EFFECT OF VARIOUS CHEMICAL SEED PRIMING TREATMENTS ON STORABILITY OF MAIZE CV CO 1

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Abstract

Maize (*Zea mays L.*) is the third most important cereal in the world only exceeded by wheat and rice as staple food in the tropics and is a valuable source of raw material for many industrial products. Seed is a living hygroscopic material with a very complex and heterogeneous composition. It should be maintained well from harvest to next sowing season without appreciable loss in vigour and viability. Seed ageing is a main problem of seed storage. Storage is a basic practice in the control of the physiological quality of the seed and is a method through which the viability of the seeds can be preserved and their vigour is kept at a reasonable level during the time between planting and harvesting. With these in background, the effect of various seed halo priming treatment, period and containers on the storability of maize cv Co 1 was studied in the Department of Genetics and Plant Breeding, Annamalai University. The genetically pure seeds of maize cv Co 1 seeds were given with various chemical seed priming treatments i.e., hydro priming with water, halo-primed with KH_2PO_4 1% for 6 h, KNO_3 3% for 6 h, $CaCl_2$ 2% for 6 h, $ZnSo_4$ 1% for 6 h, KCL 1% for 6 h. Then above primed seeds were dried adequately and stored along with untreated seeds in two different containers viz. cloth bag and aluminum container to evaluate the storability of seeds under ambient condition of Annamalainagar. The seeds were evaluated initially and at bimonthly intervals upto 10 months for its seed quality parameters. The study revealed the maize seeds halo primed with KH_2PO_4 1% for 6 h and stored in Aluminum container maintained its germination for minimum seed certification standard till the end of the storage period in maize cv. Co 1

Key words: Maize, chemical seed priming, seed quality, etc.

1. Introduction

Maize is an important cereal crop of India and is grown under a wide range of agro ecological conditions, both rain fed and irrigated. It is one of the world's leading crops cultivated over an area of about 177.73 million hectares with production of about 961.85 million metric tonnes and productivity of 5.41 metric tonnes per hectare. In India, it is grown in area of 8.81 million hectares with production of about 22.57 million metric tonnes and productivity of 2.56 metric tons per hectare. Proper crop storage plays an integral part in ensuring domestic food supply and that seed quality and vigour is maintained. Fluctuations in temperature, humidity and prolonged storage result in considerable nutrient losses. Several ways exist for maintaining the viability and vigour of seeds. The cheapest and easiest way is by storing seeds. Seed being a living entity, deterioration beyond physiological maturity is inevitable especially when stored under ambient conditions. Seed quality maintenance especially under storage conditions has gained importance in the present context. Since agriculture is season bound, the storage of seeds has become inevitable for an ordinary farmer, seed producer and a breeder as the case may be. It is a quite natural phenomenon that the seed loses its viability and vigour under storage as any biological material. The complete control over the seed deterioration is quite impossible but the rate of deterioration can be slowed down to a great extent. Seed priming is a controlled hydration process that involves exposing seeds to low water potentials that restrict germination, but permits pre-germinative physiological and biochemical changes to occur. Information on storage of seeds to preserve the viability and vigour from harvest to next planting season and for carry over purposes is of prime importance in any seed production programme. Under such situation a pre-storage seed treatment that will go along with the routine operations in seed industry would be more appropriate and adoptable. Seed producers and farmers are confronted with serious problems of loss of viability and vigour when stored under local conditions within a season. Developing controlled storage facilities would solve this problem. But such facilities are not available for bulk quantity of seeds besides it would be very expensive. In its place developing effective storage technologies for larger adoption at reasonable cost would be most welcome and feasible for our conditions. With this background, study was carried out in maize cv CO1 to make a comparative assessment of various chemical seed priming treatments, containers and period of storage on seed quality in maize.

2. Materials and methods

The present study was carried using genetically pure seeds of maize (*Zea mays L.*) cv. Co 1 obtained from the Tamilnadu Agricultural University Coimbatore, Tamilnadu. The experiments were conducted at the Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalai Nagar (11°24'N latitude and 79°44'E longitude with an altitude of +5.79 mts above mean sea level). The bulk seeds were first dried to below 12% moisture content, cleaned, then graded with suitable sieves and imposed for following priming treatments *viz.*, soaking in water for 6 h, soaking in KH_2PO_4 1% for 6 h, soaking in KNO_3 3% for 6 h, soaking in $CaCl_2$ 2% for 6 h, soaking in $ZnSo_4$ 1% for 6 h, and soaking in Kcl 1% for 6 h. After the treated seeds were removed from the solutions, rinsed in water, shade and sun dried at room temperature to bring back to its original moisture content. The treated seeds along with control (T_0) were stored in cloth bag (C_1) and aluminium container (C_2) under ambient condition at Annamalainagar for a period of 12 months. The experiment was formulated adopting FCRD with three replications and evaluated for its seed quality parameters once in two months viz. germination percentage, speed of germination, shoot length, root length, dry matter production and electrical conductivity under laboratory condition. The data were statistically analyzed as per the method of Panse and Sukhatme.

3. Results and discussions

Establishment of a good seedling stand in the field is an important and foremost need for higher crop yield. This depends largely on the field germination and vigour potential of the seeds used for sowing. In the normal course, the seeds start to deteriorate during post maturity period whether the seed is in the mother plant or in seed store. Seed undergoes considerable quantitative and qualitative changes during storage, which leads to loss of viability. In the present study, the moisture content increased with increase in the storage period, which was found to be 8.4 to 9.2 per cent irrespective of the containers and treatments (Table. 1). The increase was higher in the untreated seeds of maize seeds stored in moisture pervious container (cloth bag) compared to those stored in moisture vapour proof container (Aluminum container). The increase was low in maize seeds halo-primed with KH_2PO_4 1% for 6 h and stored in aluminum container. At the end of the storage period the above treatment recorded 8.4%. The rapid increase in the moisture content of seeds of sesame stored in moisture vapour pervious container (cloth bag) might be due to the absorption of atmospheric moisture. The porous nature of the container would have permitted the entry of moisture into the bag and the differential moisture content of the atmosphere and the seeds would have attained equilibrium that would have raised the moisture content of the seeds, as they were stored after drying to low moisture content. While the very low increase in the moisture content of the treated and untreated seed of maize, that were stored in moisture vapour proof containers is due to the prevention of moisture entry into the containers.

The germination potential is the basic requirement for seed. The viability and vigour are the two important facts of seed quality and they go hand in hand while judging the quality of seeds. In the present study, the germination percentage decreased with increase in the storage period *viz*. 95 to 76 per cent (Table 2). The study highlighted that maize seeds halo-primed with KH_2PO_4 1% for 6 h and stored in aluminum container maintained their germination for minimum seed certification purpose till the end of the storage period. Where the actual germination per cent recorded after storage was 88 per cent. Increased germination due to KH_2PO_4 priming might be due to ions absorption by seeds as reported by Alvarado, et al. Moreover, the potassium salts had been reported to raise the ambient oxygen level by making less oxygen available for the citric acid cycle. The reason for this increase is still unknown but it may be due to better metabolic activity in seeds primed at higher water potentials. Degree of seed hydration has been found to be correlated with the osmotic potential of the priming solution. Therefore, seeds incubated in KH_2PO_4 solutions with relatively high water potentials have higher moisture contents and potentially greater metabolic activity. Hegarty has shown that oxygen use is highest in seeds in solutions with the highest osmotic potential. The KH_2PO_4 treated seed was closely associated with their rapid utilization in the synthesis of various amino acids and amides, which could be the reason for the increased germination rate.

Seed deterioration as evident from loss of viability is associated with decreased growth of root and shoot. The root length could be considered as a good criterion for assessing seed vigour. In the present study, the root and shoot length of the seedling showed significant reduction over periods of storage, irrespective of the treatment and container. The maize seeds halo primed with KH_2PO_4 1% for 6 h and stored in aluminum container produced lengthier seedlings compared to those stored in cloth bag. At the end of the storage period the above treatment were superior in producing lengthier seedlings than the untreated ones. It produces 21.6 cm root and 27.3 cm shoot (Table. 3 and 4). The KH_2PO_4 seed priming improved germination and seedling growth and improved seedling FW might be due to increased cell division within the apical meristem of seedling roots, which cause an increase in plant growth. It was reported earlier that KH_2PO_4 participated in regulation of many growth and developmental processes in plants and was particularly important in regulating stem elongation. The increased shoot and root length with KH_2PO_4 halo priming treatment may be due to the fact that, halo priming increased nuclear replication in shoot and root. Priming significantly improved root length. Early reserve breakdown and reserve mobilization might be the cause due to efficient mobilization and utilization of seed reserves and better development of root and shoot growth.

The dry matter production of seedlings is the ultimate manifestation of physiological vigour. Seedling vigour is usually characterized by weight of the seedlings after a period of growth and this is essential physiological phenomenon influenced by the reserve metabolites, enzyme activities and growth regulators. The vigour estimations based on physiological manifestations such as seedling length, dry matter accumulation and the vigour index arrived at from germination percentage with the respective seedling length had clearly brought out the importance of such estimations for determining the vigour of seeds in storage. The vigour index, which is the totality of germination and seedling growth, has been regarded as a good index to measure the vigour of seeds. In the present study, the dry matter production and vigour index decreased with increase in the storage period irrespective of treatments and containers. The decrease was low in maize seeds halo-primed with KH_2PO_4 1% for 6 h and stored in aluminum container. At the end of the storage period the above treatment recorded dry matter (198 g) and vigour index (4303) (Table. 5 and 6). In the present study, increase in shoot length, root length and dry matter production due to priming might be due to earlier start of emergence. Farooq, et al. in wheat reported that pre-soaking with KH_2PO_4 inorganic salts improved seedling emergence, shoot and root length, and biomass, which leads to increase in the vigour index and protein.

The EC values showed negative association with germination percentage of seeds. Increased leaching of electrolytes occurred in control and comparatively lowers values for 1% KH_2PO_4 and 6 hours halo primed seeds. Electrical conductivity was increased with increase in the storage period. The increase was from 152 to 305 dSm^{-1} (Table 7). The maize seeds halo primed with KH_2PO_4 and 6 hours and aluminum container relatively low electrical compared to the untreated ones. At the end of the storage period the above treatment recorded low electrical conductivity (241 dsm^{-1}). The electrolyte in the seed leachate was more especially at the later period of storage particularly in untreated control seeds in cloth bag. Weakening of cell membrane might cause increase in leaching of metabolites and electrolytes through the semi permeable membranes into the imbibing medium. The increase in the electrical conductivity might be due to the alteration in the membrane permeability during ageing, loss of integrity of plasmalemma and tonoplast and concomitant increase for molecules that leach out of seeds. The formation of free radicals has the potential to damage the biomembranes resulting in increased leaching of electrolytes and sugars during storage. The K iron present in the KH_2PO_4 counteracting the free radical chain propagation reaction and consequent stabilization of lipo-protein moiety of the membrane maintained or improved the membrane integrity thereby minimized the leakage of electrolytes. The study revealed the maize seeds halo primed with KH_2PO_4 1% for 6 h and stored in aluminum container maintained its germination for minimum seed certification standard till the end of the storage period. This type of seed storage recorded low moisture content, electrical conductivity and high germination percentage, seedling length, dry matter production and vigour index, when compared to control in maize cv. Co.

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TABLE 1

Effect of Chemical Seed Priming Treatments, Storage Containers and Period of Storage on Moisture Content (%) Maize cv. CO1

Containers	Treatments	P_0	P_2	P_4	P_6	P_8	P_{10}	Mean
C_1	T_0	8.5 (16.95)	8.6 (17.05)	8.8 (17.25)	9.5 (17.95)	9.9 (18.33)	10.2 (18.62)	9.2 (17.69)
	T_1	8.8 (17.25)	8.9 (17.35)	8.9 (17.35)	9.1 (17.55)	9.2 (17.65)	9.6 (18.04)	9.1 (17.53)
	T_2	8.3 (16.74)	8.4 (16.84)	8.6 (17.05)	9.0 (17.45)	9.1 (17.55)	9.1 (17.55)	8.7 (17.20)
	T_3	8.4 (16.84)	8.5 (16.95)	8.6 (17.05)	9.1 (17.55)	9.2 (17.65)	9.3 (17.75)	8.8 (17.30)
	T_4	8.4 (16.84)	8.5 (16.95)	8.6 (17.05)	9.2 (17.65)	9.3 (17.75)	9.5 (17.95)	8.9 (17.36)
	T_5	8.3 (16.74)	8.4 (16.84)	8.6 (17.05)	9.0 (17.45)	9.1 (17.55)	9.3 (17.75)	8.8 (17.23
	T_6	8.3 (16.74)	8.3 (16.74)	8.6 (17.05)	9.1 (17.65)	9.2 (17.65)	9.4 (17.85)	8.8 (17.26)
	Mean	8.4 (16.87)	8.5 (16.96)	8.7 (17.12)	9.1 (17.59)	9.3 (17.73)	9.5 (17.93)	8.9 (17.37)
C_2	T_0	8.5 (16.95)	8.5 (16.95)	8.6 (17.05)	8.8 (17.25)	9.0 (17.45)	9.3 (17.75)	8.8 (17.23)
	T_1	8.8 (17.25)	8.8 (17.25)	8.8 (17.25)	8.8 (17.25)	8.7 (17.15)	8.8 (17.25)	8.8 (17.23)
	T_2	8.3 (16.74)	8.4 (16.84)	8.4 (16.84)	8.4 (16.84)	8.4 (16.84)	8.4 (16.84)	8.4 (16.83)
	T_3	8.4 (16.84)	8.3 (16.74)	8.3 (16.74)	8.4 (16.84)	8.5 (16.95)	8.5 (16.95)	8.4 (16.84)
	T_4	8.4 (16.84)	8.4 (16.84)	8.4 (16.84)	8.4 (16.84)	8.5 (16.95)	8.6 (17.05)	8.4 (16.89)
	T_5	8.3 (16.74)	8.3 (16.74)	8.3 (16.74)	8.3 (16.74)	8.4 (16.84)	8.6 (17.05)	8.4 (16.81)
	T_6	8.3 (16.74)	8.3 (16.74)	8.3 (16.74	8.4 16.84)	8.5 (16.95)	8.5 (16.95)	8.4 (16.82)
	Mean	8.4 (16.87)	8.4 (16.87)	8.4 (16.89)	8.5 (16.94)	8.6 (17.02)	8.7 (17.12)	8.5 (16.95)
Treatment mean	T_0	8.5 (16.95)	8.5 (17.00)	8.7 (17.15)	9.1 (17.60)	9.4 (17.89)	9.7 (18.18)	8.9 (17.46)
	T_1	8.8 (17.25)	8.8 (17.30)	8.7 (17.30)	8.9 (17.40)	8.8 (17.40)	9.2 (17.65)	8.8 (17.38)
	T_2	8.3 (16.74)	8.4 (16.84)	8.5 (16.94)	8.7 (17.15)	8.7 (17.20)	8.7 (17.20)	8.3 (17.01)
	T_3	8.4 (16.84)	8.4 (16.84)	8.4 (16.81)	8.7 (17.20)	8.8 (17.30)	8.9 (17.35	8.6 17.07
	T_4	8.4 16.84	8.4 16.84	8.5 16.94	8.8 17.25	8.9 17.35	9.0 17.50	8.6 17.13
	T_5	8.3 16.74	8.3 16.79	8.5 16.89	8.6 17.10	8.7 17.20	8.9 17.40	8.5 17.02
	T_6	8.3 16.74	8.3 16.74	8.4 16.89	8.7 17.20	8.8 17.30	8.9 17.40	8.5 17.04
	Mean	8.4 16.87	8.4 16.92	8.5 17.00	8.7 17.07	8.8 17.13	9.2 17.52	8.6 17.16

Figures in parenthesis are Arcsine Transformed value

	C	T	P	C x T	T x P	C x P	C x P x T
CD P = 0.05	0.05	0.09	0.106	0.15	0.26	0.13	0.36

TABLE 2

Effect of Chemical Seed Priming Treatments, Storage Containers and Period of Storage on Germination (%) of Maize cv. CO 1

Containers	Treatments	P_0	P_2	P_4	P_6	P_8	P_{10}	Mean
C_1	T_0	92 (73.68)	92 (73.68)	89 (70.69)	81 (6.18)	74 (59.35)	68 (55.55	83 (66.19)
	T_1	94 (76.00)	93 (74.80)	91 (72.63)	84 (66.45)	79 (62.73)	70 (56.79	85 (68.23)
	T_2	98 (83.08)	97 (80.61)	95 (77.32)	94 (76.00)	91 (72.60)	86 (68.07	93 (76.28)
	T_3	97 (80.42)	97 (80.61)	95 (77.32)	93 (74.80)	88 (69.76)	81 (64.18	92 (74.51)
	T_4	94 (75.93)	92 (73.68)	90 (71.64)	86 (68.07)	81 (64.18)	70 (56.79	85 (68.38)
	T_5	97 (80.61)	96 (78.82)	94 (76.00)	90 (71.64)	87 (68.91)	78 (62.04	90 (73.00)
	T_6	94 (76.00)	92 (73.68)	90 (71.64)	87 (68.91)	81 (64.18)	70 (56.79	86 (68.53)
	Mean	95.1 (77.96)	94.1 (76.55)	92.3 (73.89)	87.8 (70.01)	83 (65.96)	74.7 (60.03	88 (70.03)
C_2	T_0	92 (73.68)	92 (73.68)	90 (71.64)	83 (65.67)	77 (61.35)	70 (56.79	84 (67.14)
	T_1	94 (76.00)	93 (74.80)	93 (74.80)	85 (67.25)	81 (64.18)	72 (58.06	86 (69.18)
	T_2	98 (83.40)	98 (83.40)	96 (78.84)	96 (78.69)	93 (74.80)	88 (69.78	95 (78.15)
	T_3	97 (80.61)	97 (80.61)	95 (77.32)	94 (75.93)	90 (71.64)	85 (6.25)	93 (75.56)
	T_4	94 (76.00)	93 (74.80)	92 (73.68)	89 (70.67)	83 (65.67)	71 (57.42)	87 (69.71)
	T_5	97 (80.61)	97 (80.61)	95 (80.61)	92 (73.68)	89 (70.69)	80 (63.45)	92 (74.39)
	T_6	94 (76.00)	94 (76.00)	93 (74.80)	91 (72.63)	84 (66.45)	75 (60.01)	88 (70.98)
	Mean	95.1 (78.04)	94.8 (77.70)	93.4 (75.48)	90 (72.08)	85.2 (67.83)	77.3 (61.82)	89 (72.16)
Treatment mean	T_0	92 (73.68)	93 (73.68)	89.5 (71.17)	82 (64.92)	75.5 (60.35)	69 (56.17)	83 (66.66)
	T_1	94 (76.00)	93 (74.80)	92 (73.71)	84.5 (66.85)	80 (63.45)	71 (57.42)	86 (68.71)
	T_2	98 (83.24)	97.5 (82.00)	95.5 (78.07)	95 (77.35)	92 (73.70)	87 (68.92)	94 (77.21)
	T_3	97 (80.5)	97 (80.61)	95 (77.32)	93.5 (75.37)	89 (70.70)	83 (65.71)	92 (75.04)
	T_4	94 (75.9)	92.5 (74.24)	91 (72.66)	87 (69.37)	82 (64.93)	70.5 (57.11)	86 (69.04)
	T_5	97 (80.61)	96.5 (79.71)	94.5 (76.66)	91 (72.66)	88 (69.80)	79 (62.75)	91 (73.70)
	T_6	94 (76.00)	93 (74.84)	92 (73.22)	89 (70.77)	82.5 (65.31)	72.5 (58.40)	87 (69.76)
	Mean	95 (78.00)	94.5 (77.13)	92.7 (74.69)	88.8 (71.04)	84.1 (66.89)	76 (60.93)	88 (71.45)

Figures in parenthesis are Arcsine Transformed value

	C	T	P	C x T	T x P	C x P	C x P x T
CD P = 0.05	0.192	0.408	0.451	0.577	1.355	0.638	1.916

TABLE 3

Effect of Chemical Seed Priming Treatments, Storage Containers and Period of Storage on Root Length (cm) of Maize cv. CO 1

Containers	Treatments	P_0	P_2	P_4	P_6	P_8	P_{10}	Mean
C_1	T_0	19.1	18.7	18.2	18.3	17.1	16.4	18.0
	T_1	20.0	19.6	19.2	18.8	18.1	17.4	18.8
	T_2	23.3	22.4	21.9	21.4	21.0	20.5	21.7
	T_3	23.3	22.4	21.9	21.4	21.0	20.5	21.7
	T_4	20.9	19.8	19.1	18.2	17.3	16.7	18.7
	T_5	23.2	22.4	22.1	21.3	20.8	20.2	21.7
	T_6	21.1	20.2	19.5	18.7	18.1	17.4	19.2
	Mean	21.5	20.8	20.3	19.7	19.0	18.4	19.1
C_2	T_0	19.1	18.8	18.4	18.0	17.3	16.9	18.1
	T_1	20.0	19.7	19.4	19.0	18.5	18.0	19.1
	T_2	23.8	23.4	23.0	22.5	22.0	21.6	23.1
	T_3	23.3	22.9	22.3	21.8	21.4	20.9	22.1
	T_4	20.9	20.2	19.5	18.7	18.1	17.2	19.1
	T_5	23.2	22.8	22.5	22.0	21.5	20.4	22.1
	T_6	21.1	20.6	20.0	19.2	18.6	17.9	19.6
	Mean	21.6	21.2	20.7	20.2	19.6	18.9	20.8
Treatment mean	T_0	19.1	18.7	18.3	18.1	17.2	16.6	18.0
	T_1	20.0	19.6	19.3	18.9	18.3	7.7	19.0
	T_2	23.5	22.9	22.4	21.9	21.5	21	22.2
	T_3	23.3	22.6	22.1	21.6	21.2	20.7	21.9
	T_4	20.9	20.0	19.3	18.4	17.7	16.9	18.9
	T_5	23.2	22.6	22.3	21.6	21.1	20.3	21.9
	T_6	21.1	20.4	19.7	18.9	18.3	17.6	19.4
	Mean	21.6	21.0	20.5	20.0	19.3	18.7	20.2

	C	T	P	C x T	T x P	C x P	C x P x T
CD P = 0.05	0.13	0.24	0.2	0.2	0.3	0.2	0.8

TABLE 4

Effect of Chemical Seed Priming Treatments, Storage Containers and Period of Storage on Shoot Length (cm) of Maize cv. CO 1

Containers	Treatments	P0	P2	P4	P6	P8	P10	Mean
C_1	T_0	24.7	23.7	22.6	21.2	19.3	17.5	21.5
	T1	26.9	26.1	25.7	24.3	23.0	21.5	24.6
	T2	30.1	29.3	28.5	27.7	27.1	26.0	28.1
	T3	29.0	28.1	27.4	26.1	25.1	24.1	26.6
	T4	25.2	24.1	23.1	21.7	20.1	18.7	22.1
	T5	28.6	27.6	27.0	25.8	24.5	23.2	26.1
	T6	27.1	26.1	25.2	23.8	22.5	21.0	24.3
	Mean	27.4	26.4	25.6	24.4	23.1	21.7	21.4
C_2	T0	24.7	24.3	23.8	22.3	21.1	18.7	22.5
	T1	26.9	26.2	25.5	24.2	22.7	21.3	24.5
	T2	30.1	29.8	29.1	28.3	27.9	27.3	28.7
	T3	29.0	28.6	28.1	27.2	26.1	25.1	27.3
	T4	25.2	24.4	23.5	22.1	21.0	19.8	22.7
	T5	28.6	28.1	27.4	26.5	25.3	24.1	26.7
	T6	27.1	26.6	25.7	24.5	23.3	22.1	24.9
	Mean	27.4	26.8	26.1	25.0	23.9	22.6	25.3
Treatment mean	T_0	24.7	24	23.2	21.6	20.2	18.1	22
	T_1	26.9	26.2	25.6	24.3	28.9	21.4	24.5
	T_2	30.1	29.5	29.0	28.0	27.5	27.7	28.4
	T_3	29.0	28.4	27.8	26.7	25.7	24.6	27.0
	T_4	25.2	24.2	23.3	21.9	20.5	19.2	22.4
	T_5	28.6	27.9	27.2	26.2	24.9	23.7	26.4
	T_6	27.1	26.4	25.5	24.2	22.9	21.6	24.6
	Mean	27.4	26.6	25.9	24.7	23.5	20.2	25.0

	C	T	P	C x T	T x P	C x P	C x P x T
CD P = 0.05	0.16	0.30	0.28	0.42	0.74	0.39	1.04

TABLE 5

Effect of Chemical Seed Priming Treatments, Storage Containers and Period of Storage on Dry Matter Production (g. seedlings^{-1}) of Maize cv. CO 1

Containers	Treatments	P_0	P_2	P_4	P_6	P_8	P_{10}	Mean
C_1	T_0	214	206	188	178	163	143	182
	T_1	217	208	189	181	168	151	185.7
	T_2	242	232	219	211	201	190	215.8
	T_3	238	226	214	200	192	187	209.5
	T_4	225	212	201	190	179	165	195.3
	T_5	233	221	210	199	187	180	205
	T_6	229	217	205	194	183	169	199.5
	Mean	228.3	217.4	203.7	193.3	181.8	169.3	189.0
C_2	T_0	214	201	194	184	168	152	185.5
	T_1	217	212	197	187	172	157	190.3
	T_2	242	234	223	214	205	198	219.3
	T_3	238	230	218	209	199	189	213.8
	T_4	225	216	205	195	186	170	199.5
	T_5	233	225	214	205	194	183	209
	T_6	229	221	210	200	189	174	203.8
	Mean	2283	219.8	208.7	199.1	187.6	174.7	203.0
Treatment mean	T_0	214.0	203.5	191.0	181.0	165.5	147.5	183
	T_1	217.0	210.0	193.0	184.0	170.0	154.0	188
	T_2	242.0	233.0	221.0	212.5	203.0	194.0	228
	T_3	238.0	228.0	216.0	204.5	195.5	188.0	211
	T_4	225.0	214.0	203.0	192.5	182.5	167.5	197
	T_5	233.0	223.0	212.0	202.0	190.5	181.5	207
	T_6	229.0	219.0	207.5	197.0	186.0	171.5	201
	Mean	228.3	218.6	206.2	196.2	184.7	172.0	201.0

	C	T	P	C x T	T x P	C x P	C x P x T
CD P = 0.05	1.3	2.4	2.24	3.4	5.9	3.2	8.40

TABLE 6
Effect of Chemical Seed Priming Treatments, Storage Containers and Period of Storage on Vigour Index of Maize Cv. CO 1

Containers	Treatments	P_0	P_2	P_4	P_6	P_8	P_{10}	Mean
C_1	T_0	4029	3900	3631	3199	2693	2305	3293
	T_1	4408	4250	4085	3620	3246	2723	3722
	T_2	5233	5014	4788	4615	4377	3999	4671
	T_3	5073	4898	4683	4417	4056	3612	4457
	T_4	4333	4038	3798	3431	3029	2478	3518
	T_5	5024	4800	4615	4239	3941	3385	4334
	T_6	4530	4259	4023	3697	3288	2688	3748
	Mean	4661	4451	4232	3888	3519	3027	3843
C_2	T_0	4029	3965	3798	3344	2956	2492	3431
	T_1	4408	4268	4175	3672	3337	2829	3782
	T_2	5282	5213	5001	4876	4640	4303	4886
	T_3	5073	4995	4788	4606	4275	3910	4608
	T_4	4333	4147	3956	3631	3245	2627	3657
	T_5	5024	4937	4740	4462	4165	3560	4481
	T_6	4530	4436	4250	3976	3519	3000	3952
	Mean	4668	4566	4387	4081	3734	3246	4214
Treatment mean	T_0	4029	3932	3715	3272	2824	2399	3362
	T_1	4408	4259	4130	3646	3292	2776	3751
	T_2	5257	5113	4895	4745	4509	4151	4778
	T_3	2073	4946	4736	4511	4166	3761	4532
	T_4	4333	4092	3877	3531	3138	2552	3587
	T_5	2024	4868	4677	4351	4053	3473	4407
	T_6	4530	4347	4137	3837	3404	2844	3849
	Mean	4664	4509	4309	3985	3626	3136	4038

	C	T	P	C x T	T x P	C x P	C x P x T
CD P = 0.05	26.9	49.2	45.5	69.5	120.4	64.4	170.3

TABLE 7

Effect of Chemical Seed Priming Treatments, Storage Containers and Period of Storage on Electrical Conductivity (dsm-1) of Maize Cv. CO 1

Containers	Treatments	P_0	P_2	P_4	P_6	P_8	P_{10}	Mean
C_1	T_0	189	219	241	275	308	346	263
	T_1	175	207	238	269	296	330	252
	T_2	129	155	177	206	235	266	195
	T_3	137	164	187	217	246	282	206
	T_4	170	202	222	254	289	327	244
	T_5	147	180	206	236	269	303	224
	T_6	152	186	211	243	277	310	230
	Mean	157	188	212	243	275	309	239
C_2	T_0	189	204	231	264	296	328	252
	T_1	175	203	226	255	286	315	243
	T_2	129	146	168	197	225	241	184
	T_3	137	155	178	206	235	265	196
	T_4	170	193	210	242	276	312	234
	T_5	147	169	195	225	258	292	214
	T_6	152	176	199	232	264	297	220
	Mean	157	178	201	232	263	293	207
Treatment mean	T_0	189	212	236	269	302	337	258
	T_1	175	205	232	262	291	322	247
	T_2	129	151	172	201	230	253	189
	T_3	137	159	182	211	240	273	209
	T_4	170	198	216	248	282	319	238
	T_5	147	175	200	230	263	297	218
	T_6	152	181	205	237	270	303	224
	Mean	152	189	206	237	268	305	226

	C	T	P	C x T	T x P	C x P	C x P x T
CD P = 0.05	1.5	2.8	2.6	4.0	6.9	3.7	9.7