

Foliar Applied KNO₃ on Rice Resulted in 15% More Yield and 13% Increase in Farmers' Net Income

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Summary

In Vietnam, 4 trials in total on spring and summer rice, grown on a heavy and a sandy soil, were conducted with 1, 2 or 3 foliar applications each containing 9 kg KNO₃/ha/spray, applied at one or more growth stages (active tillering, panicle initiation and/or end of flowering), in order to test the effect on yield and farmers' net income.

The highest increases in average yield (+15%; + 840 kg/ha) and average farmers' net income (+13%; + 150 US\$/ha) were obtained with 3 foliar sprays of 9 kg KNO₃/ha/spray each at the growth stages of active tillering, panicle initiation and end of flowering in combination with a standard base dressing, compared to the farmers' standard practices.

Interestingly enough, 50% less KCl applied in the base dressing, in combination with 3 foliar sprays of 9 kg KNO₃/ha/spray each at active tillering, panicle initiation and end of flowering, resulted in 10% more yield and 12% more farmers' net income, compared to the farmers' standard practices.

Introduction

Worldwide, 156 million ha of rice is grown, of which 81% in Asia. Rice and maize/corn rank second after wheat as the most grown cereal grain crop in the world. This makes rice a very attractive crop for foliar potassium nitrate applications as the sales potential is huge.

On behalf of the PNA, Dr C. Witt, Director IPNI Southeast Asia Programme, and Dr. Tran Thuc Son (SFRI, Hanoi) conducted trials in Vietnam in 2009 to test if foliar applications of potassium nitrate on rice could increase yield and farmers' net income.

Materials and methods

4 trials in total were conducted on a spring and summer rice crop, grown on 2 locations (Tables 1, 2 and 3). Trials were laid out in a randomized complete block design with 4 replicates. Plot size was 24 m² (4,6 * 5,2 m²).

Potassium nitrate was sprayed at one or more different growth stages: Active Tillering (AT), Panicle Initiation (PI) and End of Flowering (EF), at 3% concentration, equal to 9 kg KNO₃/ha/spray (Table 4).

Table 1. Varieties and planting density per trial.

Location	Season	Rice Variety	Spacing	Density
			(cm ²)	(hills/m ²)
Nam Dinh	Spring	hybrid Juu 527 (China)	25*13	31
	Summer	TH3-3 (Vietnam)	25*13	31
Bac Giang	Spring	inbred Khang Dan 18	20*10	50
	Summer	inbred Khang Dan 18	20*10	50



Table 2. Description of the experimental sites in Nam Dinh and Bac Giang.

Nam Dinh site	Parameters	Bac Giang site
Alluvial, heavy soil	Soil type	Degraded, sandy soil
0,15 cmol/kg	Exc K	0,08 cmol/kg
13,5 g/kg	Organic carbon	8,6 g/kg
15	CEC	4-5
5,5 - 6,0	pH	5,5

Table 3. Fertiliser sources, moments of application and applied dose rates for the 2 trial sites in Vietnam.

Source	Moment of application	Unit	Spring rice		Summer rice	
			Nam Dinh	Bac Giang	Nam Dinh	Bac Giang
Farmyard manure	basal	MT/ha	8	8	8	8
Urea 46 % N	10-15 DAT	kg/ha	40	30	30	20
Urea 46 % N	25 DAT (AT)	kg/ha	40	30	40	30
Urea 46 % N	50-55 DAT (PI)	kg/ha	40	30	30	30
Urea 46 % N		total kg/ha	120	90	100	80
SSP 16 % P ₂ O ₅	basal	kg/ha	70	60	60	45
KCl 60 % K ₂ O	basal	kg/ha	90	70	90	70
DAT: Days After Transplanting AT: Active Tillering PI: Panicle Initiation						

Results and conclusions

Yield

The rice grain yield per treatment and per trial is presented in Table 4. 3 foliar sprays with KNO₃ (T9) resulted in a statistically significant ($P < 0,05$) higher yield (on average +15%) compared to the control plot (T3). Also a single spray (T4, T5 or T6; on average +7%) or 2 sprays (T7 or T8; on average +11%) resulted in a statistically significant ($P < 0,05$) higher yield compared to the control plot (T3). Interestingly enough, T11 shows that 10% yield increase, compared to the control T3, was achieved with 3 foliar applications of KNO₃, while KCl base dressing was reduced with 50%.

Farmers' net income

The farmers' net income per treatment and per trial is presented in Table 5. 3 foliar sprays with KNO₃ (T9) resulted in a statistically significant ($P < 0,05$) higher net income (on average +13%) compared to the control plot (T3). Also a single spray (T4, T5 or T6; on average +7%) or 2 sprays (T7 or T8; on average +10%) resulted in a statistically significant ($P < 0,05$) higher net income compared to the control plot (T3). Interestingly enough, T10 and T11 showed that 12% net income increase, compared to the control T3, was achieved with 3 foliar applications of KNO₃, while KCl base-dressing was reduced with 25% and 50% respectively.



Table 4. Treatments, application stages, applied dose rates and yields for the 2 trial sites in Vietnam.

Treatments		Application stage of foliar KNO ₃			Spring 2009				Summer 2009				Grand total	
		AT	PI	EF	Nam Dinh		Bac Giang		Nam Dinh		Bac Giang		Average %	
					MT/ha	%	MT/ha	%	MT/ha	%	MT/ha	%		
1	Average of NP without and with farmyard manure	0	0	0	6,69	92	4,89	88	4,62	93	3,85	85	90	
2	NP	+	+	+	7,80	107	5,59	101	5,38	109	4,47	99	104	
3	NPK (Basal 100% MOP)	0	0	0	7,30	100	5,53	100	4,95	100	4,52	100	100	
4	NPK (Basal 100% MOP)	+	0	0	7,84	107	5,78	105	5,29	107	4,90	108	107	107
5	NPK (Basal 100% MOP)	0	+	0	8,02	110	5,79	105	5,41	109	4,89	108	108	
6	NPK (Basal 100% MOP)	0	0	+	7,87	108	5,83	105	5,36	108	4,83	107	107	
7	NPK (Basal 100% MOP)	+	+	0	8,16	112	5,86	106	5,48	111	5,13	113	110	111
8	NPK (Basal 100% MOP)	0	+	+	8,18	112	5,94	107	5,50	111	5,14	114	111	
9	NPK (Basal 100% MOP)	+	+	+	8,49	116	6,16	111	5,67	115	5,26	116	115	115
10	NPK (Basal 75% MOP)	+	+	+	8,33	114	6,12	111	5,43	110	5,13	113	112	
11	NPK (Basal 50% MOP)	+	+	+	8,15	112	6,06	110	5,41	109	5,02	111	110	
12	NPK (Basal 50%, and 50% at PI)	0	0	0	7,97	109	5,74	104	5,21	105	4,78	106	106	
	LSD (P=0,05)				0,576		0,14		0,342		0,11			
0: 0 kg KNO ₃ /ha/application +: 9 kg KNO ₃ /ha/application AT: Active Tillering (20-25 days after transplanting) PI: Panicle Initiation (50-55 days after transplanting) EF: End of Flowering (25-28 days before harvest)														



Table 5. Treatments, application stages, applied dose rates and farmers' net income for the 2 trial sites in Vietnam.

Treatments		Application stage of foliar KNO ₃			Spring 2009				Summer 2009				Grand total	
		AT	PI	EF	Nam Dinh		Bac Giang		Nam Dinh		Bac Giang		Average %	
					US\$/ha	%	US\$/ha	%	US\$/ha	%	US\$/ha	%		
1	Average of NP without and with farmyard manure	0	0	0	1441	99	1165	94	953	105	903	92	97	
2	NP	+	+	+	1650	113	1291	104	1075	119	1007	102	109	
3	NPK (Basal 100% MOP)	0	0	0	1463	100	1239	100	905	100	986	100	100	
4	NPK (Basal 100% MOP)	+	0	0	1576	108	1286	104	967	107	1069	108	107	107
5	NPK (Basal 100% MOP)	0	+	0	1621	111	1289	104	997	110	1066	108	108	
6	NPK (Basal 100% MOP)	0	0	+	1583	108	1300	105	985	109	1049	106	107	
7	NPK (Basal 100% MOP)	+	+	0	1633	112	1285	104	992	110	1110	113	109	110
8	NPK (Basal 100% MOP)	0	+	+	1638	112	1308	106	997	110	1113	113	110	
9	NPK (Basal 100% MOP)	+	+	+	1692	116	1346	109	1017	112	1123	114	113	113
10	NPK (Basal 75% MOP)	+	+	+	1684	115	1359	110	988	109	1111	113	112	
11	NPK (Basal 50% MOP)	+	+	+	1670	114	1367	110	1014	112	1105	112	112	
12	NPK (Basal 50%, and 50% at PI)	0	0	0	1625	111	1292	104	965	107	1053	107	107	

0: 0 kg KNO₃/ha/application
 +: 9 kg KNO₃/ha/application
 AT: Active Tillering (20-25 days after transplanting)
 PI: Panicle Initiation (50-55 days after transplanting)
 EF: End of Flowering (25-28 days before harvest)

