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Effect of Row Spacing on the Growth and Yield of Peanut (*Arachis hypogaea* L.) Varieties in Cau Ngang, Tra Vinh, Vietnam

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Abstract— *Field experiments were conducted at the research field of the Cau Ngang, Tra Vinh from May to October to determine the influence of row spacing on growth and yield of peanut under wet and dry season (2023). The experimental design was a 6×5 factorial was a split-split plot experiment laid out in randomized complete block design with three replicates. The factors studied included: Variety [(A1) MD7; (A2) HATRI 03 ĐP; (A3) HATRI 02 ĐP; (A4) HATRI 14 ĐP; (A5)VD08; (A6) VD01-01]; (M) Row spacing [(M1) 20×20 cm, (M2) 15x20 cm, (M3) 15×15 cm, (M4) 10x20 cm, (M5) fellow farmers 10x10 cm] The result showed that Peanut varieties HATRI 03 DP, HATRI 02 DP, HATRI 14 DP, VD08, VD01-01 have weight the seed 100, number of branches/plant, and significantly higher yield than MD7 varieties. The planting spacing of 15 cm x 20 cm for leaf , plant height, number of plant harvested and yield is higher than the spacing of 20 x 20 and 15 x 15 cm in the wet and dry season in 2023. Spacing of 20 x 20 cm and 15 x 15 cm for the highest yield.*

Keywords— ***Peanut, row spacing, yield and yield components.***

I. INTRODUCTION

Cultivated peanut (*Arachis hypogaea* L.; 2n = 4x = 40) is an important oil and cash crop that is grown worldwide, with an annual global yield of about 54 million tons and harvest area of over 32 ha (FAOSTAT, http://www.fao.org/faostat/en/#data/QC, 2021). Because of their unique biological characteristics, peanuts must be shelled before they can be used (e.g., oil extraction, food processing, and seeding). Shelling refers to a process that breaks the peanut shell and separates it from the kernel (Guzman et all.,2019).

The management of planting distances has been a topic of discussion among agronomists for many years of research. In different local natural conditions such as soil, water, climate and rain, there is little information about the optimal row spacing and tree spacing for newly studied varieties. The peanut variety response to planting distance has been published by Konlan et al. (2013). Distances of 30 cm x 15 cm and 50 cm x 15 cm create conditions for taller trees, the highest number of branches, and wider canopy; high yield and quality of peanuts in relation to the respective grain . The highest pod yield (7511.9 kg ha-1) was obtained from 75x10 cm and the lowest (5171 kg ha-1) from 75x25 planting density according to a two-year average. As a result; optimum planting density was found 75x10 cm for Virginia market type varieties in double crop peanut production(Bihter et all.,2017) . Peanut variety L14 is grown in plant densities and row spacing of 35 plants m-2 (25 cm × 25 cm) and 40 plants m-2 (25 cm × 20 cm) are most appropriate; plants grow, develop better and give a higher yield than other densities under the same conditions.(Minh et all.,2021). Most previous studies have focused on food and fruit trees and characteristic forests1(Jayathilaka et all.,2012). Few studies have been conducted on the growth-appropriate zoning of peanuts, a field economic cropand determine peanut quality into zones(Li et al .,2010)such as short duration, small study scope, single selection index, and no distinction between reproductive stages. On the basis of existing research, the

temperature, rainfall and sunlight conditions for the growth and development of peanuts in Tra Vinh have been carefully considered. A comprehensive suitability model for the peanut growing season was developed by considering the suitability of the variety, the spacing of the variety and the characteristics of yield variation and composition The yield over time of suitability for the peanut variety in different seasons was analyzed. can provide a scientific basis for the rational use of climate resources and adjustment of planting techniques, which will also increase the income of peanut production, and help economic development(Sicheng et all.,2022). The purpose of this study was to determined, how pod yield and yield components of peanut are affected by row spacing and plant spacing of double crop peanut production in Cau Ngang ,Tra Vinh, VietNam.

II. MATERIAL AND METHODS

The experiment was conducted in Cau Ngang district, Tra Vinh province on sandy soil. With 6 varieties :HATRI 03 DP, HATRI 02 DP, HATRI 14 DP, VD08, VD01-01, MD7.Experimental soil is peanut soil for ten years and in recent years has been managed in the conservation system for the peanut region. Prior to the experiment, topsoil layers from 0 cm to 30 cm were collected in each area to analyze the chemical indicators according to the method of Raij et al., (2001) and the mechanized composition according to Camargo et al., (2009).

- Experiment arrangement: Field experiment consists of 2 elements

Tree Height Tracking Index: determined by a cm ruler at the end of the harvest cycle (90 days) from soil surface to the end of the main trunk of 10 plants in each experiment. Number of leaves and number of branches: calculated at the end of the harvest period, using a sample of 10 plants per experiment. Yield and yield components : The number of pod per plant, the number of seeds per plant is determined by counting the bark and seeds of 10 plants selected from each experiment. Weight of 100 grains: Weigh the mass of 100 grains in each experiment. Seed yield: Weigh the seed weight of the plant, collect over 3m2. The particle size is measured in rulers.

III. RESULTS AND DISCUSSION

Experimental soil properties

Properties of experimental soil The results of soil analysis after harvesting 2 crops Wet and dry in Cau Ngang district show that the total nitrogen parameters in the soil are 0.874%. The content of organic carbon was not high before the test from 0.92 (Tran et al., 2021) to 1.04%. In this experiment, organic carbon increased after the first crop from 0.21%. Some physicochemical properties of untreated soil, treated soil, and peanut husks From the test results, the pH, organic matter, nitrogen, phosphorus, potassium, and magnesium of the samples have been listed in table 1. According to the results, the pH values in the soil sample (6.15), the soil sample after crop (6.05) were found to be consistent with the recommended pH of the soil, i.e. the pH value is from 5.8 to 6.8 (Thermo Fisher Scientific, 2013). The chemical composition of the soil indicates higher soil nitrogen, phosphorus, potassium, and organic carbons after single-crop bean cultivation (table1).

Table 1 : Soil properties before and after harvest at Cau Ngang

Parameter	Soil physicochemical indicators	
	Before Testing	After Testing
pH_{KCl}	6.15	6.05
Organic carbons (OC - %)	0.97	1.18
N total (%)	0.099	0.971
P_2O_5 total (%)	0.74	0.98
K_2O total (%)	0.58	1.16
Easily digestible phosphorus (mg P_2O_5/100 g soil)	3.14	3.63
Easily digestible Kali (mg K_2O/100 g soild)	19.22	28.9
CEC (lđl/100 g soil	2.01	2.67
Mg (%)	1.09	1.02
Sand (%)	62.1	62.1
Limôn (%)	20.5	20.5
Clay (%)	10.1	10.1

Effects of spacing on growth development and components peanut yield in** wet **season 2023 at Cau Ngang

Effect of distance, fertilizer on growth. development and factors constituting peanut yield in wet season 2023 at Cau Ngang Analysis of the impact of fertilizer on plant growth This analysis is based on three factors: plant height. number of branches on the tree. and number of leaves on the tree in different varieties. The fluctuation of height plant is statistically significant. The average height plant of the MD7 variety is 62.2cm. while the HATRI 03 DP variety has a height plant of 64.3cm. The height at the M5 spacing is the highest 58.3cm. The average height of the plant in the experiments is 56.82cm. Thus. in the M5 experiment, the palnt density is large, so the height plant is higher than that of other experiments. The number of branches on the plant in the experiments is different and has no statistical significance. The number of leaves on the plant of the MD7 variety is higher than that of the HATRI 03 DP variety. In terms of the average spacing of the experiments, the highest number of leaves on the plant in the M5 experiment is M4; the lowest in the M1 experiment.As for the number of seeds on a plant in most experiments there is an interaction between variety and spacing . The highest number of is the spacing in the M1 (20 × 20m) and M2 (15× 20m) experiments. The weight of 100 seeds of HATRI 03 DP. HATRI 02 DP. HATRI 14 DP is higher than that of MD7. Differences between varieties and spacing are not statistically significant. The interaction between variety and spacing was statistically significant in terms of height, number of leaves on the plant , number of pod/plant, and weight of 100 seeds. (Table 2).

Table 2.: Effects of spacing and yield component peanut in wet season 2023 at Cau Ngang

Treatments	**Hight Plant (cm)**	**No branch /plant**	**No Leaf / plant**	pod per plant	**No. seed/ plant**	Weight the seed (100) **(g)**
Varieties						
A1 = MD7	62.2b	10.5e	79.2a	18.4f	31.3e	45.6d
A2= HATRI 03 ĐP	64.3a	11.4d	72.4f	21.6c	35.8b	46.7c
A3= HATRI 02 ĐP	60.36d	14.4b	74.5e	22.4a	36.4a	48.4a
A4= HATRI 14 ĐP	61.41c	15.4a	77.6b	21.3c	35.7b	47.5b
A5=VD 08	66.55a	12.4c	76.4c	20.4d	34.6c	45.6d
A6= VD01-01	62.15b	12.3c	75.5d	19.5e	32.4d	47.1b
Mean	63.25	10.95	75.8	20.0	33.55	46.15
$LSD_{0.05}$	*	*	*	*	*	*
Spacing (cm)						
M1 (20× 20m)	55.1b	10.2b	82.4d	18.6b	35.3a	45.6a
M2 (15x20)	57.5b	11.3a	84.5c	21.4a	35.6a	45.5a
M3 (15X15)	56.9b	10.7b	84.8c	16.9c	30.6c	45.5a
M4 (10X20)	56.7b	8.5b	85.3b	16.8c	30.4c	45.5a
M5: Farmers(10 x 10)	58.3a	9.2b	86.6a	16.3c	32.3b	45.1a
Mean	56.92	9.98	84.72	18.0	32.84	45.44
$LSD_{0.05}$	*	*	*	*	*	ns

*Note: ns: No statistical significance; *. ** Statistically significant in the order of P=0.05 and P=0.01.*

In terms of planting spacing the fluctuation in the number of nodules on the plant shows that there is a difference in statistical significance. The spacing in the M1 and M2 experiments for the number of nodules on tall plant was 40.6 nodules/ plant and 46.8 nodules/plant , respectively. (Table3). For yield (Pod shell). HATRI 13 DP is higher than MD7. The spacing test also has special statistical significance, especially the M3 treatment spacing is the highest followed by M2. Seed (nucleus) yield also recorded statistically significant experiments. Highest seed yields on M2. M1 and M3 (Table 3).

Table 3: Effect of spacing and yield and seed size in wet season 2023 at Cau Ngang

Treatment	**Number of nodules/plant**	**Yield of** Pod shell **(g/ plant)**	**Yield of grain (g/plant)**	pod length **(cm)**	**Seed length (cm)**	**seed** width **(cm)**
Varieties						
A1 = MD7	41.6 a	29.9e	18.7f	3.5	1.6	1.1
A2= HATRI 03 ĐP	46.8b	30.2d	21.9d	3.9	1.8	1.2
A3= HATRI 02 ĐP	48.6b	35.5b	25.4a	3.8	1.9	1.5
A4= HATRI 14 ĐP	50.7a	56.5a	22.8c	3.4	1.8	1.2
A5=VD 08	48.2b	25.6f	19.4e	3.1	1.6	1.1
A6= VD01-01	41.1c	32.7c	23.1b	3.6	1.5	1.2
Mean	42.2	30.05	20.3	3.7	1.5	1.15
$LSD_{0.05}$	*	*	*	*	Ns	ns
Spacing (cm)						
M1 (20× 20m)	43.5c	29.1a	18.5b	3.1	1.4	1.3
M2 (15x20)	44.8b	29.2a	19.4a	3.0	1.6	1.2
M3 (15X15)	46.8a	29.6a	18.8b	3.1	1.8	1.1
M4 (10X20)	43.1c	29.3a	17.2c	3.0	1.8	1.2
M5: Farmers(10 x 10)	40.6 e	28.3b	18.7b	2.8	1.6	1.3
Mean	43.76	29.10	18.52	3.0	1.58	1.22
$LSD_{0.05}$	**	**	**	ns	ns	ns

*Note: ns: No statistical significance; *. ** Statistically significant in the order of P=0.05 and P=0.01.*

Effect of spacing on growth development and compenents peanut yield in dry season 2023 at Cau Ngang

Analysis of the impact of spacing àn 6 varieties on plant growth ,this analysis is based on three factors: plant height, number of branches on the plant, and number of leaves on the plant in different varieties. The plant height is statistically significant. The average height of the MD7 variety is 60.2 cm, while the HATRI 03 DP variety has a height of 61.3 cm. The height at the highest M5 spacing is 59.45 cm. The average height of the plant in the experiments is 55.92 cm. Thus. in the M5 experiment, the tree density is large. so the plant height is higher than that of other experiments. The number of branches on the plant in the experiments is different and has no statistical significance. The number of leaves on the plant of the MD7 variety is higher than that of the HATRI 03 DP variety. In terms of the average distance of the experiments. the highest number of leaves on the tree in the M5 experiment is M4; the lowest in the M1 experiment.

The number of pod on the plant of the HATRI 03 DP variety is higher than that of MD7.Spacing affects the number of pod on the plant . Most recorded the highest number of pod on the plant at M2 (15 × 20m) with 22.4 pod/plant . As for pod / plant , number of seeds on plant , in most experiments there is an interaction between variety and spacing. The highest number of pod is the spacing in the M1 (20 × 20m) and M2 (15× 20m) experiments. The weight of 100 seeds of HATRI 03 DP, HATRI 02 DP. HATRI 14 DP is higher than that of MD7. Differences between varieties and spacing are not statistically significant at Weight of seed (100). The interaction between variety and spacing was statistically significant in terms of hight number of leaves on the plant , number of pod/plant , and number of seeds/ plant. (Table 4.).

Table 4.: Effect of spacing and yield component peanut in the dry season 2023 crop at Cau Ngang

Treatments	**Hight Plant (cm)**	**No. branch /plant**	**No. Leaf / plant**	pod per plant.	**No. seed/ plant**	Weight of seed (100) **(g)**
Varities						
A1 = MD7	60.2b	11.26e	75.2a	20.3f	38.3e	45.3d
A2= HATRI 03 ĐP	61.3a	12.35d	70.4f	25.7c	37.9b	46.2c
A3= HATRI 02 ĐP	58.36d	15.44b	73.5e	23.5a	36.3a	48.6a
A4= HATRI 14 ĐP	60.41c	15.4a	76.6b	24.3c	36.7a	47.5b
A5=VD 08	62.55a	14.4c	76.4c	20.4d	33.6c	45.6d
A6= VD01-01	61.15b	12.5c	75.5d	20.5e	36.4d	47.1b
Mean	61.22	12.95	76.8	21.0	34.55	46.15
$LSD_{0.05}$	*	*	*	*	*	*
Spacing (cm)						
M1 (20× 20m)	54.6b	12.36b	82.4d	18.6c	35.3a	45.6a
M2 (15x20)	56.27b	12.65b	84.5c	22.4a	35.6a	45.5a
M3 (15X15)	55.39b	14.27a	84.8c	18.9c	32.66d	45.5a
M4 (10X20)	56.62b	9.45c	85.3b	18.8c	34.47b	45.5a
M5: Farmers(10 x 10)	59.45a	9.21c	86.7a	20.3b	33.42c	45.8a
Mean	55.92	10.33	85.71	19.0	33.45	45.46
$LSD_{0.05}$	*	*	*	*	*	ns

*Note: ns: No statistical significance; *. ** Statistically significant in the order of P=0.05 and P=0.01.*

Analysis of the impact of spacing on yield and seed size The average number of nodules on the plant of HATRI 14 DP was higher than that of MD7, HATRI 3 DP, HATRI 2 DP . In terms of planting spacing , the fluctuation in the number of nodules on the plant shows that there is a difference in statistical significance. The spacing in the M1 and M2 experiments for the number of nodules on the hight plant was 49.6 nodules/ plant and 49.1 nodules/plant, respectively. (Table 5). For the pod yield (Pod shell). HATRI 14 DP is higher than MD7, HATRI 3 DP, HATRI 2 DP. The spacing treatment also has special statistical significance, especially the M1 treatment spacing is the highest, followed by M2. Seed (nucleus) yield also recorded statistically significant experiments. Highest seed (nucleus) yield on,M1 , M2 (Table 5)

Table 5: Effect of spacing and yield and grain size of the 2023 dry season at Cau Ngang

Treatments	**Number of nodules/plant**	**Yield of** Pod shell **(g/ plant)**	**Yield of grain (g/plant)**	pod length **(cm)**	**Seed length (cm)**	Seed width **(cm)**
Varieties						
A1 = MD7	44.4 d	33.4e	20.4f	3.5	1.7	1.1
A2= HATRI 03 ĐP	49.9b	45.4b	25.3c	3.7	1.8	1.2
A3= HATRI 02 ĐP	47.7c	37.2c	26.2b	3.9	1.9	1.5
A4= HATRI 14 ĐP	56.6a	62.3a	27.6a	3.5	1.9	1.2
A5=VD 08	49.3b	32.5f	21.6e	3.2	1.6	1.1
A6= VD01-01	45.5e	34.9d	24.7d	3.6	1.5	1.2

Mean	48.9	40.95	24.3	3.7	1.5	1.15
$LSD_{0.05}$	*	*	*	*	Ns	ns
Spacing (cm)						
M1 (20× 20m)	49.6a	48.5b	27.7a	3.2	1.6	1.4
M2 (15x20)	49.1a	53.6a	24.6b	3.1	1.7	1.3
M3 (15X15)	48.2b	47.4c	19.6d	3.1	1.6	1.3
M4 (10X20)	47.3c	42.7d	21.7c	3.0	1.7	1.2
M5: Farmers(10 x 10)	42.7 d	41.5e	21.2c	2.8	1.6	1.3
Mean	47.58	46.74	22.96	3.4	1.64	1.32
$LSD_{0.05}$	**	**	**	ns	ns	ns

*Note: ns: No statistical significance; *. ** Statistically significant in the order of P=0.05 and P=0.01.*

IV. DISCUSSION

The HATRI 03 DP variety has significant values in terms of height, number of branches/plant , number of seeds/ plant , Weight of seed (100) number of nodules/plant . Yield of Pod shell (g/ plant) and grain yield (kernels) as well as grain size were higher than those of MD7, except for the number of upper leaves/plant. This is due to the early maturation and high yield potential of the HATRI 03 DP variety. In addition. HATRI 03 DP is a large-seed variety, so it is necessary to use a higher amount of fertilizer than MD7. The traits of the number of Pod shell in this study varied significantly and were similar to the results of Waghmode et al. (2017). For the varieties HATRI 03 DP. HATRI 14 DP. VD08. the distance of 15cm x 20cm. the number of fruits (seeds with shells) on the tree is significantly higher.

This is consistent with the results of Jaiswal et al. (2018) who found that a distance of 30cm x 15cm proved superior in terms of the increasing number of grain on the plant compared to a closer distance of 22.5cm x 10cm. Previous reports have shown that a significant interaction effect exists between planting distance x degree of fractionation on the number of peanut kernels (kernels). Previous reports have shown that a significant interaction effect exists between planting distance× degree of ownership for the number of peanut kernels (kernels). (Gadade et al.. 2018). Fertilizers promote plant growth as well as root growth and increase peanut yield (Jakusko et al.. 2015). Although there was a difference in yield (g/plant), there was no significant difference between varieties, planting distances,and their interactions. Higher yields can be achieved with wide spacing (20cm x 15cm) than with narrower spacing (10cm x 10cm) in the wet season.

The experiment of (Phuong et al.,22) in Tra Cu Tra Vinh with a distance of 15 x 20 cm and 15 x 15 cm for the highest yield . howver ,in this experiment with prolonged rainfall, the yield of the 6 varieties showed a very significant difference in yield indicators and constituent factors. The pod yield (shelled seeds),seed yield (kernels) and number of nodules/plant had statistically significant interactions between variety and spacing . As for the number of seeds on a plant, in most experiments there is an interaction between variety and spacing . The highest number of pod is the spacing in the M1 (20X20) and M2 (15X20) experiments. The gap between the M3 indicators increased the nodule,but the productivity of the experiments increased in significantly.

V. CONCLUSION

Five planting densities were tested with 6 varieties in Randomized Complete Block Design with three replications in 2023 dry and wet crop on the coastal sandy land area in Cau Ngang district, Tra Vinh ,Vietnam. The different density treatments affect the growth. development and yield and yield components of the peanut variety HATRI 03 D, HATRI 02 DP, HATRI 14 DP, VD08, VD01-01. These varieties increasing plant density, the number of pod per plant, whereas plant height,number of branches/plant, leaf and significantly higher yield than MD7 varieties. The planting with treatment M2(15 cm x 20 cm)for spacing , plant height, number of pod and yield is higher than the spacing of M1(20 x 20) and M2(15cm x 15 cm) in the both wet and dry sesaon 2023. Spacing of 20 x 20 cm and 15 x 20 cm for the highest yield. However, the difference in the 100 seeds weight has not been statistically significant in the experiments. For sustainable peanut

production, attention should be paid to choosing the appropriate variety.

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