Increased farmer’s income with 24% higher rice yield by applying Qrop® KS

Prilled potassium nitrate (Qrop® KS) makes it easy for the farmer to apply fertilizers timely in order to supply nutrients during the critical booting stage in Japonica rice. In a demonstration trial coordinated by Franco Fan and Alice Li of the SPN department of SQM China, extra application of only 75 kg/ha before booting led to a 24% higher rice yield compared to the farm practice without application of fertilizers in this stage. The extra K and N applied at this time resulted in higher seed-set, but also the thousand seed weight and milled rice rate were increased by 17% and 12%.

Rice being the largest grain crop in China, rice producers bear a heavy responsibility for China's food security. It is a national mission to increase cropping efficiency and farmer’s income. How can potassium nitrate be best applied for rice yield improvement, and how can we best use the principles of rational fertilization? These questions set us thinking. After
a year of tracking and study of several demonstration trials, we finally had a breakthrough with the development of the use of Qrop® KS as booting fertilizer at the rice panicle development stage.

Qrop® KS contains 100% K and N-NO_3 which can be directly taken up by the crop. The exact timing of application is very important, and it is well worth the investment in time to determine this. The best application time is before the early booting stage, when the young panicle length is 1,5 cm.

The booting stage is a critical crop stage for rice. Almost half of the total dry matter is produced until panicle initiation, requiring the first half of the total N-uptake, and

accordingly the other half of the total N uptake occurs after this stage, during booting. Additionally, potassium is needed by the crop at that time for optimal production of carbohydrates to fill the grains.

The team of SQM China identified that in the Liaoning province, 50% of the farmers habitually apply booting fertilizer by broadcasting urea and potassium chloride (KCl) at a the dosage of 37,5 kg/ha and 75 kg/ha, respectively. The other 50% of the farmers do not apply booting fertilizer at all, because it is difficult to master the proper fertilization time, and this timing is crucial. The aim of the work was to show these farmers how they can profit by the easy application of potassium nitrate with Qrop® KS to provide the optimal source nutrition at the right time of crop development.

This work builds on prior experience with Qrop® in Ecuador and Mexico. In Ecuador, two stage specific Qrop® mix formulas provided prilled potassium nitrate to replace the farmer's routine application of KCl at 30 and 45 days after transplant. This improved yield of paddy rice with 12%. In Mexico, 2 MT/ha extra paddy rice was produced after the replacement of Urea and KCl with 300 kg/ha of KNO_3 as Qrop® KS, one month after transplant.

To investigate the effect of providing potassium nitrate before the booting stage, an extra application of 75 kg/ha of Qrop® KS was broadcast on half of a 0,6 ha rice field planted with Japonica rice. The correct application stage is when the young panicle length is 1,5 cm, and this optimal timing was followed (Figure 2). The other half of the field did not receive fertilizer at this stage, following the local practice. For the whole

field, the basal fertilizers were the same (Table 1). The crop was transplanted on the 21st of May and harvested on 26th of October 2020. At harvest, the total yield of each 0,3 ha, the 1000-grain weight and the milling quality (as milled rice rate) were determined. Before milling, the rice grains were naturally air-dried and processed.

Table 1. Treatments and nutrient application on Japonica rice. DAT=Date after transplant

Product	Timing of application	Controle (kg/ha)				Qrop® KS (kg/ha)			
		Product	N	P_2O_5	K_2O	Product	N	P_2O_5	K_2O
NPK 26-11-16	Base (before transplant)	600	156	66	108	600	156	66	108
Ammonium sulphate	8 DAT	300	83	-	-	300	82	-	-
NPK 25-0-25	25 DAT	255	56	-	11	255	56	-	11
SOP		75	-	-	38	75	-	-	38
DAP		38	7	17	-	38	7	17	-
Qrop® KS 12-0.46	60 DAT (penicle 1,5 cm)	-	-	-	-	75	9	-	35
Total	-	**1238**	**282**	**83**	**157**	**1313**	**201**	**83**	**191**

Figure 1. Franco Fan, sales manager SQM China SPN dept. and coordinator of the demonstration trial.

Figure 2. The best application time for Qrop® KS is when the young panicle length measures 1,5 cm.

Results Highlights

Before harvest, the beneficial effect of the extra Qrop® KS application to support booting and seed formation was clearly visible, with better filled heads with larger seeds (Figure 3). In figure 3, a typical potassium deficiency can be seen in the farm

practice, by incomplete seed fill at the lower end. The lower pockets are empty or poorly filled, while in the Qrop® KS treated field, the lower pockets are filled with seed. This visual observation may explain why the crop responded so well to KNO_3. This difference was quantified at harvest (Figure 4). Total paddy rice yield increased from 11,2 to 13,9 MT/ha, a 24% increase (Table 2). Not only total yield was improved, but also grain size, measured as 1000-grain weight, and milling quality. This demonstrates the need of the plant for this extra dose of N and K fertilizers at panicle development, and that this need is met when rapidly absorbed nutrients are provided.

The costs for an extra application of 75 kg/ha Qrop® KS make up 4% of the total cultivation costs. They are a sum of fertilizer cost (85%) and the labor costs (15%). Nevertheless, the financial analyses in table 3 shows that investment in a booting application of Qrop® KS is returned already at 2% yield increase of paddy rice. In this trial, the cost was returned with a great profit, increasing the net income of the famer by 60%. The customer will additionally value the larger grains and better milling quality, which is not included in the financial analyses.

These promising results are an excellent outcome of SQM China's initiative to develop the use of Qrop® KS on this important food crop. In the coming season, the work will focus on further confirmation of the proper dose of K and N at panicle development, the effect of this application on lodging, and a comparison of the application of potassium nitrate in Qrop® KS with a booting application of Urea + potassium chloride.

Figure 3. Better filled heads of grain with application of Qrop® KS at the booting stage.

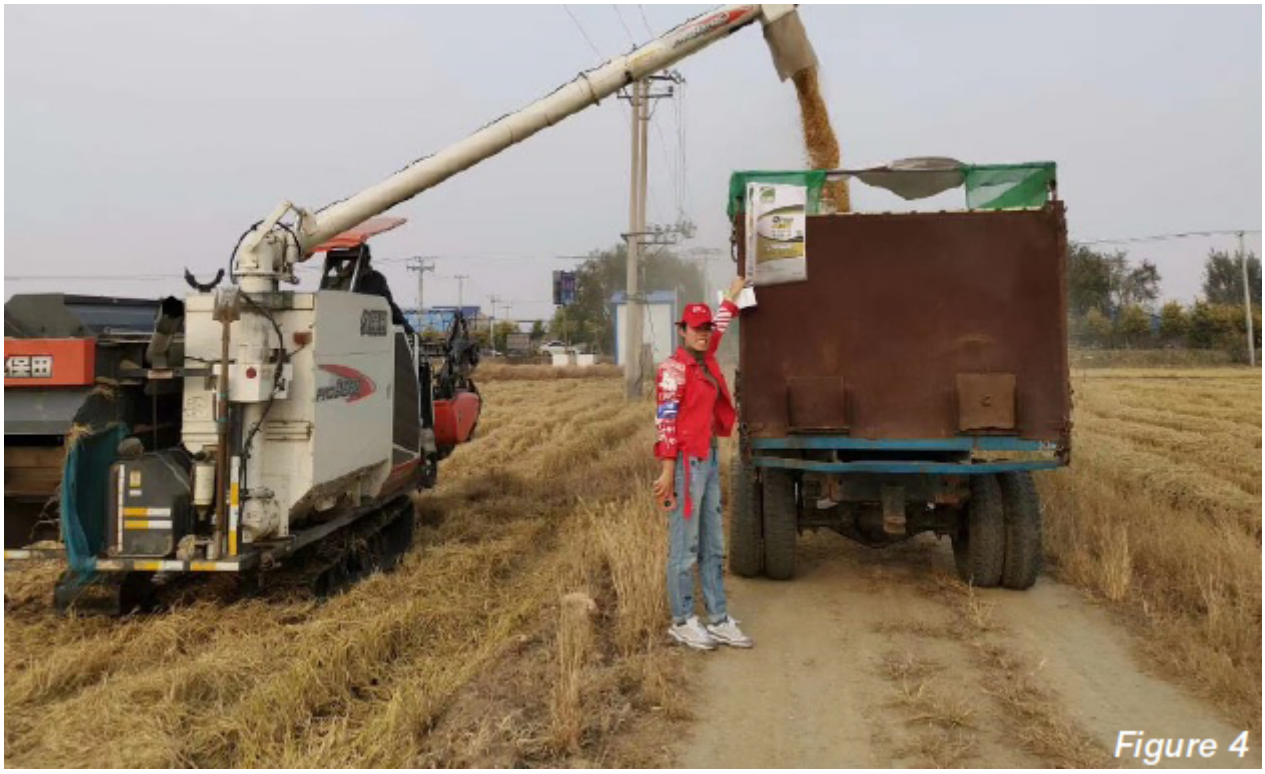

Figure 4. The two fields during harvest.

*Table 2. Increase in yield (paddy rice) and grain quality from application of Qrop® KS (75 kg/ha) at booting. Milled rice rate = rice weight after processing / rice weight before processing * 100%.*

Parameter	Difference (%)
Yield (MT/ha)	24%
Thousand seed weight (g/1000 seeds)	17%
Milled rice rate (%)	12%

Table 3. Financial analyses of costs and returns of booting application of Qrop® KS (75 kg/ha). The costs and returns are based on a conversion of yuan to USD at 1:0,15 at a paddy rice price of 2,52 yuan/kg. Fertilizer costs include costs for extra labor of one broadcast application in the Qrop® KS treatment.

Parameter	Control	Qrop® KS
Yield (MT/ha)	11,2	13,9
Price paddy rice (USD/MT)	378	378
Fertilizer cost incl. labor (USD/ha)	558	664
Other costs (USD/ha)	2205	2205
Cost of production (USD/ha)	2783	2869
Income (USD/ha)	4234	5237
Net income (USD/ha)	1471	2368
Yield increase to return on investment	0,3	MT extra yield
	2%	% extra yield

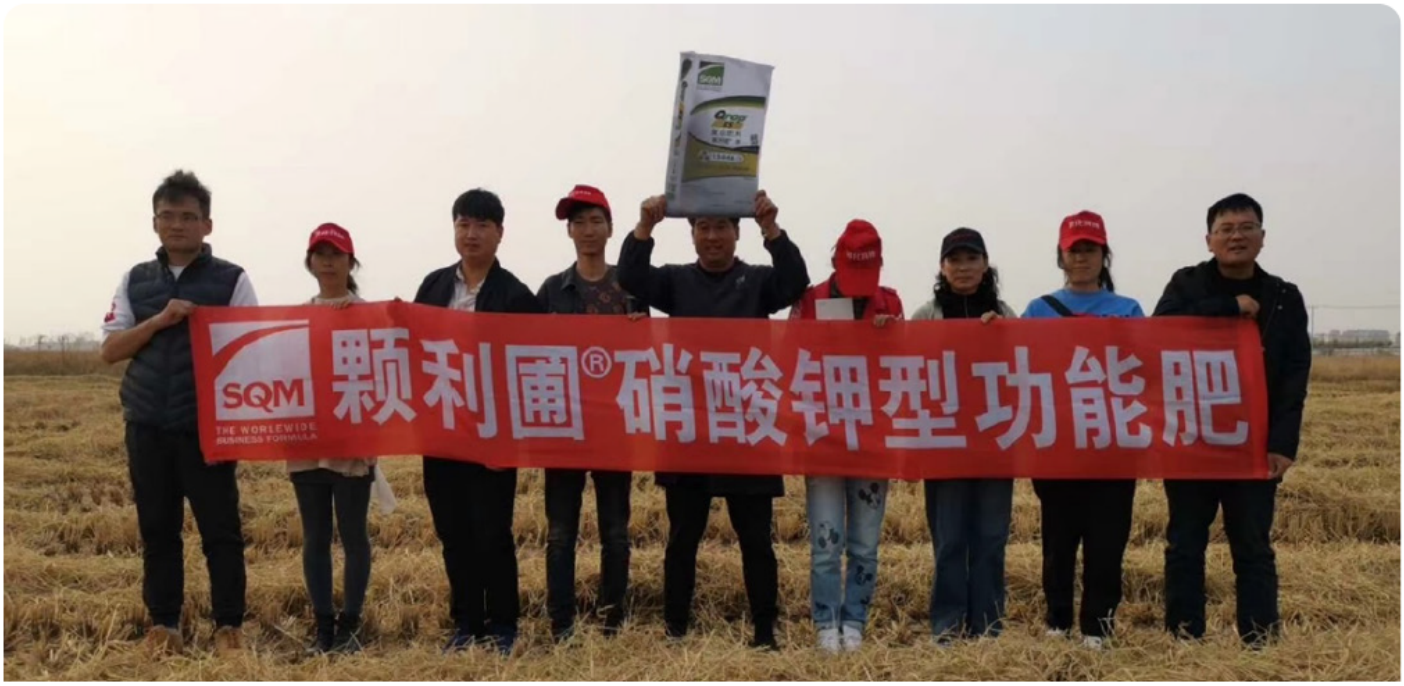

Figure 5. The banner declares: Qrop® KS is not just potassium nitrate, it is a well-performing fertilizer. On the far left, Franco Fan, sales manager SQM China SPN dept. and coordinator of the demonstration trial, on the right Gao Kaixiang and Haicheng Aofeng, involved in the sales of SQM's products and their colleagues from the Liaoning Province dealer's company. Holding the bag in the middle is Chen Xvlong, owner of the trial field and agro-input retailer.

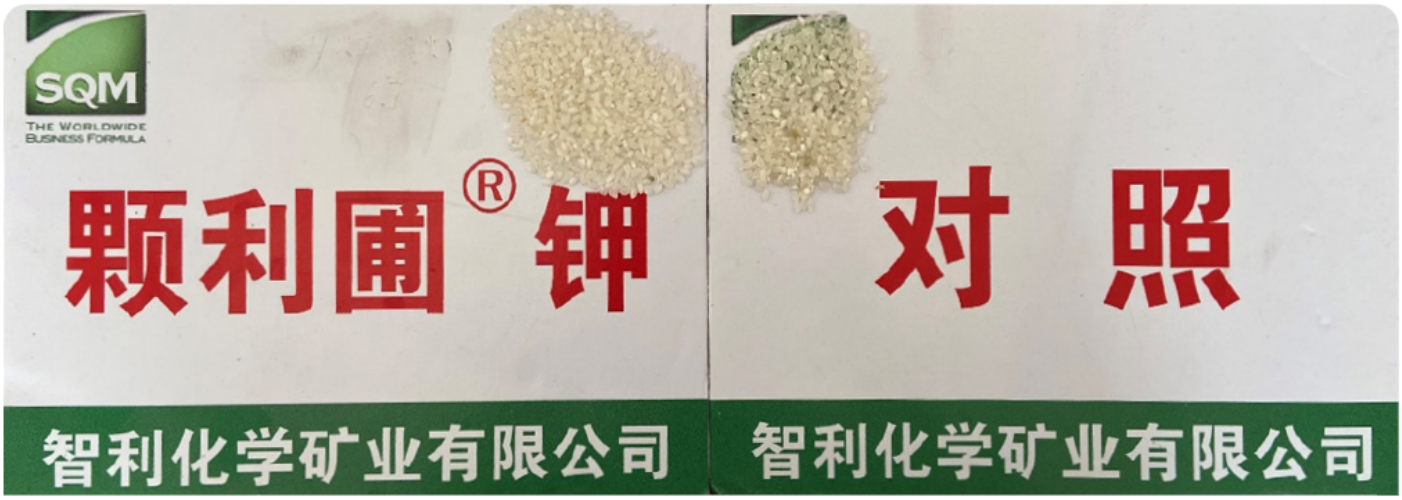

Figure 6. A higher percentage of milled grain was measured after application of Qrop® KS at booting.