Needle disease strategy Research Programme

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Effect of A.I. rate and adjuvant addition on uptake of phosphorus acid formulation "Foschek"

PPC report for Stefan Gous-Scion

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Preliminary Report for Stefan Gous, Scion **03 August 2015**

Effect of A.I. rate and adjuvant addition on uptake of phosphorus acid formulation "Foschek"

This study was undertaken to determine the uptake of phosphorus acid from the Foschek™ formulation (Zelam Ltd), over the use range of 6-24 kg/ha, with and without the addition of penetrating adjuvants. A second formulation, Phosgard™ (Grochem), was compared with Foschek at a single use rate with no adjuvant addition.

Methods

Phosphorus acid solutions (Foschek™, 400 g/L phosphorous acid, Zelam) were prepared at 6, 12 & 24 kg/ha phosphorus acid in 100 L/ha of water. Uptake of phosphorus acid was determined from each solution and in combination with a single recommended concentration of each of four adjuvants.

The adjuvants investigated were:

1) Actiwett®, a linear alcohol ethoxylate (Etec Crop Solutions); 0.2%
2) LI-1000™, lecithin plus methyl esters of fatty acids & alcohol ethoxylate (Etec Crop Solutions); 0.25%
3) Hasten™ spray oil, a blend of esterified vegetable oil and non-ionic surfactants (Victorian Chemicals); 0.25%
4) Du-Wett®, an organosilicone-blend superspreader containing siloxane polyalkeneoxide copolymers (Etec Crop Solutions); 0.2%.

Phosgard™ (400 g/L phosphorus acid, Grochem) has similar physical properties to Foschek. Uptake of phosphorus acid was determined from a single solution of Phosgard, at 12 kg/100 L/ha phosphorus acid.

All treatments were replicated 3x on each of two clones: Clone A = 870-605, Clone B = 875-51. Summer CE conditions were 25/18°C day/night temp, 70% rh, 15 h day. Uptake was determined at the single time interval of 24 HAT.

Results and Discussion

A summary of uptake results is tabulated (Table 1). Major effects examined were adjuvant, phosphorus acid rate and clonal differences.

The effect of adjuvant on phosphorus acid uptake was highly significant ($P<0.0001$), in the order;

Actiwett = Du-Wett = no adjuvant > Hasten = LI 1000

From an uptake perspective, this suggests that Foschek formulation is sufficiently well adjuvanted (Zelam 2012) not to require extra adjuvant addition to sprays. Adjuvants may assist in spray retention and coverage, and may also increase or alleviate the risk of spray phytotoxicity, but this has not been examined here.

The effect of phosphorus acid rate on uptake was highly significant ($P<0.0001$), in the order;

24 kg = 12 kg > 6 kg

This effect on uptake correlated with observed phytotoxicity of treatments, where 6 kg exhibited no phyto and 24 kg consistently exhibited the greatest phyto. Note however, that all phyto was judged as relatively mild at 24 HAT, and it is unknown how it may progress with time.

The effect of clone on phosphorus acid uptake was highly significant (P<0.0001), in that uptake was consistently higher in the three replicates of Clone A (68.1, 65.5, 63.6%) than in Clone B (52.7, 51.2, 50.9%). Both clones were healthy. Clone B needles were observed to be shorter in length than Clone A, and B were more prone to exhibit phytotoxicity despite the lower mean uptake. This suggests that clonal variation is significant and phosphorus acid rates may need to be kept low(er) to avoid damage to sensitive clones.

Overall, it appears from both this study (Table 1) and previous work, that 6 kg/ha is a "safe" rate of phosphorus acid to apply over *P. radiata*. This provided an uptake dose of up to 4 kg/ha (Table 1). An application rate of 9 or 12 kg/ha may well be tolerated by mature pines, but increasing the rate increases the uptake dose and the risk of damage.

Foschek is stable with adjuvant addition, and will benefit from addition of Du-Wett (and maybe Actiwett) at the 6 kg/ha rate. But, the additional cost may not be justified; Foschek is well formulated for phosphorus acid penetration into pines. This is in contrast to the Agrifos 600 formulation, which showed high instability with adjuvants (Horgan & Gaskin 2015) and poor uptake without them (Rolando *et al* 2014; Horgan & Gaskin 2012). Phosgard may be an alternative and more cost effective option? It is adjuvanted and caused no phytotoxicity at 12 kg/ha use rate (Table 1). Its use with adjuvants warrants further investigation. The only other consideration for further work is to determine the uptake of phosphorus acid under "winter" conditions; colder temperatures are highly likely to reduce uptake, and adjuvant addition may offer advantages under such conditions, with less risk of phytotoxicity.

Table 1: Uptake of [^{32}P] phosphorus acid into P. radiata needles at 24 HAT.

Treatment	[^{32}P] phosphorus acid uptake % (uptake dose as kg/ha)[1]					
	6 kg/ha		12 kg/ha		24 kg/ha	
Foschek alone	53.4 ef	(3.2)	64.3 abcd	(7.7)*[2]	71.9 ab	(17.3)**
+Actiwett 0.2%	59.4 cdef	(3.6)	72.4 a	(8.7)**	63.9 abcd	(15.3)**
+ LI-700 0.25%	35.0 g	(2.1)	51.6 f	(6.2)**	59.1 cdef	(14.2)**
+ Hasten 0.25%	39.9 g	(2.4)	56.8 def	(6.8)*	57.3 def	(13.8)**
+ Du-Wett 0.2%	65.3 abcd	(3.9)	62.6 bcde	(7.5)*	66.9 abc	(16.1)**
Phosgard alone	-		34.6	(4.2)	-	

Means sharing common postscripts are not significantly different (P=0.05). Phosgard not included.
[1]Nominal dose calculated as phos acid rate x % uptake
[2]Phytotoxicity observed on treated needles; *very mild, **mild

References

Horgan D. B and R. E. Gaskin 2012. Optimising uptake of phosphorous acid into *Pinus radiata* foliage**.** Report to Scion. 12 pp.

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Rolando C, Gaskin R, Horgan D, Williams N, Bader M, 2014. The use of adjuvants to improve uptake of phosphorus acid applied to *Pinus radiata* needles for control of foliar *Phytophthora* diseases. NZJFS 44:8.

Zelam 2012. Safety Data Sheet Foschek™. Issued 17 April 2012. 2p.