台中區水稻施肥量與施肥方法之調查研究 II.水稻期作、類型及地域間施肥量的統計檢定[1]

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摘　要

本研究於民國八十年在台中地區四縣市共計調查1,150位農民，所得資料利用t檢定、單因子變異數分析及最小差異顯著性(LSD)等方法檢定水稻不同期作、不同類型及不同地區間肥料施用的差異性。結果顯示無論現在或五年前水稻期作間氮、磷、鉀肥的施用量均無顯著差異，而相同期作下不同水稻類型間氮肥的施用量亦無顯著差異，但鉀肥的施用量則顯示有顯著的不同。此與作物施肥手冊中水稻推薦施肥之情況不一致。

關鍵字：水稻、施肥量、統計檢定。

前　言

台中地區各類型水稻的期作別以及縣市別之平均施肥量已於第一報作過詳細分析，然爲期瞭解水稻施肥量是否因不同期作、不同水稻類型或不同縣市而有顯著差異，本文擬進一步進行水稻施肥量的統計檢定，期供推廣水稻施肥技術之參考。

研究方法及步驟

本研究是利用台中地區1,150戶水稻樣本農家之資料(樣本農戶分布請參閱第一報)進行統計檢定，檢定方法及步驟：(一)分別就粳稻、秈稻與糯稻的期作間氮(N)、磷(P_2O_5)、鉀(K_2O)肥平均施用量差進行t檢定(2)。(二)分別就一、二期作的水稻類型間、縣市間，氮、磷、鉀肥施用量進行單因子變異數分析(5)。(三)分別就一、二期作粳稻、秈稻與糯稻的縣市間氮、磷、鉀肥施用量進行單因子變異數分析。(四)由(二)及(三)單因子變異數分析結果呈顯著差異者，再引用最小差異顯著性(least significant difference)方法做平均施肥量的多重比較(4)。

結果與討論

檢定結果列如表一~七(在1%、5%或10%顯著水準下檢定)，此檢定結果顯示：不論粳稻、秈稻或糯稻，其氮素、磷酐或氧化鉀的平均施用量期作間均無顯著差異(表一)。

就同期作的水稻類型間施肥量觀之，氮素施用量不論一期作或二期作，水稻類型間均無顯著差異；磷酐施用量一期作並無顯著差異，二期作則呈顯著差異，其中粳稻與糯稻的平均施用量顯著高於秈稻；氧化鉀施用量一、二期作水稻類型間均呈顯著差異，其中，粳稻的平均施用量顯著高於秈稻(表二、三)。

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[1] 台中區農業改良場研究報告第 0273 號。

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表一、兩期作水稻平均施肥量差之統計檢定

Table 1. Test on average difference of individual fertilizer amount on rice between two crop seasons

Item	1990-1991			1985-1986		
	Japonica rice	Indica rice	Glutinous rice	Japonica rice	Indica rice	Glutinous rice
N	0.1203[1]	0.3004	0.4350	0.5090	-0.1342	0.3446
P_2O_5	-0.0365	0.7488	0.4949	-0.1961	0.5491	0.5799
K_2O	0.0135	0.3769	0.3984	0.2319	0.5352	0.5124

[1] Numerals in this table are t values, and all t values were not significant at 5% level of probability.

表二、水稻類型間個別肥料施用量之變異數分析

Table 2. Analysis of variance for individual fertilizer amount among various rice types

Item	1990-1991		1985-1986	
	1st crop	2nd crop	1st crop	2nd crop
N	1.52	0.72	0.40	0.03
P_2O_5	2.22	3.48*[1]	5.00**	6.14**
K_2O	9.03**	10.78**	7.60**	9.81**

[1] Numerals in this table are F values, and **, * respresent significant at 1% and 5% levels of probability, respectively.

表三、水稻類型間個別肥料平均施用量之多重比較(LSD 方法)

Table 3. Pairs comparison of means of individual fertilizer amount among various rice types

Item	1990-1991				1985-1986			
	1st crop		2nd crop		1st crop		2nd crop	
P_2O_5	Ind[1]	—	Ind	60.0a[2]	Ind	55.7a	Ind	54.0a
	Jap	—	Jap	68.4b	Jap	64.8b	Glut	64.5b
	Glut	—	Glut	72.3b	Glut	69.9b	Jap	65.2b
K_2O	Ind	112.1a	Ind	109.2a	Ind	117.0a	Ind	112.6a
	Glut	131.5ab	Glut	123.7ab	Glut	140.5ab	Glut	129.0ab
	Jap	142.2b	Jap	142.1b	Jap	114.8b	Jap	143.8b

[1] Ind=Indica rice; Jap=Japonica rice; Glut=Glutinous rice.

[2] The same letter in each column means that there is no significant difference at 5% level of probability.

另就同期作的縣市間施肥量觀之，水稻的氮素施用量不論一期作或二期作，縣市間均呈顯著差異，其中南投縣的平均施用量顯著低於台中縣、台中市及彰化縣，台中縣平均施用量又顯著低於彰化縣；磷酐的施用量一、二期作縣市間亦均呈顯著差異，唯一期作的平均施用量台中縣顯著低於南投縣、台中市及彰化縣，二期作的平均施用量台中縣顯著低於台中市及彰化縣；氧化鉀的施用量一、二期作縣市間均無顯著差異(表四、五)。

再者，就同期作且同類型水稻的縣市間施肥量觀之，一期作粳稻的氮素平均施用量，南投縣顯著低於台中縣與彰化縣，而台中縣又顯著低於彰化縣；磷酐平均施用量台中縣顯著低於南投縣與彰化縣；氧化鉀平均施用量台中縣顯著低於彰化縣。一期作秈稻的磷酐平均施用量彰化縣顯著低於台中縣，但一期作糯稻的磷酐平均施用量則正好相反。二期作粳稻的氮素平均施用量，南投縣顯著低於台中縣、台中市及彰化縣，而台中縣又顯著低於彰化縣；磷酐平均施用量台中縣顯著低於南投縣、台中市及彰化縣，而南投縣又顯著低於彰化縣；氧化鉀平均施用量，南投縣及台中縣均顯著低於彰化縣及台中市(表六、七)。

表四、水稻縣市間個別肥料施用量之變異數分析

Table 4. Analysis of variance for the amout of individual fertilizers on rice at different localities

Item	1990-1991		1985-1986	
	1st corp	2nd corp	1st corp	2nd corp
N	16.30**[1]	15.98**	9.50**	12.67**
P_2O_5	7.95**	7.46**	11.07**	6.72**
K_2O	0.76	1.01	0.14	0.28

[1] Numerals in this table are F values, and **, * represent significant at 1% and 5% levels of probability, respectively.

表五、水稻縣市間個別肥料平均施用量之多重比較(LSD 方法)

Table 5. Pairs comparison of means of fertilizer amount on rice in different localities Unit: kg/ha

Item	1990-1991				1985-1986			
	1st crop		2nd crop		1st crop		2nd crop	
N	NT[1]	18.2a[2]	NT	17.6a	NT	17.5a	NT	16.7a
	TC	21.1b	TC	22.2bc	TC C.	20.4ab	TC	20.9b
	TC C.	22.4bc	TC C.	23.5cd	TC	21.2b	TC C.	21.6bc
	CH	24.6c	CH	24.3d	CH	22.6b	CH	22.5c
P_2O_5	TC	5.8a	TC	5.8a	TC	5.4a	TC	5.5a
	NT	6.8b	NT	6.7ab	TC C.	6.1ab	TC C.	6.4ab
	TC C.	7.0b	TC C.	7.1b	CH	6.7b	CH	6.7b
	CH	7.2b	CH	7.1b	NT	7.2b	NT	6.9b

[1]NT=Nantou county, TC=Taichung county, TC C.=Taichung city, CH=Changhua county.

[2] The same letter in each column means that there is on significant difference at 5% level of probability.

表六、各水稻類型縣市間個別肥料施用量之變異數分析

Table 6. Analysis of variance for the amount of individual fertilizers in different localities for three rice types

Item		1990-1991		1985-1986	
		1st crop	2nd crop	1st crop	2nd crop
Japonica rice	N	14.36***[1]	14.82***	8.79***	12.18***
	P_2O_5	13.06***	13.64***	15.19***	10.55***
	K_2O	2.79**	3.82***	0.54	1.56
Indica rice	N	1.22	1.17	2.09*	2.03*
	P_2O_5	1.93*	1.39	0.19	0.16
	K_2O	0.38	0.13	0.45	0.27
Glutinous rice	N	1.18	0.49	1.09	0.61
	P_2O_5	2.40*	0.90	0.53	0.20
	K_2O	1.78	0.86	1.13	0.97

[1] Numerals in this table are F values, and ***, **,* represent significant at 1%, 5% and 10% levels of probability, respectively.

表七、各類型水稻縣市間個別肥料平均施用量之多重比較(LSD)

Table 7. Pairs comparison of means of individual fertilizer amount in different localities for three rice types

Unit: kg/ha

Item		1990-1991				1985-1986			
		1st crop		2nd crop		1st crop		2nd crop	
Japonica rice	N	NT[1]	181.7a[2]	NT	175.8a	NT	176.9a	NT	168.6a
		TC C.	213.0abc	TC	221.5b	TC	210.8b	TC	208.1b
		TC	219.3b	TC C.	230.6bc	TC C.	210.9abc	TC C.	227.2bc
		CH	247.0c	CH	244.6c	CH	230.0c	CH	228.4c
	P_2O_5	TC	57.2a	TC	56.9a	TC	53.0a	TC	54.5a
		TC C.	67.5ab	NT	67.4b	TC C.	66.3ab	NT	69.0b
		NT	68.0b	TC C.	75.0bc	NT	72.2b	TC C.	71.6ab
		CH	76.7b	CH	76.9c	CH	72.8b	CH	72.4b
	K_2O	NT	128.7ab	NT	128.9a	NT	—	NT	—
		TC	134.3a	TC	132.9a	TC	—	TC	—
		CH	150.2b	CH	150.4b	CH	—	CH	—
		TC C.	167.2ab	TC C.	182.2b	TC C.	—	TC C.	—
Indica rice	N	NT	—	NT	—	NT	102.0a	NT	95.0a
		TC	—	TC	—	TC C.	195.1ab	TC C.	203.4b
		TC C.	—	CH	—	CH	214.1b	CH	215.1b
		CH	—	TCC.	—	TC C.	220.5b	TC	217.1b
	P_2O_5	CH	59.6a	CH	—	CH	—	CH	—
		NT	69.3ab	NT	—	TC C.	—	TC C.	—
		TC C.	73.4ab	TC C.	—	TC	—	TC	—
		TC	78.9b	TC	—	NT	—	NT	—
Glutinous rice	P_2O_5	TC	50.7a	TC	—	TC	—	TC	—
		NT	69.2ab	NT	—	NT	—	CH	—
		CH	89.6b	CH	—	CH	—	NT	—

[1] NT=Nantou county, TC=Taichung county, TC C.=Taichung city, CH=Changhua county.

[2] The same letter in each column means that there is no significant difference at 5% level of probability.

至於五年前的資料檢定結果與目前的情況大致雷同(表一~七)，所不同者爲：(一)就同期作的水稻類型間施肥量觀之，磷酐施用量一、二期作水稻類型間均呈顯著差異，而且，粳稻與糯稻的平均施用量均顯著高於籼稻。(二)就同期作的縣市間施肥量觀之，一期作水稻氮素平均施用量台中市與南投縣並無顯著差異；一、二期作磷酐平均施用量均以彰化縣與南投縣顯著高於台中縣。(三)就同期作且同類型水稻的縣市間施肥量觀之，一期作粳稻的氧化鉀平均施用量縣市間均無顯著差異。一期作籼稻的氮素平均施用量南投縣顯著低於彰化縣及台中縣；磷酐平均施用量縣市間並無顯著差異。一期作糯稻的磷酐平均施用量縣市間亦無顯著差異。二期作粳稻的磷酐平均施用量台中縣顯著低於南投縣及彰化縣，其餘縣市無顯著差異；氧化鉀平均施用量縣市間均無顯著差異。二期作籼稻的氮素平均施用量南投縣顯著低於台中市、彰化縣及台中縣。

綜合以上分析結果可見，不論目前或五年前，稻農對氮、磷、鉀肥料的施用並未因期作而有別；相同期作下，氮肥的施用亦未隨水稻類型而異，但鉀肥的施用則呈顯著差異。此與作物施肥手冊中一般水稻田氮素推薦量依期作別與水稻類型別而不同，磷酐與氧化鉀推薦量則隨期作別而異之情況相違背。

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Studies on the Amount and Method of Fertilizer Application in Paddy Field in Taichung District II. Statistical Tests on the Amount of Fertilizer Application within Rice Types, Crop Seasons and Localities[1]

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ABSTRACT

A study on the fertilizer application from rice farmers in Taichung District was conducted in 1990-91. A total of 1,150 rice famers randomly sampled from 3 counties and 1 city of Taichung District was visited to analyze the difference of the amount of fertilizer application on rice among crop seasons, types of rice, and localities. The t-test, one-factor analysis of variance and the least significant difference (LSD) method were used. Results showed that there was no significant difference in the amount of N, P, and K fertilizers within two rice crop seasons. Except K fertilizer, the amount of N fertilizer applied on three types of rice was not statistically significant in each crop season. The results in this study was not coincident with the fertilization quantilies recommended by the handbook of rice fertilizer application.

Key words: rice type, fertilizer amount, locality, crop season.

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