Petroleum spray oils against the cotton aphid in Australia: how effective are they?

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The cotton aphid (*Aphis gossypii* Glover), once considered to be only a secondary pest on cotton in Australia, is now considered an important late-season pest on this crop. The major reasons for this resurgence include the introduction of transgenic cotton, the development of resistance to synthetic insecticides, and the recent appearance of cotton bunchy top disease (which the aphids transmit)(Spora & Wilson, 2001: Redall *et al*. 2004).

We determined the efficacy of direct applications of a range of concentrations between 1% and 10% of an nC24 petroleum spray oil (PSO) (Sacoa, Biopest) for use against the cotton aphid, *Aphis gossypii*. We focused on the effects of the oils on aphid behaviour and mortality. We also determined the indirect effects of the deposits of the PSO. We focused on the effects of the oils on acceptance of cotton as host plant by the aphids, as well as on aphid mortality rates and their success in establishing colonies.

Direct applications of the nC24 oil proved to be highly effective at controlling *A. gossypii* at a range of concentrations between 1% and 10% v/v. The oil killed cotton aphids quickly with most of the mortality occurring within the first 10 minutes of spraying (Fig. 1). The fast action of the oils prevented any escape responses by the aphids. The quick death of the aphids suggested a physical (contact) mode of action of the oils. This is supported by the lack of any negative effect on aphids not initially reached by the oils. However, when those aphids not hit by the oils, but which subsequently encountered oil-treated areas, moved elsewhere, they also died indicating the oil deposits are also toxic to the aphids. The mode of action of the oils thus seems to be versatile and the means by which the oils kill the aphids may be more complex than anoxia, which is the widely claimed mechanism attributed to PSOs.

The deposits of the nC24 oil proved to be toxic to *A. gossypii*, too. They remained effective up to six days after spraying in the field and up to eight days in a mesh house. Mortality rates decreased with time, so that the older the deposit the lower the mortality. Significantly higher aphid mortalities were achieved on younger (and smaller) leaves than mature ones (Table 1). Thus, leaf age (and probably leaf morphology and structure) proved a significant factor in the efficacy of the oil deposits. Consecutive prophylactic applications (at 9 day intervals) did not have a cumulative effect, so their killing power proved to be independent of one another (Fig 2). Thus, applying oils prior to aphid infestations would confer only minimal protection. Oil deposits did not deter *A. gossypii* alates from landing on oil-sprayed plants. Oil deposits did, however, affect subsequent alate and nymphal survival, and thus establishment of aphid colonies (Fig 3). The impact the oils could have on the longer-term development of aphid populations in the field was thus demonstrated.

In conclusion, the results show that cotton growers can use nC24 oils as a stand alone product to manage cotton aphids (particularly early in the season). However, at high aphid infestations and when cotton plants are bigger (late cotton season), oils alone will not be able to provide complete control of aphids. Growers are advised to alternate the use of oils as a stand alone when aphids are at low densities and mixtures of oils plus synthetic insecticide when aphid densities are close to economic thresholds as part of the same integrated pest management program. The fact that other major cotton pests, including *Helicoverpa* spp., are also susceptible to the oils (Mensah *et al.* 1995), increases the range of target pests that will be controlled as part of the spraying program.

References

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Redall A, Ali A, Able JA, Stonor J, Tesoriero L, Wright PR, Rezain MA and Wilson LJ, Cotton bunchy top: an aphid and graft transmitted cotton disease. Australasian Plant Pathology 33: 197-202 (2004).

Mensah RK, Harris W and Beattie GAC, Response of *Helicoverpa* spp. and its natural enemies to petroleum spray oils in cotton. *Entomophaga* **40**: 263-272 (1995).

Figure 1. Effect of Biopest oil (2% and 5% v/v) on the mortality of *Aphis gossypii* adults in the laboratory.

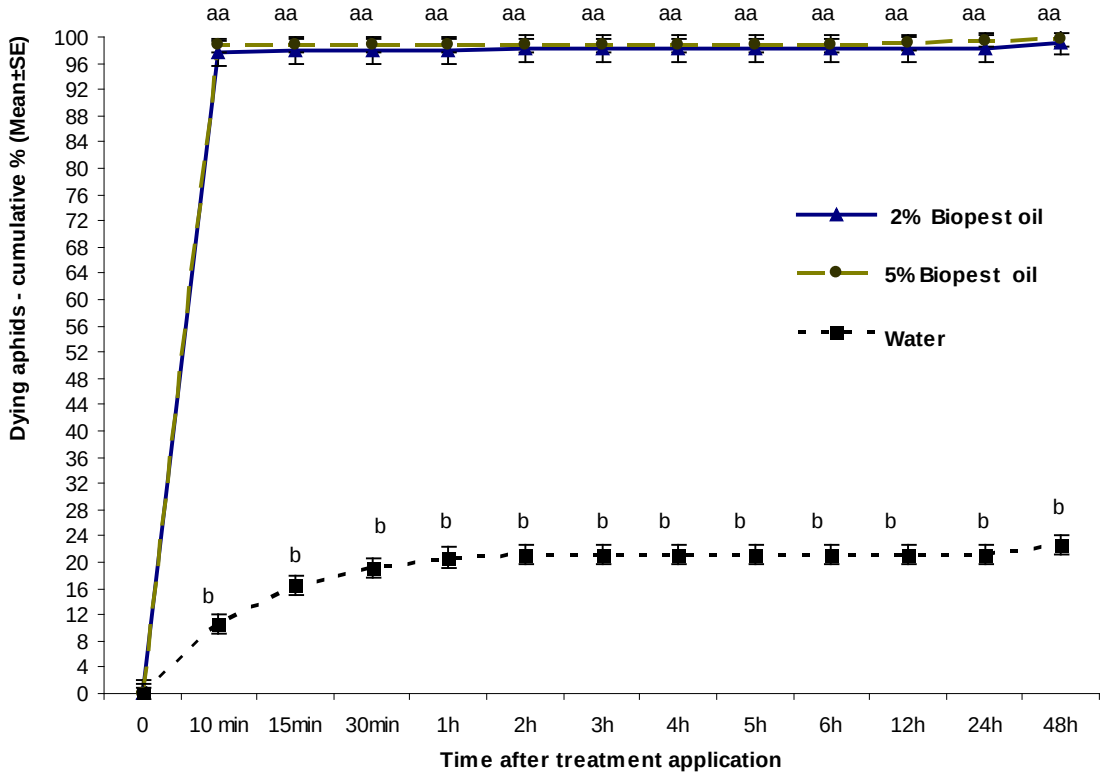

Figure 2. Effect of two consecutive prophylactic applications of Biopest oil (2%v/v) on the survival and establishment of *Aphis gossypii* colonies in a cotton field (Narrabri, NSW).

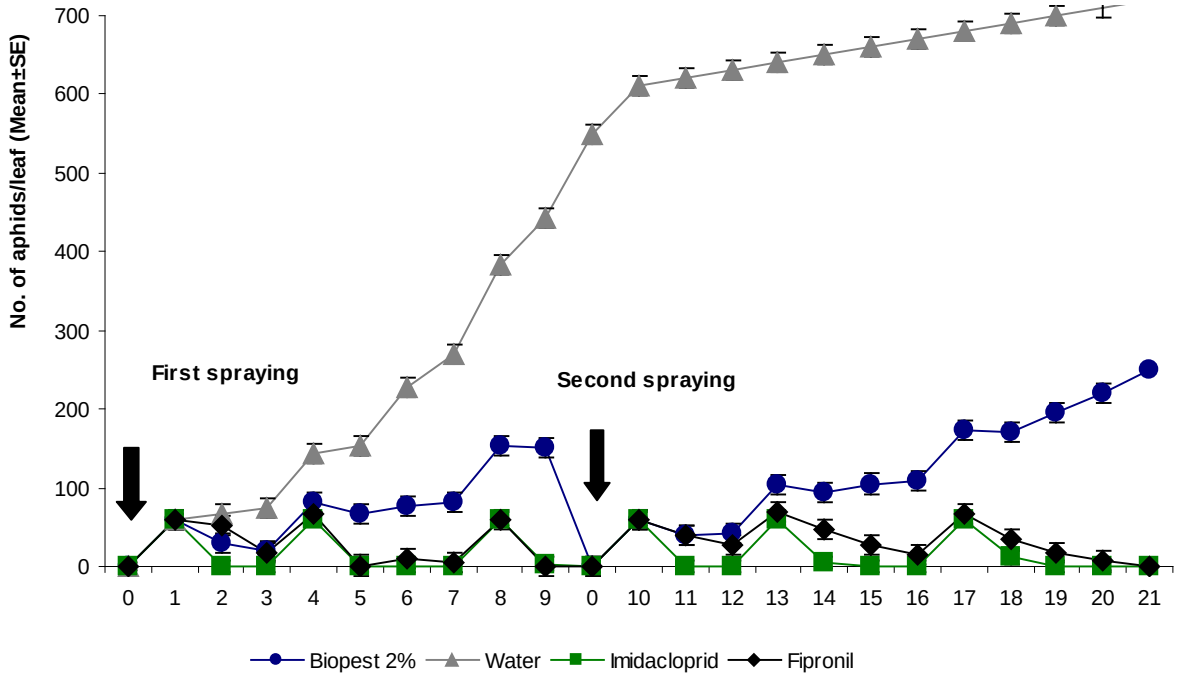

Figure 3. Effect of the deposits of Biopest oil (2% v/v) on the survival of *Aphis gossypii* alates and on the colonies established by surviving alates.

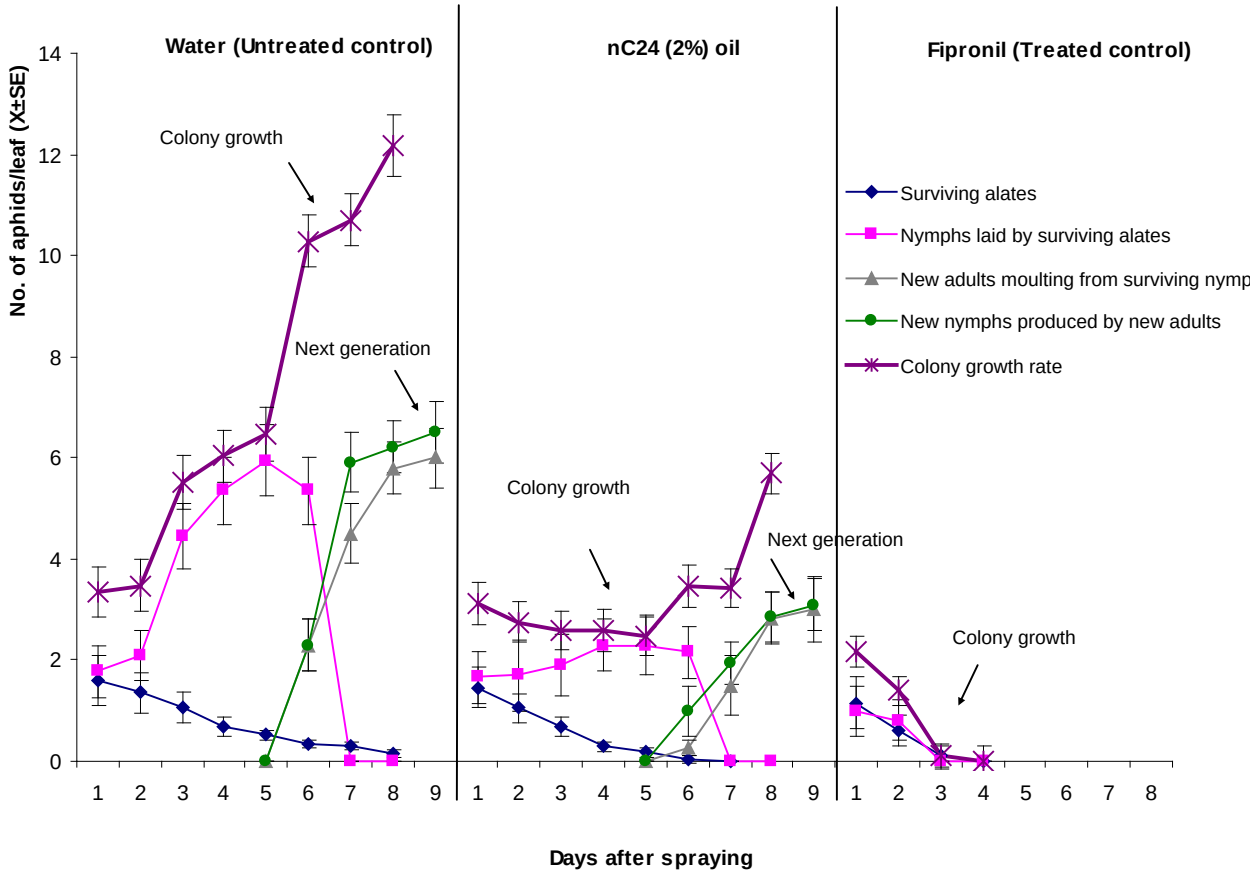

Table 1. Effect of Biopest oil (2% v/v) deposits of different ages on cotton aphid mortality - duration of activity and relationship with leaf age.

Days after treatment	% mortality at day 1 of exposure of a new aphid cohort (Mean ± SE)		
	Water	2% Biopest	
		Young leaves	Mature leaves
1	0.0±0.00a	84.8±10.25 c	14.6±5.81 b
2	0.0±0.00a	70.7±5.29 b	12.5±3.09 b
3	0.0±0.00a	50.5±10.80 b	10.8±6.23 b
4	0.0±0.00a	57.1±5.72 c	13.3±7.06 b
5	0.0±0.00a	56.3±9.76 b	3.3±3.28 a
6	0.0±0.00a	43.3±6.7 b	3.43±0.98 a
7	0.0±0.00a	28.4±5.27 b	4.48±1. 09 a
8	0.0±0.00a	12.5±2.66 a	1.70±0. 87 a
9	0.0±0.00a	4.0±1. 09 a	1.0±0. 67 a