DEVELOPMENT OF MAIZE CULTIVATION AFTER RICE IN SMALL COMMUNITY FARMS IN KHAO WONG DISTRICT, KALASIN PROVINCE, THAILAND

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ABSTRACT

Two experiments were conducted at the paddy field used for maize growing after rice in the irrigated area of the royal-initiated upper Lam Phayang river basin development project, Tambon Khum Ghao, Khao Wong District, Kalasin Province. Experiment 1: To study the effects of rice straw burning before planting maize and plant density of maize on grain yield. A trail of 6 treatments was arranged in a split plot design with 3 replications. The main plots were non-burning and burning rice straw before maize planting. The sub plots were of plant density (1) 7.69 plants/m^2 (65x20 cm, 1 plant/hill), (2) 7.69 plants/m^2 (65x40 cm, 2 plants/hill) and (3) 11.54 plants/m^2 (65x20 cm, 1 plant/hill alternate 2 plants /hill). Experiment 2: To study the effects of maize cultivars and rates of organic fertilizers on grain yield. A trail of 6 treatments was arranged in a 2x3 factorial in randomized complete block design with 3 replications. The first factors were opened-pollinated and hybrid cultivars. The second factors were 3 rates of organic fertilizer at the dose 0, 375 and 1,500 kg/ha. The results of these study revealed that planting with 1 plant/hill at 20x65 cm was recommended. The highest grain yield was observed in the variant where 1,500 kg/ha of organic fertilizer was applied. Burning of rice straw before planting was not recommended, however, negative effect of burning was not found in the short-term experiment.

Key words: maize, farmer-participatory action, organic fertilizer

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INTRODUCTION

His Majesty the King granted a royal initiative on 25 November 1992 to consider constructing a reservoir at upper Lampayang Basin along with a water regulating tower. Later on 16 November 1995, His Majesty the King granted another initiative to expand the water delivery system and consider the possibility of digging a pond fixed for each plot for storing water which is transferred through such a system, as specified by the New Theory practice. He also raised the possibility of diverting water from Huai Pai Reservoir, which is close to Mukdahan Province, to replenish Lampayang Reservoir in order to expand the areas under irrigation. Being a water source for the people living in the project area and those in the villages at Khao Wong District in Kalasin Province, the reservoir will solve the problem of water shortage for agricultural use during the dry season and will alleviate flood damage during the rainy season. The reservoir can supply water to about 736 hectares of cropland area which covers 5 villages and benefits 862 households. It provides water in the project area to people and for agricultural purposes all year round and allows having some reserves to meet the needs during the rainy and the dry seasons. Chaisomboon (2004) studied the requirements of the people living in the project area and found that they needed second crop after rice harvesting. Although these areas would get some water from the upper Lum Payang basin, it was still insufficient in the dry season. Moreover, almost all soils were of coarse texture and low water holding capacity. It was necessary to consider the main crop instead of rice in the dry season because maize was less water requiring than rice. Therefore the Thai government promoted maize to plant it in the dry season to gain the incremental revenue for farmers. However, yield and gross profit gained from maize production was still low. Then, main goals of this project were to study soil, fertilizer and cultivar managements which were suitable for cultivation of maize after rice.

MATERIAL AND METHODS

Two experiments were conducted at the paddy field of farmers in small community farms which produces maize after rice. The first experiment studied the effects of rice straw burning before planting maize and plant density of maize on the yield. The experiment was conducted in Split Plot Design with 3 replications. Each plot size was 16.25 m^2. The cultivar used in this experiment was an opened-pollinated cultivar, SUWAN 5. The main plot consisted of 2 variants of rice straw management (non-burning and burning rice straw). Sub plot consisted of 3 variants of plant density and spacing: 1) 7.69 plants/m^2, spacing 65x20 cm^2 by 1 plant/hill, 2) 7.69 plants/m^2, spacing 65x40 cm^2 by 2 plants/hill and 3) 11.54 plants/m^2, spacing 65x20 cm^2 by 1 plant/hill alternated 2 plants/hill. The second experiment was focused on the effect of maize cultivars and rates of organic fertilizer (pig manure) on yield. It was arranged in a 2x3 factors in randomized complete block design with 3 replications. The first factors consisted of 2 different cultivars - opened-pollinated (SUWAN 5) and hybrid cultivars (SUWAN4452). The second factors consisted of 3 rates of organic fertilizer 0, 375, and 1500 kg/ha. Each plot size was 16 m^2. Spacing 65x20 cm and 1 plant/hill was used. Chemical fertilizers were applied according to the suggestion of the Thai government. After completion of the experiment, the amount of water supplied to farms from upper Lam Phayang basin was evaluated using satellite imaging.

The organic fertilizer was analyzed. pH was determined using a 1:1 ratio of soil to deionised water. Electrical conductivity (EC) was determined using a 1:5 ratio of soil to deionised water. Organic matter content was determined by wet oxidation and titration using the Walkley and Black method (Nelson et al. 1982). Total N was determined by the Kjeldhal method. The total P concentration was measured by the flame atomic absorption spectrophotometer. The total K concentration was measured by the atomic absorption spectrophotometer (AAS). The organic fertilizer had the following characteristics: 38% organic matter; pH of 6.75; EC of 2.75 dS/m; total N of 3.75% ; total P of 8.15% and total K of 2.1% .

RESULTS AND DISCUSSION

Data in table 1 show that there are not any interactions between rice straw burning and plant density of maize and effect on grain yield and fresh aboveground biomass. However, non- burning of straw before planting maize have the tendency to increase grain yield and fresh aboveground biomass when compared to the treatments with burning of straw before planting. At the same plant density, spacing of plants 65x20 cm caused higher increase of grain yield compared to the spacing of 65x40 cm and 2 plants/hill. It can be explained by the fact that the roots of maize competed for nutrients and water. Higher plant density caused the decrease of grain yield but there was no effect on fresh aboveground biomass.

Table 1. The effects of rice straw burning before planting maize and population density of maize on grain yield and fresh aboveground biomass

Plants/m^2	Spacing (cm^2)	Grain yield (kg/ha)			Fresh shoot matter (kg/ha)		
		Non burning	Burning	average	Non burning	Burning	average
7.69	65x20	5,094	5,213	5,156a	14,872	15,507	15,189a
7.69	65x40	4,581	4,556	4,569b	10,453	13,895	15,299a
11.54	65x20	4,806	3,938	4,369b	17,094	17,338	17,216a
average		4,825a	4,569a	4,694	16,223a	15,580a	15,902
CV (%)			7.52			16.38	

Data in table 2 show that there are not any interactions between maize cultivars and rates of fertilizers. The highest grain yield was observed in the variant treated with 1,500 kg/ha of organic fertilizer. The SUWAN 4452 which is a hybrid cultivar gave more grain yield when compared to SUWAN 5 which is an opened-pollinated one. Comparison of the costs of maize production in each variant (Table 3) showed that the highest gross profit was observed in the variant which used SUWAN 4452 and applied 1,500 kg/ha of organic fertilizer. Jatupornpong et al. (2009) reported that the application of organic fertilizer higher than 1,562.5 kg/ha increased grain yield of field crops.

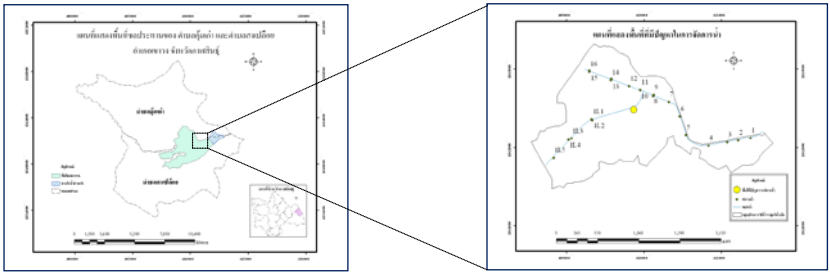
Table 2. The effect of maize cultivars and rates of organic fertilizers on grain yield

Rate of organic fertilizer (kg/ha)	Grain yield (kg/ha)		
	SUWAN 5	SUWAN 4452	average
0	4,068.8	4,668.8	4,368.8b
375	4,281.3	5,062.5	4,671.9b
1500	4,525.0	5,906.3	5,215.6a
average	4,291.7b	5,212.5a	4,752.1
cv(%)		8.85	

Table 3. The cost, revenue and gross margin of maize production with different cultivar and organic fertilizer rates

Cultivar	SUWAN 5	SUWAN 5	SUWAN 5	SUWAN 4452	SUWAN 4452	SUWAN 4452
Organic fertilizer rates (kg/ha)	-	375	1,500	-	375	1,500
Direct costs (Euro/ha)	396	427	518	428	459	550
Grain yield (ton/ha)	4.07	4.28	4.53	4.67	5.06	5.91
Revenue (Euro/ha)	695	731	773	797	864	1,008
Gross margin (Euro/ha)	298	304	254	369	405	458

Royal Irrigation Department found that in the dry season of 2009/2010, the Lam Phayang basin can support water to maize production in around 70,429 m^3. Field Crops Institute (1993) reported that water use of maize was around 470-500 mm/crop. So Lam Phayang basin will be able to supply water up to 14-15 ha of maize. However, it was still insufficient because some areas are far away from pipelines which transfer water from the reservoir to the cultivated area (Figure 1). Therefore it is necessary to have water supplies on a farm.



(a) (b)

Figure 1. Irrigation areas of Lam Payank Basin (a) and the areas having problem of transfer water (b).

CONCLUSIONS

Planting of 1 plant/hill (7.69 plant/m^2) at the spacing 20x65 cm and application of organic fertilizer at the dose 1500 kg/ha was recommended. The highest profit was observed when the cultivar SUWAN 4452 was grown and 1500 kg/ha of organic fertilizer was applied. Burning of rice straw before planting was not recommended, however, negative effect of burning was not found in the short-term experiment.

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