

## TABLE OF CONTENTS

	Page
Acknowledgement	i
Abstract	ii
Table of contents	vii
List of tables	ix
List of figures	x
List of appendix tables	xi
<b>CHAPTER 1. INTRODUCTION</b>	<b>1</b>
<b>CHAPTER 2. LITERATURE REVIEW</b>	<b>4</b>
2.1 The role of food legumes in farming systems	4
2.1.1 Farming systems and farming system research concept	4
2.1.2 Role of food legumes in human nutrition and animal feeds	5
2.1.3 Role of food legumes in cropping systems	8
2.2 Food legume production in Asia and Viet nam	10
2.3 Limitations to food legume production	13
2.3.1 Socio-economic factors	13
2.3.2 Agronomic factors	14
2.4 Management practices for yield improvement	16
<b>CHAPTER 3. MATERIALS AND METHODS</b>	<b>24</b>
3.1 Field surveys	24
3.2 Field experiment	25
3.2.1 Conditions of experiment	25
3.2.2 Treatment and design	26
3.2.3 Cultural management practices	27
3.2.4 Sampling for observation indicators	28
3.2.4.1 Soil	28
3.2.4.2 Plant	29
<b>CHAPTER 4. RESULTS OF THE STUDY</b>	<b>31</b>
4.1 Field surveys	31
4.1.1 Natural conditions of the study site	31
4.1.2 Socio-economic conditions	35
4.1.3 The role of food legumes in farming systems in the region	38
4.1.3.1 Food legumes as an important source of human nutrition	40
4.1.3.2 Food legumes as a source of animal feeds	42
4.1.3.3 Food legumes in cropping systems	43
4.1.4 Food legume production and constraints	45
4.1.4.1 Food legume production	45
4.1.4.2 The constraints for food legume production	48
4.2 The field experiment	51
4.2.1 Effect of N, P, and L on plat height of soybean and peanuts	51

4.2.2 Effect of N, P, and L on leaf area index of soybean and peanuts	53
4.2.3 Effect of N, P, and L on nodulation of soybean and peanuts	56
4.2.3.1 Nodule number	56
4.2.3.2 Nodule dry weight	58
4.2.4 Effect of N, P, and L on dry matter yields of soybean and peanuts	60
4.2.5 Effect of N, P, and L on nitrogen concentration in the plant of soybean and peanuts	63
4.2.6 Effect of N, P, and L on nitrogen yield of soybean and peanuts	66
4.2.7 Effect of N, P, and L on economic yield and its components of soybean and peanuts	69
4.2.7.1 Pods plant <sup>-1</sup>	69
4.2.7.2 Filled pods plant <sup>-1</sup>	71
4.2.7.3 Weight of 100 seeds	73
4.2.7.4 Economic yields	75
4.2.8 Evaluation of economic efficiency of the different treatments	77
<b>CHAPTER 5 DISCUSSION</b>	79
5.1 The role of food legumes in farming systems	79
5.1.1 Food legumes and human activities	79
5.1.2 Food legumes as a feed source for livestock	81
5.1.3 Food legumes in cropping systems	82
5.1.4 Food legumes and soil environment	84
5.2 Responses of soybean and peanuts to soil improving measures	85
5.2.1 Responses to P	85
5.2.2 Responses to acid soil and liming	88
5.2.3 Responses to N	91
5.3 Implications of the study in the socio-economic context of farming systems	95
<b>CHAPTER 6. CONCLUSIONS</b>	96
References	98
Appendices	105
Curriculum vitae	133

## LIST OF TABLES

	Page
Table 1.1. Distribution of area and production of food legumes in Asia compared with the world (1982-84 average)	10
Table 1.2. Average yield of food legumes in Asia region and in developing and developed world	11
Table 2. Food legume production in Northern mountainous region and Red river delta Viet nam	12
Table 3. Forest area (in 1993) of the region	32
Table 4. Some soil chemical properties of three surveyed villages	32
Table 5. Socio-economic situation of three surveyed provinces	37
Table 6. The results of the surveys in three villages on the role of food legumes in farming systems	38
Table 7. Percentage of farmer's opinions on the role of food legumes in farming systems	39
Table 8. Food legume production in three surveyed provinces	46
Table 9. Food legume production in three surveyed villages	47
Table 10. Farmer's opinions on the constraints to food legume production	49
Table 11. Analysis of variance for plant height	53
Table 12. Analysis of variance for leaf area index	55
Table 13. Analysis of variance for nodule number plant <sup>-1</sup>	58
Table 14. Analysis of variance for nodule dry weight	60
Table 15. Analysis of variance for dry matter yields	63
Table 16. Analysis of variance for plant nitrogen content	64
Table 17. Analysis of variance for nitrogen yields	69
Table 18. Analysis of variance for pod number plant <sup>-1</sup>	71
Table 19. Analysis of variance for filled pod number	73
Table 20. Effect of N, P, and L on 100 seed weight	74
Table 21. Analysis of variance for yields	77
Table 22. Effect of the different soil improving measures on economic return	78

## LIST OF FIGURES

Figure 1. Farm household systems with 4 production-consumption subsystems	4
Figure 2. Viet nam map and the study site	32
Figure 3. Climate characteristics in Bac thai province	35
Figure 4. Food legumes in cropping patterns	43
Figure 5. Food legumes in farming systems	45
Figure 6. Effect of N, P, and L on plant height of soybean and peanuts at different growth stages	52
Figure 7. Effect of N, P, and L on LAI of soybean and peanuts at different growth stages	54
Figure 8. Effect of N, P, and L on nodule number plant <sup>-1</sup> of soybean and peanuts at different growth stages	57
Figure 9. Effect of N, P, and L on nodule dry weight of soybean and peanuts at different growth stages	59
Figure 10. Effect of N, P, and L on dry matter yields of soybean and peanuts at different growth stages	62
Figure 11. Effect of N, P, and L on plant nitrogen concentration of soybean and peanuts at different growth stages	65
Figure 12. Effect of N, P, and L on nitrogen yields of soybean and peanuts at different growth stages	68
Figure 13. Effect of N, P, and L on pods plant <sup>-1</sup> of soybean and peanuts	70
Figure 14. Effect of N, P, and L on filled pods plant <sup>-1</sup> of soybean and peanuts	72
Figure 15. Effect of N, P, and L on economic yields of soybean and peanuts	76

## LIST OF APPENDIX TABLES

Appendix A. Layout of experiment	105
Appendix B. Analysis of variance (ANOVA)	106
Appendix B1. ANOVA for plant height	106
Appendix B2. ANOVA for LAI	106
Appendix B3. ANOVA for nodule number	106
Appendix B4. ANOVA for nodule dry weight	107
Appendix B5. ANOVA for dry matter yields	108
Appendix B6. ANOVA for plant nitrogen concentration	108
Appendix B7. ANOVA for nitrogen yields	109
Appendix B8. ANOVA for yield components	109
Appendix B9. ANOVA for economic yields	110
Appendix B10. ANOVA for gross return and net return	110
Appendix C. Data of the field experiment	111
Table 1. Effect of N, P, and L on plant height of soybean and peanuts	111
Table 2. Effect of N, P, and L on nodule number of soybean and peanuts	113
Table 3. Effect of N, P, and L on nodule dry weight of soybean and peanuts	114
Table 4. Effect of N, P, and L on LAI of soybean and peanuts	116
Table 5. Effect of N, P, and L on dry matter yields of soybean and peanuts	117
Table 6. Effect of N, P, and L on plant N content of soybean and peanuts	119
Table 7. Effect of N, P, and L on N yields of soybean and peanuts	120
Table 8. Effect of N, P, and L on economic yield and its components	122
Table 9. Gross return at different soil treatments	124
Table 10. Total variable costs for both soybean and peanuts	125
Table 11. Net return	125
Table 12. Soil chemical properties after experiment	126
Appendix D. Climate characteristics in three surveyed provinces	127
Appendix E. Soil chemical properties in three surveyed villages	127
Appendix G. Determination of P applied rate	129
Appendix H. Survey questionnaire	129