EFFECT OF SEED QUALITY ON YIELD OF PIMA COTTON

by

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ABSTRACT

Several methods of determining quality of cotton planting seed have been investigated and more precise methods of predicting field emergence of cotton seedling are needed than are presently available. The purpose of the present study was to evaluate possible correlations among seed vigor, speed of emergence, total emergence, and yield in *Gossypium barbadense* L. (Cultivar Pima 'S-5').

Field studies were conducted using 13 commercial lots of 'Pima S-5' grown in various parts of the state and harvested in 1974, 1975, and 1976. Significant differences were found among seed lots in both lab and field tests except for plant heights and yield in Marana. High correlations of field emergence were found with standard germination test and cold germination test, indicating reliability of these tests to predict seed quality under the conditions described. High correlation coefficients were also found between these tests and time to 50% emergence (ET50) and yield.

A negative correlation of .66 between emergence and ET50 for the pooled data was found suggesting that rapidity of emergence is related to total emergence. Correlation coefficient among plant height and other elements of germination and emergence were very poor and inconsistent indicating that in this test plant height may not be useful as an indicator of seed quality.

INTRODUCTION

Stand establishment is a prime consideration in successful crop production. If poor stands are not replanted an insufficient number of plants may result in reduced yield, whereas replanting shortens the growing season. In either case, poor stands result in potential losses for growers. To insure an adequate stand of healthy seedlings, care in selecting good quality seed must be taken. Seed of poor quality and vigor perform poorly even under favorable planting and growing conditions, while seed of high quality generally perform well even under relatively adverse environmental conditions.

Planting is one of the most critical operations in cotton production. Several vigor testing methods have been utilized as seedsmen and consumers become more aware of the importance of high quality seed. Accurate and reliable vigor tests are required to elucidate vigor level as an aid in selecting planting rates and dates. They are also helpful in making decisions concerning distribution and marketing of cottonseed.

In the case of cotton, seeds of the same genotype are known to differ widely in seedling vigor (15). The differences are largely due to differences in environment during seed formation and subsequent storage. Presently however, there is no satisfactory way of estimating the quality of planting seed. The objective of this study is to evaluate standard and cool temperature tests as predictors of planting seed quality and determine the relationship between predictors of planting seed quality, seed vigor, field energence, and yield of Gossypium barbadense L. (Cultivar Pima 'S-5').

REVIEW OF LITERATURE

According to the International Association of Official Seed Analysts (5,p.5) "vigor is the sum total of those properties of the seed which determine the potential level of performance and activity of a non-dormant seed or seed lot during germination and seedling emergence." The Association of Official Seed Analysts (AOSA) defines seed vigor as "the sum total of all of those properties in seed which under planting results in a rapid and uniform production of healthy seedlings under a wide range of environment including both favorable and stress conditions (5,p.6)."

Factors Affecting Seed Vigor

Many factors influence variation in the level of seed vigor but the principle causes are genetic constitution, environment of the mother plant, stage of maturity at harvest, seed size, deterioration and aging, and finally pathogens.

Genetic Constitution

It is difficult to determine the effect of genetic factors involved in germination since the environment during seed development and storage critically affects germination. Willey (65) studied field emergence of four monogerm sugar beet (*Beta vulgaris* L.) seed lots at three locations over 4 years and reported that varietal variation was significant but was less important than the effects of years or sites of production. He concluded that differences attributed to genetic variation were more easily observed when environmental conditions were favorable. Perdok (41) found that diploid sugar beet seed stored under adverse storage conditions survived better than triploids and tetraploids. Whitington (66) reported that several single gene differences, particularly those involved in carbohydrate or amino acid composition of the endosperm may influence viability of seed in storage and time required for radicle emergence or seedling establishment.

Buxton and Sprenger (15) studied the germination of 18 lines of *Gossypium barbadense* seed and 12 *Gossypium hirsutum* lines at 15 and 25 C and reported significantly different germination percentage values indicating that a wide range of variability exists. The data showed that the temperature X genotype interaction was significant. A low temperature of 15 C reduced germination percentage of all genotypes significantly, however, germination percentage was significantly better at 25 C compared to 15 C. The workers suggested that the temperature X genotype interaction was due to an absence of a close association between germination response to low and favorable temperatures. A poor positive correlation was found between percentage germination or rate of development of genotypes and temperature.

Influence of Environment on Seed Vigor

Peacock and Hawkins (40) studied the effect of seed storage on seedling vigor, yield, and lint characteristics of two wilt resistant upland cotton cultivars. They reported that in the rainbelt, environmental factors at the location where the parent seed was grown accounted for 35% of the variability in progeny yield and 32% of the variability in seedling vigor. Significant differences in vigor were observed among the progeny from seed sources as early as 14 days after emergence. Yields were also found to be highly significant. A negative correlation of -0.54 was reported between the September minimum temperature of seed production source and progeny yield. August rainfall at the seed production site was positively correlated to progeny yield. August rainfall and September minimum temperature each accounted for 27% of the seed vigor variability among seed sources. The combined 2 year data of Peacock and Hawkins shows that progeny grown under higher August rainfall yielded more lint per hectare and with a greater lint percent than progenies from five other seed sources used in their test. Buxton and Sprenger (15) found that the rate of germination of 30 cotton lines was associated with the geographical area where they were produced. They concluded that lines developed for elevations of 304 meters (low elevations) had better germination properties at both 15 and 25 C than lines developed for elevations above 912 meters (high elevations). They further indicated that lines adapted to Mississippi were adapted to low elevations and those lines from the high plains of Texas were adapted to areas where temperatures are lower. Gipson and Joham (28) reported that percent germination was reduced when seed were produced under low night temperature. Gipson (27) reported that low night temperature produced seeds with a low protein and oil content and a high amount of free fatty acids. Quisenberry and Gipson (46) reported that low night temperature during seed maturation reduced viability and in field plantings seedlings emerged slower, grew slower and had lower yields than seed produced under high night temperature.

Stage of Maturity at Harvest

Albert (4) reported that seed from bolls set in midseason had higher percent germination than seed set from bolls late in the season. Buxton (14) showed that cottonseed harvested and ginned late were of considerably lower quality than seed harvested and ginned by mid-October. A delay of one month in harvesting and ginning reduced field emergence an average of 16% when planted the following spring. Also seedlings from cottonseed harvested early in the season grew faster than from seed harvested later in the season. According to Bilbro and Ray (9) when early and late maturing lines of *G. hirsutum* are planted late in the season, yield, lint percentages, fiber strength, and micronaire units decreased. Fiber elongation was not significantly affected by planting date. They also observed that early maturing cultivars had better performance than late maturing cultivars when planted late in the season.

Seed Physical Characteristics

Several physical characteristics of seed have been used as measures of seed vigor and have been correlated to field performance. Turner and Ferguson (54) used x-ray photography and classified cottonseed into categories based on the extent the meats filled the space within the seed coat. They reported that fully filled seed was superior to partially filled seed or unsorted in emergence and vigor as measured by dry weight accumulation during 8 weeks of seedling growth. Plants from fully filled seeds had a higher blooming rate and, although not significant, a larger yield than from partially filled or unsorted seed lots. Wheeler, Cole, and Sackett (63) separated cottonseed based on color, density, and cut and cracked seed coats. They reported that mature black seeds that sank in water produced seedlings with a higher average weight, germination percentage, vigor, and emergence than brown floaters and cracked seed. Brown floater seed made up 4% of the seed samples and therefore their contribution to the effects on germination and emergence were minimal. However, black seeds with cracks made up 22% of the total were largely responsible for the poor germination and emergence of seed lots. Suh, Casady, and Vanderlip (52) compared sorghum (*Sorghum bicolor* (L.) Moench) seed of two different weights to determine the influence of seed weight on the resulting crop. Emergence percentage, days to 50% bloom, leaf blade width, length and area, plant height, number of nodes, kernel weight, and grain yield were studied. No significant differences were found among paremeter studied. In contrast, Bartel and Martin (6) concluded that seedling growth of sorghum during the first 12 days after emergence was logarithmically proportional to seed weight. Krieg and Bartee (36) studied the effect of seed density with some physical and biological processes associated with cottonseed germination and seedling establishment. They reported that germination percentages were positively correlated to both seed density and seed weight, however, density showed greater association with germination than seed weight. The rate of imbibition and radicle elongation were related to seed density within a cultivar. Radicle elongation rate was slowest for the highest density seed. Nevertheless, radicles of seedlings from this group were nearly 10% longer at the end of test period than the lowest density group. The data indicated that at germination chamber temperatures that ranged 20 to 30 C, seedlings from the most dense seed emerged more rapidly than at 15 to 25 C. Total emergence decreased and cotton seedlings took a longer time to emerge at 15 than 25 C, however, total emergence was positively related to seed density at both temperature regimes. Rate of emergence in the field was related to standard germination test results. The 4-day germination count was highly correlated to number of plants that survived in field plantings.

Although the effect of seed size on vigor has been examined by many investigators, the results are not unanimous. Johnson and Luedders (33) evaluated the effect of seed on emergence and yield of four soybean (*Glycine max* (L.) Merr.) cultivars and reported that seed size had no effect on emergence and/or yield. Fehr and Probst (26) compared yield of 10 soybean cultivars and obtained a highly significant correlation of 0.66 between seed size and yield. Hartwig and Edwards (31) selected seed for size and found that yields of isogenic soybean lines did not differ from recurrent parents even though their seed weight varied from less than 100 mg/seed to heavier than 250 mg/seed. Burris, Edje, and Wahab (13) obtained lower yields of soybean from small seed. Abdullahi (2) reported no significant differences among sorghum grain (Sorghum vulgare L.) yields when produced from large, medium, and small seeds, respectively. Vanderlip (56) compared many sorghum hybrids and found a poor relationship between seed size and field performance. Within a seedlot, both extremely large and small seed were below average in performance in the field.

Deterioration and Aging

Barton (8) reported that low moisture content, cool temperature and low oxygen increased the longevity of seed in storage. Simpson (50) stated that cottonseed containing less than 13% moisture did not deteriorate in 15 years when stored at 0 C in sealed containers with ambient air, O_2, CO_2, and N_2 had the same germination potential for 10 years, however, seeds lost partial viability after 3½ years at 32 C. Bockholt, Rogers, and Richmond (11) reported that storage at 10 C compared to higher temperature had considerable influence on maintaining viability. After 26 years sorghum, cotton, and corn (Zea mays L.) germinated 91, 41, and 0%, respectively. Sorghum seed held in commercial type refrigerated storage exceeded 85% germination during a 26 year period, cotton 22 years and corn 3 or 4 years. Bockholt et al. (11) found that seed of cotton, corn, and sorghum stored in sealed containers at room temperature increased viability for about 2 years. However, storage at low temperature and relative humidity was the most effective method of preserving seed quality. Simpson (50) stated that sorghum seed sealed in ambient air in partial vacuum, germinated significantly higher than those held in carbon dioxide, nitrogen, helium, and argon. Villiers (59) observed that storing seed in low relative humidity and temperature was important for seed which had not fully imbibed water. He reasoned that seed colloids reach equilibrium with moisture content and as the water absorption rate increased, the metabolic processes increased. Temperature will also induce the same effect. High relative humidity and temperature can reduce the expected life of stored seed. This process has been used by Byrd (18) for artificial aging seed prior to evaluation with various seed vigor tests.

Pathogens

The effect of different pathogens on loss of seed vigor and quality following planting are greatest when seed are deteriorated or exposed to cool temperatures. Young cotton seedlings are soft, semi-transparent tissue and contain small quantities of starch and considerable amount of protein and oil which may favor growth of fungi and other organisms. Presley (45) reported that deteriorated cottonseed were susceptible to common fungi while non-deteriorated seed were not. Guinn and Hunter (30) stated that cotton seedling diseases were more severe during cool weather resulting in the following possibilities: (a) low temperature slowed down growth of cotton seedlings more than growth of the disease organisms, (b) seedlings remained in the susceptible stage of development longer, (c) biochemical changes in cotton seedlings provided favorable substrate for disease organisms, and (d) under cool weather sugar content of cotton increased, making an ideal media for diseases such as _Rhizoctonia solani_.

Henfer, Bird, and Thames (32) showed that destructive effects of bacteria on seedlings grown at 20 C were not visible at 24.4 C. Dransfield (25) studied the effect of fungicide treatment on cottonseed and stated that at lower temperature untreated seed had a high pre-emergence mortality resulting from damping off. He suggested that damping off of cotton occurred at low temperature and could be greatly reduced by the use of seed treatment. Russell, Easley, and Cannon (48) studied the efficacy of several fungicide treatments on seedling diseases of _G. barbadense_ and _G. hirsutum_. They indicated that application of seed treatment to seed planted in _R. solani_ infested soil resulted in an increase in yield of 352 and 394 kilograms of seedcotton over the untreated check. They suggested that differences in yield of seedcotton were due to skips in the stands produced by damping off of seedlings. In another study, Russell and Easley (47) reported similar results for the effect of 28 different cottonseed treatments in the presence of the fungus _R. solani_.

Most of the cottonseed used today are covered with seed protectant fungicide prior to planting and may have a layer of systemic fungicide and/or a systemic insecticide. Alkyl mercury compounds were used as the principal fungicide on cotton as early as 1950. They are no longer available for treating seed. Several new seed protectant and synthetic fungicides have been developed and evaluated as a result of cooperation of industry and plant pathologists.

Minton and Fest (39) studied the effect of 10 different fungicides on germinating cottonseed and stated that all fungicide treated seed had significantly higher overall average percent surviving seedlings than the untreated check. Also certain combined application of fungicides had a synergist effect.

Vigor Tests

Several direct and indirect approaches have been used to evaluate seed vigor. These are: biochemical processes and reactions which occur during germination such as enzyme reactions and respiratory activity, rate of uniformity of seed germination and seedling growth, rate of uniformity of seedling emergence and development in the field and emergence ability of seedlings under favorable environmental conditions.

Physiological and Biochemical Approach

Abdul-Baki (1) reviewed biochemical and physiological studies on vigor and reported that loss of germinability and vigor in seed is followed or occurred along with a series of biochemical and physiological events. These are classified into four categories: (a) decline of metabolic activity expressed by lowered germination or decrease of seedling growth; (b) reduced respiration; (c) increase in total activity of certain enzymes such as phytase, protases, and phosphatases, peroxidase, dehydrogenase, cytochrome oxidize, and glumatic acid decarboxylase; and (d) increase in membrane permeability which induces greater leaching of sugars, amino acids, and organic solutes from the seed.

Abdul-Baki (1) compared changes in seed germinability or vigor by aging naturally or artificially by exposing seed to high temperature and relative humidity. He found that glucose metabolism of germinating barley (<u>Hordeum vulgare</u> L.) and wheat (<u>Triticum aestivum</u> L.) was greatly reduced by small changes in seed germinability of vigor. Results of this study further indicates that decline in glucose utilization was not due to lack of glucose absorption as some low vigor seed absorbed much greater amounts than high vigor seed. The main difference was the increased rate of glucose utilization by seed of higher quality as compared to low vigor seed. Standard germination, seedling shoot growth and seed respiration showed that a great reduction in glucose utilization occurred before any changes in percent germination, shoot length growth, or oxygen uptake become visible.

McDaniel (37) working on seedling vigor of germinating barley cultivars found positive association among seedling fresh weight, seedling mitochondrial protein and mitochondrial chemical activity. He reasoned that heavier seedlings had more mitochondrial protein and showed higher respiratory rate and greater amount of energy production (ATP) and hence, had more rapid growth and development. McDaniel and Sarkissian (38) reported that mitochondrial respiration was associated with seedling vigor in corn. Woodstock and Feeley (68) and Kittock and Law (35) have demonstrated that tissue respiration is correlated with seedling vigor. Wanjura, Hudspeth, and Bilbro (62) stated that staining the seed embryo with tetrazolium or measuring the respirating rate of germinating seed is useful in determining seed quality.

Woodstock (67) found a significant positive correlation between respiration rate during the first hours of imbibition and growth rate of barley and corn seedlings. Woodstock and Grabe (69), working with corn seed lots under different relative humidity and temperature storage for 4 years reported that respiration rates and glumatic acid decarboxylase were significantly correlated with germination and seedling growth. Clay, Buxton, and Katterman (23) found a highly positive correlation of 0.94 between DNA specific activity and percentage of field emergence of cottonseed. Bartkowski et al. (7) found a positive relationship between unsaturated/saturated fatty acid ratio and percent field emergence of cottonseed.

Direct Approach

Direct tests are those in which an environmental stress expected in the field is produced in the laboratory.

Standard germination has been used universally to estimate seed quality. Unfortunately, the optimum conditions in this test have made it unreliable for detecting cottonseed of low vigor. Comer (24) stated identification of vigorous cottonseed lots is inconsistent with the standard germination test due to optimal conditions provided for in the standard germination test. Buxton et al. (17) studied 12 lines of *G. hirsutum* and 14 lines of *G. barbadense* of similar standard germination values. They noticed little difference in emergence in the field among lines when soil temperatures were favorable and greater differences when soil temperatures were unfavorable. Perry (43) has shown that differences in vigor are due to interaction between seed and environment. When conditions are favorable, field emergence relates well to germination in the laboratory. However, a stress imposed on germinating seed decreases the correlation. Low vigor seed are more sensitive to stress factors than high vigor seed. Wiles (64) recommended application of both the low temperature germination test (20 C) and standard germination test in evaluation of cottonseed for planting until more accurate methods of measuring seed quality are developed. Christiansen (20) studied two genetic lines of cotton and suggested that percentage of cotyledon dry weight to total seedling dry weight can be used as a quantitative indicator of heritable seed vigor. Cladwell (21) reported a positive correlation between field emergence and the standard germination test for 17 pea (Pisum sativum L.) seedlots. Abdullahi and Vanderlip (3) compared several vigor tests such as accelerated aging, cold test, soaking seed in ammonium chloride as well as standard germination with field establishment of sorghum. They reported significant correlation of all tests with field performance, but the ammonium chloride treatment gave a better correlation. Grain yields were not significantly correlated with any vigor test. In another study, Vanderlip, Mockel, and Jan (57) confirmed the use of ammonium chloride treatment in predicting field stands of sorghum. Germination following ammonium chloride application correlated more consistently with field establishment than standard germination test results. Comparison of vigor tests showed that seed size and tetrazolium test results were poor indicators of field performance in sorghum. Pinthus and Rosenblum (44) concluded that cold germination test results did not effectively determine vigor of sorghum.

Time required to emerge is a good indication of cotton plant vigor and potential yield ability (61).

Temperature variation is usually the most important factor in determining the emergence period even though depth of planting is also important. Wanjura et al. (62) reported that 94% of variation in emergence rate up to the time of 45% of ultimate emergence was due to soil temperature. According to Johnson, Cowely, and Hoverson (34) cotton required a constant temperature of 18.3 C for 12 days to reach 50% final emergence. At 15.6 C, 17 days were required and a temperature of 12.8 C resulted in zero emergence. Broyles (12) tested cotton in the greenhouse and found that the last plants to emerge were slow to develop and never reached the height or fruitfulness of early emerging plants. Wanjura et al. (61) showed that cotton plants emerging earlier had higher survival rates. They also found that survival rate was positively associated with percentage of early emergence. A high significant correlation of 0.94 was reported between emergence time and lint yield. Buxton et al. (16) found that total emergence decreases linearly with increases in time to 50% total emergence (ET50). They indicated that the average decrease ranged from nearly 2% per day to more than 4% when tests were conducted on a salt effected soil. A highly significant negative correlation of (-.6) was reported between ET50 and surviving stand.

Seed Quality and Yield

Application of vigor tests in the past have generally been related to storage potential. Little information is available relative to the relationship between vigor tests and plant performance and yield. Vechi (58) working with deteriorated cowpea (*Vigna sinensis* L.) seed concluded that plants produced from low vigor seed set a low percentage of fruit and consequently had lower yields. Byrd (18) reported that soybean plants produced from seed with higher vigor were consistently taller during the growing season and yielded more than plants produced from medium and low vigor seed. Smith and Camper (51) concluded that soybean plants produced from large seed yielded more and were taller during the entire growing season than plants from small seed. Bishoni (10) has shown that low vigor sorghum seed emerged poorly and produced plants that grew slower and yielded about 18% less when compared to high vigor seed. Camagro and Vaughan (19) reported that planting low vigor sorghum seed resulted in shorter plants with delayed panicle extension and anthesis, lowered tillering capacity, and reduced yield. Grabe (29) found that seed of corn, soybean, and oats (*Avena sativa* L.) with low vigor resulted in lower yields despite the high germinability of seed under favorable conditions.

MATERIALS AND METHODS

Three experiments were conducted using 13 commercial lots of Pima S-5 cottonseed furnished by the Arizona Cotton Planting Seed Distributors. Seed were grown in Salome, Marana, Casa Grande, and Aguila and harvested in 1974, 1975, and 1976. These areas were selected since they represent the primary areas Pima seed is grown in Arizona, (15). The processing and characteristics of seed lots are presented in Table 1. The seed lots were all acid delinted and received Captan^R (cis-N-(trichloro methyl) thio) 4 cyclohexene-1.2-4 di carboximide and PCNB^R (Pentachloro nitro benzene) chemical seed treatment.

Standard Germination Test

The standard germination test consisted of placing 100 seed of each lot on two standard germination towels moistened with 60 ml of tap water (55). The seed were arranged with the micropile oriented toward the base of the towels. The seed were covered with a third moist towel. Care was taken to blot water film surrounding the seed since excessive moisture restricts germination. The towels were rolled into rag dolls placed in the germinator under alternating temperature of 20±1 C for 16 hours and 30±1 C for 8 hours for a period of 12 days. The towels were examined daily and water was added, as needed, to maintain a moist condition. A complete

TABLE 1. Characteristics of Commercial Seed Lots Planted in 1977 in Phoenix and Marana.

Seedlot	Year Harvest	Area of State	Date Harvest	Date Ginning	Date Delinted
1	1976	Salome	10/18-10/20	11/20-11/22	1/18/77
2	1976	Salome	11/22-11/27	11/10-11/24	1/18/77
3	1976	Salome	11/4 -11/12	11/5 -11/17	1/13/77
4	1976	Marana	12/27-12/28	12/30-1/3	1/13/77
5	1974	Salome	11/15-11/17	11/16-11/18	2/25/75
6	1974	Salome	11/15-11/17	11/16-11/18	2/21/75
7	1975	Salome	10/29-11/31	11/3 -11/4	1/18/77
8	1975	Casa Grande	12/2 -12/6	12/18	1/21/76
9	1975	Salome	11/18-11/20	11/18-11/20	2/25/76
10	1975	Salome	11/18-11/20	11/18-11/20	2/21/76
11	1975	Marana	11/22-11/24	11/24	2/21/76
12	1975	Aguila	11/20-12/5	12/10	2/24/76
13	1975	Aguila	11/25-12/3	12/8 -12/10	2/16/76

randomized design with four replications was used. The number of normal and healthy seedlings were recorded on the 4th and 12th day. Discolored and abnormal seedlings were discarded on the 12th day (55). A germinated seed was defined as one producing a radicle at least 2 cm long.

Cool Temperature Germination Test

A cool temperature germination test was conducted in July, 1977. Fifty seed of each seed lot were placed on two moist standard germination paper towels with the micropile of each seed oriented toward the base of the towels. The seed were covered with two additional towels following the removal of water film surrounding the seed. The towels were rolled and randomly placed upright in 1000 ml pyrex beakers and placed in the germinator in the dark at a constant 18±.5 C for a period of 6 days. The germinator did not have humidity control, therefore, towels were checked daily and water added as necessary to maintain moisture. A complete randomized design with four replications was used. After the 6th day, the number of normal seedlings were counted (5). All normal seedlings producing a combined hypocotyl and radicle length of 0.5 cm or longer were considered germinated at the end of the test period.

Field Test

Field plantings were made at the University of Arizona Cotton Research Center Farm in Phoenix on March 29 and the University of Arizona Marana Experimental Farm on April 7, 1977. The soil in Phoenix is Avondale clayloam, a member of fine, loamy, mixed

Hyperthermic Torrifluventic Haplustolls. The Marana soil is Pima clayloam a member of the fine, silt, mixed Thermic Typic Torrifluvents (42).

The plantings followed a preplant irrigation and were arranged in a completely randomized block design with six replications. Individual plots consisted of four rows 9.4 m long and 1 m apart with 150 seed per row. The seed were hand dropped through a four row planter mounted on a tractor. Seed rows were capped with about 10 cm of soil to conserve moisture (16). Caps were removed after radicle extension and seedlings emerged 4 cm of soil.

Emergence counts were made from the two center rows two or three times weekly until emergence was complete. Total number of seedlings emerged are referred to as potential stand. Those plants that remained at the final stand count are referred to as surviving stand. Daily minimum and maximum soil temperatures at the seed depth were recorded (Table 2).

Time to 50% emergence was based on the potential stand after the final count. An interpolation technique was used to obtain 50% emergence data.

Plots were thinned to a uniform stand of 60 plants 15 cm apart in 9.4 m of row on May 16 and 19 at Marana and Phoenix, respectively. The plants were in the three leaf stage at time of thinning. Seed lots 1, 2, and 4 did not have an adequate stand and 60 plants were left intact (Table 3). Since standard germination test results were not available at planting time, no attempt was

TABLE 2. High and low temperature (C) recorded at Phoenix and Marana after planting.

Days After Planting	Phoenix March 29			Marana April 7		
	Max	Low	Ave	Max	Low	Ave
1	18.1	7.8	12.9	27.8	16.1	21.9
2	19.9	9.7	14.8	27.2	15.6	21.4
3	---	10.7	---	25.00	13.3	19.2
4	18.5	7.2	12.8	---	---	---
5	---	---	---	29.4	15.4	22.3
6	21.0	---	---	31.3	16.7	24.0
7	22.5	11.1	16.8	25.6	15.2	20.3
8	---	13.6	---	28.9	16.7	22.8
9	25.2	---	---	31.1	16.8	24.0
10	---	15.7	---	32.2	17.9	25.1
11	27.9	14.3	21.1	31.3	18.3	24.8
12	---	---	---	29.3	15.3	22.3
13	25.6	---	---	28.2	15.8	22.1
14	29.2	14.3	21.7	31.5	16.8	24.2
15	29.2	14.2	21.7	30.7	18.7	24.7
16	27.2	14.9	21.1	26.6	20.7	23.7
17	---	14.3	---	28.2	18.9	23.6
18	31.3	13.8	22.5	33.9	20.6	27.2
19	---	---	---	35.2	22.1	28.6
20	31.8	---	---	32.6	20.6	26.6
21	32.2	16.1	24.2	33.9	20.2	27.0
22	30.7	14.3	22.5	35.0	20.6	27.8
23	32.4	12.8	22.6	33.5	22.1	27.8
Ave	26.4	12.8	19.6	30.4	17.9	24.2
Ave to 50% Emergence	24.0	12.1	18.0	29.0	16.2	22.6

TABLE 3. Potential stand and surviving stand percentage for 13 commercial lots planted in Phoenix and Marana.

	Phoenix		Marana	
Seed Lot	Potential Stand	Surviving Stand	Potential Stand	Surviving Stand
1	53.2 g*	52.0 f	60.5 e	60.2 d
2	60.6 f	59.7 e	65.4 d	64.6 d
3	67.3 e	66.3 d	71.8 c	70.7 c
4	54.1 g	52.7 f	59.3 e	59.0 d
5	81.1 bc	80.3 b	84.7 ab	84.2 ab
6	78.0 bcd	76.7 bc	82.6 ab	82.1 ab
7	81.8 b	81.0 b	85.4 ab	85.2 ab
8	78.8 bcd	78.0 bc	78.9 b	78.6 b
9	76.9 bcd	75.9 bc	80.1 b	79.7 ab
10	80.7 bc	80.1 b	83.7 ab	83.1 ab
11	86.3 a	85.8a	87.6 a	86.5 a
12	76.3 cd	75.7 bc	78.7 b	78.2 b
13	74.0 d	73.2 c	78.6 b	77.8 b
Ave.	73.0	72.1	76.7	76.2
Std.	10.8	11.0	9.5	9.5
CV.	4.2	4.32	5.3	5.7

*Values followed by the same letter within a column are not significant at 0.05 level according to Student-Newman-Keul's Test.

made to plant an excess number of seeds to compensate for differences in emergence between seedlots.

Plant heights were taken from 10 randomly selected plants located in the two center rows within each plot on June 7 and August 5 at Phoenix and June 15 and July 30 in Marana.

Seed cotton was harvested from the two center rows with a two-row spindle cotton picker on December 7 and 14 in Marana and Phoenix, respectively. Seed cotton harvested from each plot was weighed to determine yield. Random samples of 25 fully mature open bolls were handpicked the day before machine harvest and ginned before fiber properties were determined at the University of Arizona Cotton Fiber Laboratory.

Multiple correlation coefficients between values of standard germination test observed at 4 and 12 days, cool temperature germination test, days to 50% emergence, potential stand, surviving stand, yield,and fiber properties were determined.

RESULTS AND DISCUSSION

There were significant differences in the percent germination of 13 seed lots 4 and 12 days after the start of the test (Table 4). The germination percentage values ranged from 71 to 94% and 73 to 95%, after 4 and 12 days, respectively. Twelve days after initiation of the test, 95% of the seed in seed lot 11 had germinated. This was numerically the highest percent germination of the group and significantly greater than seed lots 1, 2, 4, and 12. The germination of seed lot 4 was 75 percent and significantly less than all other seed lots. The results are consistent with field emergence counts obtained under favorable and mild conditions in Marana and Phoenix, respectively (Table 4).

Predictive Tests : Standard and Cool Temperature Germination Tests

Germination under cool temperature ranged from 30 to 75% (Table 4). Seed lot 11 had numerically the highest percent germination while seed lots 4 and 1 were significantly lower than other seed lots tested. Seed lot 4 was produced in a field harvested in late December, approximately 3 weeks later than any other seed lot in the test (Table 1). These data support the findings of other reseachers who have shown that poor quality seed is associated with a late harvest (53) and (14). It is believed that the poor quality seed is a result of field weathering and/or contribution of late set

TABLE 4. Percent germination from standard and cool temperature germination tests for 13 commercial lots planted in 1977 at Phoenix and Marana.

Seed Lot		Standard Germination Test		
		4 day	12 day	Cool temp germ.
1		75.5 c[*]	80.3 c	31.0 e
2		76.5 c	82.3 c	50.8 bcd
3		89.8 ab	90.8 ab	60.8 abcd
4		71.0 c	75.0 d	30.3 e
5		91.5 ab	92.5 ab	63.5 abc
6		90.0 ab	91.0 ab	58.5 abcd
7		92.8 ab	93.3 ab	69.5 a
8		88.0 ab	89.3 ab	67.8 a
9		90.0 ab	91.5 ab	65.0 ab
10		92.3 ab	92.8 ab	71.5 a
11		94.0 a	95.0 a	75.8 a
12		84.8 b	85.8 bc	46.0 d
13		85.8 ab	87.0 abc	48.3 cd
	Ave.	86.3	88.2	56.8
	Std.	7.4	5.9	14.7
	CV.	4.1	4.1	13.9

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[*] Values followed by the same letter within a column are not significant at 0.05 level according to Student-Newman-Keul's Test.

bolls. Seed lot 1 was harvested in October and stored 1 month before ginning which may have affected seed quality.

The standard germination percent and cool test germination were hypothesized to be indicative of seed quality. Correlation coefficients between standard germination and cool test are .93 indicating that high quality seed lots performed similarly in both tests. Since average temperatures during the emergence period were about 5 C higher at Marana than Phoenix, the data are presented separately (Tables 2, 5, and 6). Pooled correlation coefficients are presented in Table 7 to support general statements concerning tests. There is a strong association between standard germination and cool test and field emergence at Marana, Phoenix and combined data from both locations. The correlation coefficients are .91 and .92 for standard germination and field emergence and .87 and .83 for cool test and field emergence in Phoenix and Marana, respectively (Tables 5 and 6).

Significant negative correlation coefficients were found between time to reach 50% emergence (ET50) and 12 day percent germination and cool test, indicating reliability of cool and standard germination test to predict performance in the field (Tables 5, 6, and 7). A significant positive relationship was found between predictive tests and seed cotton yield. The correlation coefficients are: .74 and .77 for standard germination and seed cotton yield and .72 and .77 for cool test and yield in Phoenix and Marana, respectively. Correlation coefficients between predictive tests and fiber

TABLE 5. Correlation coefficients for 13 commercial lots planted in Phoenix.

	4 day std.germ	12 day std.germ	Potential stand	ET50	Surviving stand	1st plant height	2nd plant height	Yield	Cool test	Span length (2.5%)	Span length (50%)	Uniformity ratio	Strength	Fineness
4 day std germ	---	.99***	.93***	-.78**	.93***	-.58*	-.24	.78**	.91***	-.73**	-.39	-.24	.23	-.67*
12 day std germ	---	---	.91***	-.82**	.91**	-.59*	-.22	.74**	.93***	-.75**	-.45	-.27	.29	-.68*
Potential stand	---	---	---	-.68**	.99***	-.63*	-.24	.79**	.87***	-.64*	-.28	-.15	.05	-.66*
ET50	---	---	---	---	-.69**	.48	.28	-.58*	-.92***	.59*	.46	.18	-.41	.37
Surviving stand	---	---	---	---	---	-.63*	-.23	.79**	.87***	-.64*	-.28	-.14	.05	-.66*
1st plant height	---	---	---	---	---	---	.08	-.70**	-.62*	.69**	.57**	.65*	.09	.57*
2nd plant height	---	---	---	---	---	---	---	-.22	-.28	.24	.19	-.09	-.11	-.15
Yield	---	---	---	---	---	---	---	---	.72**	-.53	-.13	-.19	-.31	-.56*
Cool test	---	---	---	---	---	---	---	---	---	-.67*	-.49	-.27	.24	-.63*
Span length#2 (2.5%)	---	---	---	---	---	---	---	---	---	---	.75**	.46	-.23	.37
Span length#1 (50%)	---	---	---	---	---	---	---	---	---	---	---	.79**	.55	.36
Uniformity ratio	---	---	---	---	---	---	---	---	---	---	---	---	-.24	.56*
Strength	---	---	---	---	---	---	---	---	---	---	---	---	---	-.02
Fineness	---	---	---	---	---	---	---	---	---	---	---	---	---	---

*, **, ***, are significant at 0.05, 0.01, 0.000 level, respectively.

TABLE 6. Correlation coefficients for 13 commercial lots planted in Marana.

	4 day std.germ	12 day std.germ	Potential stand	ET50	Surviving stand	1st plant height	2nd plant height	Yield	Cool test	Span length (2.5%)	Span length (50%)	Uniformity ratio	Strength	Fineness
4 day std germ	---	.99***	.94***	-.76**	.94***	.19	.06	.69**	.91***	.08	-.13	-.08	-.17	.28
12 day std germ	---	---	.92***	-.80**	.92***	.15	.03	.77**	.93***	.08	-.12	-.07	-.13	.31
Potential stand	---	---	---	-.66*	.99***	.27	.25	.57*	.85***	.05	-.13	-.26	-.32	.24
ET50	---	---	---	---	-.65*	-.08	.27	-.88***	-.9	.36	.42	.21	.01	-.39
Surviving stand	---	---	---	---	---	.28	.26	.56*	.85***	.04	-.13	-.27	-.34	.26
1st plant height	---	---	---	---	---	---	.44	-.13	.27	-.18	.06	.09	-.30	.31
2nd plant height	---	---	---	---	---	---	---	-.31	.04	.25	.18	-.04	-.48	.27
Yield	---	---	---	---	---	---	---	---	.77**	-.17	-.32	-.17	.05	.29
Cool test	---	---	---	---	---	---	---	---	---	-.12	-.27	-.17	-.12	.43
Span length#2 (2.5%)	---	---	---	---	---	---	---	---	---	---	.86***	.59*	.29	-.27
Span length#1 (50%)	---	---	---	---	---	---	---	---	---	---	---	.70**	.26	-.31
Uniformity ratio	---	---	---	---	---	---	---	---	---	---	---	---	.47	-.20
Strength	---	---	---	---	---	---	---	---	---	---	---	---	---	-.38
Fineness	---	---	---	---	---	---	---	---	---	---	---	---	---	---

*, **, ***, are significant at 0.05, 0.01, 0.000 level, respectively.

TABLE 7. Pooled correlation coefficients of Marana and Phoenix plantings.

	4 day std.germ	12 day std.germ	Potential stand	ET50	Surviving stand	1st plant height	2nd plant height	Yield	Cool test	Span length (2.5%)	Span length (50%)	Uniformity ratio	Strength	Fineness
4 day std germ	---	$.99^{***}$	$.93^{***}$	$-.76^{***}$	$.93^{***}$	$-.18^{*}$	-.12	$.73^{***}$	$.91^{***}$	-.30	-.24	-.13	.05	-.04
12 day std germ	---	---	$.91^{***}$	$-.80^{***}$	$.91^{***}$	-.20	-.12	$.74^{***}$	$.93^{***}$	-.30	-.26	-.14	.10	-.02
Potential stand	---	---	---	$-.67^{***}$	$.99^{***}$	-.19	-.07	$.70^{***}$	$.86^{***}$	-.29	-.20	-.21	-.11	-.08
ET50	---	---	---	---	-.67	.23	.28	$-.68^{***}$	$-.90^{***}$	$.47^{*}$	$.42^{*}$	.18	-.26	-.06
Surviving stand	---	---	---	---	---	-.18	-.06	$.70^{***}$	$.86^{***}$	-.29	-.19	-.21	-.11	-.08
1st plant height	---	---	---	---	---	---	.23	$-.44^{*}$	-.14	.20	.26	.28	-.10	.38
2nd plant height	---	---	---	---	---	---	---	-.25	-.14	.24	.18	-.05	-.10	.19
Yield	---	---	---	---	---	---	---	---	$.73^{***}$	-.36	-.21	-.16	-.18	-.07
Cool test	---	---	---	---	---	---	---	---	---	-.37	-.36	-.20	.07	.07
Span length#2 (2.5%)	---	---	---	---	---	---	---	---	---	---	$.81^{***}$	$.54^{**}$	.03	-.07
Span length#1 (50%)	---	---	---	---	---	---	---	---	---	---	---	$.72^{***}$	-.07	-.12
Uniformity ratio	---	---	---	---	---	---	---	---	---	---	---	---	.17	-.02
Strength	---	---	---	---	---	---	---	---	---	---	---	---	---	.27
Fineness	---	---	---	---	---	---	---	---	---	---	---	---	---	---

*, **, ***, are significant at 0.05, 0.01, 0.000 level, respectively.

length, strength, uniformity ratio, and fineness are insignificant except for Phoenix (Tables 5, 6 and 7).

Field Test

Although planting dates were early, soil temperatures were above the minimum temperature (18 C) required for germination and seedling growth of cotton (60). Average daily soil temperature at seed depth ranged from 12.9 to 24.2 C in Phoenix and from 19.2 to 28.6 C in Marana (Table 2). Comparison of time to reach 50% emergence and average temperature shows that at Phoenix the average temperature to 50% emergence was 17.9 C compared to 22.6 C at Marana. The average time required for 50% emergence at Phoenix was 15.0 days compared to 10.6 days at Marana (Tables 2 and 8). These data support research of Wanjura et al. (61) and Buxton et al. (16) who observed that temperature variation is the most important factor affecting time to 50% emergence although other factors such as depth of planting and soil salinity are also important.

Potential stand and surviving stand (final stand) of 13 commercial lots were significantly different (Table 3). In Phoenix, where temperatures were cooler, potential stand counts ranged from 53.2 to 86.3%. In Marana, the range was 59.3 to 87.6%. Seed lot 11 had the highest potential stand and was significantly better than other seed lots in Phoenix. Similarly, lot 11 had the highest potential stand in Marana and was significantly different from the rest of the seed lots except lots 5, 6, 7, and 10. The results are consistent with predictive tests values. Due to wide range of

TABLE 8. (ET50) values for 13 commercial lots planted in 1977 at Phoenix and Marana.

Seed Lot		Phoenix (ET50)	Marana (ET50)
1		15.5 ab*	11.1 c
2		15.1 ab	10.5 ab
3		14.7 ab	10.4 a
4		15.9 b	11.0 bc
5		15.0 ab	10.4 a
6		15.1 ab	10.4 a
7		14.7 ab	10.3 a
8		14.6 ab	10.4 a
9		14.9 ab	10.3 a
10		14.3 a	10.5 ab
11		14.5 ab	10.3 a
12		15.4 ab	11.0 bc
13		15.5 ab	10.8 abc
	Ave.	15.00	10.6
	Std.	0.46	.29
	CV.	4.71	3.1
Ave. temp. at ET50		17.98C	22.68C

*Values followed by the same letter within a column are not significant at 0.05 level according to Student-Newman Keul's Test.

environmental conditions in the field, differences among seed lots were expected to exceed the range within the standard germination test. The relatively lower temperatures in Phoenix resulted in a greater range in number of plants emerging than at Marana where temperatures were warmer. This observation suggests that cool temperature stress affects emergence of seeds of marginal quality to a greater degree than seed of high quality.

Correlation coefficients between 12 day percent germination and potential stand and surviving stand are .91 and .92 for Phoenix and Marana, respectively. A similar relationship was found between cool test and potential stand or surviving stand (Tables 5, 6, and 7). Correlation coefficients between potential stand or surviving stand and standard germination test are not always high and have resulted in considerable controversy. Perry (43) reported that when soil temperatures are favorable, field emergence is closely related to germination in the laboratory. However, when a stress is imposed on germinating seed, the correlation decreases. These observations are supported by Clark (22), Sherf (49), Abdullahi (2), Wiles (64), and Buxton et al. (17).

Correlation coefficients between cool test and potential stand or surviving stand are similar to corresponding coefficients between standard germination test and potential stand or surviving stand. These data indicate that the standard germination test is equal to the cool test for use as a predictor of seed quality. Comer (24) stated that identification of vigorous cottonseed lots is inconsistent using the standard germination test. He found a poor correlation of 0.4 between standard germination test and field emergence under adverse field conditions. Wiles (64) recommended application of both cool test and standard germination test in evaluation of cottonseed for planting. He emphasized the importance of a low temperature test as a means of detecting low vigor seed. In field tests, temperatures may have not been low enough to result in sufficient stress to measure seed vigor differences.

Emergence Period (ET50)

Significant differences were found among ET50 values (Table 8). The time period to reach 50% emergence ranged from 14.3 to 15.9 days in Phoenix. Seed lot 10 took the shortest time to reach ET50 and was significantly different from lot 4. At Marana, the range was from 10.3 to 11.1 days. Seed lots 5, 6, 7, 8, 9, and 11 took shorter time to reach 50% emergence and were significantly different than lots 1, 4, and 12. The length of time required for emergence is an indicator of degree of tolerance to cold stress. The average time required to reach 50% emergence in Phoenix was 15 days compared to 11.6 days in Marana. These values reflect differences in average soil temperature of 18.0 and 22.6 C in Phoenix and Marana, respectively. As expected, higher temperature reduced the time required for emergence in all seed lots. The difference in time period to reach 50% emergence between seed lots was 0.8 days at favorable temperature in Marana compared to 1.6 days at a cooler temperature in Phoenix. These differences suggest that at a cool temperature, seed lots took a longer time to reach 50% emergence and the emergence time period was more variable. Correlation coefficients between ET50 and cool test are -.92 and -.90 in Phoenix and Marana, respectively (Tables 5 and 6). The correlation coefficients between standard germination and ET50 are -.82 and -.80 in Phoenix and Marana. These data suggest that although either test may be used to predict how rapidly seedlings emerge, the cool temperature germination test is the better indicator.

A significant negative correlation was found between ET50, and field emergence at both locations (Tables 5 and 6). Correlation coefficients of -.68 and -.66, in Phoenix and Marana, respectively, suggests that as the time period required to reach 50% emergence increases, the number of seedlings that emerge decreases. Buxton et al. (16) stated that seedling emergence is reduced as emergence time increases. They found that seedling emergence was reduced about 2% per day but may reach 4% in salt affected soil. The results support Buxton et al. findings although the average soil temperatures in the present study were higher.

There is a negative relationship between ET50 and seed cotton yield. The correlation coefficients are -.58 and -.88 for Phoenix and Marana, suggesting seed lots requiring a longer time to emerge produced lower seed cotton yields. Seed lots 1, 2, 4, and 12 in general performed poorly in predictive tests, had delayed emergence and produced significantly lower yields in Phoenix than all other lots. The same trend is true for Marana (Tables 8 and 9).

TABLE 9. Seed cotton yield means for 13 commercial lots planted in Phoenix and Marana.

Seed Lot		Phoenix	Marana
		Kgm per plot	
1		5.1 c[*]	6.6 a[†]
2		5.8 abc	6.9 a
3		6.0 ab	6.9 a
4		5.4 bc	6.4 a
5		6.2 a	7.1 a
6		5.8 ab	6.9 a
7		6.0 ab	6.9 a
8		6.1 a	6.8 a
9		5.8 ab	6.9 a
10		6.2 a	6.7 a
11		5.9 ab	7.1 a
12		5.8 ab	6.4 a
13		6.2 a	6.6 a
	Ave.	5.9	6.8
	Std.	1.7	1.8
	CV.	10.6	11.9

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[*] Values followed by the same letter are not significant at 0.05 level according to Student-Newman-Keul's Test.

[†] Data for Marana are not statistically significant at F0.05.

Plant Height

First and second plant height measurements were not significantly different in Marana or Phoenix (Table 10). The average heights ranged from 18.95 to 101.33 cm in Phoenix and from 30.23 to 78.95 cm in Marana for first and second measurements, respectively.

Correlation coefficients between first plant height and predictive tests and field emergence at Phoenix were significant (Table 5). These data suggest that plant height was affected by early season cold stress at Phoenix. Vechi (58), Smith and Camper (51), Byrd (18), and Camagro and Vaughan (19) have demonstrated that low vigor seed resulted in slower growing plants. Early plant height is positively associated with fiber length, uniformity, and fineness in Phoenix. The correlations are .69, .57, .65, and .57 for 2.5% upper length, 50% upper length, uniformity ratio and fineness, respectively. Other significant differences were not observed indicating seed quality is not as important when temperatures are adequate for germination and emergence.

Second plant height data are not related to the predictive tests, field emergence, seed cotton yield, and fiber quality in Phoenix and Marana (Tables 5 and 6). It appears that good seed quality is important to initiate early rapid growth and high yields. The height of plants in June was a good predictor of yield. By August, boll load, insect population, maturation cycle, and vigor masks effects of seed quality on plant height and yield.

TABLE 10. First and second height measurements for 13 commercial lots planted in Phoenix and Marana.

		Plant Height Measurements (cm)				
Seed Lot		Phoenix			Marana	
		June 7	Aug. 5		June 15	July 20
1		20.2 a*	102.7 a		29.4 a	79.1 a
2		18.3 a	101.8 a		30.4 a	78.4 a
3		19.4 a	101.8 a		29.8 a	76.8 a
4		19.5 a	101.5 a		29.7 a	78.5 a
5		18.5 a	100.3 a		30.4 a	78.6 a
6		18.4 a	99.1 a		29.3 a	76.5 a
7		19.0 a	97.3 a		30.3 a	79.9 a
8		19.4 a	99.3 a		31.7 a	79.3 a
9		18.8 a	102.4 a		30.3 a	78.8 a
10		17.8 a	100.8 a		30.8 a	79.2 a
11		18.6 a	104.3 a		29.5 a	80.2 a
12		19.5 a	101.9 a		30.7 a	81.2 a
13		18.5 a	103.9 a		30.9 a	79.9 a
	Ave.	19.0	101.3	Ave.	30.2	79.0
	Std.	2.8	5.8	Std.	1.5	11.8
	CV.	13.2	4.6	CV.	4.8	4.8

*Values followed by the same letter are not significant at 0.05 level according to Student-Newman-Keul's Test.

Yield

Seed cotton yields are presented in Table 9. Significant differences were found in Phoenix but not Marana. The average seed cotton yields ranged from 5.13 to 6.24 Kgm/plot in Phoenix and from 6.35 to 7.08 Kgm/plot in Marana. Lot 13 had numerically the highest yield in Phoenix and was significantly greater than lots 1 and 4. Seed lots 1 and 4 performed poorly in predictive tests as well as field emergence and produced lower yields than other lots in Phoenix. The same trend is generally true for Marana.

Seed cotton yield is strongly associated with predictive test, field emergence, and emergence period (Tables 5 and 6). Except for the first plant height measurement in Phoenix, plant heights were not related to yield. The correlation between yield and fiber properties are inconsistent in Phoenix and Marana.

Fiber Analysis

Fiber length and strength were not significantly different at Phoenix or Marana (Table 11). The uniformity ratio from bolls collected at Marana were significant and ranged from 46.00 to 49.50. Although fineness values were significantly different at Marana, they were all in the premium range. The values ranged from 3.49 to 3.75. Fiber data were all typical for Pima cotton.

The correlation coefficients between fiber data and predictive test, field emergence, ET50, plant heights, and seed cotton yields are significant in Phoenix but insignificant in Marana.

TABLE 11. Fiber analysis data for 13 commercial lots planted in Phoenix and Marana.

	Phoenix					Marana				
Seed Lot	Span Length (50%)	Span Length (2.5%)	Uniformity Ratio	Strength	Fineness	Span Length (50%)	Span Length (2.5%)	Uniformity Ratio	Strength	Fineness
1	.622 a*	1.383 a	47.830a	5.170a	3.460a	.672 a	1.390 a	48.330ab	5.080a	3.630abcd
2	.638 a	1.382 a	46.330a	5.070a	3.400a	.658 a	1.368 a	48.000abcd	5.170a	3.580 bcd
3	.643 a	1.373 a	46.670a	5.130a	3.380a	.647 a	1.375 a	49.500a	5.200a	3.560 bcd
4	.652 a	1.385 a	47.000a	4.990a	3.430a	.625 a	1.353 a	46.200 cd	5.060a	3.580 bcd
5	.638 a	1.358 a	47.000a	5.020a	3.390a	.622 a	1.353 a	46.000 d	5.010a	3.630abcd
6	.638 a	1.364 a	46.600a	5.080a	3.360a	.658 a	1.378 a	46.670 cd	5.130a	3.490 d
7	.642 a	1.372 a	46.670a	5.110a	3.330a	.642 a	1.370 a	47.000 bcd	5.080a	3.750a
8	.668 a	1.380 a	48.500a	4.990a	3.420a	.643 a	1.363 a	47.000 bcd	5.030a	3.650ab
9	.633 a	1.358 a	46.670a	5.080a	3.380a	.655 a	1.367 a	48.200abc	5.000a	3.640abc
10	.633 a	1.358 a	46.330a	5.130a	3.400a	.653 a	1.377 a	47.500abcd	5.080a	3.690ab
11	.642 a	1.372 a	46.670a	5.170a	3.340a	.642 a	1.380 a	46.670 cd	5.050a	3.610 bcd
12	.658 a	1.380 a	47.500a	5.070a	3.420a	.665 a	1.383 a	48.000abcd	5.090a	3.500 cd
13	.647 a	1.380 a	46.380a	4.950a	3.350a	.677 a	1.387 a	48.830ab	5.060a	3.580 bcd
Ave.	.646	1.373	46.934	5.074	3.390	.651	1.373	47.531	5.080	3.607
Std.	.011	0.010	0.646	0.070	0.038	0.016	0.012	1.051	0.058	0.071
CV.	4.990	2.300	2.800	2.700	4.470	4.860	2.300	3.740	3.110	3.390

*Values followed by the same letter within a column are not significant at 0.05 level according to Student-Newman-Keul's Test,

SUMMARY AND CONCLUSION

Experiments were conducted to evaluate predictions of planting seed quality. The rate and percent germination of 13 commercial lots of 'Pima S-5' were made using the standard and cool temperature tests. Field experiments were conducted in Phoenix and Marana to determine the relationship between the predictors of planting seed quality, seed vigor, field emergence, and yield of commercial lots.

Significant differences were found among seed lots in both laboratory and field tests. High correlations of field emergence were found with standard germination and cool temperature test, indicating reliability of these tests to predict seed quality. Differences in plant height and yield at Marana were not significant.

Total emergence was negatively correlated with time to 30% emergence. The results of this study are consistent with other findings and suggest that ET50 may be used as a guideline for making early replanting decision and as a measure of expected stand under wide range of climatic conditions.

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