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RESPONSE OF PEANUT GENOTYPES TO THREE DENSITY PLANTING AND PRESENT DISEASES AT QUEVEDO, ECUADOR

Respuesta de genotipos de maní a tres densidades de siembra y presencia de enfermedades en Quevedo, Ecuador

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ABSTRACT. The aim of this study was to determine the effect of seeding density on sanitary and agronomic characteristics of promising peanut genotypes, in Quevedo, Ecuador. The following promising peanut lines were used: CB-02, CB-16 and CB-23, Runner type, with a standard distance of 0,50 m between rows and 3,6; 5 and 10 plants m^{-1} for each cultivar. The disease intensity of leaf spot and rust were determined, furthermore, agronomic variables such as plant height, number of pods and seeds, pod weight per plant, weight of 1000 seeds, weight of pods per parcel and pod yield (kg ha^{-1}). The experiment was carried on a Completely Randomized Block design with 9 treatments and four replications, using a factorial arrangement 3 (lines) x 3 (plants m^{-1}). Tukey's test at 5% of significance level was used for separation of means. The smallest number of leaf spot and rust lesions was observed on the peanut line CB-23. On the one hand, at plant densities of 3,6 and 5 plants m^{-1} lead to the highest number of pods per plant (321,83 and 286,50 respectively). On the other hand, the highest plant height (47,24 cm), weight of pods per parcel (2,00 kg) and pod yield (1809,42 kg ha^{-1}) were observed at 10 plants m^{-1}. The interaction between factors was significant for the following variables: number of seeds per plant ($p<0,05$) and yield ($p<0,01$), showing the dependence between the analyzed factors.

Key words: *Arachis hypogaea*, seed density, leaf spot, rust, yield

RESUMEN. El objetivo del estudio fue determinar el efecto de la densidad de siembra en las características fitosanitarias y agronómicas de genotipos promisorios de maní, en Quevedo, Ecuador. Se utilizaron las líneas promisorias de maní CB-02, CB-16 y CB-23, tipo Runner, con distanciamiento estándar de 0,50 m entre hileras y una población de 3,6; 5 y 10 plantas m^{-1} para cada cultivar. Se cuantificó la intensidad de cercosporiosis y roya, así también las variables agronómicas altura de la planta, número de frutos y de semillas, peso de frutos por planta de 1000 semillas, frutos por parcela, y rendimiento de frutos (kg ha^{-1}). Fue empleado un Diseño de Bloques Completos al Azar con nueve tratamientos y cuatro réplicas, con arreglo factorial 3 (líneas) x 3 (plantas m^{-1}). Para la comparación entre las medias de los tratamientos se empleó la prueba de Tukey al 5 % de probabilidad del error. La línea de maní CB-23 obtuvo menor número de lesiones para cercosporiosis y roya. Con 3,6 y 5 plantas m^{-1} fue obtenido el mayor número de frutos por planta (321,83 y 286,50, respectivamente), y con 10 plantas m^{-1}, la mayor altura de planta (47,24 cm), peso de frutos por parcela (2,00 kg) y rendimiento de frutos (1809,42 kg ha^{-1}). Se observó interacciones entre los factores, solamente para el número de frutos por planta ($p<0,05$) y para el rendimiento ($p<0,01$), mostrando dependencias entre ellos.

Palabras clave: *Arachis hypogaea*, densidad de plantas, cercosporiosis, roya, rendimiento

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INTRODUCTION

Peanut (*Arachis hypogaea* L.) is grown all over the world, from the tropics to template areas mainly as an oil producing crop (1), being economically valuable, reason for which it is extensively grown worldwide (2). Peanut contributes to human nutrition for its high oil and protein contents (3). Some therapeutic effects have also been reported by using extracts from peanut seeds (4).

In Ecuador, the peanut grain is very important for domestic consumption since it is used to produce simple products (peanut paste) or elaborated ones (confectionery, toasted peanut and chocolates). It is also used in most houses of the Ecuadorian Coast to prepare certain meals (5). The main peanut growing provinces in Ecuador are Manabí, Los Ríos and Guayas.

At the central region of the coast, peanut is grown by a few growers that mostly grow varieties acquired to be established in other areas of the Ecuadorian Coast, so the sanitary and agronomical potential of this genetic material is not the highest one. For this reason, the Technical State University of Quevedo - UTEQ through the Scientific Research and Technological Board - DICYT, has been working in the selection of a variety with ideal sanitary and agronomical features for the central part of the Ecuador Coas; some promising materials have been selected so far. Likewise, in this region of the country there is not information on peanut growing.

In the planting season, plant population per hectare directly interferes with peanut growing since it is determined by the spacing used (6). In general, productivity grows up as plant population increases, till reaching a point in which competition for light, nutrients, and water start limiting plant development and therefore, commercial yields (7). At present there are no investigations on the planting density effect on diseases, just on weeds conducted in other latitudes (8, 9). The fact of not having information on the ideal spacing for the promisory materials from UTEQ, the objective of this research has been determining the effect of planting density on the sanitary and agronomical characteristics of three peanut promising lines in Quevedo, Los Ríos, Ecuador.

MATERIALS AND METHODS

Location of the experiment

This research was conducted in the dry period, from July to December 2011, at the Experimental Farm "La María", property of UTEQ, located at the km 7,5 road to Quevedo – El Empalme, whose geographical coordinates are 79° 30´ 08´´ of West longitude and 01° 00´ 35´´ South latitude. The conditions of the place where the following: climatic area [Tropical humid forest (bh-T)], average temperature 24,2°C, relative humidity 77,4 %, photoperiod of 823 light hours per year, annual rainfall 1,537 mm, flat topography, soil texture franc clay and pH de 5,7.

Management of the experiment

Soil preparation consisted in one pass of rotative harrows and two of rake harrow three days before planting. Seeds were previously disinfected with 2,3-dihidro-2,2-dimethyl 7 benzofuranilmethylcarbamate at rates of 5 g per each 500 g of seeds. Planting was made manually on July 21st 2011 using a handspike, placing seeds per hole (thinning was practiced later). It is good to mention that the previous crop in that area was corn. The promising peanut lines CB-02, CB-16 and CB-23, Runner type were used; they were taken from a selection of lines introduced from Colombia. Spacing used was 0,050 m between rows and 0,10 between plants (10 plants/linear meter or 200 000 plants ha^{-1}), 0,20 (5 plants/ linear meter or 100 000 plants ha^{-1}) and 0,30 m (3,6 plants/ linear meter or 72 000 plants ha^{-1}) for each of the promising lines. The experimental area has 36 plots, each of them with 7,5 m^2, made up of four rows, totalizing 494,5 m^2. Fertilization was splitted in two stages, after 19 (09/08/2011) and 29 (19/08/2011) days of planting (DDS), using a source of N, P, and K, in a relation of 30-60-30, at rates of 150 kg ha^{-1}, and the second one using a N source at 46 % at rates of 100 kg ha^{-1}, at a distance of 5 cm from the plant with the help of a handspike. For weed control, two herbicides were applied, pendimetaline and glyphosate at the rates of 1,5 L ha^{-1} each, in pre-emergence, backing it up with four hand weeding.

Pest control included the use of insecticides like lambdacihalotrine (0,2 L ha^{-1}), metomil (0,5 kg ha^{-1}) and pyriclor (0,5 L ha^{-1}). Three sprinkling irrigations were applied to compensate the water needs of the crop; the first one was 8 days after planting and the other two when necessary. Harvest was done on December 7th (139 days after planting).

Meteorological data were made available by the Meteorology Division, Department of Sinoptic from the Autonomous Institute of Agricultural Research (INIAP), Quevedo[A]. During the crop cycle, sanitary and agronomical evaluated variables were described as follows:

Evaluation of cercosporiose and rust

In order to determine the intensity of foliar diseases, the natural pressure of the inoculum generated by pathogens was used.

[A] Instituto Nacional de Investigaciones Agropecuarias, Estación Experimental Tropical Pichilingue. *Datos meteorológicos del año 2011*, Quevedo, Los Ríos, Ecuador, 2011.

The number of lesions leaflet^{-1} of the leaf spot disease [*Cercospora arachidicola* Hori and *Cercosporidium personatum* (Berk. & Curt.) Deighton] and blisters.cm^{-2} of the rust (*Puccinia arachidis* Speg.): three cuadrifoliate, one in each stratum (lower, medium and upper) were detached from four random selected plants located in the two lateral rows of the useful plot (two central rows) of each of the treatments. Immediately, this plant material was arranged in plastic cases to take it to the Lab of Environmental and Plant Microbiology of UTEQ. Aided by a stereoscopic microscope with binocular lens of 2X magnification, the severity of the cuadrifoliate was quantified based on the number of lesions.leaflet^{-1} for leaf spot disease and the number of blisters cm^{-2} for the rust according to the methodology of Garcés-Fiallos and Forcelini (10). This activity was developed during eight weeks, from 07/10 to 25/11, and four weeks, from 03/11 to 25/11 for leaf spot disease and rust, respectively, at weekly intervals. The severity of the last date was designed as final disease variable.

Severity percentage (%) of foliar diseases in marked plants: Four plants were initially labelled (two in each row of the useful plot, that is, four per treatment) with yellow polyethilene strips at the basal part of the stem (close to soil surface). Those plants were estimated as to severity (visual evaluation of each of the marked plants, considering the diseased plant the one with ncrosis or foliar tissue death), using a subjective phytopatometry and granting a percentage value in relation to the necrosis or foliar tissue death in each of the marked plant. This activity was developed during twelve weeks, from 06/09 to 22/11, at weekly intervals. Like in the previous variable, the severity of the last date was taken for the final disease variable.

Yield and its components

Plant height. It was recorded on November 22nd, in 10 plants taken at random in each useful plot (two central rows), measuring the distance between the soil and the stem apex using a graduated rule in centimeters.

Number of pods and seeds and pods weight per plant. It was deterined after harvest, taking 10 plants at random per each useful plot, removing and counting the number of pods and seeds per plant and calculating the average later on. In these plants, pods were weighed on a digital balance and average values were expressed in grams.

Weight of 1000 seeds. Se pesaron 1000 semillas obtenidas de plantas de maní, en una balanza digital, siendo luego sus valores promedios expresados en gramos.

Pod weight per plot and pod yield (kg ha^{-1}). After harvesting all the plants of the useful plot (two central rows), all the pods were extracted and weighed on a digital balance, maintainig field moisture. To calculate pod yield, this value from each treatment was transformed into kg hectare^{-1}, adjusted at 9 % moisture. Grain moisture was calculated by a digital moisture gauge.

Statistical analysis

A Complete Random Block Design with nine treatments and four replicates was used (Table I) with a factorial arrangement of 3 (promising lines) x 3 (plants m^{-1}). For all sanitary variables of severity (lesions leaflet^{-1} and blisters cm^{-2}) of the leaf spot disease and rust as well as for severity (%) of foliar diseases in labelled plants, their averages were integralized as Area Below the Progress Curve of the Disease (AACPE):

$$\text{AACPE: } \sum_{i}^{n-1} [(yi + yi + 1)/2]\ [ti + 1 - ti]$$

Table I. Description of each of the treatments in the experiment of peanut made during the dry period of the year 2011. Farm "La María", UTEQ, Quevedo

Treatments	Cultivar	Plants/lineal meter^{-1}	Plants/hectare^{-1}
1	CB-02	3,6	72,000
2		5	100,000
3		10	200,000
4	CB-16	3,6	72,000
5		5	100,000
6		10	200,000
7	CB-23	3,6	72,000
8		5	100,000
9		10	200,000

Later on, the tests of Bartlett and Kolmogorov-Smirnov to check the homocedasticity (variances) and the normality (residues) of data, respectively were used. For means comparison of the treatments, the Tukey's Multiple Range Test was used at 5 % of error probability. The statistical data processing included the software package ASSISTAT 7.6 beta (2012).

RESULTS AND DISCUSSION

The climatic conditions prevailing during the 139 days of the crop cycle are shown in Table II. The average temperature along the crop cycle was 24,2 °C, the average relative humidity was 83,0 %, total photoperiod of 276,8 light hours and a total rainfall of 18,4 mm. Temperature is a limiting factor for peanut production, the optimum temperature for this crop is nearly 27 °C, lower temperatures at 20°C or above 30 °C reduce growth processes (11). Climatic factors did not affect crop growth, because 24,2 ºC was an average temperature and the lack of rainfall (18,4 mm) was compensated with sprinkling irrigation.

Evaluation of leaf spot disease and rust

The two most important peanut diseases worldwide are the leaf spot disease caused by *C. arachidicola* and *C. personatum* and the rust, caused by *Puccinia. arachidis* (12), both of them are present in this part of Ecuador. However, the leaf spot disease is the most intensive one with yield losses from 10 and 50 %, depending on the climate, sanitary management, and peanut genotypes (13).

As to the interaction among factors A (lines) and B (plants m^{-1}), each of the sanitary variables shown in Table IV, did not have statistical differences which confirms the independence of each of the factors (lines and plants m^{-1}).

For leaf spot disease (Table III) given by AACPD based on the number of lesions $leaflet^{-1}$ reached from 189.48 (CB-02) and 191.57 units (CB-16) for factor A (líneas), and from 183.04 (10 plants m^{-1}) and 198,62 units (5 plants $meter^{-1}$) for factor B (plants m^{-1}), not existing statistical differences for any factor. On the other hand, for final disease, values ranged from 4,29 (CB-23) and 5,08 (CB-02) lesions.$leaflet^{-1}$ for factor A (lines), and from 4,43 (3,6 plants.$meter^{1}$) and 4,64 lesions $leaflet^{-1}$ (10 plants $meter^{-1}$) for factor B (plants m^{-1}). There was statistical difference ($p<0,05$) only for factor A (lines), highlighting lines CB-16 and CB-23 for having less lesions $leaflet^{-1}$.

The average temperature of 24,2 °C recorded in this trial, was ideal for pathogens development (*C. arachidicola* y *C. personatum*), since the optimum temperature is from 24 y 26 °C during the day and from 20 and 24 °C during the night (11). The significant statistical differences for factor A (lines), where lines CB-16 (4,33) and CB-23 (4,29) stood out for having less quantity of lesions $leaflet^{-1}$, being similar to the values attained by (field experiment) for *C. arachidicola* and *C. personatum* (14) in cultivars DP-1 (4,4) (3,7) and Georganic (3,3) (3,9), the same that were statistically different to cultivar Georgia Green (8,3) (7,1). However, there is another research where 5 and 15 lesions $leaflet^{-1}$ for *C. arachidicola* and from 2 and 9 lesions $leaflet^{-1}$ for *C. personatum* in the United States of America has been reported (15).

The differences in these three experiments and the present research were possibly due to the different agroclimatic conditions in which each of the experiments were conducted.

This is also the case of rust (Table III) provided by AACPD based on the number of blisters cm^{-1} that reached from 171,41 (CB-23) and 232,79 units (CB-16) for the factor A (lines), and from 183,03 (10) and 196,77 units (5) for factor B (plants m^{-1}), existing highly statistical differences ($p<0,01$) for factor A (lines). Lines CB-02 and CB-23 stood out, with less quantity of blisters cm^{-2}, and on the other hand, without statistical differences for factor B (plants m^{-1}).

Table II. Climatic conditions prevailing during the development of the trial on spacing of peanut promising lines evaluated during the dry period of 2011. Farm "La María", UTEQ, Quevedo

Climatic conditions[1]	July	August	September	October	November	December	Time passed (139 days)[2]
Average temperature (°C)	24,0	23,2	24,2	23,8	24,6	25,3	24,2
Average relative humidity (%)	88,0	87,3	84,2	81,8	76,2	74,0	83,0
Total Heliofany (light hours)	11,9	37,3	84,3	54,3	65,5	23,5	276,8
Total rainfall (mm)	1,1	1,1	4,2	4,2	4,8	3,0	18,4

[1] Source: Division of Meteorology, Department of Sinoptic of the National Autonomous Institute of Agricultural Research – INIAP, Quevedo, Ecuador. 2011.

[2] Days (139) from the planting time (21/07) till harvest (07/12) of all materials established in the field

Likewise, for the final disease, values were between 28,20 (CB-02) and 42,68 (CB-16) blisters cm^{-2} for factor A (lines), and between 27,51 (10) and 37,61 blisters cm^{-2} (5 plants m^{-1}) for factor B (plants m^{-1}), existing highly significant differences (p<0,01) for factor A (lines), highlighting lines CB-02 and CB-23, and for factor B (plants m^{-1}), the 10 plants per linear meter, for showing less quantity of blisters cm^{-2}.

Under field conditions in Thailand, significant differences were also found among seven cultivars subjected to a natural rust epidemy, the materials NC 17090 and NC 17135, with 3,72 and 6,15 blisters cm^{-2}, respectively, as superior sanitarily wise to the rest, with even less damages (scale from 1-9) (16). In relation to the effect of planting density on the rust, when 10 plants m^{-1} were used, disease severity was less (27,51 blisters cm^{-2}). It was probably due to the competition of uredospores in the canopy of the crop, by having less space between plants which could cause a reduced temporal dispersion of the pathogen by the wind (main dissemination source of rust).

In fact, in one peanut trial the spacing of 0,30 m, recorded a higher quantity of foliar tissue because of the foliar growth rate with 3,1 g m^{-2} día^{-1}, compared to spacings 0,15 and 0,10 m, with 2,5 y 2,1 g m^{-2}day^{-1}, respectively (17). Likewise, the incidence of stem rots like the one caused by *Sclerotium rolfsii* Sacc. in peanut, can have a constant increase based on the higher populations of peanut plants in fields with significant levels (> 5 %) of this disease (18). Coincidentally, the population of 10 plants m^{-1} in this trial recorded a higher number of blisters.cm^{-2}, causing that plants reached their maximum height at 47,24 cm (Table IV). This latter result was possibly due to the competence among plants.

Finally, the variable severity of diseases in labelled plants (Table IV), the analysis of variance did not show statistical differences among each of the treatments for factors A (lines) and B (plants m^{-1}).

Table III. The Area Below the Curve Progress of the Disease (AACPE) and final disease based on the lesions leaflet^{-1} (leaf spot disease), blisters cm^{-2} (rust) and disease severity in labelled plants during the dry period of 2011. Farm "La María", UTEQ, Quevedo

Treatments	Leaf-spot disease (lesions leaflet^{-1})		Rust (blisters cm^{-2})		Severity of diseases in marked plants	
	AACPE	Final disease	AACPE	Final disease	AACPE	Final disease
p for factor A (lines)	ns	p<0,05	p<0,01	p<0,01	ns	ns
CB-02	189,48	5,08 a[1]	171,47 b	28,20 b	1327,69	49,69
CB-16	191,57	4,33 b	232,79 a	42,68 a	1414,74	52,33
CB-23	190,60	4,29b	171,41b	30,29 b	1459,83	52,82
for factor B (plants m^{-1})	ns	ns	ns	p<0,01	ns	ns
3,6	189,99	4,43	196,77	36,06 a	1375,54	50,01
5	198,62	4,63	195,88	37,61 a	1406,12	51,99
10	183,04	4,64	183,03	27,51 b	1420,60	52,83
p for interactions A x B	ns	ns	ns	ns	ns	ns
CV (%)	24,39	15,05	20,63	23,12	12,32	11,81

[1] Means followed by the same letter in one column differ according to the Tukey's test with 5 % of probability

Table IV. Plant height (AP), number of pods per plant (NFP), number of seeds per plant (NSP), pods weight per plant (PFP), weight of 1000 seeds (PMS), pods weight per plot (PFP) and yield (kg ha^{-1}), variables that were evaluated in the dry period of 2011. Farm La María, UTEQ, Quevedo

Treatments	AP (cm)	NFP	NSP	PFP (g)	PMS (g)	PFP (kg)	Yield (kg ha^{-1})
p for factor A (Lines)	ns	ns	ns	ns	ns	ns	ns
CB-02	39,96	262,58	337,33	126,67	54	1,57	1350,72
CB-16	39,03	270,75	387,17	128,50	51	1,50	1210,40
CB-23	39,37	237,92	313,75	132,67	62	1,44	1213,27
for factor B (plants.m^{-1})	p<0,01	p<0,01	ns	ns	ns	p<0,01	p<0,01
3,6	35,43 b[1]	321,83 a	370,33	136,58	58	1,00 c	776,18 c
5	35,68 b	286,50 a	368,25	132,50	58	1,52 b	1188,79 b
10	47,24 a	162,92 b	299,67	119,75	52	2,00 a	1809,42 a
p for interactions A x B	ns	ns	p<0,05	ns	ns	ns	p<0,01
CV (%)	16,32	19,10	25,52	22,70	22,34	15,89	17,03

[1] Means followed by the same letter in one column do not statistically differ according to the Tukey's test with 5 % of probability

Yield and its components

All the averages of each of these variables are found in Table IV. As to interactions among factors A (lines) and B (plants m^{-1}) for each of these variables, there were no statistical differences for most of the variables, except the number of seeds per plant and yield, where there were statistical differences for $p<0,05$ and $p<0,01$, respectively. This behavior shows that factors (lines and plants m^{-1}) are influenced and/or are dependant among themselves.

For the plant height variable values were between 39,03 (CB-16) and 39,96 cm (CB-02) for factor A (lines), and between 35,43 (3,6) and 47,24 cm (10) for factor B (plants m^{-1}), without significant differences for factor A. However, there were highly significant differences ($p<0,01$) for factor B (plants m^{-1}), showing that when 10 plants m^{-1} were used, height was higher (47,24 cm), being this fact confirmed in soybean, where increased plant population per hectare (200.000, 300.000 and 400.000), was proportional to the plant height (44,17; 49,98 and 54,33 cm) (19). Higher density planting than 44,4 and 25,0 plants m^{-2} can grasp more radiation compared to lower densities of 11,1 or 16,0 plants m^{-2} (18).

As to the number of pods per plant, averages were between 237,92 (CB-23) and 270,75 pods (CB-16) for factor A (lines), and between 162,92 (10) and 321,83 pods (3,6), for factor B (plants m^{-1}), without statistical differences for factor A, and really highly significant differences ($p<0,01$) for factor B, standing out the 3,6 and 5 plants.m^{-1} for having more pods per plant. This behavior was also confirmed for peanuts in Indonesia for variables like total number of pods, dry pod mass, volume of fresh and dry pods, reaching with the density of 5 plants meter^{-1} (the lowest one of the peanut evaluated in this experiment) values of 10,87 pods plant^{-1}, 14,50 g plant^{-1}, 0,73 and 0,66 L.10 plants^{-1}, respectively (20).

On the other hand, for the number of pods per plant, means were around 313,75 (CB-23) and 387,17 seeds (CB-16) for factor A (lines), and from 299,67 (10) to 370,33 seeds (3,6) for factor B (plants m^{-1}). The same is true for the weight of pods, their averages were between 126 67 (CB-02) and 132 67 g (CB-23) for factor A (lines), and from 119,75 (10) and 136,58 g (3,6), for factor B (plants m^{-1}). In both variables there were no statistical differences for both factors.

As to the seed number per plant, there was a significant interaction between factors A (lines) and B (plants.meter^{-1}). Only the lines CB-02 and CB-16 with 5 plants meter^{-1} (factor A), and with 5 and 3.6 plants meter^{-1} genotypes CB-02 and CB-23, respectively (factor B), showed the highest number of seeds (unpublished data).

Later on, for the weigtht of 1000 pods, there were not statistical differences for any of the factors A (lines) and B (plants m^{-1}), with values from 51(CB-16) to 62 g (CB-23) for factor A, and from 52 (10) and 58 g (3,6 y 5). In this case, the variable shows uniformity in the size of the seeds of the three peanut evaluated lines. This would be something positive because of having found a lower weight (small seed size) it could be prone to a higher intensity of pathogens like *Aspergillus* and *Penicillium* (21).

On the other hand, for the pods weight per plot, averages were between 1.44 (CB-23) and 1,57 kg (CB-02) for factor A (lines), and between 1,00 (3,6) and 2,00 kg (10), for factor B (plants m^{-1}). Finally, average yields were between 1210.40 (CB-16) and 1350,72 kg ha^{-1} (CB-02) for factor A (lines), and between 776,18 (3,6) and 1809,42 kg ha^{-1} (10), for factor B (plants m^{-1}).

In the two variables, there were no statistical differences for factor A, and highly statistical differences ($p<0,01$) for factor B, standing out the 10 plants m^{-1} for having reached a higher production (kg and kg ha^{-1}). The first fact is confirmed by Garcés (22) in the same cultivars for two years of research under similar agroclimatic conditions.

On the other hand, it has been proven that as an increase of 3; 5,3 and 8,3 plants m^{-2}, occur, there is also an increase of 2,6; 3,2 and 3,4 ton ha^{-1} in peanut crop (23), thus confirming the results of this trial. Even in Ghana, Africa, a planting density of 12 plants m^2 and the application of fungicides can significantly improve peanut yields under rainfed conditions (24).

Regardless the peanut genotype evaluated, increased population density can significantly increase, the accumulated biomass and seed yield per surface unit (25).

Finally, pod yield (kg.ha^{-1}) showed significant interaction among factors A (lines) and B (plants meter^{-1}). Only the line CB-02 with 10 plants meter^{-1} (factor A), and as the number of plants meter^{-1} (factor B) increases, pod yield is also increased.

CONCLUSIONS

- Peanut lines CB-16 and CB-23, with 4,33 and 4,29 lesions leaflet^{-1} reached a lower final severity of the leaf-spot disease, while lines CB-02 and CB-23 recorded a lower final AACPE of the rust. With 10 plants m^{-1}, a lower severity of the rust was attained.

- ♦ The highest plant height was recorded with10 plants m^{-1}. On the other hand, the higher number of pods per plant was attained with 3,6 and 5 plants m^{-1}. And finally, for variables like pods weight per plot and yield when 10 plants m^{-1}, were used, the weight was higher than the rest which shows that at higher densities production is also higher.
- ♦ There were significant interactions between factors A (lines) and B (plants m^{-1}) for the variables number of seeds per plant (p<0,05) and grain yield (kg ha^{-1}) (p<0,01), with influences between the two factors.

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