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Effect of N, P K, Ca and Mg Fertilizer Application on Peanuts in Tra Vinh Province, Vietnam

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Abstract— *This study was to evaluate the effects, determine the appropriate, fertilizers on peanut production. The experiment was installed in Tra Cu with two variety MD7, L14. Seven fertilizer treatments were designed. The treatments consisted of the application of T1:(Trichoderma sp + Bordeaux 1% + Probiotics 3M); T2: (organic fertilizer =10 ton/ha) ;T3:(Trichoderma sp + Bordeaux 1% + Probiotics 3M) + chemical fertilizers (35N-60P-60K + 150kg Ca + 40kg Mg) + organic fertilizer 100%); T4: (Trichoderma sp + Bordeaux 1% + Probiotics 3M) + chemical fertilizers(35N-60P-60K + 150kg Ca + 40kg Mg) + organic fertilizer 75% ;T5(Trichoderma sp + Bordeaux 1% + Probiotics 3M) + chemical fertilizers + organic fertilizer 50%) ;T6: chemical fertilizers (35N-60P-60K + 150kg Ca + 40kg Mg) +(Trichoderma sp + Bordeaux 1% + Probiotics 3M) and T7 control and treatment of farmers: (120 N-60 P-60 K + 200 Ca kg/ha). The experimental design adopted consisted of randomized complete blocks with three replications. Results showed that the analysis of absorption N, P, K in the seeds, both varieties have statistical significance on the experiments. The treatment T5, with the highest N content (2.175) for MD7, and L14 variety (2.588). For P both varieties the highest N content at treatment T7. Only K with MD7 varieties the highest N content at treatment T7 and L14 in the treatment T4. The Ca and Mg content in the seed had the highest in treatment T5 with both two varities. For the leaf: +N content in the leaves in the treatment T2 was the highest N content (4.852) for MD7. For the L14 variety in the treatment T6 (4.989) (Trichoderma sp + Bordeaux 1% + CPVS 3M) for the highest N content, followed by the fertilization level in the treatment T3 (4,625) using probiotics (Trichoderma sp + Bordeaux 1% + CPVS 3M) + MKC chemical fertilizer + 100% organic fertilizer). P content, on MD7 varieties, at the treatment (T2) using only organic fertilizers and (T3) using biological products (Trichoderma sp + Bordeaux 1% + CPVS 3M) + MKC chemical fertilizers + 100% organic fertilizers for the highest P content (1.521; 1.365) respectively. K content, on the MD7 variety, at the treatment T2 and treatment T4, had the highest content (0.142; 0.102) respectively. For the L14 variety, the treatment T7 gave the highest K content (0.612). The leaves in the treatment T3 gave the highest Ca content. Mg content in the leaves depends on the age and genotypic location of the plant. On MD7 varieties, the highest Mg content in treatment T5 (1.140). For the L14 variety, at the level of treatment T3, use biological products (Trichoderma sp + Bordeaux 1% + CPVS 3M) + MKC chemical fertilizer + 100% organic fertilizer for the highest Mg content (0.712) and the lowest in T1 (0.012). It is essential to apply the correct dose and correct time for peanut at Tra Vinh.*

Keywords— *absorption, Peanut. N. P. K Ca, Mg. leaf, seed.*

I. INTRODUCTION

Nitrogen (N) stands out as a crucial nutrient and a limiting factor in agricultural systems worldwide (Fageria et al., 2005). N fertilizer application is a common practice to sustain crop productivity, supporting the rapid global population growth (Maaz et al., 2021), however, excessive

use can reduce N utilization efficiency, leading to environmental issues like soil degradation and water contamination (Michalczyk et al., 2020). Previous studies have shown that NPK combined with calcium and magnesium sulfate fertilizers significantly increased the yield of rape (Tian et al., 2019). In Jinzhou, Fujian and other places, experiments applying calcium, magnesium and sulfur containing fertilizers to peanut have shown that peanut yield has increased significantly (Huang et al., 2012). Effective management and appropriate use of nitrogen fertilizers in the pod zone present a promising strategy to boost peanut productivity and optimize nitrogen utilization efficiency. Peanut cultivars are commonly categorized into large-seeded and small-seeded based on seed size/weight. Large-seeded cultivars generally have a more extended pod filling period, leading to increased nitrogen uptake and accumulation compared to small-seeded ones (Sun et al., 2010). In Brazil, for peanut cultivation normally nitrogen is supplied by biological fixation, phosphorus is supplied up to 100 kg ha^{-1} P_2O_5 and potassium up to 60 kg ha^{-1} of K_2O, both at sowing, while calcium and magnesium are provided by liming and sulfur about 20 kg ha^{-1} of S (Ambrosano et al., 1997) Similarly, Ca should be applied during early bloom of groundnuts. This is because the developing pods and pegs absorb Ca directly from the root zone (Rodrigues et al., 1986). According to (FAO. 2006), the application of high K can potentially cause Ca deficiencies in groundnut production. In K deficient soils, the K requirement of the crop can be met by applying potassium sulphate (K2SO4) to supply (FAO. 2006) 16.60-41.55 kg K ha–1.Additionally, the crop requires more Ca especially at seed filling and pod development which must be readily available in the pegging zone (Fao. 2006), Our study aims to explore the NPK, Ca, Mg accumulation in two peanut cultivars with seed and leaf when apply fertilizer application at Tra Cu (Tra Vinh).

II. MATERIAL AND METHODS

2.1. Varieties: MD7 and L14.

2.2. Experimental design and treatments

- Experiment was conducted at Tra Cu Tra Vinh province, with sandy soil structures. Experimental soils have been growing peanuts for ten years and in recent years are managed in the conservation system for the peanut region. Prior to the experiment the soil layer was collected in each area in layers 0 to 30 cm deep to make up the composite sample. which was used to analyze chemical indicators according to the method of Raij et al. (2001) and particle size according to Camargo et al. (2009).

- The experiment was arranged on the farmer's field in a completely random mass (02 varieties, 7 treatments, 3 repetitions. at Tra Cu locations. the area of plots is 25 m^2).

Table 1: Treatments

no	Treatments	Contents	note
1	T1	(Trichoderma sp + Bordeaux 1% + Probiotics 3M)	
2	T2	organic fertilizer =10 ton/ha	
3	T3	Trichoderma sp + Bordeaux 1% + Probiotics 3M) + chemical fertilizers (35-60-60 + 150kg Ca + 40kg Mg)+ organic fertilizer 100%	
4	T4	Probiotics (Trichoderma sp + Bordeaux 1% + Probiotics 3M) + chemical fertilizers (35-60-60 + 150kg Ca + 40kg Mg)+ organic fertilizer 75%	
5	T5	Probiotics (Trichoderma sp + Bordeaux 1% + Probiotics 3M) + chemical fertilizers(35-60-60 + 150kg Ca + 40kg Mg) + organic fertilizer 50%	
6	T6	Chemical fertilizers (35-60-60 + 150kg Ca + 40kg Mg)+ (Trichoderma sp + Bordeaux 1% + Probiotics 3M)	
7	T7	Fellowing farmers (120-60-60+ 200 Ca kg). (control)	

The process of planting and caring techniques (land preparation, planting density, care, harvesting) is carried out in accordance with Guidance No. 52/HD-SNN.

2.3. Data collection

Plant samples were collected at growth stages (90 DAE) for leaves and for nuts, to determine plant concentration of N, P, K, Ca, Mg following standard procedures for each. The concentration of phosphorus, potassium, calcium, magnesium, in the plants were determined by inductively coupled plasma (ICP) after digestion in a mixture of concentrated HNO_3 and H_2O_2 in a microwave oven. Nitrogen was determined by Kjeldahl after digestion in a mixture of concentrated H_2SO_4 and H_2O_2.

The effects of different combinations of the applied NPK and polyhalite fertilizers on the leaf and seed accumulation and partitioning were statistically analyzed using ANOVA.

III. RESULTS AND DISCUSSION

3.1. Experimental soil propertie

In the condition that the land of peanuts has been arranged to grow peanuts for 1 crop with innocuous fertilizer levels. Soil analysis results at Tra Cu locations showed that the soil Nitrogen parameters were 1.04% at Tra Cu. Organic C levels were not high (0.92% and 0.86%) (Tran et al., 2021) to 1.04 (Tra Cu) at this experiment after planting a peanut experiment. (Table 2). Total Nitrogen also increased from 0.87% for Tra Cu. Mild sour soil - neutral (pHKCl 6.1-6.5). Peanuts grow best in slightly acidic soil with 6.0 to 6.5.

Table 2: Some properties of the tested soil (0–30 cm depth) after harvested one season (Lang et al.,2021)

Property	Tra Cu
% Nitrogen	0.87
% Potassium	150.2
% Sodium	71.6
% Magnesium	97.2
% Calcium	241
% Manganese	95.7
% Zinc	2.56
% Cooper	3.68
% Iron	79.5
% Organic	1.04
pH	6.1
% Sand	58.36
% Silt	31.5
% Clay	1.20

3.2. Nutrient absorption peanut in seed

3.2.1. Nutrients N, P, K. Through the analysis of absorption in the seeds, both varieties have statistical significance on the experiments. (Table 3). N content in the seed in the treatment T5, with the highest N content (2.175) for MD7, and L14 variety in the treatment T5 (2.588). For P both varieties the highest P content at treatment T7. Only K have the highest K content at treatment T7 at MD7 and L14 in the treatment T4.

Table 3. Nutrient analysis of peanuts in the winter-spring crop 2022

Fertilizer Factor (F) (N-P-K)	MD7			L14		
	N	P	K	N	P	K
Sites: Tra Cu						
T1	1.750d	0.850e	0.097e	1.880e	0.981b	0.190c
T2	1.850c	0.690f	0.095e	1.570f	0.850c	0.189c
T3	2.145a	1.350b	0.170d	2.023c	0.980b	0.139c
T4	2.135a	1.180c	0.191d	2.180b	0.698d	0.371a
T5	2.175a	1.071d	0.391c	2.588a	0.941b	0.137c
T6	2.127a	1.071d	0.541b	1.930d	0.625d	0.257b
T7	2.013b	1.425a	0.981a	2.037c	1.001a	0.269b

Cv%	2.33	2.11	1.33	1.78	0.17	0.98
LSD 0.05	0.04	0.34	0.15	0.06	0.12	0.22

3.2.2. Ca, Mg nutrients

Through the analysis of the absorption of Ca and Mg in the seeds, both varieties were analyzed with statistical significance on the experiments. (Table 4). The Ca and Mg content in the seed had the highest in treatment T5 with both two varities.

Table 4. Analysis of Ca and Mg nutrients of peanut seed in the winter-spring crop 2022

Fertilizer Factor (F) (N-P-K)	MD7		L14	
	Ca	Mg	Ca	Mg
Site: Tra Cu				
T1	1.026c	0.055e	1.021d	0.178e
T2	1.541a	0.058e	1.102c	0.215d
T3	1.24b	0.181d	1.474a	0.787b
T4	0.953d	0.654b	1.235b	0.045f
T5	1.574a	1.182a	1.451a	1.541a
T6	1.512a	0.132d	1.457a	0.567c
T7	0.541e	0.214c	1.412a	0.781b
CV%	1.17	3,25	5.81	3.58
LSD 0.05	0.83	0.12	0.24	0.15

3.3 Nutrient absorption peanut in leaves

3.3.1. Nutrients N, P, K

Through the analysis of the absorption of nitrogen, phosphorus, and potassium fertilizers on peanut leaves of the above treatment of statistical significance on the MD7 variety, while on the L14 variety, the absorption of potassium fertilizers was not statistically significant. The N content in the leaves in the treatment T2 was only using the organic fertilizer with the highest N content (4,852) calculated for MD7, which was significantly different from the other treatment (Table 4) and then in the treament T3 (4,742) using probiotics (Trichoderma sp + Bordeaux 1% + CPVS 3M) + MKC chemical fertilizer + 100% organic fertilizer; T4 (4,487) uses probiotics (Trichoderma sp + Bordeaux 1% + CPVS 3M) + MKC chemical fertilizer + 75% organic fertilizer and the lowest in T5 (3,151). For the L14 variety in the treatment T6 (4,989) using MKC chemical fertilizer + Bio-products (Trichoderma sp + Bordeaux 1% + CPVS 3M) for the highest N content, followed by the fertilization level in the T3 experiment (4,625) using probiotics (Trichoderma sp + Bordeaux 1% + CPVS 3M) + MKC chemical fertilizer + 100% organic fertilizer and the lowest in T7 (3,365). N content in leaves decreases with age and varies with plant variety, according to Cox et al. (1970) reported that the N content in leaves at the vegetative stage is more than 5%. The sufficient level of N in the leaves, has been reported to be between 3.0-4.0% (Dwivedi, 1988; Jones et al., 1991) and nitrogen deficiency symptoms appear when the concentration of N in the leaves drops below 2.2% (Dwivedi, 1988).

P content, on MD7 varieties, at the treatment (T2) using only organic fertilizers and (T3) using biological products (Trichoderma sp + Bordeaux 1% + CPVS 3M) + MKC chemical fertilizers + 100% organic fertilizers for the highest P content (1,521; 1,365) respectively and the lowest P content in the treatment T1 (0.154) using only biological fertilizers without using organic fertilizers and chemical fertilizers. For the L14 variety, in contrast to the MD7 variety, the treatment T1 gave the highest P content (1.725), followed by the treatment T4 (1.552) and the lowest in the treatment T5, treatment T6 and treatment T7 (0.125; 0.154; 0.174) respectively.

The K content in the leaves of MD7 varieties was the highest (0.654; 0.302) in treatment T6 and T5 respectively and the lowest in T2 and T4 respectively (0.025; 0.052). The L14 variety, the content of K in the leaves in the treatment was not statistically significant. (Table 5)

Table 5. Nutrient analysis of leaf peanut in the winter-spring crop 2022

Fertilizer Factor (F) (N-P-K)	MD7			L14		
	N	P	K	N	P	K
Site: Tra Cu						
T1	4.151d	0.154e	0.120d	4.541c	1.725a	0.012b
T2	4.852a	1.521a	0.025e	4.321d	0.895c	0.024b
T3	4.742b	1.365b	0.210c	4.625b	0.399d	0.023b
T4	4.487c	1.125c	0.052e	4.184e	1.552b	0.056b
T5	3.151f	1.021d	0.302b	4.562c	0.125e	0.142a
T6	4.132d	1.011d	0.654a	4.989a	0.154e	0.014b
T7	3.999e	1.124c	0.065d	3.365f	0.174e	0.012b
Cv%	7.25	2.13	4.25	1.42	0.58	0.47
LSD 0.05	0.12	0.74	0.02	0.17	0.52	0.23

3.3.2. Ca, Mg nutrients: Analyzed the absorption of Ca and Mg in peanut leaves of statistical significance on both MD7 and L14 varieties.

The Ca content in the leaves in the T1 test of probiotics (Trichoderma sp + Bordeaux 1% + CPVS 3M without chemical fertilizer and organic fertilizer with the lowest Ca content (0.857), followed by the T2 test (0.951) using only organic fertilizers calculated for MD7 was significantly different from the other tests (Table 6) and in the test using bioproducts (Trichoderma sp + Bordeaux 1% + CPVS 3M) + MKC chemical fertilizer + 50% organic fertilizer (T5) for the highest Ca content, followed by T4, T7 and T3 experiments with values of 1,314; 1,251; 1,214 and 1,104 respectively. For the L14 variety in the T3 experiment, use biological products (Trichoderma sp + Bordeaux 1% + CPVS 3M) + MKC chemical fertilizer + 100% organic fertilizer for the highest Ca content (1,514). Suggest that the Ca content in the leaves gives a maximum yield of 1.8% and is stable at 1.2 – 2.0% (Nicholaides and Cox, 1970).

The Mg content in the leaves depends on the age and genotypic location of the plant. On MD7 varieties, T1 and T2 fertilization yielded the lowest Mg content (0.154; 0.239) respectively and the highest Mg content in T5 experiment (1.140). For the L14 variety, at the level of T3 fertilization, use biological products (Trichoderma sp + Bordeaux 1% + CPVS 3M) + MKC chemical fertilizer + 100% organic fertilizer for the highest Mg content (0.712) and the lowest in T1 (0.012).

Table 6. Analysis of Ca and Mg nutrients of peanut leaves in the winter-spring crop 2022

Fertilizer Factor (F) (N-P-K)	MD7		L14	
	Ca	Mg	Ca	Mg
Site: Tra Cu				
T1	0.857e	0.154f	1.147c	0.012d
T2	0.951d	0.239e	1.365b	0.021d
T3	1.104c	0.625c	1.514a	0.712a
T4	1.251b	0.951b	1.112c	0.132c
T5	1.314a	1.140a	1.120c	0.054d
T6	1.187c	0.954b	1.002d	0.084d
T7	1.214b	0.321d	1.121c	0.561b
CV%	5.12	4,25	5.22	2.57
LSD 0.05	0.41	0.15	0.47	0.24

3.4. Discussion

The soil growing peanut at Tra Cu with sand: 58.36%, a favourable condition for plant and hight yield for peanut (Lang et al., 2021) .The role of soil during pegging and pod development, and reported loam soil more suitable for peg swelling and pod development, as well as yield formation over clay and sandy type of soil (Zhao C. et al., 2015). The loam soil provides moderate aeration and water along with fertility retention, a favourable condition for plant and peg growth, and pod development (Zhao C. et al., 2015). The optimal growth of subterranean peg and pod require slightly acid soil pH of 6.0 to 6.5, but a range of 5.5 to 7.0 is acceptable. Plant nutritional balance combined with proper nutrient supply can maximize productivity and quality of peanuts, ensuring an adequate supply of this oilseed with analysis of absorption in the seeds, both varieties have statistical significance on the experiments. (Table 3). N content in the seed in the treatment T5, with the highest N content (2.175) for MD7, and L14 variety in the treatment T5 (2.588). The Ca and Mg content in the seed had the highest in treatment T5 with both two varities. (Table 4) mean note treament with: Probiotics (Trichoderma sp + Bordeaux 1% + Probiotics 3M) + chemical fertilizers (35-60-60 + 150kg Ca + 40kg Mg) + organic fertilizer 50%. However, N content in the leaves in the treatment T2 was only using the organic fertilizer with the highest N content (4.852) calculated for MD7. For the L14 variety in the treatment T6 for the highest N content, followed by the fertilization level in the treatment T3 (4.625). This the same (Godoy et al., 2017), high oleic type cultivars have expanded their production area. The development of more productive genotypes with higher levels of protein and oil increased the demand for more fertile soils so that the maximum potential of the crop is reached (da Silveira et al., 2013). The cultivars used MD7 absorbed in seed an average of 1.574 and 0.981 more Ca and K than the L14 cultivars, respectively (table 4 and 5). The greater need for K and Ca by newer modern peanut cultivars suggests that they are more responsive to soil acidity correction by liming, thus providing Ca and improving the availability of Mg for the crop. The same with research Potassium is the second most absorbed nutrient by peanut plants (Neto et al., 2012), while Ca is the third most absorbed (Rodrigues et al., 1986). For Peanut at Tra Cu , Tra Vinh the famers do not pay attention to the decline of the soil and the quality of peanut , but focus on productivity. Sometimes the selling price is high, so it affects the quality of the peanut. For the proper management of fertilization, it is essential to apply the correct dose and correct time, among others (Roberts et al., 2007). However, any fertilization recommendation must be based on knowing the rate of nutrient accumulation by plants (Xie et al., 2020).

IV. CONCLUSION

-For the seed, the analysis of absorption N, P, K in the seeds, both varieties have statistical significance on the experiments. N content in the seed in the treatment T5, with the highest N content (2.175) for MD7. and L14 variety in the treatment T5 (2.588). For P both varieties the highest N content at treatment T7. Only K MD7 varieties the highest N content at treatment T7 and L14 in the treatment T4. The Ca and Mg content in the seed had the highest in treatment T5 with both two varities.

- For the leaf

+ N content in the leaves in the treatment T2 was only using the organic fertilizer with the highest N content (4.852) calculated for MD7. For the L14 variety inthe treatment T6 for the highest N content, followed by the fertilization level in the treatment T3 (4.625) using probiotics

+ P content, on MD7 varieties, at the fertilization level (T2) using only organic fertilizers and (T3) using biological products (Trichoderma sp + Bordeaux 1% + CPVS 3M) + MKC chemical fertilizers + 100% organic fertilizers for the highest P content (1.521; 1.365) respectively,

+K content, on the MD7 variety, at the treatment T2 and treatment T4 fertilization levels, had the highest content. For the L14 variety, on the contrary, the treatment T7 gave the highest K content.

+ Ca content in the leaves in the T1 test of probiotics (Trichoderma sp + Bordeaux 1% + CPVS 3M without chemical fertilizer and organic fertilizer with the lowest Ca content (0.857), followed by the T2 test (0.951).

+ Mg content in the leaves depends on the age and genotypic location of the plant. On MD7 varieties, Treatment T1 and treatment T2 fertilization yielded the lowest Mg content and the highest Mg content in T5 experiment (1.140). For the L14 variety, at the level of T3 fertilization, use biological products.

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