

On Farm pH adjustment trials in Zone 2 – Output 2 Written Report

Background

In Zone 2 the pH of more than 70% of subsurface soils were more acidic than recommended. Growers in Zone 2 also understand that subsurface acidity constrains yields and productivity by restricting the plants roots system to access moisture and nutrients from deeper in the soil profile. During the dry winter period, the inability of the plants roots system to access the available moisture and nutrients has resulted in reduced yield. Growers recognise that to rectify this they need to address low pH in the soil below 10cm.

More frequently growers are looking at alternatives, including incorporation techniques, such as spading or the use of inclusion plates on deep rippers to incorporate lime at depth. Another option is to band alternative fluid or liquid type lime products with liquid systems at seeding. In the absence of tillage, soil pH rarely increases at depth below 5 cm in treatments with lime sand since the limited solubility of lime sand means that the liming material must contact acidic soil before it will react and change soil pH.

However, the key issue is the tyranny of distance from a lime sand source and associated transport costs making it financially prohibitive. When things are tight financially, lime sand is one of the first budget line items to be deleted. Increasing the cost of lime sand applications due to the need to incorporate the product to be effective below 5 cm (with various equipment) increases this financial burden.

Long term results of lime sand application trials with no incorporation, show that soil acidity is increasing at depth. An example of this is “a case study examining response to the application of lime at Mingenew in 1994 shows that rates of lime, previously considered to be adequate, do not ameliorate soil pH to depth”. The paper further states that “The soil pH of the plots that received 8 t/Ha lime over a 20-year period almost meets the recommended targets” (Gazey et al 2013). Thus, growers are looking for cost effective alternatives to getting pH change at depth.

Research into other industries such as Horticulture, Hydroponics and general home gardens has revealed working alternatives which effect pH change that could be incorporated into broadacre agriculture. The products, Garden Lime (powder), Potassium Hydroxide (liquid) and liquid lime (liquid), have proven increased solubility in soil in comparison to Lime Sand. Therefore, these products have potential to increase pH change to greater than 5 cm when sprayed or spread on the soil surface.

Liquid Potassium Hydroxide and lime can be banded in soil with liquid delivery systems at planting. Garden lime requires blending with carrier products such as Gypsum and/or Lime Sand to be spread effectively. Initial testing with a Potassium Hydroxide solution available in Garden Centres and marketed to increase soil pH was undertaken using a jar test filled with acidic soil. The Potassium Hydroxide solution was mixed with the soil to assess if overall pH change was effective. Using the equivalent of 10kg per hectare, Potassium Hydroxide achieved a pH rise of 1 from soil samples at all 4 testing depths.

8/20/2017

HY-GEN 250ml PH Up Potassium Hydroponic Additive | Bunnings Warehouse





Nearest store **Homebase Subiaco**
55 Salvado Road (08) 9380 2600

Today 7:00am - 7:00pm Mon 7:00am - 9:00pm





**HY-GEN 250ml PH Up Potassium
Hydroponic Additive**

LINE 3030507

\$77.39

Price correct as at Fri 18 Aug 2017 8:52:50 AM

Not all products available in all stores

Contact your **nearest store** for product information.

Product Description

pH Up Potassium Hydroxide 40% 250ml

Bring the pH up in your nutrient or fish tank. Use with caution in aquaponics.

In hydroponics "pH" is an extremely important factor. When it is poorly monitored or controlled, plants can become sick or die. It is therefore recommended that pH is tested daily. Hy-Gen pH Up and Hy-Gen pH Down provide the grower with an added control in maintaining optimum pH levels and hence maximising nutrient availability and plant productivity. A too high or too low pH can complicate the absorption of important nutrients such as iron, calcium, magnesium, etc.

Generally the pH of the hydroponic solution should be 5.5-6.5 is acceptable, however, to maintain the pH in the range of 6.0 to 6.5. For rockwool a lower pH of 5.5 to 6.0 is recommended. This allows for optimum nutrient solubility and availability.

- pH Up
- Bring the pH up in your nutrient or fish tank. Use with caution in aquaponics.
- Added control in maintaining optimum pH levels
- Aids in maximising nutrient availability
- Aids in Increasing Plant Productivity

Product Details

Material	Additive	Product Dimensions (mm)	W50 H:170 L:50
Package Dimensions (mm)	W50 H:170 L:50	Weight	460g

Ideas & Advice

https://www.bunnings.com.au/hy-gen-250ml-ph-up-potassium-hydroponic-additive_p3030507

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8/20/2017

HY-GEN 250ml Phosphoric Hydroponic Additive | Bunnings Warehouse





Nearest store **Homebase Subiaco**
55 Salvado Road (08) 9380 2600

Today 7:05am - 7:05pm Mon 7:05am - 9:00pm





**HY-GEN 250ml Phosphoric
Hydroponic Additive**

LIN 3030450

\$77.52

Price correct as at Sat 30 Aug 2017 11:32:32 AM

Not all products available in all stores

Contact your **nearest store** for product information.

Product Description

pH Down Phosphoric Acid 80% 250ml

Bring the pH down in your nutrient or fish tank. Use with caution in aquaponics

In hydroponics "pH" is an extremely important factor. When it is poorly monitored or controlled, plants can become sick or die. It is therefore recommended that pH is tested daily. Hy-Gen pH Up and Hy-Gen pH Down provide the grower with an added control in maintaining optimum pH levels and hence maximising nutrient availability and plant productivity. A too high or too low pH can complicate the absorption of important nutrients such as iron, calcium, magnesium, etc.

Generally the pH of the hydroponic solution should be 6.3. It is acceptable, however, to maintain the pH in the range of 6.0 to 6.5. For rockwool a lower pH of 5.8 to 6.0 is recommended. This allows for optimum nutrient solubility and availability.

- pH Down
- Brings pH down in your Nutrient or Fish Tank
- Aided Control in Maintaining pH levels
- Aids in Maximising Nutrient Availability
- Aids in Increasing Plant Productivity

Product Details

Material	Additive	Product Dimensions (mm)	W:50 H:170 L:50
Package Dimensions (mm)	W:50 H:170 L:50	Weight	450g

Ideas & Advice

https://www.bunnings.com.au/hy-gen-250ml-phosphoric-hydroponic-additive_p3030450

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Trial methodology

Table 1: Product information.

Products	pH	Applied	NV (%)	Particle Size (µm)	Calcium (%)
Liquid lime (SuperCal 30)	8	In-furrow	91	100% <0.025	30
Potassium Hydroxide (KOH)	12.5	In-furrow	-	-	-
Gypsum	-	Top-dressed	-	-	23.3
Garden lime	8	Top-dressed	91	95% <0.85	32.5
Lime sand	8	Top-dressed	91.8	100% <1.00	36.1

Plot size & replication	40m x 2m x 7 replications With treatments randomised through out the plot
Treatments	<ol style="list-style-type: none"> 1. Control 2. 20L/ha Liquid lime 3. 20 L/ha Liquid lime + 10 L/ha Soluble Potassium Hydroxide (KOH) 4. 10 L/ha Soluble Potassium Hydroxide (KOH) 5. 0.3t/ha Gypsum + KOH + Garden lime 6. 2 t/ha Lime sand

Randomisation of Treatments

Plot	Treatment	Plot	Treatment	Plot	Treatment	Plot	Treatment
1	1	12	5	23	2	34	1
2	2	13	1	24	6	35	6
3	3	14	5	25	4	36	4
4	4	15	4	26	1	37	2
5	5	16	6	27	3	38	3
6	6	17	2	28	6	39	1
7	2	18	3	29	5	40	5
8	3	19	5	30	2	41	4
9	1	20	1	31	5	42	6
10	6	21	3	32	3		
11	4	22	4	33	2		

Treatment 1: Control plots with no applications applied

Treatment 2: SuperCal 30 is a 30% Calcium product developed for soil with a neutralising value of 91% and foliar applications. Banded it may provide growers an efficient tool for manipulating soil pH, soil structure and plant physiology. At seeding 20L will be applied in furrow below the seed.

Treatment 3: Is a combination of applications 2 and 4.

Treatment 4: Potassium Hydroxide (KOH) has a very alkaline nature and banded below the seed the trial aims to raise the pH within the seed zone. At seeding 10 L/Ha soluble KOH, equivalent to 10 kg/Ha of dry flake, will be applied in furrow below the seed. The problem with KOH is that it can be easy to create toxicities when banded in close proximity to seed.

Treatment 5: Garden Lime as calcium carbonate with a neutralising value of 91% applied at 20 kg/Ha combined with Gypsum having 23.3% calcium at 0.3 t/Ha and KOH 10 kg/Ha, top-dressed.

Treatment 6: Lime Sand at 2 t/Ha with a neutralising value of 91%, top-dressed.

Aim: To validate which pH Adjustment Products can improve acid soils by increasing the soil pH in Zone 2* with a rainfall of less than 325ml.

Trial Details

COGGO pH Trial	Phil and Bev Logue			
Property	Lakesend Farm, Latham			
Plot size & replication	40m x 2m x 7 replications			
Soil type	Grey sand			
Soil pH (CaCl₂)	0-10cm: 4.54	10-20cm: 4.26	20-30cm: 4.34	30-40cm: 4.45
EC (dS/m)	0-10cm: 0.062	10-20cm: 0.045	20-30cm: 0.039	30-40cm: 0.047
Sowing date	23/06/2015			
Seeding rate	60kg/ha Westonia Wheat			
Treatments	<ol style="list-style-type: none"> 1. Control 2. 20 L/ha Liquid lime 3. 20 L/ha Liquid lime + 10 L/ha Soluble Potassium Hydroxide (KOH) 4. 10 L/ha Soluble Potassium Hydroxide (KOH) 5. 0.3 t/ha Gypsum + 10 kg/Ha KOH + 20 kg/Ha Garden lime 6. 2 t/ha Lime sand 			
Paddock rotation	2015: wheat 2014: wheat 2013: wheat			
Fertiliser	23/06/2015: 40 kg/ha MAP, 35 Kg/ha Urea			
Herbicides	23/06/2015: 1.5 L/ha Round Up, 1.8 L/ha Trifluralin Post emergence: Hand weeded			
Growing season rainfall	169.5mm			
Treatment costs	<ol style="list-style-type: none"> 1. \$ 0 Control 2. \$56 @ 20 L/ha Liquid lime 3. \$66 @ 20 L/ha Liquid lime + 10 L/ha KOH 4. \$10 @ 10 L/ha KOH 5. \$56 @ 0.3 t/ha Gypsum + 10 kg/Ha KOH + 20 kg/Ha Garden lime 6. \$52 @ 2 t/ha Lime sand 			



Steve Cosh (DAFWA) seeding trial site at Latham



*TASS Soil Testing Services - 160 soil samples
taken for testing*



*Stephen Davies explaining the benefits of liming
for crop production at the Perenjori Spring Field
Day*

Results

The baseline sampling – Table 2, shows that the selected site has a severe soil acidity issue that could be addressed with pH adjustment products.

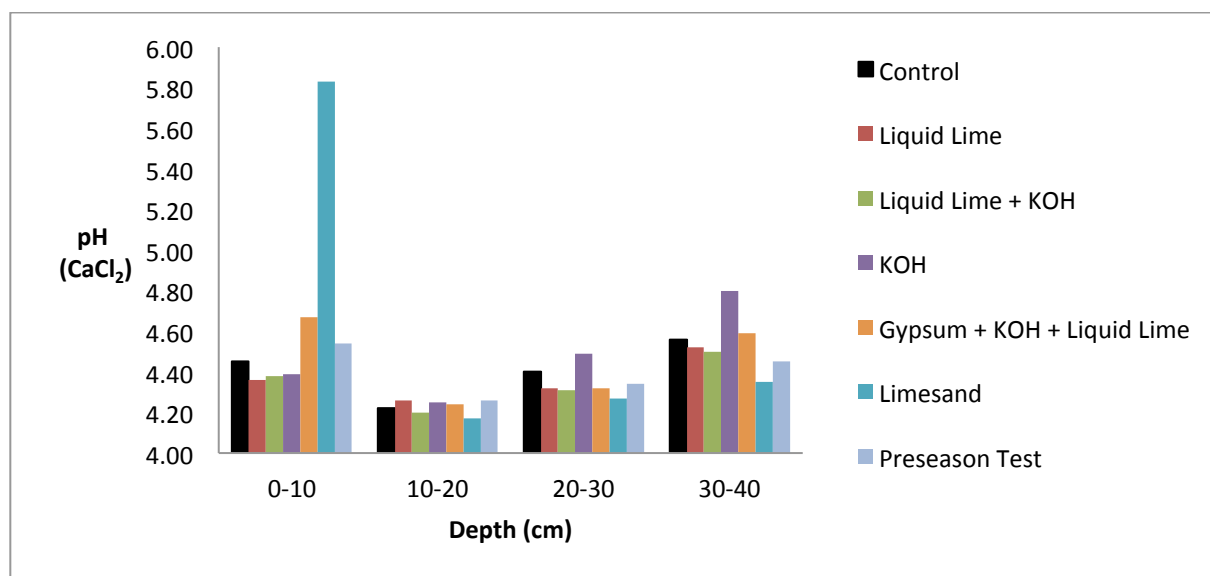
Table 2: Baseline results for selected soil properties (0-40cm) collected prior to treatments being imposed at the trial site in March 2015.

Depth (cm)	EC (dS/m)	pH (CaCl ₂)	NH ₄ (mg/kg)	NO ₃ (mg/kg)	Sulphur (mg/kg)	Exchangeable Aluminum (c.mol/kg)
0-10	0.062	4.54	9.8	11.1	8.1	0.20
10-20	0.045	4.26	3.0	7.0	11.2	0.49
20-30	0.039	4.34	3.7	5.3	21.5	0.45
30-40	0.047	4.45	3.7	4.7	35.6	0.39

Table 3: Averaged results for selected soil properties (0-40cm) collected post treatments being imposed at the trial site in December 2015.

Treatment #	pH (CaCl ₂)				Exchangeable Aluminum (c.mol/kg)			
	0-10cm	10-20cm	20-30cm	30-40cm	0-10cm	10-20cm	20-30cm	30-40cm
1	4.45	4.22	4.40	4.56	0.16	0.24	0.14	0.10
2	4.36	4.26	4.32	4.52	0.19	0.28	0.24	0.15
3	4.38	4.20	4.31	4.50	0.15	0.29	0.26	0.15
4	4.39	4.25	4.49	4.80	0.15	0.27	0.14	0.08
5	4.67	4.24	4.32	4.59	0.09	0.27	0.22	0.14
6	5.83	4.17	4.27	4.35	0.04	0.35	0.30	0.20

Figure 1: Effect of liming products on pH (CaCl₂) at Latham in 2015.



Best Treatment/% Improvement vs Control

L/sand/31% LiqLime/0.95% KOH/2% KOH/5.3%

Aluminium toxicity generally becomes an issue when the pH drops below 4.8 and except for Treatment 6 (2 t/ha lime sand), all other treatments are below this tipping point in the topsoil. All of the subsoils are at or below a pH of 4.8, Figure 1.

Figure 2: Effect of treatments on aluminium levels at Latham 2015. Line Graph

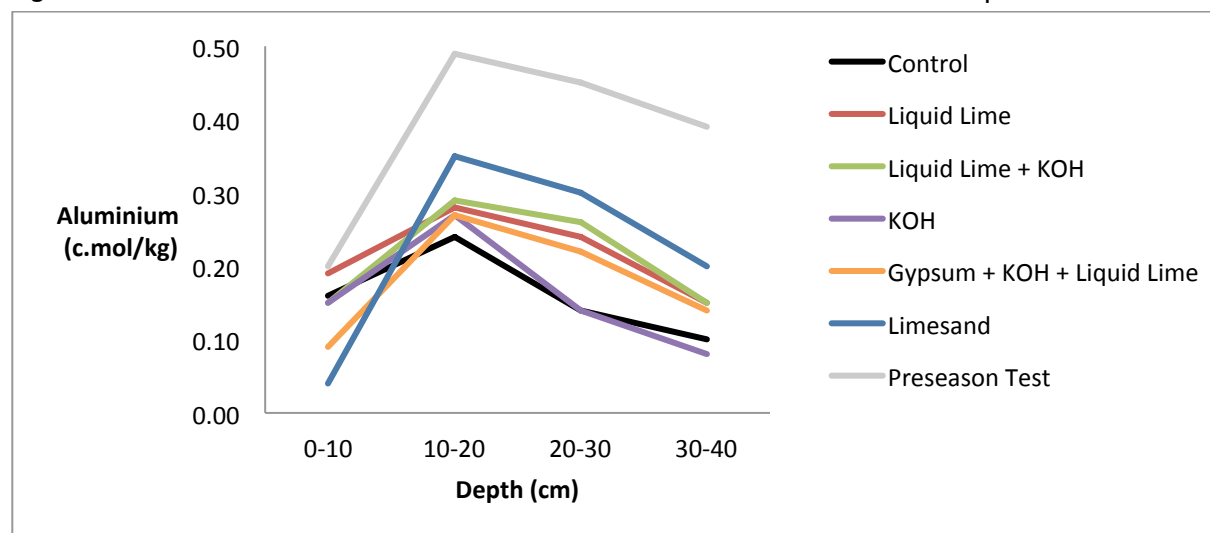


Figure 3: Effect of treatments on aluminium levels at Latham 2015. Bar Graph

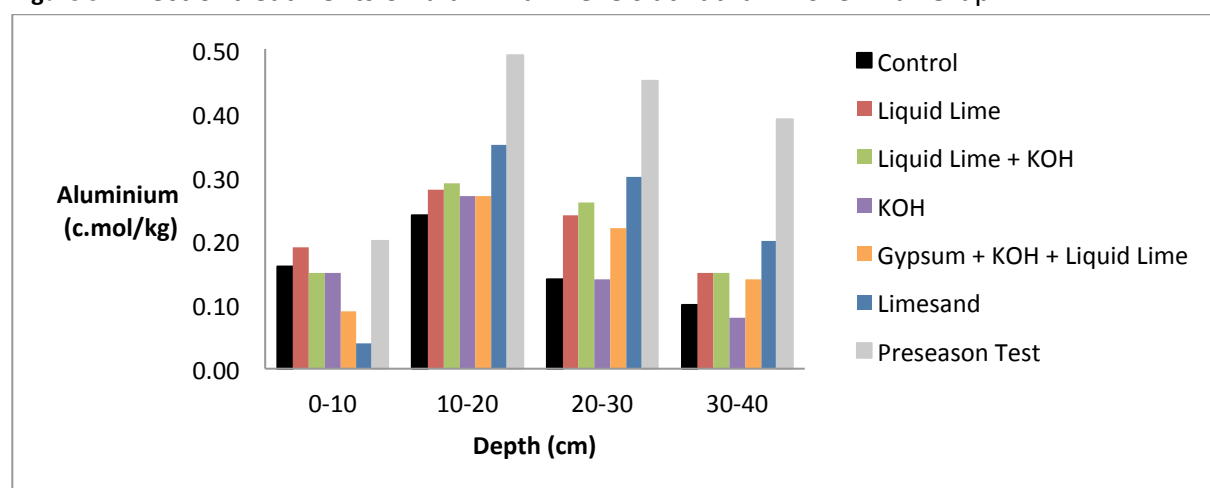


Table 3: Yield results for Westonia wheat with 169.5 ml Rainfall at Latham, 2015.

Treatment Number	Treatment list/Rate	Yield (t/ha)
1	Control	1.35
2	20 L/ha Liquid Lime	1.35
3	20 L/ha Liquid lime, 10 L/ha KOH	1.30
4	10 L/ha KOH	1.29
5	0.3 t/ha Gypsum, 10 kg/ha KOH, 20 kg/ha Garden Lime	1.33
6	2 t/ha Lime sand	1.34
LSD		ns
CV (%)		4.1
P Value		0.245

ns = not significant (P=0.05)

There are no significant differences in the yield results collected in 2015 in Latham.

Comments

The KOH appears to be having a negative effect with slightly lower yields both treatments 3, 4 and 5. As the KOH was applied down the tube with the seed is possible that the seed was burnt as KOH is extremely alkaline and banding below the seed was not possible with the available machinery.

When compared to the control treatment the lime sand changed the topsoil pH from 4.45 to 5.83. As the lime sand was top-dressed in 2015 and not incorporated there is no expected response down through the profile. However, all of the other treatments had better pH and Aluminium results including the Control from 10 cm to 40 cm and Lime Sand appears to be having a negative effect on subsoil pH from 10 cm to 40cm with increasing margins to the control at depth.

pH (CaCl ₂)	0-10	10-20	20-30	30-40
Preseason	4.54	4.26	4.34	4.45
Control	4.45	4.22	4.40	4.56
Lime Sand	5.83	4.17	4.27	4.35
Dif between 6 & 1	+ 1.38	- 0.05	- 0.13	-0.21

There was no significant yield difference in any of the applied treatments when compared to control. One of the major issues with banding liquid lime type products seems to be the amount of calcium carbonate that can be injected into the soil profile. A 20L/ha band of liquid banded at 5cm will only give us 2ml of product per square metre, which is not enough carbonate to provide positive pH changes within one year.

KOH, which is not a carbonate neutraliser, has had a slightly positive effect on pH at 10-20cm and larger positive effects with results of 4.49 pH at 20-30cm and 4.80 pH at 30-40 cm. In comparison at 30-40 cm the pH of the control was 4.56 pH and Lime Sand was 4.35. Further research into KOH placement to alleviate negative yield effects may provide a basis for broadacre adoption of this product to address subsoil acidity and aluminium toxicity.

pH (CaCl ₂)	0-10	10-20	20-30	30-40
Preseason	4.54	4.26	4.34	4.45
Control	4.45	4.22	4.40	4.56
KOH	4.36	4.25	4.49	4.80
Dif between 4 & 1	-0.09	+0.03	+0.09	+ 0.24

The application of liquid or fluid type products at seeding can however provide growers with options to add to their existing liming programs, or in situations where growers may lease country and not want to start a full liming program. Available products such as Calsap (highly soluble calcium carbonate) from Optima Agriculture and Hi-Sil Plus (highly soluble potassium silicate) from HiTech Agriculture among others, are addressing subsoil acidity and aluminium toxicity whilst supporting strong plant health.

These are potential carbonate and non-carbonate subsoil constraint solutions.

References

Gazey, C, Andrew J and Griffin E (2013). 'Soil acidity'. In: Report card on sustainable natural resource use in agriculture, Department of Agriculture and Food, Western Australia.
Chris Gazey, Department of Agriculture and Food, Western Australia; Yvette Oliver, CSIRO; James Fisher, Desiree Futures; Joel Andrew, Precision SoilTech and Stephen Carr, Aglime of Australia (2014). In: 20 years of soil acidity RD and E in Western Australia—what have we learnt?