Quantifying Economic and Environmental Tradeoffs of Walnut Arthropod Pest Management

Many walnut pest management strategies (PS)[1] used by California walnut growers have been linked to water quality impairment.

However lower risk alternatives are often associated with higher costs. The purpose of this research was to:

[1]A PS was defined as all insect and mite pest control products used on an orchard during a year by a grower as reported to the Pesticide Use Reports (PUR) database maintained by the California Department of Pesticide Regulation

(1) Identify currently practiced PSs with probable high water quality impact and their cost

Reviewed 2,531 walnut PSs, representing the practices of 891 growers on around 35,000 acres of walnuts in the counties of San Joaquin, Stanislaus, and Merced over the years 2002-2006

The Environmental Impact Quotient (EIQ) model was used to estimate the likely impact to water quality. (Kovach, J., Petzoldt, C., Degni, J., Tette, J., 2007. A Method to Measure the Environmental Impact of Pesticides, at http://nysipm.cornell.edu/publications/eiq/files/EIQ_values07.pdf.)

$$EIQ_j = \frac{\sum_{i=1}^{n}(AI_{ij} \times INDEX_i)}{TRT_j} \qquad COST_j = \frac{\sum_{i=1}^{n}(PRD_{ij} \times PRICE_i)}{TRT_j} + \left(SPRYR \times \frac{15.57}{acre}\right)$$

j: PS being analyzed

i: pesticide product in the PS

n: total number of products used in the PS

AI_{ij}: total lbs of dominant active ingredient of product *i* in PS_j

TRT_j: total acres treated by all of the pesticides

$INDEX_i$: online water quality index for the dominant active ingredient of product *i*, as calculated by Kovach et al. (2007)

PRD_{ij}: total amount of product *i* used in PS_j

$PRICE_i$: price of product *i* in $/unit amount

$SPRYR_j$: total number of sprayer applications for PS_j

(2) Identify pest management strategies that could potentially lower water quality impact with less economic consequence.

The water quality impact EIQ and cost of each PS was compared to that of a hypothetical alternative strategy composed of lower risk products considered by experts to be effective in controlling the same pests.

Codling Moth (*Cydia (Laspeyresia) pomonella*) Pheromone Puffer, Methoxyfenozide (Intrepid 2F)

Walnut Husk Fly (*Rhagoletis completa*) Spinosad (Success), Bait (NuLure)

Navel Orangeworm (*Amyelois transitella*) Methoxyfenozide (Intrepid 2F)

Webspinning Spider Mite (*Tetranychus urticae, T. pacificus*) Naturally occurring biological control or Etoxazole (Zeal)

Aphid (*Chromaphis juglandicola, Callaphis juglandis*) Naturally occurring biological control or Acetamiprid (Assail)

The comparisons were run first under an assumption that the use of low risk products allows biological control to replace the need for miticide, and then under the assumption that a miticide would still be needed.

	Assumptions: Naturally occurring biological control	
Economic Tradeoff	**Does not** eliminate need for miticide	**Does** eliminate need for miticide
Cost Increase	96%	56%
Cost Decrease	4%	44%

Table 1. % of PSs that would see a cost increase or decrease upon lowering water quality impact by replacing the current PS with an alternative PS (APS)

(3) Quantify the importance of factors which affect economic tradeoffs associated with reducing water quality impact

The difference in cost between the PS and an alternative PS assuming effective biological control replaced the need for a miticide or aphicide was regressed on multiple factors to identify their influence on costs. The regression equation is as follows:

$$COST_{PS\text{-}APS} = \text{Intercept} + NOBIO + ALT + MITE + OP + PYR + NOBIO*NOBIO + ALT*ALT + MITE*MITE + OP*OP + PYR*PYR + ALT*NOBIO + ALT*MITE + ALT*OP + ALT*PYR + MITE*NOBIO + MITE*OP$$

Key:

NOBIO: the number of pests targeted by a PS without potential to be successfully controlled biologically

OP: the cost per acre of organophosphates

PYR: the cost per acre of pyrethroids

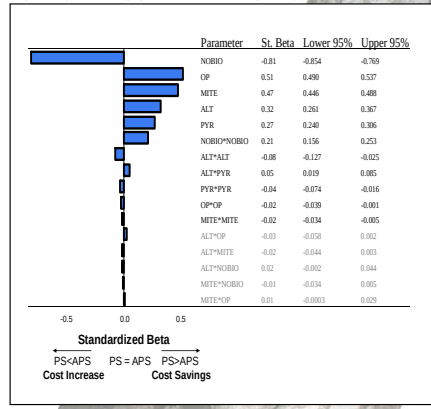
MITE: the cost per acre of miticides

ALT: the cost per acre of alternative products

PS: Pest management system: all insect and mite pest control products used on an orchard during a year by a grower as reported to the Pesticide Use Reports (PUR) database

APS: Alternative Pest management system under assumption of effective biological control

Figure 1. Magnitude, sign and 95% confidence intervals of regression parameters (grayed-out values are not significant).



Take-Home Points

1. 96% of the PSs analyzed were candidates for reducing the impact on water quality.
2. Replacement of current pesticides by alternatives lowered probable impact, but resulted in an economic tradeoff of higher costs for the majority of growers.
3. If biological control could eliminate the need for miticides and aphicides, this tradeoff could be replaced by savings for nearly half (44%) of the sample analyzed (See Table 1).
4. Characteristics of PSs most likely to realize a cost savings upon lowering risk: have low numbers of pests that are not candidates for biological control and relatively high use of organophosphates and miticides (See figure 1).
5. Had all high impact PSs been replaced by alternative strategies and effective biological control, then **total organophosphate, pyrethroid, and miticide active ingredient use would have been reduced by an average of 4.5 lbs/acre per year, while simultaneously lowering the grower's pest management costs by an average of $52/acre, thus contributing to both economic and environmental long-run sustainability.**

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