Quality of Phosphorus Sources

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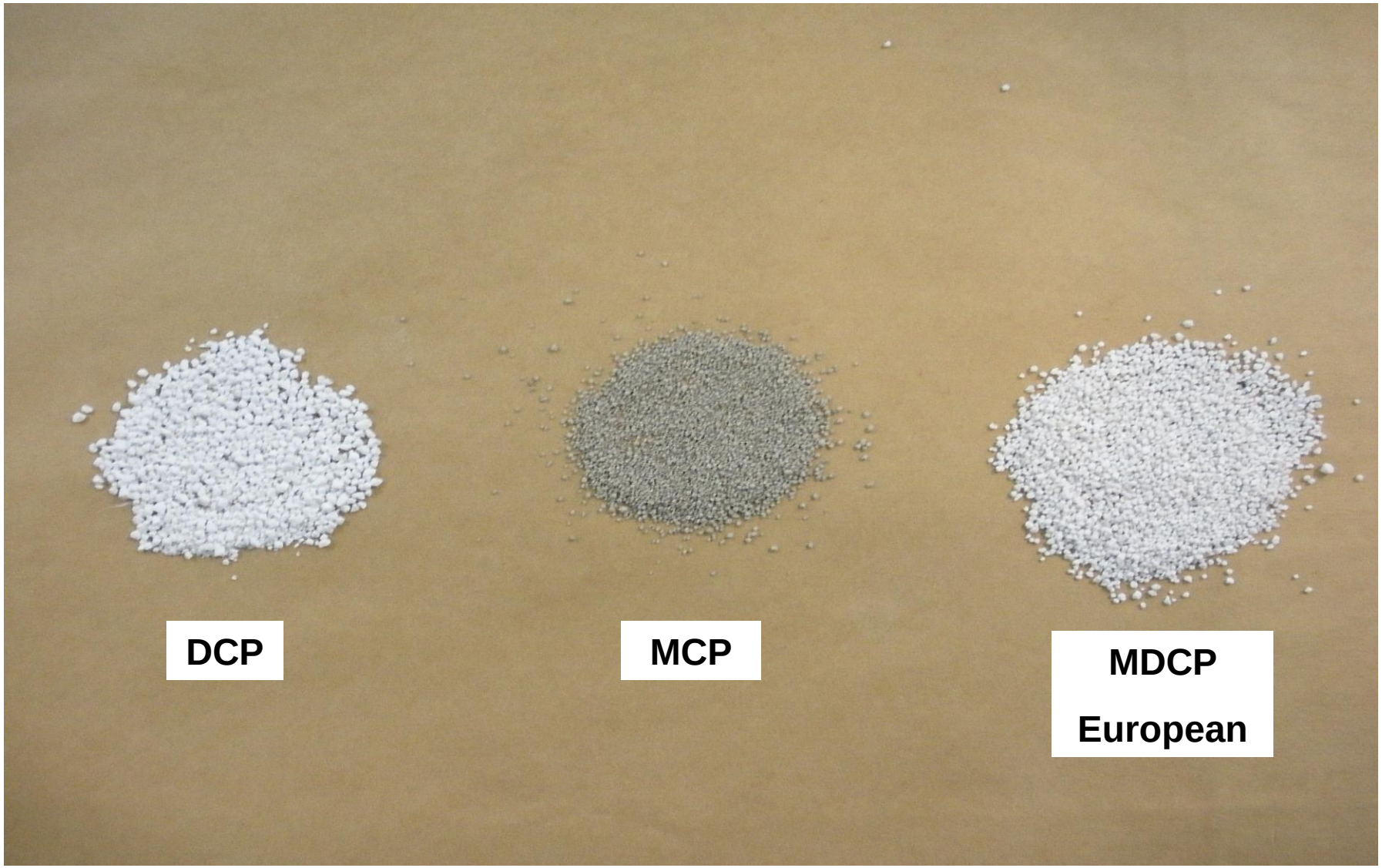
Phosphate Supplements

- There are many phosphorus supplements available for feeding to cattle, ranging from 24% P to 14% P.
- Monosodium phosphate - benchmark
- Monocalcium phosphate (MCP)
- Monodicalcium phosphate (MDCP)
- Dicalcium phosphate dihydrate (DCPh)
- Dicalcium phosphate anhydrous (DCPa)
- Tricalcium phosphate (TCP)
- Rock Phosphate
- Fertilizer forms (superphosphate, MAP, DAP)

Phosphate Supplements



DCP

MDCP

MCP

Kynofos

Composition of P supplements

Name	Calcium %	Phosphorus %	Other Content %
Monosodium phosphate	0	24	Na - 19
Monocalcium phosphate	15	23	F < 0.2%
Monodicalcium phosphate	16	21	F <0.2%
Dicalcium phosphate dihydrate	24	18	Mg, F <2%
Dicalcium phosphate anhydrous	24	18	Mg, F <2%
Tricalcium phosphate	32	16	Mg, F
Rock phosphate	32	14	F 3-4%, Mg 3-5%

What about P from bone meal?

- If it is imported it is absolutely not to be used for ruminants because of the risk of transmission of BSE.
- BSE prions are not destroyed by rendering temperatures,

Availability of P sources to Ruminants

- "The data indicate that the *in vitro* solubility measured in ruminal fluid might be used to rank mineral P sources qualitatively"
- **If it can't be dissolved – it can't be absorbed.**

Solubility of different mineral P sources in vitro in ruminal and abomasal fluid, and in vivo in the rumen

	In vivo	*In vitro*	*In vitro*
	Rumen[1]	Ruminal fluid [2]	Abomasal fluid[2]
	%	% of sodium phosphate	% of sodium phosphate
Sodium phosphate	100	100	100
Mono-dicalcium phosphate	87.6	55.9	76.6
Dicalcium phosphate	61.5	29.7	43.9
Defluorinated rock phosphate	39.7	1.3	35.5

[2] Measured after 2 h incubation.

Total availability (%), and true absorption of P

	Balance trials	Mobile nylon bag
Feed	True absorption of P (%)	Total availability of P (%)
Roughages	64-76	83-97
	67-80	
	84-94	
Oilseeds meal/cake	70-81	
Grain and peas	71-79	
Milling products 64 1 78 /93 7	64	78-93
Mineral P*		29-100
Monosodium phosphate	62	**100**
Monocalcium phosphate		**74**
Dicalcium phosphate	62	**30**
Dicalcium phosphate	68	
Tricalcium phosphate	65	
Superphosphate	70	
	65	
Monoammunium phosphate	59	
	58	
Urea phosphate	62	

Modified from: Sehested, J. Animal Sci. **54**: 169-180 (2004)

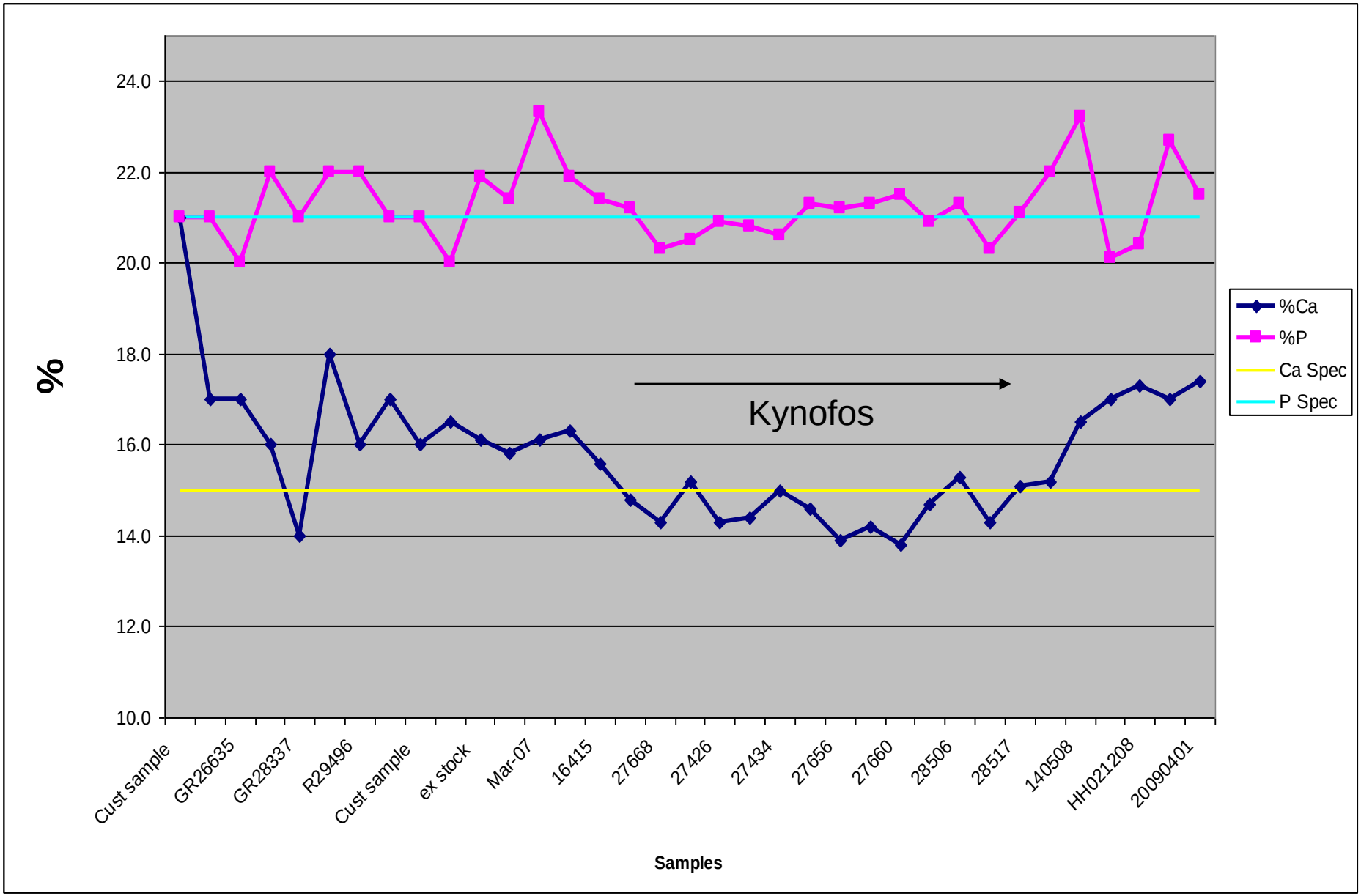
Analysis of MDCP and Kynofos 21 samples from Brisbane Export

	MDCP	Kynofos 21	EU Standards	Unit
Phosphorus (P)	20.2	21.17		%
Calcium (Ca)	16.5	16.54		%
Magnesium (Mg)	0.7	1.7		
Rel. solubility of P in water	**66**	**74**		%
Rel. solubility of P in citric acid	94	99		%
Fluorine (F)	0.19	0.07	max 0.2	%
Arsenic (As)	13	1.75	max 10	ppm
Cadmium (Cd)	4.5	1.43	max 10	ppm
Lead (Pb)	3	13	max 15	ppm
X-ray diffraction				
$CaCO_3$	12	6-Sep		%
DCP anhydrate	22	17-33		%
MCP	44	52 - 68		%
$CaSO_4$ / Bassanite	11	7		%
Potassium Al Hydrogen P	3	-		%

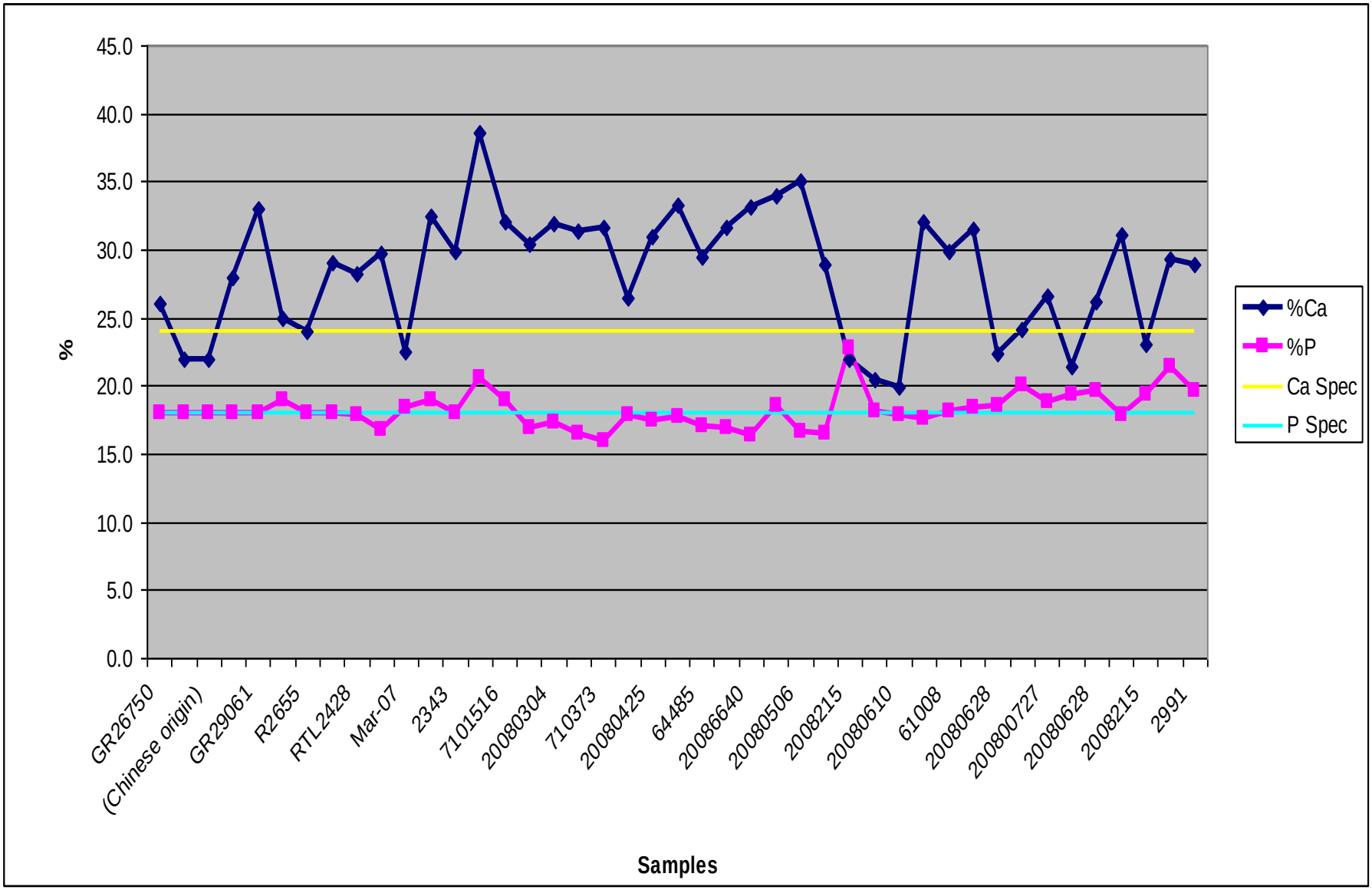
What do we see from Analysis?

- BEC Feedsolutions over the years have conducted over 14,000 tests on minerals.
- On Phosphate supplements, over 220 tests for Ca, P and Mg have been done since 2005.
- The method used is ICP
- Tests for Fluorine cannot be done by this method – hence no results.

MDCP Analyses



DCP Analyses



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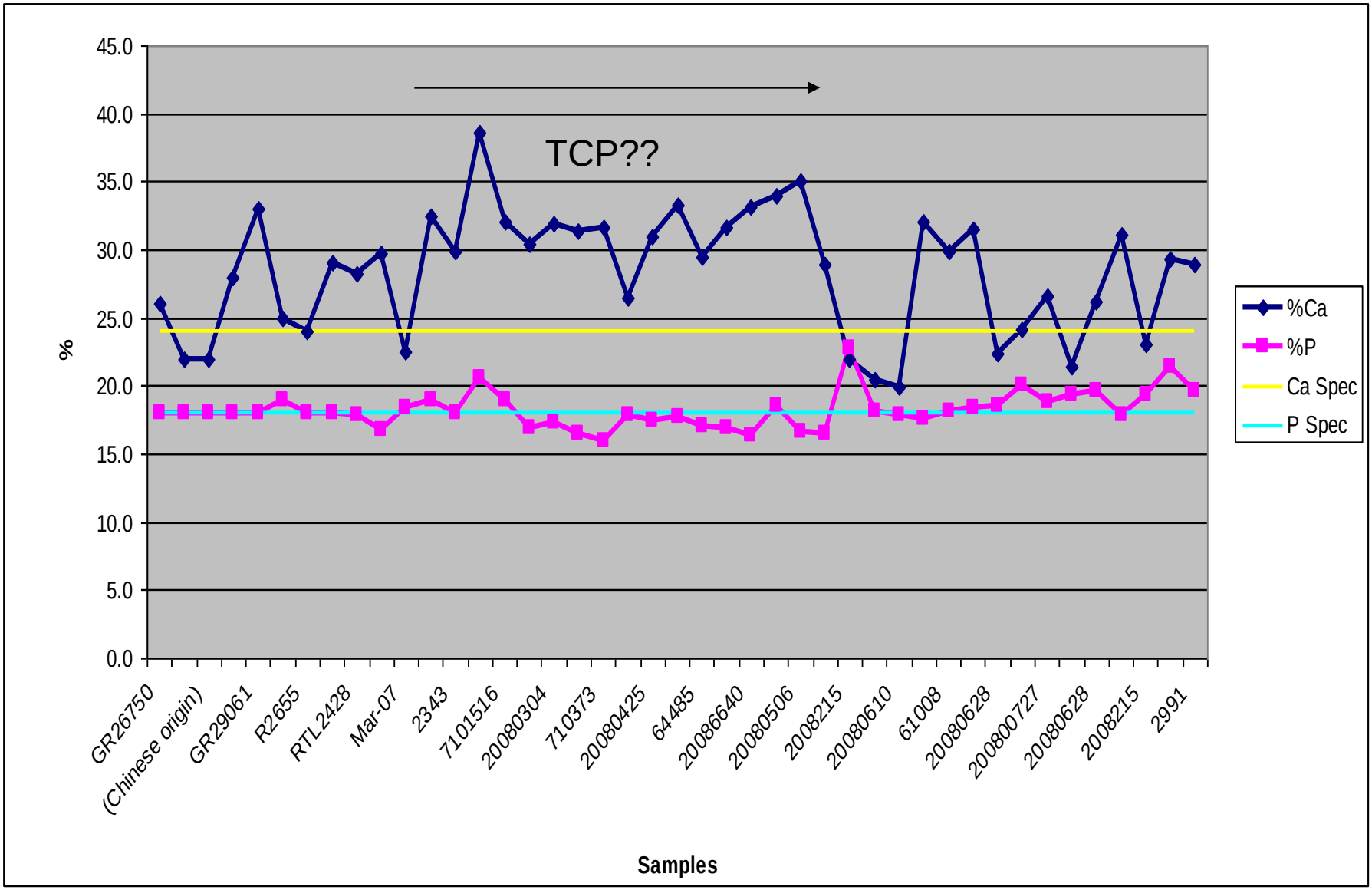
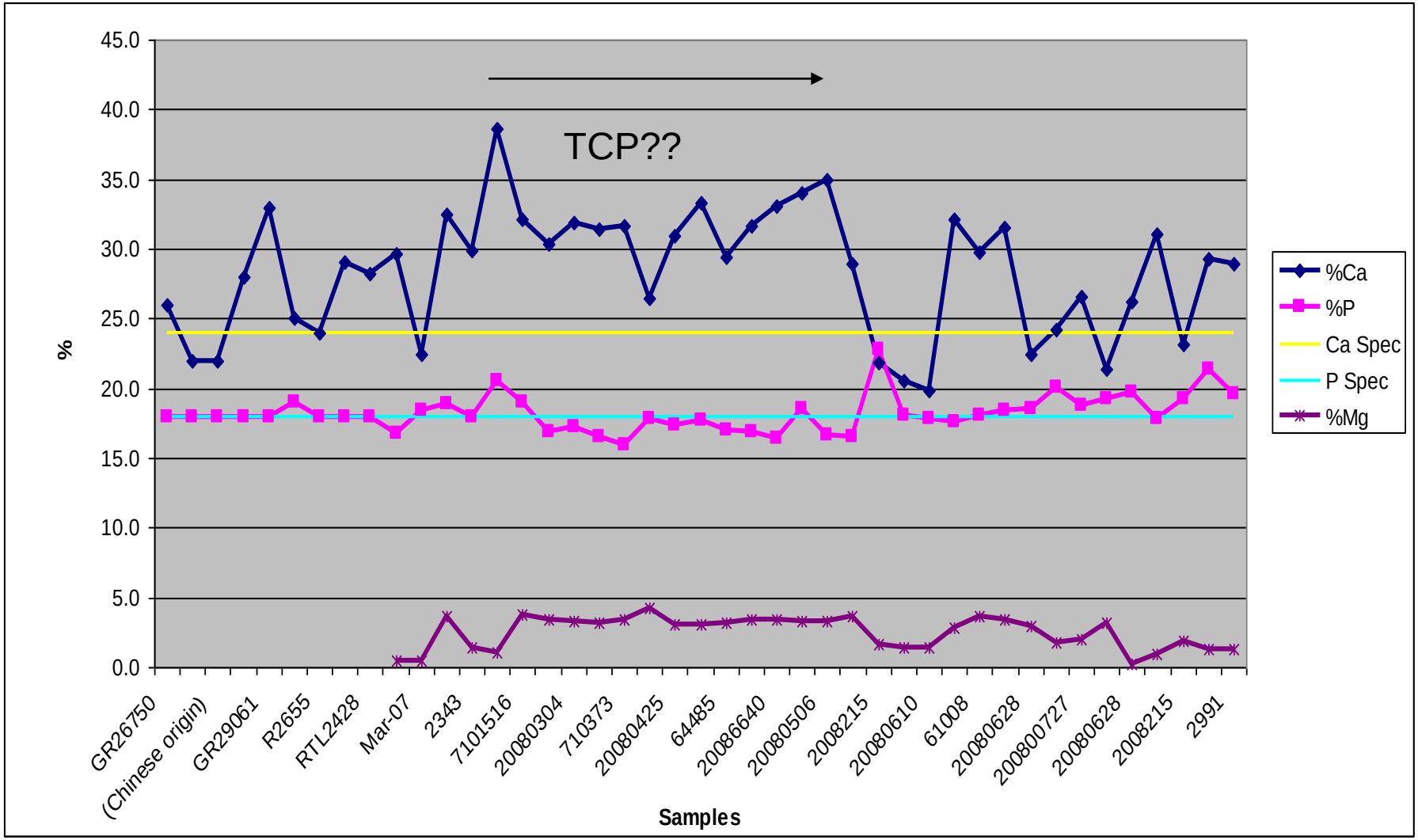


DCP Analyses



Maximum Fluorine (F) content for mineral substances and total ration

Class of Animal	Maximum F content of any mineral mixture which is to be used directly for the feeding of animals shall not exceed -		F content of phosphate source (or other ingredients) shall be such that the maximum F content of the total ration shall not exceed -	
	%	ppm	%	ppm
Cattle	0.30	300.00	0.009	9
Sheep	0.35	350.00	0.01	10
Pigs	0.45	450.00	0.014	14
Poultry	0.60	600.00	0.035	35

Is fluorine a potential Problem?

- A typical lick intake is 200 g/h/d and delivers ~4 g of P.
- Therefore a lick must contain 19g of kynofos /200g (9.5%)
- Rock phosphate contains 14% P and requires 28.6g in 200 g of lick to deliver 4 g of P.
- Rock phosphate can be up to 2-4% F
- = 20-40 g F/kg = 20-40 mg F/g
- Assuming the rock phos is 2% F, at 28.6 g/200 g, the F content would be 570 mg/200g or 2850 mg/kg, which is >9 times the US limit
- Kynofos is 0.13% F = 1.3 g/kg = 1.3 mg/g. At 9.5% inclusion the concentration of F in the kynofos lick <125 mg/kg

Cost Effectiveness

Phosphate source	Price	P content	P digestibility	Dig. P	Cost/g Dig P
	c/kg	g/kg	%	g/kg	c/g
MDCP (kynofos)	130	210	75.00%	157.5	0.825
DCP	90	180	60.00%	108	0.833
TCP	60	160	45.00%	72	0.833
Rock Phosphate	48	140	30.00%	42	1.143

Summary

Advantages of MDCP

- High P level
- High digestibility
- Purity
  - Low Fluorine
  - Low Magnesium
- Consistency
- Relationship with supplier
  - Can maintain supply in tough times