

IMPROVING OF MAIZE YIELD AND PROFITABILITY THROUGH SITE-SPECIFIC NUTRIENT MANAGEMENT (SSNM) AND PLANTING DENSITY

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ABSTRACT

Maize is the second most important cereal crop after rice in Southeast Asian countries. Currently, recorded average maize yields as compared to the yield potential for a given variety and climate indicate significant opportunities to further increase maize productivity through site-specific, integrated nutrient and crop management. The on-farm experiments were conducted at Tan Chau district, An giang Province, Vietnam in 2006 dry season and 2006 wet season on maize-maize-rice cropping system. The 10 treatments were the combination of planting densities: regular density 67,000 plants ha⁻¹ (75x20cm), and improved planting density (iPD) 50x30cm, and ICM with high plant density 74,000 plants ha⁻¹ (75x18cm), and fertilizer application methods: FFP (fertilizer farmer practices), SSNM and the omission plots of N, P and K on five farmer fields in a randomized completed block design. The results revealed that maize yields of 8-10 t ha⁻¹ can be achieved in Tan chau, An giang. The highest yield was recorded at 9.85 t ha⁻¹ on alluvium soil in dry season and 8.58 t ha⁻¹ in wet season. Yields increased of about 0.3-0.4 t ha⁻¹ by increasing plant density. At planting density of 67,000 plants ha⁻¹, improved plant density (50x30 cm) gave a better grain yield as compared to farmer's planting density (75x20 cm). Improved planting density with higher NPK rate of SSNM got higher grain yield by 0.7 t ha⁻¹ and higher net benefit by 833 thousand VND ha⁻¹ and 786 thousand VND ha⁻¹ in 2006 DS and 2006 WS, respectively.

Keywords: fertilizer farmer practices (FFP), grain yield (GY), improved planting density (iPD), Integrated Crop Management (ICM), Regular density (Reg), Site-Specific Nutrient Management (SSNM)

INTRODUCTION

In Vietnam as well as in many Southeast Asia countries, maize is the second most important cereal crop after rice. Although the maize area and yield continuously increased in recent years, it get lower grain yield than that of other countries. Otherwise, the maize productivity of Vietnam as well as in the Mekong Delta is very large, in which An giang is one of provinces fairly yielded 7.4 t/ha with 8,900 ha in 2004 and its productivity obtained 77,000 tons. For getting the best goal, the approaches are quickly expansion of growing areas of good maize varieties and combined with intensive crop managements. Moreover, currently recorded average maize yields compared with the yield potential for a given variety and climate indicate significant opportunities to further increase maize productivity through site-specific,

integrated nutrient and crop management (Dobermann et al. 2003; Witt et al. 2004). The research aims at determining the effect of Site-Specific Nutrient Management (SSNM) and improving planting density on grain yield and economic efficiency.

MATERIALS AND METHODS

The experiments were conducted in five farmer fields at Tanchau, An giang in 2006 dry season and 2006 wet season on the Maize-Maize-Rice cropping pattern. The experiment was comprised of ten treatments, which were the combination of planting densities and fertilizer application methods. The planting densities were 67.000 plants/ha with spacing of 75x20 cm. Improved planting density (iPD) was recommended as 50x30 cm and high plant density of ICM (74.000

plants/ha) with spacing of 75x18 cm. The fertilizer application methods included of fertilizer farmer practice (FFP) and Site-Specific Nutrient Management (SSNM) (Table 1). The omission fertilizer plots were +PK, +NK and +NP.

The experimental soil was a loamy alluvium with the contents of 40% sand, 51% silt and 9% clay at 0-20 cm layer and 40% sand, 49% silt and 11% clay at 20-40 cm layer. The chemical soil properties were low in organic C and total N, medium-high in P, low-medium in K, low in Ca

and Mg, no micro-nutrients deficiency and no soil toxicity.

The maize variety of G49 with 90-95 days growth duration was used in both seasons.

Data of yield components and grain yield were collected and calculated the economic efficiency of improvement of planting density and fertilizer application method followed by the procedure of IRRI (Fairhurst et al. 2005) and IPNI.

Table 1: Fertilizer rate in FFP and SSNM treatments for maize G49 at Tanchau, An giang.

	FFP (kg/ha)			SSNM (kg/ha)		
	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
06 DS	180	91	71	200	120	100
06 WS	166	83	73	200	120	100

RESULTS AND DISCUSSIONS

Effect of planting density and fertilizer application methods on yield components and grain yield

In 2006 DS and 2006 WS, the ears no./ha among fertilizer treatments and planting densities varied from 65,000-73,000 ears/ha at iPD-50x30cm and ICM. The kernel No/ear got highest value at the SSNM and plant density 75x20 cm treatment (471 kernels /ear in 2006 DS and 416 kernels /ear in 2006 WS). The difference on the kernel No/ear was very clear between the omission plots of NK and NP. The SSNM treatment got the higher ear No/ha than that of FFP treatment. The treatment of FFP and iPD-50x30cm got the higher ear No/ha than that of regular plant density 75x20 cm. The averaged weight of 100 grains of G49 varied from 27 to 28.6 g at the SSNM and FFP treatments, but it only got from 21-27.6 g in the omission fertilizer treatments (Fig.1 and 2)

The grain yield of G49 got the highest value at SSNM and improved planting density (iPD-50x30 cm). It got 9.85 t/ha in 2006 DS and 8.58 t/ha in 2006 WS. The combined treatment of FFP and

ICM plant density-75x18cm got higher grain yield than that of the FFP and regular planting density 75x20 cm treatment. No nitrogen fertilizer application, the grain yield was very low. It got only 1.8 t/ha in 2006 DS and 3.8 t/ha in 2006 WS. Without phosphorus, the grain yield of WS was lower than that of DS. It got 6.9 t/ha in 2006 WS compared to 8.3 t/ha in 2006 DS (Fig.1 and 2). These data affirmed that had a high need of nitrogen nutrient for hybrid maize. The SSNM method with higher applied-nutrients, especially nitrogen, adequately responded the plant need that led to getting higher grain yield than FFP treatment (Table 1).

Effect of planting density and fertilizer application methods on profitability of maize

Compared to FFP, SSNM method combined with improved planting density (iPD) gave the highest profit for both seasons (Table 2 and 3). The increased profit of SSNM-iPD treatment was VND 833,000 / ha in 2006 DS and VND 786,000 / ha in 2006 WS. The profit was increased by high plant density (ICM) of VND 444,000 / ha in 2006 DS and VND 401,000 / ha in 2006 WS.

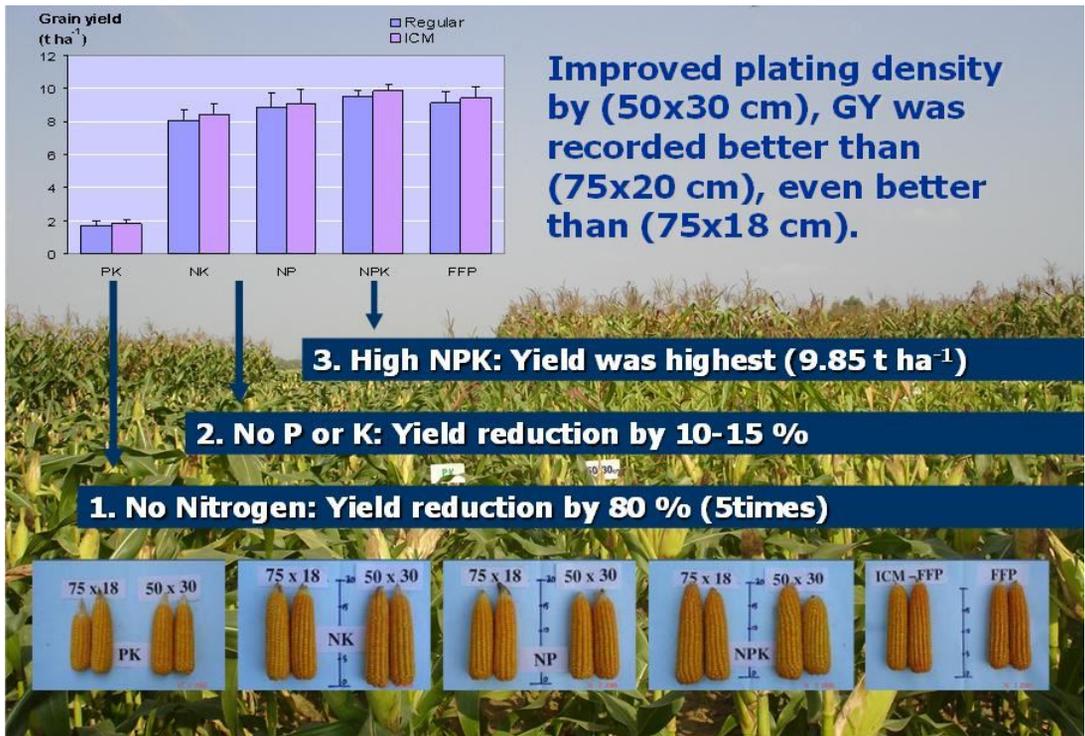


Fig 1: Comparison of GY and the ear size of maize G49 under effect of planting densities and fertilizer rates.

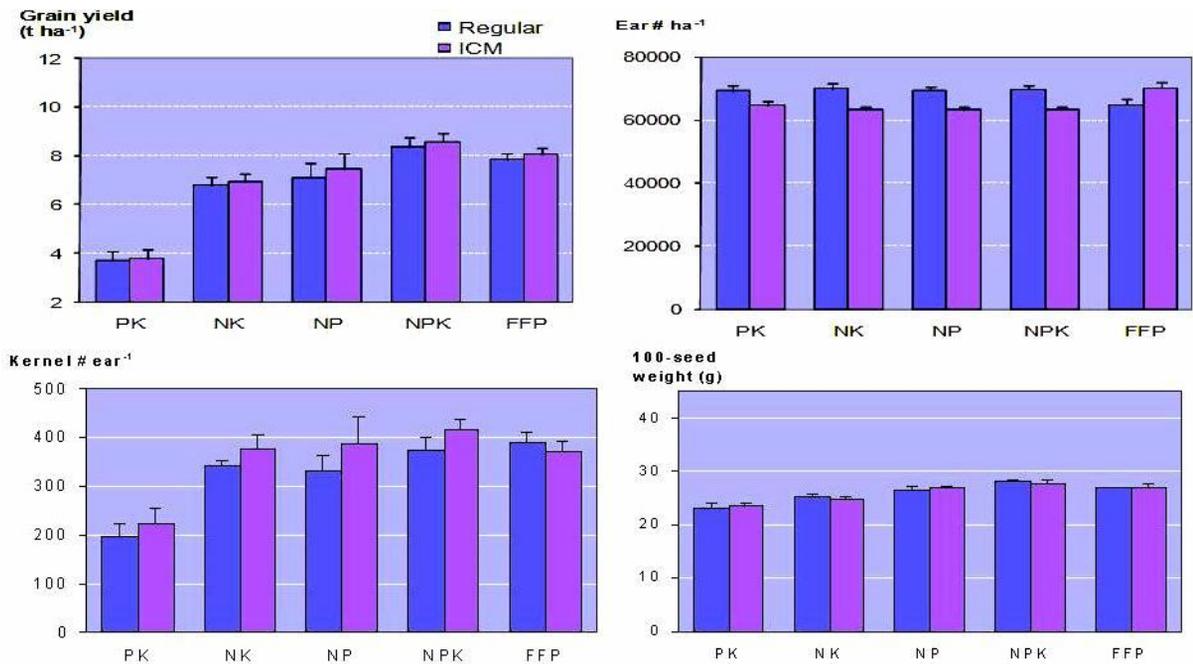


Fig 2: Grain yield and yield components of Maize G49 at Tanchau, An giang in 2006 WS.

Table 2: Economic analysis of planting densities and fertilizer application methods on maize G49 at Tanchau, An giang in 2006 DS.

	Treatments			
	FFP-Reg (75x20cm)	FFP-ICM (75x18 cm)	SSNM-iPD (50x30 cm)	SSNM-ICM (75x18 cm)
Grain yield (t/ha)	9.14	9.42	9.85	9.56
Prize of maize (VND/kg)	1800	1800	1800	1800
Gross benefit (1000 VND/ha)	16452	16956	17730	17208
Fertilizer cost (1000 VND/ha)	3377	3377	3822	3822
Seed cost(1000 VND/ha)	579	639	579	639
Net benefit (1000 VND/ha)	12496	12940	13329	12747
Profit (fertilizer)(1000VND/ha)			833	-193
Profit (plant density)(1000VND/ha)		444		-582

Table 3: Economic analysis of planting densities and fertilizer application methods on maize G49 at Tanchau, An giang in 2006 WS.

	Treatments			
	FFP-Reg (75x20cm)	FFP-ICM (75x18 cm)	SSNM-iPD (50x30 cm)	SSNM-ICM (75x18 cm)
Grain yield (t/ha)	7.87	8.07	8.58	8.39
Prize of maize (VND/kg)	2300	2300	2300	2300
Gross benefit (1000 VND/ha)	18101	18561	19734	19297
Fertilizer cost (1000 VND/ha)	3025	3025	3871	3871
Seed cost(1000 VND/ha)	561	619	561	619
Net benefit (1000 VND/ha)	14516	14917	15302	14806
Profit (fertilizer)(1000VND/ha)			786	-111
Profit (plant density)(1000VND/ha)		401		-496

CONCLUSION

Maize yield of 8-10 t ha⁻¹ can be achieved in Tanchau, An giang. The highest yield was recorded at 9.85 t ha⁻¹ on alluvium soil in dry season and 8.58 t ha⁻¹ in wet season. Yield increased of about 0.3-0.4 t ha⁻¹ by increasing plant density. Grain yield increased 0.14-0.32 ha⁻¹ by SSNM method. At planting density of 67,000 plants ha⁻¹, improved plant density (50x30 cm) gave a better GY as compared to farmer's planting density (75x20 cm). Improved planting density with higher NPK rate of SSNM, the GY was recorded higher by 0.7 t ha⁻¹ and the profit of maize production was increased by VND 833,000 and VND 786,000 in 2006 DS and 2006 WS, respectively.

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Cải thiện năng suất và lợi nhuận bắp lai bằng biện pháp bón phân theo địa điểm chuyên biệt và mật độ cây

Ở các nước Đông Nam Á, bắp là cây lương thực quan trọng đứng thứ hai sau lúa. Các ghi nhận gần đây cho thấy năng suất bắp trung bình so với tiềm năng suất của một giống trong điều kiện khí hậu nhất định có cơ hội gia tăng hơn nữa bằng biện pháp quản lý cây trồng và dinh dưỡng tổng hợp. Các thí nghiệm đồng ruộng được thực hiện trên 05 ruộng nông dân ở Tân Châu, An Giang trong hai vụ ĐX2005-06 và HT2006 trên cơ cấu 3 vụ bắp-bắp- lúa/năm. Thí nghiệm được bố trí theo khối hoàn toàn ngẫu nhiên với 10 nghiệm thức là sự kết hợp giữa 3 mật độ cây (75x20 cm, 50x30cm và 75x18 cm) và các phương bón phân (bón phân theo nông dân-FFP; bón phân theo địa điểm chuyên biệt-SSNM; các lô khuyết không bón phân N, P và K).

Năng suất bắp ở Tân Châu, An Giang có thể đạt được từ 8-10 t/ha. Năng suất bắp cao nhất trên đất phù sa trong vụ ĐX05-06 là 9,85t/ha và 8.58 t/ha trong vụ HT2006. Năng suất gia tăng do cải thiện mật độ cây là từ 0,3-0,4 t/ha. Ở mật độ 67.000 cây/ha, khoảng cách cải tiến iPD (50x30 cm) đạt năng suất cao hơn so với mật độ trồng của nông dân (75x20 cm). Mật độ cây cải tiến kết hợp với mức phân bón cao hơn của SSNM gia tăng được 0,7 t/ha và gia tăng lợi nhuận được 833 ngàn đồng/ha trong vụ ĐX05-06 và 786 ngàn đồng/ha trong vụ HT2006.