

Effect of ammonium polyphosphate applications to a commercial potato crop during the 2024-25 season in Tuakau, New Zealand.

January 2025 S. Slack & R. Cox

Summary

A field trial was established to assess the efficacy of foliar and soil applied ammonium polyphosphate (APP) as a method to increase plant phosphorus uptake. Results indicate that the application of APP did not have a significant effect on plant phosphorus uptake, and consequently these applications did not have a significant effect on yield.

Method

Experimental site and application details

An experimental area was established within a commercial potato planting of the cv “Orwell” in Tuakau, New Zealand. The commercial crop was planted on the 29 October 2024, following standard commercial practices. The experimental design was a randomised complete block design (RCBD) with four treatment replicates. A total of six treatments were included in the experiment including an untreated control (Table 1). Plots were one bed (1.62m) wide and 7m in length. APP applications were made in the form of “Nutri PZ” (product label in Appendix iii) liquid fertiliser with two application methodologies utilised (Table 2). Treatments 2, 3, and 4 were applied as foliar spray applications using a CO₂ powered plot sprayer using 11002 AITTJ60 teejet nozzles spaced at 30cm. The sprayer was calibrated to apply a water volume equivalent to 400L/Ha. Treatments 5 and 6 were a single application, as a banded, soil applied application to a depth of 20mm. Foliar applications began on December 5 when plants were approximately 30cm high and at tuber initiation, with a total of three applications made at 7-10 day intervals.

Seventeen days following the third foliar application, leaf samples were taken for petiole analysis. Ten petioles were taken from each replicate, with replicates then analysed as a bulk sample for each treatment. Analyses were conducted by Hill Labs and are reported in Appendix ii. Once the crop had reached full senescence a 2m sample was harvested from each replicate, with potatoes graded and weighed based on tuber diameter. The size grades were; <30mm, 30-75mm, 75-100mm, and >100mm. Tubers were considered “marketable” if they were between 30 and 100mm in diameter and without obvious defects. Sample data were extrapolated to a per hectare basis.

Statistical analysis

Data were analysed using a 95% confidence interval. Analyses of variance (ANOVA) were computed using the statistical software ARM. Treatment means were separated using Tukeys test. As the LSD is computed using transformed data, comparisons of means should rely on the letters of separation, rather than the LSD value.

Table 1: APP treatment details yield within a commercial potato (cv. Orwell) planting in Tuakau, New Zealand during the 2024-25 growing season.

Treatment	Product name	Product	Rate/ Ha	Application code
1	Untreated	-	-	-
2	Foliar	Nutri PZ	5L/ha	ABC
3	Foliar	Nutri PZ	10L/ha	ABC
4	Foliar	Nutri PZ	20L/ha	ABC
5	Soil Applied	Nutri PZ	100L/ha	A
6	Soil Applied	Nutri PZ	200L/ha	A

Table 2: Application and assessment details

Date	Application	Growth Stage	Event
5/12/2024	A	Hook	First trial application
13/12/2024	B	Tuber initiation	Second trial application
23/12/2024	C	Tuber development	Third trial application
9/01/2025	-	Tuber development	Petiole samples taken
12/03/2025	-	Crop senescence	Trial harvest

Results

Petiole tests

Results of petiole leaf analysis did not indicate any substantial changes in any nutrient across the six treatments (Appendix v). Phosphorus levels varied from 0.11-0.13% and this is not considered significant.

Yield analysis

Yield analyses indicate that none of the treatments studied here showed any significant effect on tuber yield, number, or size distribution. Treatment F statistics for all metrics studied were low, and treatment probabilities were high, indicating that the effect of the treatment was small relative to the variability within the trial. This variability may be as a result of environmental factors, sampling error, or biological variation. Soil Olsen P at this site was 133 mg/L, it is likely that in situations like this with excess soil available phosphorus, additional phosphorus applications have little effect on potato tuber number and yield.

Table 3: Effect of APP treatments on potato tuber count and yield within a commercial potato (cv. Orwell) planting in Tuakau, New Zealand during the 2024-25 growing season.

Treatment	Total Tuber No. (per Ha)	Gross Yield (t/Ha)	Marketable Tuber No. (per Ha)	Marketable Yield (t/Ha)
1	350823.0 -	33.76 -	331275.8 -	33.54 -
2	317901.3 -	30.50 -	307613.0 -	30.35 -
3	360008.0 -	35.08 -	343621.5 -	34.88 -
4	366255.5 -	33.18 -	338477.3 -	32.77 -
5	380658.0 -	35.20 -	356996.0 -	34.88 -
6	360082.3 -	36.16 -	330247.0 -	35.80 -
Tukeys HSD (p=0.05)	140040.79	15.42	131326.19	15.303
S D	62121.53	6.71	57157.44	6.605
CV	17.49	19.75	17.08	19.76
Replicate F	2.143	0.795	1.402	0.842
Replicate Prob(F)	0.148	0.5154	0.2810	0.4921
Treatment F	0.571	0.360	0.332	0.348
Treatment Prob(F)	0.689	0.8681	0.8857	0.8756

*means followed by the same letter do not differ significantly (p=0.05, Duncans New MRT)

t= mean descriptions are reported in transformed data units, and are not de-transformed

^ calculated from residual

Table 4: Effect of APP treatments on potato tuber size distribution within a commercial potato (cv. Orwell) planting in Tuakau, New Zealand during the 2024-25 growing season.

Treatment	<30mm Tuber No.	<30mm Yield	30-75mm Tuber No.	30-75mm Yield	75-100mm Tuber No.	75-100mm Yield
1	4.2 -	0.1919 -	80.3 -	33.23 -	0.3 -	0.308 -
2	1.8 -	0.1159 -	74.8 -	30.350 -	0.0 -	0.000 -
3	2.6 -	0.1502 -	83.3 -	34.568 -	0.3 -	0.308 -
4	6.1 -	0.3774 -	82.0 -	32.563 -	0.3 -	0.205 -
5	4.9 -	0.2715 -	86.8 -	34.873 -	0.0 -	0.000 -
6	6.8 -	0.3409 -	79.0 -	34.258 -	1.3 -	1.543 -
Tukeys HSD (p=0.05)	6.48	0.363-0.582	32.97	14.19	1.94	2.25
S D	5.21t	1.237t	14.62	6.176	0.84	0.9798
CV	44.12t	44.89t	17.97	18.54	252.98	248.84
Replicate F	2.346	1.319	1.600	0.992	1.094	1.147
Replicate Prob(F)	0.114	0.305	0.241	0.423	0.3822	0.3624
Treatment F	1.232	1.037	0.365	0.299	1.219	1.400
Treatment Prob(F)	0.3425	0.4319	0.8293	0.906	0.3479	0.2798

*means followed by the same letter do not differ significantly (p=0.05, Duncans New MRT)

t= mean descriptions are reported in transformed data units, and are not de-transformed

^ calculated from residual

Appendix:

Appendix i- Trial site layout, Tuakau, New Zealand



Appendix ii- Banded APP application on potato mound



Appendix iii- Nutri PZ product label

Analysis:			
		Wt/Wt	Wt/Vol
Total Nitrogen	(N)	10,0%	136 gms/litre
Ammonia	(N)	10,0%	136 gms/litre
Phosphate	(P ₂ O ₅)	34,0%	463 gms/litre
Zinc	(Zn)	0,2%	2,5 gms/litre
pH: (10% Solution)		6,0 -7,0	
Specific Gravity:		1,34 g/ml @ 18°C	

Dilution:

Rates recommended are for standard spray volumes 500-1500 Litres/Ha

Handling Information & Storage:

NUTRI-PZ should be stored in frost free conditions. Optimal storage temperatures range from 5-40 Degrees Centigrade. NUTRI-PZ is non-hazardous & non-flammable. Wear gloves & ace shield when handling the concentrate. NUTRI-PZ is low in toxicity but can cause eye and skin irritation in concentrate form.

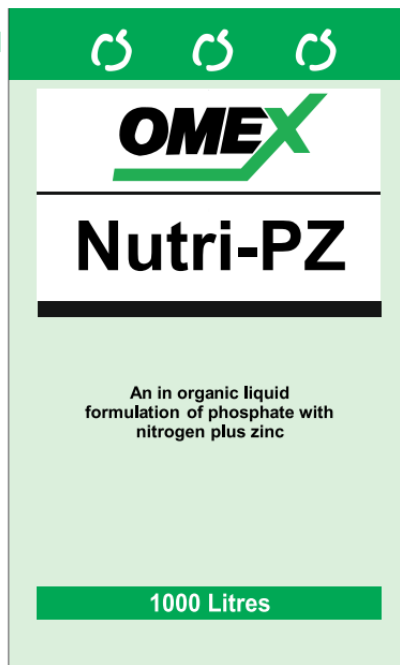
For further information please contact OMEX Agrifluids in Kings Lynn.

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Recommendations for use:

CROP	RATE L/ha	RATE M/1000	APPLICATION DETAILS
Coffee	1,0-1,5	200	Apply after conversion. Repeat application according to pesticide programme.
Cereals	1,0-1,5	500	Apply at any stage to phosphorus deficient crops
Potatoes	20		Apply 7-10 days after tuber initiation
	2-3Ltr/ha in 500Ltr of water		Maintenance
Strawberries	1,5-3,0	300	Single application 3 weeks after planting
Tomatoes/Peppers	1,5-3,0	250	1 st application 3 weeks after transplanting. Follow by 2 nd
Vegetables	1,5-3,0	500	1 to 2 applications early on in growth period of crop
Other crops	1,0-2,0	300-600	For crops with phosphorus deficiencies, repeat at 10-14 day intervals as required

Mixing & Spraying:

Always add NUTRI-PZ to spray tank first after initial pre-mixing with water while agitating. When applying NUTRI-PZ alone, an anionic wetting agent should be added to achieve maximum crop cover.

Tank mixing compatibility:

OMEX NUTRI-PZ is compatible with most, but not all pesticides, both as regards physical mixing in the tank & as regards the biological effect on the crop. However OMEX cannot accept any liability for any loss or damage as not all pesticides have been tested & because the efficacy of any mix depend on, among other factors, the pesticide concerned, crop conditions, growth stage, weather & volumes of water used.



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Certificate of Analysis

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Client: Address: Phone:		Lab No: Date Received: Date Reported: Quote No: Order No: Client Reference: Submitted By:		shvpv1
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Interim Report

This is an Interim report, prepared before all test results are completed. As all final Q.C. checks may not have been possible, it is not regarded as an official certificate of analysis. The final, official report will be issued upon completion of all tests.

Sample Name: XXXXXXXXXX **Lab Number:** 3609595.6
Sample Type: SOIL Potato (S64)

Analysis	Level Found	Medium Range	Low	Medium	High
pH	pH Units 6.4	5.4 - 5.8			
Olsen Phosphorus	mg/L 133	30 - 60			
Potassium	me/100g 1.24	0.50 - 1.00			
Calcium	me/100g 9.0	4.0 - 10.0			
Magnesium	me/100g 1.40	1.00 - 3.00			
Sodium	me/100g 0.16	0.00 - 0.50			
CEC	me/100g 17	12 - 25			
Total Base Saturation	% 69	35 - 75			
Volume Weight	g/mL 0.90	0.60 - 1.00			
Boron	mg/kg 1.2	1.0 - 2.0			
Potentially Available Nitrogen (15cm Depth)	kg/ha 46	100 - 150			
Anaerobically Mineralisable N	µg/g 34				
Organic Matter	% 4.8	7.0 - 17.0			
Total Carbon	% 2.8				
Total Sulphur	mg/kg 441				
Soil Sample Depth†	mm 0-150				
Base Saturation %	K 7.3 Ca 52 Mg 8.2 Na 1.0				
MAF Units	K 23 Ca 10 Mg 28 Na 7				

Certificate of Analysis

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Client:	Seed & Field Services Limited	Lab No:	3751727	shvpv1
Address:	45 Kitchener Road Pukekohe 2120	Date Received:	09-Jan-2025	
		Date Reported:	13-Jan-2025	
		Quote No:		
		Order No:		
Phone:	09 237 1153	Client Reference:		
		Submitted By:	Steve Slack	

Plant Analysis Results

Sample Name:	TRT1	TRT2	TRT3	TRT4	TRT5	TRT6
Lab Number:	3751727.1	3751727.2	3751727.3	3751727.4	3751727.5	3751727.6
Sample Type:	PETIOLE Potato, Mid Season	PETIOLE Potato, Mid Season	PETIOLE Potato, Mid Season	PETIOLE Potato, Mid Season	PETIOLE Potato, Mid Season	PETIOLE Potato, Mid Season
Sample Type Code:	T2	T2	T2	T2	T2	T2
Nitrate-N (Petiole) mg/kg	11,200	12,160	9,980	9,840	12,400	11,210
Phosphorus (Petiole) %	0.11	0.13	0.13	0.12	0.13	0.13
Potassium (Petiole) %	11.9	11.7	11.5	11.4	12.0	12.5
Sulphur (Petiole) %	0.13	0.13	0.13	0.13	0.13	0.14
Calcium (Petiole) %	1.12	1.11	1.00	1.18	1.07	1.16
Magnesium (Petiole) %	0.17	0.18	0.14	0.16	0.14	0.15
Sodium (Petiole) %	0.03	0.03	0.03	0.03	0.03	0.03
Iron (Petiole) mg/kg	40	53	33	45	54	43
Manganese (Petiole) mg/kg	300	310	320	420	310	300
Zinc (Petiole) mg/kg	40	36	36	42	39	39
Copper (Petiole) mg/kg	2	3	3	2	2	3
Boron (Petiole) mg/kg	27	27	26	27	26	27

Appendix vi- Weather data

Date	December			January			February			March		
	Max (°C)	Min (°C)	Rainfall (mm)	Max (°C)	Min (°C)	Rainfall (mm)	Max (°C)	Min (°C)	Rainfall (mm)	Max (°C)	Min (°C)	Rainfall (mm)
1	-	-	-	21	12.7	0.1	28.6	15.6	0	29.5	15.6	0
2	-	-	-	22.9	14.5	1.8	28.6	14	0	29.4	12.4	0
3	-	-	-	23.6	12.7	0	27.7	17	2.1	26.9	13.7	0
4	-	-	-	23.9	13.2	10.9	26.7	14.7	0	27.6	13.7	0
5	25.3	12.7	0	21	11.9	5.6	26.6	13.5	0	23.6	12.5	15.2
6	24.9	14.2	0.4	22.3	9.1	0.1	27	12	0	23.1	6.5	0.1
7	23	12.5	0	21.6	10.6	0	27.2	13.9	0	22.7	9.2	0
8	22.6	12.2	0	23.3	13.7	0	27.4	16.2	0.8	23.1	9.6	0
9	25.4	16.9	1.6	22.7	13.6	0.1	28.7	15.9	2.2	24.4	14.4	0.2
10	24.1	14.7	6.4	27.3	12.5	0	28.5	14.8	0	26.1	12.3	0
11	22.1	9.3	0.3	25.1	10.2	0	29.9	15.9	0	26.1	9.8	0
12	25.8	18.1	0.1	25	11.5	0	28.3	15.2	0	25.5	15.9	0
13	23.4	16.6	0.9	24.5	9.7	0	29.2	12.5	0	-	-	-
14	23.9	12.3	0	22.5	12.9	0	28.9	15	0	-	-	-
15	26.4	14.1	0	23.6	13.6	0	27	13.4	26.1	-	-	-
16	29.3	16.3	1.3	25.1	10.3	0	23.1	15.7	0	-	-	-
17	20.5	13.8	5.1	28.3	15.1	0	23.8	18	0	-	-	-
18	25.8	7.8	0.1	25.1	13.4	0	26.4	18.6	0.4	-	-	-
19	23.5	13.7	0	25.5	13.4	0	29	15.1	0.1	-	-	-
20	26.5	14.3	0	25.4	16.3	1.5	26.8	17.6	1.9	-	-	-
21	26.6	14.6	4.5	22.9	16.8	0.3	28.6	16.2	0	-	-	-
22	26.2	14.3	0.4	21.4	16.3	16.5	27.4	11.1	0	-	-	-
23	27	15.4	14.3	27.5	17.8	0	24.6	11.8	0	-	-	-
24	23.9	16.3	2.2	26.7	15.3	0	25.2	13	0	-	-	-
25	24.7	10.8	0	28.4	14.8	0	29	13.4	0	-	-	-
26	24.6	15.3	8.3	26.9	18.7	14.8	28	13.8	0	-	-	-
27	23.7	16.8	1.6	23.6	16.2	10.9	27.3	13.2	0	-	-	-
28	23.8	11.5	0	22.6	10.3	0	27.5	12.6	0	-	-	-
29	23	15.6	0	25.3	14.4	0	-	-	-	-	-	-
30	25.2	12.5	0	26.8	15.1	0	-	-	-	-	-	-
31	25.5	13.9	7.3	26.1	16.8	0	-	-	-	-	-	-