Comparative study of input-output benefit of high-efficient integration technology in double-low rapeseed

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Abstract Four kinds of different cultivation modes were used to double-low rapeseed through multi-location tests from 2006-2010 along China's Yangtze river downstream, and their operating costs, labour input, yield, benefit as well as rate of input and output were analyzed quantitatively, and the differences of input and output, which of the different cultivation modes in different regions as well as the same mode in different year, were analyzed systematically. The result showed that there were significant difference in operating costs, labour input, yield, benefit as well as rate of input and output to adopt these modes, whole mechanization, transplanting through culture of seedling under tillage and land preparation by mechine, direct sowing artificially after tillage and land preparation by mechine, and direct sowing artificially under zero tillage etc. In them, the mode benefit adopting transplanting through culture of seedling under tillage and land preparation by mechine and whole mechanization was best. So it was thought that the key to rapeseed high-efficient integration technology was to select the new variety to be suitable for mechanized harvesting, and gradually implement the new cultivation mode of whole mechanization, try to save labor and reduce cost, increase efficiency in order to scale and industrialize, it will be the major leading of double-low rapeseed scientific research and production in China.

The key words double-low rapeseed varities, high-efficient, integration technology, input, output, benefit analysis

China’s Yangtze valley is the world's largest rapeseed planting area.According to the distribution of resource in different rapeseed production area and rapid development of agricultural mechanization in China, high-efficient integration technology of whole mechanization using machine to plough, sow, fertilize and harvest, and artificially transplanting under ploughing and preparing soil by machine, and direct sowing artificially after ploughing and preparing soil by machine, and direct sowing artificially under zero tillage, etc. will form gradually. The four different cultivation modes were analyzed deeply from operating cost and labor input and using cost of agricultural mechinery, the result defined adaptation area of different rapeseed cultivation modes in China’Yangtze river valley, and the development direction to reduce further production input and develop high-efficient integration technology.

Materials and Methods

Test sites Chizhou, Wuhu, Maanshan and Xuanzhou in Anhui province in China's Yangtze river downstream.

Condition of test sites The test area was located south shore of China's Yangtze river downstream, which annual average temperatures was 16℃ or so, ≥10℃ active accumulated temperature 5000℃ or so, annual precipitation 1169—1525mm, the annual average sunshine hours of 2118 h, radiation amount 469.8—492.4KJ, and soil cultivation layer PH 5.8—6.8, organic matter 27.6g/kg, total-N 1.54g/kg, total-P 0.28g/kg, total-K13.1g/kg, rapidly available P 5mg/kg, rapidly available K 68mg/kg.

Test varities Qinyou 33,Zayou 66 etc. were provided by Hybrid Rapeseed research Center of Shaanxi Province;Ningza 11,Fengyou 737, C420,Qi 9605, Mianyou 11 etc. by Shaanxi Ronghua Hybrid Rapeseed Limited Company.

Test program Four kinds of cultivation modes, whole mechanization, artificially transplanting under ploughing and preparing soil by machine, and direct sowing artificially after plaughing and preparing soil by machine and direct sowing artificially under zero tillage, were established uniformly.Each cultivation mode formulated operation regulation, and to record development process to fixed site and fixed plant, to calculate the operating cost and yield and output value, benefit as well as input-output ratio to all kinds of cultivation modes using the market price.

Contrast test in field No repetition,test area 800m^2(10m×80m).

Contrast test in plot 3 times repetition, plot area 125m^2(5m×25m), and recording development process to fixed site and fixed plant, sampling for examining characters of varieties.

Result and analysis

Input-output comparison of different cultivation modes in canola

From table 1, the four different cultivation modes,their operating cost was whole mechanization＞direct sowing artificially after ploughing and preparing soil by machine＞artificially transplanting under ploughing and preparing soil by machine＞direct sowing artificially under zero tillage. From labor input, the order was whole mechanization＜artificially transplanting under ploughing and preparing soil by machine＜direct sowing artificially after plaughing and preparing soil by machine and direct sowing artificially under zero tillage. From output value, the order was artificially transplanting under ploughing and preparing soil by machine＞whole mechanization＞direct sowing artificially after plaughing and preparing soil by mahine＞direct sowing artificially under zero tillage. But whole mechanization benefit was less than artificially transplanting under ploughing and preparing soil by machine, and direct sowing artificially after plaughing and preparing soil by machine and direct sowing artificially under zero tillage, their benefits were negative.From another point of view, whole mechanization, artificially transplanting under ploughing and preparing soil by machine and direct sowing artificially after plaughing and preparing soil by machine and direct sowing artificially under zero tillage, benefit difference of the four modes was very significant.

From table 1, artificially transplanting under ploughing and preparing soil by machine and whole mechanization are effective ways to get significant economic benefit, input-output ratio is 1:1.28 to 1:1.36,but that of direct sowing artificially after ploughing and preparing soil by machine and direct sowing artificially under zero tillage can not get to 1:1.

Table 1 The comparison between average production cost and benefit of different cultivation models for consecutive four years.

Items	Different cultivation models			
	Whole mechanization（yuan/hm^2）	Artificially transplanting under ploughing and preparing soil by machine（yuan/hm^2）	Direct sowing artificially after ploughing and preparing soil by machine（yuan/hm^2）	Direct sowing artificially under zero tillage（yuan/hm^2）
A operating cost (production cost)	4416.30	3321.30	3503.59	2691.30
B labour employment (workday/hm^2)	45.0	90.0	97.5	97.5
8 hours（yuan/day）	57.50	57.50	57.50	57.50
Labour cost(yuan/hm^2)	2587.50	5175.00	5606.25	5606.25
C total of cost（yuan/hm^2）	7003.80	8496.30	9109.84	8297.55
D yield（kg/ hm^2）	2490.0	3201.0	2476.5	2194.5
price（yuan/kg）	3.60	3.60	3.60	3.60
E production value（yuan/h m^2）	8964.00	11523.60	8915.40	7900.20
F benefit（yuan/hm^2）	1960.20	3027.30	-194.4	-397.4
G input-output ratio	1:1.28	1:1.36	1:0.98	1:0.95

*These data are means of operating cost , labour, yield and output value for four consecutive years in the four test points of the Yangtze River downstream.

Comparative analysis of input-output ratio of rapeseed cultivation models in different regions

Input-output ratio in different regions was analyzed, the result showed that the differece of whole mechanization cultivation model is rather big in different regions, the order is Wuhu City＞Maanshan City＞Xuanzhou City＞Chizhou City, while the difference of direct sowing artificially after ploughing and preparing soil by machine was smaller, and the trend was that Xuanzhou City and Wuhu City was higher(table 2).

Table 2 Comparison between average production cost and output benefit of rapeseed in different regions of different cultivation models for consecutive four years.

cultivation modes / items	Whole mechanization（yuan/hm^2）				Direct sowing artificially after ploughing and preparing soil by machine （yuan/ hm^2）			
Cities	Chizhou	Wuhu	Maanshan	Xuanzhou	Chizhou	Wuhu	Maanshan	Xuanzhou
A operating cost (production cost)	4444.73	4416.30	4412.55	4464.53	3439.73	3516.30	3587.55	3489.53
B labour (workday /hm^2)	45.0	37.5	37.5	45.0	97.5	90.0	90.0	90.0
8 hours(yuan/day)	50.00	60.00	65.00	55.0	50.00	60.00	65.00	55.00
Labour cost (yuan/hm^2)	2250.00	2250.00	2437.50	2475.00	4875.00	5400.00	5850.00	4950.00
C total of cost (yuan/ hm^2)	6694.73	6666.30	6850.05	6939.53	8314.73	8916.30	9437.55	8439.53
D yield（kg/ hm^2）	2389.50	2617.50	2556.00	2487.00	2323.50	2509.50	2478.00	2460.00
price（yuan/kg）	3.56	3.62	3.62	3.60	3.56	3.62	3.62	3.60
E production value (yuan/ hm^2)	8506.62	9475.35	9252.72	8953.20	8271.66	9084.39	8970.36	8856.00
F benefit (yuan/ hm^2)	1811.89	2809.05	2402.67	2013.67	-43.07	168.09	-467.19	416.47
G ratio of input-output	1:1.27	1:1.42	1:1.35	1:1.29	1:0.99	1:1.02	1:0.95	1:1.05

*These data were gotten through adopting uniform operation procedures to fixed points and fixed peasant households, and calculated according to local actual condition in different regions of Yangtze River downstream.

The comparative analysis between input and output ratio of whole mechanization model in different years

According to the variation of operation cost of rapeseed in Yangtze river downstream in China, the result from the analysis of input-output in the four years from 2007 to 2010 showed that production operation cost and labour price of good rapeseed varieties rised quickly, these became important limiting factor to hinder production and benefits increase of good rapeseed varieties.

Table 3 Comparation between cost of rapeseed production and output benefit under cultivation model of whole mechanization in different years

items \ years	2007	2008	2009	2010
A operating cost (production cost) (yuan/hm^2)	3817.50	4461.30	4416.30	4528.80
B labour (workday /hm^2)	42.5	42.5	42.5	42.5
8 hours（yuan/day）	50.00	55.00	60.00	65.00
Labour cost (yuan/hm^2)	2125.00	2337.50	2550.00	2762.50
C total of cost (yuan/hm^2)	5942.50	6798.80	6966.30	7291.30
D Yield (kg/hm^2)	2773.50	2617.50	2389.50	2269.50
Price (yuan/kg)	2.94	4.21	3.44	3.80
E Production value (yuan/hm^2)	7695.45	10059.80	9540.84	8624.10
F Benefit (yuan/hm^2)	2022.95	3261	2574.54	1332.8
G Input-output ratio	1:1.29	1:1.48	1:1.37	1:1.18

*Using same cultivation mode and uniform operation procedures, track records were done to fixed points and fixed peasant households in the downstream of Yangtze River, and these data were gotten from actual input and yield.

From table 3, the order for yield from high to low is 2007＞2008＞2009＞2010. From benefit, the order is 2008＞2009＞2007＞2010. From table 3, though the yield was low in 2008, the price of rapeseed was highest, so the benefit was best. In 2007, rapeseed yield was higher, but the price was lower, so the benefit was quite low. From input-output ratio, the order is 2008＞2009＞2007＞2010. And from the total cost of production, the order is 2010>2009>2008>2007, it showed that the rapeseed production cost was rising trend all the time in recent years.

Comparative analysis of operation cost and labor input to different cultivation models in rapeseed production

From labour input, the order is direct sowing artificially under zero tillage and direct sowing artificially after ploughing and preparing soil by machine＞artificially transplanting under ploughing and preparing soil by machine＞whole mechanization. The result is labour input of whole mechanization reduce 100.0—116.7%.

Table 4 Comparation of labour force cost among different cultivation models

Cultivation models	Whole mechanization (yuan/hm2)	Artificially transplanting under ploughing and preparing soil by machine (yuan/hm^2)	Direct sowing artificially after plaughing and preparing soil by machine (yuan/hm^2)	Direct sowing artificially under zero tillage (yuan/hm^2)
Cost of labour force	2587.51	5175.00	5606.25	5606.25
Comparation %	100.0	200.0	216.7	216.7

*Labour force cost of four cultivation models was average value of continuous four years.

Disscussion

The same rapeseed variety with high quality, their yield and benefit have significant difference in different region and different cultivation models. Transplanting artificially after ploughing and preparing soil by machine, both its benefit and input-output ratio were highest than other three cultivation models. There are more labor force and less land in some regions, transplanting artificially after ploughing and preparing soil by machine may be selected according to local condition for increasing economic benefit and job placement of surplus laborers.

To compare whole mechanization with direct sowing artificially after plaughing and preparing soil by machine, though there was no significance difference in yield, this difference in benefit and input-output ratio was very significantly. Especially, the cost of labor force reduced 117%. The model of whole mechanization can not only rise rapeseed benefit but also the ratio of input-output, and more labor forces may transfer from the primary industry to the secondary industry and the third industry.

Though direct sowing artificially under zero tillage do not occur too much tillage cost in machinery, increasing lots of labour forces, so it is not suitable to adopt the model. Therefore, it is necessary to study new cultivation technology matched with whole mechanization, and especially continuously improve those machinery, and breed new rapeseed varieties with high quality that are suitable for whole mechanization, these will reduce greatly labor intensity in rapeseed cultivation and labor cost, and make integration technology with high efficiency of whole mechanization operating of rapeseed show new vitality in new period.

References *omitted*