Effects of a urease inhibitor NBPT on the growth and quality of rape

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Abstract
Reducing nitrate concentration and improving the quality of vegetable crops have been two areas of major research effort. The aim of this study was to determine the effects of adding a urease inhibitor NBPT (N-(n-butyl) thiophosphoric triamide) to urea on the growth and quality of rape plants in a pot experiment. The amount of NBPT added was equivalent to 0.5%, 1.0%, 1.5%, 2.0% and 2.5% of the total nitrogen (N) applied. Results showed that NBPT significantly increased crop yield by 22.67%~27.82%, and decreased nitrate concentration in the crop by 4.19%~32.63%. Total N, N up-taken and N use efficiency were also increased by the NBPT treatments. Rape Vc had the highest uptake when the amount of NBPT was 1.0% of the total N applied, while other treatments were equivalent or lower. The highest N uptake and N recovery by the plants was when the amount of NBPT added was 0.5% of the total urea-N applied. Therefore, a suitable amount of NBPT applied could not only reduce nitrate content and increase yield, but also improve N use efficiency.

Key Words
Urease inhibitor, NBPT, nitrate; Vc, water soluble sugar, N use efficiency.

Introduction

Urease inhibitor has been applied with urea in recent years. It can restrain urease activity, slow down the hydrolysis process of urease decomposition, prolong urease diffusion time, and decrease the concentration of NH_4^+ and NH_3 in soil solution. Recent studies have showed that urease inhibitor NBPT was almost always applied on corn, rice, cotton fields to reduce ammonia and there is a need for more investigation about nitrogen transformations (Zu *et al.* 2000; Xu and Zhou 2001; Chen *et al.* 2004; Zhou *et al.* 2004; Sun *et al.* 2004; Zhao *et al.* 2007).

Materials and Methods

Materials

The tested soil was medium loam, Chao soil, and the tested vegetable was oilseed rape (*Brassica campestris L.*) Jinglv No. 7. The basic physical and chemical properties of tested soils are showed in Table 1.

Table 1 Basic physical and chemical properties of tested soil

pH Ratio of soil : water	Organic matter	Total N	NO_3^--N	NH_4^+-N	Available P	Available
(2.5 : 1)	(----------g/kg----------)		(----------mg/kg----------)			
8.20	21.53	1.23	59.01	5.63	13.31	87.52

Methods

In this pot experiment, nitrogen applied was 0.27 g/kg soil (urease, N46%), P_2O_5 was 0.2 g/kg soil (superphosphate, P_2O_5 12%), K_2O was 0.2 g/kg soil (potassium sulfate, K_2O 50%), all fertilizer and inhibitor were applied one time as base fertilizer. Six different doses of NBPT (0, 0.5%, 1.0%, 1.5%, 2.0%, 2.5% nitrogen) were carried out in different treatments, each treatment had 3 replicates. Rape was harvest after 40 days. Yield, nitrate content, Vc, water soluble sugar and N use efficiency were analyzed in different treatments.

Results

Effects of NBPT application on yield

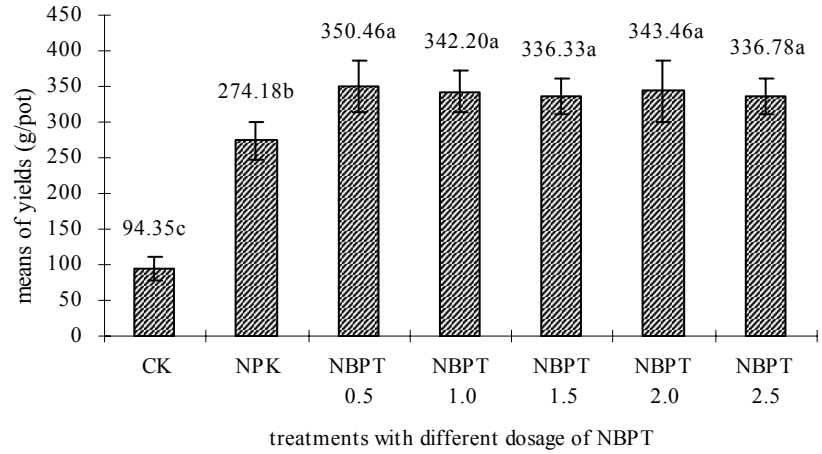

Figure1. Effects of NBPT application on yield of rape

Notes: The values of different treatments are means of three repeats. Different letters in each column mean significant at 5% level, the same below.

Effects of NBPT application on NO_3^--N content in rape

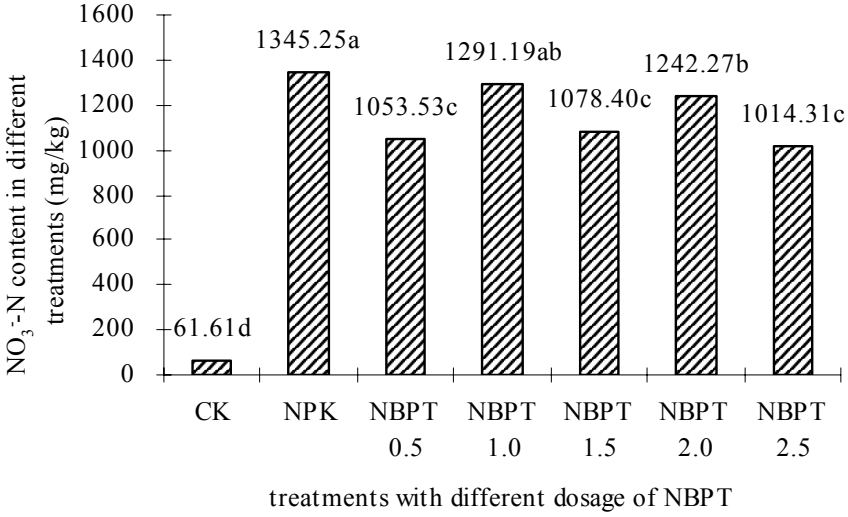

Figure 2. Effects of NBPT application on NO_3^--N content in rape.

Effects of NBPT application on nutrient content

Table 2. Vc and water soluble sugar content in rape treated with different dosage of NBPT

Treatments	Vc content in rape (mg/100g fresh sample)	Increase(+) or decrease(-) compared to NPK %	Water soluble sugar content in rape %	Increase(+) or decrease(-) compared to NPK %
CK	45.44±4.07a	37.70	1.71±0.14a	111.11
NPK	33.00±5.70b	-	0.81±0.15 b	-
NBPT0.5	32.49±1.48b	-1.55	0.74±0.06b	-8.04
NBPT1.0	41.00±1.85a	24.24	0.80±0.21b	-0.58
NBPT1.5	25.47±1.13c	-22.81	0.85±0.19b	5.28
NBPT2.0	28.18±3.97bc	-14.60	0.79±0.17b	-2.51
NBPT2.5	30.53±3.30bc	-7.49	0.77±0.16b	-4.17

N use efficiency

Table 3. Effects of total N, N up-taken and nitrogen use efficiency of rape treated with different dosages of NBPT.

Treatments	Total N content in rape (%)	Increase (+) or decrease (-) compared to NPK (%)	N up taken (g/pot)	Increase (+) or decrease (-) compared to NPK (%)	N use efficiency (%)	Increase (+) or decrease (-) compared to NPK %
PK	2.19±0.32d	-29.00	0.10±0.04 d	-73.68	-	-
NPK	3.08±0.21c	-	0.38±0.03 c	-	11.15±0.97c	-
NBPT0.5	3.69±0.27a	19.91	0.52±0.07 a	37.71	16.80±2.78ab	50.70
NBPT1.0	3.40±0.42abc	10.28	0.52±0.03 ab	36.84	16.72±1.20ab	49.96
NBPT1.5	3.26±0.36abc	5.95	0.40±0.10 c	5.26	11.86±4.02c	6.40
NBPT2.0	3.67±0.22a	19.26	0.53±0.05 a	40.34	17.29±1.84a	55.10
NBPT2.5	3.10±0.30bc	0.65	0.41±0.08 bc	8.76	12.61±3.27bc	13.06

Conclusion

NBPT significantly increased crop yield by 22.67%-27.82%, and decreased nitrate concentration in the crop by 4.19%-32.63%. Also it was very strange that there were two NO_3^--N peak in the range of 0.5% to 2.5% NBPT. Rape Vc the highest concentration when the amount of NBPT was 1.0%.

The highest N uptake and N recovery by the plants was when the amount of NBPT added was at 0.5% of the total urea-N applied, and had no affect on Vc and water soluble sugar content. It is suggested that NBPT 0.5% was the optimum amount in this experiment.

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