MINISTRY OF EDUCATION AND TRAINING

TAY NGUYEN UNIVERSITY

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STUDY ON THE EFFECTIVE FARMING TECHNIQUES OF FLOODING RICE FIELDS IN BU DOP DISTRICT, BINH PHUOC PROVINCE

Field of Study: Crop Science
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SUMMARY OF PHD THESIS IN CROP SCIENCE

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LIST OF FINDINGS THAT HAVE BEEN PUBLISHED BY AUTHOR RELATED TO THE THESIS

1. **Nguyen Van Bac, Tran Van Thuy (2017),** "Study on the growth and development of some rice varieties in Bu Dop, Binh Phuoc", Journal of Science, Tay Nguyen University, No. 24, pp 20 - 24.
2. **Nguyen Van Bac, Tran Van Thuy, Nguyen Van Thuong (2017),** "The growth and development of some hybrid maize and soybean varieties grown in winter-spring crop in paddy rice land in Bu Dop district, Binh Phuoc province " Journal of Science, Tay Nguyen University, No 26, pp. 7-12.
3. **Nguyen Van Bac, Tran Van Thuy, Nguyen Van Thuong (2018),** "The effect of nitrogen and potassium levels on yield of VN 121 hybrid rice variety in Bu Dop district - Binh Phuoc province, Journal of Science, Tay Nguyen University, No. 32, pp. 32 -38.
4. **Nguyen Van Bac (2018),** "Determination of appropriate fertilizer levels for soybean grown in dry season in paddy rice land in Bu Dop district, Binh Phuoc province", Journal of Science, Tay Nguyen University, No 33, pp. 41 - 45.

INTRODUCTION

1. Thesis imperiousness

Bu Dop district is Bu Dop is a mountainous district of Binh Phuoc province located in the southern key economic region. With a natural area of 38,051.43 ha, agricultural land is 20,606.34 ha, of which paddy land is 1783.41 ha. Mountainous terrain, gently sloping in the Northeast - Southwest direction; is a low hill terrain with absolute altitude of 100 - 300 m. The origin is the type of erosion terrain - accumulation.

Bu Dop district is located in the region characterized by tropical monsoon sub-equatorial climate, there are two distinct seasons: rainy and dry seasons with 14,318 households, 56,201 people, there are more than 10 ethnic groups living together. Rural population accounts for 90.6%. Bu Dop district has more than 1783,41 hectares of flooding rice lands with only one to two crops produced due to lack of initiative in irrigation water, of which 1.801 hectares are cultivated for the whole year (summer-autumn crop is 1.617 hectares and winter-spring crop is 184 hectares). The above area can be used to plant winter crops such as hybrid maize, vegetables and legumes. However, most of these areas are vacant due to lack of farming techniques, suitable varieties and production experiences causing waste of land resources.

Besides, Bu Dop district also has many economic development constraints which are not corresponding to the potential and economic slowdown, lack of sustainability, unreasonable crop structure, low coefficient of farming land use and economic efficiency and the rate of poor households is high. Therefore, i proceeded with the topic: "Study on some effective farming techniques in flooding rice fields in Bu Dop district, Binh Phuoc province".

2. Objectives of the study

To select new rice (Summer - Autumn crop), maize and soybean varieties (winter-spring crop) showed high yield, stability and good resistance to the conditions of production in Bu Dop district, Binh Phuoc province.

Determining the suitable fertilizer formula for rice, soybean and corn grown on wet rice land in Bu Dop district, Binh Phuoc province.

To select the rotation crop with wet rice suitable to natural conditions in Bu Dop district, Binh Phuoc province.

3. Materials and scope of the study

Materials in the study included 7 rice varieties: VD20, VN121, OM 4900, OM 5451, OM 6162, OM 7347 and OM 3536 (control); 4 soybean varieties: HLDN 29, MTD 720, VDN 14, VDN 98 and HL 07-15 (control) and 8 maize varieties including NL 13-1A, LVN 255, P2P, LVN 154, TB 1515, A 380 and the two control varieties including LVN 10 (control 1), CP 888 (control 2).

The studies were carried out on wet rice land from 2015 to 2017 in Bu Dop, Binh Phuoc districts.

4. New contributions of the study

To select VN 121 rice variety, LVN 154 maize variety and HLDN 29 soybeen with high yield, good resistance to production in Bu Dop district, Binh Phuoc province. Since then, enriched varieties of rice, corn, soybean in the cropping system in Bu Dop district; as a scientific basis for restructuring the agricultural sector of the district, contributing to exploiting land resources more effectively.

The studies has identified suitable fertilizer formulas for the following crops: 8 tons of manure + 90 kg N + 70 kg P_2O_5 + 100 kg K_2O for VN 121 rice variety (Summer-Autumn crop); 5 tons of manure + 60 kg N + 70 kg P_2O_5 + 90 kg K_2O for HLĐN 29 soybean variety; 8 tons of manure + 200 kg N + 90 kg P_2O_5 + 120 kg K_2O for LVN 154 corn soybean (Winter-Spring crop) on wet rice land in Bu Dop district, Binh Phuoc province.

The economic efficiency of the rotation formulas has been determined: wet rice (Summer-Autumn crop) – maize (winter-spring crop) and wet rice (Summer-Autumn crop) – soybean (winter-spring crop) in Bu Dop district, Binh Phuoc province.

The topic is a first comprehensive study of crop structure, rotation on wet rice land, and the fertilizer regime for each experimental crop. This result is very significant in diversifying the cultivation system of short-term crops on the basis of meeting the requirements of sustainable agricultural production in Bu Dop district.

5. The structure of the study

The thesis consisted of 150 pages, divided into the following main sections: Introduction: 04 pages. Chapter 1: Literature review and scientific basis of the topic: 38 pages. Chapter 2: Materials, contents and methodology: 16 pages. Chapter 3: Results and Discussions: 72 pages. Conclusions and Suggestions: 02 page. References: 15 pages. The results of the study were illustrated by 41 tables, 6 graphs and 8 illustrations. There were 4 published works related to the study.

Chapter 1
OVERVIEW DOCUMENT AND SCIENTIFIC BASIS OF THE STUDY

1.1. The scientific basis of the study

Bu Lop district has about 1.783,41 hectares of paddy rice land. However, the yield is very low at 35 quintals/ha (equal to 62.50% of the average yield of the whole contry). One of the reasons leading to the low average rice yield of the district is due to the fact that the varieites and fertilizers are not paid much attention, there is no scientific research on the varieties as well as fertilizers for flooding rice had done in Bu Dop district. Therefore, study on varieties and fertilizers on rice in Bu Dop district are very necessary. Finding the appropriate fertilizer levels will greatly contribute to increase rice yield of the district in particular and in Binh Phuoc province in general.

Although Bu Dop has more than 1.783 hectares of flooding rice field, farmers only grow one crop of rice due to lack of water in the dry season and most of the time in the year is abandoned land, causing waste of land and manpower. The selection of suitable crops in the winter-spring crop will increase the annual cultivated area, creating jobs for hundreds of workers and can increase income for farmers in the area, increasing the efficiency of land use and address the demand for food for the people. Therefore, *study on farming techniques in flooding rice field in Bu Dop district, Binh Phuoc* province is very necessary.

1.2. Studies on farming systems in rice fields

Tao Zhang et al. (2017) conducted an experiment comparing the effects of two rotational crops: rice - garlic (RG) and rice - fava beans (RF) in southern China. The results showed that the change of farming systems from RG to RF increased N efficiency year-round from 21.6% to 34.4% and the N reduction in the soil from 547 kg/ha to 93 kg/ha, increased significantly in the organic carbon stock of the soil and thus reduced the risk of N loss in paddy rice field. Yao He et al. (2017) also made similar conclusions about the effect of soil protection when growing crop rotation between flooding rice and maize. The crop rotation between rice and maize will reduce the loss of water, nitrogen and organic carbon dissolved in the soil. The author concluded that the loss of water and soil nutrients will only increase rapidly in the first year after applying maize into long-term rice crop systems. Howerver, from the second year onwards these characteristics were significantly reduced compared to monoculture, specifically, from the second to the fourth year after applying of maize into rotation reduced 388 l/m^2 of water was lost, nitrogen and carbon organic dissolved reduced about 0.6g/m^2 and 1.6g/m,^{2} respectively. Tran Ba Linh et al. (2015) investigated the effect of crop rotation between rice and maize and green beans on soil properties, growth, yield and economic profits. The experiment was conducted in the Mekong Delta on clay soils for 10 years with 4 treatments: (i) rice - rice - rice (control - farming practices of farmer), (ii) rice - maize - rice, (iii) rice - green beans, and (iv) rice - green beans - maize. The results showed that the rotation of paddy rice with upland crops significantly improved soil physical properties in terms of volume, porosity, stability and waterproofing ability compared to traditional monoculture practices, especially in the 10-20 and 20-30 cm depths. The results also showed that root depth and root density increased sharply, resulting in higher plant height, total spikelet numbers and yield were 32-36% higher compared to monoculture, profits increased by 2.5-2.9 times.

1.3. Studies on fertilizers for rice

Fertilizers play an important role in intensive farming, increasing

crop yields, protecting crops and improving soil fertility. In particular, NPK are the three most important nutrients for plants in general and rice in particular. Yosef Tabar (2013) studied the effect of nitrogen and phosphorus on growth and rice yield in Iran with three levels of N (50,100, 150 kg/ha) and four levels of P: 0 (control), 30, 60, 90 kg/ha. The results showed that plant height, total number of spikelets, effective tillers, yield increased significantly with nitrogen and phosphorus. At N of 150kg/ha, yield was increased higher incomparision to the level of 50 kg/ha applied, yield was also increased at the P level of 90 kg/ha applied. However, the interaction effects of N and P levels on yield were not significant. Zain and Ismail (2016) studied the effects of potassium (KCl, K_2SO_4) on three levels (80, 120, 160) on leaf growth, leaf gas exchange and biochemical changes in rice under lack of water conditions. The results suggested that increasing the fertilizer levels from 80> 120>160 kg K_2O/ha will increase the yield of proline (an amino acid that is a component of most proteins, especially collagen). When applied from 80> 120> 160 kg K_2O/ha, the evapotranspiration rate also increased in both potassium levels, the high potassium levels will reduce the stress effects of water on growth and physiology as well as enhancing the nutrient uptake capacity of the plant. Nguyen Quoc Khuong et al. (2016) investigated the effect of NPK fertilizers on growth and yield of rice in the Mekong Delta with the following treatments: (i) NPK application; (ii) none K application; (iii) none P application; (iv) none N application and farmer fertilizers application. The results showed that the effect of N on rice yield in alkaline soil was showed by the increase in the panicle numbers/m^2 and pikelet numbers/panicle. The effect of phosphorus and potassium application on rice yields in different experiemntal sites was not significant. The yield of winter-spring crop was 3 tons/ha higher compared to summer-autumn crop, although (N: P_2O_5: K_2O) used on alkaline soil in winter-spring crop (100-60-30) were not much different compared to summer-autumn crop (80-60-30). The characteristics of panicle numbers/m^2 and spikelet numbers in winter-spring rice were significant higher than those of summer-autumn rice. In none P application, the yield was not significant less than that of P application,

but the number of panicles/m^2, spikelet numbers/panicle and 1000 spikelet weight decreased.

1.4. Results of research on fertilizer for soybean

Samia et al. (2012) investigated the effects of three fertilizers: urea (180 kg/ha), NPK (361 kg/ha), organic fertilizers on growth and yield of soybean in Shambat. The results showed that there were significant different in yield, economic yield and harvesting index between the treatments in the first crop. The highest average yield was 6803.35 kg/ha, the economic yield was 2150.40 (kg/ha) in the control treatment and the harvesting index was 25.7% in organic fertilizer treatments. In the second crop, there was a significant difference in the yield between treatments but no significant difference in economic yield and harvesting index. The highest average yield was 5310.68 (kg/ha) in the NPK treatment, while the economic yield was 1193.63 kg/ha in the urea treatment and the harvesting index was 19.86% in organic fertilizer treatment. Nguyen Chi Dung et al. (2016) studied the effect of nitrogen on growth and yield of DT84 soybean variety in Bac Ninh with 5 levels of fertilizer: CT1: 20; CT2 (control): 40; CT3: 60; CT4: 80 and CT5: 100kg N/ha based on 5 tons of manure + 60kg P_2O5 + 40kg K_2O/ha. The results showed that the lowest yield in treatment 1 was 13.5 quintals/ha (winter crop, 2013). 13.4 quintals/ha (winter crop, 2014), then increased in treatment 2: 14.1 quintals/ha and 13.9 quintals/ha, reaching the maximum in treatment 3 (15.1 and 14, 9 quintals/ha), then the downward trend appeared in treament 4 (14.5 quintals/ha) and treatment 5 (14.1 quintals/ha). Thus, it was found that when the amount of nitrogen was increased, the yield increased proportionally in the first stage, then continue to increase the N levels, the yield tended to decrease.

Chapter 2
MATERIALS, CONTENTS AND METHODS

2.1. Materials

- The study included 7 rice varieties: VD20, VN121, OM 4900, OM 5451, OM 6162, OM 7347, OM 3536 (control); 4 soybean varieties: HLDN 29, MTD 720, VDN 14, VDN 98, MTD (control) and 6 maize

varieties: NL 13-1A, LVN 255, P2P, LVN 154, TB 1515, A 380 (with two control varieties were LVN 10, CP 888).

2.2. Research contents

- To identify appropriate rice, soybean and maize varieties adapted Bu Dop condition (2015).

- To determine appropriate fertilizer levels for rice (summer-autumn crop) and plants planted in paddy rice fields (maize, soybean: winter-spring crop) in Bu Dop (2016).

- Performing demonstration models for rice, soybean and maize varieties that has been selected with farming techniques and to evaluate the economic efficiency of crop rotation (2017)

2.3. Methods

2.3.1. Identification of appropriate plants in flooding rice fields in Bu Dop district

The study evaluated rice, soybean and maize varieties which were randomly designed with three replications.

Cultivation procedures and monitoring characteristics were carried out in accordance with the National Technical Regulation on adaptability of cultivation value and use of rice variety, QCVN 01-55: 2011/BNNPTNT; The National Technical Regulation on adaptability of cultivation value and use of soybean variety, QCVN 01-58: 2011/BNNPTNT and The National Technical Regulation on adaptability of cultivation value and use of maize variety, QCVN 01-56: 2011/BNNPTNT.

2.3.2. Determination of appropriate fertilizer levels for rice and winter crops on flooding rice fields in Bu Dop district

2.3.2.1. Determination of appropriate fertilizer levels for rice

The experiment was designed in split-plot design, in which potassium was the main plot and nitrogen was the sub plot, with 3 replications. The experiment was supplemented with 70 kg P_2O_5, 8 tons of organic fertilizers (manure)/1ha. Main plots had 5 potassium levels (K_2O): K1: 40; K2: 60; K3: 80; K4: 100; K5: 120 (kg/ha). Meanwhile, the sub plots had 5 nitrogen levels: N1: 50; N2: 70; N3: 90; N4: 110; N5: 130 (kg/ha).

2.3.2.2 Determination appropriate fertilizer levels for soybean

The experiment was designed in split-plot design, in which potassium was the main plot and nitrogen was the sub plot, with 3 replications. The experiment was supplemented with 70 kg P_2O_5, 5 tons of organic fertilizer (manure), 300 kg lime powder/1ha. Main plots had 5 potassium levels (K_2O): K1: 0; K2: 30; K3: 60; K4: 90; K5: 120 K_2O (kg/ha). Meanwhile the sub plots had four nitrogen levels: N1: 0N; N2: 30N N3: 60N; N4: 90N (kg/ha).

2.3.2.3 Determination appropriate fertilizer levels for maize

The experiment was designed in split-plot design, in which potassium was the main plot and nitrogen was the sub plot, with 3 replications. The experiment was supplemented with 90 kg P_2O_5, 8 tons of organic fertilizer (manure)/1ha. The main plots had four levels of potassium (K_2O): K1: 0; K2: 60; K3: 90; K4: 120 K_2O (kg/ha) and the sub plots had six levels nitrogen: N1: 0N; N2: 80N; N3: 120N; N4: 160N; N5: 200; N6: 240 (kg K_2O/ha).

2.3.3 Demonstration model

Demonstration model was carried out with the best variety selected in 2 experimental sites, each site was caried out in 3 households with 2000m^2 for each plant. On the basis of the demonstration models, taking the productivity targets, cost accounting for each model, assessing the economic efficiency of each model and each rotation formula, then selecting the effective rotation formula Best.

2.4. Data measurements

- The growth and development data were averaged over three replications using the Average, Sum function in Microsoft excel.
- The data was analised according to the DSAASTAT program

2.5. Site and period of studies

2.5.1. Study sites

The study was conducted in Bu dop district, Binh Phuoc province

2.5.2. Study period

The study was conducted from 2015 to 2017

Chapter 3
RESULTS AND DISCUSSION

3.1. Study on identification of appropriate plants in flodding rice field in Bu Dop district.

3.1.1 Results of determination of appropriate hybrid rice varieties for Summer – Autumn season, 2015 in Bu Dop district, Binh Phuoc province

3.1.1.1. Growing period of experimental rice varieties

Growing period of rice varieties ranged from 89 to 105 days at both experimental sites. All varieties had a longer growing time compared to the control variety (OM 3536) and belonged to short-term rice varieties. VD 20 variety had the longest growing period, it was 16 days longer in comparision to the control variety at both study sites.

3.1.1.2 Plant height of experimental rice varieties

In Thuy Hung commune: Plant height ranged from 90.8 to 107.4 cm. VN 121 had the highest plant height (107.4 cm), it was significantly ($p<0.01$) higher compared to the other varieties. There was no signifiacnt difference in plant height between remaining varieties and the control varieties. In Thanh Hoa study site: Plant height varied from 84.9 - 106.1 cm. Among them, plant height of VN 121, OM 6162 and VD 20 varieties ranged from 93.9 - 106.1 cm, they was singnificantly ($p<0.01$) higher in comparision to the control variety. The remaining varieties had similar plant height to the control variety.

3.1.1.3. Effective panicle numbers, spikelet losses and spikelet sterility percentage of experimental rice varieties.

Table 3.1 Effective panicle numbers, spikelet losse and spikelet sterility percentage

Variety	Thien Hung			Thanh Hoa		
	Effective panicle number (panicle)	Spikelet losse (grade)	Spikelet sterility (%)	Effective panicle number (panicle)	Spikelet losse (grade)	Spikelet sterility (%)
VN 121	$2,80^{ab}$	1	$20,65^{c}$	$2,80^{ab}$	1	$18,80^{c}$
OM 6162	$2,87^{ab}$	1	$26,39^{ab}$	$2,87^{a}$	1	$23,52^{abc}$
OM 5451	$3,00^{a}$	1	$27,94^{a}$	$3,00^{a}$	1	$22,29^{bc}$

Variety	Thien Hung			Thanh Hoa		
	Effective panicle number (panicle)	Spikelet losse (grade)	Spikelet sterility (%)	Effective panicle number (panicle)	Spikelet losse (grade)	Spikelet sterility (%)
OM 4900	3,13[a]	1	25,56[ab]	3,00[a]	1	27,39[ab]
VD 20	2,40[c]	1	23,80[abc]	2,40[b]	1	28,36[a]b
OM 7347	2,60[bc]	1	23,54[bc]	2,60[ab]	1	29,93[a]
OM3536 (control)	2,80[ab]	1	25,79[ab]	2,73[ab]	1	29,55[a]
P	*<0,001*	-	*0,029*	*0,004*	-	*0,023*
CV%	*4,76*	-	*8,75*	*5,53*	-	*14,51*
LSD0,01	*0,33*	-		*0,38*	-	
LSD0,05			*3,86*			*6,63*

* Effective panicle numbers/plant: Effective panicle numbers/plant ranged from 2.40 to 3.13 panicles/plant. VN 121, OM 6162, OM 5451, OM 4900 and OM 7347 varieties showed no significant difference in panicle numbers in comparision to the control variety. Among them, VD 20 variety had the lowest number of panicles/plant (2.4 panicles/plant), it was significant ($p<0.01$) lower compared to the other varieties (Thien Hung). In Thanh Hoa commune, the effective panicle numbers/plant varied from 2.40 to 3.00 panicles. Among them, Type VD 20 variety had 2.40 panicles/plant, it was significant ($p<0.01$) lower compared to OM 6162, OM 5451and OM 4900 varieties and similar to VN 121, OM 7347 varieties and the two control varieties.

* Spikelet losses: all rice varieties in the experiment were in the hard-fall group, having a 10% lower rate and were ranked grade 1 in both experimental sites.

* Spikelet sterility (%): In Thuy Hung commune, the percentage of spikelet sterility ranged from 20.65 to 27.94%. VN 121 showed the lowest percentage with 20.65%, while OM 5451 had the highest percentage of spikelet sterility (27.94%). Meanwhile, the percentage of spikelet sterility in Thanh Hoa commune ranged from 18.80 to 29.93%. Among them, VN 121 had the lowest rate with 18.8%, while OM 7347 showed the highest rate with 29.93%.

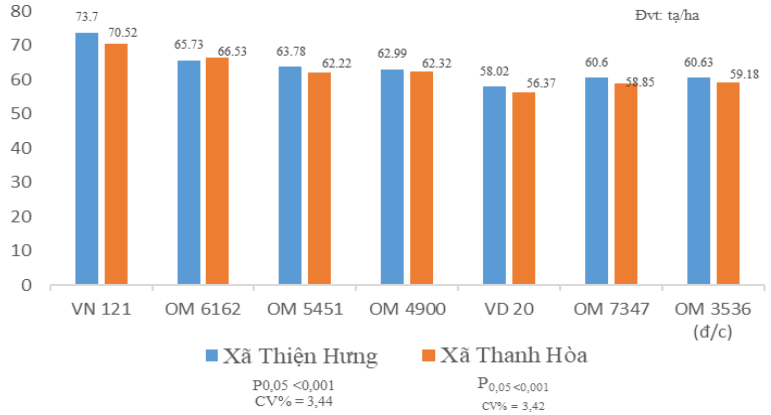
* 1000 spikelet weight: ranged from 21.8 to 27.1 grams (Thien Hung)

and from 21.4 to 26.9 grams (Thanh Hoa). OM 7347 variety (27.1 grams) had similar 1000 spikelet weight to the control and OM 4900, OM 6261 and VN 121 varieties (Thien Hung). In the Thanh Hoa, the OM 7347 and OM 4900 had similar 1000 spikelet weight and significant ($p<0.01$) higher in comparision to the control as well as the other varieties.

3.1.1.4. Yield of experimental rice varieties

In Thien Hung commune, yields ranged from 58.02 - 73.70 quintals/ha. Among them, VN 121 variety showed the highest yield with 73.7 quintals/ha, which was significantly ($p<0.01$) higher than that of the control and other varieties. The remaining varieties had similar yield to the control variety.

In Thanh Hoa commune, yields varied from 56.37 to 70.52 quintals/ha. Among 7 varieties, VN 121 and OM 6162 showed the highest yield with 70.53 and 66.53 quintals/ha, respectively and they were higher than that of the control varieties as well as the other varieties in the experiment, while OM 6162, VN 121, OM 5451and OM 4900 varieties had similar yield and they were significantly ($p<0.01$) higher in comparision to the control variety and others varieties.



3.1.2. Identification of appropriate soybean varieties in flooding rice fields in winter-spring, 2015

3.1.2.1. Growth and development of soybean varieties

Days to seedling were 5 days for all varieties, except for VDN 98

variety showed longer days to seedling (6 days).

Days to flowering varied from about 30 - 38 days. In particular, the latest days to flowering variety was VDN 98 and the earliest variety was VDN 14.

Days to maturity ranged from 80 to 85 days. Among them, VDN 98 showed the latest day (85 days) and VDN 14 was the earliest (80 days).

3.1.2.4 Yield and yield components of experimental soybean varieties

Results of yield and yield components of soybean varieties were obtained in Table 3.2.

Table 3.2 Yield and yield components of soybean varieties

Variety	Pod numbers (pod)	Pod fertility numbers (pod)	1000 seed weight (gr)	Yield (quintal/ha)
VDN 98	$47,0^{ab}$	$43,5^{ab}$	$147,1^{b}$	$27,91^{c}$
HLĐN 29	$41,0^{ab}$	$39,5^{ab}$	$158,7^{a}$	$33,66^{a}$
MTD 720	$53,3^{a}$	$50,1^{a}$	$120,5^{d}$	$32,04^{ab}$
VDN 14	$34,5^{b}$	$33,1^{b}$	$133,8^{c}$	$31,40^{ab}$
HL 07-15 (control)	$49,1^{a}$	$47,3^{a}$	$146,2^{b}$	$29,28^{bc}$
P	*0,04*	*0,045*	*<0,001*	*0,010*
CV%	*13,79*	*13,51*	*0,64*	*4,85*
$LSD_{0,01}$			*2,50*	
$LSD_{0,05}$	*11,67*	*10,86*		*2,82*

Note: The average values in the same column with at least one identical character are not statistically significant in the Duncan classification test based on LSD

The number of pods/plant ranged from 34.5 to 53.3 pods. Among 5 varieties, The MTD of 720 (53.3 pods/plant) showed higher compared to VDN 14 and it was similar to the other varieties in the experiment, while VDN 14 (34.5 pods) was significantly ($p<0.05$) lower than that of the control as well as other varieties.

The number of pod fertility/plant is a very important characteristic affected directly on yield. This ranged from 33.1 to 50.1 pods. The VDN 14 variety (33.1 pods) showed significantly ($p<0.05$) lower pod fertility/plant compared to MTD 720 and HL 07-15 (control), which was similar to VDN 98 and HLDN 29 varieties, while the other varieties had similar the number of pod fertility/plant.

1000 seed weight is also a very important characteristic affected

directly on yield. It ranged from 120.51 to 158.68 grams. HLĐN 29 had 158.68 grams, it was significantly ($p<0.01$) higher than that of the control varieties (HL 07-15) and other varieties in the experiment, while MTD 720 and VDN 14 showed similar 1000 seeds weight with 120.51 and 133.83 grams, respectively, which was significantly ($p<0.01$) lower than that of the control variety (HL 07-15).

Yield is the actual yield per unit area. This characteristic accurately reflects the genetic characteristics as well as the level of the variety adaptation under specific cultivation conditions. The potential for high yield can only be promoted in a certain ecological condition. Yield of experimental varieties ranged from 27.91 to 33.66 quintals/ha. Among them, HL 29 (33.66 quintals/ha) showed the highest yield, it was significantly ($p<0.05$) higher in comparision to the control (HL 07-15), while the remaining varieties showed similar yield to the control variety.

3.1.3. Determination of appropriate maize varieties in flooding rice fields in winter-spring, 2015

3.1.3.1. The growth and development of maize varieties in the experiment

Days to flowering ranged from 56 to 61 days and days to silking varied from 57-61 days. Generally, all varieties of the experiment had shorter days to flowering and silking compared to CP 888 (control) with 1 to 3 days, respaectively and from 1 to 4 days compared to LVN 10 (control). The variety which had latest days to flowering and silking was LVN 10 (61 days). The growth time of varieties ranged from 102 to 109 days. Growing period of all varieties were 2 to 7 days shorter compare to the 2 control varieties. The experimental varieties were late maturing in winter-spring crop in Thien Hung commune, Bu Dop district.

3.1.3.2 Morphological characteristics of maize varieties in the experiment

Plant height of the experimental varieties ranged from 189.4 to 237.8 cm. Among them, NL 13-1A (189.4 cm) had similar plant height to LVN255, P2P, LVN154 and A 380 and it was significantly ($p<0.01$) lower than that of both control varieties as well as the other varieties in the experiment.

Plant height at ear initiation stage of the experimental varieties ranged from 85.4 to 139.2 cm. A 380 variety (139.2 cm) showed similar plant height to the control variety 1 (CP888- 129.6 cm) and it was significantly ($p<0.01$) higher than that of control variety 2 (LVN 10) as well as the other varieties, while TB 1515 variety was 85.4 cm (similar to NL 13-1A, LVN 255 and P2P, which was signifiacntly ($p<0.01$) lower than that of both control varieties and the other varieties.

3.1.3.3. Ear morphological characteristics of maize varieties in the experiment

Ear length varied from 17.4 to 19.4 cm. NL 13-1A had ear length of 19.4 cm which was similar to LVN 255 the control varieties 1 (CP 888) and it was significantly ($p<0.01$) higher than that of the other varieties in the experiment and the control variety 2 (LVN 10), while P2P variety had ear length of 17.4 cm, it was similar as LVN 154, TB 1515, A 380 and the control varieties 2 (LVN 10) and significantly ($p<0.01$) lower than that of the control variety 1 and other varieties.

Ear diameter ranged from 4.33 to 5.04 cm. Pacticularly, TB 1515 (5.04 cm) and LVN 154 had the largest ear diameter and they were significantly ($p<0.01$) higher than that of both control varieties as well as other varieties, while P2P, LVN 154 and A 380 varieties showed larger diameter compared to both control varieties (CP 888, LVN 10). The remaining varieties had similar ear diameters to the two control varieties.

The ear coverage of all varieties was good (point 1-2) so the kernels were well protected by husk.

The ear status show the uniformity of maize, the experimental varieties had good ear status (1-2).

3.1.3.4. 1000 kernels weight

The 1000 kernel weight of all experimental varieties ranged from 233.9 to 342.7 grams. A 380 was 261.2 grams, it was similar to the two control varieties. The remaining varieties showed significantly ($p<0.01$) higher than those of the two control varieties.

3.1.3.5. Yield of experimental maize varieties

Table 3.3 Yield of experimental maize varieties

Variety	Yield (quintals/ha)	% exceeding yields compared to the controls (%)	
		CP 888 (control 1)	LVN 10 (control 2)
NL 13-1A	82,06^{c}	-0,28	3,79
LVN 255	92,05^{bc}	9,71	13,78
P2P	102,73^{ab}	20,39	24,46
LVN 154	109,27^{a}	26,93	31,00
TB 1515	96,94^{ab}	14,60	18,67
A 380	102,47^{ab}	20,13	24,20
CP 888 (đ/c1)	82,34^{c}	-	-
LVN 10 (đ/c2)	78,27^{c}	-	-
P	*<0,001*	-	-
CV%	*5,37*		

Note: The average values in the same column with at least one identical character are not statistically significant in the Duncan classification test based on LSD

Yield is the actual yield obtained and is the most important characteristic for selection. Yield depends on the genetic characteristics of the variety, the impact of the external factors and farming techniques. The varieties having high potential yield in good condition and good climate will give high yield. Yield of experimental varieties ranged from 78.27 to 109.27 quintals/ha. The varieties including LVN 154, P2P, A 380, TB 1515 had high yield varied from 96.94 - 109.27 quintals/ha, they were significantly ($p<0.01$) higher than those of both control varieties (CP 888, LVN 10). Yield of the remaining varieties were similar to those of both control varieties.

3.2. Effect of nitrogen and potassium levels on growth, development and yield of VN 121 rice variety, soybean PL 29 and LVN154 maize varieties

3.2.1 Effect of nitrogen and potassium levles on growth, development and yield of VN 121 rice variety

3.2.1.1. The interaction effect of potassium and nitrogen levels on growth and plant height of VN121 rice varieity

Changing potassium and nitrogen levels did not significantly change the growing period of the VN121. Growth period ranged from 95 to 96

days, the difference between the treatments was 1 day.

The potassium and nitrogen both affected plant height of the VN 121 rice variety. Plant height of K1N5 treatment (40 kg K/ha and 130 kg N/ha) was 116.4 cm, it was similar to treaments K1N4, K2N4, K2N5, K4N5, K5N5 and significantly ($p<0.05$) higher than that of the other varieties.

3.2.1.2 Effect of planting distance and nitrogen levels on some yield components and yield of VN 121 variety

The interaction effect of potassium and nitrogen levels on the effective panicle numbers, spikelet fertilily numbers/panicle, number of panicle/m^2, 1000 spikelet weight of VN 121 were highest in K4N3 treatment (100 kg K_2O + 90 kg N/ha): effective panicle (2.53 panicles), spikelet fertility numbers/panicle (87.7 spikelets), panicle numbers/m^2 (653.7 panicles), 1000 spikelet weight (26.0 grams). Meanwhile, the percentage of spikelet sterility was highest at K1N5 (40 kg K/ha and 240 kg N/ha) with 31,5% and it was significantly ($p<0.05$) higher than that of all other treatments.

* Yield

The results of the interaction effect of potassium and nitrogen on yield of VN 121 varieity were shown in Table 3.4.

Table 3.4: The separate effects of nitrogen and potassium factors and their interaction on the actual yield of varieties VN121 in Summer – Autumn, 2015 in Bu Dop

Liều lượng N	Liều lượng K (Kg/ha)					TB theo N
	K1 = 40	K2 = 60	K3 = 80	K4 = 100	K5 = 120	
N1 = 50	$37,10^{j}$	$38,03^{j}$	$37,80^{j}$	$56,37^{hi}$	$50,33^{i}$	$43,92^{c}$
N2 = 70	$58,97^{fghi}$	$60,80^{efgh}$	$73,43^{abcd}$	$66,00^{cdefg}$	$66,07^{cdefg}$	$65,05^{b}$
N3 = 90	$59,03^{fghi}$	$62,50^{efgh}$	$74,77^{abc}$	$76,53^{a}$	$75,50^{ab}$	$69,67^{a}$
N4 = 110	$58,70^{fghi}$	$61,03^{efgh}$	$64,87^{defgh}$	$67,43^{bcdef}$	$69,23^{abcde}$	$64,25^{b}$
N5 = 130	$57,30^{ghi}$	$59,30^{fgh}$	$63,43^{efgh}$	$66,13^{cdefg}$	$65,20^{defgh}$	$62,27^{b}$
TB theo K	$54,22^{b}$	$56,33^{b}$	$62,87^{a}$	$66,47^{a}$	$65,27^{a}$	
$P_{0,05\ (K)} = 0,002$ $P_{0,05\ (N)} < 0,001$ $P_{0,05\ (NxK)} = 0,031$ $CV\% = 7,74$						

Note: The average values in the same column with at least one identical character are not statistically significant in the Duncan classification test based on LSD

Yield of VN121 variety ranged significantly (P <0.05) according to different potassium levels. The results from table 3.7 showed that, yield ranged from 54.22 to 66.47 quintals/hectare. When the amount of potassium was applied increasingly from 40-100 kg K_20/ha, yield of VN121 variety was also increased (3.6-12.25 quintals/ha). Howerver, when applied the amount of potassium to 120 kg K_20/ha, yield of VN121 tended to decrease slightly.

At different levels of nitrogen applied, the yield of VN121 was significant difference. Applying 90 kg N/ha showed the highest yield (69.67 quintals/ha), it was significantly higher than that of the other nitrogen application levels, while 50 kg N/ha showed the lowest yield. The results of table 3.7 showed that although the increase in nitrogen led to an increase in yield, only a certain threshold will result in no increase in yield or even decrease. At the level of 90 kg N/ha, yield was highest but then decreased at 110 and 130 kg N/ha (decreased from 5.42 to 7.4 quintals/ha).

Yields of VN121 rice variety in the treatments of interaction between nitrogen and potassium levels ranged from 37.10 to 76.53 quintals/hectare. The yield of VN121 variety (76.53 quintals/ha) was the highest when 100 kg K_2O + 90 kg N/ha (K4N3) was applied, it was similar to K3N2, K3N3, K5N3, K5N4 and higher than that of the remaining treatments in the experiment, while K1N1, K3N1, K2N1 treatments showed from 37.10 to 38.03 quintals/ha and ranked in "j" group, which was the lowest ranking compared to all treatments.

* *The economic efficiency of treatments:* VN 121 rice variety based on 70 P_2O_5 kg/ha + 10 tons of manure/ha when applied 100 K_2O + 90 N kg/ha showed the highest economic efficiency (27.438.400 VND/ha). Therefore, when using VN 121 variety in the structure of paddy rice in Bu Dop district, it is suggested to use 90 kg N + 100 kg K_2O + 70 kg P_2O_5 + 10 tons of manure.

3.2.2. The effect of appropriate potassium and nitrogen levels on HLN 29 soybean variety in Bu Dop, Binh Phuoc.

3.2.2.1. Effects of potassium and nitrogen levels on growing period and

morphological characteristics of HLDN 29 soybean variety in Bu Dop district, Binh Phuoc province.

** Effects of potassium and nitrogen levels on growth stages and morphological characteristics of HLN 29 soybean variety*

Days to seedling were 5 days.

Days to flowering of HLDN29 were not significantly affected by the interaction effect of potassium and nitrogen elements and ranged from 1 to 3 days among treatments, this time varied from 30 to 33 days.

The effects of nitrogen and potassium factors to days to maturity of HLDN29 ranged from 83 to 90 days.

** Effects of potassium and nitrogen levels on the morphology characteristics of HLDN 29 soybean variety*

The interaction effect between potassium and nitrogen factors on the morphological characteristics of HLDN 29 soybean variety showed the main stem height (37.4 - 62.2 cm), the number of primary branches (1.3 to 2.3 branches), the number of actually plants collected on the plot (239.7 to 254.7 plants), but this difference was not significant (P>0.05).

3.2.2.2 Effects of potassium and nitrogen on the resistance of DNN 29 soybean variety in Bu Dop district, Binh Phuoc province

In general, different levels of N and K did not affect the logging power of the HLN29 (grade 1).

Rate of Rhizoctonia solani disease at different levels of nitrogen and potassium applied was generally low, ranging from 4.77 to 11.11%. Overall, the rate of these diseases did not significantly affect the yield of the variety.

Different nitrogen and potassium levels were not affected Puccinia arachidis Speg resistance of HLN29 and yield.

3.2.2.3 Effects of potassium and nitrogen levels on yield and yield components of HLDN 29 soybean varieties in Bu Dop district, Binh Phuoc province.

In general, treatment K5 (120 kg K_2O/ha) showed the highest pod numbers/plant (42.0 pods), pod fertility numbers/plant (38.0 pods), 1000 seed weight (161.1 g) and yield (33.12 quintals/ha). Similarly, the

highest values were recorded at the treatment N3 (60 kg N/ha), corresponding to the number of pods/plant (40.1 pods), the number of pods fertility/plant (33.1 pods), 1000 seed weight (157.5 g) and the yield (31.55 quintals/ha).

** The interaction effects of potassium and nitrogen levels on yield and yield components of HLDN soybean variety*.

The interaction effects between nitrogen and potassium levels on pods numbers/plant of HLDN29 variety was not significant (P> 0.05)

Table 3.5 The interaction effect of between potassium and protein levels on yield and yield components of HLN 29 soybean variety in winter-spring in Bu Dop, 2016

Treatment	Pod numbers/plant (pod)	Pod fertility/plant (pod)	1000 seed weight (gr)	Yield (quintal/ ha)	Profit (VND)
K1N1	24,9	$19,5^{j}$	$148,1^{l}$	$17,77^{g}$	3.101.000
K1N2	28,1	23^{hij}	$152,3^{j}$	$20,85^{fg}$	6.635.560
K1N3	30,5	$24,7^{ghij}$	$150,5^{k}$	$21,99^{ef}$	7.648.120
K1N4	29,4	$22,3^{ij}$	$147,8^{l}$	$20,44^{fg}$	5.162.960
K2N1	32,7	$29,5^{efg}$	$154,1^{h}$	$23,71^{ef}$	10.493.000
K2N2	32,6	$28,8^{efgh}$	$156,2^{g}$	$27,68^{d}$	15.148.560
K2N3	38,1	$32,4^{def}$	$153,8^{hi}$	$25,59^{de}$	11.998.120
K2N4	35,0	$28,6^{efgh}$	$152,5^{ij}$	$25,61^{de}$	11.553.960
K3N1	38,2	$34,2^{cde}$	$156,4^{fg}$	$24,69^{de}$	11.437.000
K3N2	40,0	$36,1^{bcd}$	$158,3^{de}$	$32,94^{c}$	21.692.560
K3N3	42,0	$36,5^{bcd}$	$159,3^{cd}$	$34,25^{bc}$	22.926.120
K3N4	40,0	34^{cde}	$156,3^{fg}$	$35,03^{abc}$	23.469.960
K4N1	32,4	$27,8^{fghi}$	$157,2^{efg}$	$24,94^{de}$	11.432.000
K4N2	39,4	$34,3^{cde}$	$159,5^{cd}$	$35,87^{abc}$	25.171.560
K4N3	44,2	$42,9^{a}$	$160,3^{bc}$	$37,86^{a}$	27.289.120
K4N4	45,1	$41,6^{ab}$	$157,6^{ef}$	$37,19^{ab}$	25.947.960
K5N1	35,0	$33,6^{cdef}$	$158,2^{de}$	$23,32^{ef}$	8.996.000
K5N2	42,3	$38,1^{abcd}$	$161,3^{b}$	$33,82^{bc}$	22.176.560
K5N3	45,7	$41,3^{ab}$	$163,7^{a}$	$38,08^{a}$	27.248.120
K5N4	45,0	$38,8^{abc}$	$161,1^{b}$	$37,26^{ab}$	25.708.960
P0,05	*0,626*	*0.038*	*<0.001*	*<0.001*	
CV%	*11,18*	*9,99*	*0,48*	*6,59*	

Note: The average values in the same column with at least one identical character are not statistically significant in the Duncan classification test based on LSD

There was significant (P <0.05) interaction effect between nitrogen and potassium levels on pod fertility number/plant of HLN29 variety. Among treatments, K4N3 (90 kg K_2O + 60 kg N) showed the highest pod fertility number/plant with 42.9 pods, it was similar to K4N4, K5N2, K5N3 and K5N4 treatments and significantly (p<0.05) higher compared to the other treatments, while K1N1 was at 19.5 pods and it was similar to the K1N2, K1N3 and K1N4 treatments and significantly (P <0.05) lower than other treatments.

The interaction effect between nitrogen and potassium levels on 1000 seed weight of the HLDN in different treatments ranged from 147.8 and 163.7 g. Among treatments, K5N3 (120 kg K_2O/ha + 60 kg N/ha) had the highest 1000 seed weight (163.7 g), it was significantly higher than all other treatments.

Yield: The interaction effect between nitrogen and potassium levels of HLN29 on yield of all treatments was significant (P <0.05). Yield of HLDN29 varied from 17.77 to 38.08 quintals/ha, while K4N3 (60 kg N + 90 kg K2O) and K5N3 (60 kg N + 120 kg K2O) varieties were 37.86 and 38.08 kg/ha, respectively and they were similar to K3N4, K4N2, K4N4 and K5N4 treatments and they were significantly (p<0.05) higher in comparision to the other treatments. Yield of K1N1 treatment was 17.77 quintals/ha, it was similar to K1N2 and K1N4 varieties and significantly (p<0.05) lower than that of the other treatments.

Meanwhile, yield of PL 29 variety when applied 70 P_2O_5 + 5 kg manure + 90 kg K_2O/ha + 60 kg N/ha (K4N3 treatment), although the yield was similar to K5N3 (70 P_2O_5 + 5 tons of manure + 120 kg K_2O/ha + 60 kg N ha), this treatment showed the highest economic efficiency (27,568,100 VND/ha), it was 196,400 VND/ha higher than that of K5N3 treatment and costs less than 330,000 VND.

3.2.3. Effects of potassium and nitrogen levels on LVN154 maize variety, in Bu Dop, Binh Phuoc

3.2.3.1. The interaction effect of potassium and protein levels on the growth stages of maize varieties in winter-spring crop in Bu Dop, Binh Phuoc.

The interaction effect between the potassium and nitrogen levels did little change on the growing period of hybrid maize varieties (ranged from 0 to 2 days). The growth stages of LVN 154 varied slightly between treatments. Days to flowering and silking of all treatment ranged from 55 days to 66 days, the longest days to flowering and silking treatment was K4N1 (120 kg K2O/ha with no nitrogen applcation - 66 days). Days to maturity were not much different among treatments, it was of 2 days.

3.2.3.2. Effects of potassium and nitrogen levels on the morphological characteristics of LVN154 maize variety in Bu Dop

The interaction effect between potassium and nitrogen levels on plant height and ear initiation height of LVN154 variety showed that K3N5 treatment (90 kg K_2O + 200 kg N/ha) showed the highest values including: plant height (218.9 cm), ear initiation height (117.5 cm). Howerver, there was no significant difference in the number of leaves between treatments.

3.2.3.4. Effect of potassium and nitrogen levels on yield and yield componenets of LVN 154 variety

The highest number of ears/plant was obtained in the K4N4 treatment (1.4 ears/plant), while treatment of 90 kg K_2O + 200 kg N/ha showed the longest ear length (20 cm), this treatment also showed the largest corn ear diameter (5.25 cm).

* *Yield*: The results of the study on the interaction effect of potassium and nitrogen on yield of LVN 154 variety were obtained as follows:

Table 3.6 Separate effects and interactions between potassium levels and nitrogen levels to yield of LVN154 maize in Winter-Spring crop in Bu Dop, 2016

Liều lượng N	Liều lượng K (Kg/ha)				TB theo N
	K1 = 0	K2 = 60	K3 = 90	K4 = 120	
N1 = 0	$13,21^{k}$	$15,87^{k}$	$15,59^{k}$	$33,48^{j}$	$19,54^{d}$
N2 = 80	$49,25^{i}$	$79,12^{efg}$	$63,62^{ghi}$	$70,16^{fgh}$	$65,54^{c}$
N3 = 120	$65,66^{gh}$	$81,27^{efg}$	$76,85^{efg}$	$98,79^{bcd}$	$80,64^{b}$
N4 = 160	$79,92^{efg}$	$81,09^{efg}$	$102,71^{abc}$	$115,49^{ab}$	$94,80^{a}$
N5 = 200	$76,90^{efg}$	$92,40^{cde}$	$100,16^{bcd}$	$117,49^{a}$	$96,74^{a}$
N6 = 240	$54,25^{hi}$	$79,93^{efg}$	$85,64^{def}$	$112,45^{ab}$	$83,07^{b}$
TB theo K	$56,53^{b}$	$71,61^{b}$	$74,10^{ab}$	$91,31^{a}$	
$P_{0,05\ (K)} < 0,018$ $P_{0,05\ (N)} < 0,001$ $P_{0,05\ (NxK)} < 0,007$ $CV\% = 12,46$					

Note: The average values in the same column with at least one identical character are not statistically significant in the Duncan classification test based on LSD

The interaction effect between potassium and nitrogen levels on yield of LVN154 maize variety ranged from 13.21 to 117.49 quintals/ha. Based on the application of 90 P_2O_5 + 8 tons of manure, K4N5 treatment (120 kg K_2O/ha + 200 kg N/ha) showed high yield (117.49 kg/ha), it was similar to K3N4, K4N4 and K4N6 treatments and significantly ($p<0.05$) higher compared to the remaining treatments.

** Economic efficiency of treatments:*

Choosing the right varieties together with appropriate farming techniques only makes sense when it comes to high economic efficiency. For LVN 154 variety when applied 90 P_2O_5 + 8 tons of manure + 120 kg K_2O/ha + 200 kg N/ha (K4N5 treatment) showed the highest yield (117.49 kg/ha). This also showed the highest economic efficiency (profit reached 55,090,590 VND).

3.3 The results of pilot implementation of demonstration models and economic efficiency of rotational formulas in Bu Dop district - Binh Phuoc province

The results of pilot implementation of demonstration model of VN 121 rice variety for 1 ha: 10 tons of manure + 90 kg N + 70 kg P_2O_5 +

100 kg K_2O was implemented in Thuy Hung and Thanh Hoa communes in Bu Dop district in summer-autumn reached yields of 70.5 and 74.25 quintals/ha, respectively, while HLDN 29 soybean variety applied 5 tons of manure + 60 kg N + 70 kg P_2O_5 + 90 kg K_2O/ha showed 35.85 quintals/ha (Thanh Hoa) and 36.55 quintals/ha (Thien Hung). LVN 154 maize variety applied 8 tons of manure + 200 kg N + 90 kg P_2O_5 + 120 kg K_2O reached 84.12 kg/ha (Thanh Hoa) and 78.47 kg/ha (Thien Hung).

** Economic efficiency of crop rotation systems on flooding rice fields in Bu Dop district is assessed through demonstration models:*

The rice-maize rotation showed the highest income/farmer/ha/year (49.987.243 – 51.879.743 VND). If farmers leave the winter-spring crop, they will only earn 20.146.178 – 22.208.679 VND/ha/year.

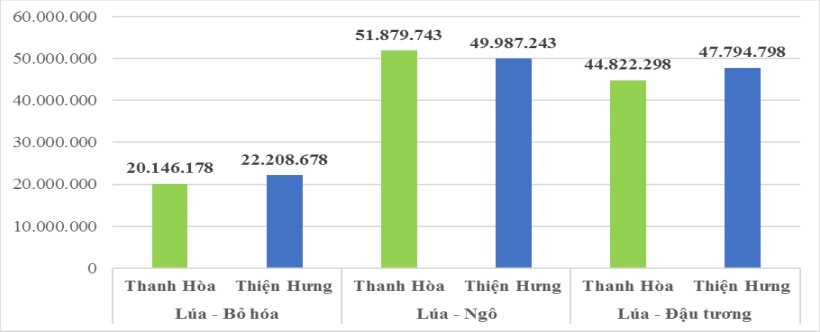


Figure 3.2. Economic efficiency of crop rotation systems on flooding rice fields in Bu Dop (VND)

CONCLUSION AND RECOMMENDATIONS

1. Conclusion

The most suitable set of plant varieties on wet rice land in Bu Dop district, Binh Phuoc province is rice variety VN 121, LVN 154 maize variety and HLDN 29 soybean variety. The VN 121 rice varieties is grown in Summer-Autumn crop had good agrobiological traits, highest yield (70.5 - 73.7 quintals/ha), it was higher incomparision to the two varieties in both study sites from 19 to 21,5%. HLĐN 29

soybean varieties is grown in Winter-Spring crop had the highest yield with 33.66 quintals/ha, which was significantly higher compared to the control variety is 15%, while LVN 154 maize varietiy is grown in Winter-Spring crop was able to grow and develop and show the highest yield with 109.27 quintals/ha, which was significantly higher than that of both control varieties from 32 to 39,6%.

The most suitable fertilizer formula to apply fertilizer/ha for VN 121 rice variety in Summer-Autumn crop, HLDN 29 soybean variety and LVN 154 corn crop in Winter-Spring crop, on wet rice land in Bu Dop district is: 8 tons of fertilizer manure + 90 kg N + 70 kg P_2O_5 + 100 kg K_2O; 5 tons of manure + 60 kg N + 70 kg P_2O_5 + 90 kg K_2O; 8 tons of manure + 200 kg N + 90 kg P_2O_5 + 120 kg K_2O.

Demonstration model identified that VN 121 rice variety had good growth and development in summer-autumn crop in Bu Dop, yield reached 70,50 – 74,25 quintals /ha, while HLDN 29 soybean variety and LVN 154 maize variety made crop rotation with flooding rice. HLDN 29 soybean variety also showed high yield of 35,85 – 36,55 quintals/ha and LVN 154 maize yielded 78,47 - 84.12 quintals/ha.

The most effective rotation formula on wet rice land in Bu Dop district is:

- Wet rice (Summer - Autumn crop, VN 121 variety) – Maize (Winter - Spring crop, LVN 154 variety).

- Wet rice (Summer - Autumn crop, VN 121 variety) - Soybean (Winter - Spring crop, HLĐN 29 variety).

2. Recommendations

To continue to study some farming techniques for VN 121 rice variety; HLDN 29 soybean variety and LVN 154 maize variety such as planting density, phosphorus levels etc.

To continue to test the model on a large scale for 1 to 2 years, to draw a stronger conclusion.

To continu research on some other crop rotation to diversify winter-spring crop, increase economic efficiency for people.