

# Spatial mixed intercrops of rapeseed field

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## Abstract

Rapeseed were multifariously intercropped with potato, green cabbage “Aikangqing” (*Brassica rapa*), radish- “Duanye 13”, “Yanghua”, coriander, spinach, garlic stems, watermelon, etc. on outskirts of city in middle and lower reaches of the Yangtze River. Results of field experiments showed that the models of mixed intercrops of rapeseed-potato-radish and rapeseed-garlic stems-radish were considered as most appropriate one for outskirts of city. Compared with mono-crop pattern, the yield of both rapeseed and intercropped crops didn't lost significantly when intercropped with 2-3 other crops in rapeseed field with a plant density of 60000 /hm<sup>2</sup>. And as a spatial mixed intercropping pattern, it could reduce disease incidence by 20 % for rapeseed and by 40% for other crops in average. The production value of this model was obtained more than 105000 yuan/hm<sup>2</sup> per year as intercropped with four or five other crops, which notably exceeds the production value about 27960 yuan/hm<sup>2</sup> of traditional planting model of rape-rice-rice. Generalization of spatial mixed intercrops can effectively improve the income of farmers, and promote the rapeseed production eventually.

**Key words:** Rapeseed; spatial mixed intercrop; income; outskirts of city

## Introduction

Rapeseed, as the fifth largest crops in the Reaches of the Yangze River, plays an important role in improving soil fertilizer and increasing farmers' income in China. However, at present there are many problems, such as comparative income decreasing, farmers' enthusiasm of planting rapeseed frustrated and rapeseed planting area holding down etc., existed in the current rapeseed production. Therefore, developing new and practical rapeseed cultivation pattern or technologies to increase farmers' income, has become the most important content of rapeseed cultivation and field management. This paper presents the results of the field experiments of spatial mixed intercrops of rapeseed with other crops.

## Materials and methods

Two rapeseed varieties (*Brassica napus* L) with high resistance and high quality were used in the research. Seeds sow from 1<sup>st</sup> to 6<sup>th</sup> September, 2005. The young plants were transplanted into field in middle October. Plant density was about 60000/hm<sup>2</sup>.

*Following crops after rapeseed:* Spring potato, Chinese green cabbage, Radish and seedlings of garlic, etc. were harvested in time for sale. Seeds of watermelon, Huami No.8 and Xinong No.8 were raised on 1<sup>st</sup> March and mulched with plastic film. The young plants were transplanted in early April with a plant density of 9000 /hm<sup>2</sup> and harvested for sale in June. Rice “Wieyou 64”, “Jinyou 77” and “Jinfanzao” were sown on seedling bed from 1<sup>st</sup> to 3<sup>rd</sup>, June and were transplanted in field in middle of July.

*Rapeseed intercropped with vegetables and watermelon, and fallowing crops of late rice(TA)*

Totally there were 21 experimental plots with a width of 150cm. 3 rows of rapeseed were planted in each plot with a density of 50cm×35cm. Two rows of vegetables were intercropped with rapeseed in some of the plots. Watermelon was intercropped with rapeseed in a density of 28 cm×28cm in the other plots.

*Rapeseed intercropped with spring potato(TB)* Spring potato was intercropped with rapeseed in a density of 25 cm×25cm, mulched with plastic film.

*Rapeseed intercropped with garlic (TC)* Two rows of garlic were planted in each of the row of rapeseed plants.

Based on the models of rapeseed spatial mixed intercrops above, experiments in the field for several years showed that, the benefits of intercropping was significantly improved. Though many models of spatial mixed intercrop were done, three of them were selected and showed in table 1.

## Result and analysis

*Income analysis on TA model:*

Income of rapeseed was 344.31 yuan/667m<sup>2</sup>. And incomes of Chinese green cabbage, watermelon and rice was 1089.50 yuan, 5136.20yuan, 955.26yuan/667m<sup>2</sup> respectively. Therefore, the total value was 7825.27yuan/667m<sup>2</sup>, and the net benefit reached 6704.02yuan/667m<sup>2</sup>.

*Benefits analysis on TB model:*

Income of rapeseed was 463.91 yuan/667m<sup>2</sup>. And the incomes of Spring potato, radish, late rice and chinese green cabbage was 729.00yuan, 4619.25yuan, 977.22yuan and 1804.00 yuan / 667m<sup>2</sup> respectively. Therefore, the total value was

8593.38yuan/667m<sup>2</sup>, and the net benefit reached 7363.68yuan/667m<sup>2</sup>.

**Table 1. Cropping index of Spatial mixed intercrops models**

Treatment	Intercropping sequence					cropping index (%)
	1	2	3	4	5	
CK		/	Early rice		/	300.0
TA		Chinese cabbage	watermelon		/	383.3
TB	Rapeseed	Spring potato	Early April Radish	Late rice	High-stem Chinese cabbage	425.0
TC		Garlic	Early April Radish		/	383.3
Mean value of T						397.2
T±CK						+97.2

Provide same cropping index, growth different vegetable, obtain different incomes

#### Benefits analysis on TC model:

Income of rapeseed was 617.09yuan/667m<sup>2</sup>. And the incomes of garlic seedling, radish, late rice and chinese green cabbage was 1132.92yuan, 5076.45yuan/667m<sup>2</sup>,and 976.14yuan/667m<sup>2</sup> respectively. Therefore, the total output was 7802.60yuan/667m<sup>2</sup>, and the net benefit reached 6692.77yuan/667m<sup>2</sup>.

#### Benefit analysis of spatial mixed intercrop mode

Conventional rapeseed-rice-rice mode vs spatial mixed intercrop mode

Average production value of conventional cropping system rapeseed-rice-rice was 1859.84 yuan/667 m<sup>2</sup> and the net income was 939.64 yuan/667 m<sup>2</sup> annually. Thus, the spatial mixed intercrop mode produced higher yield and income. The average production value reached 8073.75 yuan/667 m<sup>2</sup> and the net income was 6920.16yuan/667 m<sup>2</sup>. It was as higher as 7.36 times of the control) annually. (Table 2)

**Table 2 average yield and benefit of traditional cultivation system**

Year	Rapeseed		Early rice		late rice		income	cost	Net income
	Yield	Income	Yield	Income	Yield	Income			
1996~1997	183.3	435.39	430.3	602.42	441.4	794.52	1832.33	920.20	912.13
1997~1998	189.5	435.85	452.3	633.22	447.0	804.60	1873.61	920.20	953.47
1998~1999	182.0	418.60	445.7	623.98	440.0	792.00	1834.58	920.20	914.38
1999~2000	181.0	416.30	440.5	616.70	439.5	791.10	1825.10	920.20	903.90
2000~2001	190.2	437.46	450.3	630.42	458.5	825.30	1893.18	920.20	972.98
200~12002	192.4	442.52	451.5	632.10	459.2	826.56	1901.18	920.20	980.98
Mean	187.4	431.02	445.1	623.14	447.6	805.68	1859.84	920.20	939.64

Unit: yield=kg/667m<sup>2</sup>, income=yuan/667m<sup>2</sup>; the same as below

**Table 3 Benefits comparison between Conventional rapeseed-rice-rice mode and spatial mixed intercrop mode**

Treatment	Income						Income	Cost	Net income
	Rapeseed	Intercrops	Watermelon	Early rice	Late rice	Cabbage			
CK	431.02	/	/	623.14	805.68	/	1859.84	920.20	939.64
TA	344.31	1089.50	5436.20	/	955.26	/	7825.27	1121.25	6704.02
TB	463.91	729.00	/	4619.25	977.22	1804.00	8593.38	1229.70	7363.68
TC	617.09	1132.92	/	5076.45	976.14	/	7802.60	1109.83	6692.77
T mean	475.10	983.81	1812.07	3231.90	969.54	601.33	8073.75	1153.59	6920.16
T±CK	44.08	983.81	1812.07	2608.76	163.86	601.33	6213.91	233.39	5980.52

## Discussion and conclusions

Applying the cultivation mode of spatial mixed intercrops of rapeseed with other crops, not only can solved the problems such as sunlight escaping from rapeseed field during seedling stage under a low density planting, but also increased crop diversity to improve crop productivity. Meanwhile, it offers more job opportunity for residences in rural area and supplies more vegetable for city people. It needs to study further for intercropping beans with rapeseed.

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