Effect of different combination of NPK on yield and quality of *Brassica napus* L

WANG Ruiqing, CAI Dongfang, SONG Zheng, YAO Yanli, YANG Guozheng

College of Plant Science and Technology, Huazhong Agricultural University, Wuhan, China, 430070
Email: andywang111@tom.com

Abstract

Huayouza No.6 was used to study the effect of four NPK combinations on yield and quality of field-grown *Brassica napus*. The result showed that the highest yield reached 2625 kg/hm^2 under the NPK combination of 1:0.4:0.6, which was significantly higher than that under the combination of 1:0.4:0.7. The highest oil content was also gained under 1:0.4:0.6 and the lowest appeared under 1:0.5:0.7, however no significant difference was existed among the four combinations. On the contrary, the highest protein content was realized under 1:0.5:0.7 and the lowest was under 1:0.4:0.6, but no significant difference was also detected. What's more, the economic coefficient was the highest under 1:0.4:0.6.

Key words: *Brassica napus*, NPK combination, yield, quality

Introduction

N, P and K are necessary nutrients for plant development, so many scientists preferred to study them[1]. Rapeseed is an important oil plant and industrial material in China, which occupied important status in national economy. Rapeseed is mainly distributed in Yangtze River stream and the potential production of rapeseed is prospective. The rapeseed production in Yangtze River stream has been restricted both in seed yield increase and quality improvement further[2-6]. This study was taken using rapeseed cultivar Huayouza No.6 as the material to research the effect of different proportion of NPK on yield, quality, agronomical character. It was hoped to find an optimal NPK combination to make the yield and quality best.

1 Material and Method

1.1 Experimental material

The experiment was carried out at the experimental farm of Huazhong agronomical university. The rapeseed cultivar was Huayouza No.6 (*Brassica napus*). Seeds were sown on Sept. 12, 2005 and the seedlings were transplanted on Oct.14. The soil organic matter, available N, total N, total P and available K were 22 g/kg, 121.1 mg/kg, 0.16%, 0.13%, and 157mg/kg.

The former stubble crop was cotton. The fertilizers used were urea (N,46%), compound fertilizer(N:P_2O_5:K_2O=15:15:15), KCl(K_2O, 59%)and borax, respectively.

1.2 Experimental design

The four NPK combinations were designed, which were F1, N: P_2O_5:K_2O=1:0.3:0.5; F2, N: P_2O_5:K_2O =1:0.4:0.6; F3, N: P_2O_5:K_2O =1:0.5:0.7; and F4, N: P_2O_5:K_2O =1:0.4:0.7. The area of each plot was 20 m^2(10 m×2 m)and the density was 75000 plant/ hm^2. All plots were arranged randomized with 3 repeats.

Of the nitrogen, 70% were applied as base fertilizer and the rest were applied as dressing fertilizer during in the winter season. All of phosphorus and potassium fertilizers were applied as base fertilizers.

1.3 Method

In each plot, 15 plants each row were remained for the field investigation which included leaf chlorophyll content with SPAD method, leaf numbers, green leaf numbers, plant height and stem diameter and root neck diameter at seedling stage every 10 days till the midwinter. The remained 15 plants were harvested in a nylon net bag on May 12, 2006 and economic character, yield composition, seed yield and seed quality was investigated after the plant got dried. The seed quality analysis was conducted by infrared method (TR-3700, Foss Company).

2 Results and analysis

2.1 Effect of different NPK combinations on seed yield

The table 1 and table 2 showed the effect of different treatments on seed yield was not significant through the variance analysis. But the result of multi-comparison shown that there was a Influence of additional inputs in higher management level delayed maturation by 1-2 days, reduced lodging (very different depending on variety) and damage especially in case of Sclerotinia sclerotiorum and Phoma lingam. Thousand grain weight was higher for most varieties in higher management level (+ 0,16 g = + 3,3 % on average), yield increased by 11 % on average (-1 to +29 % depending on location). Oil content of major part of varieties decreased in higher managment level (on average by -0,4 %). Yield increase of varieties varied greatly due to trial location. As expected, higher yields were achieved at higher level of crop management, but response to higher

inputs was not the same. Efficiency of input used by some varieties was better compared to others. This phenomenon can be exploited by farmers when choosing the most appropriate variety for the actual both environmental and fiscal position of their farm.t difference between F2 and F4 treatments at the significant level of 5%, while no Influence of additional inputs in higher management level delayed maturation by 1-2 days, reduced lodging (very different depending on variety) and damage especially in case of Sclerotinia sclerotiorum and Phoma lingam. Thousand grain weight was higher for most varieties in higher management level (+ 0,16 g = + 3,3 % on average), yield increased by 11 % on average (-1 to +29 % depending on location). Oil content of major part of varieties decreased in higher managment level (on average by -0,4 %). Yield increase of varieties varied greatly due to trial location. As expected, higher yields were achieved at higher level of crop management, but response to higher inputs was not the same. Efficiency of input used by some varieties was better compared to others. This phenomenon can be exploited by farmers when choosing the most appropriate variety for the actual both environmental and fiscal position of their farm.t difference was found among F1, F2 and F3 at both the levels of 5% and 1%. The theoretical yield was highest in F2 which reached 2625 kg/hm^2. The lowest was F4 which was 1860 kg/hm^2.

Table 1 Variance analysis of effect of the different NPK combination on seed yield

Source	DF	Sum-of-square	Mean Square	F value	Pr>F
Model	3	4993.01	1664.33	2.73	0.1139
Error	8	4878.23	609.77		
Total	11	9871.24			

Table 2 Variance analysis of effect of the different NPK combinations on seed yield

Treatment	Theory yield (kg/hm^2)	Increase percent compared with F4	Significance level at 5%	Significance level at 1%
F2	2625	41.1%	a	A
F1	2445	31.5%	ab	A
F3	2025	8.9%	ab	A
F4	1860	0	b	A

2.2 Effect of different NPK combinations on yield component

The figure 1 showed that 1000-seed weight in F1 was the highest and F4 was the lowest. The magnitude order of seeds per pod was F2>F1>F3>F4 and that of pods per plant was F2>F1>F4>F3. Seeds per pod and pods per plant were positive correlated to seed yield.

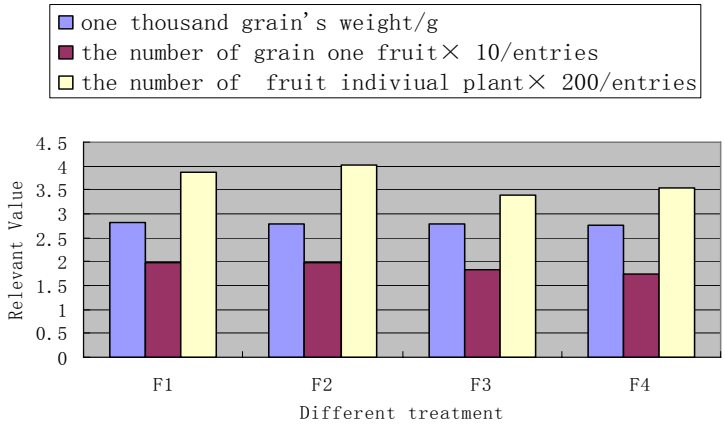

Fig. 1 Yield components of different treatments

2.3 Effect of different NPK combinations on seed oil content

There was no significant difference in oil content among the four NPK combinations (Table 3), but the oil content in F2 was the highest (38.05%), which followed by F4, F1, and F3 was the lowest. When the application of N and P was unchanged, the oil content was decreased with the increase of K fertilizer., When application of N and K was unchanged, the oil content decreased 0.3% with P increase between F3 and F4. Between F2 and F1, when application of N was unchanged, the oil content increased 0.31% when P and K increased by 15 kg/hm^2. At the level of F2, the oil content decreased 0.6% when P and K were increased by 15 kg/hm^2.

Table 3 Variance analysis of effect of different NPK combinations on oil content

Treatment	Average of oil content (%)	Significance level at 5%	Significance level at 1%
F2	38.05	a	A
F4	37.75	a	A
F1	37.74	a	A
F3	37.45	a	A

2.4 Effect of different NPK combinations on seed protein content

The result from Table 4 showed that there was no significant difference in average protein content among the four NPK combinations at levels of 5% and 1%. But the protein content of F3 was the highest (22.68%), followed by F1, F4, and F2 was the lowest. When applications of N and P were fixed, the average protein content increased when the application of K was increased. When applications of N and K were fixed, the average protein content increased 0.69% from F4 to F3 with P increase. Between F2 and F1, when application of N was fixed, the average protein content decreased 0.57% when applications of P and K were increased by 15 kg/hm^2, respectively. At the level of F2, the average protein content increased 0.92% when P and K were increased by 15 kg/hm^2.

Table 4 Variance analysis of effect of the different NPK combinations on protein content

treatment	Average of protein content (%)	Significance level at 5%	Significance level at 1%
F3	22.68	a	A
F1	22.33	a	A
F4	21.99	a	A
F2	21.76	a	A

2.5 Effect of different combinations on agronomical character

Table 5 Effect of different NPK combinations on rapeseed agronomical characters and economic coefficient

Treatment	Height (cm)	Stem diameter(cm)	Pot density (p/cm)	No. of branche/plant	Ratio of root to shoot	Economic coefficient
F1	196.9	2.28	1.36*	13.90*	0.083	0.189
F2	198.3	2.32*	1.17	13.67	0.086	0.204*
F3	202.2	2.13	1.23	12.63	0.10*	0.191
F4	203.6*	2.05	1.32	11.97	0.095	0.185

* denoted the highest in the row.

The variance analysis of agronomical character suggested that branch per plant in F1 was the highest which was much higher than that in F4 (Table 5). Table 5 showed the plant height in F4 was the highest among four treatments and the magnitude order was F4>F3>F2>F1. The stem diameter in F2 was the largest and the root/shoot ratio in F3 was the highest. The pod density in F1 was the biggest. It was concluded that the application of N, P and K affected the agronomical characters to different extent, for example, the application of P decreased the plant height, and branch height increased on the contrary compared F3 with F4.

2.6 Effect of different NPK combinations on economic coefficient

Table 5 showed the economic coefficient in F2 was the largest and the magnitude order was F2>F3>F1>F4. Compared F2 with F3, the economic coefficient was decreased when application of N was unchanged, and the applications of P and K were increased by 15 kg/hm^2. Compared F1 with F2, the economic coefficient was increased when the application of N was unchanged, and application of P and K were increased by 15 kg/hm^2.

3 Conclusion and discussion

3.1 The application of N, P, and K had distinct influences on seed yield. The seed yield was the highest at the NPK combination of 1: 0.4: 0.6, which was influenced when application of P and K was changed. The application of N, P and K affected the 1000-seed weigh, and Te 1000-seed weight was decreased when the applications of P and K were increased in this study. The number of pods was changed with the change of theoretical yield besides the F3 and F4 treatments.

3.2 The application of N, P and K didn't affect the quality of rapeseed prominently. However, the change trend of protein and oil content was opposite. So we could regulate the protein and oil content in rapeseed by fertilization reasonably.

3.3 The application of N, P and K didn't show significant effect on agronomical character. The application of N, P and K fertilizers affect mainly main anthotaxy length, pod length and root/shoot ratio. The more the fertilizers were used, the better were the agronomical characters and the economic coefficient and the yield were beneficial from it at the study.

References

[1] Zhang Y. Research on high efficient cultivating modes of rape [D]. Master's degree paper of Huazhong agricultural university.2006
[2] Fu Q D. The status and future of rape production and breed improved in china [J]. Anhui J Agric Sci, 2000(1):2-8.
[3] Wang Z Y, Li B Z. The effect of N, P, K, B on yield and quality of Yellow-seeded Brassica napes [J].Chin J Soil Sci, 2005, 42(3).
[4] Zhu H X, Li G B, Zhang X, et al. The rule of alimentation of high yield rape and the effect of N P K on yield and quality [J]. Soil –ferti, 1995-5.
[5] Zhou J X, et al. The effect of different descriptions of N, P, K, B on yield of rape [J].culti-plant, 2002 (1).
[6] Lu J W, et al. The effect of N P K fertilizer used cooperatively on the yield and nutrient accumulation [J]. Chin J Oil plant Sci, 2003, 25(2).