

## **PREAMBLE**

### **1. INTRODUCTION**

Binh Dinh province of the South Central Coast ecological region, with a total area of 606.6 thousand hectares, but only 137.1 thousand hectares of agricultural land. According to Vietnam's soil classification, there are 8 main soil groups in Binh Dinh, in which the sandy soil group covers an area of 13,283 ha and accounts for 9.7% of the agricultural production land area. Sandy soil group, with light mechanical composition, high fine sand content, field moisture capacity, low content of total substances, poor digestible substances, so the ability to retain water and nutrients is very least.

Peanut is a short-term crop with high economic value and highly commodity crop, has a very good soil improvement ability, requires soil with light mechanical composition and is suitable for many different crop structures.

In recent years, most of the sandy land area planted with long-term crops has been replaced by agricultural crops, in which peanut is a crop that has clearly shown adaptation and is in which peanut has clearly shown adaptation and is being paid special attention by local people and authorities.

However, to effectively produce peanuts on sandy soil in Binh Dinh province, there are still many difficulties such as fertilizer regime, irrigation water, seed variety, planting distance and density, mulching and moisturizing measures, ...

According to the research results on the effects of nutritional deficiencies on peanut yield on sandy soils in the South Central Coast, without K application, the yield of peanuts decreased from 14.9 to 35.2%, without S application, the peanut yield reduced from 12.7-23.3%.

Based on the above issues, in order to expand the area and increase the efficiency of peanut production on sandy soil, the project was implemented: "Study on applying potassium and sulfur fertilizers for peanuts on sandy soil in Binh Dinh province" is very necessary, meets the

practical demand of production.

## **2. OBJECTIVES**

### **2.1. The general objective**

Evaluation of the effects of K and S fertilizers on peanuts on sandy soil; thereby proposing a method to use K and S fertilizers reasonably to improve productivity and economic efficiency in peanut production on sandy soil in Binh Dinh province.

### **2.2. The specific objective**

- Determine the effect of not applying K and S on growth and dry matter accumulation ability of peanuts on sandy soil.
- Proposing an appropriate dose of K and S for peanuts on sandy soil in order to achieve high productivity, economic efficiency and improve K and S content on sandy soil.
- Proposing a suitable form of K and S fertilizers for peanuts on sandy soil in order to achieve high productivity, economic efficiency and improve K and S content in sandy soil.

## **3. SCIENTIFIC AND PRACTICAL MEANINGS**

### **3.1. Scientific meanings**

- The results obtained from the project will be the scientific basis for proposing measures to use K and S fertilizers in peanut production to both ensure productivity and bring high economic efficiency.
- The results of the project can be used as a reference for other scientific researches in Binh Dinh province in particular and other provinces with similar ecological conditions.

### **3.2. Practical meanings**

- Properly assess the effectiveness of K and S fertilizers, determine the level and appropriate K and S fertilizers for peanuts on sandy soil in Binh Dinh province. It is recommended that farmers use K and S fertilizers reasonably for peanuts to increase yield, quality, and high economic efficiency.
- Contributing to perfecting the peanut production process on sandy soil.

#### **4. NEW POINT OF THE THEME**

K and S are identified as one of the limiting nutritional factors to the growth and development of peanuts on sandy soil in Binh Dinh province;

Research results have determined that the appropriate dosage of K and S for high yield and quality peanuts on sandy soil in Binh Dinh province is (90 kg  $K_2O$  + 30 kg S)/ha on the basal (8 tons of manure + 40 kg N + 90 kg  $P_2O_5$  + 500 kg lime)/ha;

Research results have determined that the effective K and S form in peanut production on sandy soil in Binh Dinh province is  $K_2SO_4$ .

### **CHAPTER 1 OVERVIEW DOCUMENT**

#### **1.1. THEORETICAL BASIS OF RESEARCH PROBLEM**

##### **1.1.1. The role of peanuts in the crop system**

##### **1.1.2. Ecological requirements of peanuts**

###### **1.1.2.1. Soil requirements**

###### **1.1.2.2. Temperature requirements**

###### **1.1.2.3. Light requirements**

###### **1.1.2.4. Water needs**

##### **1.1.3. The role of K and S in peanuts**

###### **1.1.3.1. The role of K in peanuts**

###### **1.1.3.2. The role of S in peanuts**

##### **1.1.4. K and S nutrient uptake and requirements of peanuts**

###### **1.1.4.1. Plant K uptake and K nutrient requirements of peanuts**

###### **1.1.4.2. Plant S uptake and S nutrient requirements of peanuts**

###### **1.1.4.3. The interaction between K and S in peanuts**

##### **1.1.5. Characteristics of sandy soil**

#### **1.2. PRACTICAL BASIS OF RESEARCH PROBLEM**

##### **1.2.1. Peanut production in the world, Vietnam and Binh Dinh province**

###### **1.2.1.1. Peanut production in the world**

- 1.2.1.2. Peanut production in Vietnam
- 1.2.1.3. Peanut production in Binh Dinh province
- 1.2.2. Fertilizer application for peanuts in the world and Vietnam
  - 1.2.2.1. Fertilizer application for peanuts in the world
  - 1.2.2.2. Fertilizer application for peanuts in Vietnam
  - 1.2.2.3. Fertilizer application for peanuts in Binh Dinh province
- 1.3. RESEARCH WORKS RELATED TO THE PROJECT
  - 1.3.1. Research findings on K and S fertilizers for peanuts in the world
    - 1.3.1.1. Research findings on K fertilizers for peanuts in the world
    - 1.3.1.2. Research findings on S fertilizers for peanuts in the world
  - 1.3.2. Research findings on K and S fertilizers for peanuts in Vietnam
    - 1.3.2.1. Research findings on K fertilizers for peanuts in Vietnam
    - 1.3.2.2. Research findings on S fertilizers for peanuts in Vietnam

## **CHAPTER II**

### **MATERIALS AND METHODOLOGIES**

#### **2.1. Materials**

##### **2.1.1. Materials**

- *Type of peanut*: Ly Tay Nguyen,
- *Fertilizers*: urea, Van Dien phosphate, KCl,  $K_2SO_4$ ,  $(NH_4)_2SO_4$ , NPK 16 - 16 - 8- 13S (16% N + 16%  $P_2O_5$  + 8%  $K_2O$  + 13% S), Lam Thao superphosphate, item cow dung, lime.
- *Soil*: The experimental soil is sea sand soil (Arenosol) specialized in growing peanuts in Cat Hiep and Cat Hanh communes, Phu Cat district, Binh Dinh province.

##### **2.1.2. Scope**

Experiments and experimental models were deployed in winter-spring and Summer-Autumn crops (from winter-spring crop 2014 - 2015 to winter-spring crop 2017 - 2018) on sandy soil in Binh Dinh province.

#### **2.2. Methodologies**

*2.2.1. Content 1: Study on the effects of not applying K and S on peanuts on sandy soil in Binh Dinh province*

- The experiment consisted of 12 formulas established from 3 nutrient regimes (All nutrition, no K and no S) combined with 2 layers of sandy soil (0 - 20 cm and 20 - 40 cm) were taken in 2 communes Cat Hanh and Cat Hiep, Phu Cat district, Binh Dinh province.

- The experiment was arranged in Double-pot (upper and lower pots) in a randomized complete block design (RCBD) with 3 replicates, conducted in the 2014-2015 winter-spring crop.

*2.2.2. Content 2: Study on the effects of K and S doses on peanuts on sandy soil in Binh Dinh province*

- The experiment consisted of 12 treatments with 4 levels of K fertilizer (0, 60, 90 and 120 kg K<sub>2</sub>O/ha) combined with 4 levels of S fertilizer (0, 15, 30, 45 kg S/ha) carried out on the basal (8 tons manure + 40 kg N + 90 kg P<sub>2</sub>O<sub>5</sub> + 500 kg lime)/ha.

- The experiment was arranged in a Split - plot design with 3 replicates, carried out in the winter-spring crop of 2015 - 2016 and summer-autumn crop of 2016 in Cat Hanh and Cat Hiep communes, Phu Cat district, Binh Dinh province.

*2.2.3. Content 3: Study on the effects of K and S fertilizers on peanuts on sandy soil in Binh Dinh province*

- The treatment are proposed based on the results of studying the effects of K and S doses on peanuts on sandy soil:

<b>Treatment</b>	<b>Types of K and S fertilizers (kg/ha)</b>
T1 (Control 1)	Basal (8 tons manure + 40 kg N + 90 kg P <sub>2</sub> O <sub>5</sub> + 500 kg lime)
T2 (Control 2)	100 kg K <sub>2</sub> O (KCl) + 13 kg S (NPK 16 - 16 - 8 - 13S) + Basal
T3	90 kg K <sub>2</sub> O (KCl) + 30 kg S ((NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> ) + Basal
T4	(90 kg K <sub>2</sub> O + 30 kg S) (K <sub>2</sub> SO <sub>4</sub> ) + Basal
T5	90 kg K <sub>2</sub> O (KCl) + 30 kg S (NPK 16-16-8-13S) + Basal
T6	90 kg K <sub>2</sub> O (KCl) + 30 kg S (super phosphate Lam Thao) + Basal

- The experiment was arranged in a randomized complete block design with 3 replicates, performed in winter - spring 2016-2017 and Summer - autumn 2017 in Cat Hanh and Cat Hiep communes, Phu Cat district, Binh Dinh province.

*2.2.4. Content 4: Building an experimental model of appropriate K and S fertilizers for peanuts on sandy soil in Binh Dinh province.*

- Based on the K and S dosage in the study and the control use of local farmers, the models were built as follow:

T1 (Control): 8 tons manure + 24 kg N (urea) + 74 kg  $P_2O_5$  (Phosphate Van Dien) + 84 kg  $K_2O$  (KCl) + 100 kg NPK (16 - 16 - 8 - 13S) + 500 kg lime/ha;

T2 (Experimental): 8 tons manure + 40 kg N (urea) + 90 kg  $P_2O_5$  (phosphate Van Dien) + 90 kg  $K_2O$  ( $K_2SO_4$ , 90 kg  $K_2O$  and 30 kg S) + 500 kg lime/ha;

- The demonstration model is applied by the participatory method of the people, arranged in a non-repeating large plot and shown in the Winter - spring crop of 2017 - 2018.

**\* *Data processing methods***

The collected data were calculated, biologically processed with averages, analyzed with 1 or 2 factor ANOVA,  $LSD_{0.05}$  and analyzed by correlation using Statistix 9.0 and Excel software.

## CHAPTER 3

### RESULTS AND DISCUSSION

#### 3.1. Research results on the effects of not applying K and S on peanuts on sandy soil in Binh Dinh province

The results of monitoring the effects of not applying K and S on the number of nodules, leaf area, plant height and biomass of peanuts are presented in table 3.1.

*Table 3.1. Effects of not applying K and S on growth and biomass of peanuts under net house condition*

Treatment	Number of nodules/plant	Area of leaves/plant (dm <sup>2</sup> /plant)	Plant height (cm)	Dry biomass (g/plant)
T 1	152.2 <sup>a</sup>	6.58 <sup>a</sup>	30.72 <sup>a</sup>	8.0 <sup>a</sup>
T 2	103.2 <sup>c</sup>	1.62 <sup>f</sup>	16.05 <sup>f</sup>	2.5 <sup>f</sup>
T 3	72.5 <sup>e</sup>	3.59 <sup>d</sup>	24.67 <sup>c</sup>	6.3 <sup>b</sup>
T 4	103.4 <sup>c</sup>	6.09 <sup>bc</sup>	28.95 <sup>b</sup>	8.0 <sup>a</sup>
T 5	67.6 <sup>e</sup>	1.52 <sup>f</sup>	13.94 <sup>g</sup>	1.9 <sup>g</sup>
T 6	107.5 <sup>c</sup>	3.16 <sup>e</sup>	22.56 <sup>d</sup>	5.4 <sup>c</sup>
T 7	153.3 <sup>a</sup>	6.15 <sup>b</sup>	29.33 <sup>ab</sup>	6.4 <sup>b</sup>
T 8	22.5 <sup>f</sup>	1.62 <sup>f</sup>	14.50 <sup>g</sup>	2.8 <sup>f</sup>
T 9	94.0 <sup>d</sup>	3.33 <sup>e</sup>	23.72 <sup>cd</sup>	4.3 <sup>d</sup>
T 10	125.7 <sup>b</sup>	5.88 <sup>c</sup>	28.05 <sup>b</sup>	5.4 <sup>c</sup>
T 11	89.1 <sup>d</sup>	1.61 <sup>f</sup>	17.61 <sup>e</sup>	2.5 <sup>f</sup>
T 12	67.6 <sup>e</sup>	3.22 <sup>e</sup>	24.72 <sup>cd</sup>	3.9 <sup>e</sup>
<i>LSD<sub>0,05</sub></i>	7.33	0.25	1.43	0.3

*Note: Data was collected at the fruiting stage*

The results in table 3.1 show that the growth ability of peanuts in the 0-20 cm soil layer is better than in the 20-40 cm soil layer and in Cat Hiep commune better than in Cat Hanh commune. Peanuts are grown on sandy

soil under net house conditions; the absence of additional application of K and S resulted in a statistically significant reduction in the number of nodules, total leaf area, and dry biomass compared with the fully fertilized control.

The content of K and S in the sandy soil and in the plant has a great influence on the growth and the ability to accumulate dry matter of peanuts, the results of analysis of the K and S content in the plant and the soil after the experiment under the influence of The effects of not applying K and S showed that the  $K_2O$  and S concentrations in plants and soil were significantly reduced when K and S were not added.

Thus, in order for peanuts grown on sandy soil to grow, develop well and give high yield, the additional application of K and S is necessary. Not adding K and S to peanuts will reduce the number of nodules, leaf area, plant height, biomass, accumulated K and S content in the plant, and  $K_2O$  and S content in the soil after each crop.

### **3.2. Research results on the effects of K and S doses on peanuts on sandy soil in Binh Dinh province**

For peanuts, the growth of leaf area from sprouting to fruit and seed formation corresponded to plant height growth. The period from flowering to fruit formation is the period when the stems and branches develop strongly, the leaf area also develops the fastest, the peanut leaf area index is highest in the period of fruit and seed formation.

The results of monitoring the effect of K and S doses on height, number of first-grade branches, number of nodules, leaf area index and biomass of peanuts on sandy soils have reached the following conclusions:

The number of level 1 branches of peanuts increased at a statistically significant level when increasing the K dose from 0 to 90 and 120 kg  $K_2O/ha$  and when starting to simultaneously increase the K dose from 0 to 60 kg  $K_2O/ha$  and S from 0 to 30 kg S/ha.

The number of nodules: at the flowering stage increased and there was a statistical difference when increasing the K dose from 0 to 90 and 120 kg  $K_2O/ha$ , the dose of S from 0 to 30 and 45 kg S/ha; At the fruiting



stage, there was an increase and there was a statistical difference when increasing the K dose from 0 to 60, 90 and 120 kg K<sub>2</sub>O/ha, the dose of S from 0 to 30 and 45 kg S/ha. At the same time, the number of nodules of peanuts at the branching stage started to increase at the dose 90 kg K<sub>2</sub>O/ha combined with 30 kg S/ha, at the flowering stage started to increase at the dose 60 kg K<sub>2</sub>O/ha combined with 15 kg S/ha.

The leaf area index of peanuts at the stage from full flowering to fruit formation began to increase significantly when the K dose was increased to 90 kg K<sub>2</sub>O/ha; At the fruiting stage also increased significantly when increasing the dose of S to 30 kg S/ha and simultaneously increasing the dose of K from 0 to 60 kg K<sub>2</sub>O/ha in combination with the dose of S from 0 to 15 kg S/ha.

The biomass of peanuts in the period from full flowering to fruit formation increased and there was a statistical difference when increasing the K dose from 0 to 90 and 120 kg K<sub>2</sub>O/ha and simultaneously increasing the dose of K from 0 to 60 kg K<sub>2</sub>O/ha combined with increasing the dose of fertilizer S from 0 to 15 kg S/ha.

Yield is the end result that reflects the suitability and effectiveness of farming solutions applied to a cultivar under specific ecological conditions. The results of K and S doses applied on the yield and yield components of peanuts on sandy soil are presented in tables 3.8 and 3.9.

**Table 3.8.** *Effect of K and S dosage on yield and components of yield of peanut in winter-spring crop*

Amount K <sub>2</sub> O (kg/ha)	Amount S (kg/ha)	Number of pods/ plant	Number of filling pods/plant	Theoretical yield (tons/ha)	Yield (tons/ha)
<i>Cat Hiep commune</i>					
0	0	16.63 <sup>d</sup>	13.03 <sup>h</sup>	4.17 <sup>g</sup>	2,75 <sup>g</sup>
	15	17.20 <sup>cd</sup>	13.67 <sup>gh</sup>	4.39 <sup>fg</sup>	2,85 <sup>fg</sup>
	30	17.77 <sup>bcd</sup>	14.50 <sup>eg</sup>	4.66 <sup>ef</sup>	3,23 <sup>ef</sup>
	45	17.80 <sup>bcd</sup>	14.53 <sup>eg</sup>	4.67 <sup>ef</sup>	3,27 <sup>e</sup>
60	0	18.17 <sup>bcd</sup>	14.53 <sup>eg</sup>	4.69 <sup>ef</sup>	3,26 <sup>e</sup>
	15	19.30 <sup>a-d</sup>	15.43 <sup>de</sup>	4.99 <sup>de</sup>	3,44 <sup>de</sup>
	30	20.67 <sup>ab</sup>	16.27 <sup>cd</sup>	5.25 <sup>cd</sup>	3,70 <sup>cd</sup>

Amount K <sub>2</sub> O (kg/ha)	Amount S (kg/ha)	Number of pods/ plant	Number of filling pods/plant	Theoretical yield (tons/ha)	Yield (tons/ha)
	45	20.53 <sup>ab</sup>	16.20 <sup>cd</sup>	5.23 <sup>cd</sup>	3,69 <sup>cd</sup>
90	0	19.57 <sup>abc</sup>	16.13 <sup>cd</sup>	5.20 <sup>cd</sup>	3,68 <sup>cd</sup>
	15	20.30 <sup>ab</sup>	16.87 <sup>bc</sup>	5.46 <sup>bc</sup>	3,85 <sup>bc</sup>
	30	21.30 <sup>a</sup>	18.07 <sup>ab</sup>	5.87 <sup>ab</sup>	4,24 <sup>a</sup>
	45	21.43 <sup>a</sup>	18.00 <sup>ab</sup>	5.85 <sup>ab</sup>	4,23 <sup>ab</sup>
120	0	19.93 <sup>abc</sup>	16.30 <sup>cd</sup>	5.27 <sup>cd</sup>	3,68 <sup>cd</sup>
	15	20.50 <sup>ab</sup>	17.10 <sup>abc</sup>	5.53 <sup>abc</sup>	3,88 <sup>abc</sup>
	30	21.47 <sup>a</sup>	18.17 <sup>a</sup>	5.88 <sup>a</sup>	4,25 <sup>a</sup>
	45	21.40 <sup>a</sup>	18.10 <sup>a</sup>	5.88 <sup>a</sup>	4,25 <sup>a</sup>
CV (%)		6,80	5.00	5.22	6.62
LSD <sub>0,05</sub> (K x S)		2,92	1.20	0.41	0.38
<i>Cat Hanh commune</i>					
0	0	12.23 <sup>f</sup>	10.13 <sup>g</sup>	3.27 <sup>f</sup>	2,36 <sup>i</sup>
	15	12.37 <sup>ef</sup>	10.63 <sup>fg</sup>	3.42 <sup>ef</sup>	2,57 <sup>hi</sup>
	30	12.70 <sup>ef</sup>	10.87 <sup>fg</sup>	3.50 <sup>def</sup>	2,82 <sup>gh</sup>
	45	12.57 <sup>ef</sup>	10.97 <sup>fg</sup>	3.55 <sup>def</sup>	2,82 <sup>gh</sup>
60	0	12.60 <sup>ef</sup>	10.70 <sup>fg</sup>	3.43 <sup>ef</sup>	2,68 <sup>gh</sup>
	15	13.13 <sup>de</sup>	11.50 <sup>c-f</sup>	3.73 <sup>b-e</sup>	2,95 <sup>efg</sup>
	30	13.83 <sup>bcd</sup>	12.20 <sup>a-e</sup>	3.92 <sup>abc</sup>	3,26 <sup>cde</sup>
	45	13.90 <sup>a-d</sup>	12.27 <sup>a-d</sup>	3.95 <sup>abc</sup>	3,28 <sup>cd</sup>
90	0	13.63 <sup>cd</sup>	11.20 <sup>ef</sup>	3.61 <sup>c-f</sup>	2,99 <sup>def</sup>
	15	14.07 <sup>abc</sup>	11.97 <sup>b-e</sup>	3.85 <sup>bcd</sup>	3,33 <sup>c</sup>
	30	14.47 <sup>ab</sup>	12.43 <sup>abc</sup>	4.02 <sup>ab</sup>	3,76 <sup>a</sup>
	45	14.67 <sup>a</sup>	12.50 <sup>abc</sup>	4.00 <sup>ab</sup>	3,71 <sup>ab</sup>
120	0	13.80 <sup>bcd</sup>	11.30 <sup>def</sup>	3.63 <sup>c-f</sup>	3,15 <sup>cde</sup>
	15	14.03 <sup>abc</sup>	12.63 <sup>ab</sup>	4.07 <sup>ab</sup>	3,45 <sup>bc</sup>
	30	14.20 <sup>abc</sup>	13.07 <sup>a</sup>	4.29 <sup>a</sup>	3,79 <sup>a</sup>
	45	14.23 <sup>abc</sup>	13.10 <sup>a</sup>	4.25 <sup>a</sup>	3,87 <sup>a</sup>
CV (%)		3,43	4.98	5.33	6.01
LSD <sub>0,05</sub> (K x S)		0,82	1.05	0.37	0.29

At the same level of S application, the number of pods of peanuts increased and there was a statistical difference when the K dose was increased from 0 to 90 and 120 kg K<sub>2</sub>O/ha. The number of pods of peanut in winter - spring crop also increased at a statistically different level when

starting to increase the dose of K from 0 to 60 kg K<sub>2</sub>O/ha and S from 0 to 30 kg S/ha.

For the indicator of number of well-rounded pods, at the same level of S application, when the K dose was increased from 0 to 90 and 120 kg K<sub>2</sub>O/ha, the number of filling pods increased and there was a statistical difference at the 95% confidence level. On the K fertilization levels of 60, 90 and 120 kg K<sub>2</sub>O/ha, the number of filling pods of peanuts increased and there was a statistical difference when increasing the dose of S from 0 to 30 and 45 kg S/ha. The number of filling pods of peanut also increased with statistical difference when starting to increase the dose of K from 0 to 60 kg K<sub>2</sub>O/ha and S from 0 to 15 kg S/ha.

The yield of peanuts in winter - spring on sandy soils increased by 12.76 - 20.6%, 26.39 - 35.07% and 30.16 - 37.07%, respectively, in corresponding to K dose from 0 to 60, 90 and 120 kg K<sub>2</sub>O/ha; the yield also increased respectively by 13.48 - 26.04% and 13.17 - 22.85% as the S added from 0 to 30 and 45 kg S/ha; the peanut yield was highest at the K fertilizer level of 90 - 120 kg K<sub>2</sub>O/ha combined with the S fertilizer level of 30 - 45 kg S/ha.

**Table 3.9.** *Effects of K and S doses on yield and yield components of peanut summer-autumn crop*

Amount K <sub>2</sub> O (kg/ha)	Amount S (kg/ha)	Number of pods/plant	Number of filling pods/plant	Theoretical yield (tons/ha)	Yield (tons/ha)
<i>Cat Hiep commune</i>					
0	0	13.60 <sup>e</sup>	10.23 <sup>g</sup>	3.18 <sup>g</sup>	1.86 <sup>f</sup>
	15	14.13 <sup>de</sup>	10.83 <sup>fg</sup>	3.37 <sup>fg</sup>	1.97 <sup>ef</sup>
	30	14.97 <sup>cde</sup>	11.21 <sup>ef</sup>	3.53 <sup>ef</sup>	2.09 <sup>de</sup>
	45	15.00 <sup>b-e</sup>	11.20 <sup>ef</sup>	3.53 <sup>ef</sup>	2.10 <sup>de</sup>
60	0	14.94 <sup>cde</sup>	11.18 <sup>ef</sup>	3.52 <sup>ef</sup>	2.08 <sup>de</sup>
	15	15.37 <sup>b-e</sup>	11.70 <sup>def</sup>	3.69 <sup>de</sup>	2.18 <sup>cd</sup>
	30	16.10 <sup>abc</sup>	12.23 <sup>bcd</sup>	3.88 <sup>bcd</sup>	2.31 <sup>bc</sup>
	45	16.07 <sup>abc</sup>	12.03 <sup>cde</sup>	3.82 <sup>cde</sup>	2.31 <sup>bc</sup>
90	0	15.90 <sup>a-d</sup>	12.33 <sup>bcd</sup>	3.90 <sup>bcd</sup>	2.30 <sup>bc</sup>
	15	16.80 <sup>ab</sup>	12.93 <sup>abc</sup>	4.10 <sup>abc</sup>	2.44 <sup>b</sup>
	30	17.27 <sup>a</sup>	13.43 <sup>a</sup>	4.28 <sup>a</sup>	2.63 <sup>a</sup>

Amount K <sub>2</sub> O (kg/ha)	Amount S (kg/ha)	Number of pods/ plant	Number of filling pods/plant	Theoretical yield (tons/ha)	Yield (tons/ha)
	45	17.23 <sup>a</sup>	13.43 <sup>a</sup>	4.28 <sup>a</sup>	2.64 <sup>a</sup>
120	0	15.93 <sup>a-d</sup>	12.40 <sup>bcd</sup>	3.92 <sup>bcd</sup>	2.31 <sup>bc</sup>
	15	16.73 <sup>abc</sup>	13.00 <sup>ab</sup>	4.13 <sup>ab</sup>	2.45 <sup>b</sup>
	30	17.33 <sup>a</sup>	13.40 <sup>a</sup>	4.26 <sup>a</sup>	2.63 <sup>a</sup>
	45	17.30 <sup>a</sup>	13.43 <sup>a</sup>	4.28 <sup>a</sup>	2.64 <sup>a</sup>
CV (%)		5.84	4.43	4.76	3.43
LSD <sub>0.05</sub> (K x S)		1.80	0.94	0.31	0.17
<i>Cat Hanh commune</i>					
0	0	13.37 <sup>i</sup>	9.43 <sup>h</sup>	2.97 <sup>h</sup>	1.70 <sup>g</sup>
	15	13.93 <sup>hi</sup>	9.60 <sup>gh</sup>	3.04 <sup>gh</sup>	1.81 <sup>fg</sup>
	30	14.69 <sup>e-h</sup>	10.03 <sup>fgh</sup>	3.18 <sup>e-h</sup>	1.97 <sup>ef</sup>
	45	14.63 <sup>fgh</sup>	9.90 <sup>gh</sup>	3.13 <sup>fgh</sup>	1.98 <sup>ef</sup>
60	0	14.55 <sup>ghi</sup>	10.04 <sup>fgh</sup>	3.18 <sup>fgh</sup>	2.03 <sup>e</sup>
	15	15.17 <sup>d-h</sup>	10.60 <sup>efg</sup>	3.36 <sup>d-g</sup>	2.13 <sup>de</sup>
	30	15.90 <sup>b-f</sup>	11.13 <sup>de</sup>	3.55 <sup>de</sup>	2.26 <sup>cd</sup>
	45	15.97 <sup>a-e</sup>	11.20 <sup>de</sup>	3.57 <sup>d</sup>	2.26 <sup>cd</sup>
90	0	15.77 <sup>c-g</sup>	11.03 <sup>def</sup>	3.50 <sup>def</sup>	2.28 <sup>cd</sup>
	15	16.63 <sup>abc</sup>	11.70 <sup>bcd</sup>	3.73 <sup>bcd</sup>	2.37 <sup>bc</sup>
	30	17.10 <sup>ab</sup>	12.53 <sup>abc</sup>	4.01 <sup>abc</sup>	2.55 <sup>ab</sup>
	45	17.13 <sup>ab</sup>	12.57 <sup>abc</sup>	4.03 <sup>abc</sup>	2.54 <sup>ab</sup>
120	0	15.73 <sup>c-g</sup>	11.00 <sup>def</sup>	3.50 <sup>def</sup>	2.27 <sup>cd</sup>
	15	16.47 <sup>a-d</sup>	11.60 <sup>cde</sup>	3.70 <sup>cd</sup>	2.37 <sup>bc</sup>
	30	17.27 <sup>a</sup>	12.77 <sup>ab</sup>	4.07 <sup>ab</sup>	2.56 <sup>ab</sup>
	45	17.23 <sup>a</sup>	12.93 <sup>a</sup>	4.13 <sup>a</sup>	2.59 <sup>a</sup>
CV (%)		4.63	4.70	5.58	5.41
LSD <sub>0.05</sub> (K x S)		1.33	1.08	0.37	0.21

Number of pods in the summer-autumn increased with increasing K and S doses. At the same level of S addition, number of pods in the summer-autumn increased and there was a statistical difference when the K dose was increased from 0 to 90 and 120 kg K<sub>2</sub>O/ha. When simultaneously increasing the dose of K fertilizer from 0 to 60 kg K<sub>2</sub>O and S from 0 to 30 kg S/ha, number of peanut pods began to increase at a level with biological statistical difference.

Similarly, number of filling pods in the summer-autumn crop summer-autumn crop increased with increasing K and S doses. At the same level of S application, the No. of well-rounded pods increased at a level that was statistically different from the increase in K dose from 0 to 90 and 120 kg K<sub>2</sub>O/ha. At the K levels of 60, 90 and 120 kg K<sub>2</sub>O/ha, the No. of well-rounded pods of peanuts increased by 8.06 - 16.06% and 7.65 - 17.58% respectively when increasing the dose of S from 0 to 30 kg S/ha and from 0 to 45 kg S/ha at the 95% confidence level. The number of filling pods of peanut in summer-autumn also increased statistically when starting to increase the dose of K from 0 to 60 kg K<sub>2</sub>O/ha and S from 0 to 15 kg S/ha.

The yield of peanuts in summer-autumn crop on sandy soil increased by 10.37 - 19.68%, 23.51 - 34.05% and 23.95 - 33.3% with corresponding increase in K dose from 0 to 60, 90 and 120 kg K<sub>2</sub>O/ha; increased by 10.93 - 15.87% and 11.05 - 16.34% respectively when increasing the dose of S from 0 to 30 and 45 kg S/ha; increased and there was a statistical difference as the dose of K increades from 0 to 60 kg K<sub>2</sub>O/ha in combination with S doses from 0 to 15 kg S/ha; the highest net yield was achieved at the K fertilizer level of 90 - 120 kg K<sub>2</sub>O/ha combined with the S fertilizer level of 30 - 45 kg S/ha.

In order to evaluate the effectiveness of fertilizer use in production, fertilizer efficiency for each specific dose and type of fertilizer is one of the important criteria to decide to change the method of fertilizer use and to determine the correct use of determine the correct use of fertilizers as well as investment efficiency efficiency. The results of calculating the effect of K and S doses on K and S fertilizer yield of peanuts on sandy soil are presented in table 3.10.

**Table 3.10.** *Effect of K and S dosage on K and S fertilizer performance of peanuts*

Amount K <sub>2</sub> O (kg/ha)	Amount S (kg/ha)	Performance K fertilizer (kg pods/kg K <sub>2</sub> O)		Performance K fertilizer (kg pods/kg K <sub>2</sub> O)	
		winter - spring	summer- autumn	winter - spring	summer- autumn
Cat Hiep commune					
0	0	-	-	-	-
	15	-	-	6.67	7.33
	30	-	-	16.00	7.67
	45	-	-	11.56	5.33
60	0	8.50	3.67	-	-
	15	9.83	3.50	12.00	6.67
	30	7.83	3.67	14.67	7.67
	45	7.00	3.50	9.56	5.11
90	0	10.33	4.89	-	-
	15	11.11	5.22	11.33	9.33
	30	11.22	6.00	18.67	11.00
	45	10.67	6.00	12.22	7.56
120	0	7.75	3.75	-	-
	15	8.58	4.00	13.33	9.33
	30	8.50	4.50	19.00	10.67
	45	8.17	4.50	12.67	7.33
Cat Hanh commune					
0	0	-	-	-	-
	15	-	-	14.00	7.33
	30	-	-	15.33	9.00
	45	-	-	10.22	6.22
60	0	5.33	5.50	-	-
	15	6.33	4.00	18.00	6.67
	30	7.33	4.83	19.33	7.67
	45	7.67	4.67	13.33	5.11
90	0	7.00	6.44	-	-
	15	8.44	5.33	22.67	6.00
	30	10.44	6.44	25.67	9.00
	45	9.89	6.22	16.00	5.78
120	0	6.58	4.75	-	-
	15	7.33	4.00	20.00	6.67
	30	8.08	4.92	21.33	9.67
	45	8.75	5.08	16.00	7.11

The results obtained in table 3.10 show that the K fertilizer performance was highest at 90 kg K<sub>2</sub>O/ha (gained 9.89 kg pods/kg K<sub>2</sub>O in the winter-spring crop and 5.93 kg pods/kg K<sub>2</sub>O in the summer-autumn crop), the S fertilizer performance was highest at 30 kg S/ha (reaching 18.75 kg pods/kg S in the winter-spring crop and 9.04 kg pods/kg S in the summer-autumn crop).

Similarly, the results of quality analysis; K and S content in leaves, fruit and soil; Other fertilizer efficiency calculations also have the following conclusions:

When the dosage of K and S was increased, the protein and lipid content in peanuts increased and reached the highest at the dose of 90 - 120 kg K<sub>2</sub>O/ha combined with 30 - 45 kg S/ha;

- The content of K<sub>2</sub>O and S in the stems, leaves and seed increased with the increase of K and S amount, the K<sub>2</sub>O and S content in peanuts reached the highest at the K fertilizer levels of 90 - 120 kg K<sub>2</sub>O/ha and S was 30 - 45 kg S/ha. There is an interaction between the dose of K and S fertilizers with the content of S and K in the stems, leaves and seed of peanut;

- Harvest index K and S increased with increasing dosage of K and S, HI<sub>K</sub> and HI<sub>S</sub> reached the highest at K amount is 90 - 120 kg K<sub>2</sub>O/ha and S amount is 30 - 45 kg S/ha;

- The agronomic performance of K fertilizer increases with increasing K amount, the agronomic efficiency of S fertilizer increases with increasing S amount, the agronomic efficiency of K and S fertilizers also increases with the increase of S and K amount; The efficiency of using K and S in fertilizers was highest at the K amount is 90 kg K<sub>2</sub>O/ha and S is 30 kg S/ha.

- The content of K and S in the sandy soil of peanuts was maintained and improved significantly when increasing the K and S amount to 120 kg K<sub>2</sub>O/ha and 45 kg S/ha.

In summary: Different amount of K and S fertilizers have effects on growth, development, yield and yield components, quality and production

of peanut. After two crops in two different locations, the research has determined the appropriate dosage of K and S for peanuts on sandy soil in Binh Dinh province is 90 kg K<sub>2</sub>O and 30 kg S.

### 3.3. Results of the effects of K and S fertilizers on peanuts on sandy soil in Binh Dinh province

Besides amount, form of fertilizer also lead to different nutrient absorption capacity of plants. The results of monitoring the influence of K and S fertilizers on peanuts have concluded: Peanuts being applied with 90 kg K<sub>2</sub>O and 30 kg S in the form of K<sub>2</sub>SO<sub>4</sub> fertilizer gave higher plant height statistically compared with no K and S fertilizer; the number of nodules, leaf area index, and biomass increased statistically and reached the highest when applying 90 kg K<sub>2</sub>O and 30 kg S in the form of K<sub>2</sub>SO<sub>4</sub> fertilizer compared with the control treatment of local farmers

The results of data collection on the effects of K and S fertilizers on yield and yield components of peanuts on sandy soil in the winter-spring and summer-autumn seasons are presented in Tables 3.24 and 3.25:

**Table 3.24.** *Effect of K and S fertilizers on yield and components yield of peanut in winter-spring crop*

Treatment	Number of pods/plant	Number of filling pods/plant	Theoretical yield (tons/ha)	Yield (tons/ha)
<i>Cat Hiep commune</i>				
T1 (Control 1)	16.73 <sup>d</sup>	13.33 <sup>c</sup>	4.58 <sup>d</sup>	2.83 <sup>e</sup>
T2 (Contrtroll 2)	17.83 <sup>cd</sup>	16.03 <sup>b</sup>	5.55 <sup>c</sup>	3.45 <sup>d</sup>
T3	19.80 <sup>ab</sup>	18.07 <sup>a</sup>	6.31 <sup>ab</sup>	4.15 <sup>ab</sup>
T4	20.93 <sup>a</sup>	18.50 <sup>a</sup>	6.47 <sup>a</sup>	4.42 <sup>a</sup>
T5	19.00 <sup>bc</sup>	17.37 <sup>ab</sup>	6.04 <sup>ab</sup>	3.84 <sup>bc</sup>
T6	18.38 <sup>bc</sup>	16.90 <sup>ab</sup>	5.87 <sup>bc</sup>	3.65 <sup>cd</sup>
CV (%)	4.58	5.82	4.39	4.69
LSD <sub>0.05</sub>	1.56	1.77	0.46	0.32
<i>Cat Hanh commune</i>				
T1 (Contrast 1)	14.13 <sup>d</sup>	12.13 <sup>e</sup>	4.18 <sup>d</sup>	2.63 <sup>e</sup>
T2 (Contrast 2)	15.63 <sup>c</sup>	13.33 <sup>d</sup>	4.61 <sup>cd</sup>	3.15 <sup>d</sup>
T3	17.77 <sup>ab</sup>	15.23 <sup>ab</sup>	5.31 <sup>ab</sup>	3.96 <sup>b</sup>



<b>Treatment</b>	<b>Number of pods/plant</b>	<b>Number of filling pods/plant</b>	<b>Theoretical yield (tons/ha)</b>	<b>Yield (tons/ha)</b>
T4	18.33 <sup>a</sup>	15.73 <sup>a</sup>	5.49 <sup>a</sup>	4.27 <sup>a</sup>
T5	17.10 <sup>ab</sup>	14.50 <sup>bc</sup>	5.04 <sup>abc</sup>	3.64 <sup>c</sup>
T6	16.50 <sup>bc</sup>	14.03 <sup>cd</sup>	4.86 <sup>bc</sup>	3.32 <sup>d</sup>
<i>CV (%)</i>	4.85	4.22	5.24	4.56
<i>LSD<sub>0.05</sub></i>	1.46	1.09	0.47	0.29

The number of pods of peanuts in the winter-spring crop increased and there was a statistical difference when supplemented with 90 kg of K<sub>2</sub>O and 30 kg of S under different forms of K and S fertilizers. The number of pods of peanuts also increased at a statistically significant difference when applying 90 kg of K<sub>2</sub>O and 30 kg of S in the form of KCl + (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub> fertilizer compared to the control. At the same level of fertilizer application of 90 kg K<sub>2</sub>O and 30 kg S, the number of pods of peanuts was highest when using K and S in the type of K<sub>2</sub>SO<sub>4</sub> fertilizer.

The number of filling pods of peanuts the winter-spring crop increased by 9.89 - 38.75% when supplemented with K and S fertilizers and reached the highest when 90 kg K<sub>2</sub>O and 30 kg S were applied in the type of K<sub>2</sub>SO<sub>4</sub> fertilizers at the 95% confidence level. The number of filling pods of peanuts also increased and there was a statistical difference when applying 90 kg K<sub>2</sub>O and 30 kg S in the form of KCl + (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> and K<sub>2</sub>SO<sub>4</sub> fertilizers compared with control.

Compared with the control, applying 90 kg K<sub>2</sub>O + 30 kg S in the form KCl + (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>, NPKS + KCl also increased the net yield of the winter-spring peanut crop by 11, 3 - 35.56% at 95% confidence level. At the same level of fertilizer application of 90 kg K<sub>2</sub>O + 30 kg S, when using K<sub>2</sub>SO<sub>4</sub> fertilizer, the actual yield increased and there was a statistical difference compared to using NPKS + KCl and super phosphate + KCl fertilizers.

**Table 3.25.** *Effect of fertilizers K and S on yield and yield components of peanut in summer-autumn crop*

<b>Treatment</b>	<b>Number of pods/plant</b>	<b>Number of filling pods/plant</b>	<b>Theoretical yield (tons/ha)</b>	<b>Yield (tons/ha)</b>
<i>Cat Hiep commune</i>				
T1 (Control 1)	13.77 <sup>d</sup>	10.70 <sup>e</sup>	3.59 <sup>e</sup>	1.71 <sup>e</sup>
T2 (Control 2)	15.03 <sup>cd</sup>	11.57 <sup>de</sup>	3.89 <sup>de</sup>	2.02 <sup>d</sup>
T3	16.63 <sup>ab</sup>	13.50 <sup>ab</sup>	4.59 <sup>ab</sup>	2.61 <sup>b</sup>
T4	17.27 <sup>a</sup>	14.23 <sup>a</sup>	4.86 <sup>a</sup>	2.93 <sup>a</sup>
T5	16.30 <sup>abc</sup>	12.80 <sup>bc</sup>	4.34 <sup>bc</sup>	2.44 <sup>bc</sup>
T6	15.73 <sup>bc</sup>	12.23 <sup>cd</sup>	4.13 <sup>cd</sup>	2.31 <sup>c</sup>
CV (%)	4.99	4.30	5.27	4.83
LSD <sub>0.05</sub>	1.43	0.98	0.41	0.21
<i>Cat Hanh commune</i>				
T1 (Contrast 1)	13.60 <sup>e</sup>	9.30 <sup>e</sup>	3.13 <sup>e</sup>	1.57 <sup>e</sup>
T2 (Contrast 2)	14.47 <sup>de</sup>	10.27 <sup>de</sup>	3.47 <sup>d</sup>	1.83 <sup>d</sup>
T3	16.53 <sup>ab</sup>	12.63 <sup>ab</sup>	4.31 <sup>ab</sup>	2.55 <sup>b</sup>
T4	17.37 <sup>a</sup>	13.23 <sup>a</sup>	4.53 <sup>a</sup>	2.84 <sup>a</sup>
T5	15.77 <sup>bc</sup>	11.90 <sup>bc</sup>	4.02 <sup>bc</sup>	2.41 <sup>b</sup>
T6	14.90 <sup>cd</sup>	11.17 <sup>cd</sup>	3.78 <sup>c</sup>	2.13 <sup>c</sup>
CV (%)	4.49	4.97	4.36	5.20
LSD <sub>0.05</sub>	1.26	1.03	0.31	0.21

When were applied 90 kg K<sub>2</sub>O/ha and 30 kg S/ha in different forms of fertilizers, the number of pods of peanut in summer-autumn crop increased and reached the highest when using K and S in K<sub>2</sub>SO<sub>4</sub>. At the same level of fertilizer application of 90 kg K<sub>2</sub>O and 30 kg S, but using fertilizer in the type of K<sub>2</sub>SO<sub>4</sub>, the number of pods of peanuts increased and there was a statistical difference compared to using super phosphate fertilizer + KCl.

Similarly, the number of filling pods of peanut in the summer-autumn crop also increased statistically when applying 90 kg K<sub>2</sub>O and 30 kg S in the form of KCl + (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub> and NPKS + KCl fertilizers compared with the control. At the same level of fertilizing 90 kg K<sub>2</sub>O and 30 kg S, but using K<sub>2</sub>SO<sub>4</sub> fertilizer, the number of filling pods of peanut

also increased statistically compared to NPKS + KCl and super phosphate + KCl fertilizers.

Compared with the control, applying 90 kg of  $K_2O$  and 30 kg of S in different forms of fertilizer has increased the yield of peanuts in the summer-autumn crop by 14.36 - 55.19% and reached the highest level. when using K and S in the type of  $K_2SO_4$ . At the same level of fertilizer application of 90 kg  $K_2O$  and 30 kg S, using  $K_2SO_4$  fertilizer also increased peanut yield at a statistically different level compared to KCl +  $(NH_4)_2SO_4$ , NPKS + KCl and superphosphate + KCl fertilizers.

Profit is an important economic efficiency indicator to determine whether a new farming technique should be developed into actual production. The results of calculating the marginal benefit cost ration (MBCR) of K and S fertilizers for peanuts are presented in tables 3.26 and 3.27.

**Table 3.26.** *The marginal benefit cost ration (MBCR) of K and S fertilizers for peanut in winter-spring crop*

Treatment	Cat Hiep commune	Cat Hanh commune	Average
T1 (Control 1)	-	-	-
T2 (Control 2)	10.15	8.61	9.38
T3	26.74	26.93	26.83
T4	55.12	56.83	55.97
T5	13.47	13.38	13.43
T6	17.86	15.07	16.46

The results of calculating the marginal benefit cost ration (MBCR) in table 3.26 show that: in comparison with the control, when applying 90 kg of  $K_2O$  and 30 kg of S in different fertilizers, the marginal benefit cost ration increase 1.43 - 5.95 times and reach the highest when using K and S in the from of  $K_2SO_4$ . At the same application rate of 90 kg  $K_2O$  and 30 kg S, the profit margin was also highest when applying K and S in the from of  $K_2SO_4$ .

**Table 3.27.** *The marginal benefit cost ration (MBCR) of K and S fertilizers for peanut in summer-autumn crop*

<b>Treatment</b>	<b>Cat Hiep commune</b>	<b>Cat Hanh commune</b>	<b>Average</b>
T1 (Control 1)	-	-	-
T2 (Control 2)	5.07	4.34	4.70
T3	18.10	19.89	19.00
T4	42.27	44.27	43.27
T5	9.73	11.26	10.49
T6	13.10	12.24	12.67

In the summer-autumn crop, compared with the fertilizer formula people are applying, when applying 90 kg of  $K_2O$  and 30 kg of S in different type of fertilizer, the marginal benefit cost ration was higher than 2.22 - 9.17 times and highest in the type of  $K_2SO_4$ .

Similarly, the analysis results of peanut quality, K and S content in leaves and peanuts also gave some conclusions:

- Protein content in peanuts increased by 0.07 - 0.36% and lipids in peanuts increased by 0.08 - 0.33% when K and S were applied. At the same fertilizer level of 90 kg  $K_2O$  and 30 kg S, protein and lipid content in peanuts reached the highest when using K and S in the form of  $K_2SO_4$  fertilizer.

- The content of K and S in the stems, leaves and seeds of peanuts on sandy soils increased when 90 kg  $K_2O$  and 30 kg S were applied in different K and S fertilizers and reached the highest in  $K_2SO_4$ .

In summary, different forms of K and S fertilizers had different effects on the growth, development, yield, quality and production efficiency of peanuts. When using a dosage of 90 kg  $K_2O/ha$  and 30 kg S/ha in the type of  $K_2SO_4$  fertilizer, peanut grown on sandy soils increased the number of nodules, leaf area index, and biomass at the full flowering stage to fruit formation, increased in number of pods, number of filling pods, theoretical yield, yield, marginal benefit cost ratio increased by 5.97 - 9.21 times, protein and lipid content in peanut increased, K and S

content in leaves and peanuts increased compared to the control.

### **3.4. Results of building an experimental model of appropriate K and S fertilizers for peanuts on sandy soil in Binh Dinh province**

From the results of research on the dosage and type of K and S fertilizers, the topic has determined the appropriate dosage of K and S for peanuts on the sandy soil of Binh Dinh province is (90 kg  $K_2O$  + 30 kg S)/ha, K and S fertilizer form that bring high yield and economic efficiency is  $K_2SO_4$ .

The results of monitoring and comparing the growth of peanuts on sandy soil between the experimental model and the control of local farmers have determined that: peanuts in the experimental model had higher in nodules number at the stage of full flowering and fruit formation and in biomass at the stage of full flowering and harvesting than that of the control.

The yield and yield components are important products and criteria to evaluate the economic efficiency of a model when applying a new farming method.

**Table 3.32.** *Level of infection, yield and yield components of peanut on sandy soil*

Criteria	Cat Hiep commune		Cat Hanh commune	
	Experiment	Control	Experiment	Control
Number of pods/plant	20.02* $\pm$ 0.94	16.92 $\pm$ 0.99	20.12 $\pm$ 1.16	17.38 $\pm$ 0.87
Number of filling pods/plant	17.50* $\pm$ 0.91	15.34 $\pm$ 0.83	17.18* $\pm$ 0.90	15.14 $\pm$ 0.79
Shelling (%)	72.99 $\pm$ 0.66	72.58 $\pm$ 0.62	73.16 $\pm$ 0.75	72.88 $\pm$ 0.78
Yield (tons/ha)	4.48* $\pm$ 0.22	3.79 $\pm$ 0.24	4.35* $\pm$ 0.26	3.63 $\pm$ 0.20

The results of data collection in table 3.32 have shown that, in the experimental model, the number of peanuts increased by 15.77 - 18.32%, the number of filling pods increased by 13.47 - 18.04%, the weight of 100 pods increased by 0.66 - 0.93 grams, weight of 100 seeds increased by 0.36 - 0.5 grams, peanut yield increased by 18.17 - 19.59% with statistical

difference compared to the control.

Economic efficiency is an important and decisive criterion for the development of a new farming method in agricultural production. The results of collecting and evaluating the economic efficiency of the model in table 3.34 show that: in the experimental model, the total cost was reduced by 791.5 thousand VND/ha, the peanut yield increased by 18.17 - 19.59 %, so the total revenue is 17.25 - 18.0 million VND/ha/crop higher than the control. Therefore, the experimental model gave a higher net profit of 18.04 - 18.79 million VND/ha/crop and the rate of return on investment increased by 34.39 - 38.05% compared to the control.

**Table 3.34.** *Economic efficiency of the model of rational use of K and S fertilizers for peanuts on sandy soil*

Criteria	Cat Hiep commune		Cat Hanh commune	
	Experiment	Control	Experiment	Control
<i>Total cost (1.000 VND/ha)</i>	36,782.5	37,574.0	36,452.5	37,244.0
- Supplies	15,472.5	16,264.0	15,672.5	16,464.0
- Labor	18,950.0	18,950.0	18,500.0	18,500.0
- Depreciation of watering equipment	1,000.0	1,000.0	1,000.0	1,000.0
- Watering energy	1,360.0	1,360.0	1,280.0	1,280.0
<i>Total revenue (1.000 VND/ha)</i>	112,000	94,750	108,750	90,750
- Yield (tons/ha)	4.48	3.79	4.35	3.63
- Price (1000 VND/tons)	25,000.0	25,000.0	25,000.0	25,000.0
<i>Net profit (1000 VND/ha)</i>	75,127.5	57,176.0	72,297.5	53,506.0
<i>Rate of return on invested capital</i>	2.04	1.52	1.98	1.44

In parallel with the criteria of productivity, quality and economic efficiency, an effective farming method needs to be environmentally sustainable. The results of analysis of some physical and chemical

parameters of the soil before and after the implementation of the model show that the soil properties after each cultivation crop are not reduced, but in some soil properties tend to be improved in a positive direction, especially for K and S content in the study.

Summary: Peanuts are grown on sandy soil, using a combination of 8 tons manure + 40 kg N (urea) + 90 kg  $P_2O_5$  (Phosphate Van Dien) + 90 kg  $K_2O$  + 30 kg S ( $K_2SO_4$ ) + 500 kg lime increased tree height, number of grade 1 branches, number of nodules, and biomass compared to the control. Therefore, peanuts in the experimental increased the number of pods/plant by 15.77 - 18.32%, the number of filling pods/plant increased by 13.47 - 18.04%, the yield of peanuts increased by 18.17 - 19.59%. , the total revenue is higher from 17.25 to 18.0 million VND/ha/crop, the net profit is higher from 18.04 to 18.79 million VND/ha/crop and the rate of return on invested capital increases by 34, 39 - 38.05%, soil properties improved compared to the control.

## **CHAPTER 4**

### **CONCLUSIONS AND RECOMMENDATIONS**

#### **4.1. Conclusions**

1- On the sandy soil of Binh Dinh province, K and S are the limiting nutrients to the growth and the ability to accumulate dry matter of peanuts; when not applying K and S reduced the number of nodules, total leaf area/plant, plant height, K and S content in plants and dry biomass decreased by 53.70 - 76.25%.

2- The appropriate dosage of K and S for peanuts grown on sandy soil in Binh Dinh province is 90 kg  $K_2O$  and 30 kg S; On the basal of fertilizer 8 tons manure + 40 kg N + 90 kg  $P_2O_5$  + 500 kg lime/ha, 90 kg  $K_2O$  + 30 kg S/ha, peanut yield in winter-spring and summer-autumn crops increased respectively 54,18 - 59.32% and 41.4 - 50.0%, the K fertilizer yield was 10.44 - 11.22 kg pods/kg  $K_2O$  and 6.0 - 6.44 kg of pods/kg  $K_2O$ , the yield of S fertilizer reached 18.67 - 25.67 kg pods/kg S

and 9.0 - 11.0 kg pods/kg S, the efficiency of using K and S in fertilizer and the protein content and lipids in peanuts are high, soil properties are maintained, the digestible forms of  $K_2O$  and  $SO_4^{2-}$  in soil are improved.

3- The effective from of K and S fertilizers for peanuts grown on sandy soil in Binh Dinh province are  $K_2SO_4$  fertilizers, based on 8 tons manure + 40 kg N (urea) + 90 kg  $P_2O_5$  (Van Dien phosphate) + 90 kg  $K_2O$  + 30 kg S + 500 kg lime, applying K and S in the form of  $K_2SO_4$  fertilizers, peanuts for biomass increased by 11.83 - 30.01%, theoretical yield increased by 16.58 - 30.55%, yield increased by 28.12 - 55.19%, cost-profit margin increased by 5.97 - 9.21 times, increased protein and lipid content in peanuts, K content and S in leaves and peanuts.

4- Peanut tree grown on sandy soil in Binh Dinh province, applying a combination of 8 tons manure (rotten cow manure) + 40 kg N (urea) + 90 kg  $P_2O_5$  (Van Dien phosphate) + 90 kg  $K_2O$  + 30 kg S ( $K_2SO_4$ ) + 500 kg lime gave biomass an increase of 6.37 - 19.57%, yield increased by 18.17 - 19.59%, increased lipid and protein content, higher net profit 18.04 - 18.79 million VND/ha/crop and the rate of return on investment increased 34.39 - 38.05%, soil properties improved compared to the fertilizer formula applied by farmers.

## **4.2. Recommendations**

1- To develop peanuts on sandy soil in Binh Dinh province to bring yield, quality and economic efficiency, it is recommended to apply a dosage of 90 kg  $K_2O$  and 30 kg S in the type of  $K_2SO_4$  on the basis 8 tons manure + 40 kg N + 90 kg  $P_2O_5$  + 500 kg lime/ha.

2- To apply the research results to actual production, it is necessary to build more demonstration models and open technical training courses and field trips to serve as a basis for propaganda and replication.

3- In order to complete the technical process of cultivating peanuts on sandy soil, it is necessary to continue to expand the contents (varieties, density, organic and micro-fertilizers, ...) and ecological conditions studied.



## LIST OF THE THESIS DISCLOSED WORKS

1- Do Thanh Nhan, Hoang Thi Thai Hoa, Hoang Minh Tam (2017), *Effect of potassium and sulfur fertilizers on peanuts in Cat Hanh commune, Phu Cat district, Binh Dinh province*, Science Journal of Hue University: Agriculture and Rural Development, Volume 126, No. 3D, Pages 75 - 84.

2- Do Thanh Nhan, Hoang Minh Tam, Hoang Thi Thai Hoa (2018), *Study on the effect of potassium and sulfur dosage on groundnut yield in Phu Cat district, Binh Dinh province*, Science and technology journal of Agriculture and Rural Development, Number 13, Pages 41 - 46.

3- Hoang Thi Thai Hoa, Do Dinh Thuc, Do Thanh Nhan (2018), *Effects of K, S deficiency on the growth of peanuts on sandy soil under net house conditions*, Journal of Soil Science, Number 54, Pages 1223 - 1228.