PACE into fruit tree spraying practice

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Introduction

A concerted effort was made over a 2 year period (2012-13) to transfer the webpage linked PACE (Pesticide dose Adjustment to the Crop Environment) (Walklate and Cross 2013a) system into commercial practice in the UK and to test the results of its implementation on 7 commercial tree fruit farms, feeding back the results to growers and industry. The aim of PACE is to support low pesticide-input to pest management called for in the Sustainable use Directive (2009/128/EC) through efficient use of orchard spraying products. PACE seeks to minimise crop-to-crop variation of spray deposits above the minimum for efficacious use (i.e. the deposit achieved by spraying a standard orchard (1, 2, 3 & 4) at the maximum label dose using a farm sprayer operating at the calibrated reference settings). PACE utilises information about: the number of open nozzles used for the reference setting of the farm sprayer, the selected pesticide type, the tree row spacing and at each of three growth-stages requires the grower to assess the target orchards to determine canopy density and the number of working nozzles to treat the target orchard to the full tree height.

Methods and materials

Seven pome fruit growers agreed to implement PACE on their farms in 2012 and 2013. They were each visited in the late dormant period and assisted in the PACE assessment of their orchards, set up of sprayers and inputting the data into the PACE webpage for dose rate recommendations. This exercise was repeated after blossom and again at full leaf each year. At the end of each season the spray programmes applied by the growers were collated and the actual doses of each pesticide application were compared with those given by PACE. The spray programmes were fully costed and the savings the growers made compared to those recommended by PACE relative to full dose applications were calculated for each pesticide type. The growers were questioned about their satisfaction with pest and disease control and with PACE.

Results and discussion

The growers found making the canopy density assessments from the PACE pictogram key and the measurement of tree height quick and easy. However, the LiDAR measurements at two of the farms in 2012 indicated there was a tendency to be too cautious and to over-estimate canopy density. The value of making a formal orchard and sprayer assessment was particularly illustrated on two of the farms where the sprayer set up was found to be incorrect, resulting in scab infection. Dose adjustments for different orchards at the same spray round were mainly made by making proportionate adjustments to the spray volume, by adjusting the number of nozzles according to tree height (as required by PACE) and by adjusting pump pressure. This approach is not suitable for making large dose adjustments for orchard density without additional adjustment of tank concentration. Growers found implementing PACE for a tank mix of different product types with differing proportional dose adjustment in different orchards to be complex. Further software to help with this planning would be helpful in the future.

Although all the seven farms evaluated the use of PACE, the degree to which they actually implemented it in their spray programmes in 2012 and 2013 varied greatly for mixed reasons (Table 1). One grower with orchards of variable structure, though unwilling to reduce insecticide doses pre-blossom beyond cuts proportional to reduced tree height, implemented PACE more or less fully reducing doses by 34% and 36% and saving £574 and £503 per ha and a total of £13,113 and £9,913 for the farm in 2012 and 2013, respectively. On another farm the orchards were more uniform in structure and PACE dose recommendations were generally for full dose. PACE was also

implemented more-or-less fully, the grower reducing doses to 84% in both years and saving £198 and £155 per ha in 2012 and 2013, respectively. PACE could not be implemented at another of the farms in 2012 because of the unusually wet weather from April onwards made spray application at the required intervals very difficult. Sprays thus were applied when they could be at the full dose and insufficiently frequently to prevent significant scab infection in some orchards. The legacy of this experience at this farm resulted in full doses being used in 2013. The grower at another of the farms was also very cautious because of the wet weather in 2012 which resulted in some scab infection. However, this grower still made substantial average reductions to 70% and 82% dose, amounting to £290 and £202 per ha 2012 and 2013, respectively. In contrast the growers at three other farms were unwilling to change their normal dose reduction practice and implement PACE, though they were very interested in its outputs, making comparisons with their own. At two farms the PACE dose was considered to be somewhat illogical as they reduced for orchards with wider row spacings with the same canopy density assessment. This undermined the growers trust in the scheme. Nonetheless, the doses used at one of the farms in particular were considerably less than those recommended by PACE, and at another they were similar. Actual doses on this former farm averaged 66% and 60% in 2012 and 2013, respectively. The grower at the remaining farm, which had exceptionally uniform, intensive and high-yielding orchards on narrow row spacings, did not implement PACE. This grower, who used the most robust and costly spay programmes, was particularly cautious about dose rate reductions considering the potential savings to be made to be small compared to the high value of the crop. Because of the orchard structures, the PACE dose recommendations were generally for full dose, though one young orchard received lower doses for reduced tree height. The actual average doses applied on this farm averaged 96% and 90% compared to PACE average doses of 77% and 80%. Another reason that the grower at Farm 4 did not implement PACE was because of the logistical difficulties of applying different proportional reductions for different pesticides in different orchards with the same tank mix.

Table 1. Mean numbers of pesticide applications and average % doses recommended by PACE and actually applied by grower and mean actual costs (£) of spray programmes and savings (£) made in in comparison to the cost of the same programme had it been applied at the full dose

Pesticide applications	Fm 1	Fm 2	Fm 3	Fm 4	Fm 5	Fm 6	Fm 7
				2012			
Mean PACE dose %	89	82	82	94	69	80	90
Mean grower dose %	84	66	77	96	66	79	68
Total no. apps	31.5	24.5	36.1	28.0	35.8	23.3	40.6
Mean actual cost (£/ha)	1091	623	1024	1230	1038	610	1065
Mean PACE saving (£/ha)	142	142	263	82	446	165	226
Mean actual saving (£/ha)	198	415	290	68	574	150	931
	2013						
Mean PACE dose %	89	78	80	77	59	73	78
Mean grower dose %	84	60	80	90	64	77	75
Total no. apps	23.9	21.5	32.2	38.0	24.7	22.3	33.7
Mean actual cost (£/ha)	823	633	960	1617	560	564	1039
Mean PACE saving (£/ha)	86	248	277	331	443	187	320
Mean actual saving (£/ha)	155	431	202	139	503	155	307

Thus the actual implementation of PACE varied greatly between the seven farms for a wide variety of reasons. In most cases the overall mean % grower dose was within 5% of the PACE calculated dose, though the overall mean values in Table 1 hide considerable spray-to-spray round and orchard-to-orchard variability. Greater actual dose reductions than those given by PACE were achieved on Farms 2 and 7 in 2012 and on Farm 2 in 2013, partly because of a tendency to use plant growth regulators at low doses.

All the growers found the webpage calculator helpful and intend to use it or refer to it in future. A label requirement for growers to consider adjusting dose rate according to canopy size and density will help to force dose adjustment into practice, particularly if it becomes a requirement of

produce Quality Assurance schemes. Two updates of the PACE webpage calculator (i.e. V3 and V4) were released during the lifetime of this projects (Walklate 2014). These updates responded to grower feed-back about: reducing the amount of time required to input data and manage previous records, making available dose adjustment estimates for the full growing season based on a simple growth model and orchard assessment at any one of three key growth-stages (Walklate & Cross 2013b).

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