

Effect of potassium fertilization on rapeseed and potassium application technique in China

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Outline

- The Present Situation of Rape production in China
- Effects of K application on Rape
- Applicative Technique of K on Rape
- Conclusions



1. The Present Situation of Rape Production in China

- Chinese rapeseed area and product has been the largest in the world since 1999.
- Sichuan, Hubei, Hunan, Jiangxi, Anhui and Jiangsu province are the major rapeseed producer area in the country.
- Rape yield in China is about 1500 kg/ha, which is near the world average yield level, but much lower than that in Europe.
- At same yield level, oil content in Canada is 5% higher than that in China (42.6% vs 37.7%) .

The Situation of Rape production in China (1999-2005)

| Years | Planting area 10 ⁴ hm ² | General products 10 ⁴ t | Per unit yield kg/hm ² |
|-------|--|---------------------------------------|--------------------------------------|
| 1999 | 689.9 | 1013.2 | 1469 |
| 2000 | 749.4 | 1138.1 | 1519 |
| 2001 | 709.5 | 1133.1 | 1597 |
| 2002 | 714.3 | 1055.2 | 1477 |
| 2003 | 722.1 | 1142.0 | 1582 |
| 2004 | 727.1 | 1318.2 | 1813 |
| 2005 | 733.6 | 1120.0 | 1527 |

Status of Soil Nutrient Resources in Yangtze River Area

- Yangtze River area is the major rapeseed production region (about 85% in China). Status of soil nutrient resources in this area is unique.
- ◆ Nutrients loss and output is intense due to its high density crops rotation.
- ◆ Nutrients input is deficient and unbalanced.
- ◆ Several nutrients (N, P, K, B, Zn, Mo, S, Mg, Ca) were inadequate in same field.



Low soil available K content is the limit factor for rapeseed growth and yield.



Relationship between K Fertilization Rates and Rapeseed Yield

(Hubei province n=1301)

| Yield classification (kg/ha) | Sample number | K ₂ O rate (kg/ha) | Average yield (kg/ha) |
|---------------------------------|------------------|----------------------------------|--------------------------|
| ≥2500 | 180 | 31 | 2876 |
| 2000-2500 | 293 | 16 | 2224 |
| 1500-2000 | 471 | 22 | 1699 |
| 1000-1500 | 200 | 17 | 1210 |
| 500-1000 | 145 | 9 | 757 |
| <500 | 21 | 6 | 355 |

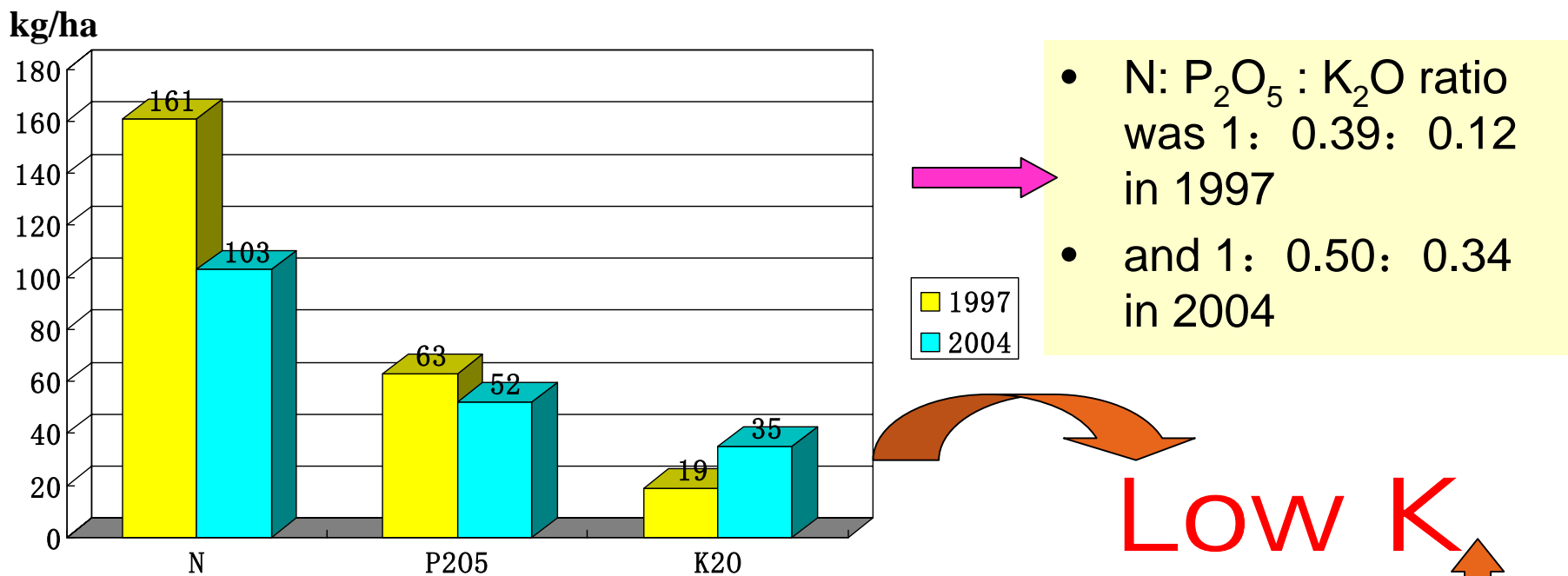


Fig. NPK fertilization level for rapeseed in 1997 (n=1301) and 2004 (n=713) in Hubei

- N: P₂O₅ : K₂O absorption amount is 119, 37 and 147 kg/ha, the ratio is 1: 0.31: 1.24

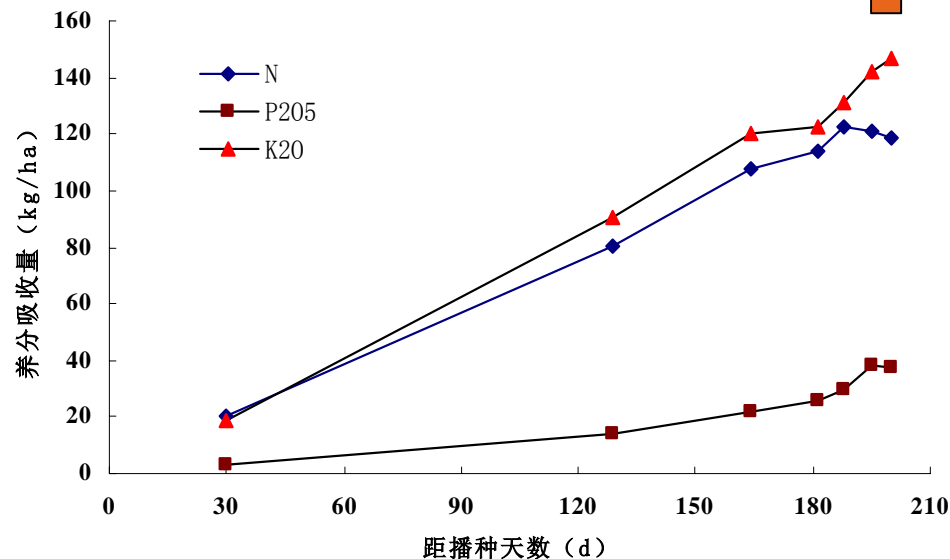


Fig. NPK absorption for rapeseed at 1500 kg/ha yield

2. Effect of K application on Rapeseed

- Since 1980s' rapeseed K deficiency symptom was reported and K has significantly effect on rapeseed nowadays.

Effect of K application on rapeseed in different area (n=167)

| Province | Soil avail. K level (mg/kg) | K ₂ O rate (kg/hm ²) | Increment | | Yield increment of per kg K ₂ O (kg/kg K ₂ O) |
|----------|-----------------------------------|--|-----------------------|------|---|
| | | | (kg/hm ²) | (%) | |
| Hubei | 28-88 | 75-180 | 54-532 | 33.8 | 3.21 |
| Anhui | 34-120 | 120-135 | 126-638 | 25.3 | 3.45 |
| Guizhou | 59-97 | 90-112.5 | 154-650 | 34.4 | 5.68 |
| Henan | 77-172 | 90-120 | 152-257 | 15.8 | 1.68 |
| Shanxi | 71-143 | 45-90 | 123-247 | 11.1 | 2.75 |
| Qinghai | 85-105 | 80-100 | 87-368 | 22.0 | 2.47 |
| Yunnan | 48 | 90 | 462 | 41.2 | 5.13 |

Effect of N, P, K and B on Rapeseed in Hubei Province

(n>30)

| Nutrients | Efficient proportion (%) | Increment (kg/ha) | Increment (%) | Yield increment of per kg Nutrients (kg) | CK /+ K (%) | Net profit (¥/ha) | VCR |
|-------------------------------|--------------------------|-------------------|---------------|--|-------------|-------------------|------|
| N | 93 | 1243 | 84.1 | 6.9 | 54.3 | 2333 | 4.01 |
| P ₂ O ₅ | 80 | 558 | 53.0 | 6.2 | 65.4 | 832 | 3.10 |
| K ₂ O | 91 | 373 | 75.4 | 3.2 | 69.0 | 544 | 2.18 |
| B | 65 | 387 | 18.2 | - | 84.6 | 840 | 7.20 |

Effect of K on Rapeseed in Hubei Province

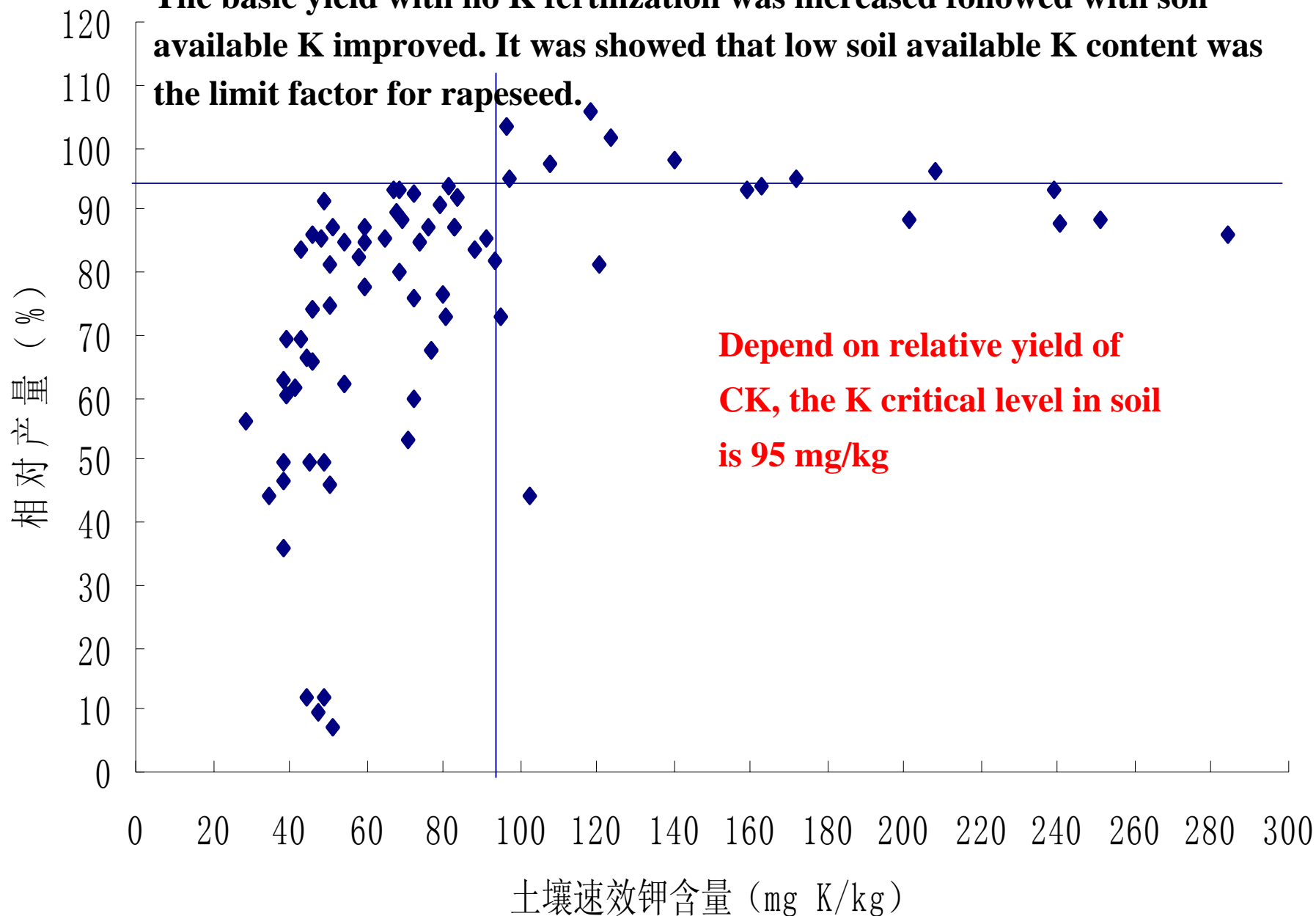
- 80 field experiments were carried out on rapeseed in Hubei, the K_2O rate was 90 kg/ha to 180 kg/ha and most was 120 kg/ha.
- Yield increment with K application was 373kg/ha and increased by 75.4% based on NPB treatment. 1 kg K_2O application can get 3.21 kg seed and the VCR was 2.18.
- 8.8% trials showed no significant effect to K fertilization (including decrease yield trials and increment less than 100 kg/ha), 87.5% trials showed K increased seed yield 100-1000 kg/ha.
- 38.8% trials (31) showed no profit or low benefit from K application, the VCR was lower than 1.5, 43.8% trials showed K had significant profit, which VCR was higher than 2.
- 63.4% trials showed that K application increased oil content and received 146 kg/ha more oil; K had little effect on the content of protein but protein yield enhanced 70 kg/ha as a result of seed yield increasing.

3. Potassium Application Technique for Rapeseed

- According to soil potassium supply ability
- According to rape varieties and target yield
- Timing of K application
- Relationship and interaction between K and other nutrients
- Organic manure and straw returning into field



The basic yield with no K fertilization was increased followed with soil available K improved. It was showed that low soil available K content was the limit factor for rapeseed.



Potassium Recommendation for Rapeseed According to Soil Available Potassium Content and Target Yield

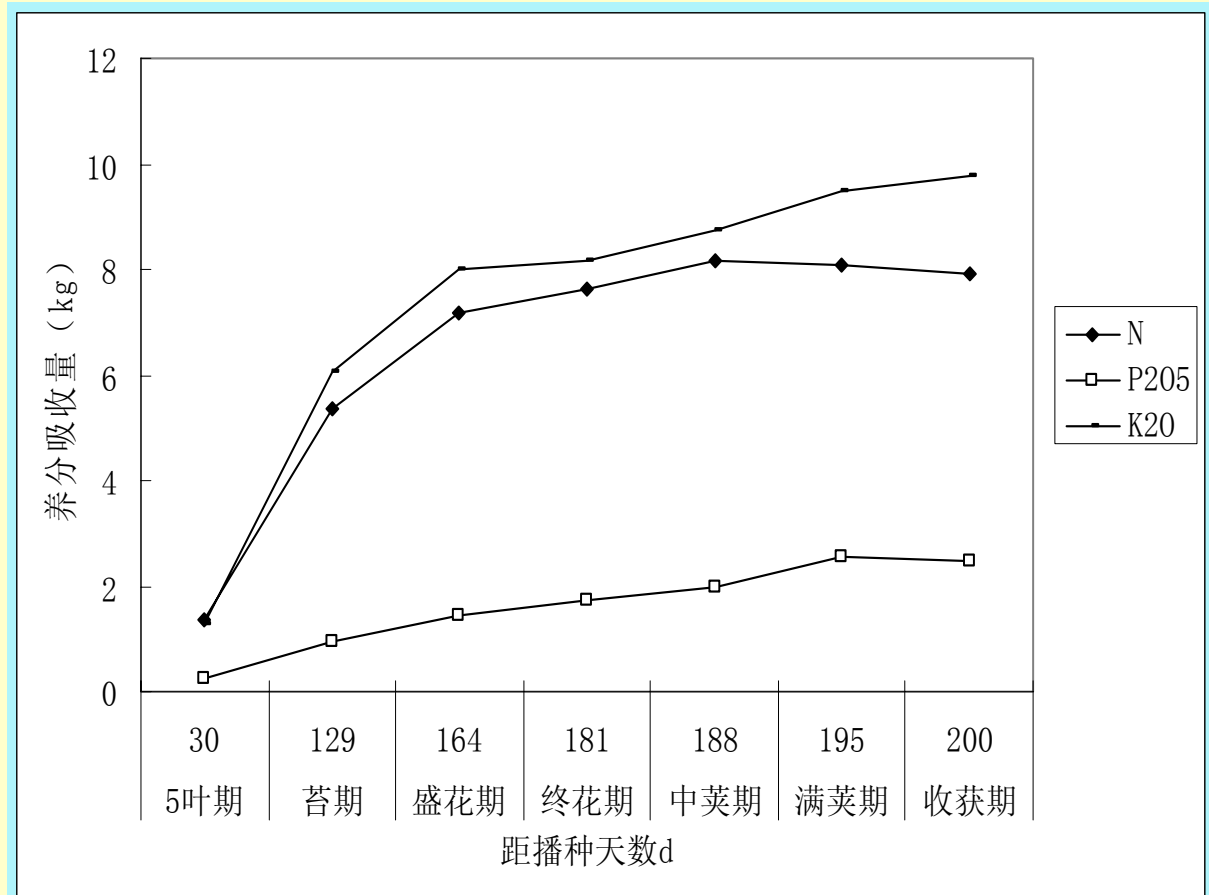
| Target yield (t/ha) | Potassium recommendation (kg/ha K₂O) | | | |
|--------------------------------|--|--------------------|---------------------|-----------------------|
| | Soil avail. K level < 50 mg/kg | 50~75 mg/kg | 75~100 mg/kg | > 100 mg/kg |
| <0.75 | 110 | 90 | 30 | 0 |
| 0.75~1.50 | 110~190 | 90~160 | 30~60 | 0 |
| 1.50~2.25 | 190~290 | 160~240 | 60~80 | 30~45 |
| 2.25~3.00 | 290~360 | 240~300 | 80~100 | 45~60 |
| 3.00~3.75 | 360~420 | 300~360 | 100~120 | 60~75 |

K Accumulation and Proportion of NPK in Different Rape Cultivars

| Rape Variety | Yield (kg/ ha) | K₂O demand for producing 100 kg seeds (kg) | Ratio of Nutrients Absorption N: P₂O₅: K₂O |
|--------------------------|---------------------------|--|--|
| Huaza No.12 | 2600 | 9.14 | 1 : 0.39 : 1.48 |
| Zhongza No.11 | 2500 | 8.32 | 1 : 0.43 : 1.67 |
| Jingza 106 | 2813 | 7.31 | 1 : 0.74 : 1.79 |
| Yuhuang No.1 | 2076 | 13.0 | 1 : 0.43 : 1.13 |
| Zhongshuang No.10 | 2139 | 8.27 | 1 : 0.71 : 2.08 |
| Huashuang No.5 | 2015 | 6.38 | 1 : 0.63 : 1.88 |
| Rongyou No.10 | 2625 | 5.67 | 1 : 0.41 : 1.16 |
| Average | 2395 | 8.30 | 1 : 0.50 : 1.60 |

K application at proper time

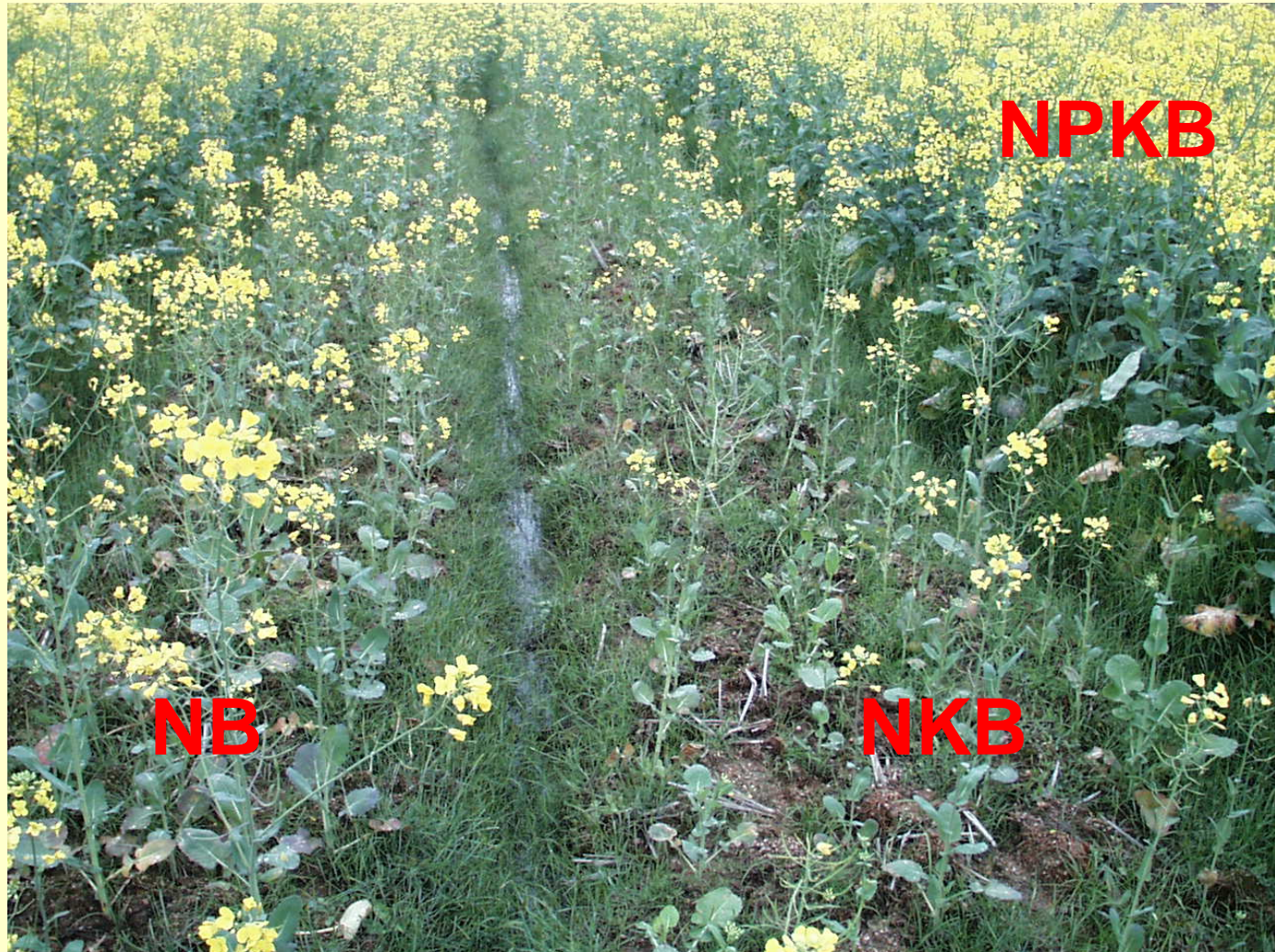
- Commonly, K fertilizer was applied at one time before sowing in large field produce. Early application of K promoted the development of root system and ensured seedlings to survive safely during winter.
- K accumulation reached the peak at bolting-flowering stage and the percentage was about 80% to the total uptake amount of K.
- It was suggested that K fertilizer should be split applied at several times on sandy soil.
- 60-70% of K should be used as base fertilizer and 30-40% can be applied in bolting stage.



Nutrients absorption for producing 100 kg seeds at different stages

Cooperate with other nutrients

- Rapeseed was sensitive to lack of N, P, K and B;
- Mg, S and Zn deficiency happened sometimes under high yield cultivation conditions.
- Several nutrients were inadequate at the same time in rapeseed area, and therefore K cooperated with other nutrients was important to improve seed yield and fertilizer use efficiency.



- **Balanced fertilization is the effective way for high yield and good quality on rapeseed.**
- **Effect of K fertilizer is based on cooperating with other nutrient element.**



Farmer Practice

Balanced Fertilization

K Absorption of Rice in Rice-Rapeseed Rotation System

| Crop rotation | Rice yield (kg/ha) | Straws yield (kg/ha) | Potassium accumulation (K ₂ O kg/ha) | | Ratio of potassium accumulation (%) | |
|--------------------|--------------------|----------------------|---|---------|-------------------------------------|-----------|
| | | | Rice | Straw | Rice | Straw |
| Rice-Rapeseed | 7564-9585 | 7469-9056 | 27-42 | 262-366 | 9.3-10.3 | 89.7-90.7 |
| Rice-Rice-Rapeseed | 6737-6959 | 5683-5806 | 20-23 | 140-219 | 9.5-12.5 | 87.5-90.5 |

The experiment of Rice-Rapeseed was carried out in Jiangnan Plain, double rice-Rapeseed in the east of Hubei Province.

K Return with Different Proportion of Rice-straw Returning into the Soil

| Returning quantity of straw into field kg/ha | Proportion of returning % | K ₂ O rate of returning (kg/ha) | |
|---|------------------------------|--|--------------------|
| | | Rice-Rapeseed | Rice-Rice-Rapeseed |
| 1500 | 20-30 | 53-61 | 37-57 |
| 2250 | 30-40 | 87-101 | 63-94 |
| 3000 | 40-50 | 116-135 | 84-126 |
| — | 100 | 262-366 | — |



It was suggested that returning rice-straw into field under rice-rapeseed double cropping system and covering rice-straw 1.5-3.0 t/ha in triple cropping system.

4. Conclusions

- Yangtze River area is the major rapeseed production region in China. Short input of K fertilizer and low soil available K content was the limit factor for rapeseed.
- Rapeseed yield improved significantly with K application in Hubei province. 1 kg K_2O application can get 3.2 kg seed, the VCR was 2.2 and K increased oil content as well.
- K application rate is determined according to soil K level, rape cultivars and target yield. At present production level, the K critical level in soil is about 100 mg/kg.
- It was suggested that suitable proportion of base fertilizer and bolting fertilizer was 2:1 under high yield cultivation conditions.
- Several nutrients were inadequate at the same time in rapeseed area, and therefore K cooperated with other nutrients was necessary.
- Returning rice-straw to soil in rice-rapeseed area should be a useful measure.

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