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Physiological and Physical Quality of Seeds from Peanut Seeds and Plants under the Influence of Fertilizer and Biostimulant

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Abstract

The foliar application and seed Ca + B, Mo + P and Stimulate® in peanut, despite being a practice used long ago, few studies have conclusive results, and then this research was to evaluate the physical and physiological quality peanut seeds from the process of application of fertilizers and bio-stimulant. The design was completely randomized, with seed from peanut plants subjected to the use of three products (Ca + B; Mo + P and Stimulate®), two types of applications (via leaf and seeds), growing with PK and absolute control, following a factorial arrangement of [(3 × 2) + 2]. For the dimensions (length and width) of seeds, as well as the thousand seed weight and number of seeds per pod, data were submitted to descriptive statistics, calculating the mean, standard deviation, variance and coefficient of variation of the data obtained. The application of fertilizers, bio-stimulants and groundnut seeds increases germination of seeds produced, causes more seedlings that are vigorous and reduces the percentage of abnormal seedlings.

Keywords

Biometrics, Electrical Conductivity, Germination

1. Introduction

The peanut (*Arachis hypogaea* L.) has significant economic importance due to the use of its seeds directly in food, preserves, confectionery industries and in the production of biodiesel [1].

The peanut fields in the 2012/2013 crop occupy an area of 108 hectares and produce around 236.000 tonnes of

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product [2]; moreover, the Northeast is the second largest consumer of peanut pole in Brazil estimated at 50.000 tonnes of seeds per year [3].

The development of techniques to improve a culture can be considered a major component of a production system by contributing to increased productivity without resulting in additional costs, which facilitates its adoption, especially by low-income producers [4].

In recent years, there has been an increase in the number of higher input producers, who use advanced technologies, and the large-scale crops [5]. The use of good quality seed is essential because they carry crucial component of farming systems, contributing to high performance of the crop [6].

A quality seed should possess the genetic potential to express purity, physical purity determined by the degree of contamination, physiological quality possessing the ability to generate a new and perfect good health and vigorous plant, and is free of potential disease-causing pathogens, which may affect the performance [7].

Plant growth depends largely on the use of high-quality seeds. The seed quality is achieved by assessing the physiological potential, which generates information for the detection and resolution of problems during the production process. The environment in which the seeds are formed may influence their physiological characteristics, so one should consider the germination and vigor to differentiate seeds with greater physiological potential due to cultural treatments applied [8].

There are two ways to determine the quality of the seeds through its germination and for measuring the force. Germination is expressed by the ability of seeds to germinate under suitable conditions, and in turn, indicates the vigor of the plant's ability to resist environmental stresses and their ability to remain viable during storage [9].

Fertilization is a limiting factor in the production of quality seeds with adequate physiology [10]. The availability of nutrients influences the formation of the embryo and the cotyledons, with effective results in physiological vigor and quality, and also participates in the formation of membranes and accumulation of carbohydrates, lipids and proteins [11]. The nutrients stored in the seed will meet the elements necessary for seedling establishment in its early stages. However, the development of plants generated can also depend on the fertility of the soil, so the medium can offset the need for a specific element, even if the seed shows little amount, having been originated from a mother plant grown in conditions of low fertility [12].

Practices such as fertilization via leaf and seeds have been applied long ago in grain production, but there are still few studies related to the application of nutrients and Stimulate® in seed production. Therefore, this study aimed to evaluate the physical and physiological seed quality of peanuts from the process of application of Ca + B, Mo + P and Stimulate.

2. Materials and Methods

The experiment was conducted at Seed Analysis Laboratory of the Federal Rural University Federal Rural of Pernambuco/Unit Academic of Garanhuns (UFRPE/UAG) in Garanhuns—PE, Brazil.

The peanut bean cultivar BR1 were harvested at 90 days after sowing, when they reached the ripeness. Confirmation of the ideal point of maturation and harvesting was done tearing at random, the useful portion of each treatment plants of different places and examining the pods. Drying was carried out in an area near UFRPE/UAG, the plants were arranged in rows, with the pods up and in contact with the sun's rays, dried in three days, beginning the testing and evaluation.

The seeds were produced as follows: T_1—Seeds coming to the absolute control; T_2—Seeds from cultivation with PK; T_3—Seeds from cultivation with application of (Ca + B) via seeds; T_4—Seeds from cultivation with application of (Mo + P) via seeds; T_5—Seeds from cultivation with application of (Ca + B) foliar application; T_6—Seeds from cultivation with application of (Mo + P) foliar application; T_7—Seeds from cultivation to Stimulate® application via seed and T_8—Seeds from cultivation with application of foliar Stimulate®.

The seeds were analyzed for chemical composition, performed according to the methodology of the College of Agriculture "Luiz de Queiroz"—USP (**Table 1**).

Biometrics seed—was determined size (length and width) from 100 randomly selected seeds of each treatment by measuring using a digital caliper.

Water content—to evaluate the water content of seeds used the oven method at 105˚C for 24 hours, according to [13] using four replicates, being placed in aluminum containers and taken to greenhouse. After the period described, the samples were weighed on an analytical balance accurate to 0.0001 and the results expressed as a percentage.

Table 1. Chemical composition of peanut seeds derived from plants and seeds subjected to different management (UFRPE/UAG, 2014).

CHEMICAL COMPOSITION	TREATMENTS							
	1	2	3	4	5	6	7	8
N (g/Kg)	55.01	52.3	45.1	53.12	49.46	53.95	55.96	55.72
P (g/Kg)	4.01	3.89	4.32	3.41	4.51	4.48	4.03	3.59
K (g/Kg)	7.5	7	7.75	6.75	7.75	7.5	9.5	7
Ca (g/Kg)	2	0.75	1.25	1	0.5	0.75	1	1.5
Mg (g/Kg)	2.18	1.98	2.23	1.93	2.15	2.15	1.93	2.08
S (g/Kg)	1.44	1.76	1.03	1.94	1.39	1.68	1.48	1.21
B (mg/Kg)	39.69	37.23	43.11	42.72	41.44	41.69	42.21	43.63
Cu (mg/Kg)	0.5	0.87	0.5	0.5	0.5	0.5	3.6	1.3
Fe (mg/Kg)	70.92	122.39	107.16	135.57	92.14	124.78	184.08	100.19
Mo (mg/Kg)	10.85	5	5	5	5	5	5	5
Zn (mg/Kg)	47.91	48.3	53.32	51.39	62.69	63.47	71.48	50.76
Na (mg/Kg)	230	230	235	225	260	245	260	255
Al (mg/Kg)	115	175	195	285	175	185	380	210

Germination test—the test was conducted on paper towel substrate, mark "germitest", arranged in rolls, moistened with distilled water equivalent to three times the weight amount in accordance with the Rules for Seed Analysis [13], Before the test facility, the substrate was sterilized at 105˚C for 24 hours, and the seeds germinated in germination *Biochemical Oxygen Demand* of type (BOD) set at a constant temperature of 30˚C, using four replicates of 50 seeds. Counting of normal seedlings were made daily from the fifth to the tenth day after sowing, germination and the criterion adopted was normal seedlings, namely those with the essential structures perfect. At the end of the test, normal, abnormal seedlings and dead seeds were evaluated.

Test emergency—were used for each treatment, four replicates of 25 seeds, which were sown in plastic trays with dimensions 0.40 × 0.40 × 0.11 m, containing sand as substrate, moistened with distilled water 60% retention capacity for water as Brazil (2009), at a depth of 2 cm and placed in a laboratory environment at an average temperature of 28˚C. At the end of the test, normal, abnormal seedlings and dead seeds were evaluated.

First count of germination and seedling emergence—was held together with germination and emergence test, computing the percentage of normal seedlings at the fifth day after installation of the test.

Index germination rate (IVG)—reviewed in conjunction with the germination test, reflecting the normal seedlings at the same time every day, from the first count, and the index calculated according to the formula proposed by [14].

Index emergence rate (IVE)—conducted in conjunction with the seedling emergence test, noting it daily, at the same time, the number of seedlings that showed visible epicótilos. The last count was done 10 days after sowing, and the daily data of the number of normal seedlings, calculated the IER using the formula proposed by [14].

Electrical conductivity (EC)—four replicates of 25 seeds were used for each treatment. The seeds were weighed to an accuracy of four decimal places and placed to soak in plastic cups disposables (capacity 200 mL) houses, containing 75 mL of deionized water (EC < $\mu S \cdot cm^{-1} \cdot g^{-1}$) at a constant temperature of 25˚C [15]. Were removed from the chamber, four containers at a time, that for each treatment. After performing a gentle shake the container was made to read the EC soaking solution in DIGIMED appliance, model CD-21, electrode constant 1.0 and the results expressed in $\mu S \cdot cm^{-1} \cdot g^{-1}$.

Statistical analysis—the experiment was conducted in a completely randomized design with four replications for each treatment, using three products (Ca + B; Mo + P and Stimulate®), two types of applications (seed and foliar), cultivation with PK and absolute control, following a factorial arrangement of [(3 × 2) + 2]. Data were subjected to analysis of variance and means were compared by Dunnett and Tukey test at 5% probability. For the

dimensions (length and width) of seeds, as well as the weight of a thousand seeds, the data were subjected to descriptive statistics, calculating the mean, standard deviation, variance and coefficient of variation. Statistical analyzes were performed using the SAEG, Version 9.1 [16] statistical software.

3. Results and Discussion

The results shown in **Table 1** express the chemical composition of peanut seeds derived from plants and seeds subjected to different management. Among the nutrient analysis showed that the similarities with respect to the amount between treatments (N), phosphorus (P), magnesium (Mg), sodium (Na), sulfur (S) and boron (B), which implies that treatments had no effect on the accumulation of these elements. According [17] the boron and magnesium are translocated into the seed medium peanut 31.4% and 33.5%, respectively.

The cultivation of the peanut plants by applying to seeds Stimulate® yielded seeds with high amounts of potassium (K), copper (Cu), zinc (Zn), iron (Fe) and aluminum (Al) (**Table 1**). This may be due to the bio-stimulant, applied to seeds, increase the absorption and utilization of nutrients by plants [18], thus explaining the accumulation of them.

Evaluating the growth and utilization of nutrients by peanut [17] stated that the elements absorbed into higher and lower quantity, are iron and copper, respectively. The same authors explain that iron is a micronutrient bit translocated to the seed (average 4.5% of the total uptake), as copper and zinc translocate 50.7% and 60.2% respectively of the total absorbed into the seed.

Although calcium (Ca) is an element known to be translocated bit, and the quantitative needs of molybdenum (Mo) between the plants is lower, there was a buildup in these seeds from the control treatment (T_1) (**Table 1**). It is noted, an ability cultivar BR1 in percentage accumulation of Ca and Mo, indicating a greater ability in their absorption, since it's coming from a treatment where there was no application of products.

The seeds of T_1, T_2, T_3 and T_4 have an average length of 34.42; 33.16; 31.99 and 31.98 mm with a range from 24.45 to 48.16; 20.50 to 48.69; 20,44 to 47.41 and from 18.71 to 48.00 mm respectively. The average widths were 12.33; 12.22; 12.23 and 11.98 mm with a range from 8.77 to 15.78; 8.30 to 16.49; 7.75 to 20.41 and 8.87 to 14.88 mm in the right order (**Figure 1**).

The control treatment (T_1) expressed average higher than others, in relation to length (34.42 mm) and width (12.33 mm). Nevertheless, had the lowest weight of 47.6540 g 100 seeds (**Table 2**) when compared to the other treatments. According to [19] for most of the seeds, the concentrations of nutrients in plants may provide seeds with higher content of these elements, but not necessarily high seed sizes.

Working with groundnut seed variety BR1, [20] classified as small ones that had 100 seed weight range 25 - 43 g, and large, 47 - 58 g. Therefore, in this study it was found that all treatments fall into the class of large seeds, as the weights ranged 47 - 50 g (**Table 2**). [21] evaluated the effect of phosphorus fertilization, yield and quality of peanut seeds, observed differences in relation to its size, similar to the results found in this work. Seed size, along with the vigor, germination, dry matter content and water content parameters are indicators of seed quality [21], used in this research. For soybean seeds (*Glycine max* L.), Crookston and Hill (1978) [22] found that the reduction in seed size as result of moisture loss is the most accurate indicator for the physiological quality.

According to the data of **Figure 2** (T_5, T_6, T_7 and T_8) the average length of peanut seeds was 33.55; 33.27; 31.75 and 33.05 mm (ranging from 18.20 to 41.60; 21.72 to 44.32; 20.61 to 42.22 and 15.70 to 45.19 mm, respectively). The average widths were 12.19; 12.02; 12.01 and 12.02 mm (range 8.49 to 15.28; 8.82 to 15.33; 6.74 to 15.19 and 6.80 to 16.19 mm, respectively).

Analyzing the results of length and width of all treatments, it can be said that the peanut seeds are irregular in size, this can be due the different substances used (Ca + B, Mo + P and Stimulate®). In **Figure 3** for the number of seeds/pod, it is noted that 42 (T_1), 35 (T_2), 40 (T_3), 37 (T_4), 33 (T_5), 43 (T_6), 36 (T_7) and 35% (T_8) respectively have 2 to 3; 1 to 2; 3 to 4; 1 to 2; 1 to 2; 1 to 2; 1 to 2 and 3 to 4 seeds per pod. These results are consistent with those presented by [23] and [24] to study the agronomic characteristics of production and seed vigor of peanut using macro and micronutrients, found no significant increase in the number of seeds per pod.

The peanut cultivar BR1, according [25] is about 3 seeds per pod, a fact that serves to affirm that the seeds resulting from this experiment are within the standard for the cultivar.

Vigorous seeds provide greater transfer of drought reserve your tissues for embryonic axis during germination mass, resulting in seedlings with greater weight due to the higher mass accumulation [26]. When we analyzed the average length, width and number of seeds per pod, there was no difference between them.

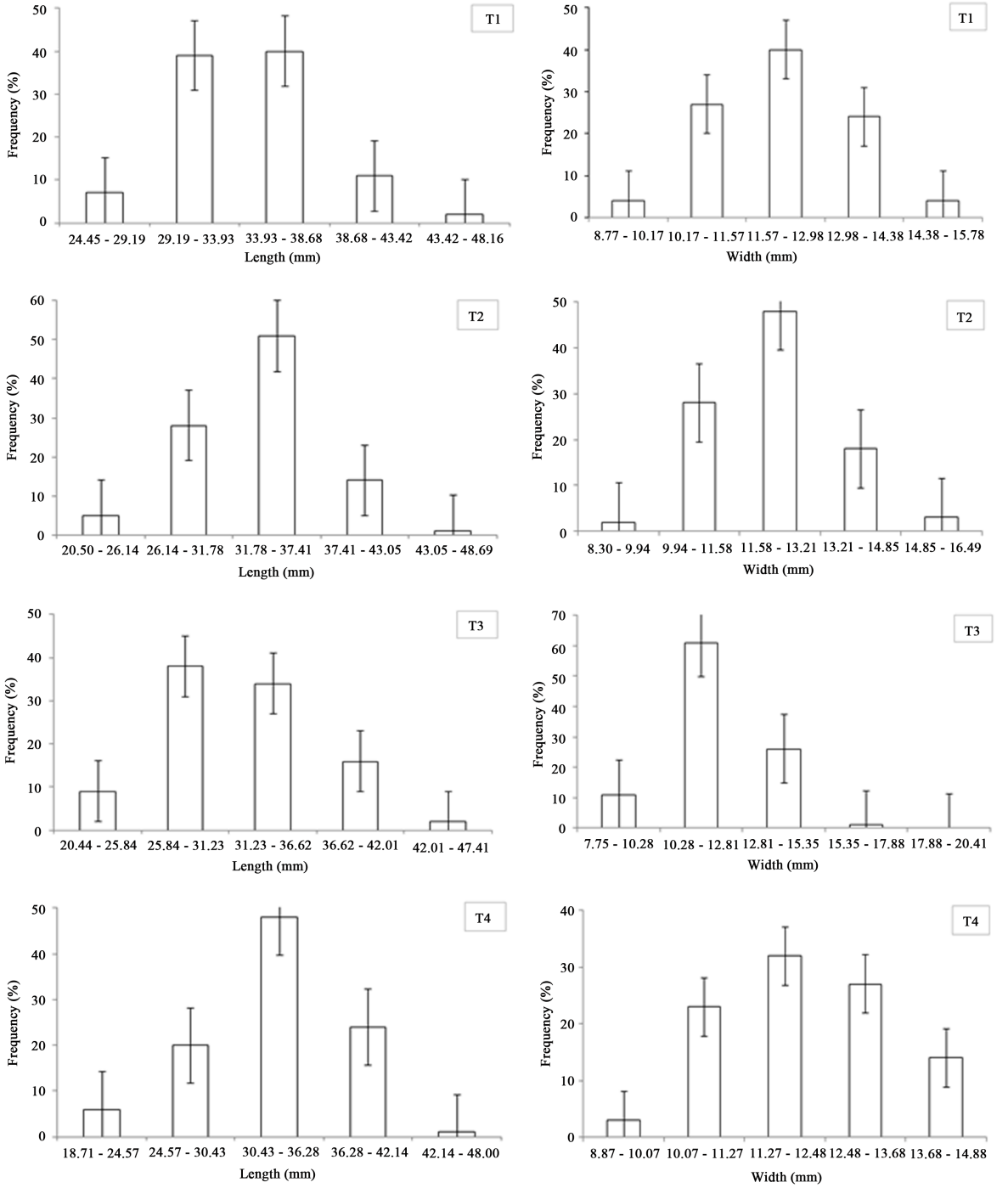

Figure 1. Distribution rate (%) on the length and width of peanut seeds from treatments 1, 2, 3 and 4 (UFRPE/UAG, 2014). $\mathbf{T_1}$ seeds derived from the absolute control; $\mathbf{T_2}$ seeds from the crop with PK; $\mathbf{T_3}$ seeds from the crop with application of (Ca + B) via seed and $\mathbf{T_4}$ seeds from the crop with application of (Mo + P) via seeds.

In germination percentage of abnormal seeds (GERAN) and germination of peanut seeds (GER) (**Table 2**), it appears that Mo + P in GERAN and Stimulate® in GER with the application forms (seed and foliar) provided higher results were not statistically different from each other. These data show that seeds from plants sprayed with nutrients and Stimulate® were not influenced on how to apply the products. [27] states that the physiological potential of peanut seeds was evaluated by means of the germination test, was not influenced by the form of nutrient

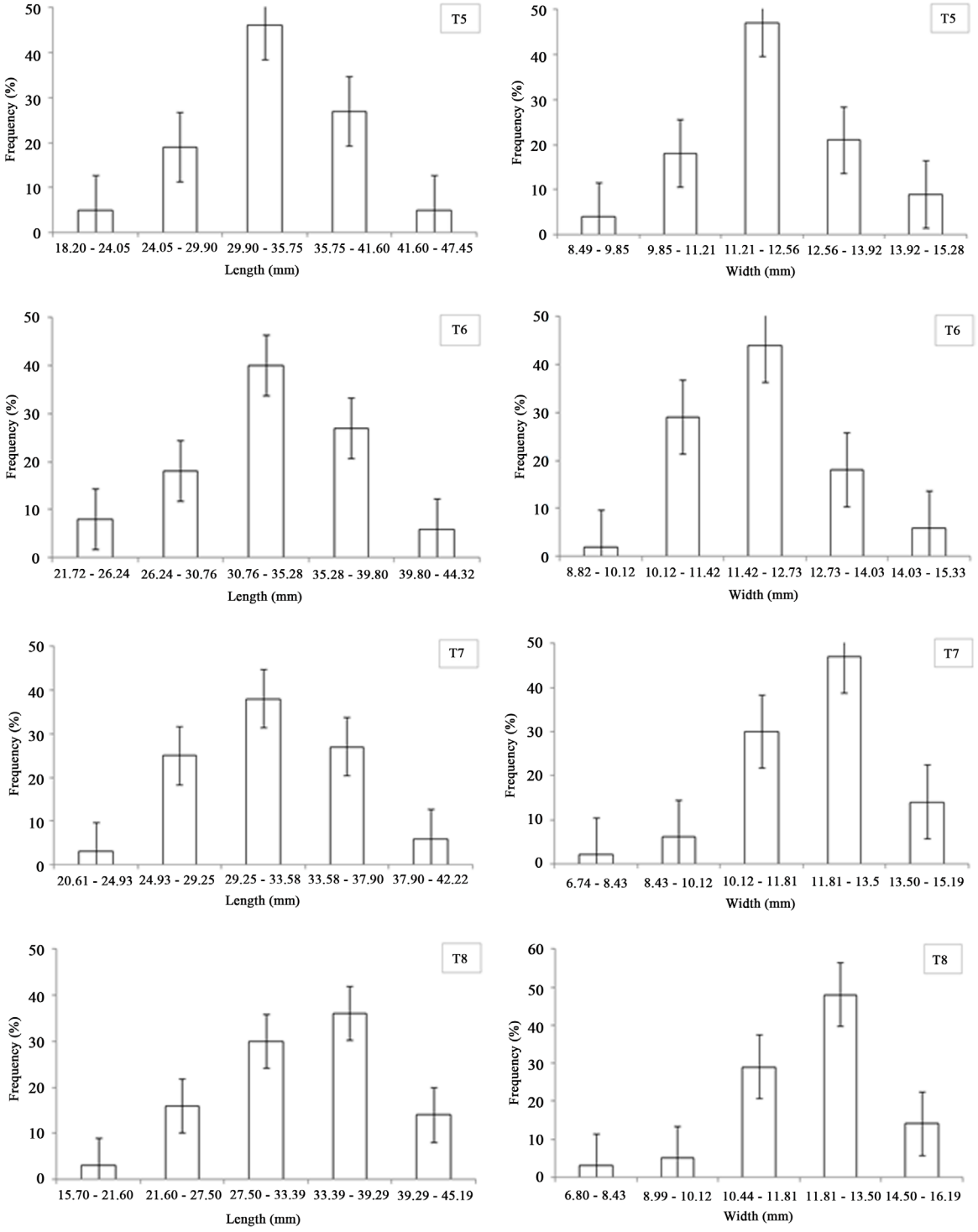

Figure 2. Distribution of the frequency of the relative length and width of peanut seed treatments 5, 6, 7 and 8 (UFRPE/UAG, 2014). $\mathbf{T_5}$ seeds from the crop with application of (Ca + B) foliar; $\mathbf{T_6}$ seeds from the crop with application of (Mo + P) foliar; $\mathbf{T_7}$ seeds from the crop to Stimulate® application via seed and $\mathbf{T_8}$ seeds harvested the crop with application of foliar Stimulate®.

application. With regard to the emergence of abnormal and normal seedlings was observed that there was no significant difference between treatments (**Table 2**).

For the number of dead seeds, deriving values of the Mo + P are superior both in germination as the emergence

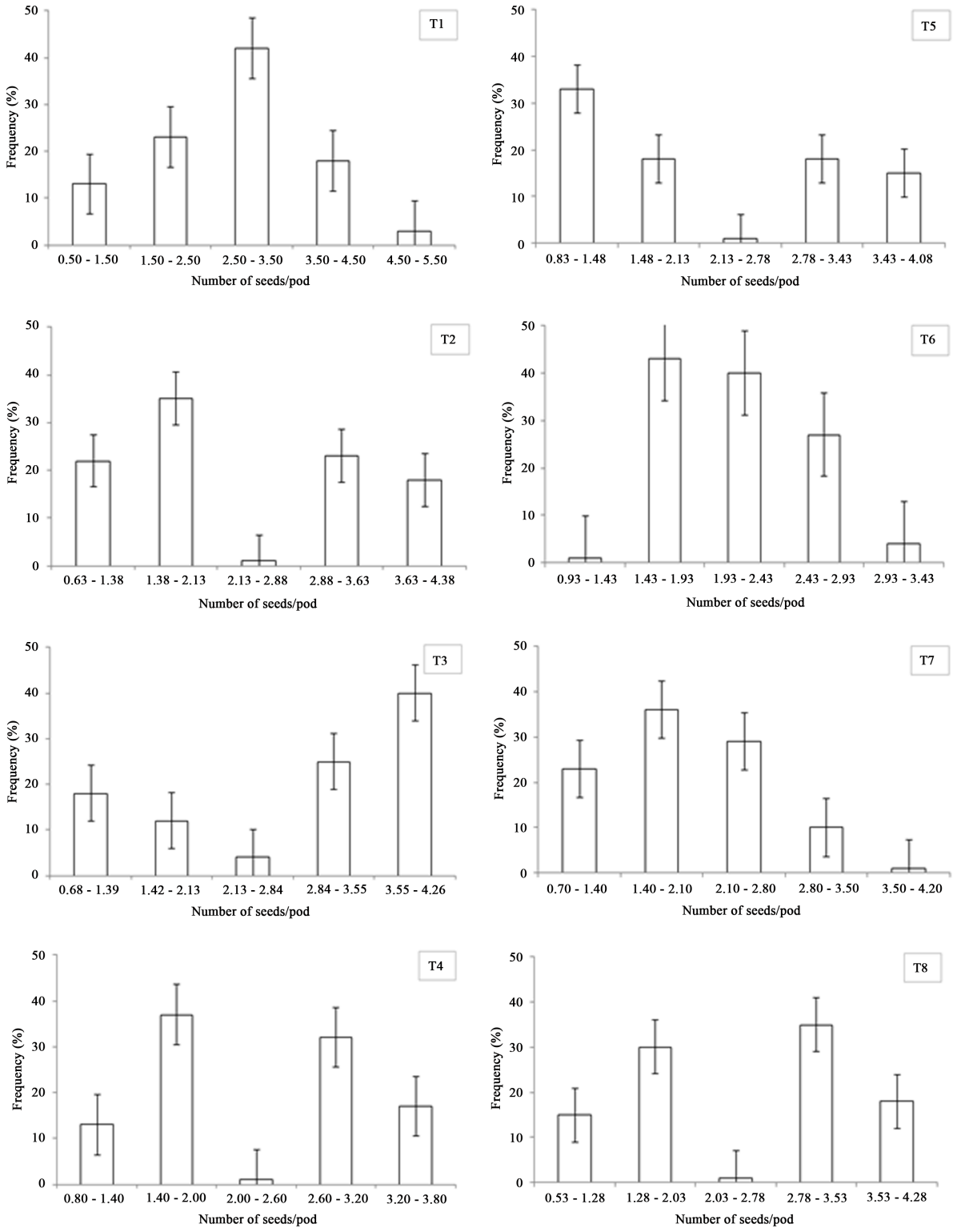

Figure 3. Distribution of the relative frequency of the number of seeds/pod peanut treatments 1, 2, 3, 4, 5, 6, 7 and 8 (UFRPE/UAG, 2014). $\mathbf{T_1}$ seeds from the absolute control; $\mathbf{T_2}$ seeds harvested the crop with PK; $\mathbf{T_3}$ seeds from the crop with application of (Ca + B) via seed and $\mathbf{T_4}$ seeds from the crop with application of (Mo + P) via seeds; $\mathbf{T_5}$ seeds from the crop with application of (Ca + B) foliar; $\mathbf{T_6}$ seeds from the crop with application of (Mo + P) foliar; $\mathbf{T_7}$ seeds from the crop to Stimulate® application via seed and $\mathbf{T_8}$ seeds from the crop by applying Stimulate® foliar.

Table 2. First count of germination (PCG), first count of seedling emergence (PCE), abnormal germination of seeds (GERAN), seed germination (GER), emergence of abnormal seedlings (EMERAN) and emergence (EMER) come from peanut plants and seeds under the influence of fertilization and bio-stimulant (UFRPE/UAG, 2014).

TREATMENTS	PCG (%)		GERAN (%)		GER (%)	
	Seeds via	Foliar	Seeds via	Foliar	Seeds via	Foliar
Ca + B	64 bA	76 aA	10 abA	8 abA	84 aA	78 bA
Mo + P	53 bA	53 bA	12 aA	12 aA	71 bA	70 bA
Stimulate®	82 aA	87 aA	5 bA	4 bA	86 aA	90 aA
	PCE (%)		**EMERAN (%)**		**EMER (%)**	
	Seeds via	Foliar	Seeds via	Foliar	Seeds via	Foliar
Ca + B	55 bA	32 bB	3 aA	3 aA	92 aA	94 aA
Mo + P	20 cB	61 aA	2 aA	2 aA	95 aA	97 aA
Stimulate®	70 aA	79 aA	3 aA	2 aA	96 aA	95 aA

Means followed by the same uppercase and lowercase on the line in the column do not differ significantly by the Tukey test at 5% probability.

(**Table 3**) were not statistically different from each other. This probably occurred because of the seeds derived from the application via both seeds and leaf possess a reduced physiological quality when compared with the others (**Table 3**). In regards to the speed of germination index (IVG) and emergency (IVE), there were higher rates of using Stimulate® in seeds from plants and seeds under different managements, not diverging from each other statistically. Therefore, regulators in the formulation of Stimulate® (auxin, cytokinin and gibberellin) favored the speed of germination and early seedling development [23], justifying its use in seeds before sowing and foliar. According to [28], the germination rate is a good index for evaluating the development of plants as it enables rapid germination advantage over weeds.

Data from first germination of seeds (PCG), germination of seeds that gave rise to abnormal seedlings (GERAN), germination (GER), dead seeds (SEMOR) and germination speed index (IVG) of peanut seeds coming and plant seeds under the influence of biostimulant fertilizer and are presented in **Table 4**. It was observed that there was no statistical difference when comparing treatments with absolute control for PCG and GER. Already as concerns GERAN, SEMOR and IVG (Mo + P via seed and leaf), showed no significant differences. This can be explained by [24] who reported that the application of plant nutrients in peanut seeds originate with increases in the percentage of germination for contributing in metabolic and morphogenetic processes that promote the transformation of an embryo into a seedling.

When the treatment was compared with cultivation with s PK (**Table 4**) yielded significance for GER (except for Mo + P foliar) and IVG (except for Mo + P via seed and leaf). The peanut seeds from the plants and seeds subjected to the products have a higher physiological quality in relation to the absolute control and cultivation with PK. Some studies have shown that peanut seeds from plants that grow with greater availability of nutrients, maintaining high germination percentage and [29] [30] work in order to verify the effect of nutrients on seed quality. [31] investigated the action of these not on the quality of soybean seeds. However, [19] studied the physiological seed quality of soybean due to fertilization with phosphorus, molybdenum, and cobalt expose the nutrients to provide increases in seed germination and seedling emergence.

The detected differences were significant between treatments in relation to the control treatment (**Table 5**), to the emergence first count (PCE), emergency (EMER) (except Ca + B foliar) and emergence speed index (IVE). When faced with cultivation with PK (**Table 5**) there was a significant difference only for the variable IVE but Ca + B via seed and leaf and Mo + P in seeds. In general, seeds of plants resulting enriched with nutritive substances cause changes in the performance of certain enzymes involved in the biochemical processes of germination and emergence [32], thus promoting a possible increase in the reservation content as occurred in [33] where the high percentage of peanut seed germination was related to the reservation of the seed itself.

Assessing the effect of nutrients on the quality of soybean seeds, [34] observed that the treatments did not affect the percentage of emergency and abnormal seedlings. [35] investigating the effect of Stimulate® in sunflower

Table 3. Dead seeds germination (SEMORTGER) and emergency (SEMORTEMER), germination speed index (IVG) and emergency (IVE) of peanut seeds derived from plants and seeds under the influence of fertilization and bio-stimulant (UFRPE/UAG, 2014).

TREATMENTS	SEMORTGER		SEMORTEMER	
	Seeds via	Foliar	Seeds via	Foliar
Ca + B	3 bA	12 aA	3 cB	12 bA
Mo + P	16 aA	17 aA	25 aA	17 aA
Stimulate®	15 aB	9 aB	16 bA	9 bB
	IVG		**IVE**	
	Seeds via	Foliar	Seeds via	Foliar
Ca + B	4.116 bA	4.240 bA	4.879 bA	4.490 Ba
Mo + P	2.933 cA	2.816 cA	4.736 bB	6.801 aA
Stimulate®	6.040 aA	5.962 aA	7.011 aA	6.759 aA

Means followed by the same uppercase and lowercase on the line in the column do not differ significantly by the Tukey test at 5% probability.

Table 4. First seed germination count (PC), seed germination giving rise to abnormal seedlings (GERAN) and normal (GERN), dead seeds (SEMOR) and germination speed index (IVG) of peanut seeds from plants and seeds under the influence of fertilization and growth promoter compared with the control treatment and cultivation with PK (UFRPE/UAG, 2014).

TREATMENTS	ABSOLUTE WITNESS				
	PCG (%)	GERAN (%)	GER (%)	SEMOR (%)	IVG
Ca + B via sementes	33^{*}	-19.5^{NS}	31^{*}	-11.5^{NS}	1.483^{*}
Ca + B via sementes	45^{*}	-21^{NS}	22^{*}	-2.25^{NS}	1.607^{*}
Mo + P via sementes	22.5^{*}	-17.5^{NS}	15.5^{*}	2^{NS}	0.300^{NS}
Mo + P via foliar	22^{*}	-17^{NS}	14.5^{*}	2.5^{NS}	0.183^{NS}
Stimulate® via sementes	51^{*}	-24.5^{NS}	30^{*}	10.5^{NS}	3.407^{*}
Stimulate® via foliar	56^{*}	-25.25^{NS}	34^{*}	5.7^{NS}	3.329^{*}
	GROWING WITH PK				
	PCG (%)	GERAN (%)	GER (%)	SEMOR (%)	IVG
Ca + B via sementes	5^{NS}	2.5^{NS}	28^{*}	-30.5^{NS}	1.241^{*}
Ca + B via sementes	17^{NS}	1^{NS}	19^{*}	-21.25^{NS}	1.365^{*}
Mo + P via sementes	-5.5^{NS}	4.5^{NS}	12.5^{*}	-17^{NS}	0.058^{NS}
Mo + P via foliar	-6^{NS}	5^{NS}	11.5^{NS}	-16.5^{NS}	-0.058^{NS}
Stimulate® via sementes	23^{NS}	-2.5^{NS}	27^{*}	-8.5^{NS}	3.165^{*}
Stimulate® via foliar	28^{NS}	-3.25^{NS}	31^{*}	-24.75^{NS}	3.087^{*}

*Significant Witness, by Dunnett's test, at the 5% level of probability; ^{NS}: Not Significant, by Dunnett's test, at the 5% level of probability.

Table 5. First emergency count (PCE), emergency abnormal seedlings (EMERAN), emergency (EMER), dead seeds (SEMOR) and emergence speed index (IVE) of peanut seedlings derived from plants and seeds under the influence of fertilizer and bio-stimulant with absolute control and cultivation with PK (UFRPE/UAG, 2014).

TREATMENTS	ABSOLUTE WITNESS				
	PCE (%)	EMERAN (%)	EMER (%)	SEMOR (%)	IVE
Ca + B via Seeds	38.75*	−6.25NS	6.75*	−0.5NS	1.317*
Ca + B via Seeds	16*	−6.25NS	−1.25NS	7.5NS	0.928*
Mo + P via Seeds	4*	−7.25NS	9.5*	−2.25NS	1.174*
Mo + P foliar	45.25*	−6.75NS	12.25*	−5.5NS	3.239*
Stimulate® via Seeds	55*	−6NS	10.75*	−4.75NS	3.448*
Stimulate® foliar	43*	−7NS	9.75*	−2.75NS	3.196*
	GROWING WITH PK				
	PCE (%)	EMERAN (%)	EMER (%)	SEMOR (%)	IVE
Ca + B via Seeds	−5.25NS	−1.75NS	−1.5NS	3.5NS	−0.407NS
Ca + B via Seeds	−28NS	−1.75NS	−9.5NS	1.75NS	−0.796NS
Mo + P via Seeds	−40NS	−2.75NS	1.25NS	1.75NS	−0.550NS
Mo + P foliar	1.25NS	−2.25NS	4NS	−1.5NS	1.514*
Stimulate® via Seeds	11NS	−1.5NS	2.5NS	−0.75NS	1.724*
Stimulate® foliar	−1NS	−2.5NS	1.5NS	1.25NS	1.472*

*Significant Witness, by Dunnett's test, at the 5% level of probability; NS: Not Significant, by Dunnett's test, at the 5% level of probability.

(*Helianthus annus* L.) found that it enhances seed germination, seedling stems stronger and reduces the percentage of abnormal seedlings.

There was no statistical difference in the moisture content of peanut seeds (**Table 6**) when comparing treatments with absolute control and cultivation with PK. This parameter was similar to those used treatments did not differ statistically between themselves, ranging up to 0.5 percentage points less than the maximum amplitude accept that is 1 - 2 percentage points [8]. This is important for the tests, for there must be uniformity of the initial moisture content of the seeds to obtain reliable results.

Studying the physical and physiological quality of peanut seeds submitted to doses of gypsum, [36] attested that the seed moisture content with little variation between treatments should not be responsible for the differences found between the parameters evaluated in an experiment, similar to what happened in this work.

Electrical conductivity (**Table 6**), emphasizes that the observed values within each treatment were statistically different for Ca + B via seeds, Mo + P in seeds and leaf and Stimulate® foliar compared to the control treatment and the cultivation with PK. Notwithstanding the findings of [21] and [36] that assessed the application of nutrients such as phosphorus and calcium in peanut plant improved seed quality.

Peanut seeds from plants that received Ca + B via seeds and Mo + P foliar (**Table 7**) lead to the highest electrical conductivity values did not differ statistically from one another, suggesting greater leaching of ions, therefore, it is inferred such seeds are less physiological, since poorly structured and damaged cells membranes are generally associated with the seed deterioration process, affecting the force [15].

Working with peanut seeds [15] and [37] with soy, revealed that the EC test is interesting for a more dynamic quality control program and effective, a fact that helped to evaluate this research.

4. Conclusions

The application of Ca + B, Mo + P and Stimulate® foliar and seeds in peanut and increases the germination of

Table 6. Water content/seeds (%) and electrical conductivity ($\mu S \cdot cm \cdot^{-1} \cdot g^{-1}$) peanut seeds produced by plants and seeds under the influence of fertilization and growth promoter compared with the control treatment and cultivation with PK (UFRPE/UAG, 2014).

TREATMENTS	ABSOLUTE WITNESS	
	MOISTURE CONTENT/SEED (%)	ELECTRICAL CONDUCTIVITY ($\mu S \cdot cm \cdot^{-1} \cdot g^{-1}$)
Ca + B via seeds	-0.36^{NS}	4.90^{*}
Ca + B via seeds	-1.68^{NS}	-0.49^{NS}
Mo + P via seeds	0.23^{NS}	0.40^{*}
Mo + P foliar	0.31^{NS}	3.67^{*}
Stimulate® via seeds	1.28^{NS}	-1.38^{NS}
Stimulate® foliar	-0.38^{NS}	2.18^{*}
	GROWING WITH PK	
	MOISTURE CONTENT/SEED (%)	ELECTRICAL CONDUCTIVITY ($\mu S \cdot cm \cdot^{-1} \cdot g^{-1}$)
Ca + B via seeds	1.33^{NS}	5.99^{*}
Ca + B via seeds	0.01^{NS}	0.59^{NS}
Mo + P via seeds	1.94^{NS}	1.49^{*}
Mo + P foliar	2.02^{NS}	4.77^{*}
Stimulate® via seeds	2.98^{NS}	-0.29^{NS}
Stimulate® foliar	1.31^{NS}	3.27^{*}

*Significant Witness, by Dunnett's test, at the 5% level of probability; ^{NS}: Not Significant, by Dunnett's test, at the 5% level of probability.

Table 7. Water content/seeds (%) and electrical conductivity ($\mu S \cdot cm^{-1} \cdot g^{-1}$) peanut seeds produced by plants and seeds under the influence of fertilization and growth promoter (UFRPE/UAG, 2014).

TREATMENTS	MOISTURE CONTENT/SEEDS (%)		ELECTRICAL CONDUCTIVITY ($\mu S \cdot cm \cdot^{-1} \cdot g^{-1}$)	
	Via Seeds	Foliar	Via Seeds	Via Foliar
Ca + B	10.80 aA	10.89 aA	16.96 aA	11.56 cB
Mo + P	10.40 aA	10.27 aA	12.45 bB	15.73 aA
Stimulate®	10.45 aA	10.56 aA	10.66 cB	14.24 bA

Means followed by the same capital letter in line and tiny column do not differ significantly by the Tukey test at 5% probability.

seeds produced, originates more vigorous seedlings and reduces the percentage of abnormal seedlings.

The weight and size of peanut seeds did not affect the germination and vigor.

References

[1] Tasso Júnior, L.C., Marques, M.O. and Nogueira, G.A.L. (2004) A Cultura do amendoim. UNESP, Jaboticabal, 218 p.

[2] Companhia Nacional de Abastecimento (2012) Acompanhamento de safra brasileira: grãos, oitavo levantamento. Companhia Nacional de Abastecimento, Brasília-DF.

[3] Barbosa, C.A. (2008) Manual da cultura do amendoim. Agrojuris, Viçosa, 140 p.

[4] Oliveira, I.R., Lemos, H.W.De C., Milani, M., Leite, M.S., Sousa, C.R. and Marisa, V.M.M. (2010) Comportamento de genótipos de mamoeira em consórcio com o feijoeiro comum na zona agreste do estado de Sergipe, congresso brasileiro de mamona, 4 & simpósio internacional de oleaginosas energéticas, João Pessoa. Inclusão Social e Energia: Anais. Embrapa Algodão, Campina Grande, 1763-1767.

[5] Wander, A.E. (2005) Introdução e importância econômica. In**:** Cobucci, T. and Biava, M., Eds., *Cultivo do feijão*

irrigado na região noroeste de Minas Gerais, Embrapa Arroz e Feijão, Santo Antônio do Goiás, Embrapa Arroz e Feijão. Sistemas de Produção, 5.

[6] Golo, A.L., Kappes, C., Carvalho, M.A.C. and Yamashita, O.M. (2009) Qualidade das sementes de soja com a aplicação de diferentes doses de molibdênio e cobalto. *Revista Brasileira de Sementes*, **31**, 40-49. http://dx.doi.org/10.1590/S0101-31222009000100005

[7] Abreu, A.F.B. (2005) Produção de sementes. In: Abreu, A.F.B. and Biava, M., Eds., *Cultivo do feijão da primeira e segunda safras na região sul de Minas Gerais*, Embrapa Arroz e Feijão, Santo Antônio do Goiás. Embrapa Arroz e Feijão. Sistemas de Produção.

[8] Marcos Filho, J. (2005) Fisiologia de sementes de plantas cultivadas. FEALQ, Piracicaba, 495 p.

[9] Vieira, E.H.N. and Rava, C.A. (2000) Características botânicas e fisiológicas das sementes. In: Vieira, E.H.N. and Rava, C.A., Eds., *Sementes de feijão***:** *Produção e Tecnologia*, Embrapa Arroz e Feijão, Santo Antonio de Goiás, 25-38.

[10] Carvalho, N.M. and Nakagawa, J. (2012) Sementes: Ciência, tecnologia e produção. FUNEP, Jaboticabal, 590 p.

[11] Teixeira, I.R., Borém, A., Araújo, G.A.A. and Andrade, M.J.B. (2005) Teores de nutrientes e qualidade fisiológica de sementes de feijão em resposta a adubação foliar com manganês e zinco. *Bragantia*, **64**, 83-88. http://dx.doi.org/10.1590/S0006-87052005000100009

[12] Jacob Neto, J. and Rossetto, C.A.V. (1998) Concentração de nutrientes nas sementes: o papel do molibdênio. *Floresta e Ambiente*, **5**, 171-183.

[13] Brasil (2009) Regras para Análise de Sementes. Ministério da Agricultura e Reforma Agrária. SNDA/DNPV/CLAV, *Brasília*, **2**, 365.

[14] Maguire, J.D. (1962) Speed of Germination-Aid in Selection and Evaluation for Seedling Emergence and Vigor. *Crop Science*, **2**, 176-177. http://dx.doi.org/10.2135/cropsci1962.0011183X000200020033x

[15] Vanzolini, S. and Nakagawa, J. (2005) Teste de condutividade elétrica em sementes de amendoim. *Revista Brasileira de Sementes*, **27**, 151-158. http://dx.doi.org/10.1590/S0101-31222005000200022

[16] SAEG—Sistema para Análises Estatísticas, Versão 9.1. (2007) Fundação Arthur Bernardes—UFV, Viçosa.

[17] Feitosa, C.T., Nogueira, S.S.S., Gerin, M.A.N. and Rodrigues Filho, F.S.O. (1993) Avaliação do crescimento e da utilização de nutrientes pelo amendoim. *Scientia Agricola*, **3**, 427-437. http://dx.doi.org/10.1590/s0103-90161993000300015

[18] Vieira, E.L. and Castro, P.R.C. (2002) Ação de estimulante no desenvolvimento inicial de plantasde algodoeiro (*Gossypium hirsutum* L.). USP. Departamento Ciências Biológicas, Piracicaba, 3 p.

[19] Guerra, C.A., Marchetti, M.E., Robaina, A.D., Souza, L.C.F., Gonçalves, M.C. and Novelino, J.O. (2006) Qualidade fisiológica de sementes de soja em função da adubação com fósforo, molibdênio e cobalto. *Acta Scientiarum Agronomy*, **28**, 91-97.

[20] Queiroga, V.P., Freire, R.M.M., Araújo, M.E.R., Lima, V.I. and Queiroga, D.A.N. (2011) Influência do tamanho da semente de amendoim sobre sua qualidade fisiológica. *Revista Agro@mbiente*, **5**, 30-34.

[21] Marubayashi, O.M., Rosolem, C.A., Nakagawa, J. and Zan Duo, M.O. (1997) Adubação Fosfatada, Produção e qualidade de sementes de populações de amendoim. *Pesquisa Agropecuária Brasileira*, **32**, 885-892.

[22] Crookston, R.K. and Hill, D.S.A. (1978) Visual Indicator of the Physiological Maturity of Soybean Seed. *Crop Science*, **18**, 867-870. http://dx.doi.org/10.2135/cropsci1978.0011183X001800050048x

[23] Silva, M.P., Sá, M.E., Berti, C.L.F., Santos, P.C., Abrantes, F.L. and Souza, L.C.D. (2009) Doses de cálcio e molibdênio via sementes e calcário via solo na produção de sementes de amendoim. *Revista Trópica—Ciências Agrárias e Biológicas*, **3**, 42.

[24] Silva, A.C., Costa, D.S., Barbosa, R.M. and Lazarini, E. (2012) Cobalto e molibdênio via foliar em amendoim: características agronômicas da produção e potencial fisiológico das sementes. *Revista Biotemas*, **25**, 9-15. http://dx.doi.org/10.5007/2175-7925.2012v25n2p9

[25] Melo Filho, P.A., Gondim, T.M.S., Lemos, S., Vasconcelos, R.A. and Santos, R.C. (2010) Produtividade de vagens e sementes de amendoim ereto em Barbalha, CE. Congresso Brasileiro de Mamona, 4 & Simpósio Internacional de Oleaginosas Energéticas, João Pessoa. Inclusão Social e Energia: Anais. Embrapa Algodão, Campina Grande, 1760-1763.

[26] Nakagawa, J. (1999) Testes de vigor baseados no desempenho das plântulas. ABRATES, Londrina, 1-24.

[27] Possenti, J.C. (2007) Qualidade fisiológica de sementes de amendoim enriquecidas com molibdênio. Tese de Doutorado, Faculdade de Agronomia "Eliseu Maciel", Universidade Federal de Pelotas, Pelotas, 51 p.

[28] Santos, C.A.C., Peixoto, C.P., Vieira, E.L., Carvalho, E.V. and Peixoto, V.A.B. (2013) Stimulate® na germinação de

sementes, emergência e vigor de plântulas de girassol. *Bioscience Jounal*, **29**, 605-616.

[29] Ferreira, A.G. and Borghetti, F. (2004) Germinação: Do básico ao aplicado. Artmed, Porto Alegre, 323.

[30] Rossetto, C.A.V. (1993) Efeitos da colheita e da calagem na produção e qualidade de sementes de amendoim (*Arachis hypogaea* L.). Dissertação de Mestrado, UNESP, Botucatu, 114 p.

[31] Silva, M.P., Sá, M.E., Abrantes, F.L.A. and Souza, L.C.D. (2012) Influência do molibdênio e do cálcio aplicados via semente nas frações protéicas de amendoim cv.iac 886. *Semina*: *Ciências Agrárias*, **33**, 2099-2108. http://dx.doi.org/10.5433/1679-0359.2012v33n6p2099

[32] Golo, A.L., Kappes, C., Carvalho, M.A.C. and Yamashita, O.M. (2009) Qualidade das sementes de soja com a aplicação de diferentes doses de molibdênio e cobalto. *Revista Brasileira de Sementes*, **31**, 40-49. http://dx.doi.org/10.1590/S0101-31222009000100005

[33] Malavolta, E. (2006) Manual de nutrição mineral de plantas. Editora Agronômica Ceres, São Paulo, 638 p.

[34] Mantovani, J.P.M., Calonego, J.C. and Foloni, J.S.S. (2013) Adubação foliar de boro em diferentes estádios fenológicos da cultura do amendoim. *Revista Ceres*, **60**, 270-278. http://dx.doi.org/10.1590/S0034-737X2013000200017

[35] Ambosano, E.J., Ambrosano, G.M.B., Wutke, E.B., Bulisani, E.A., Martins, A.L.M. and Silveira, L.C.P. (1999) Efeitos da adubação nitrogenada e com micronutrientes na qualidade de sementes do feijoeiro cultivar IAC—Carioca. *Bragantina*, **58**, 393-399.

[36] Perin, A., Marinho, J.G.G. and Grandi, M.T. (2003) Cobertura do solo e acumulação de nutrientes pelo amendoim forrageiro. *Pesquisa Agropecuária Brasileira*, **38**, 791-796. http://dx.doi.org/10.1590/S0100-204X2003000700002

[37] Pinola, M.C.M. and Cicero, S.M. (2002) Qualidades física e fisiológica de sementes de amendoim submetidas a doses de gesso agrícola combinadas a épocas e modos de aplicação: Área sem calagem. *Revista Brasileira de Sementes*, **24**, 229-236.