
Effects of different fertilizer combinations on soil nutrient and oilseed rape yield

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Abstract

For the reconstructed soils with relatively lack of nutrients on the Yellow River beach, through potted experiments, urea, diammonium phosphate, potassium sulfate, coated urea, superphosphate, and potassium chloride were used as fertilizers to compose different fertilization treatments to study the effect of different fertilization Treatment on soil nutrients and rape growth and development. The results showed that: soil electrical conductivity was significantly increased with the application of urea, superphosphate, and potassium chloride. The application of superphosphate and potassium chloride can increase soil organic matter content. Total nitrogen content in treatment 3 increased the most, reaching 18.3%. The best fertilizer combination was urea, diammonium phosphate and potassium chloride.

Keywords

Fertilizer, nutrient, potassium, urea, yield.

1. Introduction

Oilseed Rape is one of the major oil crops in China. How to increase rapeseed production is crucial to ensure the safety of Chinese edible oil[1,2]. The commonly used method to increase oilseed rape production is the application of fertilizers. Nitrogen is an essential nutrient for plant growth and development. Studies have shown that rational application of nitrogenous fertilizers is conducive to the improvement of rapeseed yield[3]. Appropriate nitrogenous fertilizers for rape in the middle and lower reaches of Yangtze River are 180kg/kg. Hm²[4-6]. At present, most of the nitrogen fertilizer applied in farmland is quick-acting nitrogen fertilizer. The nutrient release is quick and the fertilizer effect is short. Unreasonable application can easily cause nitrogen loss and environmental pollution. Controlled-release nitrogen fertilizer can release nutrients slowly with the growth of crops, which is more conducive to the growth of rapeseed. Studies have shown that the application of controlled-release nitrogen fertilizer can increase production by up to 12% compared with the application of equivalent amount of urea.[7] Phosphorus plays an important role in the enzymatic reaction and photosynthetic reaction of the meeting [8]. Studies have shown that the application of phosphate fertilizer can promote the absorption of nitrogen and potassium in rape, and then promote rapeseed growth [9,10]. Potassium fertilizer can promote the growth of rape roots, stems and leaves,

promote the transfer of substances to the grains, increase the yield of rapeseed, and increase the oil content of rapeseed. However, different types of fertilizers have different effects on rapeseed. Therefore, it is necessary to study the effects of different fertilizer applications on soil nutrients and rapeseed growth, and to select suitable combinations of fertilizer types to provide theoretical basis for increasing rapeseed yield.

2. Materials and Methods

2.1 Experimental method

In the test, conventional fertilizers (diammonium phosphate and potassium sulfate) were used as controls (CK). And coated urea, superphosphate, and potassium chloride, were selected to form four treatments. Each treatment was repeated three times (treatment settings in Table 1), a total of 12 pots. The fertilizer application rates of each treatment were consistent with nitrogen, phosphorus, and potassium (0.3 g/kg N, 0.06 g/kg P₂O₅, 0.06 g/kg K₂O) and 4 g/kg sheep manure. Phosphate fertilizer, potash fertilizer, and organic fertilizer were used as base fertilizers in rapeseed before planting. After planting, 20% nitrogen fertilizer was applied 10 days after planting, and 50% nitrogen fertilizer was applied during flowering. The remaining nitrogen fertilizer was applied to the soil during mature period.

Table 1 Fertilizer type processing settings

Treatment	Pot number	Fertilizer type			Organic Fertilizer
CK	1-3	urea	diammonium phosphate	potassium sulfate	sheep manure
1	4-6	coated urea	diammonium phosphate	potassium sulfate	sheep manure
2	7-9	urea	superphosphate	potassium sulfate	sheep manure
3	10-12	urea	diammonium phosphate	potassium chloride	sheep manure

2.2 Sample collection

After the harvest, soil samples of the tillage layer (surface layer 20 cm) were collected. Soil was taken from small soil drills with a diameter of 2 cm and 3 drills were taken from each pot as a mixed soil sample. pH, conductivity, texture, organic matter, total nitrogen, available phosphorus, and available potassium were measured.

3. Discussion

3.1 Effects of different chemical fertilizers on soil pH and conductivity

It showed that soil pH order CK > treatment 1 > treatment 2 > treatment 3 (Table 2), but the difference between the four treatments is not significant, indicating that the application of different fertilizers has little effect on the soil pH. Soil conductivities order CK < treatment 1 < treatment 2 < treatment 3, compared with CK (Table 3), soil conductivity of treatment 1, treatment 2, treatment 3 increased by

Table 2 Effect of different fertilizer types on soil pH

Treatment	Repeat			Average
	1	2	3	
CK	8.08	8.08	8.09	8.08
1	8.03	8.01	7.98	8.01
2	7.95	8.01	7.95	7.97
3	7.96	7.90	7.96	7.94

Table 3 Effect of different fertilizer types on conductivity of soil us/cm

Treatment	Repeat			Average
	1	2	3	
CK	492	487	491	490
1	568	474	695	579
2	633	579	633	615
3	488	720	670	626

18.2%, 25.5%, and 27.8%, respectively, indicating that the application package Membrane urea, superphosphate, and potassium chloride fertilizers increase soil conductivity.

3.2 Effects of different chemical fertilizers on soil organic matter content

Compared with CK, soil organic matter in Treatment 1, Treatment 2 and Treatment 3 had different degrees of increase (Table 4). The increase range was 0.7%, 5.2%, and 10.3% respectively. The increase in treatment 1 was not obvious, indicating that application of superphosphate and chlorination.

Table 4 Effect of different fertilizer types on soil organic matter content g/kg

Treatment	Repeat			Average
	1	2	3	
CK	7.76	6.92	7.25	7.31
1	7.92	6.89	7.26	7.36
2	8.39	7.44	7.23	7.69
3	7.44	9.51	7.23	8.06

3.3 Effects of different chemical fertilizers on total nitrogen content of soil

Compared with CK, total nitrogen content in soils of Treatment 1, Treatment 2 and Treatment 3 increased to varying degrees. The total nitrogen content of Treatment 1, Treatment 2, and Treatment 3 increased by 15.5%, 11.3%, and 18.3%, respectively, compared to CK, indicating that the application Coated urea, superphosphate, and potassium chloride increase the total nitrogen content of soil.

Table 5 Effects of different chemical fertilizers on total nitrogen content of soil g/kg

Treatment	Repeat			Average
	1	2	3	
CK	0.69	0.70	0.74	0.71
1	0.98	0.70	0.79	0.82
2	0.77	0.84	0.77	0.79
3	0.71	1.04	0.78	0.84

3.4 Effect of different fertilizer types on available phosphorus content in soil

Compared with CK, available phosphorus of Treatment 1, Treatment 2 and Treatment 3 soils had

Table 6 Effect of different fertilizer types on available phosphorus content in soil mg/kg

Treatment	Repeat			Average
	1	2	3	
CK	4.90	4.91	6.63	5.48
1	6.45	1.25	4.15	3.95
2	4.81	2.81	3.79	3.80
3	2.57	4.83	2.17	3.19

different degrees of reduction, with decreasing amplitudes of 27.9%, 30.7%, and 41.8%, respectively, indicating that the application of coated urea, superphosphate, and potassium chloride can be To

reduce soil available phosphorus content, the application of potassium chloride has the most significant effect.

3.5 Effects of different chemical fertilizers on soil available K content

Compared with CK, content of available potassium in treatment 1 increased by 14.0%, and the content of available potassium in treatment 2 and treatment 3 decreased. The reduction range was 15.3% and 25.3%, indicating that the application of coated urea could increase. Soil available potassium content, application of superphosphate and potassium chloride can reduce soil available potassium content, of which the application of potassium chloride has a greater reduction.

Table 7 Effects of different chemical fertilizers on soil available K Content mg/kg

Treatment	Repeat			Average
	1	2	3	
CK	136.26	130.08	130.08	132.14
1	178.31	118.95	154.81	150.69
2	118.95	105.34	111.53	111.94
3	86.79	125.13	84.32	98.75

3.6 Effects of different fertilizer types on biomass and yield of oilseed rape

Compared with CK, the weight of treatment 3 stalks increased significantly, and the weight of treatment 2 and treatment 3 increased significantly, indicating that the application of potassium chloride can promote the growth of stalk and root system of rapeseed, compared to the application of potassium sulfate, compared to the application of diammonium phosphate, The application of superphosphate can promote the growth of rapeseed roots. Single crop rapeseed yield CK <treatment 1 <treatment 2 <treatment 3. the application of coated urea, diammonium phosphate, and potassium sulfate are conducive to stable production of rapeseed.

Table 8 Effects of different fertilizer types on biomass and yield of oilseed rape g/strain

Repeat	Above ground				Root			
	CK	1	2	3	CK	1	2	3
1	32.71	43.54	31.57	56.39	2.11	2.13	7.76	15.33
2	50.19	38.67	40.54	58.92	6.68	2.22	5.96	9.54
3	36.22	38.01	43.61	47.09	4.64	5.98	7.88	12.27
Average	39.71	40.07	38.57	54.13	4.48	3.44	7.20	12.38

Table 9 Effects of different fertilizer types on rape seed yield g/strain

Treatment	Repeat			Average
	1	2	3	
CK	6.01	6.00	6.02	6.01
1	7.90	6.68	6.27	6.95
2	6.60	7.09	7.82	7.17
3	7.20	7.54	7.37	7.37

4. Conclusion

(1) The effect of different fertilizer combinations on soil pH was not significant, and soil electrical conductivity was significantly increased with the application of urea, superphosphate, and potassium chloride, which was 27.8% higher than the control.

- (2) The application of superphosphate and potassium chloride can increase soil organic matter content, of which the increase in soil organic matter content by using urea, superphosphate, and potassium chloride is the highest, an increase of 10.3% compared to the control.
- (3) The application of coated urea treatment soil total nitrogen content was higher than urea treatment, superphosphate and potassium chloride can increase total soil nitrogen content. Compared with the control, the total nitrogen content in treatment 3 increased the most, reaching 18.3%.
- (4) Compared to the control, the application of coated urea (treatment 1) can increase the content of available potassium, and the application of superphosphate and potassium chloride can reduce the content of available potassium in soil.
- (5) Compared with the application of potassium sulfate, the application of potassium chloride can promote the growth of stems and roots of rape, compared to the application of diammonium phosphate, the application of superphosphate can promote rape root growth. Application of urea, diammonium phosphate, potassium chloride treatment of rapeseed yield is the highest.

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