23	6	14	46	24	52	15	33	7	15	151	163	12
1258*	Tifspan	USA	47	31	66	12	26	4	09	47	26	55	13	28	8	17	143	162	19
0161	Tenn. Red	USA	48	21	44	20	42	7	15	44	17	39	12	27	15	34	171	196	25
3144*	Starr Colchicine	USA	44	19	43	14	32	11	25	32	10	31	8	25	14	44	182	213	31
2613	Tamnut 74	USA	37	25	68	8	22	4	11	44	22	50	8	18	14	32	143	182	39
3149	GA 123	USA	43	26	61	12	28	5	12	43	17	40	12	28	14	33	151	193	42
0006*	Starr	USA	47	26	55	14	30	7	15	33	13	39	6	18	14	42	160	203	43
3145*	New Mex. Val. A	USA	42	23	55	13	31	6	14	40	15	38	6	15	19	48	159	210	51
0002*	Argentine	USA	45	28	62	13	29	4	09	44	18	41	9	21	17	39	147	198	51
1259*	Spancross	USA	44	32	73	7	16	5	11	43	18	42	10	23	15	35	139	193	54
3147	GK-53	USA	41	25	61	7	17	9	22	45	15	33	8	18	22	49	161	216	55
2398B*	268661	USSR	50	38	76	12	24	0	00	50	7	14	40	80	3	06	124	192	68
2398A*	268661	USSR	45	23	51	15	33	7	16	42	3	07	18	43	21	50	165	243	78

* = Selections were made within this accession.
≠ = Seed Catalog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp. A1-A79, 1974, was used where possible.

TABLE XX

SUMMARY OF DATA FROM TRIAL RUN 14

Okla. P-No.	Strain or P.I. No.	Origin≠	Control Chamber (C) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Chill Treatment Chamber (T) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Index C	Index T	Index Difference
1439*	Spantex	USA	44	26	59	10	23	8	18	48	33	69	8	17	7	15	159	146	-13
2385	337419	ARGN	49	26	53	14	29	9	18	45	27	60	11	24	7	16	165	156	-10
2381	268771B	RHOD	43	17	40	21	49	5	12	46	23	50	15	33	8	17	172	167	-05
0370	268644	RHOD	47	25	53	17	36	5	11	47	26	55	14	30	7	15	158	160	02
2397	Runner Spanish	USA	45	13	29	21	47	11	24	42	15	36	12	29	15	36	196	299	04
2613	Tamnut 74	USA	43	25	58	8	19	10	23	46	24	52	10	22	12	26	165	174	09
0939*	Florispan	USA	49	39	80	8	16	2	04	49	35	71	10	20	4	08	125	137	12
2375	248759	INDIA	40	25	63	8	20	7	18	47	25	53	11	23	11	23	155	170	15
3150	TP-931	USA	46	23	50	13	28	10	22	46	18	39	15	33	13	28	172	189	17
2378*	268689	RHOD	43	33	77	6	14	4	09	47	33	70	4	09	10	21	132	151	19
0548*	248759	INDIA	46	25	54	12	26	9	20	48	22	46	11	23	15	31	165	185	20
2374	355915	ISRL	41	12	29	10	24	19	46	43	2	05	21	49	20	47	217	242	25
0385	288684	RHOD	45	24	53	15	33	6	13	47	16	34	18	38	13	28	160	194	34
1615	Small Leaflet	USA	49	38	78	9	18	2	04	45	24	53	13	29	8	18	126	164	38
0971	268661	USSR	26	5	19	9	35	12	46	30	3	10	4	13	23	77	227	267	40
0937*	Florigiant	USA	43	18	42	16	37	9	21	44	5	11	24	55	15	34	179	223	44

* = Selections were made within this accession.
≠ = Seed Catalog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp. A1-A79, 1974, was used where possible.

TABLE XXI

SUMMARY OF DATA FROM TRIAL RUN 15

Okla. P-No.	Strain or P.I. No.	Origin≠	Control Chamber (C) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Chill Treatment Chamber (T) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Index C	Index T	Index Difference
0695*	268777	RHOD	31	11	36	5	16	15	48	26	13	50	10	38	3	12	213	161	-52
0735*	268817	RHOD	32	5	16	13	41	14	44	28	13	46	8	29	7	25	228	178	-50
0698	268782	RHOD	28	9	32	10	36	9	32	21	9	43	5	24	7	33	200	190	-10
0686*	268770	RHOD	26	14	54	4	15	8	31	19	9	47	6	32	4	21	177	174	-03
0712	268795	RHOD	30	5	17	16	53	9	30	23	7	30	6	26	10	44	213	213	00
0672*	268748	RHOD	30	13	43	8	27	9	30	20	8	40	6	30	6	30	187	190	03
0691	268773	RHOD	22	11	50	4	18	7	32	13	5	39	4	31	4	31	182	192	10
0663	268741	RHOD	28	11	39	9	32	8	29	19	6	32	6	32	7	37	189	205	16
0690	268773	RHOD	28	15	54	7	25	6	21	19	8	42	5	26	6	32	168	190	22
2613	Tamnut 74	USA	43	26	61	12	28	5	12	36	19	53	7	19	10	28	151	175	24
0748*	268831	RHOD	27	6	22	15	56	6	22	13	1	08	6	46	6	46	200	239	39
0706	268791	RHOD	30	13	43	8	27	9	30	24	5	21	6	25	13	54	186	233	47
0714	268796	RHOD	30	16	53	6	20	7	23	20	6	30	6	30	8	40	163	210	47
0656	268734	RHOD	27	16	59	5	18	6	22	30	8	27	11	37	11	37	163	210	47
0746*	268828	RHOD	24	6	25	13	54	5	21	9	1	11	3	33	5	56	195	244	49
0723	268804	RHOD	37	15	41	11	30	11	30	27	5	19	6	22	16	59	189	241	52

* = Selections were made within this accession.
≠ = Seed Catalog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp. A1-A79, 1974, was used where possible.

TABLE XXII

SUMMARY OF DATA FROM TRIAL RUN 16

Okla. P-No.	Strain or P.I. No.	Origin≠	Control Chamber (C) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Chill Treatment Chamber (T) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Index C	Index T	Index Difference
0775	259591	URUG	26	6	23	10	39	10	39	7	3	43	3	43	1	14	215	171	-44
0788*	259821	NYASA	21	5	24	4	19	12	57	8	2	25	2	25	4	50	233	225	-08
2613	Tamnut 74	USA	42	22	52	9	21	11	26	38	12	32	19	50	7	18	174	187	13
0784	259771	NYASA	30	15	50	5	17	10	33	16	4	25	8	50	4	25	183	200	17
2377*	268684	RHOD	39	23	59	11	28	5	13	41	23	56	7	17	11	27	154	171	17
2386	Improved Spanish	——	40	16	40	18	45	6	15	33	12	36	11	33	10	30	175	194	19
2382	336987	——	43	23	53	13	30	7	16	42	18	43	13	31	11	26	163	183	20
0780*	259753	ARGN	33	19	58	7	21	7	21	27	11	41	9	33	7	26	163	185	22
2383	337292	BRAZ	49	31	63	13	27	5	10	37	17	46	11	30	9	24	147	178	31
2384	337400	ARGN	47	24	51	11	23	12	26	43	9	21	21	49	13	30	174	209	35
0779	259745	URUG	27	11	41	8	30	8	30	27	5	19	10	37	12	44	189	226	37
2376*	262048	BRAZ	48	33	69	5	10	10	21	44	18	41	10	23	16	36	152	195	43
0761	——	——	17	9	53	4	24	4	24	7	1	14	4	57	2	29	170	214	44
2379	268689	RHOD	43	29	67	11	26	3	07	42	14	33	19	45	9	21	139	188	49
2380	268771B	RHOD	40	29	73	7	18	4	10	45	13	29	20	44	12	27	138	198	60
0765	270830	RHOD	20	7	35	8	40	5	25	10	0	00	4	40	6	60	190	260	70

* = Selections were made within this accession.
≠ = Seed Catalog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp. A1-A79, 1974, was used where possible.

TABLE XXIII

SUMMARY OF DATA FROM TRIAL RUN 17

Okla. P-No.	Strain or P.I. No.	Origin≠	Control Chamber (C) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Chill Treatment Chamber (T) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Index C	Index T	Index Difference
0836	268612	RHOD	8	0	00	4	50	4	50	0	0	00	0	00	0	00	--	--	--
0822	248762B	INDIA	10	1	10	2	20	7	70	1	0	00	1	100	0	00	--	--	--
2613	Tamnut 74	USA	48	27	56	14	29	7	15	48	23	48	22	46	3	06	158	158	00
0802	261925	ARGN	21	4	19	9	43	8	38	7	0	00	5	71	2	29	219	229	10
0801	261923	ARGN	9	3	33	3	33	3	33	6	0	00	5	83	1	17	--	--	--
0835	268604	RHOD	13	2	15	5	39	6	46	2	0	00	1	50	1	50	--	--	--
0825	240543	ARGN	29	12	41	12	41	5	17	14	4	29	6	43	4	29	176	200	24
0805	261949	PARA	28	13	46	11	39	4	14	16	5	31	7	44	4	25	168	194	26
0791	259860	NYASA	27	10	37	12	44	5	19	25	4	16	15	60	6	24	181	208	27
0824	247375	S AFR	31	8	26	12	39	11	36	5	0	00	3	60	2	40	210	240	30
0830	268593	RHOD	19	6	32	9	47	4	21	15	2	13	7	47	6	40	190	227	37
0826*	240570	ARGN	28	13	46	10	36	5	18	10	1	10	7	70	2	20	171	210	39
0800*	261921	ARGN	14	5	36	6	43	3	21	12	1	08	6	50	5	42	--	--	--
0814*	262004	PARA	34	20	59	9	27	5	15	24	6	25	9	38	9	38	156	213	57
0795*	262049	BRAZ	19	10	53	6	32	3	16	13	2	15	5	39	6	46	163	231	68
0799	261919	ARGN	8	3	38	4	50	1	13	4	0	00	2	50	2	50	--	--	--

* = Selections were made within this accession.
≠ = Seed Catalog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp. A1-A79, 1974, was used where possible.
-- = Index values not calculated for accessions with < 30% emergence.

TABLE XXIV

SUMMARY OF DATA FROM TRIAL RUN 18

Okla. P-No.	Strain or P.I. No.	Origin≠	Control Chamber (C) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Chill Treatment Chamber (T) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Index C	Index T	Index Difference
0854*	268654	RHOD	33	19	58	6	18	8	24	19	8	42	11	58	0	00	167	158	-09
0838	268617	RHOD	24	5	21	9	38	10	42	25	3	12	13	52	9	36	221	224	03
0843	268632	RHOD	24	13	54	3	13	8	33	22	4	18	17	77	1	05	179	186	07
0850	268650	RHOD	19	9	47	3	16	7	37	8	2	25	4	50	2	25	189	200	11
0837	268616	RHOD	24	9	38	6	25	9	38	16	2	13	10	63	4	25	200	212	12
0845	268639	RHOD	30	13	43	9	30	8	27	25	6	24	14	56	5	20	183	196	13
0844	268633	RHOD	25	9	36	7	28	9	36	15	2	13	8	53	5	33	200	220	20
0842*	268630	RHOD	32	12	38	12	38	8	25	23	5	22	11	48	7	30	188	209	21
2613	Tamnut 74	USA	48	37	77	10	21	1	02	49	31	63	13	27	5	10	125	147	22
0841	268622	RHOD	16	6	38	6	38	4	25	14	1	07	10	71	3	21	187	214	27
0856*	268658	RHOD	21	7	33	7	33	7	33	20	3	15	8	40	9	45	200	230	30
0857	268659	RHOD	4	1	25	2	50	1	25	8	0	00	5	63	3	38	--	--	--
0847	268643	RHOD	21	8	38	6	29	7	33	10	1	10	4	40	5	50	195	240	45
0846	268640	RHOD	24	14	58	3	13	7	29	14	2	14	7	50	5	36	170	221	51
0852	268652	RHOD	15	7	47	5	33	3	20	9	1	11	4	44	4	44	173	233	60
0858	268660	RHOD	15	8	53	6	40	1	07	18	3	17	6	33	9	50	153	233	80

* = Selections were made within this accession.
≠ = Seed Catalog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp. A1-A79, 1974, was used where possible.
-- = Index values not calcuated for accessions with < 30% emergence

TABLE XXV

SUMMARY OF DATA FROM TRIAL RUN 19

Okla. P-No.	Strain or P.I. No.	Origin≠	Control Chamber (C)							Chill Treatment Chamber (T)							Index		
			Total Emer.	Normal		Intermed.		Abnormal		Total Emer.	Normal		Intermed.		Abnormal		C	T	Difference
				No.	%	No.	%	No.	%		No.	%	No.	%	No.	%			
0864*	268688	RHOD	20	3	15	6	30	11	55	22	3	14	15	68	4	18	240	204	-36
0881	268829	RHOD	17	3	18	7	41	7	41	10	2	20	5	50	3	30	224	210	-14
0877*	268781	RHOD	16	3	19	6	38	7	44	7	1	14	4	57	2	29	225	214	-11
0869	268694	RHOD	16	3	19	3	19	10	63	6	0	00	4	67	2	33	243	233	-10
2613	Tamnut 74	USA	49	21	43	25	51	3	06	47	23	49	21	45	3	06	163	157	-06
0889*	270842	RHOD	27	11	41	10	37	6	22	26	7	27	16	62	3	12	182	185	03
0874	268759	RHOD	8	3	38	1	13	4	50	6	1	17	3	50	2	33	--	--	--
0895	259756	VENEZ	30	9	30	7	23	14	47	22	0	00	17	77	5	23	217	223	06
0868*	268693	RHOD	20	7	35	6	30	7	35	26	3	12	15	58	8	31	200	219	19
0865	268689	RHOD	29	8	28	10	34	11	38	27	4	15	10	37	13	48	210	233	23
0892	259719	PERU	22	7	32	5	23	10	46	13	0	00	7	54	6	46	214	246	32
0878	268788	RHOD	17	4	24	7	41	6	35	10	0	00	5	50	5	50	212	250	38
0871	268752	RHOD	7	3	43	2	29	2	29	3	0	00	2	67	1	33	--	--	--
0866	268691	RHOD	21	4	19	9	43	8	38	21	2	10	3	14	16	76	219	267	48
0883	270786A	RHOD	23	12	52	8	35	3	13	12	2	17	5	42	5	42	161	225	64
0884	270791	RHOD	14	9	64	4	29	1	07	13	0	00	8	62	5	39	--	--	--

* = Selections were made within this accession.
≠ = Seed Catlog, Southern Regional Plant Introduction Station, Experiment, Georgia Regional Project S-9, pp. A1-A79, 1974, was used where possible.
-- = Index values not calculated for accessions with < 30% emergence.

TABLE XXVI

SUMMARY OF DATA FROM SPECIAL RUN

Okla. P-No.	Strain or P.I. No.	Popn.#	Control Chamber (C) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Chill Treatment Chamber (T) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Index C	Index T	Index Difference
1443	Comet	O	38	21	55	15	39	2	05	29	6	21	12	41	11	38	148	217	69
1443*	Comet	S	46	20	43	20	43	6	13	47	11	23	25	53	11	23	168	198	30
0112	Spanhoma	O	47	22	47	20	43	5	11	40	12	30	12	30	16	40	166	210	44
0112*	Spanhoma	S	50	30	60	15	30	5	10	46	23	50	15	33	8	17	150	167	17
2613	Tamnut 74	O	44	29	66	14	32	1	02	50	14	28	20	40	16	32	136	204	68
2613*	Tamnut 74	S	47	27	57	18	38	2	04	46	6	13	24	52	16	35	145	222	77
2339	Florunner	O	39	19	49	16	41	4	10	41	2	05	23	56	16	39	161	234	73
2339*	Florunner	S	46	29	63	12	26	5	11	48	10	21	30	63	8	17	148	198	50
0001	Argentine	U	16	0	00	8	50	8	50	8	0	00	0	00	8	100	250	300	50
0004*	Spantex	S	45	21	47	18	40	6	13	49	11	22	19	39	19	39	166	217	51
0010	Tex 314-1	U	13	0	00	10	77	3	23	2	0	00	0	00	2	100	--	--	--
0011*	Strat Sp.	S	45	24	53	20	44	1	02	49	26	53	14	29	9	18	147	165	18
0012	Pearl Peanut	U	27	3	11	13	48	11	41	4	1	25	1	25	2	50	230	225	-05
0021*	T-400-1	S	46	20	44	22	48	4	09	47	18	38	22	47	7	15	167	177	10
0022	T-437	U	6	1	17	3	50	2	33	0	0	00	0	00	0	00	--	--	--
0023*	226249	S	45	23	51	17	38	5	11	46	25	54	14	30	7	15	160	159	-01
0035*	242100	S	45	29	64	13	29	3	07	48	32	67	10	21	6	12	143	145	02
0045	237508	U	14	2	14	3	21	9	64	13	0	00	4	31	9	69	--	--	--

TABLE XXVI (CONTINUED)

Okla. P-No.	Strain or P.I. No.	Popn.#	Control Chamber (C) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Chill Treatment Chamber (T) Total Emer.	Normal No.	Normal %	Intermed. No.	Intermed. %	Abnormal No.	Abnormal %	Index C	Index T	Index Difference
0046*	237510	S	23†	19	83	4	17	0	00	24†	5	21	14	58	5	21	117	200	83
0062	OAEP 58-4	S	41†	33	80	8	20	0	00	39†	22	56	13	33	4	10	120	152	32
0074*	OAEP 58-16	S	36†	25	69	10	28	1	03	38†	19	50	14	37	5	13	134	163	29
0080	OAEP 58-22	S	34†	22	65	12	35	0	00	36†	25	69	8	22	3	8	135	137	02
0085	Tex 20	U	21	4	19	8	38	9	43	7	0	00	2	29	5	71	224	271	47
0090	Tex 20	U	34	3	09	15	44	16	47	10	0	00	0	00	10	100	238	300	62
0092	Tex 20	U	25	0	00	9	36	16	64	15	3	20	0	00	12	80	264	260	-04
0094	Spantex	U	18	0	00	7	39	11	61	7	0	00	0	00	7	100	261	300	39
0385	288684	U	42	18	43	19	45	5	12	40	11	28	18	45	11	28	169	202	33
0937	Florigiant	O	34	15	44	12	35	7	21	34	4	12	19	56	11	32	176	220	44
0971	268661	U	32	5	16	9	28	18	56	13	2	15	0	00	11	85	240	270	30
1439	Spantex	O	43	13	30	28	65	2	5	43	12	28	16	37	15	35	175	207	32
2381	268771B	U	44	8	18	27	61	9	21	48	17	35	20	42	11	23	203	188	-15
2385	337419	U	40	23	58	12	30	5	12	49	27	55	7	14	15	31	155	176	21

* = Selections were made within this accession.
# = Populations: S = Selected; O = Original; U = Unselected Original
† = Only 24, 42, 38, and 36 seeds/chamber were available for P-0046, P-0062, P-0074, and P-0080, respectively.
-- = Index values not calculated for accessions with < 30% emergence.

VITA

William Dean Branch

Candidate for the Degree of

Doctor of Philosophy

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Experience: Reared and worked on a farm near Sunray, Oklahoma, until after high school graduation, then during the summer months until 1973; half-time research assistant, Department of Agronomy, Oklahoma State University, 1972-1976.

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