STUDIES ON SEED GERMINATION AND STORAGE OF GERMINATED SEED OF DIFFERENT PEPPER (*Capsicum sp*) CULTIVARS - THEIR APPLICATIONS IN FLUID DRILLING

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CHAPTER I

INTRODUCTION

One of the main concerns of vegetable growers is to have a good plant stand in the field that helps assure them a uniform, high quality product at harvest time.

Many controlled factors (fertilization, irrigation, pest control, etc.) contribute to success in growing vegetable crops and a good plant stand is necessary for efficient utilization of those factors.

Good seed quality will be essential for other controlled factors to work at their maximum. However, environmental conditions (temperature variations, moisture, light, etc.) are sometimes very difficult to predict and the first stage of the process of growing a plant, seed germination, can be delayed or irreversibly damaged by unfavorable weather conditions.

Throughout the development of agriculture man has attempted to develop new techniques to assure good germination and uniformity of plant stand in the field. Seed quality, improving planting techniques, or directly controlling environmental factors (temperature, moisture, light, etc.) which are essential for seed germination, have been the main areas of research.

In the last five years, researchers from England (4) have developed a new and revolutionary technique called fluid drilling germinated seed.

Fluid drilling germinated seed is a system which involves techniques for germinating seed under controlled conditions, separating germinated from non-germinated seed, sowing the germinated seed in a gel matrix and using special planters to sow the germinated seed without damage to emerged radicles. Techniques for storing germinated seed are also incorporated into fluid drilling since weather conditions, machine breakdown, etc., can prevent timely sowing of germinated seed.

The main advantage of fluid drilling is the potential to control seed germination by manipulating as desired, the essential factors for germination. Since germinated seed is planted, emergence is faster and more uniform as compared to dry seed. This is usually reflected at harvest in higher quality and yield.

In this study, research results are reported on pepper (Capsicum sp) seed germination. The objective was to develop a technique to improve speed and uniformity of seed germination in aerated columns.

The other aspect covered in this work is storage of germinated seed. Peppers are a warm season crop and sensitive to damage from low non-freezing temperatures. The objective was to determine how long germinated seed can be stored, the optimum storage temperature and if there is a means to alleviate or avoid low temperature damage during storage.

CHAPTER II

REVIEW OF LITERATURE

Seed Germination Studies

Seed germination, as defined by Mayer and Poljakoff-Mayber (21, p. 6), is "a consecutive series of events which causes a quiescent seed with low water content to show a rise in its general metabolic activity and to initiate the formation of a seedling from the embryo."

In these studies, a germinated seed will be considered as a seed with a visible radicle and the term seedling emergence will be used to mean a seedling which has emerged from the soil after sowing.

Seed germination is the most important part in the process of fluid drilling germinated seed. Uniformity in seed germination is translated to uniform emergence in the field. Uniformity is carried throughout the length of the crop growing period and gives uniformity in quality of the harvested product.

Gray (10) showed that 60 to 90% of the variation in harvested head weight of lettuce was caused by the variation in the date of seedling emergence.

Currah (5) reported that two-thirds of the variation in the whole carrot plant weight at final harvest was due to variation in seedling weight which was closely related to time of emergence.

Uniformity in seed germination means that most of the seed in a particular lot will germinate over a short period of time. Seed will

have similar radicle length and be at the same physiological stage of growth and development. This is not easy to attain since the delay in germination is a natural mechanism for survival of the species. The gain in germination uniformity has to be accomplished by breeding for that characteristic and by using sowing techniques that allow the seed to have all the factors affecting germination at the optimal level for the species.

Since breeding takes a long time to obtain results, researchers have devoted a good deal of time in looking for new techniques for sowing seed. Techniques with potential for commercial application are 'seed priming' developed by Heydecker et al. (11, 12), and 'fluid drilling germinated seed' proposed by Currah et al. (4). Many other ideas have been proposed and they are well summarized and discussed by Heydecker and Coolbear (13).

Essentially all the techniques try to control, at optimum levels, the main factors affecting seed germination. These are seed viability and age, temperature, gas exchange (O_2 and CO_2), water and light (20, 21).

In fluid drilling, the germination step can be accomplished by using the technique developed by Darby and Salter (7). Seed are placed in a vertical column 1 m long with a 4.7 cm internal diameter, and made of transparent glass, which is used to contain the water or solution. Air is supplied by a small tube attached to a small ceramic aquarium aerator which is connected to an air pump. The aerator is placed in a plastic funnel cut to fit tightly in the bottom of the tube. Air bubbles prevent seed from settling at the bottom of the column. Using this technique factors affecting germination can be controlled at optimum

levels for each species.

Germinating seed before taking them to the field allows evaluation and improvement in seed vigor which increases the probability of success in having fast and uniform seedling emergence.

Seed vigor, as defined by Woodstock (41, p. 130), "is that condition of active good health and natural robustness which upon planting, permits germination to proceed rapidly and to completion under a wide range of environmental conditions." This definition takes into account the physiological and genetic status of the seed as well as the environmental conditions where it is sown, which determines the speed of germination. Seed must germinate completely, the quicker the better, under stress as well as favorable conditions.

The germination step in fluid drilling allows seed vigor to be improved, not only by providing all the factors for germination at optimum levels, but also by treating the seed with chemicals or other means that could stimulate seed germination.

Osmotic solutions (11, 12, 13) as well as growth regulators (13) have been used extensively in many species to stimulate seed germination.

The most studied growth regulators in regard to seed germination are the gibberellins. According to Moore (23) the number of gibberellins known up to now, extracted from all sources (angiosperms, gymnosperms, ferns, brown algae, green algae, fungi and bacteria), is 52.

The mechanism of action of gibberellic acid (GA) regarding seed germination promotion has been studied extensively in barley seed. Paleg (27, 28, 29) in the United States and Yomo (21, 23) in Japan, were the first to show that when GA was added to the endosperm of barley seed

it stimulated germination by the production of amylolitic enzymes, including α-amylase, and the release of sugars.

Radley (31) showed that GA-like substances are produced by the scutellum of the barley seed during the first two days of germination and thereafter by the embryo axis. The GA's liberated by the embryo diffuse across the endosperm to the aleurone layer in which the hydrolitic enzymes are produced.

Varner and Ho (40) showed that GA not only increases the activity of the enzyme α-amylase but other enzymes are also activated including proteases and ribonucleases and to a lesser extent the activity of β-1, 3-glucanase and the release of acid phosphatase from the cell wall. It has been shown (39) that GA promotion in the activity of those enzymes is due to de novo synthesis of the enzyme proteins and that most of the α-amylase and protease are secreted into the endosperm after their synthesis.

In peas the gibberellins are apparently released from a bound form in the cotyledons and move to the embryonic axis (21).

There is little information in the literature about GA effect on pepper seed germination.

Kanchan (14) showed that soaking dry pepper seed (cultivar 'California Wonder') for 5 and 10 hours in solutions containing GA_3 alone (250 mg GA_3/liter water) or combined with indoleacetic acid (IAA) or kinetin stimulated germination and dry weight increase. The 10 hour soaking treatment with GA_3 improved germination 97% over the control (dry seed with no treatment). There was no difference between GA_3 alone and GA_3+IAA. Unfortunately the author did not present the data showing actual daily percent germination or how many seed were used per

treatment.

Yaklich and Orzolek (42) reported that GA_3 at concentrations of 2.5, 25 and 100 ppm neither promoted or inhibited seed germination when used together with Polyethylene Glycol solutions of -8 bar.

Puls and Lambeth (30) showed that the germination rate of 10-year old tomato seed was significantly increased by continuous soaking the seed with GA_3 at concentrations of 10 and 50 ppm. Greater concentrations (100, 200 or 500 ppm) resulted in lower germination rates. The total percent germination at the end of the experiment did not differ significantly. They observed that GA_3 at 50 ppm significantly increased the mobilization of sugars on the second day of germination. This was closely related to the improvement in the germination rate. They also observed a reduction in soluble protein which reflected a GA_3-stimulated increase in protease activity, increasing the amount of free amino acids that could be available for synthesis of other enzymes. They also showed an increase in ribonuclease activity on the second day of germination indicating both an increase in nucleic acid metabolism and cell division.

Ketring and Morgen (15) showed that GA_3 at concentrations of 5×10^{-4} M (173 ppm) stimulated ethylene production in apical peanut seed and seed germination improved 40% above the control after 96 hours. The more dormant basal seed were not stimulated by GA_3. They concluded that GA_3 in peanuts seed acted by stimulating ethylene production. They had shown previously that ethylene stimulated seed germination in peanuts.

Buxton et al. (3) found that soaking cotton seed for 3 hours in GA_3 concentrations of 100 and 500 mg/liter, in general, increased seedling dry weight. Dipping the seed in GA_3 for 3 minutes had little influence.

The germination index was also increased by soaking. They studied the effect of those treatments on seedling emergence in the field. They found that dipping seed for 3 minutes in high concentrations of GA_3 (500 mg/1 or 5000 mg/1) as well as soaking seed for 3 hours in 100 and 500 mg/1 greatly reduced seedling emergence. Most seed germinated but few emerged. They concluded that the high germination but low emergence at those concentrations was related to spindly growth in which germinating seedlings were not rigid enough to develop the physical force necessary to move the seedling apex through the soil.

Nagao et al. (24, 25) showed that alexandra palm seed soaked for 72 hours in GA_3 at concentrations of 100 and 1000 ppm germinated faster than seed soaked in water. GA_3 was more effective when seed had been scarified.

Bretsloff and Pellet (2) showed that percent seed germination of Carpinus caroliniana Walt was increased when the stratification period (6, 12, and 18 weeks) was followed by 24 hours of GA_3 treatment. Seed stratified for 21 weeks were inhibited in their germination by the GA_3 treatment. GA_3 did not stimulate germination in non-stratified seed. GA_3 at 100 ppm reduced the required length of stratification by increasing the total percent germination. Scarified seed exposed to GA_3 for 24 hours germinated better than those exposed constantly to GA_3 regardless of the concentration. Concentrations of 8000 ppm GA_3 inhibited germination under all conditions.

Storage of Germinated Seed Studies

Germinated seed storage is another part of the fluid drilling technique. Storage is necessary when germinated seed cannot be sown

immediately due to bad weather conditions, machine breakdown, or when seed has to be transported a long distance.

In order to hold germinated seed for later planting it is necessary to arrest radicle growth without physical or physiological damage. Germinated seed can be safely stored by subjecting the seed to low temperatures.

For cool season crops such as onion, carrot, asparagus, and celery (4, 35, 45, 75), germinated seed can be stored at 1 °C for a period of time (6 to 15 days) without having harmful effect on emergence.

Warm season crops like pepper, tomato, cucurbits, tropical fruits, etc., are damaged when whole plants or fruits are exposed to low or non-freezing temperatures below 10 to 12 °C (65, 80).

Gray et al. (53) reported that germinated tomato seed with radicles 5 mm in length, stored for periods as short as 1 day at 0 °C, were damaged in their emergence. Germinated seed exposed to 5 °C and 10 °C for prolonged periods were not injured.

The damage resulting from low non-freezing temperatures is called chilling injury. The first symptoms of chilling injury are rapid leaf wilting and the development of sunken necrotic patches within a few hours of the start of chilling (65, 68). The same symptoms are observed in fruits with browning and decaying areas (80).

According with Levitt (59) this damage could be direct if the effect of low temperature is sudden and brief (cold shock) which increases membrane permeability leading to pseudoplasmolisis and solute leakage. Chilling injury could be indirect if the effect of low temperature is gradual and maintained. This could lead to metabolic disturbances like an increase in respiration greater than photosynthesis

causing starvation.

Another alteration in metabolism is the increase in anaerobic respiration over aerobic respiration leading to an increase in CO_2 evolution, toxin accumulation or biochemical lessions such as a deficit in ATP with inhibition of protein synthesis, inhibition of ion uptake, stimulation of ion leakage, and cessation of protoplasmic streaming (59).

Chilling stress, if gradual and maintained, could also produce secondary water stress injury by decreasing permeability of root cells which would imbalance the relationship between water absorption and transpiration leading to wilting (59).

Ion leakage due to chilling injury has been studied in a number of species sensitive to chilling (65). Lieberman et al. (60) were the first to report a continuous increase in leakage of K in sweet potato tissue stored at 7.5 °C. Tissue stored at 15 °C for long periods did not show this phenomenon. Christiansen et al. (46) and Guinn (52) have also showed loss of electrolyte, proteins and carbohydrate from chilled roots and cotyledons of cotton.

Murata and Tatsumi (71) studied the effect of temperature on ion leakage from tissue slices of a number of chilling sensitive and insensitive plants. They subjected the tissue slices to a temperature range from 0 to 30 °C. They found that cucurbit fruits (cucumber, oriental pickling melon, pumpkin, squash and chayote), had more K leakage at temperature below 10 or 5 °C (depending on the species) and that those temperatures corresponded to the critical temperatures for chilling injury of those fruits during storage.

Bell pepper fruit slices did not show any differences in the

percent of ion leakage when stored at 2 °C (chilling temperature) or 12.5 °C. The same was observed for eggplant. They suggested that some chilling sensitive tissues show little change in membrane permeability during storage at chilling temperatures (71).

Murata and Tatsumi (71) concluded from their work that the high rate of electrolyte loss at chilling temperature is not necessarily a general property of chilling sensitive plant tissues. Different types of mechanisms regarding electrolyte loss from tissues may exist in the chilling injury of fruits and vegetables.

Loss of organic substances (carbohydrates, amino acids, proteins) has also been reported as a consequence of chilling injury. Christiansen (47) showed a marked rise in carbohydrate loss in cotton seedlings germinated for 1 day at 31 °C and then stored for 24 hours at 5 °C. He also observed that Ca exerted a marked inhibition of cotton root exudation (carbohydrate) caused by chilling injury.

Most of the information regarding biochemical changes that occur when chilling injury is present have been obtained with fruit or root tissue. There is little information on seed and almost none on germinated seed.

The inhibition of mitochondrial function by chilling temperatures may lead to an increase in anaerobic respiration over aerobic respiration. This leads to an accumulation of pyruvate which is metabolyzed to acetaldehydes, ethanol and acetate (80).

Lyons (63, 65) showed that chilling injury induced changes in membrane structure and inhibit membrane bond enzymes such as those of the tricarboxilic acid cycle in the mitochondria without affecting the glycolitic enzymes in the cytoplasm. Since glycolisis is not inhibited

there is accumulation of pyruvate which cannot be metabolyzed in the normal aerobic respiration process because of the lack of enzyme activity in the mitochondria.

Murata (70) has observed accumulation of α-keto acids in the peel and of browning substances (polyphenols) around the vascular tissue in chilled bananas.

Lieberman et al. (60) found a considerable increase in chlorogenic acid in sweet potato chilled tissues and a close relationship with the darkening after long exposure to chilling temperatures. They also found a decrease in ascorbic acid in chilled tissue. Baruah and Swain (44) showed that ascorbic acid inhibited the activity of the polyphenol oxidase enzyme complex.

Levitt (59) pointed out that the inhibition of aerobic respiration leaves a higher concentration of oxygen than normal in the tissues. This oxygen can be used by oxidases other than the cytochrome system (phenol oxydase), which leads to the production of toxic substances like phenols and peroxide.

Huelin and Coggiola (55) found that a superficial scald of apples, after prolonged storage at 0 to 4 °C, was caused by conjugated triene hydroperoxides which are oxidation products of α-farnesene.

A shift from aerobic to anaerobic respiration produces a deficiency in ATP since the activity of the mitochondrial enzymes responsible for respiration is inhibited.

Stewart and Guinn (76) showed that ATP levels decreased in a relatively short time in two week old cotton seedlings subjected to 5 °C. This decline in ATP production would stop protein synthesis, and would shift the balance between protein synthesis and breakdown, leading to

net protein hydrolysis.

In fact, Stewart and Guinn (77) showed that phosphatase activity in chilled plants was relatively high compared to phosphorilation activity. They observed an overall increase in nucleotides and nucleosides which indicated that hydrolytic processes were increased with chilling temperatures. They concluded that all of these changes were related to membrane structural changes.

Lyons and Raison (63, 64) proposed that an instantaneous temperature-induced change in membrane structure causes chilling injury.

Lyons et al. (61) showed that the swelling ability of tomato fruit and sweet potato root mitochondria (chilling sensitive species) was low in hypertonic solutions (0.4 M sucrose) at 25 °C. On the other hand, chilling resistant species mitochondria (cauliflower, pea, turnip) showed high ability to swell, indicating the membrane flexibility from chilling sensitve plants is lower.

The primary effect of chilling injury is received in the mitochondrial membrane which experiences a phase change from liquid crystaline to solid gel. The phase change occurs in the lipid portion of the membrane and this in turn imposes a configurational change in the enzymes associated with those membranes (membrane-bound enzymes) and establishes a direct correlation between the physical state of the membrane lipids and enzymatic activity (61, 63, 64, 65, 73, 74).

Lyons and Asmundson (62) studied the freezing point of different mixtures of palmitic acid (saturated) with oleic, linoleic and linolenic acids (unsaturated). They found that the freezing points of those mixtures decreased slowly as the unsaturated fatty acids were increased to

60 mole %. Beyond that percentage the freezing point was decreased quite markedly by each addition of unsaturated fatty acid. Differences of less than 5 mole % in the amount of unsaturated fatty acid had a marked effect on the solidification of the mixture. Linoleic and linolenic acids had similiar effects on the freezing points of the mixtures until about 82 mole % unsaturated fatty acid.

The information on the influence of the membrane fatty acid composition on chilling injury has increased in the last decade. This knowledge and more understanding of the physiology of chilling injury have contributed to incorporate cold hardiness into certain chilling sensitive species of economic importance.

Gerloff et al. (51) showed that alfalfa roots subjected to temperatures of -2.5 °C for 1 month and then transferred to -20 °C to test for hardiness, had a 2-fold increase in fatty acid content over the control. This difference was mainly due to the increase in linolenic and linoleic acids.

St. John and Christiansen (78) found that cotton seedlings from seed germinated at 15, 20, 25 and 30 °C, showed an increase in the linolenic acid content of the polar lipids fraction as the temperature decreased. Sandoz 9785 or BASF 13338 (4-chloro-5-(dimethylamino)-2-phenyl-3(2H)-pyridazinone) reduced the low temperature-induced linolenic acid content and reduced the seedling ability to withstand 8 °C chilling.

Later, St. John (79) showed that BASF 13338, incorporated into the soil, markedly increased the incidence and severity of frost banding (low temperature injury in cereals) of wheat, barley and rye.

Severity increased as the concentration of the chemical increased

from 2.8 to 11.2 kg/Ha. Barley appeared to be the most sensitive and rye the least sensitive. Shoots from seedlings grown at temperatures as low as -1.6 °C and treated with BASF 13338 had significantly lower levels of linolenic acid. Similar results have been obtained by Khan (39).

There is some controversy about the relationship of linolenic acid and the susceptibility or tolerance to low temperature injury in cereals.

De la Roche (49) used BASF 13338 to inhibit linolenic acid synthesis in seedlings of winter wheat acclimated at 2 °C in the dark. The compound did inhibit linolenic acid synthesis but the development of freezing tolerance was not affected.

Yamaki and Uritani (84, 85, 86) showed that most (90.5 mole %) of the lipids in sweet potato mitochondria were phospholipids, rich in linolenic acid. Chilling temperatures (0 and 1 °C) always decreased the ratio of linoleic acid to total fatty acids. Chilling storage caused irreversible structural changes in the protein moiety of the lipid-protein complex within a few days, releasing the phospholipids from the membrane.

They suggested that a release of the phospholipids resulted in the destruction of the mitochondrial membrane structure followed by successive release of enzymes such as cytochrome-c-malate dehydrogenase which may have caused the decrease in the respiration rate.

Mazliak (68) showed that the lipids in flax stem and rape seed were enriched in the most unsaturated fatty acid (linolenic in flax stem and linoleic plus linolenic acids in rape seed) at the lowest temperature in the range of 22 to 27 °C for 3 cultivars of flax and from 12 to 27 °C

for rape.

After a series of studies on the optimum temperatures and oxygen levels for the activity of desaturase enzymes, Mazliak (68) concluded that temperature affects biosynthesis of unsaturated fatty acids directly and not only through increasing oxygen concentration in the cell sap. Desaturases that catalyze the formation of the different unsaturated fatty acids might have different temperature optima. Thus, depending on the species, low temperature would favor polyunsaturated fatty acid accumulation while high temperature would favor oleic or palmitoleic acid accumulation.

Bartkowski et al. (43) showed that the major increase in the double bond index took place in the microsomal membranes of 10 mm radicle tip sections from Gossypium barbadense seed germinated at 34 °C for 30 hours then 6 hours at 5 °C and 6 hours at 34 °C. The control was germinated at 34 °C for 42 hours. Mitochondria membranes from chilled sections showed a general decrease in unsaturated fatty acid content, mainly oleic and linoleic acids. The nuclear membrane did not show any change in fatty acid composition when exposed to chilling temperatures.

He also noticed that the major changes in the microsomal membranes of chilled radicle tip sections were a decrease in linoleic acid corresponding to an increase in linolenic acid. He suggested that since oxygen was not a limiting factor, increase in linolenic acid was due to differences in desturase activity as a function of temperature.

The knowledge of the mechanisms of chilling injury, has been very useful in the development of techniques to avoid damage from low temperature storage of fruit and vegetables.

It has been reported that diphenylamine, ethoxyquin and butylated

hydroxytoluene reduce the severity of superficial scald in apple fruit (55, 80).

Jones et al. (56) showed that postharvest treatment of banana fruits with dimethylpolysiloxane, safflower oil, and mineral oil prevented peel discoloration for up to 48 hours at 9 °C. The shelf life of the fruit increased and water loss decreased after treatment.

Calcium treatments to apple fruits after harvest reduced low temperature breakdown (34).

Wang and Baker (81) showed that intermittent warming to 20 °C for 24 hours at 3 days intervals, of cucumber and pepper fruits chilled at 2.5 °C for different periods, alleviated chilling injury and increased fatty acid unsaturation of the polar lipids.

They also showed that treatments with sodium benzoate (10 mM) or ethoxyquin (9.2 mM), applied as a 5 minute dip before chilling, increased the unsaturation of 18-carbon fatty acids in the polar lipids and reduced the severity of chilling injury.

CHAPTER III

MATERIAL AND METHODS

Seed Germination Studies

Preliminary Studies

Seed Germination in Distilled Water. Seed of pepper cultivars 'California Wonder Select' (CWS), 'Bahemian Hot Chili' (BHC), 'Kalspice #1 Sweet Paprika' (KS1), 'Verdeño', 'Papaloapan' and 'Tampiqueño 74' (T74) were disinfected with a 1% solution of sodium hypochlorite (20% Chlorox) for 5 minutes and rinsed immediately for 10 minutes with distilled water (9). After disinfecting, 100 seed of each cultivar were placed in an aerated column (39.5 cm in length and 4.5 cm in diameter) made of transparent glass and filled with distilled water. The columns were immersed in a constant temperature water bath maintained at 30 °C during the experiment. Water in the columns was changed every 24 hours.

Seed were observed daily in order to initiate the germination counts as soon as the first radicle was observed. Germinated seed were counted every day and discarded in such a way that only non-germinated seed remained in the column for the next 24 hours. The experiments were carried out until no more seed germinated.

The data was used to calculate the percent germination daily cumulative germination, germination rate, days to 50% germination (T50) and

uniformity of germination.

Seed Germination in Gibberellic Acid Solutions. GA_3 (MW 346.4) solutions at concentrations of 0, 200, 400, 600, 800, and 1000 ppm were prepared using distilled water. Germination conditions were the same as in the experiments with distilled water.

One hundred seed, disinfected as in the first experiment were placed in 150 cc of GA_3 solution. The solutions were changed every 24 hours and the experiments were terminated after the first count was made in each column. Separate experiments were carried out for each cultivar included in this study. Three replications were used in a completely randomized design.

The cultivars used were 'CWS', 'BHC', 'KS1', 'Verdeño', 'Papaloapan', 'T74' and 'Real Mirasol'. The experiments were terminated after three days for the first four cultivars and after two days for the last three cultivars. The percent germination was calculated and analyzed statistically.

Gibberellic Acid Rate and Seed Rate

The germination conditions were the same as the experiments described above.

The GA_3 rates were expressed as micrograms (ug) of GA_3 per milligram (mg) seed. GA_3 rates used were 0, 2, 4, 6 and 8 ug/mg seed.

Seed rates were expressed as milligrams (mg) of seed per cubic centimeter (cc) of solution. Seed rates used were 25, 50, 75 and 100 mg/cc solution.

One hundred cc of solution was used per column and the quantity of seed was calculated according to the seed rate for each treatment. The

same criteria were used to calculate the quantity of GA_3 for each treatment. The experiments were carried out separately for each cultivar included. Two replications were used for each treatment in a completely randomized block design with factorial arrangement of the treatments.

From previous experiments it was learned that it was not necessary to have the seed in the GA_3 solutions for a long period of time (as described in the second experiment) to promote germination. It was determined that after a certain period of imbibition in distilled water, depending on the cultivar, the seed will respond to the application of GA_3 in the next 24 hours after imbibition. Imbibition time was determined for each cultivar when the first radicle was observed.

The seed were imbibed in distilled water and then changed to GA_3 solutions for 24 hours. The following imbibition times were used for each of the following cultivars included in this study:

Twenty four hours for cultivars 'California Wonder P.S.' (CWPS) and 'Papaloapan'. Forty eight hours for cultivars 'BHC' and 'T74'. Sixty hours for cultivar 'KS1'.

After the germination data was collected, 20 germinated seed from each treatment were sown in a tray using Terralite Redi-Earth Peat-Lite Mix as a growing medium. The trays were placed in an incubator (GE Model 806) at 30 °C and 12 hours light. Emergence data was recorded every 24 hours. After no more seedlings emerged the trays were transferred to room conditions (29 to 30 °C and daylight) in the laboratory. The seedlings were grown for 20 days and then the tops were harvested and dried in an oven at 100 °C for three days before determining dry weight per seedling.

From the emergence data the following variables were generated and

analyzed: Total percent emergence, emergence rate, days to 50% emergence (T50), uniformity of emergence and the emergence value (6).

The emergence rate was calculated by adjusting the daily emergence data to fit a linear trend. As Czabator (6) pointed out, seed germination does not follow a linear trend. Depending on the species, germination will proceed very slow in the first two or three days and then a very rapid increase in the germination rate will be observed until small or no increments are observed. In order to evaluate the germination speed and the completeness of germination in comparing cultivars or seed lots, Czabator (6) proposed to find out when the germination rate reaches its maximum value and use that value multiplied by the mean daily germination to calculate the germination value for each cultivar or seed lot. The maximum value of the germination rate is called the peak value and it is calculated by dividing the cumulative percent daily germination by the number of days from sowing for each count corresponding to that particular percent germination.

In these studies, the peak value was calculated in the same manner as explained before. Once the peak value for each observation was found, the peak day (days from sowing corresponding to that peak value) was determined. In order to calculate the emergence rate which corresponds to the slope of the line in the linear equation, only the daily emergence data collected up to the peak day was used in the calculations. The emergence rate was expressed as the number of seedlings emerged per day.

The T50 and uniformity (the span of time between days to 10% emergence and 90% emergence) were calculated from the linear equation, after calculating the emergence rate.

The emergence value was calculated in the same manner as the germination value. It was called emergence value to mean that it is applied to germinated seed studies.

After the analysis of variance was calculated for each variable, the trend of each independent variable was investigated by partitioning the total sum squares for each factor into single degrees of freedom.

Storage of Germinated Seed Studies

Temperatures, Cultivars and Storage Periods

Six pepper cultivars were included in these studies: 'CWS', 'KS1', 'Esmeralda', 'Verdeño', 'T74' and 'Mulato Roque.' Storage temperatures were 0, 1, 2, 3, 4, 5 and 6 °C. Four periods of storage were used: 1, 2, 4 and 6 days.

Fifteen germinated seed with 1.0 to 1.5 cm radicle length were placed on Whatman #2 filter paper in a petri dish 9 cm in diameter containing 10 cc of distilled water.

A completely randomized block design with split plot arrangement of the treatments with two replications was used.

A Freas 818 GCA/Precision Scientific incubator was used. Petri dishes were placed on the top shelf of the incubator. Cultivars and storage period were randomized within the incubator and the temperatures were randomly replicated two times. In that way, temperatures were the main plots, cultivars and storage periods were the subplots.

The temperatures were recorded with a thermograph and a YSI Model 42 SC Telethermometer was used to make sure that the temperature was that desired in each particular experiment.

After cold storage treatment, the germinated seed were sown in a

flat in the greenhouse (25 to 30 °C and normal daylength). The growing medium was Terralite Metro-Mix.

Emergence data was taken daily. The variables analyzed were total percent emergence, emergence rate, days to 50% emergence and uniformity. The emergence rate was calculated in the same manner as explained in the seed germination studies.

Temperatures, Cultivars and Chemicals

The cultivars used in these studies were as follows: 'California Wonder P.S.' (CWPS), 'KS1', 'BHC', 'T74' and 'Verdeño'.

The temperatures used were 0 and 5 °C. Germinated seed were stored for six days.

Six different treatments were given to the germinated seed during storage: Distilled water, tween 20 0.05%, castor bean oil (Medic) 60%, peanut oil (Planter's oil) 60%, sodium benzoate (MW 144.11) 100 ppm, ethoxyquin (1,2-dihydro-6-etoxy-2,2,4-trimethylquinoline) 300 ppm, L-ascorbic acid (MW 176.12) 100 ppm and calcium chloride ($CaCl_2$ MW 110.99) 1 mM. All solutions were prepared with tween 20 0.05% and distilled water.

Seed were germinated in aerated columns immersed in a water bath at 30 °C. GA_3 at 6 ug/mg seed and 75 mg seed/cc solution for 24 hours was used to stimulate uniform germination.

Thirty germinated seed, 1.0 to 1.5 cm in radicle length, were placed on a Whatman #3 filter paper in a petri dish 9 cm in diameter with 4 cc of solution.

After storage for six days, 20 germinated seed were taken from the petri dish and sown in a tray containing sand. Trays were placed in a

General Electric Model 806 incubator at 30 °C constant temperature and 12 hours light. The remaining 10 germinated seed were used to determine K, Ca, and reducing sugars in the leachate.

One experiment was run separately for each temperature and cultivar. The chemical treatments were replicated 3 times for each cultivar and temperature. A completely randomized design was used.

For each storage temperature and cultivar, a non-storage treatment was included. Germinated seed were sown as described above (20 seed) immediately after the germination period had ended in the aerated columns. Ten more germinated seed were used for leachate analysis. The non-storage treatment was compared with the distilled water treatment from the two storage temperatures. The non-storage treatment was sown at the same time as the storage treatment.

Emergence data was taken daily. The variables analyzed from this data were total emergence, days to 50% emergence (T50), uniformity and emergence rate.

Seedlings one month old were harvested from the trays. The roots were washed carefully, examined and the number of damaged radicle tips was recorded as a percentage of the total seedlings emerged for each treatment. Radicle length was also measured at this time.

Dry weight of shoots and roots was determined after drying the seedlings at 100 °C for 3 days.

For leachate analysis the samples were prepared as follows: after the storage treatment 10 germinated seed were washed for 30-minutes in deionized water; the water was discarded and replaced by 15 cc of deionized water. The samples were shaken for 24 hours at room temperature (28 to 30 °C) and filtered through Schleicher and Schuell analytical

paper #604.

A Perkin Elmer Model 303 Atomic Absorption Spectrophotometer was used for determination of K (383 nm wavelength, visible, filter on) and Ca (211 nm wavelength, visible, no filter). Dionized water was used to zero the instrument and to prepare standard solutions of known concentrations used to determine the concentration of each element in the leachate.

The conductivity of the leachate was measured with a Markson Electromark Analyzer Model 4405.

Reducing sugars were determined using the Nelson Test, as described by Moore (22). One cc of leachate solution was used for each sample. The optical density readings were done in a Bausch and Lomb Spectronic 20 Spectrophotometer at 540 nm.

Fatty Acid Composition Analysis

Fatty Acid Composition Analysis in Dry Seed. Dry seed of the following cultivars was used: 'CWS', 'CWPS', 'KS1', 'BHC', '574', 'Esmeralda', 'Verdeño' and 'Mulato Roque'.

The seed was thoroughly dried and ground to a 20 mesh powder.

For oil extraction, 10 g of powder was placed in a 120 cc beaker with 100 cc Hexane practical. The beaker was covered with a watchglass and heated on a steam bath until most of the solvent had evaporated. The contents in the beaker were swirled and decanted through Whatman #1 filter paper in a conical funnel into a 10 cc vial. The filtrate was evaporated in a vacuum oven at 40 °C until there was no remaining hexane odor.

The oil extracted was esterified by placing 20 mg of oil (two drops)

in a test tube with 4 cc of sodium dried benzene, 0.4 cc of 2,2-dimethoxypropane and 0.5 cc of methanolic HCl (lipopure methanol + acetyl chloride). After adding the benzene and dimethoxy propane, the contents in the test tube were mixed by agitation, then the methanolic HCl was added and mixed by agitation until the sample appeared to be one phase. Each test tube was sealed with parafilm, wrapped with aluminum foil and allowed to stand overnight in the hood.

After esterification, the contents in the test tube were evaporated with nitrogen until a few drops remained in the test tube. One cc of sodium dried benzene was added to the ester, mixed, and 1.5 ul of sample was taken for fatty acid composition determination.

Fatty acid composition was determined using a Perkin Elmer 990 Gas Chromatograph, equipped with a Hydrogen Flame Detector (HFD). The sample was separated on a 1.8 mm x 2.8 m glass column packed with Chromasorb W 20% DEGS (Diethylene Glycol Succinate). The carrier gas was nitrogen at a flow rate of 40 ml/min. The temperature program was isothermal. Column temperature was 190 °C with 250 °C in both the injector and the detector.

Separation patterns (retention times) were determined using known methyl esters as standards for the following fatty acids: Laurate (C12:0), myristate (C14:0), palmitate (C16:0), palmitoleic (C16:1), stearic (C18:1), oleic (C18:1), linoleic (C18:2) and linolenic (C18:3).

After identification of the peaks for each sample on the chart, the area of each peak was calculated with a Aristo Model 1100A Planimeter. The sum of all peaks identified was considered as 100 and the proportion of each fatty acid in the sample was calculated as a percent of the total fatty acids.

The data was analyzed using a completely randomized design with five observations per cultivar. There was an analysis of variance for each of the fatty acids indentified. The ratio of the C18 unsaturated to saturated fatty acids was calculated by adding the percentages for oleic, linoleic and linolenic and dividing by the percentage of stearic acid. This was called Ratio A.

The linoleic/linolenic ratio was called Ratio B. Ratio C was the linoleic/oleic ratio. Ratio G was the sum of all unsaturated fatty acids compared to the sum of all saturated fatty acids.

Fatty Acid Composition Analysis in Germinated Seed, Shoots and Roots. Germinated seed of the cultivars 'CWPS' AND 'KS1' was used in these studies.

Twenty grams of dry seed were germinated in aerated columns, at 30 °C using GA_3 at a rate of 6 ug/mg seed and 75 mg seed/cc of solution, for 24 hours.

Germinated seed was stored for six days in petri dishes on Whatman #3 filter paper at 0 and 5 °C. A non-stored treatment was included. Seed from the non-stored treatment were sown immediately after germination ended, and at the same time as the stored treatments.

Before storage, germinated seed were dipped for 5 minutes in 40 cc of the following solutions: distilled water, castor bean oil 60%, sodium benzoate 100 ppm and L-ascorbic acid 100 ppm. All solutions were prepared with distilled water and tween 20 0.05%.

After the storage period half of the seed was sown in a flat in the greenhouse. Terralite Redi-Earth Peat-Lite Mix was used as a growing medium. The remaining half was dried, ground to a 20 mesh powder and

oil was extracted and analyzed as described above.

One month old seedlings were harvested from the flats in the greenhouse, their roots were thoroughly washed and the seedlings were dried at 100 °C for 3 days. Shoots and roots were ground separately and the oil was extracted and analyzed as described above.

The data was analyzed as a completely randomized design with 3 observations per treatment. Each cultivar and temperature were considered separately. The data for the non-stored treatment was compared with the distilled water treatment included in each storage temperature and cultivar.

CHAPTER IV

RESULTS AND DISCUSSION

Seed Germination Studies

Preliminary Studies

Seed Germination in Distilled Water. The evaluation of germination using only distilled water showed that almost all cultivars reached a total germination percentage above 90%. The germination speed and uniformity were not desirable for fluid drilling germinated seed. Uniformity in radicle length is very important for fluid drilling. Data from this experiment showed that by the time some of the cultivars reached 50% germination most of the radicles of earlier germinating seed were too long to be sown. The data is summarized in Table I. (Table V, Appendix A).

Seed Germination in Gibberellic Acid Solutions. Since there was not much information on the effect of GA_3 on pepper seed germination the first steps were to investigate the concentration of GA_3 at which seed of different pepper cultivars would respond. Results of these studies are presented in Table II.

There were significant differences in the response of GA_3 treated seed compared with the control which was distilled water.

In general, the best concentrations for all cultivars were 200 and 400 ppm. Even very vigorous seed, like jalapeño 'Papaloapan' responded

TABLE I

TOTAL PERCENT GERMINATION, GERMINATION RATE, T50 AND UNIFORMITY FOR SEED OF SIX PEPPER CULTIVARS GERMINATED IN AERATED COLUMNS USING DISTILLED WATER

Cultivars	Total Germination (%)	Germination Rate (seed/day)	T50 (days)	Uniformity (days)
California Wonder Select	96	13.7	5.7	5.6
Bahemian Hot Chili	95	20.7	4.0	3.7
Kalspice #1 Sweet Paprika	97	29.4	3.0	2.6
Verdeño	88	11.9	5.2	6.2
Papaloapan	100	45.5	1.9	1.7
Tampiqueño 74	90	26.4	2.8	4.1

The germination period was 10 days. 100 seed/column.

TABLE II

EFFECT OF GIBBERELLIC ACID CONCENTRATIONS ON TOTAL PERCENT SEED GERMINATION IN AERATED COLUMNS OF SEVEN PEPPER CULTIVARS

Cultivars	GA_3 Concentration (ppm)						L^x	Q^w	r^2	C.V.
	0	200	400	600	800	1000				
California Wonder Select[z]	2.7	60.7	81.0	79.0	79.7	71.3	**	ns	.97	8.4
Bahemian Hot Chili[z]	7.0	87.3	91.0	87.7	85.0	87.7	***	***	.99	5.4
Kalspice #1 Sweet Paprika[z]	40.3	94.3	91.0	92.0	94.7	93.0	***	***	.99	1.9
Verdeño[z]	19.0	76.7	78.3	74.7	78.7	79.3	***	*	.97	5.7
Papaloapan[y]	78.0	100.0	99.7	99.3	99.7	100.0	***	**	.97	1.9
Tampiqueño 74[y]	16.0	73.3	70.7	74.7	70.0	54.3	**	***	.69	28.2
Real Mirasol[y]	16.0	62.0	62.3	62.7	57.7	59.0	***	**	.95	8.8

[z]Experiments were terminated after three days.
[y]Experiments were terminated after two days.
[x]Linear.
[w]Quadratic.
*Significant at 5%.
**Significant at 1%.
***Significant at 0.01%.
[ns]Not Significant.

to the GA_3 treatment. For most of the cultivars, concentrations greater than 200 ppm did not substantially increase germination. For cultivars 'CWS' and 'T74', concentrations of 1000 ppm actually decreased the germination compared with the other GA_3 rates. Radicle length was uniform for all the GA_3 rates. The GA_3 treatments improved germination speed and some cultivars reached their maximum percent germination in a period of only 2 to 3 days.

Gibberellic Acid Rates and Seed Rates

The results obtained in the preliminary experiments with GA_3 were encouraging and showed that it was possible to accelerate pepper seed germination and have good uniformity in radicle length. Results indicated no need for high concentration of GA_3 to significantly increase the germination rate.

Unfortunately, when results were analyzed from the economical point of view, even the lowest concentration would be very expensive to use since the quantity of seed used (100 seed) was very small compared to the quantity of GA_3 in the solutions.

The next step was to find out how much GA_3 was needed for a given weight of seed to improve the germination rate and at the same time be economical to use in the fluid drilling system. Another factor considered was the concentration of seed for a given volume of solution. This factor will modify other factors in the germination environment due to competition for oxygen, water, generation of heat and accumulation of inhibitors leaching from the seed during germination.

Results for the five cultivars included in this study regarding the percent germination in the columns are summarized in Table III and

TABLE III

EFFECT OF GIBBERELLIC ACID RATES AND SEED RATES ON THE PERCENT GERMINATION OF FIVE PEPPER CULTIVARS GERMINATED IN AERATED COLUMNS

Variables	California Wonder P.S.	Bahemian Hot Chili	Kalspice #1 Sweet Paprika	Papaloapan	Tampiqueño 74
GA_3 Rates (ug/mg seed)					
0	11.3	73.3	33.8	60.8	48.4
2	26.7	77.6	39.8	70.1	55.7
4	39.2	77.0	43.6	72.0	62.5
6	48.3	80.2	44.8	78.1	61.1
8	52.9	79.7	37.5	75.5	72.7
GA_3 Rate Linear	***	**	*	***	***
GA_3 Rate Quadratic	***	ns	***	***	ns
GA_3 Rate Cubic	ns	ns	ns	ns	ns
Seed Rates (mg/cc sol.)					
25	31.4	84.3	41.7	70.5	65.3
50	35.2	80.2	40.9	73.0	59.3
75	40.0	74.4	37.6	69.7	58.3
100	36.0	70.5	39.3	72.1	57.4
Seed Rate Linear	**	***	ns	ns	**
Seed Rate Quadratic	**	ns	ns	ns	ns
Number of Seed/gram	122.0	253.0	159.0	148.0	191.0

*Significant differences at 5%.
**Significant differences at 1%.
***Significant differences at 0.01%.
nsNot significant.

Figures 1 and 2, and in Tables VI, VII, IX, X, XII, XIII, XV, XVI, XVII and XIX of Appendix A.

The analysis of variance showed significant differences amongst GA_3 rates and amongst seed rates. No significance was shown for the interaction between the two factors.

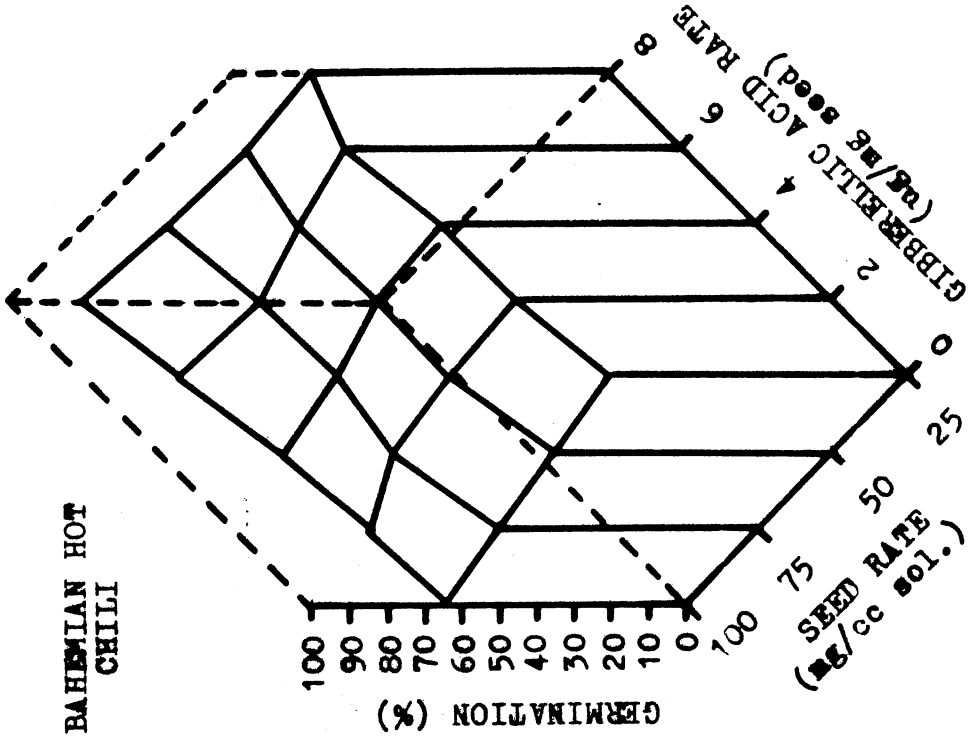
In general, percent germination increased as the GA_3 increased from 2 to 6 ug/mg seed. In cultivars 'CWPS' and 'T74' the highest germination was obtained with 8 ug GA_3/mg seed. For the other three cultivars, 8 ug/mg seed was less effective in stimulating germination than 6 ug/mg seed.

For all cultivars the percent germination decreased as the quantity of seed in the column increased from 25 mg/cc solution to 100 mg/cc solution. This trend was more prominent in 'BHC' and 'T74' than in other cultivars. It is important to point out that the number of seed per gram (Table III) in those cultivars was greater than in 'CWPS', 'KS1' and 'Papaloapan'. A greater number of viable seed in the same volume of solution, regardless the GA_3 rate, in fact modified the conditions for germination in the column. Competition for oxygen was increased, more inhibitors leached in the same volume of solution and created an environment less favorable for germination.

These data point out the importance of considering the seed as a living unit, as well as its weight, in planning germination studies. Where seed will remain in water, like aerated columns, it will be very important to have a device which delivers the amount of oxygen that is needed for a given volume of solution.

In these experiments it was assumed that the conditions regarding oxygen supply were the same for all the columns in the germinator since

Figure 1. Effect of gibberellic acid rates and seed rates on the percent germination of pepper (cultivars 'California Wonder P.S.' and 'Bahemian Hot Chili') in aerated columns.


BAHEMIAN HOT CHILI
GERMINATION (%)
100 90 80 70 60 50 40 30 20 10 0
SEED RATE (mg/cc sol.)
0 25 50 75 100
GIBBERELLIC ACID RATE (ug/mg seed)
0 2 4 6 8

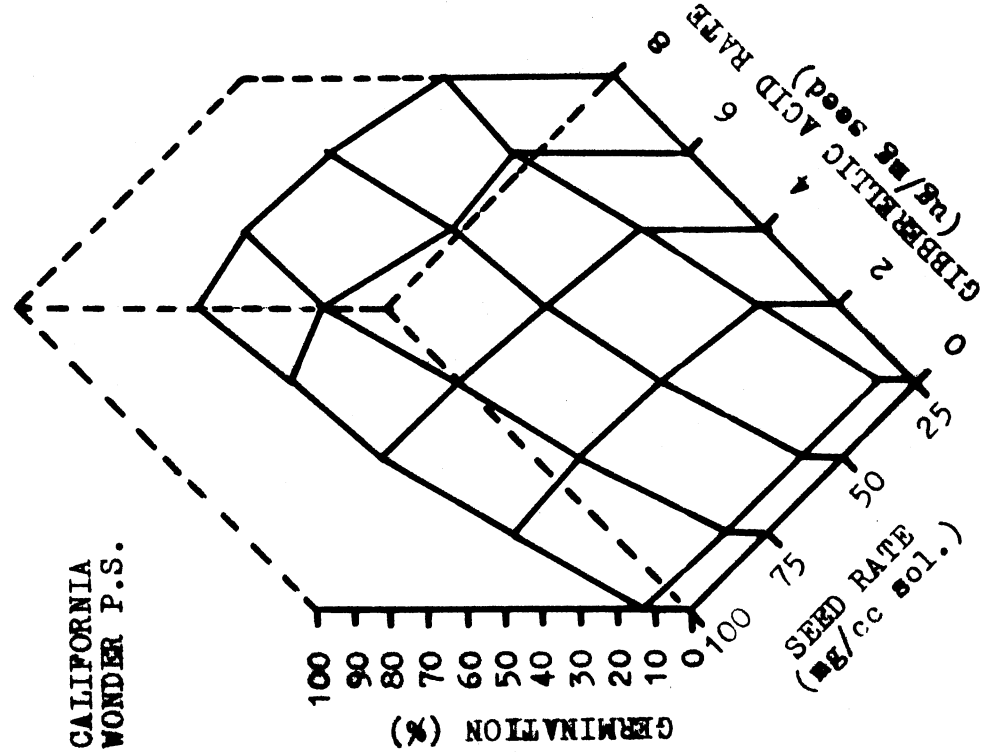
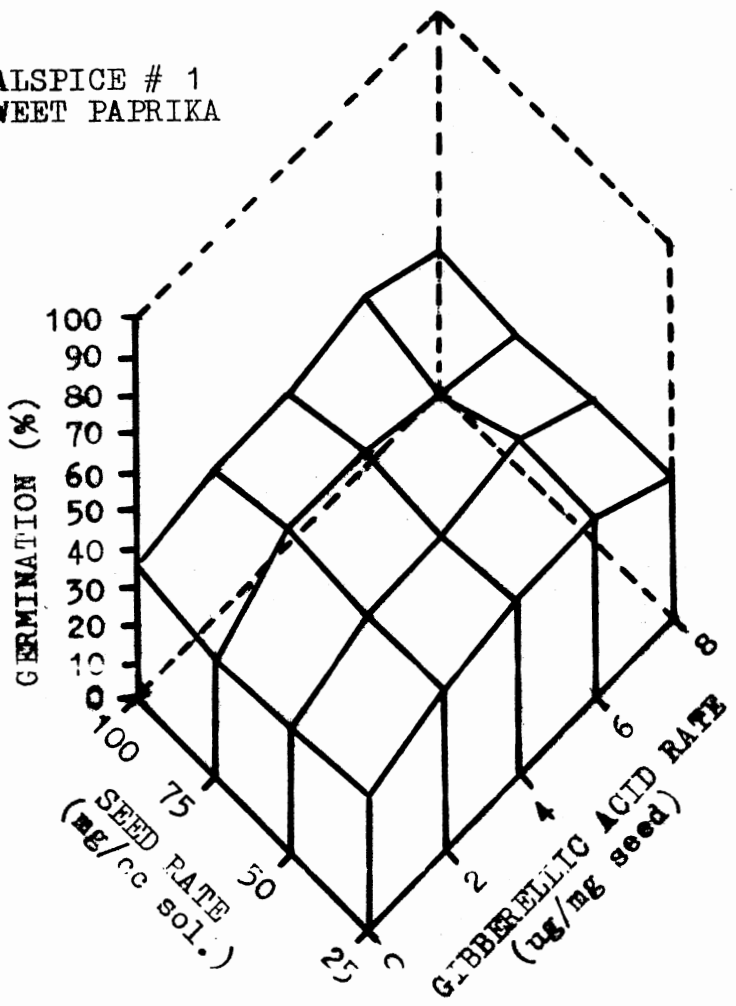
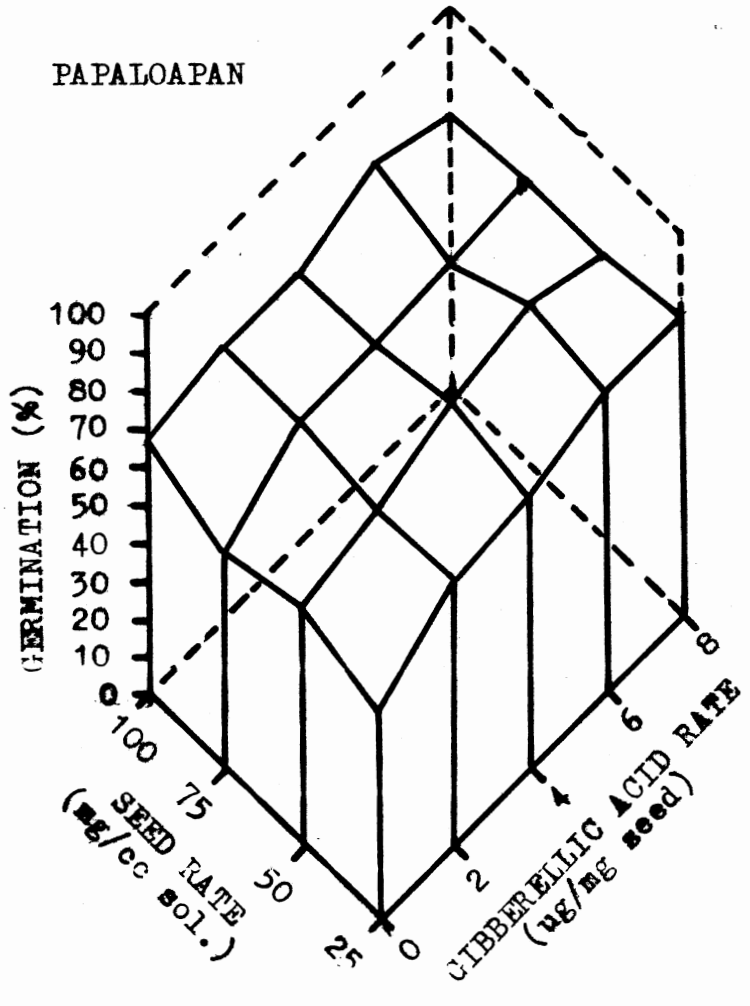

CALIFORNIA WONDER P.S.
GERMINATION (%)
100 90 80 70 60 50 40 30 20 10 0
SEED RATE (mg/cc sol.)
0 25 50 75 100
GIBBERELLIC ACID RATE (ug/mg seed)
0 2 4 6 8

Figure 2. Effect of gibberellic acid rates and seed rates on the percent germination of pepper (cultivars 'Kalspice #1 Sweet Paprika' and 'Papaloapan') in aerated columns.

KALSPICE # 1
SWEET PAPRIKA



PAPALOAPAN



the variability due to other factors different from the treatments involved in the experiments was low (Tables VII, X, XII, XVI and XIX, Appendix A).

Results of GA_3 experiments on seed germination of pepper generally agree with the findings of other researchers (2, 3, 14, 15, 24, 25, 30).

The results for the emergence studies are presented in Table IV and Figure 3, and Tables VI, VIII, IX, XI, XII, XIV, XV, XVII, XVIII, and XX of Appendix A.

In general, for all cultivars, the emergence was faster when seed were treated with GA_3 up to 6 ug/mg seed. Eight ug/mg seed seemed to delay seedling emergence, except for cultivar 'BHC' and 'Papaloapan' which emerged faster at that rate than at the lower rates (Table IV). Eight ug GA_3/mg seed delayed seedling emergence, but after the seedlings started to emerge the rate of emergence was very fast (Figure 3). For all cultivars except 'CWPS' there were no significant differences amongst the GA_3 rates regarding the total percent emergence.

Effect of seed rate on the speed of emergence of the germinated seed was greater in the cultivars 'BHC', 'T74' and 'Papaloapan'. The higher the seed rate for those cultivars the slower the emergence (Tables III and IV).

Cultivars 'CWPS' and 'KS1' did not show significant differences in speed of emergence due to seed rate.

All cultivars except 'T74', showed lower seedling weight when no GA_3 was applied during germination. For cultivars 'BHC' and 'T74', 8 ug GA_3/mg seed significantly decreased the seedling dry weight compared with the other GA_3 rates and the control (Table IV). This may be

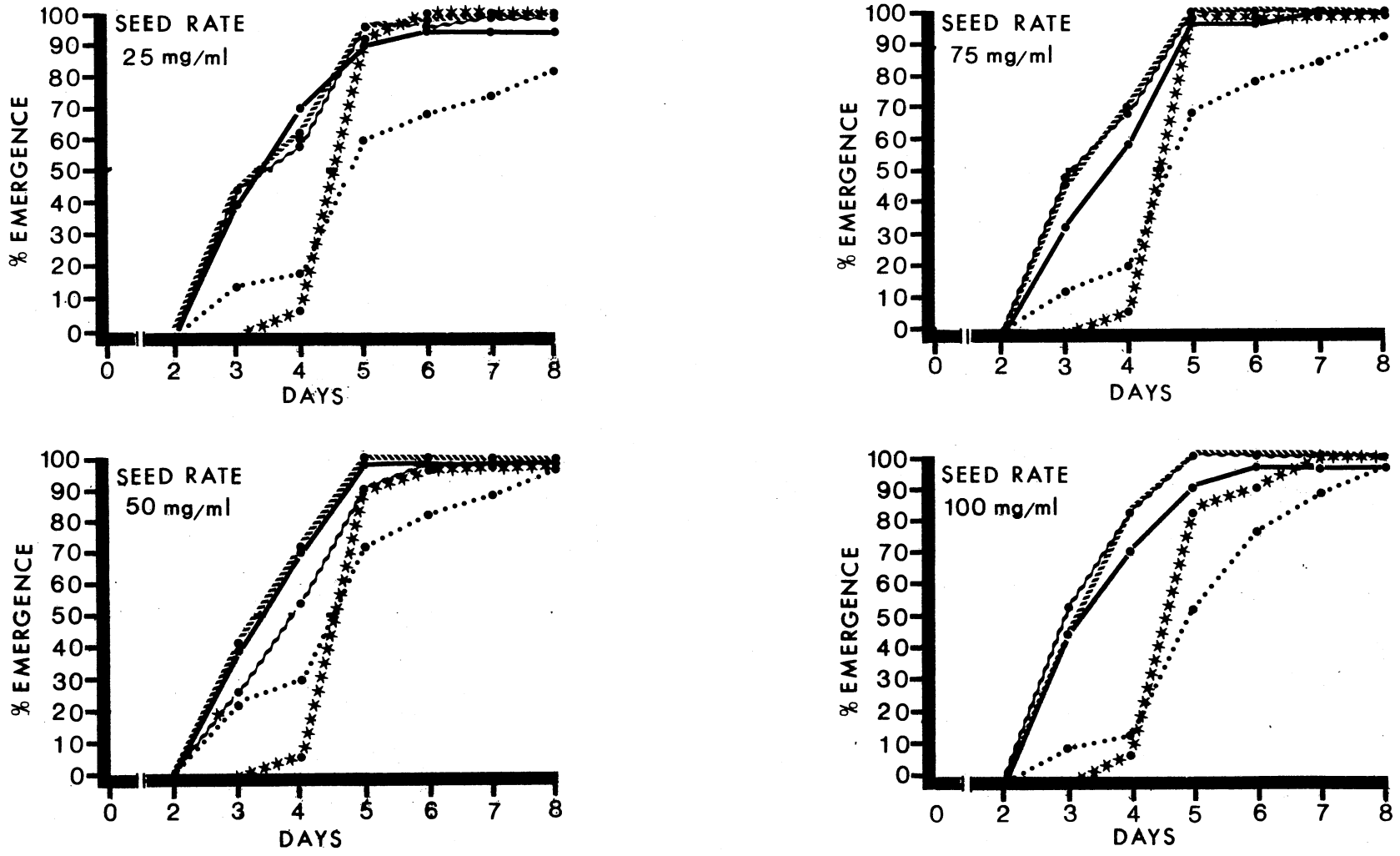
TABLE IV

EFFECT OF GIBBERELLIC ACID RATES AND SEED RATES ON THE DAYS TO 50% EMERGENCE AND SEEDLING DRY WEIGHT (mg/SEEDLING) FROM GERMINATED SEED OF FIVE PEPPER CULTIVARS

Variable	California Wonder P.S.		Bahemian Hot Chili		Kalspice #1 Sweet Paprika		Jalapeño 'Papaloapan'		Serrano 'Tampiqueño 74'	
	Days	mg	Days	mg	Days	mg	Days	mg	Days	mg
GA_3 Rates (ug/mg seed)										
0	4.5	8.5	3.2	7.8	3.2	6.4	3.4	13.8	3.5	11.4
2	3.2	12.0	3.1	8.1	3.2	6.7	3.5	15.2	3.5	11.2
4	3.2	12.5	3.1	8.6	3.2	6.8	3.5	13.9	3.4	10.6
6	3.3	12.0	3.1	8.9	3.1	6.9	3.2	14.4	3.5	9.7
8	4.4	13.8	2.7	5.6	3.9	6.5	3.0	14.3	3.5	8.0
GA_3 Rate Linear	ns	***	***	***	***	***	**	ns	ns	***
GA_3 Rate Quadratic	***	**	**	***	***	**	*	ns	*	*
GA_3 Rate Cubic	ns	***	***	***	***	*	ns	ns	ns	ns
Seed Rates (mg/cc sol.)										
25	3.8	11.1	2.8	6.7	3.4	6.5	3.2	14.7	3.2	10.6
50	3.8	11.6	3.1	8.1	3.2	7.3	3.3	15.5	3.5	10.5
75	3.7	12.6	3.1	8.3	3.4	7.3	3.4	14.7	3.6	10.0
100	3.7	11.8	3.2	8.0	3.3	7.2	3.5	12.4	3.5	9.6
Seed Rate Linear	ns	ns	***	***	ns	*	**	*	**	*
Seed Rate Quadratic	ns	ns	***	*	ns	*	ns	*	**	ns
C.V. (%)	8.7	10.7	6.3	10.0	7.0	9.8	8.9	17.3	8.3	13.1
R-Square	0.86	0.83	0.78	0.87	0.82	0.87	0.62	0.48	0.47	0.67

*Significant differences at 5%.
**Significant differences at 1%.
***Significant differences at 0.01%.
nsNot significant.

Figure 3. Effect of gibberellic acid rates and seed rates on the cumulative daily emergence from germinated pepper seed (cultivar 'California Wonder P.S.').


SEED RATE
25 mg/ml
SEED RATE
75 mg/ml
SEED RATE
50 mg/ml
SEED RATE
100 mg/ml
% EMERGENCE
DAYS
0 2 3 4 5 6 7 8
0 10 20 30 40 50 60 70 80 90 100
.....0 ug GA3/mg SEED
2 ug GA3/mg SEED
4 ug GA3/mg SEED
6 ug GA3/mg SEED
*****8 ug GA3/mg SEED

related to spindly growth. Although seedling height was not measured no apparent differences were observed when the plants were growing in the trays.

If these germinated seed had been sown in soil they might have shown the effect of high GA_3 rate on the emergence and subsequent dry matter production as observed by Buxton et al. (3) in Pima cotton. The growing medium may influence seedling emergence and growth.

The dry weight per seedling decreased as the seed rate increased for cultivars 'T74' and 'Papaloapan'. For the other cultivars, the trend was not the same but 100 mg seed/cc solution produced lower seedling dry weight compared with the other rates except 25 mg seed/cc solution.

Results showed that stimulation of germination did not always increase speed of emergence. If we compare the data for cultivar 'CWPS' in Tables III and IV it shows that the highest percent germination was obtained with 8 ug GA_3/mg seed (Table III). However, this treatment was the slowest in emergence, excluding the control (Table IV). In general, the control (0 ug GA_3/mg seed) gave the lowest percent germination in the columns, and the rate and uniformity of emergence was poorer than for the other GA_3 rates.

Tables III and IV indicate that high seed rate for cultivars 'BHC' and 'T74' resulted in slower emergence. 'T74' had lower dry weight when more seed per the same volume of solution was used.

Using GA_3 for germinating pepper seed for fluid drilling would add \$6 to \$8/acre to planting costs (6 to 8 ug GA_3/mg of dry seed and 50 to 75 mg of seed/cc of solution). This additional cost is low to gain uniformity in seedling stand and uniformity in the quality of the fruits.

Although these results need to be tested under the field conditions to determine their commercial value. It is worthwhile to further investigate products or techniques to improve speed, uniformity and total percent germination and emergence of germinated pepper seed in the field.

Seed of many types and cultivars of pepper have very poor germination even under ideal conditions. This is reflected in the minimum percent germination (60%) at which pepper seed can be legally sold (18). Something should be developed to invigorate the seed no matter what sowing technique is used.

Storage of Germinated Seed Studies

Temperatures, Cultivars and Storage Periods

These studies were conducted in order to find out how long germinated seed is able to withstand different storage temperatures. Different cultivars were included, to determine for each one the optimum temperature and storage period.

The results are presented in Figures 4, 5, 6, 7 and 8, and in Tables XXI through XXVIII in Appendix B.

Low temperatures from 0 to 3 °C were detrimental for the total emergence in all cultivars stored for more than 4 days.

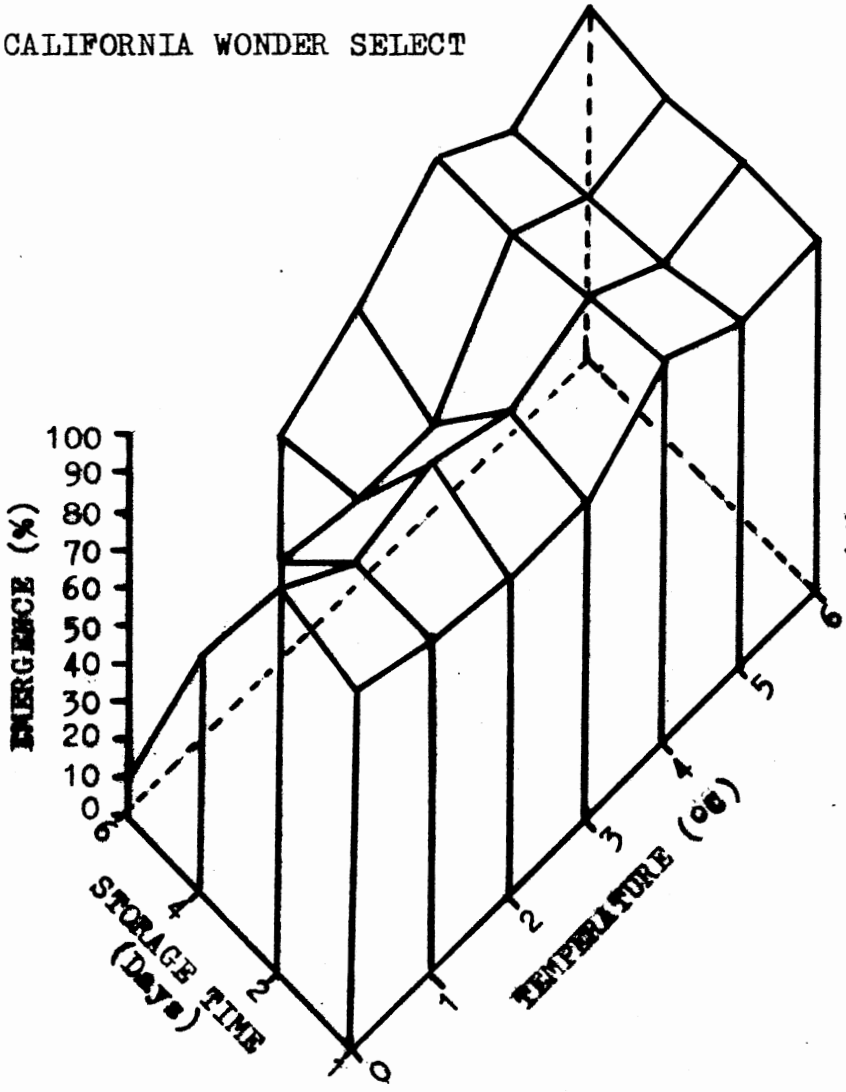
In general, the longer the storage the more harmful was the effect on total emergence.

There were significant differences among cultivars. 'CWS' was the most sensitive to low temperatures. 'T74' was the least sensitive.

The harmful effect of low temperatures and long storage was reflected in the speed of emergence, shown in Figures 7 and 8.

Figure 4. Effect of temperature and storage period on the total emergence of germinated pepper seed (cultivars 'California Wonder Select' and 'Kalspice #1 Sweet Paprika').

CALIFORNIA WONDER SELECT



KALSPICE # 1 SWEET PAPRIKA

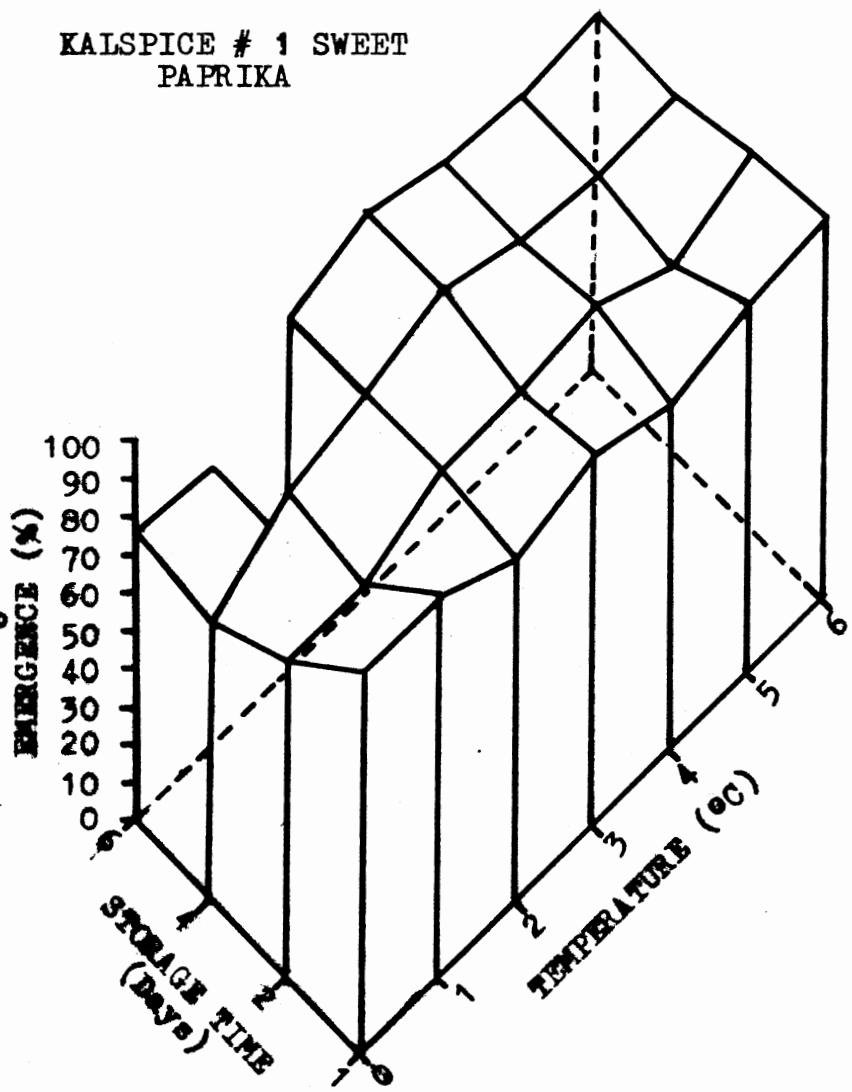
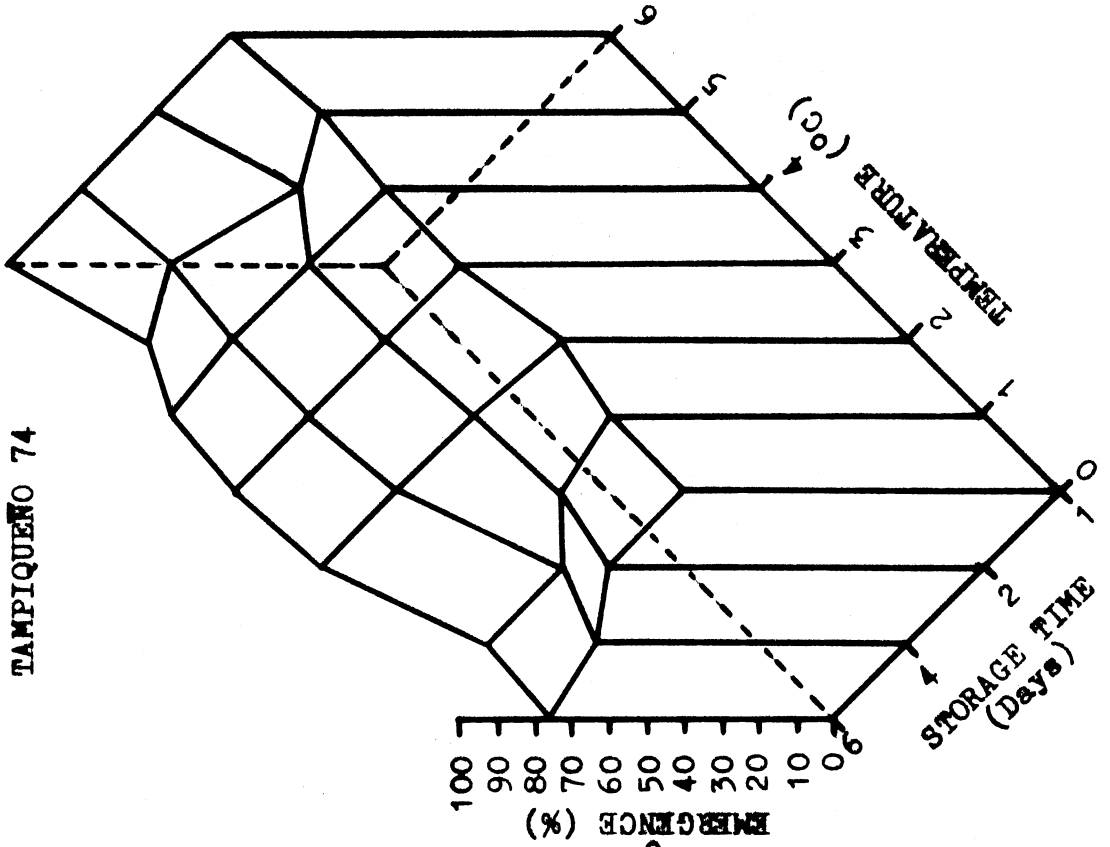


Figure 5. Effect of temperature and storage period on the total emergence of germinated pepper seed (cultivars 'Verdeño' and 'Tampiqueño 74').


TAMPIQUEÑO 74
EMERGENCE (%)
100
90
80
70
60
50
40
30
20
10
0
STORAGE TIME (Days)
0
1
2
4
6
TEMPERATURE (°C)
1
2
3
4
5
6

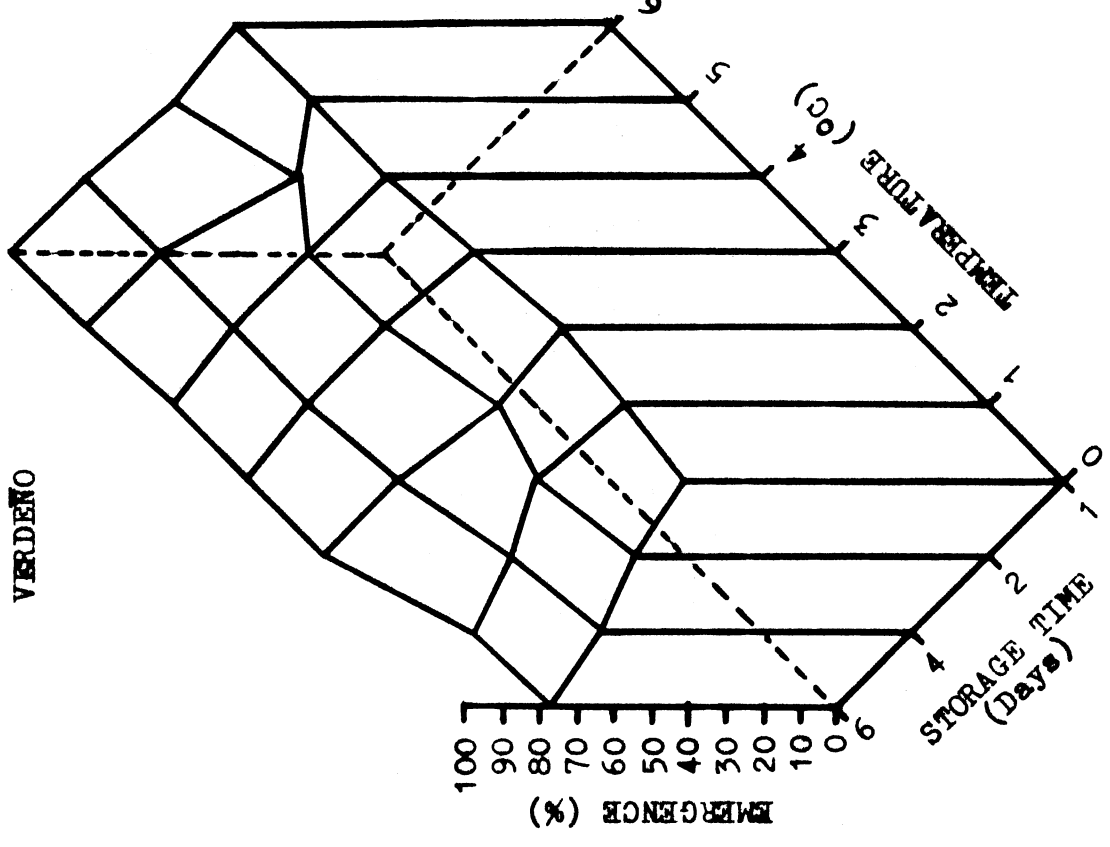

VERDEÑO
EMERGENCE (%)
100
90
80
70
60
50
40
30
20
10
0
STORAGE TIME (Days)
0
1
2
4
6
TEMPERATURE (°C)
1
2
3
4
5
6

Figure 6. Effect of temperature and storage period on the total emergence of germinated pepper seed (cultivars 'Esmeralda' and 'Mulato Roque').

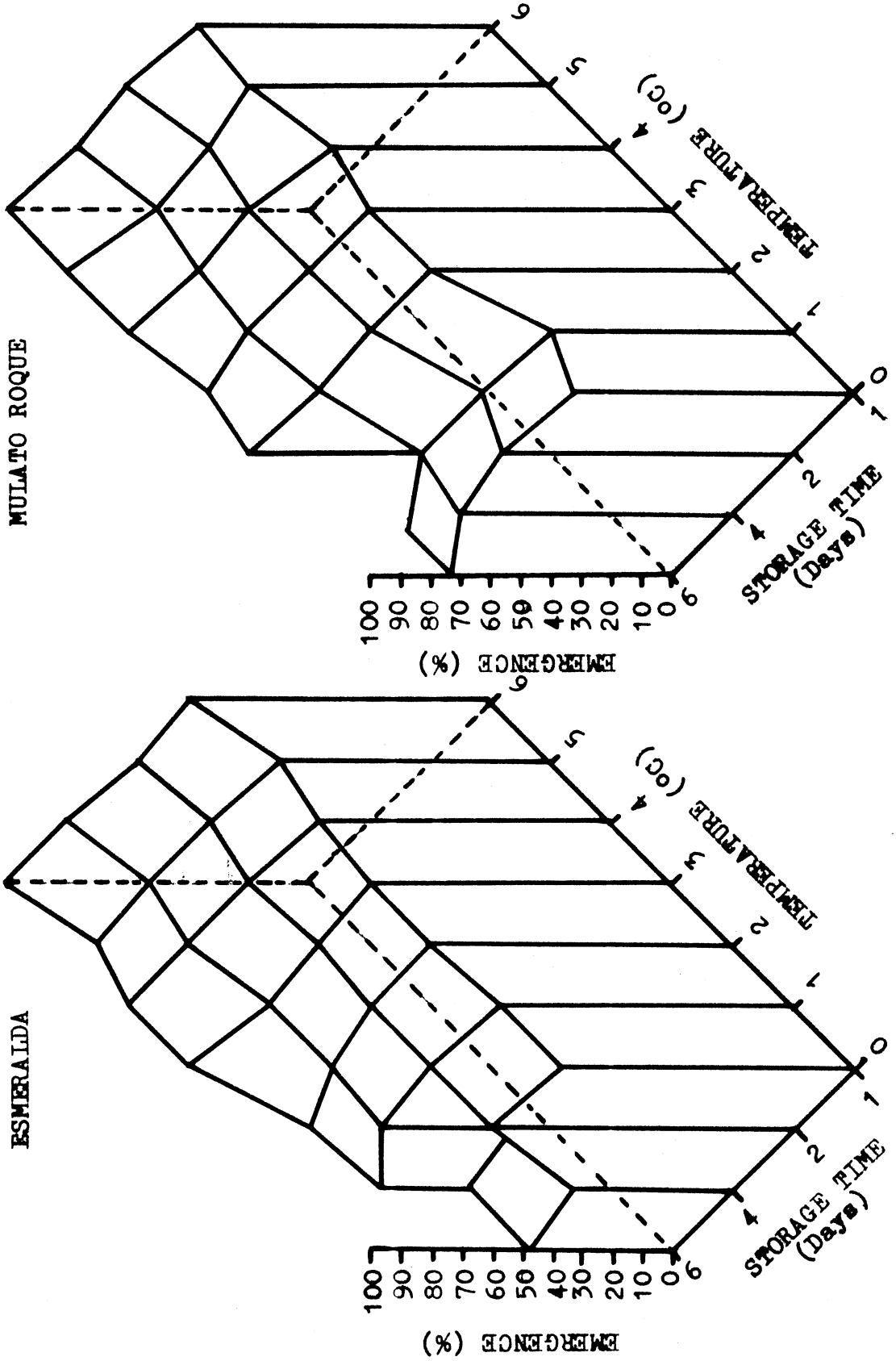
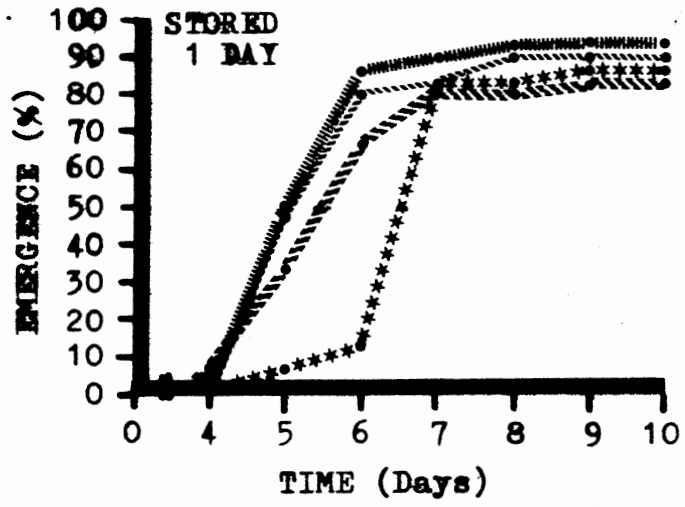
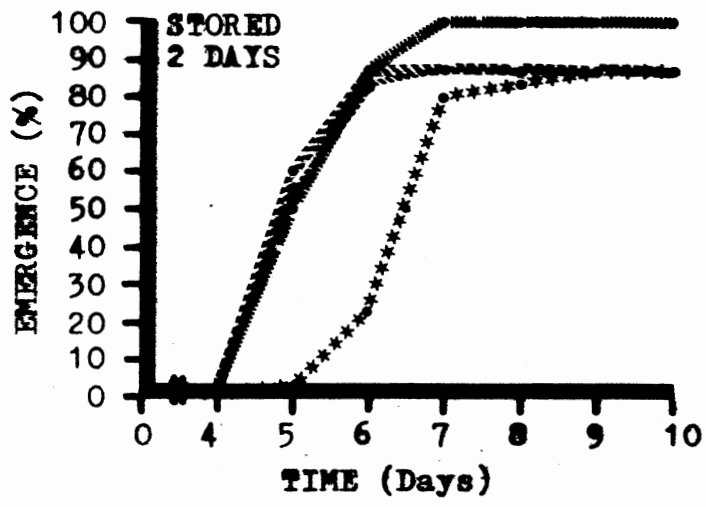
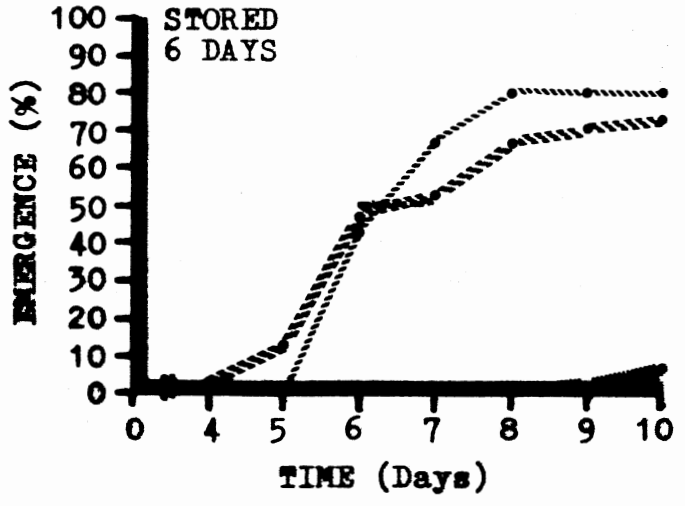
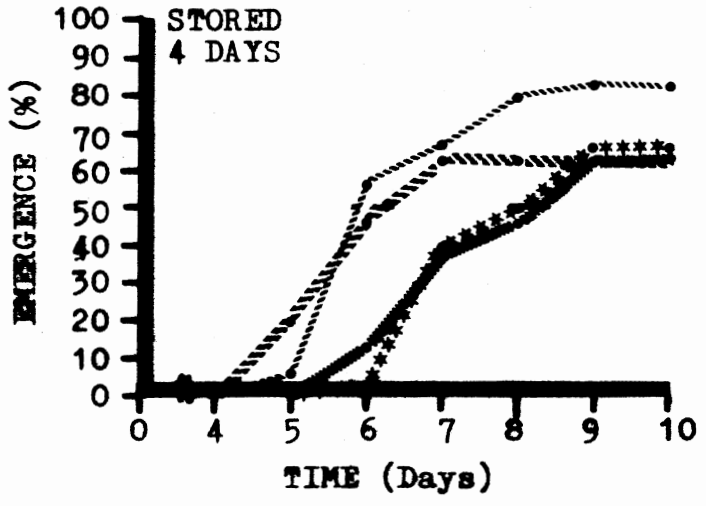

MULATO ROQUE
EMERGENCE (%)
100
90
80
70
60
50
40
30
20
10
0
STORAGE TIME (Days)
0
1
2
4
6
TEMPERATURE (°C)
1
2
3
4
5
6
ESMERALDA
EMERGENCE (%)
100
90
80
70
60
50
40
30
20
10
0
STORAGE TIME (Days)
0
1
2
4
6
TEMPERATURE (°C)
1
2
3
4
5
6

Figure 7. Effect of temperature and storage period on the daily emergence of germinated pepper seed (cultivar 'California Wonder Select').


STORED
1 DAY
EMERGENCE (%)
TIME (Days)


STORED
2 DAYS
EMERGENCE (%)
TIME (Days)


STORED
6 DAYS
EMERGENCE (%)
TIME (Days)


STORED
4 DAYS
EMERGENCE (%)
TIME (Days)

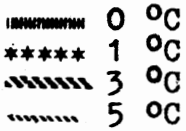
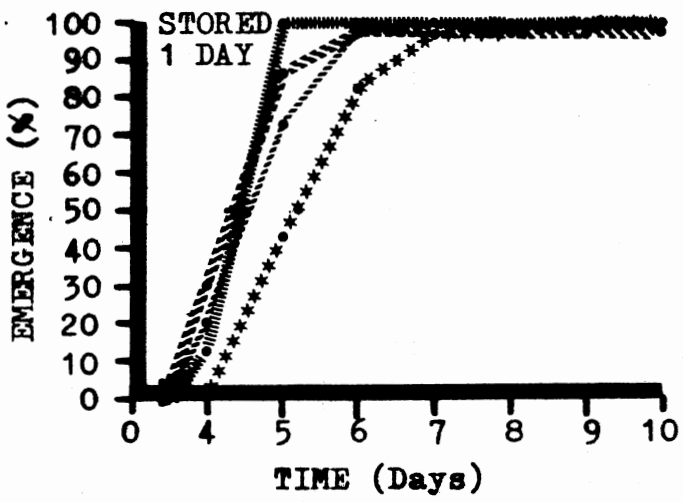
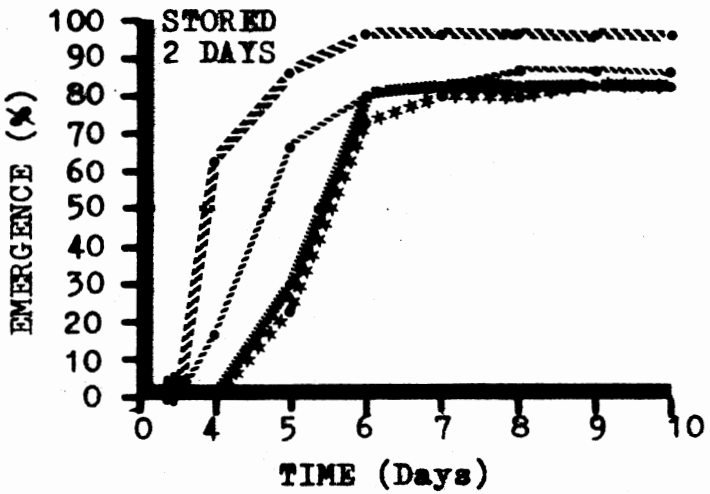
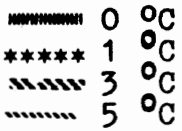
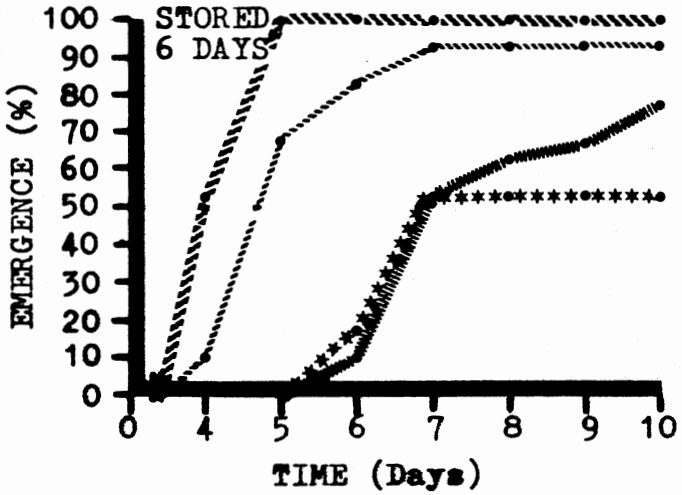

0 °C
1 °C
3 °C
5 °C

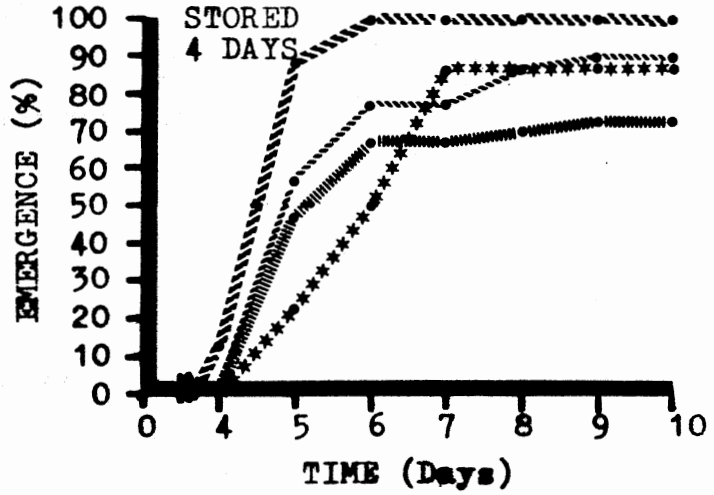
Figure 8. Effect of temperature and storage period on the daily emergence of germinated pepper seed (cultivar 'Kalspice #1 Sweet Paprika').


STORED
1 DAY
EMERGENCE (%)
TIME (Days)


STORED
2 DAYS
EMERGENCE (%)
TIME (Days)


0 °C
1 °C
3 °C
5 °C


STORED
6 DAYS
EMERGENCE (%)
TIME (Days)


STORED
4 DAYS
EMERGENCE (%)
TIME (Days)

All temperatures arrested the growth of the radicle.

There were some discrepancies in the response of the germinated seed to temperature. As can be observed clearly in Figure 7 and less conspicuously in Figure 8, 3 °C was better in speed of emergence than 5 °C.

This discrepancy could be explained by the fact that the emergence data was taken from germinated seed grown in the greenhouse. Even though care was taken to maintain a uniform temperature at least through the period of emergence, slight variations during that period might have favored that temperature (3 °C). Since only one incubator was used for the temperature treatment, and it was replicated one time, some variations in the greenhouse might have influenced the emergence in either direction for the temperature treatment.

Another factor that was not controlled was the variation due to opening the incubator for starting a new storage period. At the beginning of each experiment and while the temperature treatment was set, the 24 petri dishes with filter paper were randomly placed on the shelf as they would be in the experiment.

The first germinated seed that were stored were those corresponding to the 6 days storage period. The incubator was opened two times for each storage period: once to remove the empty dishes and a second time to return the petri dishes to the shelf with the germinated seed.

Every time that the incubator was opened the temperature inside increased to reach equilibrium with room temperature. When the incubator was closed it took at least one hour to reach the temperature set for the particular treatment being tested. Temperature in the incubator never equilibrated with room temperature because the door was opened for

a short period of time, not much than 2 or 3 minutes, but nevertheless it increased at least 10 °C from the temperature at which it was set.

For the 6 day storage period, the incubator was opened 3 times (after 2, 4 and 5 days from starting). For the 4 day storage period, the set temperature was interrupted 2 times (after 2 and 3 days from starting) and for the 2 day storage period, the temperature was interrupted once (after one day from starting).

Those warming periods might have influenced the response of the germinated seed to low temperature, particularly in temperature range 0 to 4 °C, where the warming period could have much greater effect in reversing chilling injury as found by Wang and Baker (81). This procedure had to be followed since all storage periods were compared at the same time for emergence.

Temperatures, Cultivars and Chemicals

Analyzing the results obtained in the first study, it was clear that there were differences among the cultivars, and there was an interaction between temperature and storage period (Tables XXVII and XXVIII, Appendix B).

This information was useful in planning the additional study. Since there was interaction between temperature and cultivar, it was decided to run separate experiments for each cultivar and temperature. Therefore, each cultivar was included in each of two temperature experiments (0 and 5 °C).

In this study different chemical treatments were applied to the germinated seed in storage to determine if chilling injury could be alleviated as reported by other researchers (34, 55, 56, 80, 81).

The chemicals included were those reported as antioxidants (ethoxyquin, sodium benzoate, ascorbic acid), lipid soluble compounds like vegetable oils, and those that influence membrane and cell wall structure, like calcium.

In these studies, the temperature for the emergence data was controlled by sowing the seed in trays and placing them in an incubator at 30 °C constant temperature and 12 hours of light. Thus, possible variations in temperature could be eliminated.

A non-stored treatment was included to determine how low temperature influences germinated seed performance. This non-stored treatment was compared to the distilled water treatment included for each cultivar and temperature.

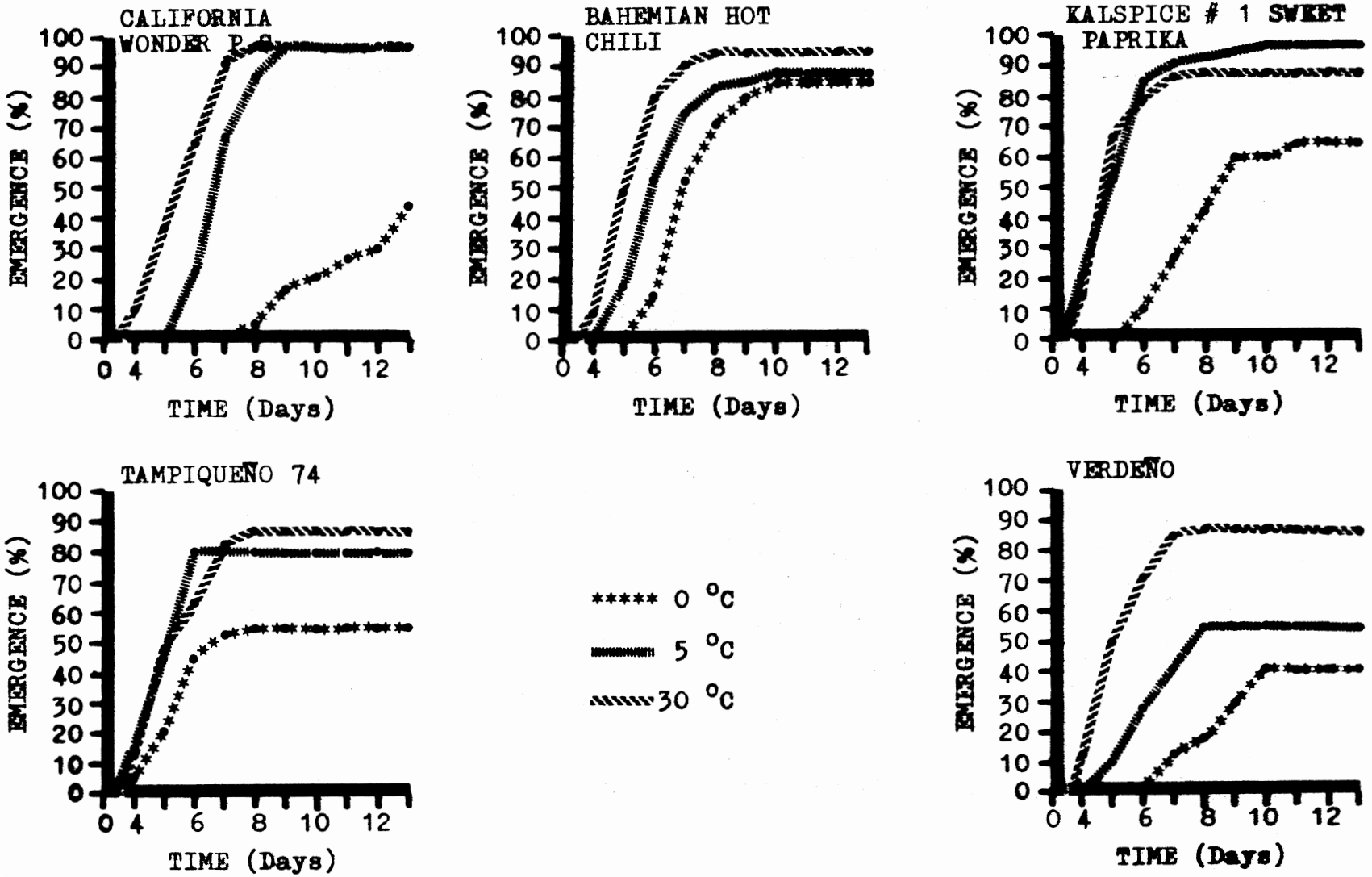
The results for the comparison between the non-stored (30°C) and stored (0 and 5 °C) germinated seed are presented in Figure 9 and Tables XXIX through XXXIII in Appendix B.

It can be seen that low storage temperature had a marked influence on the speed of emergence (5 °C) and on the speed and total emergence (0 °C).

Results in Figure 9 show that 5 °C and non-stored (30 °C) germinated seed had almost the same total percent emergence for all cultivars except 'Verdeño', but non-stored germinated seed emerged faster than seed stored at 5 °C.

The slow emergence at 0 °C could be explained by several factors. The radicle meristem was destroyed, radicles were shorter, root dry weights were lower and electrolyte leakage was higher, particularly in the cultivars more sensitive to low temperature. As pointed out by other researchers (46, 52, 59, 60, 65) high electrolyte leakage is one

Figure 9. Effect of storage temperature (0 and 5 °C for six days) and non-stored (30 °C) on the daily emergence of germinated pepper seed from different cultivars.


CALIFORNIA WONDER P.S.
BAHEMIAN HOT CHILI
KALSPICE # 1 SWEET PAPRIKA
TAMPIQUEÑO 74
VERDEÑO
EMERGENCE (%)
TIME (Days)
0 4 6 8 10 12
0 10 20 30 40 50 60 70 80 90 100
***** 0 °C
5 °C
30 °C

of the characteristic symptoms of chilling injury for many plant species.

For all cutlivars, there was more reducing sugars lost at 0 °C than at 5 °C or non-stored (30 °C) germinated seed (Tables XXIX through XXXIII, Appendix B). These data agree with the findings of Christiansen et al. (46, 47) and Guinn (52).

While the non-stored germinated seed continued functioning normally after the germination period in the columns, the stored germinated seed were arrested in their growth and development and in the case of 0 °C storage they were also physically damaged. Damaged germinated seed were delayed in emergence until the seed could resume normal functions and produce new root meristem from food reserves still in the endosperm.

Those germinated seed that never emerged, might have been more advanced in their physiological status of germination at the time they were stored. They may have had less food reserves at the beginning of the storage and more membranes already formed. Consequently, they were irreversibly damaged by low temperaturs. Seed that emerged might be physiologically younger at the time of storage, with more food reserves and less membrane produced, so the effect of low temperature could be reversed when they were placed at normal temperatures for growth.

The slow emergence in the 5 °C storage treatment might be due to slow physiological activity (slow enzyme production and activity) at the time of sowing the germinated seed since radicle meristem was not drastically damaged compared to the non-stored treatment.

For cultivars that were most sensitive to chilling injury more electrolyte was lost at 0 and 5 °C, indicating that membrane damaged was more severe (46, 47, 52, 65) than for those cultivars that were more

tolerant (Tables XXIX and XXXIII, Appendix B). For the cultivars less sensitive the differences in the electrolyte leaked from the germinated seed were small indicating less membrane damage.

All cultivars lost more reducing sugars at 0 than at 30 °C (non-stored) or 5 °C. Those losses depleted the food reserves in the germinated seed leading to starvation or slow physiological activity (59).

Other studies were carried out to determine if chemical treatments to germinated seed in storage would alleviate or avoid chilling injury.

The results are presented in Figures 10 and 11 and Tables XXXIV through XLIII in Appendix B.

Emergence. The speed and total emergence were more affected at 0 °C than at 5 °C regardless of chemical treatment during storage (Figures 10 and 11). At 0 °C the response of the cultivars to the treatments varied, because of the differences in the sensitiveness to chilling injury.

For 'CWPS' stored at 0 °C the best treatments were castor bean oil and peanut oil (Table XXXIV, Appendix B). For 'Verdeño' at the same temperature the best treatment was sodium benzoate (Table XXXVIII, Appendix B).

For cultivars 'BHC' and 'T74' the best treatments at 0 °C were sodium benzoate and $CaCl_2$ (Tables XXXV and XXXVII, Appendix B). For 'KS1' the best treatment at 0 °C was sodium benzoate (Table XXXVI, Appendix B).

At 5 °C for cultivar 'CWPS' the best treatments were $CaCl_2$, ascorbic acid and sodium benzoate which did not differ significantly from distilled water (Figure 11 and Table XXXIX, Appendix B). For cultivars 'Verdeño' the best treatment was $CaCl_2$ (Figure 11 and Table

Figure 10. Effect of different treatments on the daily emergence of germinated pepper seed from five cultivars, stored for six days at 0 °C.

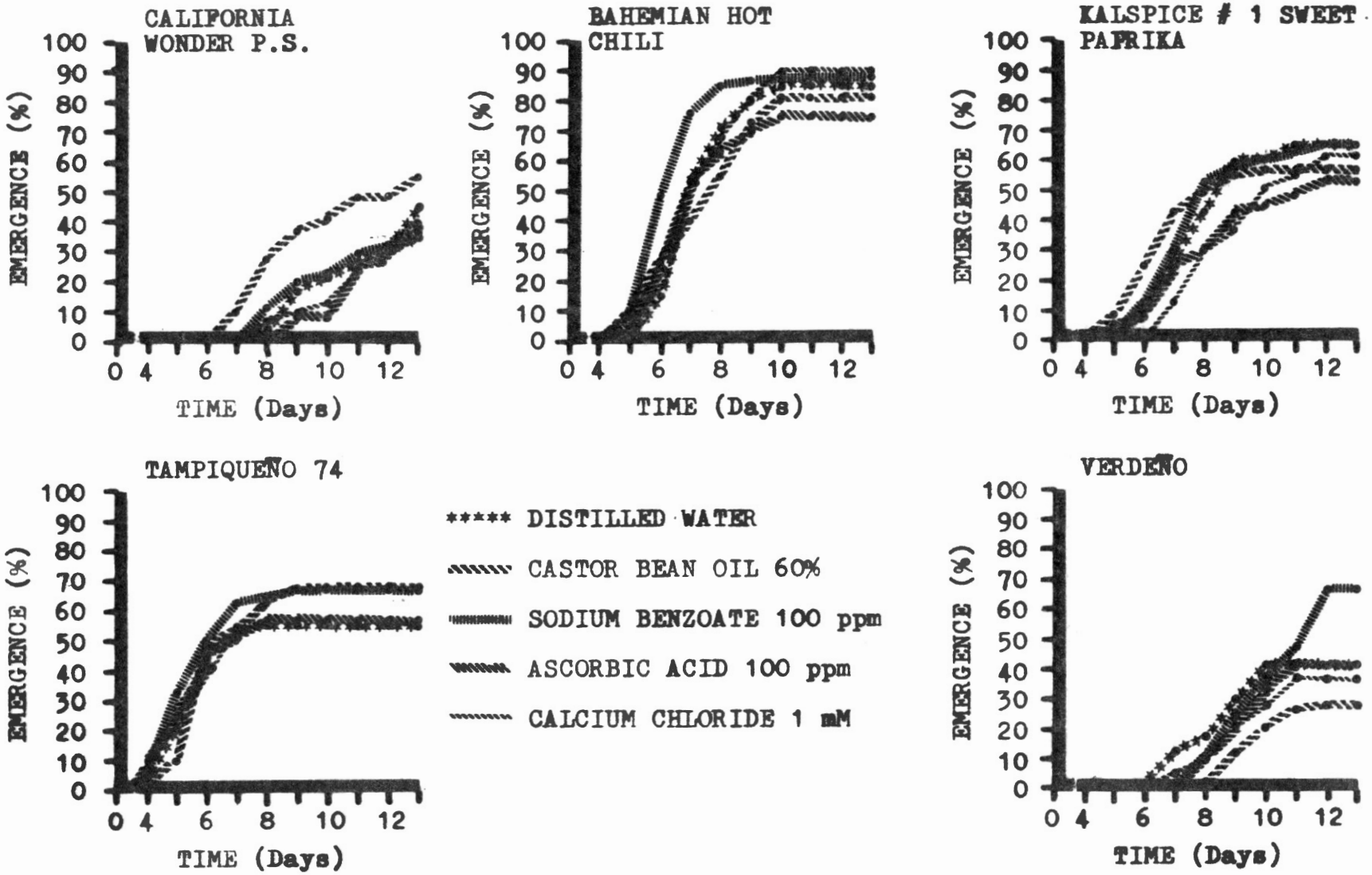
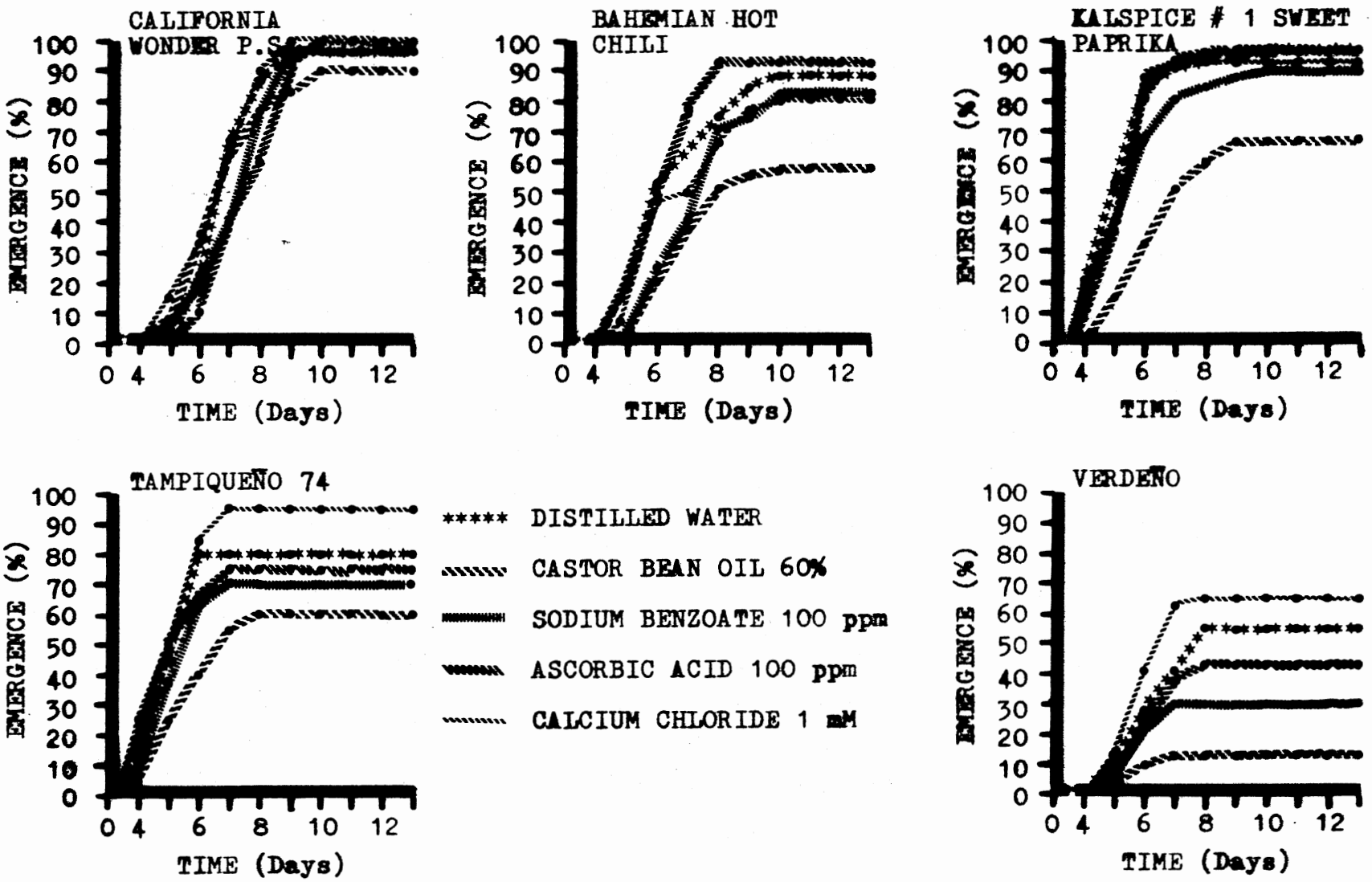

CALIFORNIA WONDER P.S.
BAHEMIAN HOT CHILI
KALSPICE # 1 SWEET PAPRIKA
TAMPIQUEÑO 74
VERDEÑO
EMERGENCE (%)
TIME (Days)
***** DISTILLED WATER
CASTOR BEAN OIL 60%
SODIUM BENZOATE 100 ppm
ASCORBIC ACID 100 ppm
CALCIUM CHLORIDE 1 mM

Figure 11. Effect of different treatments on the daily emergence of germinated pepper seed from five cultivars, stored for six days at 5 °C.


CALIFORNIA WONDER P.S.
BAHEMIAN HOT CHILI
KALSPICE # 1 SWEET PAPRIKA
TAMPIQUEÑO 74
VERDEÑO
EMERGENCE (%)
TIME (Days)
0 4 6 8 10 12
0 10 20 30 40 50 60 70 80 90 100
***** DISTILLED WATER
CASTOR BEAN OIL 60%
SODIUM BENZOATE 100 ppm
ASCORBIC ACID 100 ppm
CALCIUM CHLORIDE 1 mM

XLIII, Appendix B).

In general, at 5 °C the oils and ethoxyquin were the treatments that produced the slowest and lowest percentage emergence (Tables XXXIX through XLIII, Appendix B).

Radicle Length. At 0 and 5 °C the analysis of variance did not show significant differences for radicle length.

In general, at 0 °C longer radicles were obtained on germinated seed treated with sodium benzoate. For 'CWPS', 'BHC', and 'T74' the castor oil treatment produced comparatively long radicles. For 'Verdeño', other treatments that produced long radicles were peanut oil and ascorbic acid.

At 5 °C the longest roots were generally found in germinated seed treatment with $CaCl_2$. Ascorbic acid produced longer roots in cultivars 'CWPS', 'KS1' and 'Verdeño'. The effect of the treatments mentioned above were not significantly different from the control (Tables XXXIX through XLIII, Appendix B).

Damage to Radicle Meristem. At 0 °C, the analysis of variance did not show significant differences among the treatments. The treatments with low percentage radicle damage were castor bean oil, peanut oil and sodium benzoate.

At 5 °C, there were significant differences among the treatments for cultivar 'CWPS' which had fewer radicles tips damaged when treated with distilled water. More radicles were damaged when ethoxyquin was applied (Table XXXIX, Appendix B).

The analysis of variance did not show significant differences among the treatments for the other cultivars. In general, less radicle

damage was observed with sodium benzoate, ascorbic acid and peanut oil. For cultivar 'KS1', $CaCl_2$ also showed little damage (Tables XL through XLIII, Appendix B).

In general, less damage to radicle meristem was observed at 5 than at 0 °C.

It is important to point out that the percent radicle tips killed was calculated from the number of seedlings that emerged for each treatment and not from the total number of seed sown as was the case with total percent emergence.

Dry Weight. The analysis of variance did not show significant shoot or root dry weight differences among the chemical treaments for any cultivars stored at 0 °C. Only 'KS1' stored at 5 °C showed significant differences among chemical treatments in the shoot/root ratio.

In general, all the treatments were similar to the control. For cultivar 'CWPS', sodium benzoate produced the highest shoot dry weight and peanut oil the lowest. For cultivar 'KS1' the higher shoot dry weight was produced when treated with ascorbic acid.

For cultivars 'CWPS', 'Verdeño' and 'KS1', more shoot than root dry weight was produced at 0 °C. For cultivars 'BHC' and 'T74', both shoot and root dry weights were similar for all treatments at 0 °C (Tables XXXIV through XXXVIII, Appendix B).

At 5 °C there were significant differences among the treatments for root dry weight in cultivar 'BHC'. Peanut oil had the highest root dry weight followed by castor bean oil (Table XL).

Cultivar 'CWPS' produced proportionately the same shoot and root dry weight at 5 °C. The other cultivars showed more shoot than root dry weight for all treatments.

Potassium Leakage. The analysis of variance on K leakage did not show significant differences among the treatments at 0 °C. At 5 °C only cultivars 'CWPS' and 'Verdeño' showed significant differences among the treatments.

At 5 °C, for cultivar 'CWPS', there was more K lost in the germinated seed treated with peanut oil and castor bean oil than in the other treatments. Less K leakage was observed when treated with $CaCl_2$ (Table XLIII, Appendix B).

Calcium Leakage. There were no significant differences among treatments at 0 °C for any cultivars except 'BHC'. In this cultivar, germinated seed treated with castor bean oil lost more Ca than with the other treatments.

At 5 °C there were not significant differences among the treatments for cultivars 'CWPS', 'BHC' and 'KS1'.

However, germinated seed of 'T74' stored at 5 °C showed significant differences among the treatments. Castor bean oil treatment caused more Ca losses than the other treatments (Table XLII, Appendix B).

For cultivar 'Verdeño' stored at 5 °C more Ca was leaked from germinated seed treated with ethoxyquin than with the other chemicals (Table XLIII, Appendix B).

Reducing Sugar Leakage. The analysis of variance on reducing sugar showed significant differences among treatments at 0 °C for cultivar 'Verdeño'. Peanut oil induced more sugar losses than other treatments.

Although the analysis of variance did not show significant differences among treatments for cultivar 'CWPS', ascorbic acid and ethoxyquin induced more sugar losses than the other treatments at 0 °C. In 'T74'

greater losses were observed with the peanut oil treatment (Tables XXXIV, XXXVII and XXXVIII, Appendix B).

At 5 °C, only cultivar 'Verdeño' showed significant differences among the treatments. Peanut oil treatment was the highest in sugar loss (Table XLIII, Appendix B).

No reducing sugar leakage was determined for cultivars 'BHC' and 'KS1' at either temperature.

In general, from all the information obtained in the study detailed above, at 0 °C it was easy to tell which were the best treatments, particularly in the most sensitive cultivars. At 5 °C treatment effects were more variable. However, ethoxyquin and peanut oil in several instances were detrimental compared to distilled water.

At the two temperatures, the most promising treatments were sodium benzoate, ascorbic acid and calcium chloride.

It was observed that germinated seed of all cultivars except 'Verdeño' stored at 0 °C, had good protection when treated with castor bean oil. The response to peanut oil was more variable. Only 'CWPS' and 'T74' gave high emergence at 0 °C.

At 5 °C storage cultivars 'CWPS' and 'T74' had good response to castor bean oil. Only 'KS1' stored at 5 °C responded relatively good to peanut oil treatment.

Castor bean oil was better than peanut oil in most instances because its solidification point is much lower (-18 °C) than that for peanut oil (3 °C) (83).

Oil treatments were not easy to handle. As it is well known, they do not go into solution with water. Although care was taken to apply the oil at the given concentration (60%) (by pipeting while the mixture

was stirred and delivering it quickly to the filter paper), when the "solution" was deposited in the petri dish, the two phases separated. The distilled water phase was absorbed by the filter paper while the oil (100% concentrated) remained around the radicles.

At 5 °C storage, that high concentration of oil covering the radicle might have impaired respiration in the petri dish as well as at the time germinated seed was sown. Another possible negative effect of the oil covering the radicle might have been the impairment of water uptake after germinated seed was sown.

Fatty Acid Composition Analysis

Fatty Acid Composition Analysis for Dry Seed. The total fatty acid analysis was done for the different cultivars of pepper included in germinated seed storage studies. It was an attempt to see if there was any relationship between the degree of unsaturation and the damage from low temperature. No organelles were separated or polar lipids analyzed. The information is presented in Table XLIV.

Linolenic acid was very low or null for dry seed. The unsaturated/saturated fatty acids ratio of the 18-carbon fatty acids (Ratio A) was significantly higher for cultivars 'BHC', 'Esmeralda' and 'Mulato Roque'. The lowest was for 'CWS'. The other cultivars were intermediate in that respect.

From the first studies on the storage of germinated seed, cultivar 'CWS' was the most sensitive to chilling injury. More linoleic acid and less stearic acid was observed in those cultivars less sensitive to chilling injury. However, in 'CWPS' (chilling sensitive) that ratio was not significantly different from the other cultivars that were less

sensitive to chilling injury.

Fatty Acid Composition Analysis in Germinated Seed, Shoots, Roots and Fruits. Cultivars 'CWPS' (chilling sensitive) and 'KS1' (less chilling sensitive) were chosen to determine total fatty acid composition in germinated seed stored at 0, 5 °C, and non-stored (30 °C), and in shoots and roots of plants grown in the greenhouse from germinated seed stored for six days at 0, 5 °C, and non-stored (30 °C). Stored germinated seed was treated with castor bean oil, sodium benzoate, ascorbic acid and distilled water. The data are presented in Tables XLV through LXIII of Appendix B.

Non-stored germinated seed was compared with germinated seed stored at 0 and 5 °C.

The fatty acid composition of 'CWPS' germinated seed stored and non-stored is presented in Table XLV. The 0 °C treatment was not included. Linolenic acid content was significantly higher in germinated seed stored at 5 °C than in non-stored seed.

Non-stored seed was higher in linoleic acid. Germinated seed stored at 5 °C was higher in oleic and stearic acids. Ratios A and G were higher in non-stored germinated seed, indicating a higher degree of unsaturation in non-stored germinated seed.

The total fatty acid composition of shoots from germinated seed stored and non-stored is presented in Table XLVI of Appendix B. There were significant differences among the treatments. Shoots from germinated seed stored at low temperatures were higher in linolenic acid as has been reported by other researchers (39, 48, 51, 78, 79). No significant differences were observed for either the unsaturated/saturated fatty acid ratio of the 18-carbon (Ratio A) or for the total

unsaturated/total saturated fatty acid ratio (Ratio G).

The fatty acid composition of cultivar 'CWPS' roots is presented in Table XLVII of Appendix B. The analysis of variance did not show significant differences among treatments regarding linolenic acid content. However, roots from germinated seed stored at 0 °C showed higher linolenic acid content that these stored at 5 °C or non-stored. The degree of unsaturation for the 18-carbon fatty acids was also higher for roots from stored compared to non-stored germinated seed.

The data for germinated seed of cultivar 'KS1' stored and non-stored is presented in Tables XLVIII, XLIX and L of Appendix B.

Germinated seed stored and non-stored did not show significant differences in linolenic acid (traces) and linoleic or oleic acids. Significant differences were observed for stearic acid which was higher in germinated seed stored at 5 °C. The unsaturated/saturated ratio of the 18-carbon fatty acids (Ratio A) was significantly higher for non-stored seed than for the stored germinated seed (Table XLVIII, Appendix B).

Cultivar 'KS1' shoots did not show significant differences in any of the fatty acid contents or their ratios (Table XLIX, Appendix B).

There were significant differences in linolenic acid content in roots of cultivar 'KS1'. Roots from stored germinated seed were higher than those from non-stored germinated seed. No significant differences were found for the different ratios (Table L, Appendix B).

The data for the fatty acid composition of germinated seed from cultivar 'CWPS', stored at 0 and 5 °C, and for shoots and roots from germinated seed stored at 0 and 5 °C is presented in Tables LI through LV of Appendix B. Germinated seed in storage was treated with distilled water, castor bean oil, soidum benzoate and ascorbic acid.

The analysis for germinated seed stored at 5 °C showed significant differences among treatments for linolenic acid. Only the control showed linolenic acid (less than 1%) content. There were significant differences for oleic acid content with sodium benzoate being the highest and castor bean oil the lowest (Table LI, Appendix B).

Analysis of shoots from germinated seed stored at 0 or 5 °C did not show significant differences for any of the fatty acids or their ratios (Tables LII and LIII, Appendix B).

Roots from germinated seed stored at 0 °C did not show significant differences for any of the fatty acids or their ratios.

Analysis of roots from germinated seed stored at 5 °C showed significant differences among the treatments for oleic acid content. Distilled water was highest and ascorbic acid lowest.

Tables LVI through LXI present the data for germinated seed stored at 0 and 5 °C, and for shoots and roots from germinated seed of cultivar 'KS1' stored at 0 and 5 °C. Germinated seed was treated with distilled water, castor bean oil, sodium benzoate and ascorbic acid.

Analysis of germinated seed stored at 0 °C showed significant differences for linoleic acid content. Sodium benzoate was highest and castor bean oil the lowest. There were also differences in oleic acid content which was higher when seed was treated with castor oil (Table LVI, Appendix B).

Germinated seed stored at 5 °C showed significant differences in the total unsaturated/total saturated fatty acids ratio (Ratio G). Sodium benzoate and ascorbic acid treatments induced more unsaturation (Table LVII, Appendix B).

Analysis of shoots from germinated seed stored at 5 °C showed

significant differences among the treatments in oleic acid. Sodium benzoate was highest and castor bean oil the lowest treatment (Tables LVIII, Appendix B).

The analysis of variance did not show significant differences among the treatments for any of the fatty acids in shoots from germinated seed stored at 5 °C (Table LIX, Appendix B).

No significant differences among the treatments were detected in roots from germinated seed stored at 0 °C or 5 °C for any of the fatty acids (Table LX and LXI, Appendix B).

Tables LXII and LXIII present the comparison for the fatty acid composition between dry seed, germinated seed, shoots, roots and fruits of cultivars 'CWPS' and 'KS1' respectively.

This information showed that there are significant differences in the fatty acid composition of different parts of the plant. Seed are higher in linoleic acid and contain traces or no linolenic acid. Shoots have more linolenic acid than the other parts of the plant. Shoots contain less linoleic acid than seed, roots or fruits. Roots are higher in linoleic and lower in linolenic acids than fruits and shoots.

Unsaturated/saturated ratio in the 18-carbon fatty acids (Ratio A) is higher in germinated seed and dry seed than in roots, shoots and fruits.

Total unsaturated/saturated fatty acids ratio (Ratio G) was higher for dry and germinated seed than for shoots, roots and fruits.

No organelles (mitochondria, chloroplasts, endoplasmic reticulum, etc.) were separated and analyzed for fatty acid composition. Data in Tables LXII and LXIII show that the sensitivity of a species to low temperature can vary depending on the stage of plant growth and

development at the time it receives the low temperature treatment.

In pepper the highest degree of unsaturation is in germinated or dry seed which allows the species to withstand lower temperatures better at those stages than at later stages of growth and development.

The fact that there was a change (increase) in linolenic acid content in the shoots and roots when germinated seed was treated at 0 °C, opens the possibility of hardening for this species at the germinated seed stage by using low temperatures. This remains to be shown but it will be an interesting and useful field of research, since earliness is very important for the growers of this crop.

CHAPTER V

SUMMARY AND CONCLUSIONS

Seed Germination Studies

Seed germination is one of the most important processes in the life of a plant. The seed contains all the characteristics of the new organism. In order for those characteristics to show up fully, it is essential to have good seed viability and the factors essential for seed germination (oxygen, temperature, water, light) at optimum levels for the species.

Ideal conditions are very difficult to find even in the environment where the species are adapted. In some crops, high speed and uniformity in seed germination are difficult to attain even under optimum environmental conditions.

In general, pepper seed is difficult to germinate. Even the cultivars with high total percent germination do not have good uniformity in germination. This characteristic leads to the use of transplants or sowing techniques that allow the seed to be in a favorable environment for germination.

The fluid drilling technique of sowing germinated seed provides some control over seed germination by manipulating as desired the factors essential for germination.

In these studies, seed of different pepper cultivars were treated with gibberellic acid (GA_3) and germinated in aerated columns. The

objective was to develop a technique to improve the speed and uniformity of germination.

GA_3 rates from 0 to 8 ug/mg seed were used. Since the concentration of seed in the solution in the aerated column may modify the germination conditions (competition for O_2, leachate accumulation, generation of heat, etc.), a seed rate factor was included which varied from 25 to 100 mg seed/cc solution.

From the data presented in this study, the following conclusions can be drawn:

1. The response of various pepper types and cultivars treated with GA_3 was very similar, regarding the promotion of germination in aerated columns.
2. All GA_3 treatments were better than the control in stimulating germination.
3. For cultivars 'California Wonder P.S.' and 'Tampiqueño 74' the best GA_3 rate was 8 ug/mg seed. For the other cultivars, that rate produced lower germination than the other rates, excluding the control.
4. The effect of GA_3 on pepper seed germination was reflected in faster emergence for all cultivars except 'Tampiqueño 74'. For cultivar 'California Wonder P.S.' the highest GA_3 used (8 ug/mg seed) produced the slowest emergence.
5. In general, faster emergence was reflected in higher dry weight per seedling.
6. GA_3 rates of 8 ug/mg seed produced the lowest dry weight in cultivars 'Bahemian Hot Chili' and 'Tampiqueño 74'. Higher seed rates in the columns resulted in lower germination and

this was most clearly observed in cultivars 'Bahemian Hot Chili' and 'Tampiqueño 74' which had the highest number of seed per gram.

8. Higher seed rate in the columns produced slower emergence.
9. In general, the best GA_3 rate and seed rate was 6 ug GA_3/mg seed and 50 to 75 mg seed/cc solution.

Storage of Germinated Seed Studies

The storage of germinated seed is one of the aspects involved in the fluid drilling system. When bad weather conditions or machine breakdown make it difficult to plant the germinated seed immediately it is necessary to store it.

Storing germinated seed means to arrest the radicle growth without physiologically damaging the seed.

For cool season crops storage of germinated seed can be done at low temperatures. However, for warm season crops low temperature may produce physiological damage to the seed, resulting in low activity in the seed or irreversible damage leading to complete loss in viability.

Pepper is a warm season crop, which is damaged when temperature is lowered to 2.5 °C (fruits in storage).

Very little information has been obtained on the storage of germianted seed for warm season crops. These studies were carried out with the objective to determine how long germinated pepper seed can be stored and which temperature is best for storage. Different cultivars were included since pepper offers a great variability in species and types adapted to a wide range of environmental conditions.

Germinated seed was stored for 1, 2, 4, and 6 days at temperatures

of 0, 1, 2, 3, 4, 5 and 6 °C. Germinated seed in storage were treated with vegetable oils (castor bean oil, peanut oil), sodium benzoate, ascorbic acid, ethoxyquin and calcium chloride.

The response of germinated seed to low temperature was measured in different ways, as follows: speed and uniformity of emergence as well as total emergence, electrolyte leakage, dry weight of shoots and roots, damage to radicle meristem and radicle length.

The total fatty acid composition in dry seed, germinated seed both stored and non-stored, and in shoots and roots from germinated seed stored and non-stored. Fatty acids were also determined in an attempt to find out if there is a relationship between the degree of unsaturation and sensitivity to low temperatures.

The information obtained in this study leads to the following conclusions:

1. There were differences among cultivars regarding sensitivity to low temperatures. 'California Wonder Select', 'California Wonder P.S.' and 'Verdeño' were the most sensitive. 'Bahemian Hot Chili' and 'Tampiqueño 74' were the least sensitive. 'Kalspice #1 Sweet Paprika' was intermediate.
2. Temperatures lower than 5 °C physiologically and physically damaged germinated seed which resulted in loss of viability and vigor.
3. Storage periods longer than two days at low temperatures will lower the ability of germinated seed to produce a uniform and complete stand.
4. Germinated pepper seed can be stored for periods of 1 or 2 days at 5 °C, arresting the growth of the radicle, without damaging

their ability to resume germination. Longer storage periods will have a definitive negative effect on the future performance of the germinated seed.

5. The detrimental effect of low temperature storage (5 °C) on germinated pepper seed is slight for total seedling emergence and greater for speed of emergence.
6. Germinated seed stored at 0 and 5 °C showed higher K, Ca and reducing sugar leakage than non-stored germinated seed.
7. Shoot and root dry weights were generally lower in seedlings from stored than from non-stored germinated seed.
8. Germinated seed treated with sodium benzoate, ascorbic acid and calcium chloride showed less chilling injury.
9. The vegetable oils were more effective at 0 °C than at 5 °C. Castor bean oil was better than peanut oil.
10. Dry seed from cultivars most sensitive to chilling injury have a lower degree of unsaturation in fatty acids than dry seed of less sensitive cultivars.
11. Sodium benzoate and ascorbic acid treatments increased the degree of fatty acid unsaturation in cultivar 'Kalspice #1 Sweet Paprika' at 0 and 5 °C germinated seed storage.
12. Low temperature storage increased the degree of fatty acid unsaturation in roots of plants grown from germinated seed of 'California Wonder P.S.' and 'Kalspice #1 Sweet Paprika'.
13. The degree of fatty acids unsaturation was not substantially increased in shoots or germinated seed when subjected to chilling temperatures.
14. Shoots from germinated seed of cultivar 'California Wonder P.S.'

stored at low temperature, were higher in linolenic acid than shoots from non-stored germinated seed.

15. Dry and germinated seed had higher degrees of unsaturation in the total fatty acids than shoots, roots and fruits.

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APPENDICES

APPENDIX A

SEED GERMINATION STUDIES

TABLE V

CUMULATIVE DAILY PERCENT GERMINATION FOR SEED OF SIX CULTIVARS OF PEPPER GERMINATED IN AERATED COLUMNS USING DISTILLED WATER

Cultivar	Cumulative Daily Germination (days)									
	1	2	3	4	5	6	7	8	9	10
California Wonder Select	0	0	0	12	27	51	69	91	95	96
Bahemian Hot Chili	0	0	5	45	81	89	94	95	95	95
Kalspice #1 Sw. Paprika	0	3	48	83	89	93	94	95	96	97
Verdeño	0	0	10	30	48	56	66	77	87	88
Jalapeño 'Papaloapan'	6	60	97	100	100	100	100	100	100	100
Serrano 'Tampiqueño 74'	0	12	57	73	78	83	86	87	90	90

TABLE VI

MEANS FOR THE EFFECT OF GA_3 AND SEED RATE ON THE PERCENT GERMINATION, PERCENT CUMULATIVE DAILY EMERGENCE, T50, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE (EV) AND DRY WEIGHT FOR PEPPER SEED (CULTIVAR 'CALIFORNIA WONDER P.S.')

GA_3 Rate (ug/mg seed)	Seed Rate (mg/ml sol.)	Germination (%)	% Cumulative Daily Emergence (days from sowing)						T50 (days)	Uniformity (days)	Rate of Emergence (plant/day)	EV	Dry Wt. (mg/pl)
			3	4	5	6	7	8					
0	25	10.2	12.5	17.5	60.0	67.5	72.5	82.5	4.5	2.9	4.7	127.5	7.1
	50	10.3	22.5	30.0	72.5	82.5	87.5	95.0	4.2	3.2	4.9	175.0	9.0
	75	11.5	12.5	20.0	67.5	77.5	85.8	92.5	4.5	2.7	5.5	156.6	8.9
	100	13.0	7.5	12.5	52.5	75.0	87.5	95.0	4.8	3.0	4.8	136.2	9.0
2	25	21.9	42.5	57.5	95.0	95.0	97.5	97.5	3.4	3.0	5.2	231.9	9.7
	50	28.3	30.0	55.0	90.0	97.5	97.5	97.5	3.7	2.6	6.0	220.0	11.5
	75	29.8	47.5	77.0	100.0	100.0	100.0	100.0	3.0	3.0	5.2	250.0	13.7
	100	26.8	52.5	82.5	100.0	100.0	100.0	100.0	2.8	3.4	4.7	250.0	13.0
4	25	32.7	42.5	62.5	95.0	97.5	97.5	100.0	3.4	3.0	5.2	237.5	11.5
	50	38.8	42.5	72.5	100.0	100.0	100.0	100.0	3.2	2.8	5.8	250.0	12.0
	75	42.0	45.0	70.0	100.0	100.0	100.0	100.0	3.2	2.9	5.5	250.0	13.2
	100	43.2	42.5	82.5	100.0	100.0	100.0	100.0	3.1	2.8	5.7	250.0	13.0
6	25	46.2	40.0	70.0	90.0	95.0	95.0	95.0	3.2	3.2	5.0	213.7	12.1
	50	42.8	40.0	70.0	97.5	97.5	97.5	97.5	3.3	2.7	5.7	237.8	12.3
	75	57.9	32.5	57.5	95.0	95.0	100.0	100.0	3.6	2.6	6.2	237.5	12.3
	100	46.1	45.0	70.0	90.0	95.0	95.0	95.0	3.1	3.4	4.5	215.0	11.3
8	25	46.1	00.0	5.0	92.5	100.0	100.0	100.0	4.4	1.7	9.2	231.2	14.7
	50	55.8	00.0	5.0	90.0	95.0	95.0	97.5	4.4	1.7	9.0	219.4	13.2
	75	58.8	00.0	5.0	97.5	97.5	97.5	97.5	4.3	1.6	9.7	237.8	14.6
	100	50.9	00.0	5.0	82.5	90.0	97.5	97.5	4.5	2.0	7.9	219.1	12.7

TABLE VII

ANALYSIS OF VARIANCE FOR THE EFFECT OF GA_3 AND SEED RATE ON THE PERCENT GERMINATION IN AERATED COLUMNS OF PEPPER SEED (CULTIVAR 'CALIFORNIA WONDER P.S.')

Source	df	MS	F	PR>F
Replication	1	170.98	6.93	0.0152
GA_3 Rate	4			
GA_3 Rate Linear	1	8790.62	356.13	0.0001
GA_3 Rate Quadratic	1	359.28	14.56	0.0010
GA_3 Rate Cubic	1	1.56	0.06	0.8033
GA_3 Rate Quartic	1	0.03	0.00	0.9705
Seed Rate	3			
Seed Rate Linear	1	172.42	6.99	0.0149
Seed Rate Quadratic	1	150.93	6.11	0.0216
Seed Rate Cubic	1	48.11	1.95	0.1766
GA_3 Rate x Seed Rate	12	24.37	0.98	0.5021
Error	20	24.96		

R-Square = 0.94
C. V. = 13.9%

TABLE VIII

ANALYSIS OF VARIANCE FOR THE EFFECT OF GA_3 AND SEED RATE ON THE DAYS TO 50% EMERGENCE (T50) OF GERMINATED PEPPER SEED (CULTIVAR 'CALIFORNIA WONDER P.S.')

Source	df	MS	F	PR>F
Replications	1	0.04	0.42	0.5225
GA_3 Rate	4			
GA_3 Rate Linear	1	0.01	0.15	0.6987
GA_3 Rate Quadratic	1	13.43	125.94	0.0001
GA_3 Rate Cubic	1	0.05	0.47	0.5005
GA_3 Rate Quartic	1	0.54	5.14	0.0336
Seed Rate	3			
Seed Rate Linear	1	0.05	0.50	0.4861
Seed Rate Quadratic	1	0.002	0.02	0.8762
Seed Rate Cubic	1	0.003	0.03	0.8672
GA_3 Rate x Seed Rate	12	0.13	1.26	0.3179
Error	20	0.10		

R-Square = 0.86
C.V. = 8.7%

TABLE IX

MEANS FOR THE EFFECT OF GA_3 AND SEED RATE ON THE PERCENT GERMINATION, PERCENT CUMULATIVE DAILY EMERGENCE, T50, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE (EV) AND DRY WEIGHT FOR PEPPER SEED (CULTIVAR 'BAHEMIAN HOT CHILI')

GA_3 Rate (ug/mg seed)	Seed Rate (mg/ml sol.)	Germination (%)	% Cumulative Daily Emergence (days from sowing)						T50 (days)	Uniformity (days)	Rate of Emergence (plant/day)	EV	Dry Wt. (mg/pl)
			2	3	4	5	6	7					
0	25	80.5	17.5	25.0	97.5	97.5	100.0	100.0	3.1	2.0	8.0	348.2	5.0
	50	75.7	7.5	12.5	95.0	95.0	100.0	100.0	3.3	1.8	8.7	339.3	8.2
	75	71.2	5.0	10.0	92.5	97.5	97.5	97.5	3.3	1.8	8.7	322.2	9.1
	100	65.8	0.0	5.0	95.0	97.5	97.5	97.5	3.3	1.6	9.5	330.8	9.1
2	25	85.1	25.0	37.5	95.0	95.0	95.0	95.0	2.3	2.3	7.0	322.3	6.7
	50	82.6	10.0	15.0	97.5	97.5	100.0	100.0	3.2	1.8	8.7	348.2	8.2
	75	78.4	15.0	22.5	92.5	100.0	100.0	100.0	3.1	2.1	7.7	330.3	8.7
	100	64.1	10.0	17.5	87.5	92.5	92.5	92.5	3.2	1.9	7.7	288.8	8.6
4	25	85.5	20.0	27.5	100.0	100.0	100.0	100.0	3.0	2.1	8.0	357.1	8.2
	50	82.2	17.5	25.0	97.5	100.0	100.0	100.0	3.1	2.1	8.0	348.2	8.7
	75	72.4	5.0	10.0	97.5	100.0	100.0	100.0	3.3	1.7	9.2	348.2	9.2
	100	68.0	5.0	10.0	92.5	100.0	100.0	100.0	3.3	1.8	8.7	330.3	8.2
6	25	90.4	30.0	40.0	100.0	100.0	100.0	100.0	2.8	2.3	7.0	357.1	8.3
	50	82.7	10.0	17.5	92.5	97.5	100.0	100.0	3.2	2.0	8.2	330.3	9.7
	75	73.0	5.0	10.0	97.5	97.5	97.5	97.5	3.2	1.7	9.2	339.7	9.1
	100	74.8	10.0	15.0	90.0	95.0	95.0	95.0	3.2	1.9	8.0	307.4	8.3
8	25	79.7	42.5	62.5	100.0	100.0	100.0	100.0	2.3	2.8	5.7	357.1	5.5
	50	77.4	27.5	35.0	90.0	95.0	95.0	95.0	2.9	2.5	6.2	306.2	5.8
	75	76.9	27.5	37.5	87.5	95.0	95.0	95.0	2.8	2.7	6.0	298.2	5.2
	100	79.7	25.0	35.0	97.5	97.5	97.5	97.5	2.9	2.2	7.2	339.7	5.9

TABLE X

ANALYSIS OF VARIANCE FOR THE EFFECT OF GA_3 AND SEED RATE ON THE PERCENT GERMINATION IN AERATED COLUMNS OF PEPPER SEED (CULTIVAR 'BAHEMIAN HOT CHILI')

Source	df	MS	F	PR>F
Replications	1	65.79	3.10	0.0924
GA_3 Rate	4			
GA_3 Rate Linear	1	133.38	6.28	0.0201
GA_3 Rate Quadratic	1	39.96	1.88	0.1841
GA_3 Rate Cubic	1	0.05	0.00	0.9598
GA_3 Rate Quartic	1	34.05	1.60	0.2187
Seed Rate	3			
Seed Rate Linear	1	1108.73	52.18	0.0001
Seed Rate Quadratic	1	0.11	0.01	0.9432
Seed Rate Cubic	1	6.37	0.30	0.5894
GA_3 Rate x Seed Rate	12	37.66	1.57	0.1838
Error	20	23.99		

R-Square = 0.79
C.V. = 5.9%

TABLE XI

ANALYSIS OF VARIANCE FOR THE EFFECT OF GA_3 AND SEED RATE ON THE DAYS TO 50% EMERGENCE (T50) OF GERMINATED PEPPER SEED (CULTIVAR 'BAHEMIAN HOT CHILI')

Source	df	MS	F	PR>F
Replications	1	0.59	16.22	0.0006
GA_3 Rate	4			
GA_3 Rate Linear	1	0.77	21.14	0.0001
GA_3 Rate Quadratic	1	0.18	5.01	0.0357
GA_3 Rate Cubic	1	0.28	7.69	0.0111
GA_3 Rate Quartic	1	0.00	0.02	0.8772
Seed Rate	3			
Seed Rate Linear	1	0.78	21.62	0.0001
Seed Rate Quadratic	1	0.23	6.43	0.0188
Seed Rate Cubic	1	0.04	1.19	0.2880
GA_3 Rate x Seed Rate	12	0.01	0.39	0.9491
Error	20	0.03		

R-Square = 0.78
C.V. = 6.3%

TABLE XII

MEANS FOR THE EFFECT OF GA_3 AND SEED RATE ON THE PERCENT GERMINATION, PERCENT CUMULATIVE DAILY EMERGENCE, T50, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE (EV) AND DRY WEIGHT, FOR PEPPER SEED (CULTIVAR 'KALSPICE #1 SWEET PAPRIKA)

GA_3 Rate (ug/mg seed)	Seed Rate (mg/ml sol.)	Germination (%)	% Cumulative Daily Emergence (days from sowing)						T50 (days)	Uniformity (days)	Rate of Emergence (plant/day)	EV	Dry Wt. (mg/pl)
			3	4	5	6	7	8					
0	25	35.0	45.0	60.0	87.5	92.5	92.5	97.5	3.2	3.8	4.2	213.1	5.4
	50	33.1	42.5	72.5	97.5	97.5	97.5	97.5	3.2	2.8	5.5	237.8	6.6
	75	31.5	47.5	77.5	95.0	97.5	97.5	97.5	3.0	3.3	4.7	231.6	7.2
	100	35.5	40.0	60.0	95.0	100.0	100.0	100.0	3.4	2.9	5.5	237.5	6.5
2	25	42.3	40.0	50.0	92.5	95.0	97.5	97.5	3.5	3.0	5.2	225.3	6.1
	50	42.4	37.5	62.5	92.5	95.0	95.0	95.0	3.4	2.8	5.5	220.0	6.8
	75	37.6	42.5	72.5	97.5	100.0	100.0	100.0	3.2	2.9	5.5	243.7	7.2
	100	36.6	50.0	80.0	97.5	97.5	97.5	97.5	2.8	3.3	4.7	237.8	6.7
4	25	46.1	35.0	45.0	92.5	92.5	92.5	92.5	3.6	2.6	5.7	215.3	6.4
	50	42.9	47.5	67.5	90.0	97.5	97.5	97.5	3.1	3.7	4.2	219.4	7.1
	75	45.0	42.5	72.5	95.0	97.5	100.0	100.0	3.2	3.1	5.2	237.5	6.7
	100	40.2	45.0	85.0	100.0	100.0	100.0	100.0	3.0	2.0	5.5	250.0	7.0
6	25	46.7	42.5	72.5	95.0	97.5	97.5	97.5	3.1	3.0	5.2	231.6	6.7
	50	47.9	50.0	70.0	97.5	97.5	97.5	97.5	3.0	3.3	4.7	237.8	6.7
	75	38.7	47.5	87.5	100.0	100.0	100.0	100.0	2.9	3.0	5.2	250.0	7.0
	100	45.8	40.0	70.0	90.0	92.5	95.0	95.0	3.2	3.0	5.0	214.4	7.0
8	25	38.3	32.5	47.5	95.0	95.0	95.0	95.0	3.6	2.4	6.2	226.2	7.8
	50	38.3	37.5	52.5	80.0	92.5	95.0	95.0	3.6	3.6	4.2	190.0	9.2
	75	35.1	22.5	30.0	62.5	85.0	97.5	97.5	4.5	3.5	4.6	174.2	8.2
	100	38.4	22.5	32.5	82.5	92.5	92.5	92.5	4.0	2.5	6.0	190.9	8.7

TABLE XIII

ANALYSIS OF VARIANCE FOR THE EFFECT OF GA_3 AND SEED RATE ON THE PERCENT GERMINATION IN AERATED COLUMNS OF PEPPER SEED (CULTIVAR 'KALSPICE #1 SWEET PAPRIKA')

Source	df	MS	F	PR>F
Replications	1	1346.76	43.51	0.0001
GA_3 Rate	4			
GA_3 Rate Linear	1	125.50	4.05	0.0564
GA_3 Rate Quadratic	1	479.74	15.50	0.0007
GA_3 Rate Cubic	1	31.75	1.03	0.3222
GA_3 Rate Quartic	1	3.42	0.11	0.7425
Seed Rate	3			
Seed Rate Linear	1	54.81	1.77	0.1969
Seed Rate Quadratic	1	15.75	0.51	0.4831
Seed Rate Cubic	1	28.95	0.94	0.3440
GA_3 Rate x Seed Rate	12	11.25	0.35	0.9682
Error	20	32.60		

R-Square = 0.76
C.V. = 14.3%

TABLE XIV

ANALYSIS OF VARIANCE FOR THE EFFECT OF GA_3 AND SEED RATE ON THE DAYS TO 50% EMERGENCE (T50) OF GERMINATED PEPPER SEED (CULTIVAR 'KALSPICE #1 SWEET PAPRIKA')

Source	df	MS	F	PR>F
Replications	1	0.04	0.80	0.3805
GA_3 Rate	4			
GA_3 Rate Linear	1	1.27	22.94	0.0001
GA_3 Rate Quadratic	1	1.25	22.63	0.0001
GA_3 Rate Cubic	1	0.92	16.59	0.0005
GA_3 Rate Quartic	1	0.15	2.87	0.1045
Seed Rate	3			
Seed Rate Linear	1	0.03	0.61	0.4437
Seed Rate Quadratic	1	0.04	0.82	0.3763
Seed Rate Cubic	1	0.10	1.93	0.1790
GA_3 Rate x Seed Rate	12	0.18	3.07	0.0141
Error	20	0.05		

R-Square = 0.82
C.V. = 7.0%

TABLE XV

MEANS FOR THE EFFECT OF GA_3 AND SEED RATE ON THE PERCENT GERMINATION, PERCENT CUMULATIVE DAILY EMERGENCE, T50, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE (EV) AND DRY WEIGHT, FOR PEPPER SEED (JALAPEÑO CULTIVAR 'PAPALOAPAN')

GA_3 Rate (ug/mg seed)	Seed Rate (mg/ml sol.)	Germination (%)	% Cumulative Daily Emergence (days from sowing)						T50 (days)	Uniformity (days)	Rate of Emergence (plant/day)	EV	Dry Wt. (mg/pl)
			2	3	4	5	6	7					
0	25	54.8	5.0	10.0	92.5	95.0	95.0	95.0	3.3	1.7	8.7	314.3	14.9
	50	63.3	5.0	10.0	92.5	97.5	97.5	97.5	3.3	1.8	8.7	322.8	16.6
	75	57.5	2.5	7.5	72.5	95.0	95.0	95.0	3.5	2.0	7.6	285.3	15.8
	100	67.5	2.5	7.5	57.5	95.0	97.5	97.5	3.7	2.2	7.3	291.8	7.9
2	25	69.3	5.0	10.0	82.5	97.5	97.5	97.5	3.4	2.0	7.9	307.5	14.1
	50	68.2	7.5	12.5	77.5	97.5	97.5	97.5	3.4	2.1	7.7	307.5	15.5
	75	71.7	2.5	7.5	62.5	92.5	95.0	95.0	3.6	2.2	7.0	264.3	15.8
	100	71.1	2.5	7.5	62.5	92.5	97.5	97.5	3.7	2.2	7.4	289.7	15.3
4	25	70.6	12.5	17.5	90.0	95.0	95.0	95.0	3.2	1.9	7.7	307.1	14.3
	50	76.1	7.5	12.5	85.0	95.0	95.0	95.0	3.4	2.0	7.6	294.3	14.2
	75	70.6	5.0	10.0	62.5	90.0	100.0	100.0	3.7	2.3	7.2	297.6	14.0
	100	70.5	0.0	5.0	72.5	97.5	97.5	97.5	3.6	2.0	7.8	287.0	12.8
6	25	78.8	10.0	15.0	90.0	92.5	92.5	92.5	3.2	1.9	8.0	300.0	15.5
	50	81.8	7.5	12.5	90.0	97.5	97.5	97.5	3.3	1.9	8.2	312.9	15.4
	75	72.9	10.0	15.0	72.5	92.5	92.5	92.5	3.4	2.1	6.9	276.9	13.8
	100	79.0	15.0	20.0	90.0	95.0	95.0	95.0	3.1	2.0	7.5	305.3	12.9
8	25	78.7	27.5	40.0	92.5	97.5	97.5	97.5	2.8	2.5	6.5	322.3	14.5
	50	75.5	17.5	25.0	95.0	97.5	97.5	97.5	3.1	2.0	7.7	331.2	15.9
	75	75.6	20.0	27.5	95.0	95.0	95.0	95.0	3.0	2.0	7.5	323.2	13.9
	100	72.3	12.5	17.5	77.5	90.0	95.0	95.0	3.3	2.3	6.5	262.9	13.0

TABLE XVI

ANALYSIS OF VARIANCE FOR THE EFFECT OF GA_3 AND SEED RATE ON THE PERCENT GERMINATION IN AERATED COLUMNS OF PEPPER SEED (JALAPEÑO CULTIVAR 'PAPALOAPAN')

Source	df	MS	F	PR>F
Replications	1	1.05	0.06	0.8100
GA_3 Rate	4			
GA_3 Rate Linear	1	1126.50	63.18	0.0001
GA_3 Rate Quadratic	1	217.84	12.22	0.0021
GA_3 Rate Cubic	1	1.62	0.09	0.7656
GA_3 Rate Quartic	1	69.86	3.92	0.0604
Seed Rate	3			
Seed Rate Linear	1	1.39	0.08	0.7824
Seed Rate Quadratic	1	0.03	0.00	0.9675
Seed Rate Cubic	1	67.16	3.77	0.0652
GA_3 Rate x Seed Rate	12	26.16	1.33	0.2781
Error	20	19.60		

R-Square = 0.82
C.V. = 6.2%

TABLE XVII

ANALYSIS OF VARIANCE FOR THE EFFECT OF GA_3 AND SEED RATE ON THE DAYS TO 50% EMERGENCE (T50) OF GERMINATED PEPPER SEED (JALAPEÑO CULTIVAR 'PAPALOAPAN')

Source	df	MS	F	PR>F
Replications	1	0.97	10.83	0.0034
GA_3 Rate	4			
GA_3 Rate Linear	1	0.99	11.07	0.0031
GA_3 Rate Quadratic	1	0.31	3.54	0.0733
GA_3 Rate Cubic		0.02	0.25	0.6225
GA_3 Rate Quartic	1	0.00	0.01	0.9217
Seed Rate	3			
Seed Rate Linear	1	0.66	7.38	0.0126
Seed Rate Quadratic	1	0.01	0.17	0.6875
Seed Rate Cubic	1	0.01	0.17	0.6834
GA_3 Rate x Seed Rate	12	0.03	0.40	0.9478
Error	20	0.09		

R-Square = 0.62
C.V. = 8.9%

TABLE XVIII

MEANS FOR THE EFFECT OF GA_3 AND SEED RATE ON THE PERCENT GERMINATION, PERCENT CUMULATIVE DAILY EMERGENCE, T50, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE (EV) AND DRY WEIGHT FOR PEPPER SEED (SERRANO CULTIVAR 'TAMPIQUEÑO 74')

GA_3 Rate (ug/mg seed)	Seed Rate (mg/ml sol.)	Germination (%)	% Cumulative Daily Emergence (days from sowing)						T50 (days)	Uniformity (days)	Rate of Emergence (plant/day)	EV	Dry Wt. (mg/pl)
			2	3	4	5	6	7					
0	25	56.3	20.0	27.5	90.0	97.5	97.5	97.5	3.1	2.2	7.0	314.3	11.8
	50	46.4	5.0	10.0	75.0	95.0	95.0	95.0	3.5	2.2	7.0	264.6	11.5
	75	45.9	2.5	7.5	62.5	80.0	87.5	92.5	3.7	2.5	6.0	214.3	11.3
	100	44.8	10.0	15.0	70.0	85.0	97.5	97.5	3.5	2.7	6.0	244.2	10.8
2	25	62.4	20.0	27.5	72.5	97.5	100.0	100.0	3.2	2.9	5.8	294.6	12.4
	50	54.9	2.5	7.5	80.0	95.0	97.5	97.5	3.5	2.0	7.8	288.4	12.5
	75	55.2	10.0	15.0	70.0	85.0	90.0	90.0	3.5	2.5	5.9	231.8	10.6
	100	50.3	0.0	5.0	60.0	75.0	85.0	92.5	3.8	2.5	6.2	215.3	9.4
4	25	67.3	5.0	10.0	90.0	100.0	100.0	100.0	3.3	1.9	8.5	321.4	10.8
	50	65.2	10.0	15.0	65.0	85.0	90.0	90.0	3.5	2.5	5.8	228.2	10.2
	75	61.2	7.5	12.5	72.5	90.0	90.0	90.0	3.4	2.2	6.5	233.5	11.3
	100	56.1	20.0	27.5	72.5	85.0	97.5	97.5	3.3	3.0	5.2	251.8	10.0
6	25	67.8	7.5	12.5	82.5	90.0	95.0	95.0	3.3	2.0	7.5	279.9	10.0
	50	58.7	5.0	10.0	72.5	90.0	95.0	95.0	3.6	2.3	6.6	249.1	10.5
	75	57.0	5.0	10.0	57.5	87.5	97.5	97.5	3.8	2.6	5.9	243.9	9.5
	100	60.7	10.0	15.0	72.5	92.5	92.5	92.5	3.4	2.3	6.3	251.4	8.9
8	25	72.5	20.0	27.5	80.0	90.0	95.0	95.0	3.2	2.5	6.0	271.4	8.1
	50	71.3	0.0	5.0	67.5	87.5	90.0	90.0	3.6	2.2	6.5	226.1	7.7
	75	72.0	0.0	5.0	47.5	85.0	90.0	90.0	3.8	2.4	5.9	218.6	7.4
	100	75.2	5.0	10.0	77.5	92.5	95.0	95.0	3.5	2.2	7.2	270.0	8.6

TABLE XIX

ANALYSIS OF VARIANCE FOR THE EFFECT OF GA_3 AND SEED RATE ON THE PERCENT GERMINATION IN AERATED COLUMNS OF PEPPER SEED (SERRANO CULTIVAR 'TAMPIQUEÑO 74')

Source	df	MS	F	PR>F
Replications	1	444.88	9.49	0.0055
GA_3 Rate	4			
GA_3 Rate Linear	1	2340.36	49.94	0.0001
GA_3 Rate Quadratic	1	0.16	0.00	0.9532
GA_3 Rate Cubic	1	148.78	3.17	0.0886
GA_3 Rate Quartic	1	95.04	2.03	0.1685
Seed Rate	3			
Seed Rate Linear	1	302.58	6.46	0.0186
Seed Rate Quadratic	1	66.04	1.41	0.2478
Seed Rate Cubic	1	11.04	0.24	0.6321
GA_3 Rate x Seed Rate	12	20.21	0.39	0.9523
Error	20	52.33		

R-Square = 0.77
C.V. = 12.0%

TABLE XX

ANALYSIS OF VARIANCE FOR THE EFFECT OF GA_3 AND SEED RATE ON THE DAYS TO 50% EMERGENCE (T50) OF GERMINATED PEPPER SEED (SERRANO CULTIVAR 'TAMPIQUEÑO 74')

Source	df	MS	F	PR>F
Replications	1	0.002	0.03	0.8725
GA_3 Rate	4			
GA_3 Rate Linear	1	0.02	0.26	0.6181
GA_3 Rate Quadratic	1	0.01	0.21	0.6479
GA_3 Rate Cubic	1	0.00	0.00	0.9476
GA_3 Rate Quartic	1	0.05	0.66	0.4241
Seed Rate	3			
Seed Rate Linear	1	0.53	6.34	0.0195
Seed Rate Quadratic	1	0.51	6.04	0.0223
Seed Rate Cubic	1	0.002	0.03	0.8666
GA_3 Rate x Seed Rate	12	0.05	0.56	0.8503
Error	20	0.09		

R-Square = 0.47
C.V. = 8.7%

APPENDIX B

STORAGE OF GERMINATED SEED STUDIES

TABLE XXI

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS OF 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE AND EMERGENCE VALUE FOR GERMINATED PEPPER SEED (CULTIVAR 'CALIFORNIA WONDER SELECT') STORED FOR 4 PERIODS OF TIME AT DIFFERENT TEMPERATURES

Temperature (°C)	Storage Period (days)	Percent Cumulative Daily Emergence (days from sowing)							T50 (days)	Uniformity (days)	Emergence Rate (pl/day)	EV
		4	5	6	7	8	9	10				
0	1	00.0	50.0	86.7	90.0	93.3	93.3	93.3	5.0	1.7	6.5	134.8
	2	3.3	50.0	86.7	100.0	100.0	100.0	100.0	5.1	2.1	5.8	149.2
	4	00.0	00.0	13.3	36.7	46.7	63.3	63.3	6.8	3.7	2.0	45.7
	6	00.0	00.0	00.0	00.0	00.0	3.3	6.7	9.6	6.5	0.1	00.5
1	1	00.0	6.7	13.3	83.3	83.3	86.7	86.7	6.2	2.7	3.8	103.2
	2	00.0	3.3	23.3	80.0	83.3	86.7	86.7	6.1	2.7	3.9	99.0
	4	00.0	00.0	3.3	40.0	50.0	66.7	66.7	6.9	3.6	2.2	51.3
	6	00.0	00.0	00.0	00.0	00.0	00.0	6.7	10.3	7.5	0.1	00.4
2	1	26.7	46.7	66.7	83.3	83.3	83.3	83.3	4.4	3.7	3.0	102.5
	2	10.0	46.7	80.0	86.7	90.0	93.3	93.3	5.0	2.3	5.2	124.4
	4	00.0	23.3	33.3	53.3	56.7	60.0	63.3	5.7	3.0	2.5	49.2
	6	00.0	16.7	40.0	43.3	53.3	56.7	60.0	5.7	2.6	3.0	47.4
3	1	6.7	33.3	66.7	80.0	80.0	83.3	83.3	5.2	2.3	4.4	98.4
	2	00.0	60.0	86.7	86.7	86.7	86.7	86.7	4.9	1.6	6.5	125.2
	4	00.0	20.0	46.7	63.3	63.3	63.3	63.3	5.5	2.3	3.2	58.7
	6	3.3	13.3	46.7	53.3	66.7	70.0	73.3	5.8	2.9	3.0	65.9
4	1	53.3	83.3	86.7	100.0	100.0	100.0	100.0	3.9	3.4	3.6	171.4
	2	60.0	96.7	96.7	96.7	96.7	96.7	96.7	3.7	2.1	5.5	187.1
	4	53.3	80.0	86.7	86.7	86.7	86.7	93.3	3.5	3.5	3.2	149.3
	6	36.7	56.7	90.0	93.3	93.3	93.3	93.3	4.3	3.0	4.0	140.3

TABLE XXI (Continued)

Temperature (°C)	Storage Period (days)	Percent Cumulative Daily Emergence (days from sowing)							T50 (days)	Uniformity (days)	Emergence Rate (pl/day)	EV
		4	5	6	7	8	9	10				
5	1	00.0	46.7	80.0	83.3	83.3	90.0	90.0	5.1	1.8	6.0	121.1
	2	3.3	53.3	83.3	86.7	86.7	86.7	86.7	4.9	1.7	6.0	120.7
	4	00.0	6.7	56.7	66.7	80.0	83.3	83.3	5.8	2.6	4.0	88.1
	6	00.0	00.0	43.3	66.7	80.0	80.0	80.0	6.0	2.6	3.8	85.7
6	1	00.0	30.0	76.7	86.7	93.3	93.3	93.3	5.3	2.1	5.4	124.4
	2	00.0	50.0	90.0	93.3	93.3	93.3	93.3	5.0	1.6	6.7	140.3
	4	00.0	43.3	76.7	86.7	90.0	90.0	90.0	5.2	2.1	5.2	115.5
	6	00.0	63.3	83.3	93.3	93.3	93.3	93.3	5.0	2.1	5.5	129.6

TABLE XXII

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE AND EMERGENCE VALUE FOR GERMINATED PEPPER SEED (CULTIVAR 'KALSPICE #1 SWEET PAPRIKA') STORED FOR 4 PERIODS OF TIME AT DIFFERENT TEMPERATURES

Temperature (°C)	Storage Period (days)	Percent Cumulative Daily Emergence (days from sowing)							T50 (days)	Uniformity (days)	Emergence Rate (pl/day)	EV
		4	5	6	7	8	9	10				
0	1	13.3	100.0	100.0	100.0	100.0	100.0	100.0	4.4	0.9	13.0	200.0
	2	00.0	30.0	80.0	83.3	83.3	83.3	83.3	5.1	1.7	6.0	111.1
	4	00.0	46.7	66.7	66.7	70.0	73.3	73.3	4.9	1.8	5.0	81.5
	6	00.0	00.0	10.0	53.3	63.3	66.7	76.7	6.8	3.5	2.6	61.5
1	1	00.0	43.3	83.3	96.7	96.7	100.0	100.0	5.3	2.1	5.9	144.4
	2	00.0	23.3	73.3	80.0	80.0	83.3	83.3	5.3	1.8	5.5	102.2
	4	00.0	23.3	50.0	86.7	86.7	86.7	86.7	5.6	2.4	4.3	107.9
	6	00.0	00.0	16.7	53.3	53.3	53.3	53.3	6.0	2.4	2.6	40.6
2	1	50.0	83.3	86.7	86.7	90.0	90.0	90.0	2.3	6.1	2.3	120.0
	2	70.0	86.7	90.0	93.3	93.3	93.3	93.3	1.4	7.5	1.5	140.0
	4	10.0	53.3	80.0	86.7	90.0	93.3	93.3	4.9	2.1	5.2	124.4
	6	53.3	90.0	93.3	93.3	93.3	93.3	93.3	3.7	2.2	5.5	168.4
3	1	30.0	86.7	96.7	96.7	96.7	96.7	96.7	4.3	1.4	8.5	168.0
	2	63.3	86.7	93.3	93.3	93.3	93.3	93.3	3.0	4.0	3.5	161.8
	4	13.3	90.0	100.0	100.0	100.0	100.0	100.0	4.5	1.1	11.5	180.0
	6	53.3	100.0	100.0	100.0	100.0	100.0	100.0	3.7	2.1	7.0	200.0
4	1	66.7	80.0	90.0	90.0	90.0	90.0	90.0	1.4	7.1	2.0	144.0
	2	73.3	93.3	96.7	96.7	96.7	96.7	96.7	2.7	3.9	3.0	180.4
	4	70.0	93.3	93.3	93.3	93.3	93.3	93.3	2.9	3.3	3.5	174.2
	6	70.0	93.3	93.3	93.3	93.3	93.3	93.3	2.9	3.3	3.5	174.2

TABLE XXII (Continued)

Temperature (°C)	Storage Period (days)	Percent Cumulative Daily Emergence (days from sowing)							T50 (days)	Uniformity (days)	Emergence Rate (pl/day)	EV
		4	5	6	7	8	9	10				
5	1	20.0	73.3	96.7	96.7	96.7	96.7	96.7	4.5	2.1	5.7	155.9
	2	16.7	66.7	80.0	83.3	86.7	86.7	86.7	4.6	2.2	4.7	115.5
	4	00.0	56.7	76.7	76.7	86.7	90.0	90.0	5.0	1.9	5.7	114.8
	6	10.0	66.7	83.3	93.3	93.3	93.3	93.3	4.8	2.3	5.1	134.8
6	1	30.0	96.7	100.0	100.0	100.0	100.0	100.0	4.3	1.2	10.0	193.3
	2	56.7	96.7	96.7	96.7	96.7	96.7	96.7	3.8	1.9	6.0	187.1
	4	50.0	93.3	93.3	93.3	93.3	93.3	93.3	3.9	1.7	6.5	174.2
	6	33.3	90.0	90.0	93.3	93.3	93.3	93.3	4.2	1.4	8.5	168.0

TABLE XXIII

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE AND EMERGENCE VALUE FOR GERMINATED PEPPER SEED (SERRANO CULTIVAR 'TAMPIQUEÑO 74') STORED FOR 4 PERIODS OF TIME AT DIFFERENT TEMPERATURES

Temperature (°C)	Storage Period (days)	Percent Cumulative Daily Emergence (days from sowing)							T50 (days)	Uniformity (days)	Emergence Rate (pl/day)	EV
		4	5	6	7	8	9	10				
0	1	53.3	93.3	96.7	100.0	100.0	100.0	100.0	3.7	3.0	4.5	171.1
	2	63.3	96.7	100.0	100.0	100.0	100.0	100.0	3.6	2.5	5.0	193.3
	4	0.0	36.7	56.7	63.3	66.7	70.0	73.3	5.7	3.2	4.0	80.6
	6	0.0	6.7	46.7	73.3	76.7	76.7	76.7	5.8	2.3	3.9	80.6
1	1	36.7	96.7	100.0	100.0	100.0	100.0	100.0	4.1	1.5	9.0	193.1
	2	0.0	13.3	70.0	83.3	90.0	93.3	93.3	5.7	2.7	4.2	112.0
	4	0.0	10.0	33.3	60.0	66.7	70.0	73.3	6.1	2.9	3.2	65.9
	6	0.0	10.0	23.3	46.7	53.3	53.3	53.3	5.6	2.2	2.8	42.8
2	1	76.7	83.3	90.0	93.3	93.3	93.3	93.3	-2.8	15.0	0.9	134.0
	2	76.7	86.7	90.0	93.3	93.3	93.3	96.7	-0.8	12.8	1.3	147.5
	4	60.0	93.3	96.7	96.7	96.7	96.7	96.7	3.6	2.4	5.0	180.4
	6	73.3	93.3	96.7	96.7	96.7	96.7	96.7	2.1	5.2	2.7	172.6
3	1	83.3	100.0	100.0	100.0	100.0	100.0	100.0	0.3	7.5	2.5	200.0
	2	83.3	100.0	100.0	100.0	100.0	100.0	100.0	0.3	7.5	2.5	200.0
	4	63.3	96.7	100.0	100.0	100.0	100.0	100.0	3.6	2.5	5.0	193.3
	6	56.7	100.0	100.0	100.0	100.0	100.0	100.0	3.8	1.9	6.5	200.0
4	1	73.3	100.0	100.0	100.0	100.0	100.0	100.0	3.1	3.0	4.0	200.0
	2	73.3	100.0	100.0	100.0	100.0	100.0	100.0	3.1	3.0	4.0	200.0
	4	73.3	100.0	100.0	100.0	100.0	100.0	100.0	3.1	3.0	4.0	200.0
	6	66.7	86.7	96.7	96.7	96.7	96.7	96.7	3.1	3.9	3.0	167.5

TABLE XXIII (Continued)

Temperature (°C)	Storage Period (days)	Percent Cumulative Daily Emergence (days from sowing) 4	5	6	7	8	9	10	T50 (days)	Uniformity (days)	Emergence Rate (pl/day)	EV
5	1	33.3	76.7	90.0	96.7	96.7	96.7	96.7	4.2	2.3	5.2	158.6
	2	23.3	70.0	70.0	76.7	76.7	83.3	83.3	4.3	1.5	7.0	120.0
	4	43.3	86.7	90.0	93.3	93.3	96.7	96.7	4.1	1.8	6.5	168.0
	6	0.0	70.0	86.7	90.0	93.3	93.3	93.3	4.9	1.7	6.5	134.8
6	1	66.7	93.3	100.0	100.0	100.0	100.0	100.0	3.2	3.2	4.0	186.6
	2	73.3	100.0	100.0	100.0	100.0	100.0	100.0	3.1	3.0	4.0	200.0
	4	66.7	100.0	100.0	100.0	100.0	100.0	100.0	3.5	2.4	5.0	200.0
	6	70.0	90.0	100.0	100.0	100.0	100.0	100.0	3.1	3.9	3.2	183.3

TABLE XXIV

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE AND EMERGENCE VALUE FOR GERMINATED PEPPER SEED (CULTIVAR 'VERDEÑO') STORED FOR 4 PERIODS OF TIME AT DIFFERENT TEMPERATURES

Temperature (°C)	Storage Period (days)	Percent Cumulative Daily Emergence (days from sowing)							T50 (days)	Uniformity (days)	Emergence Rate (pl/day)	EV
		4	5	6	7	8	9	10				
0	1	0.0	26.7	63.3	96.7	100.0	100.0	100.0	5.6	2.3	5.4	138.9
	2	0.0	33.3	63.3	93.3	93.3	93.3	93.3	5.5	2.4	4.6	125.1
	4	0.0	6.7	30.0	63.3	80.0	80.0	83.3	6.2	2.9	3.5	85.2
	6	0.0	0.0	0.0	20.0	66.7	73.3	76.7	7.1	3.6	2.5	68.4
1	1	0.0	10.0	20.0	90.0	96.7	96.7	96.7	6.1	2.7	4.2	125.9
	2	0.0	10.0	53.3	90.0	96.7	100.0	100.0	5.9	2.6	4.6	129.7
	4	0.0	0.0	3.3	63.3	86.7	86.7	86.7	6.6	3.0	3.5	96.4
	6	0.0	0.0	3.3	53.3	66.6	73.3	76.7	6.7	3.2	2.9	70.2
2	1	16.7	80.0	93.3	93.3	93.3	93.3	93.3	4.5	1.2	9.5	150.2
	2	6.7	46.7	86.7	90.0	90.0	90.0	90.0	4.9	1.8	6.0	130.0
	4	0.0	30.0	66.7	86.7	96.7	96.7	96.7	5.6	2.6	4.4	120.0
	6	0.0	16.7	70.0	93.3	96.7	96.7	96.7	5.6	2.3	5.0	129.2
3	1	0.0	36.7	86.7	96.7	96.7	96.7	96.7	5.2	1.8	6.5	139.6
	2	3.3	40.0	86.7	96.7	100.0	100.0	100.0	5.2	1.9	6.2	144.4
	4	0.0	36.7	83.3	96.7	100.0	100.0	100.0	5.3	2.0	6.2	150.0
	6	6.7	16.7	83.3	93.3	93.3	96.7	96.7	5.4	2.1	5.6	141.1
4	1	30.0	83.3	100.0	100.0	100.0	100.0	100.0	4.4	1.9	6.2	170.0
	2	40.0	80.0	100.0	100.0	100.0	100.0	100.0	4.2	2.2	5.5	170.0
	4	26.7	80.0	93.3	100.0	100.0	100.0	100.0	4.5	1.9	7.2	165.5
	6	33.3	56.7	90.0	96.7	96.7	96.7	96.7	4.6	2.7	4.2	145.2

TABLE XXIV (Continued)

Temperature (°C)	Storage Period (days)	Percent Cumulative Daily Emergence (days from sowing)							T50 (days)	Uniformity (days)	Emergence Rate (pl/day)	EV
		4	5	6	7	8	9	10				
5	1	3.3	26.7	76.7	100.0	100.0	100.0	100.0	5.4	2.0	5.9	149.2
	2	0.0	40.0	63.0	76.7	83.3	83.3	83.3	5.3	2.2	4.6	98.9
	4	0.0	6.7	70.0	90.0	100.0	100.0	100.0	5.7	2.3	5.6	140.3
	6	3.3	13.3	66.7	86.7	90.0	100.0	100.0	5.7	2.6	4.5	123.8
6	1	3.3	36.7	93.3	96.7	96.7	96.7	100.0	5.1	1.8	6.7	155.5
	2	0.0	26.7	96.7	100.0	100.0	100.0	100.0	5.2	1.6	7.2	161.1
	4	0.0	16.7	46.7	76.7	90.0	96.7	96.7	6.0	3.0	3.9	112.4
	6	3.3	30.0	96.7	96.7	100.0	100.0	100.0	5.1	1.7	7.0	177.8

TABLE XXV

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE AND EMERGENCE VALUE FOR GERMINATED PEPPER SEED (CULTIVAR 'MULATO ROQUE') STORED FOR 4 PERIODS OF TIME AT DIFFERENT TEMPERATURES

Temperature (°C)	Storage Period (days)	Percent Cumulative Daily Emergence (days from sowing)							T50 (days)	Uniformity (days)	Emergence Rate (pl/day)	EV
		4	5	6	7	8	9	10				
0	1	0.0	16.7	73.3	90.0	93.3	93.3	93.3	5.5	2.0	5.5	124.4
	2	0.0	6.7	50.0	93.3	93.3	96.7	96.7	5.8	2.4	4.8	128.9
	4	0.0	0.0	10.0	33.3	73.3	90.0	90.0	7.0	3.6	3.0	91.1
	6	0.0	0.0	3.3	16.7	30.0	56.7	73.3	7.9	4.7	1.9	57.8
1	1	0.0	23.3	63.3	76.7	76.7	80.0	80.0	5.4	2.1	4.6	90.8
	2	0.0	0.0	10.0	60.0	76.7	80.0	83.3	6.6	3.1	3.2	79.7
	4	0.0	0.0	0.0	60.0	83.3	83.3	83.3	6.6	2.9	3.4	90.3
	6	0.0	0.0	0.0	10.0	20.0	36.7	46.7	7.9	4.6	1.2	23.0
2	1	3.3	30.0	83.3	90.0	90.0	96.7	100.0	5.3	2.3	5.2	133.3
	2	3.3	26.7	80.0	100.0	100.0	100.0	100.0	5.3	2.1	5.8	149.2
	4	0.0	33.3	86.7	96.7	96.7	96.7	96.7	5.2	2.0	6.1	145.5
	6	0.0	10.0	60.0	96.7	100.0	100.0	100.0	5.7	2.3	5.1	138.1
3	1	0.0	30.0	90.0	93.3	96.7	100.0	100.0	5.2	1.8	6.7	150.0
	2	0.0	26.7	73.3	100.0	100.0	100.0	100.0	5.4	1.9	6.3	154.7
	4	0.0	6.7	43.3	90.0	100.0	100.0	100.0	6.0	2.7	4.4	129.1
	6	0.0	0.0	43.3	76.7	86.7	93.3	93.3	6.1	2.8	4.0	103.9
4	1	46.7	86.7	90.0	90.0	90.0	93.3	93.3	4.0	1.9	6.0	161.8
	2	66.7	96.7	100.0	100.0	100.0	100.0	100.0	4.0	2.7	4.5	193.3
	4	26.7	93.3	96.7	96.7	96.7	96.7	96.7	4.3	1.2	10.0	180.9
	6	20.0	70.0	100.0	100.0	100.0	100.0	100.0	4.6	2.0	6.0	166.6

TABLE XXV (Continued)

Temperature (°C)	Storage Period (days)	Percent Cumulative Daily Emergence (days from sowing)							T50 (days)	Uniformity (days)	Emergence Rate (pl/day)	EV
		4	5	6	7	8	9	10				
5	1	0.0	16.7	76.7	100.0	100.0	100.0	100.0	5.5	2.0	5.9	143.6
	2	0.0	10.0	83.3	93.3	93.3	93.3	93.3	5.4	1.9	5.9	129.6
	4	0.0	6.7	26.7	46.7	80.0	90.0	90.0	6.5	3.2	3.4	93.6
	6	0.0	20.0	83.3	100.0	100.0	100.0	100.0	5.4	2.0	5.9	143.6
6	1	6.7	56.7	90.0	93.3	93.3	93.3	97.3	4.9	1.8	6.2	144.8
	2	0.0	56.7	90.0	100.0	100.0	100.0	100.0	5.0	1.8	6.7	150.0
	4	0.0	10.0	73.3	83.3	96.7	96.7	96.7	5.7	2.4	5.1	126.6
	6	0.0	63.3	93.3	100.0	100.0	100.0	100.0	5.0	1.7	7.0	155.5

TABLE XXVI

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE AND EMERGENCE VALUE FOR GERMINATED PEPPER SEED (CULTIVAR 'ESMERALDA') STORED FOR 4 PERIODS OF TIME AT DIFFERENT TEMPERATURES

Temperature (°C)	Storage Period (days)	Percent Cumulative Daily Emergence (days from sowing)							T50 (days)	Uniformity (days)	Emergence Rate (pl/day)	EV
		4	5	6	7	8	9	10				
0	1	3.3	16.7	83.3	90.0	96.7	96.7	96.7	5.3	1.9	6.0	134.4
	2	0.0	36.7	80.0	96.7	100.0	100.0	100.0	5.3	2.1	5.7	143.6
	4	0.0	3.3	16.7	46.7	53.3	53.3	53.3	5.7	2.2	2.6	50.3
	6	0.0	0.0	10.0	13.3	30.0	40.0	46.7	7.4	4.4	1.3	25.8
1	1	0.0	6.7	43.3	96.7	96.7	96.7	96.7	5.8	2.3	4.9	133.6
	2	0.0	3.3	16.7	100.0	100.0	100.0	100.0	6.1	2.5	4.7	142.8
	4	0.0	10.0	23.3	90.0	96.7	96.7	96.7	6.1	2.6	4.4	125.9
	6	0.0	0.0	0.0	16.7	40.0	70.0	76.7	7.6	4.1	2.3	62.4
2	1	0.0	3.3	30.0	83.3	100.0	100.0	100.0	6.2	2.8	4.2	125.0
	2	0.0	0.0	50.0	73.0	93.0	100.0	100.0	6.3	3.2	3.7	118.0
	4	10.0	50.0	73.3	90.0	90.0	93.3	93.3	5.1	2.4	4.7	129.6
	6	3.3	10.0	43.3	66.7	73.3	76.7	80.0	6.0	2.9	3.3	79.0
3	1	0.0	33.3	90.0	100.0	100.0	100.0	100.0	5.2	1.8	6.7	150.0
	2	3.3	30.0	83.3	93.3	96.7	96.7	96.7	5.3	2.1	5.8	139.2
	4	0.0	6.7	50.0	66.7	76.7	93.3	93.3	6.2	3.4	3.4	97.3
	6	10.0	20.0	66.7	86.7	93.3	93.3	100.0	5.6	2.8	4.3	129.1
4	1	43.3	83.3	90.0	96.7	96.7	96.7	96.7	4.1	1.9	6.0	161.8
	2	10.0	70.0	100.0	100.0	100.0	100.0	100.0	4.8	1.8	6.7	166.7
	4	20.0	76.7	100.0	100.0	100.0	100.0	100.0	4.5	1.6	8.2	170.0
	6	20.0	80.0	96.7	96.7	100.0	100.0	100.0	4.7	1.6	8.2	171.1

TABLE XXVI (Continued)

Temperature (°C)	Storage Period (days)	Percent Cumulative Daily Emergence (days from sowing)							T50 (days)	Uniformity (days)	Emergence Rate (pl/day)	EV
		4	5	6	7	8	9	10				
5	1	0.0	3.3	20.0	73.3	86.7	90.0	90.0	6.3	2.9	3.7	100.2
	2	3.3	20.0	73.3	93.3	93.3	93.3	93.3	5.4	2.1	5.7	137.0
	4	3.3	20.0	80.0	86.7	86.7	93.3	93.3	5.3	1.9	5.7	124.4
	6	3.3	13.3	56.7	80.0	80.0	90.0	90.0	5.7	2.6	4.1	102.8
6	1	0.0	60.0	90.0	100.0	100.0	100.0	100.0	5.0	1.8	6.7	150.0
	2	0.0	33.3	70.0	93.3	96.7	96.7	96.7	5.4	2.1	5.8	140.0
	4	3.3	20.0	100.0	100.0	100.0	100.0	100.0	5.2	1.6	7.2	166.6
	6	0.0	46.7	96.7	96.7	96.7	96.7	100.0	5.0	1.6	7.2	161.1

TABLE XXVII

ANALYSIS OF VARIANCE FOR THE TOTAL EMERGENCE OF GERMINATED SEED OF SIX PEPPER CULTIVARS, STORED FOR FOUR PERIODS OF TIME AT SEVEN TEMPERATURES

Source	df	MS	F	PF>F
Replication	1	58.333	0.54	0.4613
Temperature	6	2555.202	78.10	0.0001
Temperature Linear	1	10744.047	328.40	0.0001
Temperature Quadratic	1	1558.377	47.63	0.0001
Temperature Cubic	1	26.080	0.79	0.6222
Temperature Quartic	1	2579.515	78.84	0.0001
Error a	6	32.716		
Cultivar	5	1945.211	29.26	0.0001
Temperature x Cultivar	30	201.816	3.04	0.0100
Storage	3	2933.818	44.14	0.0001
Storage Linear	1	8674.309	130.51	0.0001
Storage Quadratic	1	95.617	1.44	0.3457
Storage Cubic	1	31.528	0.47	0.4783
Temperature x Storage	18	954.908	14.36	0.0001
Temp L X Storage L	1	10723.184	161.33	0.0001
Temp L x Storage Q	1	483.124	7.27	0.0050
Temp L x Storage C	1	168.957	2.54	0.0500
Temp Q x Storage L	1	2519.128	37.90	0.0001
Temp Q x Storage Q	1	4.610	0.07	0.8358
Temp Q x Storage C	1	22.733	0.34	0.6455
Cultivar x Storage	15	348.104	5.24	0.0001
Temp x Cultivar x Storage	90	100.922	1.51	0.0010
Error b	161	66.465		

L = Linear
Q = Quadratic
C = Cubic
C.V. = 15.4%

TABLE XXVIII

ANALYSIS OF VARIANCE FOR DAYS TO 50% EMERGENCE OF GERMINATED SEED OF SIX PEPPER CULTIVARS, STORED FOR FOUR PERIODS OF TIME AT SEVEN TEMPERATURES

Source	df	MS	F	PF>F
Replication	1	1.160	1.00	0.3558
Temperature	6	39.073	33.71	0.0002
Temperature Linear	1	64.181	55.37	0.0001
Temperature Quadratic	1	61.842	53.35	0.0001
Temperature Cubic	1	0.761	0.65	0.3951
Temperature Quartic	1	55.817	48.15	0.0001
Error a	6	1.159		
Cultivar	5	53.058	76.34	0.0001
Temperature x Cultivar	30	3.233	4.65	0.0001
Storage	3	22.802	32.80	0.0001
Storage Linear	1	65.930	94.90	0.0001
Storage Quadratic	1	0.390	0.56	0.2785
Storage Cubic	1	2.084	2.99	0.1000
Temperature x Storage	18	2.527	3.63	0.0001
Temp L X Storage L	1	33.861	48.72	0.0001
Temp L x Storage Q	1	0.870	1.25	0.1706
Temp L x Storage C	1	0.268	0.38	0.5425
Temp Q x Storage L	1	0.353	0.51	0.5119
Temp Q x Storage Q	1	1.527	2.20	0.0085
Temp Q x Storage C	1	0.345	0.49	0.5163
Cultivar x Storage	15	1.644	2.36	0.0063
Temp x Cultivar x Storage	90	0.848	1.22	0.1840
Error b	161	0.695		

L = Linear
Q = Quadratic
C = Cubic
C.V. = 7.6%

TABLE XXIX

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE, RADICLE LENGTH, RADICLE TIP KILLED, DRY WEIGHT, SHOOT/ROOT RATIO, CONDUCTIVITY, POTASSIUM, CALCIUM AND REDUCING SUGARS IN LEACHATE, OF GERMINATED PEPPER SEED (CULTIVAR 'CALIFORNIA WONDER P.S.') STORED FOR SIX DAYS AT 0 AND 5 °C AND NON-STORED

Variable	Temperature (°C) 0	5	30[y]
Cumulative Daily Emergence (%) (days from sowing)			
4	0.0	0.0	9.2
5	0.0	0.0	37.5
6	0.0	23.3	65.0
7	0.0	66.7	91.7
8	5.0	86.7	96.7
9	16.7	96.7	96.7
10	21.7	96.7	96.7
11	26.7	96.7	96.7
12	30.0	96.7	96.7
13	45.0b[z]	96.7a	96.7a
T50 (days)	10.1a	6.6b	5.4c
Uniformity (days)	7.3a	3.4b	2.9b
Rate of Emergence (plants/day)	1.0b	4.5a	5.5a
Emergence Value	16.0b	109.2a	126.7a
Radicle Length (mm)	19.7[c]	54.0a	43.3b
Radicle Tip Killed (%)	100.0a	3.7b	3.3b
Shoot Dry Weight (mg/plant)	3.6b	3.8b	5.5a
Root Dry Weight (mg/plant)	1.8b	2.8b	4.5a
Shoot/Root Ratio	2.0a	1.5ab	1.3b
Conductivity (umhos/cm)	80.0a	21.7a	21.8a
Potassium (ppm)	1.5a	2.0a	1.5a

TABLE XXIX (Continued)

Variable	Temperature (°C)		
	0	5	30[y]
Calcium (ppm)	2.4a	1.3a	0.9a
Reducing Sugars (ppm)	3.0a	0.6b	0.3b

[y]Seeds were sown when the germination period had ended. Germination temperature was 30 °C.

[z]Means in a row followed by the same letter are not significantly different according with the Tukey's HSD Test at 5%.

TABLE XXX

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE, RADICLE LENGTH, RADICLE TIP KILLED, DRY WEIGHT, SHOOT/ROOT RATIO, CONDUCTIVITY, POTASSIUM, CALCIUM AND REDUCING SUGARS IN LEACHATE, OF GERMINATED PEPPER SEED (CULTIVAR 'BAHEMIAN HOT CHILI') STORED FOR SIX DAYS AT 0 AND 5 °C AND NON-STORED

Variable	Temperature (°C)		
	0	5	30[y]
Cumulative Daily Emergence (%) (days from sowing)			
4	0.0	0.0	9.2
5	0.0	18.3	49.2
6	15.0	53.3	80.0
7	53.3	75.0	90.8
8	71.7	83.3	95.0
9	80.0	85.0	95.0
10	85.0	88.3	95.0
11	85.0	88.3	95.0
12	85.0	88.3	95.0
13	85.0b[z]	88.3b	95.0a
T50 (days)	6.8a	5.8b	5.1c
Uniformity (days)	3.7a	2.8b	2.4b
Rate of Emergence (plants/day)	3.7a	5.1a	6.7a
Emergence Value	76.1b	98.8ab	133.9a
Radicle Length (mm)	45.5a	31.7b	50.8a
Radicle Tip Killed (%)	93.7a	19.3b	0.8c
Shoot Dry Weight (mg/plant)	2.7a	2.3a	3.1a
Root Dry Weight (mg/plant)	2.6a	2.6a	2.2a
Shoot/Root Ratio	1.0a	1.0a	1.4a
Conductivity (umhos/cm)	20.0b	30.0a	17.2b
Potassium (ppm)	0.5b	1.0a	1.2a

TABLE XXX (Continued)

Variable	Temperature (°C)		
	0	5	30[y]
Calcium (ppm)	0.8a	1.0a	1.0a
Reducing Sugars (ppm)	---	---	---

[y]Seeds were sown when the germination period had ended. Germination temperature was 30 °C.

[z]Means in a row followed by the same letter are not significantly different according with the Tukey's HSD Test at 5%.

TABLE XXXI

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE, RADICLE LENGTH, RADICLE TIP KILLED, DRY WEIGHT, SHOOT/ROOT RATIO, CONDUCTIVITY, POTASSIUM, CALCIUM AND REDUCING SUGARS IN LEACHATE, OF GERMINATED PEPPER SEED (CULTIVAR 'KALSPICE #1 SWEET PAPRIKA') STORED FOR SIX DAYS AT 0 AND 5 °C AND NON-STORED

Variable	Temperature (°C) 0	5	30[y]
Cumulative Daily Emergence (%) (days from sowing)			
4	0.0	21.7	15.0
5	0.0	53.3	67.5
6	10.0	85.0	79.2
7	26.7	91.7	86.7
8	43.3	93.3	88.3
9	60.0	95.0	88.3
10	60.0	96.7	88.3
11	65.0	96.7	88.3
12	65.0	96.7	88.3
13	65.0b[z]	96.7a	88.3b
T50 (days)	7.2a	4.8b	4.7b
Uniformity (days)	4.0a	2.2b	2.4b
Rate of Emergence (plants/day)	2.5a	7.3a	7.1a
Emergence Value	45.0b	137.8a	124.5a
Radicle Length (mm)	43.3b	42.7b	53.8a
Radicle Tip Killed (%)	59.7a	7.0b	1.0b
Shoot Dry Weight (mg/plant)	3.1b	4.4a	3.5b
Root Dry Weight (mg/plant)	3.0a	2.3b	1.9b
Shoot/Root Ratio	1.1b	1.9a	1.9a
Conductivity (umhos/cm)	28.0b	120.3a	19.0b
Potassium (ppm)	0.9a	3.5a	1.5a

TABLE XXXI (Continued)

Variable	Temperature (°C)		
	0	5	30[y]
Calcium (ppm)	1.0a	1.8a	0.9a
Reducing Sugars (ppm)	---	---	---

[y]Seeds were sown when the germination period had ended. Germination temperature was 30 °C.

[z]Means in a row followed by the same letter are not significantly different according with the Tukey's HSD Test at 5%.

TABLE XXXII

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE, RADICLE LENGTH, RADICLE TIP KILLED, DRY WEIGHT, SHOOT/ROOT RATIO, CONDUCTIVITY, POTASSIUM, CALCIUM AND REDUCING SUGARS IN LEACHATE, OF GERMINATED PEPPER SEED (CULTIVAR 'TAMPIQUEÑO 74') STORED FOR SIX DAYS AT 0 AND 5 °C AND NON-STORED

Variable	Temperature (°C)		
	0	5	30[y]
Cumulative Daily Emergence (%) (days from sowing)			
4	5.0	15.0	13.3
5	21.7	45.0	49.2
6	45.0	80.0	63.3
7	53.3	80.0	83.3
8	55.0	80.0	87.5
9	55.0	80.0	87.5
10	55.0	80.0	87.5
11	55.0	80.0	87.5
12	55.0	80.0	87.5
13	55.0b[z]	80.0ab	87.5a
T50 (days)	5.1a	4.7a	5.1a
Uniformity (days)	2.1b	2.0b	3.1a
Rate of Emergence (plants/day)	4.1a	6.5a	4.6a
Emergence Value	47.8b	108.3a	106.7a
Radicle Length (mm)	53.7a	58.5a	43.8b
Radicle Tip Killed (%)	43.3a	16.5ab	0.8b
Shoot Dry Weight (mg/plant)	5.5a	3.8a	4.6a
Root Dry Weight (mg/plant)	2.5a	2.0a	2.8a
Shoot/Root Ratio	2.4a	1.9a	1.7a
Conductivity (umhos/cm)	19.3a	19.0a	20.2a
Potassium (ppm)	1.0c	1.8a	1.2b

TABLE XXXII (Continued)

Variable	Temperature (°C)		
	0	5	30[y]
Calcium (ppm)	1.0a	1.0a	0.8a
Reducing Sugars (ppm)	1.5a	0.9a	0.3a

[y]Seeds were sown when the germination period had ended. Germination temperature was 30 °C.

[z]Means in a row followed by the same letter are not significantly different according with the Tukey's HSD Test at 5%.

TABLE XXXIII

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE, RADICLE LENGTH, RADICLE TIP KILLED, DRY WEIGHT, SHOOT/ROOT RATIO, CONDUCTIVITY, POTASSIUM, CALCIUM AND REDUCING SUGARS IN LEACHATE, OF GERMINATED PEPPER SEED (CULTIVAR 'VERDEÑO') STORED FOR SIX DAYS AT 0 AND 5 °C AND NON-STORED

Variable	Temperature (°C)		
	0	5	30[y]
Cumulative Daily Emergence (%) (days from sowing)			
4	0.0	0.0	13.3
5	0.0	10.0	50.0
6	1.7	28.3	71.7
7	13.3	41.7	84.2
8	18.3	55.0	86.7
9	30.0	55.0	86.7
10	41.7	55.0	86.7
11	41.7	55.0	86.7
12	41.7	55.0	86.7
13	41.7b[z]	55.0b	86.7a
T50 (days)	7.8a	6.0b	5.0c
Uniformity (days)	4.6a	3.1b	3.0b
Rate of Emergence (plants/day)	1.4b	2.8a	5.0a
Emergence Value	21.0b	39.7b	105.5a
Radicle Length (mm)	53.3b	65.3a	60.7ab
Radicle Tip Killed (%)	92.0a	13.0b	1.0b
Shoot Dry Weight (mg/plant)	7.6a	5.2b	5.0b
Root Dry Weight (mg/plant)	4.9a	4.1a	2.7a
Shoot/Root Ratio	1.6a	1.4	2.0a
Conductivity (umhos/cm)	32.7a	18.7a	19.7a
Potassium (ppm)	1.2b	1.6a	1.8a

TABLE XXXIII (Continued)

Variable	Temperature (°C)		
	0	5	30[y]
Calcium (ppm)	1.2a	1.0a	0.9a
Reducing Sugars (ppm)	0.6a	0.1a	0.2a

[y]Seeds were sown when the germination period had ended. Germination temperature was 30 °C.

[z]Means in a row followed by the same letter are not significantly different according with the Tukey's HSD at 5%.

TABLE XXXIV

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE, RADICLE LENGTH, RADICLE TIP KILLED, DRY WEIGHT, SHOOT/ROOT RATIO, CONDUCTIVITY, POTASSIUM, CALCIUM AND REDUCING SUGARS IN LEACHATE OF GERMINATED PEPPER SEED (CULTIVAR 'CALIFORNIA WONDER P.S.') TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 0 °C

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Cumulative Daily Emergence (days from sowing)								
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	1.7	10.0	5.0	0.0	0.0	0.0	0.0
8	5.0	5.0	26.7	13.3	13.3	0.0	0.0	6.7
9	16.7	13.3	36.7	26.7	20.0	5.0	8.3	10.0
10	21.7	16.7	41.7	30.0	23.3	8.3	8.3	13.3
11	26.7	28.3	48.3	36.7	30.0	8.3	18.3	23.3
12	30.0	28.3	48.3	41.7	33.3	8.3	25.0	26.7
13	45.0ab[z]	40.0ab	55.0a	51.7a	40.0ab	10.0b	36.7ab	38.3ab
T50 (days)	10.1a	11.5a	8.3a	9.6a	9.1a	9.5a	10.8a	10.6a
Uniformity (days)	7.3a	9.8a	9.4a	7.1a	6.0a	6.3a	7.7a	8.2a
Rate of Emergence (plants/day)	1.0ab	0.8ab	1.6a	1.2ab	1.1ab	0.2b	0.08ab	0.7ab
Emergence Value	16.0ab	10.6ab	27.5a	19.8ab	13.9ab	0.9b	11.0ab	10.5ab

TABLE XXXIV (Continued)

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Radicle Length (mm)	19.7a[z]	26.7a	32.7a	27.3a	31.7a	25.0a	17.3a	28.3a
Radicle Tip Killed (%)	100.0a	90.3a	47.3b	77.7ab	88.7a	100.0a	89.0a	85.7a
Shoot Dry Weight (mg/plant)	3.6ab	3.7ab	3.2ab	2.9b	5.7a	3.7ab	3.3ab	5.2ab
Root Dry Weight (mg/plant)	1.8a	2.1a	2.0a	2.0a	3.1a	2.2a	2.4a	2.8a
Shoot/Root Ratio	2.0a	1.9a	1.6a	1.5a	1.8a	1.8a	1.3a	1.8a
Conductivity (umhos/cm)	80.0a	116.0a	50.0a	76.0a	79.3a	2771.3a	28.3a	79.0a
Potassium (ppm)	1.5a	2.7a	1.6a	1.5a	1.4a	2.1a	2.0a	1.2a
Calcium (ppm)	2.4a	3.9a	2.0a	1.2a	3.8a	5.7a	3.1a	1.7a
Reducing Sugars (ppm)	3.0a	31.1a	1.0a	4.7a	1.7a	41.1a	57.6a	1.5a

[z]Means in a row followed by the same letter are not significantly different according with the Tukey's HSD Test at 5%.

TABLE XXXV

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE EMERGENCE VALUE, RADICLE LENGTH, RADICLE TIP KILLED, DRY WEIGHT, SHOOT/ROOT RATIO, CONDUCTIVITY, POTASSIUM, CALCIUM AND REDUCING SUGARS IN LEACHATE OF GERMINATED PEPPER SEED (CULTIVAR 'BAHEMIAN HOT CHILI') TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 0 °C

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Cumulative Daily Emergence (days from sowing)								
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	1.7	10.0	5.0	8.3	0.0	1.7	5.0
6	15.0	18.3	26.7	11.7	48.3	8.3	25.0	21.7
7	53.3	45.0	40.0	20.0	76.7	26.7	53.3	53.3
8	71.7	56.7	55.0	21.7	85.0	38.3	63.3	68.3
9	80.0	65.0	73.3	23.3	86.7	51.7	70.0	81.7
10	85.0	66.7	81.7	23.3	86.7	55.0	75.0	85.0
11	85.0	66.7	81.7	23.3	88.3	65.0	75.0	90.0
12	85.0	66.7	81.7	23.3	88.3	65.0	75.0	90.0
13	85.0a[z]	66.7a	81.7a	23.3b	88.3a	65.0a	75.0a	90.0a
T50 (days)	6.8ab	6.6ab	6.9ab	6.0b	5.9b	7.7a	6.5ab	6.7ab
Uniformity (days)	3.7ab	3.5b	4.0ab	2.7b	2.6b	4.8a	3.4ab	3.6ab
Rate of Emergence (plants/day)	3.7ab	3.0b	3.4abc	1.4d	5.4a	2.3cd	3.6ab	4.1ab
Emergence Value	76.1ab	50.0bc	74.0ab	7.5c	99.5a	45.2bc	62.2ab	84.7ab

TABLE XXXV (Continued)

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Radicle Length (mm)	45.3a	49.7a	49.7a	43.0a	51.3a	43.7a	44.7a	46.7a
Radicle Tip Killed (%)	93.7a	88.3a	68.0ab	52.0b	78.0ab	96.3a	73.0ab	84.7a
Shoot Dry Weight (mg/plant)	2.7a	3.2a	2.4a	2.9a	2.8a	2.7a	2.9a	2.4a
Root Dry Weight (mg/plant)	2.6a	2.9a	2.5a	2.4a	2.3a	2.3a	2.7a	2.6a
Shoot/Root Ratio	1.0a	1.1a	1.0a	1.3a	1.2a	1.2a	1.2a	1.0a
Conductivity (umhos/cm)	20.0a	17.7a	27.0a	17.7a	22.3a	39.7a	15.3a	36.7a
Potassium (ppm)	0.5a	0.8a	1.2a	0.9a	1.1a	1.0a	0.5a	0.5a
Calcium (ppm)	0.8b	0.9ab	1.3a	0.9ab	0.8b	0.8b	0.8b	1.0ab
Reducing Sugars (ppm)	---	---	---	---	---	---	---	---

[z]Means in a row followed by the same letter are not significantly different according with the Tukey's HSD Test at 5%.

TABLE XXXVI

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE, RADICLE LENGTH, RADICLE TIP KILLED, DRY WEIGHT, SHOOT/ROOT RATIO, CONDUCTIVITY, POTASSIUM, CALCIUM AND REDUCING SUGARS IN LEACHATE OF GERMINATED PEPPER SEED (CULTIVAR 'KALSPICE #1 SWEET PAPRIKA') TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 0 °C

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Cumulative Daily Emergence (%) (days from sowing)								
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	8.3	3.3	0.0	0.0	5.0	0.0
6	10.0	0.0	25.0	8.3	13.3	0.0	8.3	0.0
7	26.7	5.0	43.3	10.0	30.0	0.0	25.0	13.3
8	43.3	5.0	50.0	20.0	53.3	3.3	30.0	30.0
9	60.0	13.3	55.0	23.3	58.3	10.0	43.3	36.7
10	60.0	26.7	56.7	36.7	61.7	26.7	45.0	51.7
11	65.0	35.0	56.7	41.7	63.5	40.0	48.3	55.0
12	65.0	50.0	56.7	43.3	65.5	50.0	53.3	61.7
13	65.0a[z]	50.0a	56.7a	43.3a	65.5a	50.0a	53.3a	61.7a
T50 (days)	7.2c	9.7ab	6.1c	8.0abc	7.2c	9.9a	7.6bc	8.1abc
Uniformity (days)	4.0bc	6.7a	3.0c	5.8ab	4.3abc	6.7a	4.8abc	4.9abc
Rate of Emergence (plants/day)	2.5a	1.2a	3.0a	1.2a	2.7a	1.2a	1.9a	2.0a
Emergence Value	45.0a	24.6a	42.3a	18.1a	46.7a	24.0a	27.8a	38.4a

TABLE XXXVI (Continued)

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Radicle Length (mm)	43.3a[z]	27.0a	34.3a	28.3a	44.7a	46.3a	41.0a	31.0a
Radicle Tip Killed (%)	59.7a	68.0a	59.0a	39.0a	36.7a	86.7a	69.3a	81.3a
Shoot Dry Weight (mg/plant)	3.1a	2.8a	4.0a	2.8a	3.8a	4.1a	5.0a	3.3a
Root Dry Weight (mg/plant)	3.0a	2.2a	3.7a	4.3a	4.3a	3.9a	3.1a	4.9a
Shoot/Root Ratio	1.1a	1.6a	1.1a	0.7a	0.9a	1.3a	2.0a	0.7a
Conductivity (umhos/cm)	28.0a	27.7a	25.7a	23.3a	24.0a	57.3a	22.3a	35.0a
Potassium (ppm)	0.9a	1.1a	1.5a	1.3a	0.9a	1.2a	0.7a	1.5a
Calcium (ppm)	1.0a	1.2a	0.9a	0.8a	0.8a	0.6a	0.8a	2.9a
Reducing Sugars (ppm)	---	---	---	---	---	---	---	---

[z]Means in a row followed by the same letter are not significantly different according with the Tukey's HSD Test at 5%.

TABLE XXXVII

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE, RADICLE LENGTH, RADICLE TIP KILLED, DRY WEIGHT, SHOOT/ROOT RATIO, CONDUCTIVITY, POTASSIUM, CALCIUM AND REDUCING SUGARS IN LEACHATE OF GERMINATED PEPPER SEED (CULTIVAR 'TAMPIQUEÑO 74') TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 0 °C

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Cumulative Daily Emergence (%) (days from sowing)								
4	5.0	1.7	3.3	1.7	5.0	0.0	10.0	5.0
5	21.7	31.7	10.0	15.0	33.3	1.7	25.0	25.0
6	45.0	51.7	48.3	45.0	50.0	11.7	43.3	41.7
7	53.3	63.3	55.0	56.7	63.3	30.0	51.7	55.0
8	55.0	70.0	63.3	61.7	65.0	40.0	56.7	63.3
9	55.0	70.0	68.3	68.3	66.7	48.3	56.7	66.7
10	55.0	70.0	68.3	68.3	66.7	48.3	56.7	66.7
11	55.0	70.0	68.3	68.3	66.7	48.3	56.7	66.7
12	55.0	70.0	68.3	68.3	66.7	48.3	56.7	66.7
13	55.0a[z]	70.0a	68.3a	68.3a	66.7a	48.3a	56.7a	66.7a
T50 (days)	5.1b	5.3b	5.8b	5.8b	5.3b	6.7a	5.2b	5.6b
Uniformity (days)	2.1a	2.2a	3.0a	3.2a	2.8a	3.5a	2.9a	3.2a
Rate of Emergence (plants/day)	4.1ab	5.3a	4.0ab	3.5ab	3.8ab	2.2b	3.1ab	3.3ab
Emergence Value	47.8a	74.4a	60.2a	63.5a	64.6a	26.4a	45.1a	55.3a

TABLE XXXVII (Continued)

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Radicle Length (mm)	53.7a[z]	51.7a	55.7a	47.7a	53.0a	54.0a	52.7a	49.7a
Radicle Tip Killed (%)	43.3a	32.0a	33.7a	42.3a	41.0a	80.7a	42.0a	61.0a
Shoot Dry Weight (mg/plant)	5.5a	5.0a	3.4a	4.6a	5.0a	3.8a	5.9a	5.1a
Root Dry Weight (mg/plant)	2.5a	2.4a	2.4a	3.0a	2.1a	2.5a	2.5a	2.3a
Shoot/Root Ratio	2.4a	2.2a	1.6a	1.5a	2.7a	1.6a	2.4a	2.4a
Conductivity (umhos/cm)	19.3a	17.7a	22.0a	21.3a	23.3a	24.7a	23.3a	26.3a
Potassium (ppm)	1.0a	0.9a	1.4a	1.2a	1.0a	1.3a	0.9a	0.9a
Calcium (ppm)	1.0a	0.9a	0.9a	1.0a	1.4a	1.2a	1.4a	1.5a
Reducing Sugars (ppm)	1.5a	2.3a	0.5a	5.8a	0.7a	0.7a	0.9a	0.7a

[z]Means in a row followed by the same letter are not significantly different according with the Tukey's HSD Test at 5%.

TABLE XXXVIII

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE, RADICLE LENGTH, RADICLE TIP KILLED, DRY WEIGHT, SHOOT/ROOT RATIO, CONDUCTIVITY, POTASSIUM, CALCIUM AND REDUCING SUGARS IN LEACHATE OF GERMINATED PEPPER SEED (CULTIVAR 'VERDEÑO') TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 0 °C

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Cumulative Daily Emergence (%) (days from sowing)								
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1.7	3.3	0.0	3.3	0.0	0.0	0.0	1.7
7	13.3	11.7	0.0	5.0	0.0	0.0	0.0	5.0
8	18.3	21.7	3.3	13.3	11.7	0.0	10.0	13.3
9	30.0	28.3	13.3	18.3	25.0	0.0	21.7	21.7
10	41.7	33.3	21.7	21.7	38.3	6.7	33.3	28.3
11	41.7	33.3	26.7	25.0	28.3	11.7	41.7	36.7
12	41.7	33.3	28.3	25.0	66.7	30.0	41.7	36.7
13	41.7ab[z]	33.3b	28.3b	25.0b	66.7a	30.0b	41.7ab	36.7ab
T50 (days)	7.8ab	7.4b	9.0ab	7.5b	9.4ab	9.9a	8.8ab	8.4ab
Uniformity (days)	4.6a	4.2a	5.5a	4.1a	6.1a	6.5a	5.3a	5.3a
Rate of Emergence (plants/day)	1.4ab	1.3ab	0.8c	1.0ab	1.7a	0.7b	1.3ab	1.1ab
Emergence Value	21.0a	17.0a	12.8a	7.3a	40.1a	8.2a	17.0a	12.4a

TABLE XXXVIII (Continued)

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Radicle Length (mm)	53.3a[z]	64.3a	47.0a	62.0	58.0a	55.0a	65.7a	53.7a
Radicle Tip Killed (%)	92.0a	75.0a	52.0a	41.7a	82.0a	100.0a	80.0a	78.7a
Shoot Dry Weight (mg/plant)	7.6a	7.6a	6.0a	7.5a	6.9a	10.0a	8.6a	7.2a
Root Dry Weight (mg/plant)	4.9a	9.1a	6.1a	6.8a	5.1a	6.6a	7.1a	6.5a
Shoot/Root Ratio	1.6a	0.8a	1.0a	1.2a	1.4a	1.5a	1.2a	1.1a
Conductivity (umhos/cm)	32.7a	24.0a	22.7a	36.0a	22.3a	31.0a	21.7a	26.0a
Potassium (ppm)	1.2a	1.2a	1.3a	1.5a	1.1a	1.1a	1.1a	1.0a
Calcium (ppm)	1.2a	1.1a	1.0a	1.0a	0.8a	1.0a	0.9a	1.1a
Reducing Sugars (ppm)	0.6b	0.3b	1.1b	7.2a	0.3b	0.1b	0.0b	0.1b

[z]Means in a row followed by the same letter are not significantly different according with the Tukey's HSD Test at 5%.

TABLE XXXIX

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE, RADICLE LENGTH, RADICLE TIP KILLED, DRY WEIGHT, SHOOT/ROOT RATIO, CONDUCTIVITY, POTASSIUM, CALCIUM AND REDUCING SUGARS IN LEACHATE OF GERMINATED PEPPER SEED (CULTIVAR 'CALIFORNIA WONDER P.S.') TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 5 °C

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Cumulative Daily Emergence (%) (days from sowing)								
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	8.3	6.7	5.0	0.0	0.0	15.0
6	23.3	0.0	33.3	30.0	20.0	3.3	10.0	36.0
7	66.7	26.7	63.3	40.0	40.0	6.7	40.0	63.3
8	86.7	56.7	76.7	43.3	76.7	13.3	60.0	90.0
9	96.7	83.3	83.3	43.3	83.3	36.7	93.0	100.0
10	96.7	96.7	90.0	43.3	96.7	63.3	100.0	100.0
11	96.7	96.7	90.0	43.3	96.7	63.3	100.0	100.0
12	96.7	96.7	90.0	43.3	96.7	63.3	100.0	100.0
13	96.7a[z]	96.7a	90.0a	43.3b	96.7a	63.3ab	100.0a	100.0a
T50 (days)	6.6b	7.6ab	6.4b	5.6b	7.0b	8.6a	7.3a	6.4b
Uniformity (days)	3.4bc	4.2ab	3.4bc	2.1c	3.7b	5.3a	4.0ab	3.2bc
Rate of Emergence (plants/day)	4.5a	3.7ab	4.2ab	3.3ab	4.2ab	1.9b	4.1ab	5.1a
Emergence Value	109.2a	100.4a	94.1a	28.6b	105.0a	49.7ab	107.9a	121.6a

TABLE XXXIX (Continued)

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Radicle Length (mm)	54.0a[z]	46.3a	46.3a	45.3a	51.7a	42.3a	48.3a	48.0a
Radicle Tip Killed (%)	3.7b	17.7ab	11.3b	11.0b	27.7ab	52.3a	6.7b	6.7b
Shoot Dry Weight (mg/plant)	3.8a	3.1a	3.3a	4.0a	3.4a	3.0a	3.7a	3.3a
Root Dry Weight (mg/plant)	2.8a	3.5a	3.2a	4.1a	3.5a	2.4a	3.7a	2.7a
Shoot/Root Ratio	1.5a	0.9a	1.0a	1.0a	1.0a	1.2a	1.0a	1.2a
Conductivity (umhos/cm)	21.7a	20.0a	73.7a	31.0a	18.7a	21.7a	19.0a	21.0a
Potassium (ppm)	2.0ab	1.7ab	2.4a	2.5a	1.8a	2.0ab	1.8ab	1.4b
Calcium (ppm)	1.3a	1.3a	3.2a	1.8a	1.2a	1.4a	1.1a	1.3a
Reducing Sugars (ppm)	0.6a	1.5a	3.8a	8.5a	1.2a	5.1a	0.8a	1.7a

[z]Means in a row followed by the same letter are not significantly different according with the Tukey's HSD Test at 5%.

TABLE XL

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE, RADICLE LENGTH, RADICLE TIP KILLED, DRY WEIGHT, SHOOT/ROOT RATIO, CONDUCTIVITY, POTASSIUM, CALCIUM AND REDUCING SUGARS IN LEACHATE OF GERMINATED PEPPER SEED (CULTIVAR 'BAHEMIAN HOT CHILI') TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 5 °C

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Cumulative Daily Emergence (%) (days from sowing)								
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	18.3	21.7	1.7	5.0	3.3	0.0	20.0	6.7
6	53.3	58.3	20.0	10.0	25.0	1.7	50.0	46.7
7	75.0	75.0	38.3	18.3	41.7	13.3	78.3	50.0
8	83.3	85.0	51.7	21.7	71.7	26.7	93.3	66.7
9	85.0	86.7	55.0	25.0	75.0	38.3	90.0	76.7
10	88.3	90.0	56.7	28.3	83.3	41.7	93.3	80.0
11	88.3	90.0	58.3	28.3	83.3	48.3	93.3	81.7
12	88.3	90.0	58.3	28.3	83.3	51.7	93.3	81.7
13	88.3a[z]	90.0a	58.3ab	28.3b	83.3a	51.7ab	93.3a	81.7a
T50 (days)	5.8b	5.8b	6.7ab	6.3ab	6.7ab	8.1a	5.9b	6.4ab
Uniformity (days)	2.8b	3.1ab	3.5ab	3.0ab	3.7ab	5.1a	3.0ab	3.9ab
Rate of Emergence (plants/day)	5.1a	4.8a	2.8ab	1.5b	3.6ab	1.6b	5.2a	3.5ab
Emergence Value	98.8ab	98.3ab	42.2bcd	10.4d	74.4ab	29.4cd	106.4a	72.0ab

TABLE XL (Continued)

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Radicle Length (mm)	31.7a[z]	35.3a	39.3a	31.3a	37.7a	36.3a	38.7a	53.3a
Radicle Tip Killed (%)	19.3a	12.7a	3.3a	9.3a	12.7a	13.3a	9.0a	22.0a
Shoot Dry Weight (mg/plant)	2.3a	2.9a	2.4a	2.1a	3.0a	2.5a	2.5a	2.7a
Root Dry Weight (mg/plant)	2.6b	2.7b	3.8ab	6.4a	2.7b	2.3b	2.5b	2.4b
Shoot/Root Ratio	1.0a	2.3a	0.7a	0.4a	1.1a	1.1a	1.0a	1.1a
Conductivity (umhos/cm)	30.0a	22.3a	23.7a	25.7a	21.7a	25.0a	20.0a	28.7a
Potassium (ppm)	1.0a	1.2a	1.1a	1.2a	0.8a	1.3a	0.8a	1.0a
Calcium (ppm)	1.0a	0.9a	0.9a	1.0a	0.8a	0.8a	0.7a	1.1a
Reducing Sugars (ppm)	---	---	---	---	---	---	---	---

[z]Means in a row followed by the same letter are not significantly different according with the Tukey's HSD Test at 5%.

TABLE XLI

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE, RADICLE LENGTH, RADICLE TIP KILLED, DRY WEIGHT, SHOOT/ROOT RATIO, CONDUCTIVITY, POTASSIUM, CALCIUM AND REDUCING SUGARS IN LEACHATE OF GERMINATED PEPPER SEED (CULTIVAR 'KALSPICE #1 SWEET PAPRIKA') TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 5 °C

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Cumulative Daily Emergence (%) (days from sowing)								
4	21.7	16.7	0.0	8.3	18.3	0.0	11.7	18.3
5	53.3	43.3	15.0	31.7	40.0	11.7	38.3	51.7
6	85.0	75.0	33.3	43.3	68.3	45.0	88.3	81.7
7	91.7	81.7	51.7	65.0	81.7	78.3	93.3	93.3
8	93.3	86.7	60.0	75.0	85.0	88.3	96.7	93.3
9	95.0	83.3	66.7	78.3	88.3	88.3	96.7	93.3
10	96.7	90.0	66.7	78.3	90.0	88.3	96.7	93.3
11	96.7	90.0	66.7	78.3	90.0	88.3	96.7	93.3
12	96.7	90.0	66.7	78.3	90.0	88.3	96.7	93.3
13	96.7a[z]	90.0a	66.7b	78.3ab	90.0a	88.3ab	96.7a	93.3a
T50 (days)	4.8b	5.0b	6.1a	5.6ab	5.3ab	5.9ab	5.0ab	4.9b
Uniformity (days)	2.2a	2.5a	3.5a	3.6a	3.1a	2.6a	2.0a	2.6a
Rate of Emergence (plants/day)	7.3a	6.4ab	3.1b	3.5b	4.8ab	5.6ab	7.7a	6.0ab
Emergence Value	137.8a	117.2ab	51.2c	78.1bc	110.0ab	104.6abc	142.5a	127.8ab

TABLE XLI (Continued)

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Radicle Length (mm)	42.7a[z]	44.0a	50.0a	42.7a	43.7a	46.7a	47.3a	53.0a
Radicle Tip Killed (%)	7.0b	9.3b	15.0a	14.7b	0.0b	5.7b	0.0b	0.0b
Shoot Dry Weight (mg/plant)	4.4a	5.1a	4.5a	4.3a	4.7a	4.7a	4.7a	4.9a
Root Dry Weight (mg/plant)	2.3a	2.7a	2.3a	2.2a	2.5a	2.5a	2.5a	2.6a
Shoot/Root Ratio	1.9ab	1.9ab	2.0a	1.9ab	1.9ab	1.8b	1.9ab	1.9ab
Conductivity (mmhos/cm)	0.1a	0.9a	5.4a	0.6a	4.3a	2.5a	0.7a	2.3a
Potassium (ppm)	3.5a	3.4a	5.5a	3.9a	4.1a	2.8a	3.6a	3.6a
Calcium (ppm)	1.8a	1.9a	3.2a	1.8a	2.5a	2.2a	1.9a	2.5a
Reducing Sugars (ppm)	---	---	---	---	---	---	---	---

[z]Means in a row followed by the same letter are not significantly different according with the Tukey's HSD Test at 5%.

TABLE XLII

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE, RADICLE LENGTH, RADICLE TIP KILLED, DRY WEIGHT, SHOOT/ROOT RATIO, CONDUCTIVITY, POTASSIUM, CALCIUM AND REDUCING SUGARS IN LEACHATE OF GERMINATED PEPPER SEED (CULTIVAR 'TAMPIQUEÑO 74') TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 5 °C

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Cumulative Daily Emergence (%) (days from sowing)								
4	15.0	0.0	5.0	0.0	10.0	0.0	17.5	25.0
5	45.0	17.5	25.0	2.5	37.5	0.0	50.0	50.0
6	80.0	35.0	40.0	20.0	62.5	15.0	65.0	85.0
7	80.0	45.0	55.0	30.0	70.0	30.0	75.0	95.0
8	80.0	50.0	60.0	32.5	70.0	35.0	75.0	95.0
9	80.0	50.0	60.0	32.5	70.0	45.0	75.0	95.0
10	80.0	50.0	60.0	32.5	70.0	45.0	75.0	95.0
11	80.0	50.0	60.0	32.5	70.0	45.0	75.0	95.0
12	80.0	50.0	60.0	32.5	70.0	45.0	75.0	95.0
13	80.0ab[z]	50.0bc	60.0abc	32.5c	70.0abc	45.0bc	75.0ab	95.0a
T50 (days)	4.7c	5.5abc	5.4bc	5.8ab	5.0bc	6.4a	4.7c	4.7c
Uniformity (days)	2.0a	2.8a	2.9a	2.5a	2.4a	3.1a	2.8a	2.5a
Rate of Emergence (plants/day)	6.5a	2.8bc	3.3abc	2.0c	4.8abc	2.2c	4.4abc	6.0ab
Emergence Value	108.3ab	33.9bc	47.5bc	14.5c	75.7abc	26.4c	85.7abc	135.0a

TABLE XLII (Continued)

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Radicle Length (mm)	58.5a[z]	53.0a	58.5a	43.5a	55.0a	51.5a	51.5a	64.5
Radicle Tip Killed (%)	16.5a	8.5a	12.5a	16.0a	3.0a	41.5a	0.0a	5.5a
Shoot Dry Weight (mg/plant)	3.8a	4.0a	3.3a	3.5a	3.5a	3.8a	4.0a	4.2a
Root Dry Weight (mg/plant)	2.0a	2.8a	2.4a	2.2a	2.2a	2.0a	2.9a	2.1a
Shoot/Root Ratio	1.9a	1.4a	1.5a	1.6a	1.6a	1.9a	1.4a	1.9a
Conductivity (umhos/cm)	19.0a	19.0a	23.5a	20.5a	20.5a	22.0a	16.0a	19.5a
Potassium (ppm)	1.8a	1.8a	2.1a	1.9a	1.7a	2.0a	1.4a	1.7a
Calcium (ppm)	1.0b	0.9b	1.3a	1.1ab	1.0b	1.1ab	0.9b	1.1ab
Reducing Sugars (ppm)	0.9a	0.6a	2.2a	2.9a	0.9a	0.3a	1.3a	1.1a

[z]Means in a row followed by the same letter are not significantly different according with the Tukey's HSD Test at 5%.

TABLE XLIII

MEANS FOR THE CUMULATIVE DAILY EMERGENCE, DAYS TO 50% EMERGENCE, UNIFORMITY OF EMERGENCE, RATE OF EMERGENCE, EMERGENCE VALUE, RADICLE LENGTH, RADICLE TIP KILLED, DRY WEIGHT, SHOOT/ROOT RATIO, CONDUCTIVITY, POTASSIUM, CALCIUM AND REDUCING SUGARS IN LEACHATE OF GERMINATED PEPPER SEED (CULTIVAR 'VERDEÑO') TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 5 °C

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Cumulative Daily Emergence (%) (days from sowing)								
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	10.0	8.3	3.3	1.7	6.7	0.0	6.7	13.3
6	28.3	25.0	10.0	5.0	21.7	3.3	23.3	41.7
7	41.7	33.3	13.3	6.7	30.0	11.7	38.3	63.3
8	55.0	38.3	13.3	6.7	30.0	11.7	43.3	65.0
9	55.0	38.3	13.3	6.7	30.0	11.7	43.0	65.0
10	55.0	38.3	13.3	6.7	30.0	11.7	43.3	65.0
11	55.0	38.3	13.3	6.7	30.0	11.7	43.3	65.0
12	55.0	38.3	13.3	6.7	30.0	11.7	43.3	65.0
13	55.0ab[z]	38.3abcd	13.3cd	6.7d	30.0bcd	11.7cd	43.3abc	65.0a
T50 (days)	6.0a	5.7a	5.4a	5.8a	5.5a	6.0a	5.9a	5.7a
Uniformity (days)	3.1a	2.5a	2.0a	5.4a	2.3a	2.4a	2.6a	2.5a
Rate of Emergence (plants/day)	2.8ab	2.7ab	1.0b	0.4b	2.0ab	1.1b	2.6ab	4.3a
Emergence Value	39.7ab	20.6ab	2.9b	0.8b	13.6b	5.2b	29.2ab	60.5a

TABLE XLIII (Continued)

Variable	Distilled Water	Tween 20 0.05%	Castor Bean Oil 60%	Peanut Oil 60%	Sodium Benzoate 100ppm	Ethoxyquin 300ppm	Ascorbic Acid-L 100ppm	Calcium Chloride 1mM
Radicle Length (mm)	65.3a[z]	66.0a	45.7a	53.3a	63.3a	65.5a	64.0a	53.0a
Radicle Tip Killed (%)	13.0a	9.0a	8.3a	0.0a	0.0a	10.0a	6.7a	9.0a
Shoot Dry Weight (mg/plant)	5.2a	4.9a	3.8a	5.0a	5.8a	5.0a	4.9a	4.2a
Root Dry Weight (mg/plant)	4.1a	3.1a	3.3a	5.0a	3.6a	3.5a	3.2a	3.4a
Shoot/Root Ratio	1.4a	1.6a	1.2a	1.2a	1.6a	1.5a	1.5a	1.2a
Conductivity (umhos/cm)	18.7b	20.0b	18.7b	25.0b	17.3b	43.5a	17.7b	19.3b
Potassium (ppm)	1.6b	1.5b	1.6b	3.0a	1.5b	3.0a	1.4b	1.7b
Calcium (ppm)	1.0b	1.0b	1.0b	1.4ab	1.0b	1.9a	1.1b	1.2ab
Reducing Sugars (ppm)	0.1b	0.0b	0.8b	8.5a	0.1b	0.1b	0.0b	0.1b

[z]Means in a row followed by the same letter are not significantly different according with the Tukey's HSD Test at 5%.

TABLE XLIV

FATTY ACID COMPOSITION OF OIL EXTRACTED FROM DRY SEED OF NINE PEPPER CULTIVARS

Fatty Acid (%)	California Wonder P.S.	California Wonder Select	Bahemian Hot Chili	Kalspice #1 Sweet Paprika	Tampiqueño 74	Verdeño	Esmeralda	Mulato Roque	Papaloapan
Laurate (C12:0)	1.9a[s]	2.2a	2.2a	2.1a	2.2a	0.8a	1.8a	1.8a	1.6a
Myristate (C14:0)	0.0a	0.0a	0.1a	0.1a	0.0a	0.05a	0.05a	0.1a	0.1a
Palmitate (C16:0)	13.4ab	17.5a	15.6a	14.2ab	16.1a	15.2a	9.4b	14.3ab	17.7a
Palmitoleic (C16:1)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stearic (C18:0)	2.6bc	4.3a	1.5c	3.0ab	2.1bc	2.7bc	2.0bc	1.9bc	2.6bc
Oleic (C18:1)	11.3ab	12.6ab	9.3abc	8.9abc	6.9c	11.3ab	12.9a	12.1ab	8.7bc
Linoleic (C18:2)	70.6a	63.3a	71.2a	71.6a	72.5a	70.0a	73.6a	69.6a	69.1a
Linolenic (C18:3)	0.1a	0.0a	0.1a	0.1a	0.1a	0.06a	0.09a	0.09a	0.10a
Ratio A[z]	33.4bc	17.7c	55.6a	27.1bc	38.2ab	33.3bc	45.5ab	43.1ab	34.5bc
Ratio B[y]	85.2	---	138.3	105.6	224.2	212.2	158.2	135.3	123.2
Ratio C[x]	0.16ab	0.19a	0.13abc	0.12bc	0.09c	0.16ab	0.17ab	0.17ab	0.12bc
Ratio D[w]	25.7	---	28.3	20.7	30.0	43.2	34.5	29.7	17.9
Ratio E[v]	---	---	---	---	---	---	---	---	---
Ratio F[u]	5.3ab	3.5b	4.8ab	4.7ab	4.4ab	4.6ab	11.8a	5.1ab	3.9ab
Ratio G[t]	4.8ab	3.2b	4.2ab	4.2ab	3.9ab	4.4ab	8.7a	4.6ab	3.6b

[z](Oleic+Linoleic+Linolenic)/Stearic
[y]Linoleic/Linolenic
[x]Oleic/Linoleic
[w]Oleic/Linolenic
[v]Palmitate/Palmitoleic
[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)
[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)
[s]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE XLV

FATTY ACID COMPOSITION OF GERMINATED PEPPER SEED (CULTIVAR 'CALIFORNIA WONDER P.S.') STORED FOR SIX DAYS AT 0 AND 5 °C AND NON-STORED

Fatty Acid (%)	Temperature (°C) 0	5	30[s]	C.V. (%)
Laurate (C12:0)	---	2.6a[r]	1.7b	33.6
Myristate (C14:0)	---	0.0	0.0	
Palmitate (C16:0)	---	16.3a	13.7a	10.9
Palmitoleic (C16:1)	---	0.0	0.0	
Stearic (C18:0)	---	3.5a	2.3b	20.6
Oleic (C18:1)	---	12.8a	10.0b	9.5
Linoleic (C18:2)	---	64.1b	72.6a	4.0
Linolenic (C18:3)	---	0.7a	0.05b	70.8
Ratio A[z]	---	22.7a	38.1a	29.2
Ratio B[y]	---	100.6a	253.0a	30.4
Ratio C[x]	---	0.2a	0.1b	13.5
Ratio D[w]	---	19.6a	43.8a	25.4
Ratio E[v]	---	---	---	
Ratio F[u]	---	3.9b	5.2a	13.0
Ratio G[t]	---	3.5b	4.8a	10.5

[z](Oleic+Linoleic+Linolenic)/Stearic
[y]Linoleic/Linolenic
[x]Oleic/Linoleic
[w]Oleic/Linolenic
[v]Palmitate/Palmitoleic
[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)
[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)
[s]Seeds were analyzed for oil when the germination period had ended. Germination temperature was 30 °C.
[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE XLVI

FATTY ACID COMPOSITION OF SHOOTS FROM PEPPER PLANTS (CULTIVAR 'CALIFORNIA WONDER P.S.') GROWN FROM GERMINATED SEED STORED FOR SIX DAYS AT 0 AND 5 °C AND NON-STORED

Fatty Acid (%)	Temperature (°C) 0	5	30[s]	C.V. (%)
Laurate (C12:0)	4.6a[r]	3.6a	4.7a	8.4
Myristate (C14:0)	0.0	0.0	0.0	
Palmitate (C16:0)	20.2a	20.6a	22.1a	4.5
Palmitoleic (C16:1)	1.0a	0.8a	1.3a	21.6
Stearic (C18:0)	5.4a	5.4a	4.6a	15.5
Oleic (C18:1)	4.6b	4.4b	7.2a	11.0
Linoleic (C18:2)	29.8a	27.2a	29.9a	8.6
Linolenic (C18:3)	34.3ab	37.8a	30.2b	3.2
Ratio A[z]	12.8a	12.8a	15.2a	20.5
Ratio B[y]	0.9a	0.7a	1.0a	13.0
Ratio C[x]	0.1a	0.2a	0.2a	20.8
Ratio D[w]	0.1b	0.1b	0.2a	8.9
Ratio E[v]	19.1a	25.4a	17.4a	27.2
Ratio F[u]	2.7a	2.7a	2.5a	7.6
Ratio G[t]	2.3a	2.4a	2.2a	6.0

[z](Oleic+Linoleic+Linolenic)/Stearic

[y]Linoleic/Linolenic

[x]Oleic/Linoleic

[w]Oleic/Linolenic

[v]Palmitate/Palmitoleic

[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)

[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)

[s]Seeds were sown when the germination period had ended. Germination temperature was 30 °C.

[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE XLVII

FATTY ACID COMPOSITION OF ROOTS FROM PEPPER PLANTS (CULTIVAR 'CALIFORNIA WONDER P.S.') GROWN FROM GERMINATED SEED STORED FOR SIX DAYS AT 0 AND 5 °C AND NON-STORED

Fatty Acid (%)	Temperature (°C)			C.V. (%)
	0	5	30[s]	
Laurate (C12:0)	6.2a[r]	3.2a	4.6a	47.8
Myristate (C14:0)	2.0a	1.6a	1.3a	103.3
Palmitate (C16:0)	24.4a	28.6a	27.6a	17.2
Palmitoleic (C16:1)	0.0a	0.6a	0.8a	174.8
Stearic (C18:0)	4.6a	4.5a	6.8a	16.5
Oleic (C18:1)	7.0a	4.7b	6.4a	4.3
Linoleic (C18:2)	43.8a	52.6a	48.1a	9.2
Linolenic (C18:3)	11.9a	4.0a	4.2a	111.1
Ratio A[z]	14.1a	13.6a	8.8a	23.6
Ratio B[y]	9.5a	13.4a	11.4a	56.7
Ratio C[x]	0.2a	0.1b	0.1b	12.9
Ratio D[w]	1.4a	1.2a	1.5a	66.7
Ratio E[v]	---	18.9	17.9	
Ratio F[u]	2.2a	1.9a	1.7a	21.7
Ratio G[t]	1.7a	1.6a	1.5a	19.3

[z](Oleic+Linoleic+Linolenic)/Stearic

[y]Linoleic/Linolenic

[x]Oleic/Linoleic

[w]Oleic/Linolenic

[v]Palmitate/Palmitoleic

[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)

[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)

[s]Seeds were sown when the germination period had ended. Germination temperature was 30 °C.

[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE XLVIII

FATTY ACID COMPOSITION OF GERMINATED PEPPER SEED (CULTIVAR 'KALSPICE #1 SWEET PAPRIKA') STORED FOR SIX DAYS AT 0 AND 5 °C AND NON-STORED

Fatty Acid (%)	Temperature (°C) 0	5	30[s]	C.V. (%)
Laurate (C12:0)	2.5a[r]	0.7a	2.7a	67.4
Myristate (C14:0)	0.0a	0.1a	0.0a	202.6
Palmitate (C16:0)	14.0a	14.7a	13.9a	12.9
Palmitoleic (C16:1)	0.0a	0.0a	1.3a	
Stearic (C18:0)	2.6b	3.4a	2.1b	10.9
Oleic (C18:1)	7.8a	9.5a	9.1a	21.3
Linoleic (C18:2)	72.8a	71.4a	72.0a	6.4
Linolenic (C18:3)	0.2a	0.1a	0.1a	209.1
Ratio A[z]	31.1ab	23.8b	39.2a	13.3
Ratio B[y]	77.7	149.1	158.4	
Ratio C[x]	0.1a	0.1a	0.1a	27.2
Ratio D[w]	11.6	27.5	21.2	
Ratio E[v]	0.0	0.0	15.9	
Ratio F[u]	5.0a	4.5a	5.1a	15.4
Ratio G[t]	4.4a	4.3a	4.4a	18.8

[z](Oleic+Linoleic+Linolenic)/Stearic

[y]Linoleic/Linolenic

[x]Oleic/Linoleic

[w]Oleic/Linolenic

[v]Palmitate/Palmitoleic

[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)

[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)

[s]Seeds were analyzed for oil when the germination period had ended. Germination temperature was 30 °C.

[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE XLIX

FATTY ACID COMPOSITION OF SHOOTS FROM PEPPER PLANTS (CULTIVAR 'KALSPICE #1 SWEET PAPRIKA') GROWN FROM GERMINATED SEED STORED FOR SIX DAYS AT 0 AND 5 °C AND NON-STORED

Fatty Acid (%)	Temperature (°C) 0	5	30[s]	C.V. (%)
Laurate (C12:0)	5.8a[r]	1.9a	2.5a	83.6
Myristate (C14:0)	0.0	0.0	0.0	
Palmitate (C16:0)	17.8a	17.3a	19.0a	12.0
Palmitoleic (C16:1)	1.6a	1.7a	1.3a	49.5
Stearic (C18:0)	7.0a	8.6a	6.1a	17.9
Oleic (C18:1)	6.6a	4.4a	3.1a	65.3
Linoleic (C18:2)	27.4a	27.3a	24.6a	13.6
Linolenic (C18:3)	33.6a	38.8a	42.6a	23.4
Ratio A[z]	9.6a	8.2a	12.2a	26.1
Ratio B[y]	0.8a	0.7a	0.6a	31.4
Ratio C[x]	0.2a	0.2a	0.1a	64.1
Ratio D[w]	0.2a	0.1a	0.1a	69.6
Ratio E[v]	12.6a	11.3a	21.6a	90.1
Ratio F[u]	2.7a	2.7a	2.8a	17.3
Ratio G[t]	2.3a	2.6a	2.6a	19.9

[z](Oleic+Linoleic+Linolenic)/Stearic

[y]Linoleic/Linolenic

[x]Oleic/Linoleic

[w]Oleic/Linolenic

[v]Palmitate/Palmitoleic

[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)

[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)

[s]Seeds were sown when the germination period had ended. Germination temperature was 30 °C.

[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE L

FATTY ACID COMPOSITION OF ROOTS FROM PEPPER PLANTS (CULTIVAR 'KALSPICE #1 SWEET PAPRIKA') GROWN FROM GERMINATED SEED STORED FOR SIX DAYS AT 0 AND 5 °C AND NON-STORED

Fatty Acid (%)	Temperature (°C) 0	5	30[s]	C.V. (%)
Laurate (C12:0)	1.9a[r]	1.7a	4.3a	79.5
Myristate (C14:0)	0.0b	0.0b	2.1a	37.3
Palmitate (C16:0)	25.9a	23.7a	27.8a	16.1
Palmitoleic (C16:1)	0.0b	1.9a	1.7a	19.1
Stearic (C18:0)	5.0a	5.7a	6.3a	14.2
Oleic (C18:1)	5.3a	3.7a	6.3a	26.7
Linoleic (C18:2)	57.8a	56.0a	48.6a	5.6
Linolenic (C18:3)	4.0ab	7.3a	2.8b	23.9
Ratio A[z]	13.5a	11.8a	9.4a	10.9
Ratio B[y]	14.6a	8.0a	17.6a	20.9
Ratio C[x]	0.1a	0.1a	0.1a	21.5
Ratio D[w]	1.4a	0.5a	2.3a	41.9
Ratio E[v]	---	12.9a	15.9a	11.4
Ratio F[u]	2.2a	2.3a	1.7a	19.6
Ratio G[t]	2.1a	2.2a	1.5a	18.7

[z](Oleic+Linoleic+Linolenic)/Stearic

[y]Linoleic/Linolenic

[x]Oleic/Linoleic

[w]Oleic/Linolenic

[v]Palmitate/Palmitoleic

[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)

[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)

[s]Seeds were sown when the germination period had ended. Germination temperature was 30 °C.

[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE LI

FATTY ACID COMPOSITION OF OIL EXTRACTED FROM GERMINATED PEPPER SEED (CULTIVAR 'CALIFORNIA WONDER P.S.') TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 5 °C

Fatty Acid (%)	Distilled Water	Castor Bean Oil 60%	Sodium Benzoate 100ppm	Ascorbic Acid-L 100ppm	C.V. (%)
Laurate (C12:0)	2.6a[r]	1.6a	1.7a	1.8a	36.6
Myristate (C14:0)	0.0	0.0	0.0	0.0	
Palmitate (C16:0)	16.3a	15.4a	16.1a	22.8a	19.2
Palmitoleic (C16:1)	0.0	0.0	0.0	0.0	
Stearic (C18:0)	3.5a	3.6a	4.2a	4.2a	8.6
Oleic (C18:1)	12.8ab	11.1b	14.4a	13.6ab	5.5
Linoleic (C18:2)	64.1a	68.2a	63.6a	57.5a	4.6
Linolenic (C18:3)	0.7a	0.0b	0.0b	0.0b	83.5
Ratio A[z]	22.7a	21.9a	18.6a	16.7a	11.8
Ratio B[y]	100.6	0.0	0.0	0.0	
Ratio C[x]	0.2a	0.1b	0.2a	0.2a	7.7
Ratio D[w]	19.6	0.0	0.0	0.0	
Ratio E[v]	0.0	0.0	0.0	0.0	
Ratio F[u]	3.9a	4.2a	3.8a	2.7a	13.4
Ratio G[t]	3.5a	3.8a	3.5a	2.5a	11.2

[z](Oleic+Linoleic+Linolenic)/Stearic
[y]Linoleic/Linolenic
[x]Oleic/Linoleic
[w]Oleic/Linolenic
[v]Palmitate/Palmitoleic
[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)
[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)
[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE LII

FATTY ACID COMPOSITION OF OIL EXTRACTED FROM SHOOTS OF PEPPER PLANTS (CULTIVAR 'CALIFORNIA WONDER P.S.') GROWN FROM GERMINATED SEED TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 0 °C

Fatty Acid (%)	Distilled Water	Castor Bean Oil 60%	Sodium Benzoate 100ppm	Ascorbic Acid-L 100ppm	C.V. (%)
Laurate (C12:0)	4.6a[r]	4.4a	4.6a	7.2a	32.6
Myristate (C14:0)	0.0	0.0	0.0	0.0	
Palmitate (C16:0)	20.2a	13.9a	19.7a	19.1a	26.5
Palmitoleic (C16:1)	1.0a	1.1a	1.9a	1.0a	55.8
Stearic (C18:0)	5.4a	5.5a	5.2a	4.8a	10.3
Oleic (C18:1)	4.6a	4.7a	4.5a	4.3a	16.3
Linoleic (C18:2)	29.8a	31.3a	30.3a	29.3a	3.7
Linolenic (C18:3)	34.3a	38.1a	33.7a	33.0a	11.5
Ratio A[z]	12.8a	13.6a	13.2a	13.8a	5.8
Ratio B[y]	0.9a	0.8a	0.9a	0.9a	11.1
Ratio C[x]	0.1a	0.1a	0.1a	0.1a	19.3
Ratio D[w]	0.1a	0.1a	0.1a	0.1a	16.8
Ratio E[v]	19.1a	14.4a	14.0a	18.2a	49.6
Ratio F[u]	2.7a	4.4a	2.7a	2.8a	38.0
Ratio G[t]	2.3a	3.3a	2.4a	2.1a	30.0

[z](Oleic+Linoleic+Linolenic)/Stearic
[y]Linoleic/Linolenic
[x]Oleic/Linoleic
[w]Oleic/Linolenic
[v]Palmitate/Palmitoleic
[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)
[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)
[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE LIII

FATTY ACID COMPOSITION OF OIL EXTRACTED FROM SHOOTS OF PEPPER PLANTS (CULTIVAR 'CALIFORNIA WONDER P.S.') GROWN FROM GERMINATED SEED TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 5 °C

Fatty Acid (%)	Distilled Water	Castor Bean Oil 60%	Sodium Benzoate 100ppm	Ascorbic Acid-L 100ppm	C.V. (%)
Laurate (C12:0)	3.6a[r]	2.8a	2.9a	3.3a	28.8
Myristate (C14:0)	0.0	0.0	0.0	0.0	
Palmitate (C16:0)	20.6a	18.5a	19.7a	17.1a	6.6
Palmitoleic (C16:1)	0.8a	0.7a	1.2a	1.0a	20.2
Stearic (C18:0)	5.4a	5.2a	5.1a	4.9a	5.7
Oleic (C18:1)	4.4a	5.1a	4.0a	4.2a	13.5
Linoleic (C18:2)	27.2a	33.7a	29.1a	32.9a	12.6
Linolenic (C18:3)	37.8a	33.8a	36.9a	36.6a	5.3
Ratio A[z]	12.8a	13.9a	13.6a	15.2a	7.9
Ratio B[y]	0.7a	1.0a	0.8a	0.9a	17.3
Ratio C[x]	0.2a	0.1a	0.1a	0.1a	23.1
Ratio D[w]	0.1a	0.1a	0.1a	0.1a	12.3
Ratio E[v]	25.4a	25.1a	16.3a	16.9a	23.7
Ratio F[u]	2.7a	3.1a	2.8a	3.4a	9.4
Ratio G[t]	2.4a	2.8a	2.5a	3.0a	11.0

[z](Oleic+Linoleic+Linolenic)/Stearic
[y]Linoleic/Linolenic
[x]Oleic/Linoleic
[w]Oleic/Linolenic
[v]Palmitate/Palmitoleic
[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)
[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)
[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE LIV

FATTY ACID COMPOSITION OF OIL EXTRACTED FROM ROOTS OF PEPPER PLANTS (CULTIVAR 'CALIFORNIA WONDER P.S.') GROWN FROM GERMINATED SEED TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 0 °C

Fatty Acid (%)	Distilled Water	Castor Bean Oil 60%	Sodium Benzoate 100ppm	Ascorbic Acid-L 100ppm	C.V. (%)
Laurate (C12:0)	6.2a[r]	3.2a	2.9a	3.0a	39.3
Myristate (C14:0)	2.0a	3.3a	1.6a	1.7a	59.6
Palmitate (C16:0)	24.4a	29.2a	30.7a	29.3a	19.6
Palmitoleic (C16:1)	0.0a	0.0a	0.9a	1.8a	111.5
Stearic (C18:0)	4.6a	6.0a	5.6a	6.8a	23.7
Oleic (C18:1)	7.0a	6.7a	5.5a	5.3a	37.0
Linoleic (C18:2)	43.8a	48.5a	48.9a	48.7a	11.0
Linolenic (C18:3)	11.9a	3.1a	3.9a	3.3a	116.1
Ratio A[z]	14.1a	9.7a	11.3a	8.6a	30.5
Ratio B[y]	9.5a	15.8a	12.6a	14.6a	44.9
Ratio C[x]	0.2a	0.1a	0.1a	0.1a	29.0
Ratio D[w]	1.4a	2.2a	1.4a	1.6a	68.2
Ratio E[v]	0.0	0.0	15.5a	17.5a	34.2
Ratio F[u]	2.2a	1.8a	1.6a	1.6a	27.4
Ratio G[t]	1.7a	1.5a	1.4a	1.4a	27.6

[z](Oleic+Linoleic+Linolenic)/Stearic
[y]Linoleic/Linolenic
[x]Oleic/Linoleic
[w]Oleic/Linolenic
[v]Palmitate/Palmitoleic
[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)
[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)
[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE LV

FATTY ACID COMPOSITION OF OIL EXTRACTED FROM ROOTS OF PEPPER PLANTS (CULTIVAR 'CALIFORNIA WONDER P.S.') GROWN FROM GERMINATED SEED TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 5 °C

Fatty Acid (%)	Distilled Water	Castor Bean Oil 60%	Sodium Benzoate 100ppm	Ascorbic Acid-L 100ppm	C.V. (%)
Laurate (C12:0)	3.2a[r]	3.9a	3.2a	4.3a	30.4
Myristate (C14:0)	1.6a	2.8a	1.3a	0.0a	102.4
Palmitate (C16:0)	28.6a	28.0a	28.1a	26.9a	15.8
Palmitoleic (C16:1)	0.6a	0.7a	0.9a	1.5a	80.4
Stearic (C18:0)	4.5a	4.0a	4.0a	4.2a	11.4
Oleic (C18:1)	4.7a	3.9ab	3.2b	4.4ab	8.6
Linoleic (C18:2)	52.6a	53.5a	56.1a	54.8a	6.6
Linolenic (C18:3)	4.0a	3.2a	3.1a	3.7a	20.1
Ratio A[z]	13.6a	15.2a	15.7a	14.9a	14.5
Ratio B[y]	13.4a	16.9a	18.2a	14.9a	15.8
Ratio C[x]	0.08a	0.07a	0.05c	0.08a	4.7
Ratio D[w]	1.2a	1.2a	1.0a	1.2a	19.4
Ratio E[v]	18.9a	22.7a	35.2a	18.9a	46.5
Ratio F[u]	1.9a	1.9a	2.0a	2.0a	19.1
Ratio G[t]	1.6a	1.6a	1.8a	1.8a	17.0

[z](Oleic+Linoleic+Linolenic)/Stearic
[y]Linoleic/Linolenic
[x]Oleic/Linoleic
[w]Oleic/Linolenic
[v]Palmitate/Palmitoleic
[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)
[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)
[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE LVI

FATTY ACID COMPOSITION OF OIL EXTRACTED FROM GERMINATED PEPPER SEED (CULTIVAR 'KALSPICE #1 SWEET PAPRIKA') TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 0 °C

Fatty Acid (%)	Distilled Water	Castor Bean Oil 60%	Sodium Benzoate 100ppm	Ascorbic Acid-L 100ppm	C.V. (%)
Laurate (C12:0)	2.5ab[r]	5.7a	2.8ab	2.2b	40.6
Myristate (C14:0)	0.0	0.0	0.0	0.0	
Palmitate (C16:0)	14.0a	14.2a	12.2a	12.9a	11.0
Palmitoleic (C16:1)	0.0	0.0	0.0	0.0	
Stearic (C18:0)	2.6a	2.5a	2.2a	2.3a	12.9
Oleic (C18:1)	7.8b	11.6a	7.4b	7.9b	14.1
Linoleic (C18:2)	72.8ab	66.0b	75.4a	74.7ab	4.9
Linolenic (C18:3)	0.2	0.0	0.0	0.0	
Ratio A[z]	31.1a	31.6a	38.3a	36.1a	14.0
Ratio B[y]	77.7	0.0	0.0	0.0	
Ratio C[x]	0.1b	0.2a	0.1b	0.1b	17.6
Ratio D[w]	11.6	0.0	0.0	0.0	
Ratio E[v]	0.0	0.0	0.0	0.0	
Ratio F[u]	5.0a	4.6a	5.7a	5.5a	12.1
Ratio G[t]	4.4a	3.5a	4.8a	4.8a	16.3

[z](Oleic+Linoleic+Linolenic)/Stearic
[y]Linoleic/Linolenic
[x]Oleic/Linoleic
[w]Oleic/Linolenic
[v]Palmitate/Palmitoleic
[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)
[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)
[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE LVII

FATTY ACID COMPOSITION OF OIL EXTRACTED FROM GERMINATED PEPPER SEED (CULTIVAR 'KALSPICE #1 SWEET PAPRIKA') TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 5 °C

Fatty Acid (%)	Distilled Water	Castor Bean Oil 60%	Sodium Benzoate 100ppm	Ascorbic Acid-L 100ppm	C.V. (%)
Laurate (C12:0)	0.7a[r]	0.8a	0.0a	0.5a	137.7
Myristate (C14:0)	0.1	0.0	0.0	0.0	
Palmitate (C16:0)	14.7a	14.5ab	12.6b	12.7b	4.6
Palmitoleic (C16:1)	0.0	0.0	0.0	0.0	
Stearic (C18:0)	3.4a	3.7a	3.6a	3.4a	19.4
Oleic (C18:1)	9.5a	7.3a	8.4a	7.9a	22.6
Linoleic (C18:2)	71.4a	73.6a	75.3a	75.4a	3.2
Linolenic (C18:3)	0.1a	0.0a	0.0a	0.0a	3.3
Ratio A[z]	23.8a	21.9a	24.4a	24.7a	19.8
Ratio B[y]	149.1	0.0	0.0	0.0	
Ratio C[x]	0.1a	0.1a	0.1a	0.1a	27.0
Ratio D[w]	27.5	0.0	0.0	0.0	
Ratio E[v]	0.0	0.0	0.0	0.0	
Ratio F[u]	4.5b	4.5b	5.1ab	5.2a	4.0
Ratio G[t]	4.3b	4.2b	5.1a	5.0a	3.8

[z](Oleic+Linoleic+Linolenic)/Stearic
[y]Linoleic/Linolenic
[x]Oleic/Linoleic
[w]Oleic/Linolenic
[v]Palmitate/Palmitoleic
[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)
[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)
[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE LVIII

FATTY ACID COMPOSITION OF OIL EXTRACTED FROM SHOOTS OF PEPPER PLANTS (CULTIVAR 'KALSPICE #1 SWEET PAPRIKA') GROWN FROM GERMINATED SEED TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 0 °C

Fatty Acid (%)	Distilled Water	Castor Bean Oil 60%	Sodium Benzoate 100ppm	Ascorbic Acid-L 100ppm	C.V. (%)
Laurate (C12:0)	5.8a[r]	5.2a	1.9a	0.7a	80.8
Myristate (C14:0)	0.0	0.0	0.0	0.0	
Palmitate (C16:0)	17.8a	19.9a	20.1a	19.4a	7.3
Palmitoleic (C16:1)	1.7a	0.9a	1.0a	1.1a	44.5
Stearic (C18:0)	7.0a	6.8a	4.9a	8.0a	26.9
Oleic (C18:1)	6.6ab	5.5b	7.7a	5.9b	6.6
Linoleic (C18:2)	27.4a	25.3a	27.3a	28.7a	5.3
Linolenic (C18:3)	33.6a	36.3a	37.0a	36.2a	5.9
Ratio A[z]	9.6a	9.8a	19.9a	8.9a	61.7
Ratio B[y]	0.8a	0.7a	0.7a	0.8a	8.4
Ratio C[x]	0.2ab	0.2ab	0.3a	0.2ab	6.9
Ratio D[w]	0.2a	0.1b	0.2a	0.2a	7.5
Ratio E[v]	12.6a	21.7a	20.5a	18.7a	34.0
Ratio F[u]	2.7a	2.5a	2.9a	2.6a	10.2
Ratio G[t]	2.3a	2.1a	2.7a	2.6a	14.1

[z](Oleic+Linoleic+Linolenic)/Stearic
[y]Linoleic/Linolenic
[x]Oleic/Linoleic
[w]Oleic/Linolenic
[v]Palmitate/Palmitoleic
[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)
[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)
[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE LIX

FATTY ACID COMPOSITION OF OIL EXTRACTED FROM SHOOTS OF PEPPER PLANTS (CULTIVAR 'KALSPICE #1 SWEET PAPRIKA') GROWN FROM GERMINATED SEED TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 5 °C

Fatty Acid (%)	Distilled Water	Castor Bean Oil 60%	Sodium Benzoate 100ppm	Ascorbic Acid-L 100ppm	C.V. (%)
Laurate (C12:0)	1.9b[r]	1.2b	4.1a	3.0a	19.1
Myristate (C14:0)	0.0	0.0	0.0	0.0	
Palmitate (C16:0)	17.3a	22.5a	15.5a	15.9a	12.2
Palmitoleic (C16:1)	1.7a	2.4a	1.2a	1.4a	27.5
Stearic (C18:0)	8.6a	8.7a	9.6a	9.8a	10.2
Oleic (C18:1)	4.4a	5.6a	3.9a	5.0a	12.4
Linoleic (C18:2)	27.3a	23.9a	25.3a	25.6a	4.7
Linolenic (C18:3)	38.8a	35.6a	40.3a	39.2a	5.5
Ratio A[z]	8.2a	7.5a	7.2a	7.2a	10.1
Ratio B[y]	0.7a	0.7a	0.6a	0.6a	8.2
Ratio C[x]	0.2a	0.2a	0.1a	0.2a	13.6
Ratio D[w]	0.1a	0.2a	0.1a	0.1a	16.7
Ratio E[v]	11.3a	9.3a	13.3a	11.6a	29.2
Ratio F[u]	2.7a	2.1a	2.8a	2.7a	9.9
Ratio G[t]	2.6a	2.1a	2.4a	2.5a	8.4

[z](Oleic+Linoleic+Linolenic)/Stearic
[y]Linoleic/Linolenic
[x]Oleic/Linoleic
[w]Oleic/Linolenic
[v]Palmitate/Palmitoleic
[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)
[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)
[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE LX

FATTY ACID COMPOSITION OF OIL EXTRACTED FROM ROOTS OF PEPPER PLANTS (CULTIVAR 'KALSPICE #1 SWEET PAPRIKA') GROWN FROM GERMINATED SEED TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 0 °C

Fatty Acid (%)	Distilled Water	Castor Bean Oil 60%	Sodium Benzoate 100ppm	Ascorbic Acid-L 100ppm	C.V. (%)
Laurate (C12:0)	1.9a[r]	2.5a	2.8a	1.7a	34.8
Myristate (C14:0)	0.0	0.0	0.0	0.0	
Palmitate (C16:0)	26.0a	32.3a	25.9a	25.5a	16.2
Palmitoleic (C16:1)	0.0	0.0	0.0	0.0	
Stearic (C18:0)	5.0a	5.4a	5.8a	5.0a	6.2
Oleic (C18:1)	5.3a	5.3a	6.5a	6.7a	21.9
Linoleic (C18:2)	57.8a	51.2a	54.4a	57.2a	6.1
Linolenic (C18:3)	4.0a	3.2a	4.5a	3.8a	35.1
Ratio A[z]	13.5a	10.9a	11.2a	13.6a	8.7
Ratio B[y]	14.6a	16.0a	13.9a	15.0a	31.0
Ratio C[x]	0.1a	0.1a	0.1a	0.1a	19.2
Ratio D[w]	1.4a	1.7a	1.7a	1.8a	46.7
Ratio E[v]	0.0	0.0	0.0	0.0	
Ratio F[u]	2.2a	1.6a	2.1a	2.2a	20.9
Ratio G[t]	2.1a	1.5a	1.9a	2.1a	20.2

[z](Oleic+Linoleic+Linolenic)/Stearic
[y]Linoleic/Linolenic
[x]Oleic/Linoleic
[w]Oleic/Linolenic
[v]Palmitate/Palmitoleic
[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)
[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)
[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE LXI

FATTY ACID COMPOSITION OF OIL EXTRACTED FROM ROOTS OF PEPPER PLANTS (CULTIVAR 'KALSPICE #1 SWEET PAPRIKA') GROWN FROM GERMINATED SEED TREATED WITH DIFFERENT CHEMICALS AND STORED FOR SIX DAYS AT 5 °C

Fatty Acid (%)	Distilled Water	Castor Bean Oil 60%	Sodium Benzoate 100ppm	Ascorbic Acid-L 100ppm	C.V. (%)
Laurate (C12:0)	1.7a[r]	2.2a	2.6a	2.6a	27.3
Myristate (C14:0)	0.0	0.0	0.0	0.0	
Palmitate (C16:0)	23.7a	27.2a	24.9a	25.3a	9.2
Palmitoleic (C16:1)	1.9a	3.2a	2.0a	1.6a	61.7
Stearic (C18:0)	5.7a	3.4a	5.2a	5.3a	19.8
Oleic (C18:1)	3.7a	4.1a	2.0a	1.6a	29.3
Linoleic (C18:2)	56.0a	54.4a	57.3a	58.0a	5.6
Linolenic (C18:3)	7.3a	5.5a	5.9a	4.5a	19.5
Ratio A[z]	11.8a	21.2a	12.6a	12.3a	34.2
Ratio B[y]	8.0a	9.9a	9.7a	13.0a	13.7
Ratio C[x]	0.1a	0.1a	0.0a	0.0a	33.4
Ratio D[w]	0.5a	0.8a	0.3a	0.4a	48.1
Ratio E[v]	12.9a	12.3a	12.7a	15.5a	35.4
Ratio F[u]	2.3a	2.1a	2.2a	2.1a	12.2
Ratio G[t]	2.2a	2.0a	2.0a	1.9a	11.5

[z](Oleic+Linoleic+Linolenic)/Stearic
[y]Linoleic/Linolenic
[x]Oleic/Linoleic
[w]Oleic/Linolenic
[v]Palmitate/Palmitoleic
[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)
[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)
[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE LXII

FATTY ACID COMPOSITION OF OIL EXTRACTED FROM DRY SEED, GERMINATED SEED, SHOOTS, ROOTS AND FRUITS OF PEPPER (CULTIVAR 'CALIFORNIA WONDER P.S.')

Fatty Acid (%)	Dry Seed	Germinated Seed	Shoots	Roots	Fruits	C.V. (%)
Laurate (C12:0)	1.9b[r]	1.4b	4.7a	4.6a	5.0a	55.6
Myristate (C14:0)	0.02b	0.04b	0.0b	1.3b	6.7a	40.1
Palmitate (C16:0)	13.4c	13.7c	22.1b	27.6a	20.8b	11.8
Palmitoleic (C16:1)	0.0b	0.0b	1.3a	0.8a	0.4a	137.4
Stearic (C18:0)	2.6b	2.3b	4.6a	6.8a	4.8a	21.4
Oleic (C18:1)	11.3a	1.0ab	7.2ab	6.4ab	5.9b	23.8
Linoleic (C18:2)	70.6a	72.6a	29.9c	48.1b	38.2bc	9.0
Linolenic (C18:3)	0.1d	0.05d	30.2a	4.2c	18.1b	18.9
Ratio A[z]	33.4ab	38.1a	15.2bc	8.8c	15.1bc	32.8
Ratio B[y]	85.2b	253.0a	1.0d	11.4c	2.2d	0.9
Ratio C[x]	0.2a	0.1a	0.2a	0.1a	0.1a	31.5
Ratio D[w]	25.7b	43.8a	0.2d	1.5c	0.3d	1.5
Ratio E[v]	0.0	0.0	17.0a	34.5a	52.0a	30.6
Ratio F[u]	5.3a	5.2a	2.5b	1.7b	2.5b	19.2
Ratio G[t]	4.8a	4.8a	2.2b	1.5b	1.7b	24.7

[z](Oleic+Linoleic+Linolenic)/Stearic
[y]Linoleic/Linolenic
[x]Oleic/Linoleic
[w]Oleic/Linolenic
[v]Palmitate/Palmitoleic
[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)
[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)
[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

TABLE LXIII

FATTY ACID COMPOSITION OF OIL EXTRACTED FROM DRY SEED, GERMINATED SEED, SHOOTS, ROOTS AND FRUITS OF PEPPER (CULTIVAR 'KALSPICE #1 SWEET PAPRIKA')

Fatty Acid (%)	Dry Seed	Germinated Seed	Shoots	Roots	Fruits	C.V. (%)
Laurate (C12:0)	2.1b[r]	2.7b	2.5b	4.3ab	7.9a	51.5
Myristate (C14:0)	0.06c	0.05c	0.0c	2.1b	8.6a	19.2
Palmitate (C16:0)	14.2c	13.9c	19.7bc	27.8a	22.0ab	15.9
Palmitoleic (C16:1)	0.0b	0.0b	1.3a	1.7a	0.3b	64.1
Stearic (C18:0)	3.0b	2.1b	6.1a	6.3a	4.3ab	24.9
Oleic (C18:1)	8.9a	9.1a	3.1b	6.3ab	7.1ab	31.5
Linoleic (C18:2)	71.6a	72.0a	24.6c	48.6b	25.4c	7.7
Linolenic (C18:3)	0.1c	0.1c	42.6a	2.8c	24.3b	44.9
Ratio A[z]	27.1b	39.2a	12.2c	9.4c	14.6c	19.8
Ratio B[y]	105.6b	158.4a	0.6d	17.6c	1.0d	5.0
Ratio C[x]	0.1b	0.1b	0.1b	0.1b	0.3a	48.9
Ratio D[w]	20.7a	21.2a	0.1c	2.3b	0.3c	7.3
Ratio E[v]	0.0	0.0	21.6a	15.9a	31.0a	76.8
Ratio F[u]	4.7a	5.1a	2.8b	1.7b	2.3b	18.0
Ratio G[t]	4.2a	4.4a	2.6b	1.5b	1.3b	17.7

[z](Oleic+Linoleic+Linolenic)/Stearic
[y]Linoleic/Linolenic
[x]Oleic/Linoleic
[w]Oleic/Linolenic
[v]Palmitate/Palmitoleic
[u](Oleic+Linoleic+Linolenic)/(Palmitate+Stearic)
[t](Palmitoleic+Oleic+Linoleic+Linolenic)/(Laurate+Myristate+Stearic)
[r]Means in a row followed by the same letter are not significantly different using Tukey's HSD at 5%.

VITA

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Doctor of Philosophy

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Major Field: Crop Science

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