*Вестник ВГУИТ/ Proceedings of VSUET* ISSN 2226-910X E-ISSN 2310-1202

# Пищевая биотехнология

# Food biotechnology

**DOI**: http://doi.org/10.20914/2310-1202-2020-2-49-54 Оригинальная статья/Research article
**УДК** 640 Open Access Available online at vestnik-vsuet.ru

# Влияние предпосевной обработки семян хлористым калием на урожайность и качество двух сортов арахиса L14 и L23, выращенных во Вьетнаме

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**Аннотация**. В этом исследовании мы провели эксперимент, чтобы оценить влияние предпосевной обработки семян 0,05% KCl на урожайность и качество двух сортов арахиса L14 и L23, выращенных в провинции Бак Нинь, Вьетнам. После тщательного отбора семена L14 и L23 были разделены на две части. Часть 1 (контроль) обрабатывали дистиллированной водой, а часть 2 (эксперимент) обрабатывали 0,05% KCl. Полевой эксперимент был организован в Split-plot дизайне с четырьмя повторностями. Результаты показывают, что предпосевная обработка семян 0,05% KCl увеличивала компоненты урожайности (масса 100 стручков, масса 100 семян, массовое соотношение неочищенных арахисов, количество стручков на растение) и урожайность как L14, так и L23 по сравнению с контролем, в котором урожайность L14 выше, чем у L23. Предпосевная обработка семян 0,05% KCl также повысила качество арахиса, таких показателей, как содержание крахмала, снижение сахара, липидов, ценность омыления, белка, витаминов группы B, общих аминокислот и содержания некоторых минеральных элементов в арахисе, таких как N, K, Ca, Mg. Результаты этого исследования демонстрируют важность предпосевной обработки семян для арахиса.

**Ключевые слова**: арахис, Arachis hypogaea, хлористый калий, KCl, обработка семян, урожайность, качество

# Effects of pre-sowing seed treatment with potassium chloride on yield and quality of two peanut cultivars L14 and L23 grown in Vietnam

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**Abstract**. In this study, we conducted an experiment to evaluate the effect of pre-sowing seed treatment with 0.05% KCl to the yield and quality of two peanut cultivars L14 and L23 grown in Bac Ninh province, Vietnam. After careful selection, the seeds of L14 and L23 were divided into two parts. Part 1 (control) was treated with distilled water and Part 2 (experiment) was treated with 0.05% KCl. The field experiment was arranged in a Split-plot design with four replications. The results show that pre-sowing seed treatment with 0.05% KCl increased the yield components (weight of 100 pods, weight of 100 seeds, mass ratio of unshelled peanuts, number of pods per plant) and yield of both L14 and L23 when compared to the control, in which the yield of L14 is higher than that of L23. Pre-sowing seed treatment with 0.05% KCl also increased the quality of peanuts such as starch content, reducing sugar, lipid, saponification value, protein, B vitamins, total amino acids and content of some mineral elements in peanuts such as N, K, Ca, Mg. The results of this study demonstrate the importance of pre-sowing seed treatment for peanuts.

**Keywords**: peanut, Arachis hypogaea, potassium chloride, KCl, seed treatment, yield, quality

## Introduction

The peanut (*Arachis hypogaea* L.) is a short-term industrial crop owning high economic values and are of great significance to the processing and livestock industries [1]. Not only does the cultivar has delicious taste but their nutritional profile is also rich in protein, fat, and many other healthy nutrients [2, 3]. It has been pointed out that peanuts are beneficial for losing weight and reducing risks of cardiovascular diseases [2, 4]. Recently, the area of peanut cultivation and production worldwide (especially in China and India) has been increasing [1]. In Vietnam, peanut is a high yielding crop and being grown widely in all agro-ecological regions with a variety of peanut cultivars. In the past few years, the area and yield of peanuts in Vietnam has increased if compared to the past, but these figures are still lower than the world's. To increase the yield of peanuts, in addition to seeds, it is essential to have appropriate technical measures, pre-sowing seed treatment in particular, as this is the first step to protect plants from pests, increase productivity and crop quality.

Для цитирования
Le T.V., Bui T.B. Влияние предпосевной обработки семян хлористым калием на урожайность и качество двух сортов арахиса L14 и L23, выращенных во Вьетнаме // Вестник ВГУИТ. 2020. Т. 82. № 2. С. 49–54. doi:10.20914/2310-1202-2020-2-49-54

For citation
Le T.V., Bui T.B. Effects of pre-sowing seed treatment with potassium chloride on yield and quality of two peanut cultivars L14 and L23 grown in Vietnam. *Vestnik VGUIT* [Proceedings of VSUET]. 2020. vol. 82. no. 2. pp. 49–54. (in Russian). doi:10.20914/2310-1202-2020-2-49-54

Seed is always a top priority in cultivation. That the cultivars are qualified and strong is a prerequisite for the success of the crop [5]. Modern seed processing technology has been developed and applied to many different crops around the world. Seed treatment is the process of cleaning, eradicating germs and dressing, coating seeds with specialized formulation of the seed treatment chemicals which are highly adhesive [5]. This treatment facilitate seed germination and ensures optimal plant density during the establishment of plant populations when seeds and seedlings cannot protect themselves from pests and diseases. The appropriate seed treatment makes the seedlings be able to actively protect themselves from pests and diseases from their beginning growth stage, the plants grow well and create a premise for high productivity in the future. Seed treatment is easy to implement, reduces the amount of spraying while still achieving the purpose of pest control [6]. Most importantly, this approach helps farmers save considerable production costs.

There have been some studies in the world on the effectiveness of pre-sowing seed treatment on plant growth, development and productivity [5, 6, 7]. In Vietnam, although many studies on the effect of fertilizer on peanuts were conducted, the number of studies on pre-sowing seed treatment to the productivity and quality of legumes in general and peanuts in particular is still limited. As a result, we conducted a seed treatment experiment with 0.05% KCl before sowing to evaluate its effect on the yield and quality of two peanuts cultivars namely L14 and L23.

## Materials and methods

**Research materials.** The experiment was conducted on two peanut cultivars, L14 and L23, selected from a Chinese import corporation by Legumes Research and Development Center, Field Crop Research Institute, Vietnam Academy of Agricultural Sciences (VAAS) (Figure 1).


Figure 1. Two peanut cultivars used in this study

**Seed processing and experimental setup.** After being selected carefully, seeds of the two cultivars, L14 and L23, are divided into 2 parts. Part 1 (control): the seeds were soaked in distilled water for 7 hours, then put in a petri dish with moist cotton wool in an incubator at $28^{o}$ C – $30^{o}$ C for 24 hours. Part 2 (experiment): the seeds were soaked in 0.05% KCl solution for 7 hours, then put in a petri dish with cotton wool which had already been soaked in 0.05% KCl in an incubator at $28^{o}$ C – $30^{o}$ C for 24 hours. The seeds after the treatment were grown in the field in Que Vo district, Bac Ninh province, Vietnam from February to June in 2017.

Field experiments consisted of two factors KCl and that the cultivars were arranged in a Split-plot design in which the large plot was KCl 0.05% and the small plot was peanut cultivars. Each cultivar included two formulas (control and experiment) grown in 2 plots, each formula repeated 4 times, the total number of experimental plots was 16, the area of each plot was $15m^2$ ($240m^2$ in total).

**Analysis of indicators.** To determine the yield components, yield and quality of the studied peanut cultivars, we harvested peanuts on the experimental plots, calculated the actual yield/experimental plot ($15m^2$) and then converted into quintal/ha, and at the same time determine the Weight of 100 pods, weight of 100 seeds, mass unshelled peanuts, number of qualified pods/plant of the studied cultivars by electronic scales with an accuracy of $10^{-4}$ were determined at the same time. Reducing sugar content was calculated using Bertrand method while starch content was determined by acid hydrolysis [8]. The lipid and protein content was determined by Soxhlet method and Lowry method respectively [8, 9]. Acid value, saponification value and iodine value were determined using Birnin-Yauri and Garba's description [10]. The vitamin C content was determined by titration [8]. The content of vitamins $B_1$, $B_2$ and $B_6$ was determined by fluorescence spectroscopy [8]. The vitamin A content was determined using the description by Chau *et al*. [11]. Determination of amino acid content was conducted using automated amino acid analyzer HP-Amino Quant Series II [12]. The content of N and P was determined by molecular absorption spectroscopy (UV-VIS) [8]. The content of other minerals (K, Ca, Mg, Fe and S) was determined by atomic absorption spectroscopy (AAS) [13]. Analysis of biochemical indicators was conducted at the Plant laboratory, Hong Duc University. Amino acid and vitamin content were analyzed at the Institute of Biotechnology and Institute of Chemistry at Vietnam Academy of Science and Technology. Determination of mineral elements at National Institute of Agricultural Planning and Projection, Vietnam.

**Statistical analysis.** All indicators were conducted three times independently. The results are expressed as mean values and standard deviation (SD). Statistical processing of results was performed by IRRISTAT software package, version 5.0.

## Results and discussion

**Effect of KCl on yield components and yield.** Yield is an important indicator to assess the overall impact of technical measures on crops, yield components contribute to changes in yield [14]. In this study, the yield and yield components of the two peanut cultivars L14 and L23 in experimental and control formulas are presented in Table 1. For each 100 pods, L14 in the control formula produced 162.57g on average while in the experimental formula achieved 164.45g (1.88g higher). Meanwhile, the figures of L23 were 159.32g in the control formula and 160.78g (1.46g higher) in experimental formula. Regarding the weight of 100 seeds, the weight of L14 in the experimental formula was 1.21g higher than that of the control, the number of L23 in the experimental formula was 1.89g higher than that of the control. These results were consistent with that in Toklu's study that when potassium immersion during the seed treatment contributed to an increase in the number of pods and seeds of Lentil [5].

Table 1.

Yield components and yield of L14 and L23

| Factors | Peanut L14 | | Peanut L23 | |
|---|---|---|---|---|
| | Control | Experiment | Control | Experiment |
| Weight of 100 pods (g) | 162.57 ± 2.14 | 164.45 ± 2.76 | 159.32 ± 3.15 | 160.78 ± 2.63 |
| Weight of 100 seeds (g) | 61.17 ± 1.85 | 62.38 ± 2.05 | 58.25 ± 1.37 | 60.14 ± 1.94 |
| Mass ratio of unshelled peanuts (%) | 71.57 ± 1.19 | 72.09 ± 1.05 | 69.58 ± 2.18 | 70.47 ± 1.23 |
| Number of pods per plant (pod) | 16.66 ± 0.70 | 18.91 ± 0.63 | 15.95 ± 0.67 | 17.70 ± 1.12 |
| Economic yield (quintal/ha) | 29.88 ± 0.14 | 33.57 ± 0.35 | 27.79 ± 0.43 | 28.90 ± 0.54 |
| Notes: Values are the means of three replicates with standard deviation | | | | |

In terms of mass ratio of unshelled peanuts, L14 in the control formula was recorded at 71.57% and 72.09% in the experimental formula while the percentage of L23 in the control formula and the experimental formula was 69.58% and 70.47% respectively (Table 1). KCl made contribution to an increase of not only pod weight, seed weight, and mass ratio of unshelled peanuts but also the number of qualified pods per plant. For example, the number of qualified pods/plant was witnessed an increase by 2.25 pods/plant and 1.75 pods/plant in both L14 and L23 respectively when compared to the control (Table 1). The yield is a direct consequence of yield components; therefore, the increase in the yield components in the experimental formulas resulted in an increase in the yield of these formulas. In particular, the yield of L14 increased from 29.88 quintals/ha to 33.57 quintals/ha while that of L23 also increased from 27.79 quintals/ha to 28.90 quintals/ha (Table 1). These results were consistent with the ones in Gashti *et al*.'s study, in which Potassium helped increase the yield and yield components of peanuts [14].

**Effect of KCl on several key nutritional composition.** Table 2 shows that pre-sowing seed treatment with KCl increased the nutritional profile of peanuts. The reducing sugar content of L14 increased by 0.02% and that of L23 increased by 0.14% compared to the control. Starch content of L14 increased by 0.65% while that of L23 increased by 0.21% compared to the control. Regarding lipids, peanuts in the control formula had relatively high content which were 46.35% and 43.18% in L14 and L23 respectively. Being under treatment with KCl increased the lipid content in both cultivars to 47.20% in L14 and 45.12% in L23. In addition, KCl also increased the protein content in the experimental formulas by 0.13% in L14 and 0.68% in L23 when compared to the control. However, it should be noted that the protein content in this study was lower than that reported in other studies [15, 16].

When it comes to the acid values, the peanut seed treated with KCl had a lower acid value than the control. For example, that of L14 in the control formula was 1.76 and in the experimental formula was 1.18, while the numbers of L23 in the control formula and the experimental formula were 1.38 and 1.05 respectively (Table 2). These figures were also lower than these reported in the study of Birnin-Yauri and Garba [10]. If looking closer to the two studied cultivars, it can be seen that seeds of L23 had lower acid values than those in L14. This means the fatty acid content in peanut oil of the L23 should be good, easy to store. In terms of saponification value, the seeds with KCl treatment had greater saponification value than the control. Particularly, that of L14 in the control formula achieved 255.54 and the experimental formula was 335.53, L23 was recorded at 254.39 of saponification value while that in the experimental formula reached 291.18 (Table 2). These saponification values are higher than those reported in other studies [10, 17]. Iodine value in the experimental formulas were lower than those in the control. The iodine value of L14 in the control formula was 12.39 while it was 9.22 in the experimental one, the number of L23 in the control formula was 11.84 and in the experimental formula was 7.99 (Table 2). Compared to results of other studies, the iodine values recorded in this study was much lower [10, 17]. The value of L14 was higher than that of L23, which can indicate that L14 had the greater amount of unsaturated fatty acids than L23. In other words, it is quickly changeable and difficult to preserve.

Regarding the composition of vitamins, the results show that vitamin A and vitamin C were not detected in peanuts at the time of the study. The vitamins $B_1$, $B_2$, $B_6$ in the experimental formula were higher than the control, in which vitamin $B_1$ had the highest content, followed by vitamin $B_6$ and vitamin $B_2$ (Table 2). These results were consistent with the report of Settaluri *et al*. and Arya *et al*. on the content of vitamins in peanuts [2, 3]. To be more specific, vitamin $B_1$ of L14 was higher than the control by 0.03 mg/100g while that of L23 was higher by 0.02 mg/100g. The similar pattern was also witnessed for Vitamin $B_2$ as the amount of vitamin $B_2$ of L14 in the experimental formula was 0.01 mg/100g higher than that of the control. The figures in the L23, however, was unchanged. The content of vitamin $B_6$ of L14 in the experimental formula was 0.02 mg/100g higher than that of the control, and in L23 was 0.01 mg/100g. In short, KCl increased the content of some vitamins in peanuts compared to the control.

Table 2.

Nutritional composition of L14 and L23

| Factors | Peanut L14 | | Peanut L23 | |
|---|---|---|---|---|
| | Control | Experiment | Control | Experiment |
| Reducing sugar (%) | 0.80 ± 0.19 | 0.82 ± 0.11 | 0.70 ± 0.04 | 0.84 ± 0.05 |
| Starch (%) | 4.11 ± 0.95 | 4.76 ± 0.57 | 4.93 ± 0.54 | 5.14 ± 0.70 |
| Lipid (%) | 46.35 ± 0.62 | 47.20 ± 0.95 | 43.18 ± 0.84 | 45.12 ± 1.70 |
| Protein (%) | 4.23 ± 0.21 | 4.36 ± 0.17 | 4.97 ± 0.16 | 5.66 ± 0.25 |
| Acid Value | 1.76 ± 0.07 | 1.18 ± 0.24 | 1.38 ± 0.10 | 1.05 ± 0.14 |
| Saponification Value | 255.54 ± 1.67 | 335.53 ± 6.59 | 254.39 ± 4.45 | 291.18 ± 1.56 |
| Iodine Value | 12.39 ± 1.90 | 9.22 ± 0.05 | 11.84 ± 1.10 | 7.99 ± 1.01 |
| Vitamin A (μg/100g) | – | – | – | – |
| Vitamin C (mg/100g) | – | – | – | – |
| Vitamin $B_1$ (mg/100g) | 0.58 ± 0.03 | 0.61 ± 0.03 | 0.55 ± 0.03 | 0.57 ± 0.03 |
| Vitamin $B_2$ (mg/100g) | 0.12 ± 0.03 | 0.13 ± 0.03 | 0.13 ± 0.03 | 0.13 ± 0.03 |
| Vitamin $B_6$ (mg/100g) | 0.34 ± 0.03 | 0.36 ± 0.03 | 0.33 ± 0.03 | 0.34 ± 0.03 |
| Notes: Values are the means of three replicates with standard deviation. (–) Not detected during the time conducting the research | | | | |

**Effect of KCl on amino acid composition.** Seed treatment with KCl for L14 and L23 provided greater amino acid content than the control (Table 3). L14 had 25.64% of total amino acid content in the control formula while the number in the experimental formula was 26.50%, the figures of L23 was 25.58% and 26.77% respectively. In addition, KCl also changed the composition of amino acids. For example, aspartic acid in the control of L14 was 3.82% while in the experimental formula reached 4.10% (increased by 0.28%), the content of aspartic acid in the experimental formula of L23 also increased by 0.22%. Arginine also increased in the experimental formulas by 0.15% for L14 and 0.12% L23 when compared to the control. Glutamic acid content achieved the highest value in both the experimental and control formulas in this study. Similar results were found in reports of other studies on the composition of amino acids found in peanuts [2, 3].

Table 3.

Amino acid composition of L14 and L23 (Unit: %)

| Amino acid | Peanut L14 | | Peanut L23 | |
|---|---|---|---|---|
| | Control | Experiment | Control | Experiment |
| Aspartic acid | 3.82 ± 0.04 | 4.10 ± 0.05 | 3.85 ± 0.02 | 4.07 ± 0.05 |
| Glutamic acid | 4.56 ± 0.04 | 4.11 ± 0.06 | 4.48 ± 0.05 | 4.63 ± 0.07 |
| Serine | 1.35 ± 0.02 | 1.49 ± 0.01 | 1.37 ± 0.03 | 1.43 ± 0.01 |
| Histidine* | 0.83 ± 0.01 | 0.88 ± 0.01 | 0.85 ± 0.01 | 0.85 ± 0.01 |
| Arginine | 3.01 ± 0.07 | 3.16 ± 0.09 | 2.94 ± 0.03 | 3.06 ± 0.05 |
| Glycine | 1.70 ± 0.01 | 1.68 ± 0.02 | 1.55 ± 0.01 | 1.64 ± 0.01 |
| Threonine* | 0.70 ± 0.01 | 0.76 ± 0.01 | 0.73 ± 0.02 | 0.77 ± 0.01 |
| Tyrosine | 1.08 ± 0.02 | 1.16 ± 0.01 | 1.09 ± 0.01 | 1.17 ± 0.02 |
| Alanine | 1.04 ± 0.01 | 1.09 ± 0.01 | 1.02 ± 0.03 | 1.09 ± 0.01 |
| Valine* | 0.99 ± 0.01 | 1.11 ± 0.02 | 1.07 ± 0.01 | 1.15 ± 0.02 |
| Methionine* | 0.11 ± 0.01 | 0.10 ± 0.01 | 0.26 ± 0.01 | 0.22 ± 0.01 |
| Phenylalanine* | 1.25 ± 0.02 | 1.34 ± 0.01 | 1.26 ± 0.02 | 1.32 ± 0.01 |
| Isoleucine* | 0.94 ± 0.01 | 1.02 ± 0.01 | 0.94 ± 0.01 | 1.01 ± 0.01 |
| Leucine* | 1.60 ± 0.02 | 1.71 ± 0.02 | 1.59 ± 0.01 | 1.69 ± 0.03 |
| Lysine* | 1.24 ± 0.04 | 1.27 ± 0.02 | 1.20 ± 0.04 | 1.24 ± 0.02 |
| Proline | 0.94 ± 0.01 | 1.05 ± 0.01 | 0.97 ± 0.02 | 0.99 ± 0.01 |
| Cysteine | 0.48 ± 0.01 | 0.47 ± 0.01 | 0.41 ± 0.01 | 0.44 ± 0.01 |
| Total | 25.64 | 26.50 | 25.58 | 26.77 |
| Notes: Values are the means of three replicates with standard deviation. (*) indispensable amino acids | | | | |

Methionine had lower content in the experimental formula than the control while other amino acids such as glutamic acid, glycine, cysteine experienced an uneven increase or decrease. In short, seed treatment with KCl contributed to higher amino acid content than the control. However, whether KCl could increase or decrease the content depended on different types of those amino acids.

**Effect of KCl on the content of some mineral elements.** Pre-sowing seed treatment with KCl for L14 and L23 led to relatively high levels of a number of mineral elements such as N, P, K, Ca, Mg, Fe and S (Table 4). KCl increased the content of elements N, P, K, Ca, Mg and S when compared to that of the control in L14. Particularly, N content increased from 2.060% to 2.374%, P from 1.180% to 1.216%, K from 0.212% to 0.232%, Ca from 0.155% to 0.160%, Mg from 0.229% to 0.232% and S from 0.174% to 0.202%. Fe was the only element whose content decreased in the experimental formula, which down from 0.007% to 0.005%. KCl also increased the content of elements including N, K, Ca, Mg and decreased the amount of P, Fe, S in L23 samples treated with KCl. N content increased from 2.979% to 3.248%, K from 0.255% to 0.283%, Ca from 0.157% to 0.163%, Mg from 0.225% to 0.229%. Meanwhile, the P content decreased from 1.172% to 1.140%, Fe from 0.007% to 0.005% and S from 0.161% to 0.150%. The content of mineral elements in this study is different from the reports of other studies [2, 3]. These differences are the result of cultivars, soil characteristics, climate and sample preparation methods [18].

Thus, the pre-sowing seed treatment with KCl increased the quality of peanuts shown by an increase in the content of some mineral elements such as N, K, Ca and Mg. However, the similar increase was not recorded in the experimental formula for other mineral elements including Fe and S.

Table 4.

Content of some mineral elements of L14 and L23 (Unit: %)

| Mineral composition | Peanut L14 | | Peanut L23 | |
|---|---|---|---|---|
| | Control | Experiment | Control | Experiment |
| N | 2.060 ± 0.005 | 2.374 ± 0.004 | 2.979 ± 0.005 | 3.248 ± 0.004 |
| P | 1.180 ± 0.005 | 1.216 ± 0.003 | 1.172 ± 0.003 | 1.140 ± 0.002 |
| K | 0.212 ± 0.002 | 0.232 ± 0.001 | 0.255 ± 0.001 | 0.283 ± 0.002 |
| Ca | 0.155 ± 0.001 | 0.160 ± 0.001 | 0.157 ± 0.001 | 0.163 ± 0.001 |
| Mg | 0.229 ± 0.002 | 0.232 ± 0.002 | 0.225 ± 0.002 | 0.229 ± 0.001 |
| Fe | 0.007 ± 0.001 | 0.005 ± 0.001 | 0.007 ± 0.001 | 0.005 ± 0.001 |
| S | 0.174 ± 0.001 | 0.202 ± 0.002 | 0.161 ± 0.002 | 0.150 ± 0.002 |
| Total | 4.017 | 4.421 | 4.956 | 5.218 |
| Notes: Values are the means of three replicates with standard deviation | | | | |

## Conclusions

Pre-sowing seed treatment with 0.05% KCl increased some indicators of yield components (weight of 100 pods, weight of 100 seeds, mass ratio of unshelled peanuts, number of pods per plant) and yield of two peanut cultivars L14 and L23. In addition, KCl also enhanced the quality of peanuts such as increasing the content of reducing sugar, starch, lipid, protein, saponification value, vitamins, total amino acids content and content of some mineral elements including N, K, Ca, Mg. When comparing the two studied cultivars, L14 had higher yield than L23 in both experimental and control formulas, while L23 had higher quality than L14.

## References

1 Akhtar S., Khalid N., Ahmed I., Shahzad A., Suleria H.A.R. Physicochemical characteristics, functional properties, and nutritional benefits of peanut oil: a review. Critical Reviews in Food Science And Nutrition. 2014. vol. 54. no. 12. pp. 1562–1575. doi: 10.1080/10408398.2011.644353

2 Arya S.S., Salve A.R., Chauhan S. Peanuts as functional food: a review. Journal of Food Science and Technology. 2016. vol. 53. no. 1. pp. 31–41. doi: 10.1007/s13197–015–2007–9

3 Settaluri V.S., Kandala C.V.K., Puppala N., Sundaram J. Peanuts and their nutritional aspects – a review. Food and Nutrition Sciences. 2012. vol. 3. no. 12. pp. 1644–1650. doi: 10.4236/fns.2012.312215

4 Alper C.M., Mattes R.D. Peanut consumption improves indices of cardiovascular disease risk in healthy adults. Journal of the American College of Nutrition. 2003. vol. 22. no. 2. pp. 133–141. doi: 10.1080/07315724.2003.10719286

5 Toklu F. Effects of different priming treatments on seed germination properties, yield components and grain yield of lentil (Lens culinaris Medik.). Notulae Botanicae Horti Agrobotanici Cluj-Napoca. 2015. vol. 43. no. 1. pp. 153–158. doi: 10.15835/nbha4319832

6 Naz F., Gul H., Hamayun M., Sayyed A. et al. Effect of NaCl stress on Pisum sativum germination and seedling growth with the influence of seed priming with potassium (KCL and KOH). American-Eurasian Journal of Agricultural and Environmental Sciences. 2014. vol. 14. no. 11. pp. 1304–1311. doi: 10.5829/idosi.aejaes.2014.14.11.748

7 Azab E. Seed Pre-soaking on Gibberellic Acid (GA3) Enhance Growth, Histological and Physiological Traits of Sugar Beet (Beta vulgaris L) under Water Stress. Egyptian Journal of Agronomy. 2018. vol. 40. no. 2. pp. 119–132. doi: 10.21608/AGRO.2018.2944.1095

8 Mui N.V. Practice in biochemistry. Technology and Science Publishing House, Ha Noi, 2001. 172 p. (in Vietnamese).

9 Lowry O.H., Rosebrough N.J., Farr A.L., Randall R.J. Protein measurement with the Folin phenol reagent. Journal of Biological Chemistry. 1951. vol. 193. pp. 265–275.

10 Birnin-Yauri U.A., Garba S. Comparative Studies on some physicochemical properties of baobab, vegetable, peanut and palm oils. Nigerian Journal of Basic and Applied Sciences. 2011. vol. 19. no. 1. pp. 64–67. doi: 10.4314/njbas.v19i1.69345

11 Chau P.T.T., Hien N.T., Tuong P.G. Biochemistry practice. Educational Publishing House, 1998. 132 p. (in Vietnamese).

12 Huyen T.T.T., Mui N.V, Bang C.P. Amino Acid Composition and Nutritional Value of Seed Proteins in Sesame (Sesamum Indicum L.) Cultivars Grown in Vietnam. International Journal of Agricultural Technology. 2016. vol. 12. no. 5. pp. 939–946.

13 Ekpete O.A., Edori O.S., Fubara E.P. Proximate and mineral composition of some Nigerian fruits. Current Journal of Applied Science and Technology. 2013. vol. 3. no. 4. pp. 1447–1454. doi: 10.9734/BJAST/2014/4431

14 Gashti A.H., Vishekaei M.N.S., Hosseinzadeh M.H. Effect of potassium and calcium application on yield, yield components and qualitative characteristics of peanut (Arachis hypogaea L.) in Guilan Province, Iran. World Applied Sciences Journal. 2012. vol. 16. no. 4. pp. 540–546.

15 Basu M., Bhadoria P.B.S., Mahapatra S.C. Growth, nitrogen fixation, yield and kernel quality of peanut in response to lime, organic and inorganic fertilizer levels. Bioresource Technology. 2008. vol. 99. no. 11. pp. 4675–4683. doi: 10.1016/j.biortech.2007.09.078

16 Irmak S. Effects of selenium application on plant growth and some quality parameters in peanut (Arachis hypogaea). Pakistan Journal of Biological Sciences. 2017. vol. 20. no. 2. pp. 92–99. doi: 10.3923/pjbs.2017.92.99

17 Mora-Escobedo R., Hernández-Luna P., Joaquín-Torres I.C., Ortiz-Moreno A. et al. Physicochemical properties and fatty acid profile of eight peanut varieties grown in Mexico. CyTA-Journal of Food. 2015. vol. 13. no. 2. pp. 300–304. doi: 10.1080/19476337.2014.971345

18 Casini C., Dardanelli J.L., Martínez M.J., Balzarini M., Borgogno C.S., Nassetta M. Oil quality and sugar content of peanuts (Arachis hypogaea) grown in Argentina: Their relationship with climatic variables and seed yield. Journal of Agricultural and Food Chemistry. 2003. vol. 51. no. 21. pp. 6309–6313. doi: 10.1021/jf030183j

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**Вклад авторов**

**Ле В. Чонг** разработка дизайна исследования, получение данных для анализа, анализ полученных данных, написание первоначального текста рукописи, ответственность за плагиат

**Буй Б. Тхинь** анализ полученных данных, написание и редактирование рукописи

**Contribution**

**Le V. Trong** conceived and planned the research, set-up the experiments, collected and analyzed the data, and wrote the initial draft of the manuscript, responsible for plagiarism

**Bui B. Thinh** analyzed the data, wrote and edited the manuscript.

**Конфликт интересов**

Авторы заявляют об отсутствии конфликта интересов.

**Conflict of interest**

The authors declare no conflict of interest.

**Поступила** 13/05/2020 **После редакции** 21/05/2020 **Принята в печать** 29/05/2020

**Received** 13/05/2020 **Accepted in revised** 21/05/2020 **Accepted** 29/05/2020