

**MONTREAL PROTOCOL
ON SUBSTANCES THAT DEplete
THE OZONE LAYER**



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**SPECIAL REPORT:
VALIDATING THE YIELD PERFORMANCE OF ALTERNATIVES
TO METHYL BROMIDE FOR PRE-PLANT FUMIGATION**

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Foreword

On behalf of the Montreal Protocol Technology and Economic Assessment Panel (TEAP) we are pleased to release the *TEAP/MBTOC Special Report, 'Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation'*.

The study was undertaken by Methyl Bromide Technical Options Committee (MBTOC) Co-Chair Dr. Ian Porter, Leanne Trinder, and Debra Partington with the assistance of Dr. Jonathan Banks, Stefan Smith, Murray Hannah, and Natalie Karavarsamis. MBTOC members and members of their global expert network contributed to the report and TEAP members peer reviewed and edited the final version. MBTOC members and members of their global expert network contributed to the report.

The policy-relevant technical findings are that crops produced with certain alternatives to methyl bromide have statistically equivalent yields to crops produced with methyl bromide.

These findings give extraordinary confidence to global efforts to minimize and eliminate exemptions for Critical Use of methyl bromide allowed under the Montreal Protocol for developed countries.

The results will be welcome by farmers, farm workers and their families who are particularly vulnerable to skin cancer and cataracts from the long hours working under conditions of high ultraviolet-B (UV-B) solar radiation that is increased by stratospheric ozone depletion.

This report is one of the most comprehensive meta-analyses studies ever conducted for the agricultural sector. It considered the available global library of peer reviewed reports of field studies. These studies were collected by MBTOC members and by the authors from global internet agricultural data bases. It used sophisticated analytical techniques and computer modelling to compare yields of crops grown with methyl bromide and methyl bromide alternatives and displays its results in tabular and graphical formats that are suitable for interpretation by agricultural specialists, agribusiness managers, and policy makers.

The report was reviewed and endorsed by the MBTOC and TEAP.

Parties to the Montreal Protocol and their agricultural advisors will want to carefully study this report in order to consider the alternatives to methyl bromide that best accomplish their goal of a rapid phaseout of methyl bromide. The Multilateral Fund and its implementing agencies can use the analysis to identify the alternatives that maintain crop yields for favourable cost-effectiveness. Pest control advisors and their suppliers will want to use the analysis to guide agricultural sectors to the best alternatives. And chemical suppliers will want to use the results to focus future research on those uses that have less satisfactory options.

Action by national and regional environmental and agricultural authorities is particularly necessary in cases where the most suitable alternatives are not yet registered or where use restrictions inhibit protection of the ozone layer.

TEAP congratulates the authors and collaborators for this important analysis that supports global efforts to protect the earth for our and future generations.

Stephen O. Andersen, Lambert Kuijpers, and Jose Pons
TEAP Co-Chairs

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GLOSSARY OF KEY ACRONYMS

| | |
|------|-----------------------------|
| CUN | Critical Use Nomination |
| CUE | Critical Use Exemption |
| EC | Emulsifiable Concentrate |
| HDPE | High Density Polyethylene |
| LDPE | Low Density Polyethylene |
| LSI | Least Significant Interval |
| SE | Standard Error |
| VIF | Virtually Impermeable Films |

EXECUTIVE SUMMARY

The report presents a formal meta-analysis that validates the yield performance of alternatives to methyl bromide for some major pre-plant treatments that are currently subject to the Critical Use Exemptions under the Montreal Protocol. The policy-relevant technical finding is that crops produced with certain alternatives to methyl bromide have statistically equivalent yields to crops produced with methyl bromide.

Evaluation of Critical Use Nominations for Methyl Bromide is a very difficult and complex task. Analysis of international research studies is key part of this process. MBTOC and TEAP are required by the Parties to provide well-considered and authoritative advice on whether particular nominations meet the criteria for a Critical Use Exemption, and particularly whether there are technically and economically feasible alternatives to the nominated use available within the context of Decision IX/6.

Decision XVI/5 provided financial support to the Methyl Bromide Technical Options Committee's (MBTOC) co-chairs *inter alia* for expert to provide more detailed assessment of the nominations' claims against the criteria of Decision IX/6 and also expert assistance with the preparation of the Methyl Bromide Technical Options Committee's reports on its assessment of the critical-use nominations, so as to ensure that such reports provide sufficient levels of transparency and detail to meet the requirements of the Parties.

This report is endorsed by TEAP and MBTOC and its development was supervised by MBTOC, with funding provided under Decision XVI/5.

The report presents the methodology and outcomes of a formal meta-analysis into methyl bromide alternatives for some major pre-plant treatments that are currently subject to the CUNs. This quantitative statistical analysis allows a comparison of effectiveness of alternatives in a transparent and rigorous way for some crops for which complex CUNs have been made. It provides the statistical best estimate of the relative effectiveness of the major alternatives to methyl bromide as determined by analysis of information across a large number of studies in different regions and under different pathogen pressures. Effectiveness was assessed by comparing relative yield of the alternative to the respective methyl bromide/chloropicrin (MB/Pic) treatment. The study takes account of both registered and unregistered products.

The key steps to achieve this outcome were:

- a) a literature review of refereed and non refereed publications and develop a bibliography database of trials conducted in studies reported since 1997 evaluating alternatives to methyl bromide for pre-plant fumigation. A limitation on resources prevented reviewing previous studies. Also more recent studies are considered more appropriate as improvements in performance of new alternatives often occur with repeated trialing, new formulations and new application technologies.
- b) development of a PC based (Microsoft Access) multifactor database of parameters contained in the major studies so that the data can be used for comparative analyses of the information.
- c) development of a PC based (Excel) multifactor database of trial details in numeric format which enabled biometrical analyses.
- d) a meta-analyses using statistical comparisons of yields, paying particular attention to variations in inoculum density of the pests (fungal pathogens and nematodes), nutsedge, soil type, barrier films, method and rate of application of alternatives from major studies relevant to major crops applying for Critical Use Nominations (CUNs).

This report concentrates on two major crops, strawberry fruit and tomatoes. Comparisons are made to peppers, melons, eggplants and cucurbits data where possible. Too few articles have

been published to allow meta-analysis of the latter crops on an individual basis. However, much of the information for tomatoes (i.e. effect on target pathogens and weeds) is relevant to the outcomes for these other crops. The meta-analysis also includes a detailed assessment of the effect of alternatives for nutsedge under different pressures and the influence of low permeability barrier films across a range of regions and crops.

Sufficient published articles for the two main crops (tomatoes and strawberry fruit) have been captured during this study to provide accurate trends with most alternatives. It is recognised that there may be additional relevant studies that have been completed, but were not incorporated in this present study because full details of results were not provided or were unavailable. Incorporation of further data from these other studies may improve the precision of the meta-analysis. Conclusions about some of the newer alternatives are limited by the lack of reported studies.

The report outlines the power of the meta-analysis for decision making, and some of the challenges encountered during the data collection phase of the project and the procedures used to resolve these issues. The meta-analysis deals only with technical efficacy of alternatives measured by relative yield outcome. It considered relative yield for the crop following treatment only and made no attempt to analyse the effect on the subsequent crop(s). To this extent it closely mirrored the comparison of alternatives for many of the Critical Use Nominations. The study considered only alternatives which may directly replace MB for fumigation of soils – it did not consider methods which avoid the need for fumigation, i.e. soilless media and other substrates, potted plants and hydroponic systems which are considered as potential methods to replace production in fumigated soils.

This study has been conducted independently of restrictions to use of alternatives due to regulations, registration and market forces and recognises that economic feasibility also needs to be taken into account before a treatment can be considered a suitable alternative to MB under Decision IX/6. Full assessment of Critical Use Nominations by MBTOC takes into account both technical and economic feasibility.

OVERVIEW OF FINDINGS

The relative efficacy and variability in yield of a wide range of alternatives were compared to a standard MB/Pic treatment. The alternatives most often reported were chemicals, although a number of non-chemical alternatives were also included in the studies (eg. solarization, biofumigation, composts and biological control agents). Data from a large number of trials from regions which have applied for critical use exemptions, i.e. Europe, North America and Australasia, 101 for strawberries and 61 for tomatoes, have been included in this study.

Analyses from strawberry fruit trials showed that a large number of alternatives used alone or in various combinations had mean estimated yields which were within 5% of the estimated yield of the standard methyl bromide treatment (MB/Pic 67:33). Of these a number of alternatives and MB/Pic formulations (50:50, 30:70) had mean estimates with least significant intervals (LSI's) that were similar to MB/Pic 67:33. These included PicEC (chloropicrin), TC35EC (1,3-dichloropropene/chloropicrin), TC35 and TC35ECMNa (TC35 combined with metham sodium) and MI60 (methyl iodide/chloropicrin) which is undergoing review for registration in several countries.

Analyses from tomato trials showed that a range of alternative treatments used alone or in various combinations had mean estimated yields which were within 5% of the estimated yield of the standard methyl bromide treatment (MB/Pic 67:33). Of these, many contained the deregistered product, pebulate, but most did not. Several treatments, PicMNa (chloropicrin combined with metham sodium), 1,3D/Pic in combination with a range of herbicides and MI60 (methyl iodide/chloropicrin) (not registered), were similar to MB/Pic 67:33.

1 INTRODUCTION

1.1 *Current use of methyl bromide in pre-plant fumigation*

Under the Montreal Protocol, approximately 56,083 metric tonnes of methyl bromide was scheduled to be phased out of developed countries for pre-plant fumigation and non QPS post harvest uses by 1 Jan, 2005. Of this amount, approximately 51,000t was used for preplant soil use. As of the 17th Meeting of the Parties to the Montreal Protocol, (i.e. December, 2006), 16,050t and 13,418t of methyl bromide has been granted critical use exemptions (CUEs) for 2005 and 2006 respectively, for continued pre-plant soil use worldwide.

1.2 *Evaluation of CUNs on the basis of technical feasibility*

Paragraph 1(a)(ii) of Decision IX/6 states that a use of methyl bromide only qualifies as "critical" if the nominating party can demonstrate:

"There are no technically and economically feasible alternatives or substitutes available to the user that are acceptable from the standpoint of the environment and health and are suitable to the crops and circumstances of the nomination".

Decision XVI/4 Annex I assigns the nominating Party responsibility for providing information regarding the lack of technical feasible alternatives or substitutes.

Evaluation of Critical Use Nominations for Methyl Bromide is a very difficult and complex task. Analysis of international research studies is key part of this process. MBTOC and TEAP are required by the Parties to provide well-considered and authoritative advice on whether particular nominations meet the criteria for a Critical Use Exemption, and particularly whether there are technically and economically feasible alternatives to the nominated use available within the context of Decision IX/6.

Decision XVI/5 provided financial support to the Methyl Bromide Technical Options Committee's (MBTOC) co-chairs *inter alia* for expert to provide more detailed assessment of the nominations' claims against the criteria of Decision IX/6 and also expert assistance with the preparation of the Methyl Bromide Technical Options Committee's reports on its assessment of the critical-use nominations, so as to ensure that such reports provide sufficient levels of transparency and detail to meet the requirements of the Parties.

This report is endorsed by MBTOC and its development was supervised by MBTOC, with funding provided under Decision XVI/5.

The report presents the methodology and outcomes of a formal meta-analysis into methyl bromide alternatives for some major pre-plant treatments that are currently subject to CUNs. This quantitative statistical analysis allows a comparison of effectiveness of alternatives in a transparent and rigorous way for some crops for which complex CUNs have been made.

This analysis has been conducted to assist Parties and TEAP/MBTOC to more clearly identify alternatives to methyl bromide. During past assessments, it has been difficult for MBTOC to validate the effectiveness of alternatives when nominations are based on one study or a limited number of studies, especially when data from a large number of studies conducted internationally showed that alternatives performed similarly to methyl bromide. It was also difficult to draw conclusions about the suitability of alternatives to the circumstances of the nomination or to substantiate reported yield losses. The meta-analysis more accurately identifies the effects of many factors, such as the influence of severe pathogen or weed

pressures. Without this method to investigate these correlations, MBTOC has been unable to clearly identify whether alternatives are likely to show consistent effects across parameters specified in a nomination.

2 METHODOLOGY

The key steps in the conduct of this project were to collect and organise data so that a rigorous scientific comparison of the performance of a wide range of alternatives to methyl bromide for pre-plant fumigation could be made.

In its assessment reports (TEAP 2002), MBTOC has defined 'alternatives' as those non-chemical or chemical treatments and/or procedures that are technically feasible for controlling pests, thus avoiding or replacing the use of MB. 'Existing alternatives' are those in present or past use in some regions. 'Potential alternatives' are those in the process of investigation or development.

MBTOC has assumed that an alternative demonstrated in one region of the world would be technically applicable in another unless there were obvious constraints to the contrary, e.g. a very different climate or pest complex.

In this study, alternatives included existing and potential alternatives as defined above, and included all registered and non-registered experimental products (chemicals, biological and some physical methods) from trials on methyl bromide alternatives.

The key stages of this study included:

- a) Conduct of a structured literature review of alternative studies for pre-plant fumigation and created a citation database (ProCite®)
- b) Development of a relational PC based database (Microsoft Access®) of parameters from major studies relevant to the CUNs
- c) Construct of an analysable PC based database (Microsoft Excel®) with parameters in comparable numeric format ready for analysis
- d) Conduct of a meta-analysis using statistical comparisons of yields, focusing on the variations in inoculum density of the pests, soil type, climate, method and rate of application.

2.1 QUANTITATIVE LITERATURE REVIEW

The first procedure in the study was to collect data from trials with methyl bromide alternatives for pre-plant fumigation. These trials were obtained from peer reviewed papers and non peer reviewed papers and reports since 1997. A citation database was created to enable efficient retrieval and grouping of these studies.

2.1.1 *The Citation Database*

The citation database was created using ProCite®. Information, such as, title, author, abstract, source, and year, was recorded regardless of whether studies were included in the analysis (Mosteller and Colditz, 1996). Studies were sourced from published literature, unpublished literature, research reports and works in progress. Selection criteria for the studies are shown below. Literature searches were conducted using Internet search engines and the Department of Primary Industries on-line databases. Agricola, Science Direct and CABAbstracts provided comprehensive search results containing the keyword 'methyl bromide' for studies post 1997.

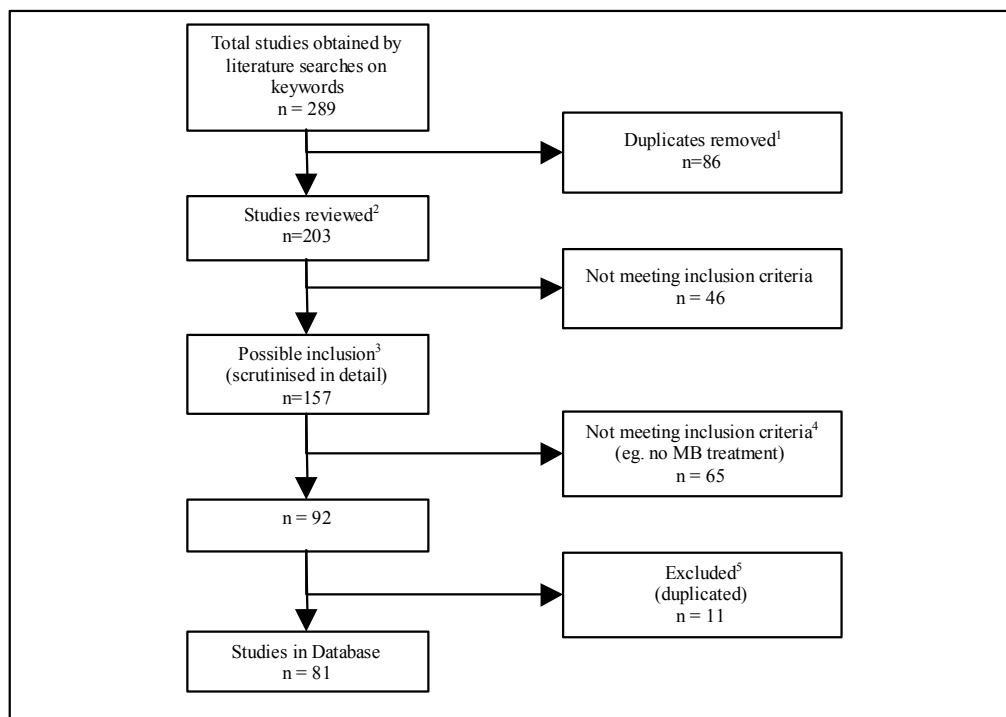
In total to date, over 460 articles have been exported into the citation database from the online searches. Of these, 289 were relevant to CUNs and 81 articles (42 for strawberry fruit containing results of 101 trials, and 30 for tomatoes containing results of 61 trials, and 9 for peppers, cucurbits, melons) contained a summary of trials that had information that could be analysed in the meta-analysis (see Tables 1, 10.1 and 10.2). These consisted of 27 refereed publications, 44 conference proceedings and 10 final reports. *Figure 1* shows a schematic of the process of selecting relevant papers/studies for inclusion in the meta-analysis.

In addition to the online database searches, information has been gathered by reviewing the Proceedings of the Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions (MBAO) and equivalent European Conferences, Major authors within the major industries were contacted by email to ensure good coverage of published literature. Post 1997 studies were entered into the citation database. The list of studies (see Tables 10.1 and 10.2) included in the meta-analysis was sent to MBTOC members in June 2005 in order to seek out further studies relevant to CUN's. This yielded a further small number of studies.

The minimum inclusion criteria for the studies included:

- Those from climatic regions and production regions relevant to those regions where Parties have applied for CUNs. In most cases studies were from within regions which had applied for CUNs.
- year (studies reported since 1997 onwards generally containing trials from 1997 - 2005)
- yield (reported in numeric format)
- a methyl bromide treatment
- an alternative treatment
- data on control of pathogenic fungi, parasitic nematodes or nutsedge
- a relevant crop (tomato, strawberry fruit, peppers, cucurbits, melons, eggplants)

Figure 1: Flow chart showing how study reports were scanned and selected for inclusion in the meta-analysis for tomatoes and strawberry fruit studies from 1997-2005



¹ Duplicate articles were removed because many articles were stored in more than one online database.

² Full article and data could not be obtained. Abstracts were examined to determine article relevance based on inclusion criteria. ³ All articles printed in hard copy. ⁴ Body of article was examined and did not satisfy the inclusion criteria e.g. article contained histograms, spatial maps, and economic reports. ⁵ Duplicated experiments were removed e.g. Kabir (2003) and Fennimore (2004) reported same experiment.

2.2 THE MAIN STUDY DATABASE

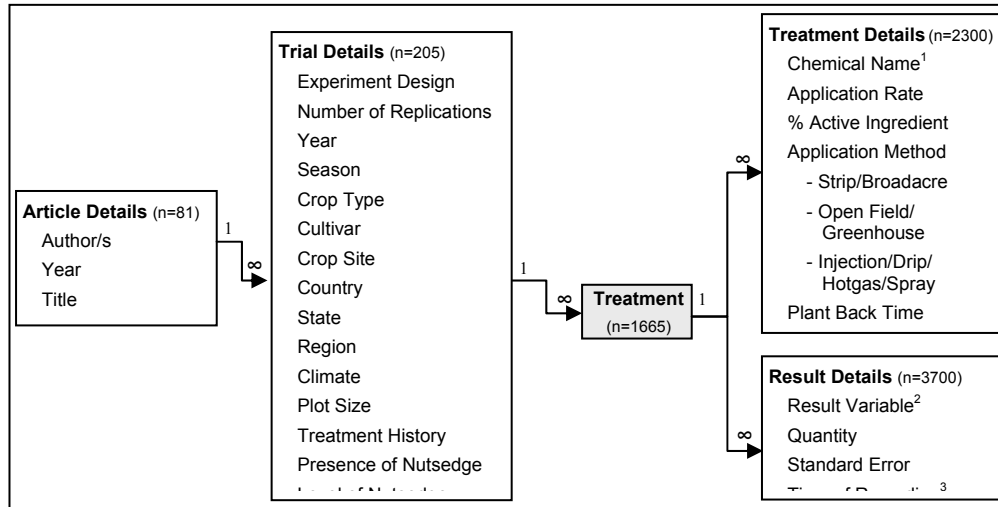
2.2.1 The Database Structure

The second database was constructed using a relational database management system using Microsoft Access (Fig 2). Detailed information about experimental conditions and the output data (i.e. yield) were gathered for each treatment and are presented in columns for each respective treatment.

For tomatoes and strawberries, the database consists of 1665 rows of data in 220 columns with 3700 entries of results, primarily expressed as either input data (Fig 3) or output data (Fig 4). Major input variables included treatments, rates, application method, type of plastic mulch and soil type. Major output variables included yields, disease incidence, pathogen population densities and weed numbers. The dataset consisted of 220 variables that could influence the output of the meta-analysis (variables were recorded in columns).

This database is the key to the accuracy of the meta-analysis and the development of relationships between parameters. The database structure enabled multiple trials, treatment combinations and experimental variables to be recorded. These variables were identified as key parameters which influenced the performance of pre-plant fumigant alternatives.

Fig 2. Size and Structure of the Access Database for Pre-Plant Fumigation Experiments



¹ *Chemical Name* includes the details of fumigants, herbicides, solarisation, biological controls etc. (see Appendix 1 for full Chemical Name list). ² *Result Variable* itemizes all treatment response variables, such as: marketable crop yield, total crop yield, nematode variety, fungi variety, weed variety. ³ *Time of Recording* is measured in days after planting.

Fig 3. Example of the structure of trial details (eg. inputs) into the main study database (220 columns of parameters included in total)

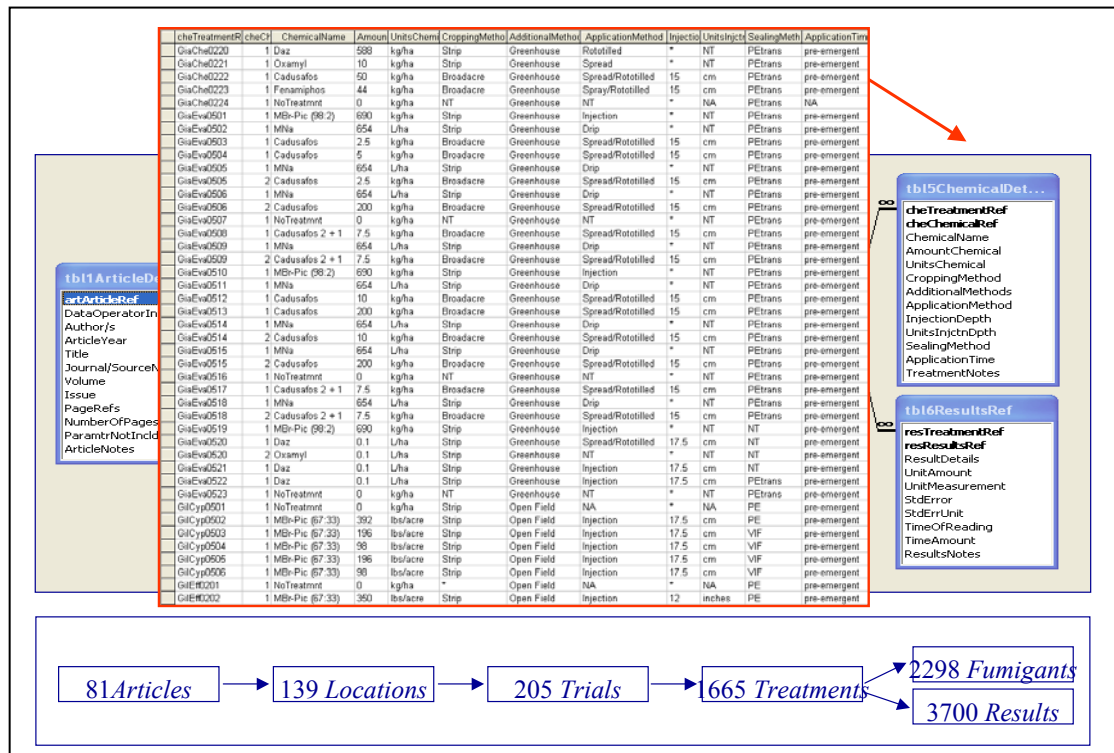
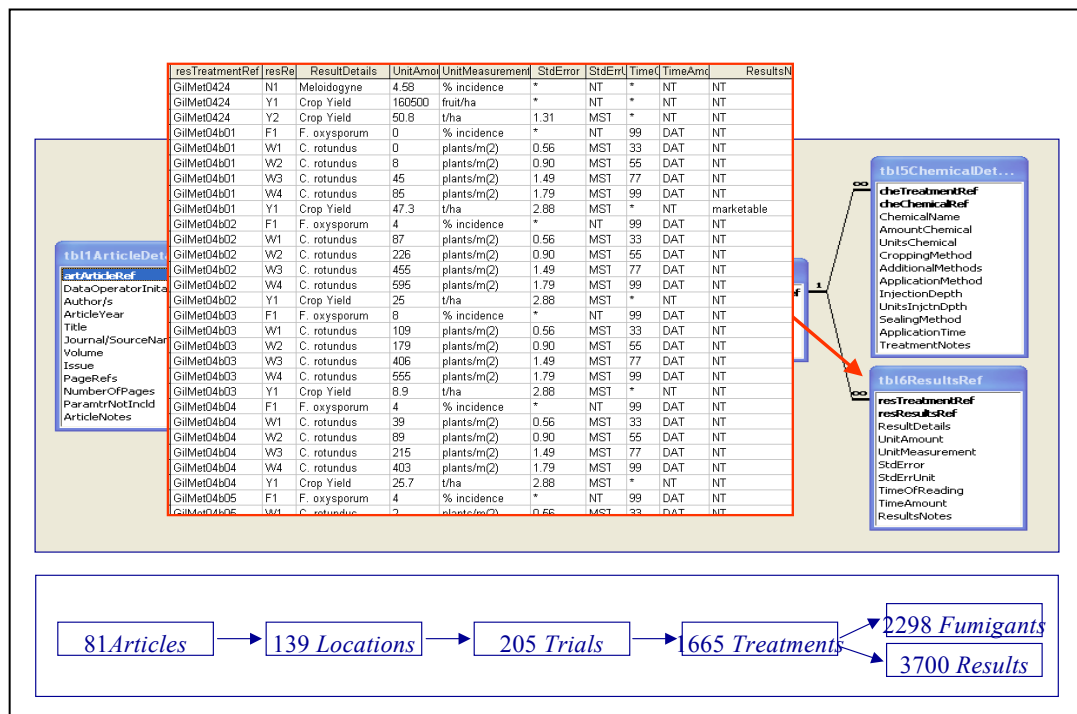


Fig 4. Example of the structure of the trial outputs (eg. Yield, nutsedge population densities, standard errors) into the main study database



Of the studies entered into the database, 101 trials were conducted on strawberry fruit crops and 61 trials were conducted on tomato crops (Section 10.1 and 10.2). *Table 1* shows that there was a good spread of studies for strawberries but that two thirds of the trials included for the tomato industry analysis were conducted on sites in Florida. Although this has some potential to create a location or author selection bias, the data has significant relevance to the CUN's submitted from this region.

Table 1. Trial description of studies included in the meta-analysis

| | | Strawberry Fruit (42 studies) | Tomatoes (30 studies) |
|-------------------------|--|----------------------------------|--------------------------|
| Total Number of Trials: | | 101 | 61 |
| Location: | <i>USA - California</i> | 28 | 1 |
| | <i>USA - Florida</i> | 15 | 40 |
| | <i>Spain</i> | 25 | 0 |
| | <i>New Zealand</i> | 15 | 0 |
| | <i>Italy</i> | 0 | 9 |
| | <i>Australia</i> | 9 | 0 |
| | <i>Other</i> | 9 | 11 |
| Experiment Year: | <i>pre 1999</i> | 22 | 19 |
| | <i>1999-2002</i> | 69 | 37 |
| | <i>post 2002</i> | 10 | 5 |
| Nematodes: | <i>Present in soil</i> | 13 | 35 |
| | <i>Not Reported</i> | 29 | 26 |
| Fungi | <i>Present in soil</i> | 18 | 33 |
| | <i>Not Reported</i> | 24 | 28 |
| Nutsedge Level: | <i>Low (1-5 plant/m²)</i> | 3 | 5 |
| | <i>Moderate (6-30 plant/m²)</i> | 2 | 4 |
| | <i>High (>30 plant/m²)</i> | 3 | 10 |
| | <i>Not Reported</i> | 93 | 42 |

Of the 220 possible variables collected, only 32 were prioritized as essential for the meta-analysis; the other variables provided reference material for future comparisons. The 32 variables used are shown in Table 2.

Table 2. Important variable codes used in the meta-analysis

| | | |
|---|--|--|
| <ul style="list-style-type: none"> • Study Code • Trial Code • Treatment Code • Crop Site • State • Country • Climate • Season • Year • Cultivar • Soil Type • Pathogenic Fungi Present | <ul style="list-style-type: none"> • Pathogenic nematodes Present • Nutsedge Group (3 levels) • Treatment Code • Treatment/Plastic seal Code • Treatment Group 1 (All) • Treatment Group 2 (Grouped) • Crop Yield • Relative Yield • Adjusted Relative Yield • Untreated Control Yield | <ul style="list-style-type: none"> • First Chemical Name • Rate of Application • Application Method • Strip/Broadarce • Sealing Method • Field Type • Second Chemical • Pebulate • Variance Group • Weed |
|---|--|--|

2.2.2 Consistency of Categories

To ensure the consistency of data entry, tables that allowed for quick cross referencing were created in the database. These contained names within specific variables. For example, recording fumigants under consistent names was essential for correct analysis and interpretation. For instance, in some studies fumigants were reported as their product name and in other studies by their chemical components, e.g. 1,3-dichloropropene/chloropicrin was reported as: Telone C35 Gas; 1,3-dichloropropene 65% + chloropicrin 35%; and Telopic 35. For the current study TC35 was used to account for all similar products. *Appendix 1* provides a list of all alternative treatment products used including their code names.

Table 3. Table of variables in the meta-analysis and the respective categories

| <i>Variable</i> | <i>No of Levels for analysis</i> | <i>Categories</i> |
|-------------------------------------|----------------------------------|---|
| <i>Treatments</i> | 63 tomato, 83 strawberry | See Appendix 1 for Treatment Codes |
| <i>Application Rate</i> | Numerous | Actual number used ^A |
| <i>Application method</i> | 4 and NS* | Drip, injection, spray, hotgas, (not specified*) |
| <i>Sealing method</i> | 2 | Non-barrier, barrier |
| <i>Soil type</i> | 3 and NS | Sand, clay, loam, (not specified)** |
| <i>Climate</i> | Not Analysed | temperate hot/cool, temperate high elevation, arid, sub tropical |
| <i>Initial density- weeds</i> | 3 and NS | Nutsedge levels: 1-5, 6-30, >30 plants/m ² (not specified) |
| <i>Inoculum density- fungi</i> | 2 | Yes (fungi present), not reported*** |
| <i>Inoculum density - nematodes</i> | 2 | Yes (nematodes present), not reported*** |

- *NS = Not specified. Note: Meta-analyses were conducted with and without the not specified levels.
- ** The major soils groupings represented those most often reported in studies, but also represented consolidation of a number of soil sub groupings from international standards determined for soil texture keys and particle size analysis. Eg silty clay = clay.
- *** Not reported. Note: Not reported

^A In the initial analysis all rates were assumed effective as a result of initial regression analysis which showed that most trials used effective rates for alternatives.

2.2.3 Standardization and Assumptions in the Database

Assumptions were made on the reporting of application rates of a number of factors.

- Application rates (unless otherwise specified) were considered to be the actual dosage rate equivalent (i.e. kg/ha) for broadacre treatment.
- In the initial analysis, a regression of application rates against yields showed that studies generally used application rates that provided consistent responses in yield. For this reason, all application rates were considered to fall in the effective dose range for MB and the alternatives used. The only exception was for when 'raw' mean comparisons were made for metham sodium studies for nutsedge where some dosage rates were below an application threshold of 200kg/ha of active ingredient.

- c) Active ingredient of metham sodium. Application rates specified in studies were reported for a product rate. Fumigants listed in the database containing metham sodium contained products with active ingredients ranging from 43.2% to 52.3%
- d) Nutsedge infestation levels were categorized into low, moderate and high groups based on the number of plants reported in the untreated control plots (i.e. 1 to 5 plants/m²; 6 to 30 plants/m²; and greater than 30 plants/m², respectively). This categorisation also matched the breakdown used in the US nominations.
- e) When multiple yield data was reported, preference was given to data from:
 - final harvest (as opposed to progressive harvest data)
 - marketable/commercial weight - then total weight
 - weight per area (including number of trays or crates per plot)
 - then weight per plant
 - then weight per fruit

2.2.4 Consistency of Units

Treatments in the database were coded to account for all the chemical combinations used. Some treatments were grouped together according to their expected behaviour e.g. MB67 and MB70 were grouped under MB67. This step was necessary in order to identify which treatments could be considered to be “in common” between studies. If a treatment included specific formulations which may alter the efficacy of a chemical i.e. EC formulation, then the treatment was left as an independent treatment and the treatment code allocated to reflect this e.g. TC35EC or PicEC.

2.2.5 Calculations for extracting datasets

Microsoft Access also permits mathematical calculations and conversions prior to data analysis. The descriptive details of the two major industries reviewed for the analysis (strawberry fruit and tomato crops) are given in Table 1 and the categories for analysis shown in Table 2. For example, nutsedge infestation levels were categorized into low, moderate and high groups based on the number of plants reported in the untreated control plots (i.e. 1 to 5 plants/m²; 6 to 30 plants/m²; and greater than 30 plants/m², respectively). The dataset has therefore been used to assess the performance of different alternatives under different nutsedge infestation levels. This will assist making technically-based recommendations and decisions on nutsedge thresholds where the use of methyl bromide is critical.

2.2.6 Benefits of the final database

Benefits of the Access database are that it provides:

- easy access to results from studies conducted on key crops to CUNs.
- results presented in a standardized format and are therefore able to be compared.
- searches that can be conducted for studies of similar characteristics of the CUNs, such as pests pressures, locations.
- searches can be conducted for studies using individual alternatives that are of interest to CUNs.
- data subsets can be extracted for further analysis (eg: subsets based on location, level of nutsedge, type of pathogen).

Further advantages of the database are:

- result details have automatically been converted into a standardized format. This feature allows data to be recorded in its original format so that there is less chance of data entry errors due to manual conversions.
- complete information about the treatment has been recorded. For example preplant incorporated metolachlor at 840 g/ha, followed by injection of 1,3-D + Pic at 330 L/acre and post-emergence application of trifloxysulfuron at 5.3 g/ha.

3 THE META-ANALYSIS

3.1 Definition

A meta-analysis is a quantitative review and synthesis of the results from related but independent studies (Glass, 1976). The purpose of a meta-analysis is to use statistical analysis to integrate the findings of a large collection of previously analysed results. Classical meta-analysis combines estimates from studies, usually as a weighted mean of the individual estimates, using weights proportional to individual within-study precisions ($1/SE^2$).

The meta-analysis process involves three important stages:

1. Undertake a detailed literature review with set protocols for study identification.
2. Evaluating the quality of the literature retrieved based on inclusion criteria.
3. Develop quantitative methods to combine the studies.

A secondary aim of the meta-analysis may be to measure whether the estimates differ by more than their individual within-study precisions and, if so, to understand why this treatment by study interaction (differential treatment responses in different studies) may be so.

Treatment by study interaction typically occurs where environmental differences between studies are important. In the current study the treatment by study interaction is likely to constitute the dominant source of variance, the variation in treatment response between studies being much larger than within-study error variance, and a random effects meta-analysis is essential. This meant that the residual errors from the trials were ignored. They were also difficult to obtain from publication as they are rarely published.

For the meta-analysis to provide successful outcomes it was important to establish the underlying variance across studies. This was accomplished by grouping like treatments and comparing the similarity of the variance. This was particularly important because trials were conducted in different biological systems where variation occurs in a large number of factors, eg. plant back times, chemical combinations, physical layouts, etc. In the final model treatment combinations were evaluated as independent variables and only a few treatments were able to be grouped. Grouping only occurred when relative yield was considered to be almost identical, eg MB/Pic 70:30 was equivalent to MB/Pic 67:33.

3.2 Processes to establish best estimate of the mean effect of alternatives

In order to get the best estimate of the estimated mean effect of an alternative from the studies the data were analysed by three processes:

1. Raw Mean Analysis. “Averaged means from studies” were expressed as a % yield relative to a within-study methyl bromide treatment (relative yields). The priority order for the standard treatment was (MB/Pic 67:33, then MB/Pic 50:50, then MB/Pic 98:2). The average means for each observation were pooled and then divided by the number of studies to determine the raw mean for the treatment. There was no further analysis.
2. Partial Meta-analysis. Partially modelled means were used in the analysis. The means were obtained by modelling the relative yields to the within-study methyl bromide treatment, allowing for both treatment and study effects.
3. Full Meta-analysis. Fully modelled means were used in the analysis. The means were obtained by modelling the raw (unscaled) data, allowing for treatment effects and effects of study (including scale), and expressing the results relative to a standard methyl bromide treatment.

Ultimately the full meta-analysis (Analysis 3) presents the best estimate of the performance of an alternative across a range of studies providing a sufficient number of studies have been entered into the database. In cases where study numbers are low the partial meta-analysis provides a better estimate. Raw mean analyses provide a quick way of comparing means and observing trends in the average performance of alternatives and can provide a reasonable estimate of the performance of an alternatives when a large number of studies have been used. Statistical correlations with other factors are not possible with this method.

This final full meta-analysis developed was able to:

- a) compare the average performance of methyl bromide alternatives, relative to methyl bromide, across all environments.
- b) test for equivalence between alternatives and methyl bromide, across a number of key parameters. This was restricted to the major parameters due to the limited resources available, although these parameters represented the key factors presented in CUNs.
- c) test for statistical significance of differences between methyl bromide alternatives relative to that of methyl bromide.
- d) identify the dependence of treatment performance upon factors such as inoculum and weed infestation pressure, soil type and climate.
- e) identify effects of method of application on the performance of methyl bromide and alternatives.

3.3 Treatment categories for the meta-analysis

Individual treatments were grouped into ‘Treatment’ categories according to the chemical types, formulation applied and the method of application. All rates were considered to be effective dosage rates in this study as regression showed no significance influence of dosage rates. This is somewhat expected as most studies included used effective dosage rates for

alternatives and not ineffective dosage rates. It was also assumed that researchers applied treatments using best practice and that the study effect would account for any variation. All treatments considered to potentially have a different effect were left as stand alone treatments. Consequently final treatments consisted of single or combined treatments of up to 5 factors. Each treatment was given a code (Appendix 1). Where possible treatments were consolidated e.g. all solarisation treatments with clear plastic film were considered equivalent.

3.4 *Standardisation of parameters to achieve best estimates of means*

The units of measurement of each outcome in a study (e.g. crop yield) often differed between studies and the model needed to be able to handle variable input data. It was not feasible to convert these to a common standard unit because the data was not available in the published papers (Section 7). Consequently, comparisons between treatments were based purely on the (multiplicative) relativities between treatment responses within studies. To facilitate this, the meta-analyses were performed on a logarithmic scale and an additive term for the main effect of study was necessarily included in each statistical model to account for units. Once this log-scale analysis was complete, the resulting treatment mean estimates were re-expressed, back transformed, as relative to a standard MB treatment, MB/Pic 67:33, for presentation. In the latter stages of analysis, the problem of scale was dealt with by expressing all data relative to the within study MB treatment prior to analyses.

The table below summarises the variation in units used in articles for strawberry yields. As the model used relative values it was able to cater for all of the different units reported in studies provided that the yields for methyl bromide and the alternatives from within the same study had the same numerical units for yield.

Table 4. Variation in units used for expressing yields in strawberry trials

| Unit | Frequency |
|----------------------------|------------------|
| flats/ha | 7 |
| no. 5.4kg flats/ha | 9 |
| 12 lb flats/ha | 13 |
| 25lb crate/acre | 136 |
| g/m ² | 36 |
| gm/20 plants | 3 |
| gm/fruit | 13 |
| gm/plant | 176 |
| kg/ha | 22 |
| kg/row m | 9 |
| plants/ha | 5 |
| t/ha | 15 |
| lbs/acre | 37 |
| Yield Relative to MB67 (%) | 91 |
| Yield Relative to MB70 (%) | 47 |

3.5 The Meta-analysis procedure, models and assumptions

The analysis was performed on the log-data using mixed (fixed and random effect) models in GenStat 8. The fixed effects were structured as follows:

Study + Treatment + Factor1 + Treatment.Factor1

or

Study + Treatment + Treatment.Factor2

Where additive terms indicate main effects and the “.” indicates an interaction. ‘Factor1’ represented factors of interest such as sealing method, rate of application, method of application and pebulate i.e. (exclusion of pebulate studies) that were applied within studies. ‘Factor2’ represented environmental management factors such as level of nutsedge, level of nematode, level of fungi, climate, season, country, etc, that varied between and were confounded with studies.

Only one Factor1 or one Factor2 was included at a time. This was because inclusion of several factors was complicated by partial confounding between them. These complexities require further analysis.

The study by treatment interaction was characterized as a random effect and provided the error variance against which fixed effects were assessed. Random effects of the study by treatment interaction and the within study error variance were thus pooled into a single term. This was primarily because information on within-study precision was rarely available. Thus, there was no differential weighting of data according to the study from which they came. However, there was differential weighting of data according to treatment. Some treatments (notably the untreated control) were likely to be more subject to environmental challenge than other treatments (e.g. methyl bromide) and thus more variable in their outcome. This was confirmed by plotting residuals verses Treatment label or number. Separate variances were henceforth included in the mixed model for each level of Treatment provided there were at least 7 occurrences of the treatment in the data.

4 PRESENTATION AND INTERPRETATION OF RESULTS

The mixed-model analysis provided a Wald asymptotic chi-square test for each term in the model, in particular for differences between treatments and for interactions between treatments, inoculum densities, application or production methods, soil type or other management factors. Appendix V shows the Strawberry and Tomato chi-square outcomes for the major parameters in the meta-analysis.

The mixed model outputs also include predicted means (adjusted for study on the log-scale) and their variance-covariance matrix (Appendix VII and VIII). These were used to construct error bars in the form of 5% least significant intervals (LSIs). These intervals provide an indication of the precision with which the adjusted treatment means were estimated. The size

of these intervals depends on both the inherent variance of the treatment and the design (including both the number of times the treatment occurred within the data set and pattern of occurrence with other treatments within studies). LSI's are constructed specifically to approximate the pair wise least significant differences and are useful for graphical presentation. If a pair of intervals overlaps then the corresponding estimated means were judged not significantly different at the 5% level. Like standard errors from which they are derived, LSIs do not indicate the spread of data for each treatment, but the precision of estimation of the predicted mean. In general, as observations for a treatment increase the accuracy of the estimated mean increases and the LSI's become smaller. The estimated means and LSI's were back-transformed and scaled as a percentage relative to a selected standard treatment (MB/Pic 67:33) for presentation. Their interpretation is preserved in this process.

The analysis proceeded under the assumption of no selection bias for treatments into the database. A normal distribution of the residuals was also assumed and checked using histograms and graphs of residuals by fitted values. Unequal variances were modelled, not assumed.

4.1 Statistical Design Structure of available data

The structure of the data was comparable to an unbalanced incomplete block design in which studies were analogous to blocks. It turned out that the *design* (allocation of treatments to "blocks") was *connected*. This means that there were sufficient treatments common between studies to enable all treatments to be compared with one another.

5 RESULTS AND DISCUSSION

Results (Figs 6 and 7) show the fully modelled mean estimates (i.e. meta-analysis) for yields for both strawberry fruit and tomato crops. Codes used for treatments used in discussion of results are shown in Appendix 1.

Modelled estimates are presented for the main effect of alternative treatments (single treatments or combinations) compared to the standard commercial treatment, i.e. MB/Pic 67:33, for strawberries and tomatoes. Fully modelled mean estimates are also provided in Appendices III and V, for seven combined factors as shown below in Table 5. In general, the results show that the greater the number of observations the smaller the LSI and the more accurate the mean estimate for the treatment.

Results are shown for both registered and unregistered products. As the registration processes within each country differ, it is important to take this into account when considering their suitability as an alternative to MB. Similarly deregistration of a product can alter the status of alternatives. A key example was the deregistration of pebulate in the US. Data obtained with pebulate in combination with other treatments was still considered useful as the results showed similar rankings to treatments without pebulate.

Results of the meta-analysis and modelled outcomes (Wald Tables) are shown in Appendices VII and VIII. The strawberry table shows that, of the parameters analysed, there was a significant effect of ‘treatment’ and ‘treatment x application’ method. The tomato table shows that, of the parameters analysed, there was a significant effect of ‘treatment’, ‘treatment x nutsche’ (i.e. nutsche inoculum densities) and ‘treatment x soil type’.

Table 5. Single factors and combined factors analysed during the meta-analyses

(Note: The meta-analyses were conducted with and without the categories in brackets (eg. not specified, hotgas, fungi number for strawberries)

| Term | General Levels |
|---------------------------------|---|
| A. Single factor | |
| Treatment Groupings | See Appendix 1 |
| B. Combined factors | |
| Treatment x Nutsche | 1-5, 6-30, >30, (Not Specified) |
| Treatment x Fungi | (No) Yes, Not specified |
| Treatment x Nematodes | No, Yes, (Not specified) |
| Treatment x Plastic seal | Non Barrier, Barrier |
| Treatment x Application method | Drip, (Hotgas), Injection, Spray, Spread (Not specified) |
| Treatment x Production Practice | Greenhouse(tunnel), Open Field (Not specified) |
| Treatment x Soil Type | Clay, Loam, Sand, (Not specified) |

5.1 Meta-analysis for effect of treatment on yields of strawberry fruit

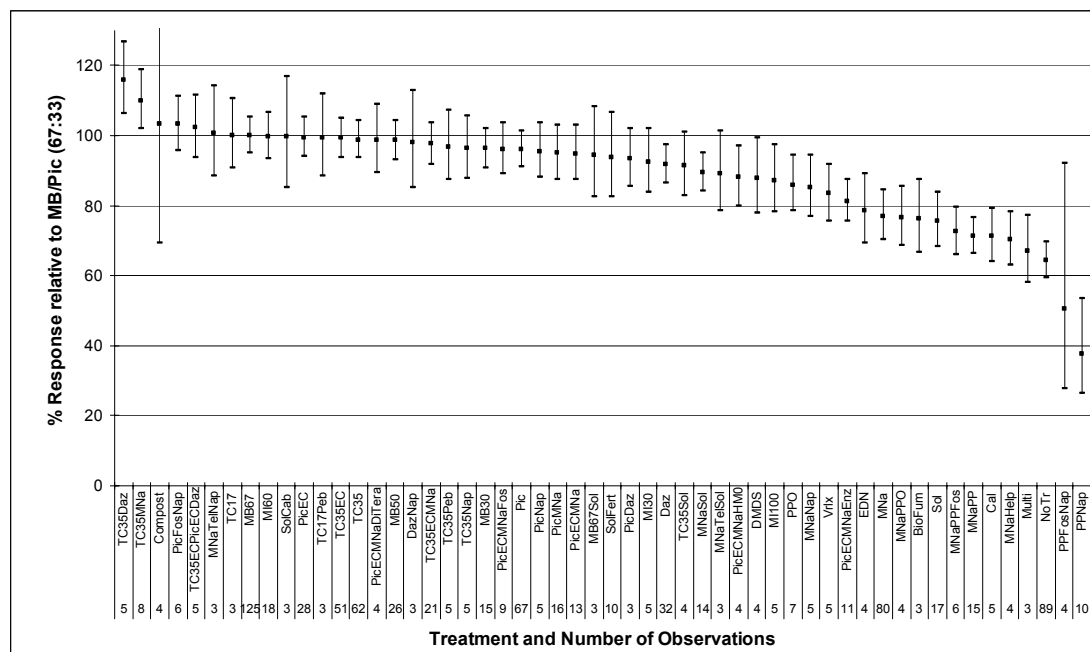
Effect of Alternative Treatments, (Fig 6, Table 6): The Wald test (meta-analysis) (Appendix VII, Wald = 382.4, $p < 0.001$) showed a significant difference between chemical treatments, as would be anticipated.

A large number (approximately thirty) treatment combinations of alternatives had mean estimated yields which were not significantly different from the estimated yield for the standard MB/Pic 67:33 by more than 5%. Of these, a number of alternatives and MB/Pic formulations (50:50, 30:70) had mean estimates with LSI's that were similar to standard MB/Pic 67:33. Treatments which had relatively small LSI's and means not significantly different to the MB/Pic standard included MI60 (methyl iodide/chloropicrin), PicEC (chloropicrin), TC35EC (1,3-D/chloropicrin), MB50, TC35 and TC35ECMNa (TC35 combined with metham sodium). TC35 combined with either dazomet or metham sodium gave a trend towards a higher estimate of mean yield than the mean estimate for MB/Pic 67:33. Four other treatments also had trends where mean estimates were greater than MB/Pic 67:33, but LSI's were more variable (i.e. Compost, PicFosNap, TC35ECPicECDaz, MNaTelNap).

Comparisons of the modelled means in the meta-analysis against the partially modelled means, using comparisons of alternatives to the within study methyl bromide, and against the ‘raw’ means showed similar estimates of the means for treatments when observations were high (i.e. greater than 5) (Table 6). These results showed that the raw means provide a closer

approximation of the likely effect (i.e. the modelled estimate of means) when a large number of trials have been evaluated. The results also show that the partially modelled means using relativity of alternatives to the within study methyl bromide provides a better estimate of the likely effect when trial numbers are very small (<3). For this reason, only the results for alternatives which have greater than 3 observations from independent trials have been shown in Fig 6.

Fig 6. Relative yield data from the full meta-analyses and LSI intervals for alternatives compared to methyl bromide (67:33) from international research studies in strawberry fruit crops from 1997 to 2005 (Treatments with three or more observations).



5.2 Meta-analysis for effect of treatment on yields of tomatoes

The Wald test (meta-analysis) (*Appendix VIII* (Wald = 266, $p < 0.001$)) showed a significant difference between chemical treatments, as would be anticipated. Approximately twenty treatment combinations of alternatives had mean estimated yields which were either greater or not significantly different from the estimated yield for the standard MB/Pic 67:33 by more than 5% (Fig 7, Table 7). Of these many contained the deregistered product pebulate, but nine did not. Of the treatments with greater than 3 observations, MI60 (ie. methyl iodide/chloropicrin) and PicMNa (chloropicrin combined with metham sodium) had mean estimates with LSI's that were similar to MB/Pic 67:33. Pic/Tel (chloropicrin combined with 1,3-D) and MNa combined with Cad (cadusafos) were the next closest mean estimates with reasonably small LSI's and mean estimates within 5%. Although only a small number of trials has been conducted, 1,3-D/Pic in combination with a range of herbicides gave mean estimates within 5% of MB/Pic 67:33. The smaller number of studies available for the dataset has led to greater LSI's and less certainty about the performance of some alternatives than that obtained with the strawberry data.

Comparisons of the modelled means in the meta-analysis against the partially modelled means using comparisons of alternatives to the within study methyl bromide and against the ‘raw’ means showed similar estimates of the means for treatments when observations were high (i.e. greater than 5) (Table 7). As with strawberries, these results showed that the raw means provide a better estimate of the modelled estimate of means when a large number of trials have been evaluated. The results also show that the partially modelled means using relativity of alternatives to the within study methyl bromide provides a better estimate of the likely effect when trial numbers are very small (<3). For this reason only the results for alternatives which have greater than 3 observations have been shown in Fig 7.

Fig 7. Relative yield data from the full meta-analyses and LSI intervals for alternatives to methyl bromide from international research studies in tomato crops from 1997 to 2005 (Treatments with three or more observations).

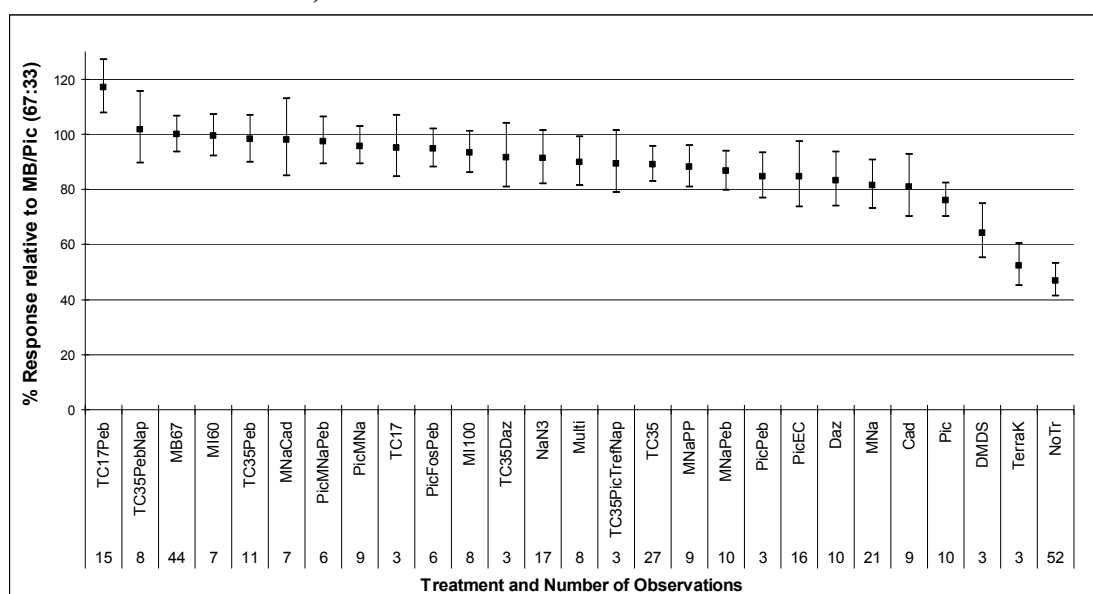


Table 6. Relationship between number of observations and treatments, and the estimated relative means for strawberry yields compared to the standard MB treatment (MB/Pic 67:33) from (i) the full meta-analysis (M); (ii) a restricted meta-analysis, (RM) and (iii) the raw means averaged for individual treatments across studies

| Obs | Treatment | Meta-analysis (M) | (M) LSI's | Restricted Meta-analysis (RM) | (RM) LSI's | Raw Means |
|-----|----------------|-------------------|-----------|-------------------------------|------------|-----------|
| 5 | TC35Daz | 115.9 | ± 10.7 | 120.1 | ± 9.0 | 112.1 |
| 8 | TC35MNa | 110 | ± 8.7 | 112.9 | ± 7.4 | 107.3 |
| 1 | PicECDaz | 109.7 | ± 30.7 | 111 | ± 14.6 | 107.9 |
| 1 | PicMNaDiTera | 108.2 | ± 59.6 | 113.2 | ± 25.8 | 104.2 |
| 2 | PicDazEnz | 107.7 | ± 20.1 | 110.7 | ± 10.5 | 107.9 |
| 2 | PicECDazEnz | 106.3 | ± 19.9 | 107.6 | ± 10.4 | 104.5 |
| 1 | MB30Cal | 104.7 | ± 29.4 | 104.8 | ± 14.8 | 111.5 |
| 2 | TC35ECDaz | 103.7 | ± 14.4 | 107.7 | ± 14.6 | 109.4 |
| 6 | PicFosNap | 103.3 | ± 8.1 | 104.4 | ± 6.5 | 102.5 |
| 4 | Compost | 103.3 | ± 50.7 | 87 | ± 17.8 | 82 |
| 1 | MB50Cal | 103 | ± 28.9 | 103.1 | ± 14.8 | 109.8 |
| 5 | TC35ECPicECDaz | 102.1 | ± 9.3 | 103.8 | ± 9.0 | 108 |
| 3 | MNaTelNap | 100.5 | ± 13.7 | 100.2 | ± 8.4 | 101.3 |
| 1 | MycCom | 100.2 | ± 31.0 | 100.2 | ± 18.8 | 100.2 |
| 3 | TC17 | 100.1 | ± 10.3 | 99.93 | ± 9.4 | 99.3 |
| 125 | MB67 | 100 | ± 5.3 | 100 | ± 3.8 | 99.9 |
| 18 | MI60 | 99.7 | ± 6.8 | 103 | ± 6.1 | 100.6 |
| 3 | SolCab | 99.7 | ± 17.0 | 77.18 | ± 9.8 | 72.1 |
| 28 | PicEC | 99.4 | ± 5.8 | 100.1 | ± 4.4 | 101.6 |
| 3 | TC17Peb | 99.3 | ± 12.4 | 103 | ± 12.7 | 99.9 |
| 51 | TC35EC | 99.2 | ± 5.8 | 99.78 | ± 4.4 | 100.2 |
| 4 | PicECMNaDiTera | 98.8 | ± 10.2 | 100.7 | ± 7.2 | 102.8 |
| 62 | TC35 | 98.8 | ± 5.5 | 98.9 | ± 4.1 | 99.9 |
| 26 | MB50 | 98.6 | ± 5.7 | 97.92 | ± 4.4 | 101.8 |
| 1 | TC35Nap | 98.3 | ± 19.8 | 101.3 | ± 21.5 | 91.4 |
| 3 | DazNap | 98 | ± 15.0 | 98.13 | ± 9.1 | 98.8 |
| 1 | DazSol | 97.9 | ± 28.2 | 99.12 | ± 15.5 | 100.9 |
| 21 | TC35ECMNa | 97.5 | ± 6.2 | 98.65 | ± 5.3 | 100.6 |
| 2 | PicDMDS | 97.3 | ± 10.7 | 97.16 | ± 9.9 | 100 |
| 1 | TC35MNaOrgFung | 96.9 | ± 20.4 | 95.59 | ± 22.4 | 94.3 |
| 5 | TC35Peb | 96.8 | ± 10.4 | 99.59 | ± 10.5 | 97.9 |
| 5 | TC35Nap | 96.3 | ± 9.3 | 101.3 | ± 21.5 | 91.4 |
| 15 | MB30 | 96.3 | ± 5.8 | 95.33 | ± 4.6 | 96.4 |
| 1 | TC35Pic | 96.2 | ± 17.8 | 97.31 | ± 17.7 | 88.6 |
| 9 | PicECMNaFos | 96.1 | ± 7.6 | 97.61 | ± 5.6 | 99.1 |
| 67 | Pic | 96.1 | ± 5.2 | 96.3 | ± 4.0 | 98.1 |
| 1 | PicCal | 95.7 | ± 14.6 | 95.28 | ± 14.1 | 102 |
| 5 | PicNap | 95.4 | ± 8.1 | 97.1 | ± 7.2 | 95.3 |
| 2 | TC17Nap | 95.2 | ± 13.6 | 97.46 | ± 14.9 | 91.3 |
| 16 | PicMNa | 95 | ± 8.1 | 96.84 | ± 6.4 | 97.8 |
| 13 | PicECMNa | 94.8 | ± 8.0 | 96.28 | ± 6.0 | 96.5 |
| 3 | MB67Sol | 94.4 | ± 13.8 | 93.58 | ± 8.4 | 99.9 |
| 1 | PicTel | 94 | ± 17.9 | 93.59 | ± 17.8 | 94.5 |
| 10 | SolFert | 93.8 | ± 12.8 | 94.15 | ± 8.5 | 93.7 |
| 3 | PicDaz | 93.5 | ± 8.6 | 92.88 | ± 8.1 | 99.4 |
| 5 | MI30 | 92.4 | ± 9.6 | 93.21 | ± 10.8 | 92.8 |
| 32 | Daz | 91.7 | ± 5.6 | 91.19 | ± 4.7 | 94 |
| 4 | TC35Sol | 91.4 | ± 9.4 | 90.74 | ± 10.3 | 91.8 |
| 14 | MNaSol | 89.5 | ± 5.5 | 89.54 | ± 4.4 | 91.3 |
| 1 | MB50Sol | 89.5 | ± 25.1 | 88.36 | ± 14.8 | 93.6 |
| 3 | MNaTelSol | 89.1 | ± 12.2 | 88.61 | ± 8.4 | 89.8 |
| 4 | PicECMNaHM0 | 88 | ± 9.1 | 89.09 | ± 7.2 | 89.8 |
| 4 | DMDS | 87.9 | ± 11.5 | 87.08 | ± 7.9 | 90.1 |
| 5 | MI100 | 87.2 | ± 10.1 | 89.45 | ± 6.9 | 88.6 |
| 2 | DazLime | 86.8 | ± 15.9 | 85.84 | ± 10.2 | 92.3 |
| 2 | MNaTelPeb | 86.4 | ± 15.1 | 90.65 | ± 11.0 | 84.8 |
| 1 | MNaPeb | 86.3 | ± 22.3 | 88.3 | ± 15.4 | 90.7 |
| 7 | PPO | 85.9 | ± 8.3 | 87.08 | ± 6.2 | 87.1 |
| 5 | MNaNap | 85.2 | ± 9.3 | 86.94 | ± 7.0 | 85.1 |
| 1 | SolBio | 85.2 | ± 23.7 | 83.24 | ± 14.6 | 89.5 |

Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation

| Obs | Treatment | Meta-analysis (M) | (M) LSI's | Restricted Meta-analysis (RM) | (RM) LSI's | Raw Means |
|-----|-------------|-------------------|-----------|-------------------------------|------------|-----------|
| 2 | PicMNaSol | 83.8 | ± 29.1 | 86.92 | ± 17.8 | 80.7 |
| 5 | Vrlx | 83.4 | ± 8.5 | 90.76 | ± 9.2 | 100 |
| 1 | PicTelNap | 82.9 | ± 17.5 | 82 | ± 22.5 | 80.7 |
| 1 | TC17PicNap | 82.2 | ± 17.3 | 81.3 | ± 22.5 | 80 |
| 11 | PicECMNaEnz | 81.2 | ± 6.2 | 87.63 | ± 5.5 | 82.8 |
| 1 | MNaCal | 80.1 | ± 19.3 | 78.7 | ± 13.2 | 85.4 |
| 2 | Tel | 80 | ± 14.9 | 85.72 | ± 8.6 | 92.5 |
| 1 | MNaRootshld | 78.7 | ± 19.1 | 77.64 | ± 13.2 | 92.1 |
| 4 | EDN | 78.5 | ± 10.6 | 79.76 | ± 8.3 | 76.7 |
| 2 | MNaLime | 78.4 | ± 12.6 | 77.65 | ± 9.2 | 84.1 |
| 80 | MNa | 77 | ± 7.5 | 82.86 | ± 4.3 | 81.4 |
| 4 | MNaPPO | 76.7 | ± 8.9 | 82.43 | ± 7.1 | 76.3 |
| 3 | BioFum | 76.3 | ± 11.2 | 75.86 | ± 8.4 | 82.5 |
| 2 | PicMNaEnz | 76.1 | ± 26.1 | 80.06 | ± 17.4 | 78.6 |
| 2 | MNaTel | 75.9 | ± 14.6 | 79.53 | ± 11.4 | 74.3 |
| 1 | DazCal | 75.8 | ± 21.3 | 74.11 | ± 14.8 | 80.8 |
| 17 | Sol | 75.6 | ± 8.1 | 75.3 | ± 6.3 | 76.1 |
| 1 | MNaMes | 75.2 | ± 18.1 | 77.16 | ± 13.0 | 74 |
| 2 | Lime | 74.2 | ± 13.6 | 73.35 | ± 10.2 | 79.8 |
| 2 | PicMNaNap | 73.6 | ± 25.5 | 79.53 | ± 17.8 | 73.3 |
| 6 | MNaPPFos | 72.5 | ± 7.1 | 71.96 | ± 6.2 | 79.2 |
| 15 | MNaPP | 71.3 | ± 5.3 | 72.42 | ± 4.9 | 74.5 |
| 5 | Cal | 71.2 | ± 8.1 | 70.58 | ± 6.8 | 75.6 |
| 4 | MNaHelp | 70.3 | ± 8.0 | 72.57 | ± 6.9 | 73.9 |
| 3 | Multi | 66.9 | ± 10.3 | 70.84 | ± 8.9 | 61.9 |
| 89 | NoTr | 64.3 | ± 5.4 | 69.01 | ± 4.2 | 68.9 |
| 2 | EMF | 61.3 | ± 11.2 | 61.36 | ± 10.2 | 67.5 |
| 4 | PPFosNap | 50.4 | ± 41.5 | 62.02 | ± 23.8 | 59.1 |
| 2 | Chick | 38.3 | ± 30.9 | 43.19 | ± 26.2 | 39.3 |
| 10 | PPNap | 37.6 | ± 16.0 | 50.04 | ± 14.2 | 48 |

Table 7. Relationship between number of observations and treatments, and the relative estimated means for tomato yields compared to the standard MB treatment (MB/Pic 67:33) from (i) the full meta-analysis (M); (ii) a restricted meta-analysis, (RM) and (iii) the raw means averaged for individual treatments across studies

| Obs | Treatment* | Meta-analysis (M) | (M) LSI's | Restricted Meta-analysis (RM) | (RM) LSI's | Raw Means |
|-----|----------------|-------------------|-----------|-------------------------------|------------|-----------|
| 15 | TC17Peb | 116.8 | ± 9.0 | 111 | ± 6.6 | 104 |
| 1 | TC35PicPebNap | 116.3 | ± 28.8 | 118.4 | ± 25.2 | 117.2 |
| 2 | TC35PicPebTrif | 109.4 | ± 18.7 | 108.7 | ± 17.0 | 109.6 |
| 1 | PicTelPebNap | 107.8 | ± 26.7 | 109.8 | ± 25.2 | 108.6 |
| 1 | TC35TrefNap | 106.1 | ± 20.0 | 104.4 | ± 18.4 | 104.6 |
| 2 | Sol | 102.3 | ± 22.5 | 103.2 | ± 16.4 | 100 |
| 2 | MNaPebFos | 101.8 | ± 14.3 | 98.5 | ± 12.5 | 78.8 |
| 8 | TC35PebNap | 101.7 | ± 11.9 | 104.6 | ± 10.5 | 101.9 |
| 2 | PicTel | 101.4 | ± 11.9 | 101 | ± 10.9 | 91.3 |
| 44 | MB67 | 100.0 | ± 6.1 | 99.2 | ± 5.1 | 99.6 |
| 7 | MI60 | 99.4 | ± 7.1 | 98.6 | ± 6.1 | 91.2 |
| 1 | MB67PebNap | 99.3 | ± 25.8 | 101.2 | ± 22.5 | 100 |
| 11 | TC35Peb | 98.0 | ± 7.9 | 97.6 | ± 7.0 | 94.3 |
| 7 | MNaCad | 97.9 | ± 12.8 | 97.1 | ± 9.8 | 88.7 |
| 6 | PicMNaPeb | 97.4 | ± 7.9 | 96.2 | ± 7.0 | 90.2 |
| 1 | Tviride | 95.9 | ± 22.1 | 92.6 | ± 17.8 | 98.8 |
| 2 | TC35NapHal | 95.8 | ± 13.4 | 94.2 | ± 13.1 | 98 |
| 9 | PicMNa | 95.7 | ± 6.3 | 94.6 | ± 5.5 | 94.3 |
| 3 | TC17 | 95.1 | ± 10.1 | 96.1 | ± 10.1 | 105 |
| 6 | PicFosPeb | 94.9 | ± 6.5 | 93.1 | ± 5.8 | 94.7 |
| 8 | MI100 | 93.2 | ± 7.0 | 92.9 | ± 6.8 | 98.8 |
| 2 | TC35MetTrif | 92.9 | ± 13.0 | 91.3 | ± 13.1 | 95.1 |
| 3 | TC35Daz | 91.6 | ± 10.6 | 89.7 | ± 10.5 | 94.7 |
| 2 | MNaFos | 91.2 | ± 12.5 | 89 | ± 12.4 | 102.8 |
| 1 | DazTviride | 91.2 | ± 24.6 | 87.5 | ± 20.1 | 95.7 |
| 17 | NaN3 | 91.2 | ± 8.9 | 97.9 | ± 13.5 | 106.6 |
| 2 | PicEnzPeb | 89.9 | ± 7.4 | 88.5 | ± 7.2 | 89.2 |
| 1 | TC35MesTref | 89.7 | ± 17.0 | 87.6 | ± 18.5 | 88.7 |
| 8 | Multi | 89.7 | ± 8.1 | 88.4 | ± 7.3 | 96.3 |
| 3 | TC35PicTrefNap | 89.3 | ± 10.4 | 87.7 | ± 10.6 | 88.2 |
| 1 | TC35Tviride | 89.3 | ± 19.3 | 85.8 | ± 20.8 | 92 |
| 27 | TC35 | 89.0 | ± 5.9 | 87.6 | ± 5.5 | 90 |
| 9 | MNaPP | 88.2 | ± 7.0 | 86.5 | ± 6.8 | 91.5 |
| 10 | MNaPeb | 86.6 | ± 6.6 | 87 | ± 6.5 | 84.7 |
| 3 | PicPeb | 84.7 | ± 7.7 | 85.3 | ± 7.6 | 74.2 |
| 16 | PicEC | 84.7 | ± 10.7 | 84.4 | ± 9.2 | 89.9 |
| 1 | PicMNaEnz | 84.1 | ± 12.1 | 80.9 | ± 13.7 | 94.7 |
| 2 | MNaTel | 83.4 | ± 12.3 | 82.6 | ± 10.7 | 83.3 |
| 10 | Daz | 83.3 | ± 9.0 | 85.6 | ± 7.5 | 81.3 |
| 2 | PPO | 82.0 | ± 12.4 | 80.3 | ± 11.1 | 84.1 |
| 21 | MNa | 81.5 | ± 8.1 | 84.8 | ± 6.5 | 85 |
| 9 | Cad | 80.7 | ± 10.2 | 83.1 | ± 9.1 | 76.4 |
| 1 | IndmusTviride | 79.5 | ± 21.4 | 75.2 | ± 20.1 | 83.4 |
| 1 | TC25 | 79.0 | ± 12.4 | 75.5 | ± 15.9 | 83 |
| 1 | MI100MNa | 79.0 | ± 16.7 | 81.3 | ± 16.1 | 66.9 |
| 2 | Tel | 78.9 | ± 12.8 | 79.8 | ± 12.0 | 78.9 |
| 1 | TvirideFert | 78.4 | ± 21.2 | 74.1 | ± 20.1 | 82.3 |
| 2 | Fos | 76.4 | ± 11.7 | 74.6 | ± 12.7 | 82.3 |
| 10 | Pic | 76.0 | ± 5.8 | 79.1 | ± 7.8 | 86.6 |
| 1 | Fen | 73.4 | ± 17.4 | 70.8 | ± 19.2 | 83.5 |

Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation

| | | | | | | |
|----------|-------------------|-------------|---------------|-----------|---------------|-------------|
| 1 | Oxa | 69.9 | ± 16.6 | 66.8 | ± 19.2 | 79.5 |
| 1 | SoilSoil | 68.3 | ± 15.9 | 71.8 | ± 18.7 | 61.1 |
| 3 | DMDS | 64.3 | ± 8.8 | 60.3 | ± 10.9 | 71.8 |
| 1 | Quil | 55.3 | ± 11.6 | 53.8 | ± 15.9 | 57.5 |
| 3 | TerraK | 52.2 | ± 7.0 | 51.4 | ± 10.4 | 55.2 |
| 52 | NoTr | 46.8 | ± 5.3 | 55.2 | ± 5.6 | 55.2 |
| <i>1</i> | <i>NoTrPebNap</i> | <i>44.5</i> | <i>± 11.6</i> | <i>46</i> | <i>± 22.5</i> | <i>44.8</i> |

Rows in italics contain treatments which contain a deregistered product, pebulate and are unsuitable for comparing yields for nutsedge control but may be suitable for comparison for pathogen control.

6 FACTOR INTERACTIONS FOR STRAWBERRY FRUIT ANALYSES

The following sections (7.0 and 8.0) discuss the comparisons of the relative efficacy of alternatives on yields of strawberry fruit and tomatoes in the presence of another parameter (eg. fungal presence, nutsedge inoculum density.). The parameters selected were those considered to have most influence on the performance of an alternative and those which Parties may have used to partly support the request for CUN's.

Note: Codes used for treatments are shown in Appendix 1.

6.1 *Meta-analysis for effect of treatment x nutsedge levels on yields of strawberry fruit, Appendix III-1*

Of the 101 trials in strawberry fruit, very few were conducted on nutsedge and fewer (for most treatments less than 3 observations only were recorded) had recorded population densities of nutsedge. This still enables conclusions to be drawn about the performance of alternatives but less certainty exists about the mean estimates due to the large variances in the LSI's. Conduct and review of more studies with nutsedge as a major factor may improve results. In spite of the low number of studies, some treatments had mean estimates and LSI's similar to the mean estimate for MB/Pic 67:33 depending on the inoculum density of nutsedge.

The Wald test (Appendix VII) showed there was no significant interaction of treatment x nutsedge population densities (ie alternatives performed similarly at each level of nutsedge). At 1-5, 6-30 and greater than 30 plants/m², 16, 7 and 3 treatments respectively (excluding treatments with pebulate) had mean estimates that were within 5% of the mean estimate of MB/Pic 67:33. As stated above, higher study numbers for these treatments would decrease the LSI's and increase the certainty of the estimated mean. At high nutsedge levels and when pebulate treatments were excluded, MNa, MNa with 1,3-D, or dazomet combined with napropamide were the most effective alternatives.

6.2 *Meta-analysis for effect of treatment x fungal levels on yields of strawberry fruit, Appendix III-2*

The Wald test (Appendix VII) showed there was no significant interaction of treatment x fungal presence. This meant there was a similar trend in the performance of alternatives whether the fungal inoculum density was stated or not. Results also showed that a much larger number of studies (101 observations of MB/Pic 67:33) were conducted on sites where the level of fungal inoculum densities was unknown than where fungal inoculum densities were known (21 observations of MB/Pic 67:33). When fungal levels were not specified, there were 20 treatments which gave a mean estimate within 5% of the mean estimate for MB/Pic 67:33 and two treatments, ie. TC35 combined with either dazomet or MNa, which exceeded the mean estimate of MB/Pic 67:33 by over 10%. When fungal pathogens were known to be present (i.e. inoculum levels stated), there were insufficient studies of the same treatments stated above to determine their effect, and TC35 and Pic combined with napropamide were the treatments which provided the closest mean estimate to MB/Pic 67:33. A large proportion

of the studies where pathogenic fungi were present comes from trials that were artificially infested (eg. Horner, 1999) and this may have attributed to the lower relative mean estimates for yield for some alternative treatments compared to the yield obtained under natural infestation levels at commercial grower sites.

The results have relevance for the assessment of CUNs, because they demonstrate;

- i) that best estimate of mean yields for alternatives compared to the standard commercial MB/Pic formulation when used in regions under high (sometimes artificially inoculated) and unknown pest pressure.
- ii) The modelled mean estimate for yields (including MB/Pic formulations) were generally higher when pathogen levels were unknown. This would be expected as some unknown sites may not have pathogens.
- iii) that 83% of studies on MB alternatives by researchers on strawberries in this study were conducted without reporting of the inoculum levels of fungal pathogens. Most of these studies were also conducted at sites on growers' properties. This may indicate that high levels of pathogens did not exist at many test sites, even though they were naturally infested field sites.
- iv) Yields in untreated plots in all studies (when fungal pressure was not known) were significantly lower (ie approximately 30%) than the yields obtained with most fumigant treatments. This indirectly indicates that some biological factors (probably pathogenic fungi) were affecting yields at many trial sites.

6.3 *Meta-analysis for effect of treatment x nematode levels on yields of strawberry fruit, Appendix III-3*

The Wald test (Appendix VII) showed there was no significant interaction of treatment x nematode presence. Results also showed that a much larger number of studies (111 observations of MB/Pic 67:33) were conducted on sites where the level of nematode inoculum densities was unknown or not published than where nematode levels were specified (12 observations of MB/Pic 67:33). When nematode levels were not specified, there were 16 treatments which gave a mean estimate within 5% of the mean estimate for MB/Pic 67:33 and one treatment, TC35 combined with MNa, which exceeded the mean estimate of MB/Pic 67:33 by approximately 10%. When pathogenic nematodes were known to be present (i.e. inoculum levels stated), there were several treatments which showed efficacies which were similar to MB. Pic combined with fosthiosate and napropamide, TC35, Pic and MI60 were the treatments which provided the closest mean estimate to MB/Pic 67:33.

The results have relevance for the assessment of CUNs, because they demonstrate;

- i) that best estimate of mean yields for alternatives compared to the standard commercial MB/Pic formulation when used in regions under high (sometimes artificially inoculated) and unknown nematode pressure.
- ii) that 90% of studies on MB alternatives by researchers on strawberries in this review were conducted without reporting the inoculum levels of nematodes. Most of these studies were also conducted at sites on growers' properties. This may indicate that

damaging levels of nematodes did not exist at many test sites, even though they were naturally infested field sites.

- iii) when nematodes were known to be present, the modelled estimate of the mean for MB/Pic 67:33 was higher indicating that nematodes were not the primary pest of strawberries in many studies.
- iv) Yields in untreated plots in all studies (when nematode pressure was not known) were significantly lower (approximately 30%) than the yields obtained with most fumigant treatments. This indirectly indicates that some biological factors, eg. pathogenic fungi, as discussed above, were leading to the yield losses at trial sites.

6.4 *Meta-analysis for effect of treatment x application method on yields of strawberry fruit, Appendix III-4*

The Wald test (Appendix VII) showed there was a significant interaction of treatment x application method, however this was almost solely due to variability in metham sodium effectiveness when applied by different methods. MNa applied by injection or drip was a better treatment than application to the surface and irrigated into the soil. Conclusions about other treatments are difficult because of the low number of studies comparing similar treatments applied by different application methods.

6.5 *Meta-analysis for effect of treatment x plastic film type on yields of strawberry fruit, Appendix III-5*

The Wald test (Appendix VII) showed there was no significant interaction of treatment x film type. This result has relevance for assessment of CUN's because it shows that despite lower rates being used with methyl bromide (refer TEAP Report, October 2005) and alternatives barrier films in studies that similar relative yields were obtained compared to standard the commercial rates for methyl bromide and alternatives used in trials. Sufficient studies had been made to make comparisons of the effect of barrier films for use with the alternatives (PicEC, TC35EC, Pic, TC35 and dazomet) and one MB/Pic formulation (MB/Pic 50:50).

6.6 *Meta-analysis for effect of treatment x production method on yields of strawberry fruit, Appendix III-6*

The Wald test (Appendix VII) showed there was no significant interaction of treatment x production method. This meant that the relative trend for how alternatives performed compared to MB/Pic 67:33 was similar for both greenhouse and open field trials.

6.7 *Meta-analysis for effect of treatment x soil type on yields of strawberry fruit, Appendix III-7*

The Wald test (Appendix VII) showed there was no significant interaction of treatment x soil type. This meant that the relative trend for how alternatives performed compared to MB/Pic 67:33 was similar for the different soil types.

6.8 ***Comparison of raw data means against the modelled mean estimates from the meta-analysis for effect of treatments on yields of strawberry fruit, Appendix III-8***

Results showed that for the treatments presented in the chart that the raw means from international studies on alternatives formed a reasonable estimate of the modelled estimated means in the meta-analysis. Although some variation is seen in the raw means these fell within the LSI's (not shown) of the estimated modelled means. The raw means that were most consistent across regions and provided the closest prediction of the modelled mean estimate across all regions were TC35 injected, chloropicrin combined with metham sodium (PicMNa) and chloropicrin (Pic) injected. These results suggest that of the treatments shown these would provide the best alternatives to methyl bromide.

6.9 ***Partial meta-analysis results for effect of treatment on yields of strawberry fruit, Appendices III-9 and III-10***

An analysis of results showing the comparison of the relative means of alternatives when compared to the methyl bromide treatment from within the same study showed that similar trends are observed to those shown for the modelled means in Fig 6. The key advantage of this comparison is that when observations for treatments were small (<3) the analysis provides a better estimate of the treatment effect relative to the standard methyl bromide treatment. This is because the variation resulting from the differences between studies is not included in this comparison. For instance, treatments which had low numbers but mean estimated yields predicted above MB/Pic 67:33 and not shown in the modelled analysis (See Fig 6) included PicMNaDiTera, PicECDaz, PicDazEnz, TC35Daz, PicECDazEnz, TC35Nap and MycCom.

6.10 ***Correlation between the fully modelled means and the partially modelled means for strawberry fruit observations, Appendix III – 11***

The comparison between the fully modelled means and the partially modelled means showed that there was a good correlation between the effect of alternatives in nearly all studies (ie the effect of alternatives relative to the methyl bromide treatment were similar for most studies). This comparison provided a means of determining outliers which could be cross checked and omitted from the meta-analysis if data was found to be in error (ie. the untreated mean was greater than methyl bromide or the methyl bromide was too low when compared to other treatments).

7. **FACTOR INTERACTIONS FOR TOMATO FRUIT ANALYSES**

7.1 ***Meta-analysis for effect of treatment x nutsedge levels on yields of tomato fruit, Appendix V-1***

Of the 61 trials in tomatoes, 24 trials were made on nutsedge. Many treatments were not studied across all nutsedge density groupings and this limited some of the comparisons. For instance, MB/Pic 98:2, had not been used as a treatment when nutsedge densities were stated

at 1-5 plants/m². Some treatments, however, had mean estimates and LSI's similar to the mean estimate for MB/Pic 67:33 depending on the inoculum density of nutsedge.

The Wald test (Appendix VIII) showed there was a significant interaction of treatment x nutsedge population densities. This meant that at least some alternatives performed differently at each level of nutsedge. At 1-5plants/m², there were insufficient treatments without pebulate to determine which treatments had mean estimates similar to methyl bromide so results could not be shown (see Appendix V-1). At 6-30 plants/m², MNa (metham sodium) and TC35 (1,3-D/chloropicrin) provided mean estimates within 5% of the mean estimate for MB/Pic 67:33. At greater than 30 plants/m², three treatments (excluding treatments with pebulate) had mean estimates that were within 5% or greater than the mean estimate of MB/Pic 67:33. MI60 and dazomet were the treatments which had the closest mean estimates to MB/Pic 67:33 at high nutsedge densities. The relatively low numbers of studies conducted without pebulate and with many of the alternatives make it difficult to be certain about the consistency and relative effectiveness of many of the alternatives shown.

The results have relevance for the assessment of CUN's, because they demonstrate;

- i) that best estimate of mean yields for alternatives compared to the standard commercial MB/Pic formulation when used in regions under moderate to severe nutsedge pressure.

7.2 *Meta-analysis for effect of treatment x fungal levels on yields of tomato fruit, Appendix IV-2*

The Wald test (Appendix VIII) showed there was no significant interaction of treatment x fungal presence. This meant there was a similar trend in the performance of alternatives whether the fungal inoculum density was stated or not. Results showed that there were a similar number of studies where the level of fungal inoculum densities was unspecified to those where fungal inoculum densities were known.

When treatments without pebulate were considered and fungal levels were not specified, four treatments gave a mean estimate within 5% of the mean estimate for MB/Pic 67:33 (MNa combined with cadusafos, Pic combined with MNa, MI60 and MI100). In studies where it was known that fungal pathogens were present, (i.e. inoculum levels stated), PicMNa and TC35 gave the best mean estimate of yield relative to MB.

The results have relevance for the assessment of CUN's, because they demonstrate that:

- i) the relative efficacy, the key alternatives and the likely variability in performance (eg. LSI) of mean yield of an alternative compared to the mean estimate of yield of a standard commercial MB/Pic formulation when fungal pressure are both known and unknown.
- ii) the yields in untreated plots in all studies (when fungal pressure was not known) were significantly lower (ie approximately 50%) than the yields obtained with most fumigant treatments.

- iii) the modelled mean estimate for yields (including MB/Pic formulations) were generally equivalent when fungal pathogen levels were known or unspecified. This together with large yield reductions in the untreated plots indicates that the meta-analysis of all studies provides relevant information on the performance of alternatives whether or not the level of fungal pressure is known.

7.3 *Meta-analysis for effect of treatment x nematode levels on yields of tomato fruit, Appendix IV-3*

The Wald test (Appendix VIII) showed there was no significant interaction of treatment x nematode presence. There were similar studies where nematode levels were known than when nematodes were unspecified, leading to good comparisons of the effects of alternatives. Several alternatives with the unregistered product pebulate gave mean estimates that were greater than 5% of the mean estimates for methyl bromide treatments.

When treatments without pebulate were considered, six treatments gave a mean estimate within 5% of the mean estimate for MB/Pic 98:2 (NaN₃, MI60, PicMNa, Multi, MNaPP, Daz) when nematode levels were not specified. When nematodes were known to be present (i.e. inoculum levels stated), three treatments provided mean estimates within the mean estimate of MB67:33 ie. MNaCad, MI60 and PicMNa.

The results have relevance for the assessment of CUNs, because they demonstrate;

- i) the relative efficacy, the key alternatives and the likely variability in performance (eg. LSI) of mean yield of an alternative compared to the mean estimate of yield of a standard commercial MB/Pic formulation. It also shows this comparison in regions where pathogenic nematodes (presence or absence) are known and unknown to occur.
- ii) Yields when nematodes were known to be present were reduced by approximately 60% in untreated plots, whereas several alternatives gave similar or better yields than the standard MB (67:33) treatment

7.4 *Meta-analysis for effect of treatment x application method on yields of tomato fruit, Appendix IV-4*

The Wald test (Appendix VIII) showed there was no significant interaction of treatment x application method. MB applied by injection gave modelled estimates higher than when applied by hotgas. TC35 and MNa gave better modelled estimates when applied by injection compared to drip application.

7.5 *Meta-analysis for effect of treatment x plastic film type on yields of tomato fruit, Appendix V-5*

The Wald test (Appendix VIII) showed there was no significant interaction of treatment x film type. This result has relevance for assessment of CUN's because it shows that despite lower rates of MB/Pic 67:33 being applied with methyl bromide (refer TEAP Report, October

2005) and the alternative TC35 under barrier films, similar effectiveness was obtained compared to the standard commercial rates.

7.6 *Meta-analysis for effect of treatment x production method on yields of tomato fruit, Appendix V-6*

The Wald test (Appendix VIII) showed there was no significant interaction of treatment x production method. This meant that the relative trend for how alternatives performed compared to MB/Pic 67:33 was similar for both greenhouse and open field trials. Results did show, however that there were fewer alternatives identified for greenhouse production as several of the alternatives used in open fields are not registered or impractical to use in greenhouse structures. As shown above, MI60, PicMNa and Telone C17 gave mean estimates within 5% of the MB/Pic 67:33 standard treatment. Metham sodium combined with cadusafos (MNaCad) was the treatment which gave the best estimate of the mean comparable to MB/Pic 67:33 for greenhouses.

7.7 *Meta-analysis for effect of treatment x soil type on yields of tomato fruit, Appendix V-7*

The Wald test (Appendix VIII) showed there was a significant interaction of treatment x soil type. This result has relevance for assessment of CUN's because it indicates that soil type can influence the relative effectiveness of alternatives in regions where tomatoes are grown. For instance, chloropicrin (Pic) and sodium azide (NaN₃) were more effective when applied to a loam or clay respectively than when applied to a sand.

7.8 *Partial meta-analysis results for effect of treatment on yields of strawberry fruit, Appendices V-8*

An analysis of results showing the comparison of the relative means of alternatives when compared to the methyl bromide treatment from within the same study showed that similar trends are observed to those shown for the modelled means in Fig 7. The key advantage of this comparison is that when observations for treatments were small (<3) the analysis provides a better estimate of the treatment effect relative to the standard methyl bromide treatment. For instance, treatments which had low numbers, but mean estimated yields predicted within 5% of the mean estimate of MB/Pic 67:33 (not shown in the modelled analysis) (see Fig 6) were TC35TrefNap (TC35 combined with the herbicides Treflan and napropamide), Sol, (Solarisation), PicTel (chloropicrin combined with 1,3-D) and TC35NapHal (TC35 combined with napropamide and halsulfuron).

7.9 *Correlation between the fully modelled means and the partially modelled means for strawberry fruit observations, Appendix V - 9*

The comparison between the fully modelled means and the partially modelled means showed that there was a good correlation between the effect of alternatives in nearly all studies (i.e. the effect of alternatives relative to the methyl bromide treatment were similar for all studies).

This comparison provided a means of determining outliers which could be cross checked and omitted from the meta-analysis if data was found to be in error (i.e. the untreated mean was greater than methyl bromide or the methyl bromide was too low when compared to other treatments). For tomatoes there were no studies which needed to be excluded on this basis.

7.10 *Relative ('averaged' raw means) of nutsedge control for treatments in international studies on tomatoes, Appendix V-10*

This figure shows the effect of treatments on nutsedge numbers directly when the mean data from all relevant studies was averaged for each treatment. There was insufficient data to do a full meta-analysis of the information. It is important for assessment of treatment effects because it shows the direct effect of treatments on nutsedge whereas previous results have used 'relative' yield as a direct comparison of the effect of alternatives on nutsedge. The results are also important because they give an indication of the carryover of nutsedge from one crop to another.

The results show that of the studies that showed nutsedge data, that sodium azide (NaN₃) and PicTelNap (chloropicrin combined with 1,3-D and the herbicide, napropamide) tended to give control of nutsedge that was as effective as the methyl bromide treatments (MB/Pic 98:2 and 67:33). TC17, TC35 combined with metalochlor and trifluralin and TC35 combined with napropamide and halsulfuron, appeared to be the next most effective treatments. These findings are only an indication of possible trends.

8 'RAW' MEAN COMPARISON OF YIELDS FOR FOUR CROPS

Appendix VI shows the 'raw' mean comparisons from studies for several major alternatives considered in four crops where there were insufficient studies to conduct a proper meta-analysis. The 'raw' means for tomatoes have been compared to the modelled estimates in Table 7. This figure gives an indication of treatments which provide consistent effects across different crops and those which vary widely.

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10 STUDIES USED IN THE META-ANALYSIS

Table 10.1 Studies and Partial Trial Details of Studies used in the Strawberry Fruit Meta-Analysis

| Source | Location | Year | Cultivars | VIF Study | UTC Group | Nut Group | Nem | Fungi |
|------------------------------------|---------------------|---------|------------|-----------|-----------|-----------|-----|-------|
| 1. Ajwa <i>et al.</i> (2004) | California, USA | 2002/03 | . | Yes | 50-85 | . | . | . |
| | | 2003/04 | . | Yes | 50-85 | . | . | . |
| 2. Ajwa & Trout (2000) | California, USA | 1998 | Selva | No | 50-85 | . | . | . |
| | | 1999 | Selva | No | <50 | . | . | . |
| | | 2000 | Selva | No | <50 | . | . | . |
| | | 1998 | Selva | No | >85 | . | . | . |
| | | 1999 | Selva | No | 50-85 | . | . | . |
| | | 2000 | Selva | No | 50-85 | . | . | . |
| 3. Bartual <i>et al.</i> (2002) | Valencia, Spain | 1998 | Pajaro | Yes | 50-85 | . | . | . |
| | | 1998 | Camarosa | Yes | 50-85 | . | . | . |
| 4. Benlioglu <i>et al.</i> (2005) | Turkey | 2002/03 | Camarosa | No | <50 | . | . | . |
| | | 2003/04 | Camarosa | No | 50-85 | . | . | . |
| 5. Cebolla <i>et al.</i> (2002) | Valencia, Spain | 1998/99 | Camarosa | No | 50-85 | . | . | Yes |
| | | 1998 | Pajaro | Yes | 50-85 | . | . | . |
| | | 1999 | Camarosa | Yes | 50-85 | . | . | . |
| 6. Duniway <i>et al.</i> (1999) | California, USA | 1998 | Selva | No | <50 | . | . | . |
| | | 1999 | Selva | No | 50-85 | . | . | . |
| 7. Fennimore <i>et al.</i> (2004) | California, USA | 2003/04 | . | Yes | NoYield | ?Type | . | . |
| | | 2002/03 | . | Yes | NoYield | . | . | . |
| 8. Ferguson <i>et al.</i> (2001) | North Carolina, USA | 2000/01 | Camarosa | No | 50-85 | . | . | . |
| | Georgia, USA | 2000/01 | Camarosa | No | 50-85 | . | . | Yes |
| 9. Ferguson <i>et al.</i> (2002) | North Carolina, USA | 2001/02 | Camarosa | No | >85 | . | . | . |
| | | 2001/02 | Camarosa | No | 50-85 | . | . | . |
| | | 2001/02 | Camarosa | No | 50-85 | . | Yes | . |
| 10. Fernandez <i>et al.</i> (2000) | North Carolina, USA | 1998 | Chandler | No | 50-85 | . | . | . |
| | | 1999 | Chandler | No | 50-85 | . | . | . |
| | | 2000 | Chandler | No | 50-85 | . | . | . |
| 11. Fritsch (1998) | Dordogne, France | 1996/97 | . | Yes | 50-85 | . | . | . |
| 12. Gilreath <i>et al.</i> (2002b) | Florida, USA | 2001/02 | . | No | >85 | 6-30 | Yes | No |
| 13. Haglund (1999) | Washington, USA | 1999 | . | No | >85 | . | . | . |
| 14. Horner (2003) | New Zealand | 1998 | Pajaro | Yes | 50-85 | . | . | Yes |
| | | 2000B | Pajaro | No | 50-85 | . | . | Yes |
| | | 2000 | Pajaro | No | 50-85 | . | . | . |
| | | 2001 | Pajaro | No | 50-85 | . | . | . |
| | | 1999/00 | Pajaro | No | <50 | . | . | . |
| | | 1998 | Pajaro | Yes | 50-85 | . | . | Yes |
| | | 1999 | Pajaro | Yes | 50-85 | . | . | Yes |
| | | 2000 | Pajaro | Yes | <50 | . | . | Yes |
| | | 2001 | Pajaro | Yes | 50-85 | . | . | Yes |
| | | 1999B | Pajaro | No | <50 | . | . | Yes |
| | | 1998 | Pajaro | No | NoUTC | . | . | . |
| | | 1999 | Pajaro | No | NoUTC | . | . | . |
| | | 2000 | Pajaro | No | >85 | . | . | . |
| 2001 | Pajaro | No | 50-85 | . | . | . | | |
| 1999 | Pajaro | No | NoUTC | . | . | . | | |
| 15. Kabir <i>et al.</i> (2003) | California, USA | 2001 | Camarosa | No | NoUTC | . | . | . |
| | | 2002 | Camarosa | No | NoUTC | . | . | . |
| | | 2003 | Camarosa | No | NoUTC | . | . | . |
| | | 2002 | Camarosa | No | NoUTC | . | . | . |
| | | 2003 | Camarosa | No | NoUTC | . | . | . |
| 16. Locascio & Dickson (2000) | Florida, USA | 1999 | Florida 47 | No | 50-85 | >30 | Yes | Yes |

Table 10.1 Studies and Partial Trial Details of Studies used in the Strawberry Fruit Meta-Analysis

| Source | Location | Year | Cultivars | VIF Study | UTC Group | Nut Group | Nem | Fungi |
|--|---------------------|------------|---------------|-----------|-----------|-----------|-----|-------|
| 17. Locascio <i>et al.</i> (1999) | Florida, USA | 2000 | Florida 47 | No | 50-85 | >30 | Yes | Yes |
| | | 1998 | Chandler | No | 50-85 | >30 | Yes | Yes |
| | | 1998 | Chandler | No | 50-85 | 1-5 | . | . |
| | | 1998 | Chandler | No | 50-85 | . | Yes | Yes |
| | | 1997/98 | Chandler | No | <50 | 6-30 | . | Yes |
| 18. Lopez-Aranda (1999) | | 1997/98 | Chandler | No | 50-85 | 6-30 | . | Yes |
| | | 1998 | Camarosa | Yes | <50 | . | . | . |
| 19. Lopez-Aranda <i>et al.</i> (2002a) | Huelva, Spain | 2002 | Camarosa | No | NoUTC | . | . | . |
| | | 2002 | Camarosa | No | NoUTC | . | . | . |
| | | 2002 | Camarosa | No | NoUTC | . | . | . |
| | | 2002 | Camarosa | No | NoUTC | . | . | . |
| | | 2002 | Camarosa | Yes | NoUTC | . | . | . |
| 20. Lopez-Aranda <i>et al.</i> (2002b) | | 1997/98 | Camarosa | Yes | >85 | . | . | . |
| | | 1998/99 | Camarosa | Yes | 50-85 | . | . | . |
| 21. Lopez-Aranda <i>et al.</i> (2001a) | Huelva, Spain | 1999/00/01 | Camarosa | Yes | >85 | . | . | . |
| 22. Lopez-Aranda <i>et al.</i> (2000) | Huelva, Spain | 1997/98 | Camarosa | Yes | 50-85 | . | . | . |
| | | 1999/00 | Camarosa | Yes | 50-85 | . | . | . |
| 23. Lopez-Aranda <i>et al.</i> (2004) | Huelva, Spain | 2002/03 | Camarosa | Yes | 50-85 | . | Yes | . |
| | | 2002/03 | Camarosa | Yes | >85 | . | . | . |
| | | 2003/04 | Camarosa | Yes | 50-85 | . | Yes | . |
| | | 2003/04 | Camarosa | Yes | 50-85 | . | Yes | . |
| 24. Lopez-Aranda <i>et al.</i> (2001b) | Huelva, Spain | 2000/01 | Camarosa | Yes | 50-85 | . | . | . |
| | Huelva, Spain | 2000/01 | Camarosa | Yes | 50-85 | . | . | . |
| 25. Martin (2003) | California, USA | 2003 | . | No | 50-85 | . | . | . |
| 26. Martinez <i>et al.</i> (2000) | California, USA | 1999 | Camarosa | No | NoUTC | . | . | . |
| 27. Mattner <i>et al.</i> (2002) | Victoria, Australia | 1999 | Selva | No | 50-85 | . | . | ? |
| | | 2000 | Selva | No | >85 | . | . | . |
| | | 2000 | Selva | No | 50-85 | . | . | . |
| | | 2000 | Seascape | No | >85 | . | . | . |
| 28. Mattner <i>et al.</i> (2005) | Victoria, Australia | 2003 | Diamante | No | >85 | . | . | Yes |
| | | 2004 | Diamante | No | 50-85 | . | . | Yes |
| 29. Medina <i>et al.</i> (2004) | Huelva, Spain | 2001/02 | Camarosa | No | NoUTC | . | Yes | . |
| | | 2002/03 | Camarosa | No | NoUTC | . | . | . |
| | | 2002/03 | Camarosa | No | NoUTC | . | . | . |
| 30. Nelson <i>et al.</i> (1999) | Florida, USA | 1998/99 | Florida 47 | No | <50 | 1-5 | Yes | Yes |
| 31. Nelson <i>et al.</i> (2000) | California, USA | 1999/00 | Camarosa | No | 50-85 | . | . | . |
| | | 1999/00 | Diamante | No | 50-85 | . | . | . |
| | | 1999/00 | Sweet Charlie | No | <50 | . | . | . |
| | | 1999/00 | Camarosa | No | <50 | . | . | . |
| | | 2000/01 | Camarosa | No | 50-85 | . | . | . |
| 32. Nelson <i>et al.</i> (2001) | California, USA | 2000/01 | Diamante | No | 50-85 | . | . | . |
| | California, USA | 2000/01 | Diamante | No | 50-85 | . | . | . |
| | Florida, USA | 2000/01 | Camarosa | No | <50 | . | . | . |
| | Florida, USA | 2000/01 | Camarosa | No | >85 | . | . | . |
| | California, USA | 2000/01 | 592 | No | >85 | . | . | . |
| 33. Nelson <i>et al.</i> (2002) | California, USA | 2001/02 | Camarosa | No | 50-85 | . | . | . |
| | California, USA | 2001/02 | Diamante | No | 50-85 | . | . | . |
| | California, USA | 2001/02 | BG-269 | No | 50-85 | . | . | . |
| | Florida, USA | 2001/02 | Camarosa | No | >85 | 1-5 | Yes | . |
| | Florida, USA | 2001/02 | Camarosa | No | <50 | . | Yes | . |

Table 10.1 Studies and Partial Trial Details of Studies used in the Strawberry Fruit Meta-Analysis

| Source | Location | Year | Cultivars | VIF Study | UTC Group | Nut Group | Nem | Fungi |
|---------------------------------|---------------------|---------|-----------|-----------|-----------|-----------|-----|-------|
| 34. Porter <i>et al.</i> (1998) | Victoria, Australia | 1996 | Selva | No | >85 | . | . | Yes |
| | | 1997 | Selva | No | 50-85 | . | . | Yes |
| | | 1997 | Selva | No | 50-85 | . | . | Yes |
| 35. Sances (2000) | California, USA | 1999/00 | Camarosa | No | NoUTC | . | . | . |

Table 10.2 Studies and Partial Trial Details of Studies used in the Tomato Fruit Meta-Analysis

| Source | Location | Year | Cultivars | VIF Study | UTC Group | Nut Group | Nem | Fungi |
|------------------------------------|-------------------|---------|-------------------|-----------|-----------|-----------|-----|-------|
| 1. Csinos <i>et al.</i> (2002) | Georgia, USA | 1997 | Heinz H8704 | No | NoYield | ?Type | . | Yes |
| | | 1997 | Heinz H8704 | No | NoYield | ?Type | . | Yes |
| 2. Dickson <i>et al.</i> (1998) | Florida, USA | 1998 | AgriSet 761 | No | 50-85 | * | Yes | Yes |
| 3. Dickson <i>et al.</i> (2003) | Florida, USA | 2003 | Florida 47 | No | <50 | >30 | Yes | . |
| 4. Freitas <i>et al.</i> (1999) | Florida, USA | 1999 | AgriSet 761 | No | >85 | . | Yes | . |
| 5. Giannakou & Anastasiadis (2005) | Macedonia, Greece | 2001/02 | Arleta | No | <50 | . | Yes | . |
| | Macedonia, Greece | 2001/02 | Arleta | No | <50 | . | Yes | . |
| 6. Giannakou <i>et al.</i> (2002) | Macedonia, Greece | 1999/00 | Arleta | No | >85 | . | Yes | . |
| | | 1999/00 | Savina | No | >85 | . | Yes | . |
| | | 1999/00 | Savina | No | 50-85 | . | Yes | . |
| 7. Gilreath & Santos (2004a) | Florida, USA | 1995/96 | Solar Set | No | <50 | >30 | . | . |
| 8. Gilreath & Santos (2004b) | | 1997 | Sunbeam | No | 50-85 | >30 | . | Yes |
| | | 1997 | Sunbeam | No | <50 | >30 | . | Yes |
| 9. Gilreath <i>et al.</i> (2004c) | Florida, USA | 1998 | Solar Set | No | <50 | 6-30 | Yes | . |
| | | 1997 | Solar Set | No | <50 | >30 | Yes | . |
| 10. Gilreath <i>et al.</i> (2002a) | Florida, USA | 2000 | Florida 47 | No | <50 | 1-5 | Yes | Yes |
| | | 2001 | Florida 47 | No | <50 | 1-5 | Yes | Yes |
| 11. Gilreath <i>et al.</i> (2005a) | Florida, USA | 2000 | Florida 47 | No | <50 | . | Yes | Yes |
| | | 2001 | Florida 47 | No | 50-85 | . | Yes | Yes |
| | | 2002 | Florida 47 | No | <50 | . | Yes | Yes |
| 12. Gilreath <i>et al.</i> (1997) | Florida, USA | 1997 | . | No | NoUTC | . | . | . |
| | | 1997 | . | No | NoUTC | . | . | . |
| | | 1997 | . | No | NoUTC | NoUTC | . | . |
| | | 1997 | . | No | NoUTC | NoUTC | Yes | . |
| 13. Gilreath <i>et al.</i> (1999) | Florida, USA | 1998 | Solimar | No | <50 | 1-5 | Yes | Yes |
| 14. Gilreath <i>et al.</i> (2005b) | Florida, USA | 2002 | Sanibel | No | NoUTC | NoUTC | Yes | . |
| | | 2002 | Florida 47 | No | NoUTC | NoUTC | Yes | . |
| 15. Gilreath <i>et al.</i> (2005c) | Florida, USA | 1999/00 | Florida 47 | No | NoUTC | NoUTC | Yes | . |
| 16. Gilreath <i>et al.</i> (2004d) | Florida, USA | 2000 | Florida 47 | No | <50 | 1-5 | Yes | Yes |
| | | 2001 | Florida 47 | No | <50 | 1-5 | Yes | Yes |
| | | 2000/01 | Florida 47 | No | NoUTC | NoUTC | Yes | . |
| 17. Gilreath <i>et al.</i> (2004e) | | 1998 | Sunbeam | No | 50-85 | 6-30 | Yes | Yes |
| 18. Gullino <i>et al.</i> (2002) | Liguria, Italy | 1999 | Cuore di bue | Yes | NoYield | . | . | Yes |
| 19. Gullino <i>et al.</i> (2002b) | Sicily, Italy | 1999 | Principe Borghese | No | 50-85 | . | . | Yes |
| | | 1999 | Vulcano | No | <50 | . | . | Yes |
| | Liguria, Italy | 1999 | Principe Borghese | No | NoYield | . | . | Yes |
| | Liguria, Italy | 1999 | Principe Borghese | No | <50 | . | . | Yes |
| | Liguria, Italy | 1999 | Principe | No | <50 | . | . | Yes |

Table 10.2 Studies and Partial Trial Details of Studies used in the Tomato Fruit Meta-Analysis

| Source | Location | Year | Cultivars | VIF Study | UTC Group | Nut Group | Nem | Fungi |
|---------------------------------------|-----------------|---------|-------------------|-----------|-----------|-----------|-----|-------|
| | | | Borghese | | | | | |
| | Liguria, Italy | 1999 | Vulcano | No | <50 | . | . | Yes |
| | Liguria, Italy | 2000 | Principe Borghese | No | >85 | . | . | Yes |
| | Liguria, Italy | 2000 | Vulcano | No | 50-85 | . | . | Yes |
| 20. Haglund (2000) | Florida, USA | 2000 | . | No | 50-85 | >30 | Yes | . |
| | | 2000 | . | No | <50 | 6-30 | Yes | . |
| 21. Hamill <i>et al.</i> (2004) | Florida, USA | 2004 | . | Yes | <50 | >30 | Yes | . |
| 22. Ioannou (2000) | Cyprus | 1996 | Dombito | No | <50 | . | Yes | Yes |
| | | 1996 | Dombito | No | 50-85 | . | Yes | Yes |
| 23. Kokalis-Burelle & Dickson (2003) | Florida, USA | 2003 | Florida 47 | No | <50 | . | Yes | . |
| 24. Locascio <i>et al.</i> (2003) | Florida, USA | 2002 | Florida 47 | No | 50-85 | * | Yes | Yes |
| | | 2002 | Solar Set | No | 50-85 | 6-30 | Yes | . |
| 25. Locscio & Dickson (2001) | Florida, USA | 2001 | Florida 47 | Yes | <50 | >30 | . | Yes |
| 26. Locscio <i>et al.</i> (2000) | Florida, USA | 1997 | Solar Set | No | 50-85 | >30 | . | Yes |
| | | 1998 | AgriSet 761 | No | 50-85 | >30 | . | Yes |
| | | 1998 | AgriSet 761 | No | 50-85 | * | . | Yes |
| 27. Nelson <i>et al.</i> (2002) | Florida, USA | 2001/02 | . | No | <50 | . | Yes | . |
| | California, USA | 2001/02 | . | No | >85 | . | . | . |
| | Florida, USA | 2001/02 | Florida 47 | No | 50-85 | . | . | . |
| 28. Noling & Gilreath (2004) | Florida, USA | 2003 | . | No | <50 | . | Yes | . |
| | | 2004 | . | No | 50-85 | . | Yes | . |
| 29. Rodriguez-Kabana & Akridge (2003) | Alabama, USA | 2002 | Paragon | No | >85 | . | . | . |
| 30. Santos <i>et al.</i> (2005) | Florida, USA | 2003 | Florida 47 | No | 50-85 | 6-30 | Yes | Yes |
| | | 2003 | Florida 47 | No | 50-85 | 6-30 | Yes | Yes |
| 31. Slusarski & Pietr (2003) | Poland | 2000 | Rumba | No | 50-85 | . | . | Yes |
| | | 2001 | Rumba | No | 50-85 | . | . | Yes |

APPENDIX 1: LIST OF TREATMENT CODES/ABBREVIATIONS USED FOR TREATMENT APPLICATIONS IN THE FINAL DATABASES

| Treatment Code | Treatment Description | Tomatoes | Strawberries |
|----------------|---|----------|--------------|
| BioFum | Bio - Brassica; ChickManure | | Yes |
| Cad | Cadusafos 2 + 1 | Yes | |
| Cal | Calcium cyanamide | | Yes |
| Chick | ChickManure; SheepManure | | Yes |
| Compost | Compost | | Yes |
| Daz | Dazomet | Yes | Yes |
| DazCal | Dazomet; Calcium cyanamide | | Yes |
| DazLime | Dazomet; Lime | | Yes |
| DazNap | Dazomet; Napropamide | | Yes |
| DazSol | Dazomet; Solarization | | Yes |
| DazTviride | Dazomet; <i>Trichoderma viride</i> | Yes | |
| Dip | Diphenamid 80WP | Yes | |
| DMDS | Dimethyl disulphide | Yes | Yes |
| EDN | Ethane dinitrile | | Yes |
| EMF | Electronic Waves | | Yes |
| Fen | Fenamiphos | Yes | |
| Fos | Fosthiazate 900 EC | Yes | |
| IndmusTviride | Indian mustard; <i>Trichoderma viride</i> | Yes | |
| Lime | Lime | | Yes |
| MB30 | Methyl bromide/chloropicrin(30:70) | | Yes |
| MB30Cal | Methyl bromide/chloropicrin(30:70); Calcium cyanamide | | Yes |
| MB50 | Methyl bromide/chloropicrin(50:50) | | Yes |
| MB50Cal | Methyl bromide/chloropicrin(50:50); Calcium cyanamide | | Yes |
| MB50Sol | Methyl bromide/chloropicrin(50:50); Solarization | | Yes |
| MB67 | Methyl bromide/chloropicrin(67:33) | Yes | Yes |
| MB67PebNap | Methyl bromide/chloropicrin(67:33); Pebulate; Napropamide | Yes | |
| MB67Sol | Methyl bromide/chloropicrin(67:33); Solarization | | Yes |
| MB98 | Methyl bromide/chloropicrin(98:2) | Yes | Yes |
| MI100 | Methyl iodide (100) | Yes | Yes |
| MI100MNa | Methyl iodide/chloropicrin(98:2); Metham sodium | Yes | |
| MI30 | Methyl iodide/chloropicrin(30:70) | | Yes |
| MI60 | Methyl idoide/chloropicrin(50:50) | Yes | Yes |
| MNa | Metham sodium | Yes | Yes |
| MNaCad | Metham sodium; Cadusafos | Yes | |
| MNaCal | Metham sodium; Calcium Cyanamid | | Yes |
| MNaFos | Metham Sodium; Fosthiazate 500 EC | Yes | |
| MNaHelp | Metham sodium; Help (ReZist + Stabiliser) | | Yes |
| MNaLime | Metham sodium; Lime | | Yes |
| MNaMes | Metham sodium; Messenger | | Yes |
| MNaNap | Metham sodium; Napropamide | | Yes |
| MNaPeb | Metham sodium; Pebulate | Yes | Yes |
| MNaPebFos | Metham sodium; Pebulate; Fosthiazate | Yes | |
| MNaPP | Metham sodium; PlantPro 45 | Yes | Yes |
| MNaPPFos | Metham sodium; PlantPro 45; PlantPro 45; Fosthiazate 500 EC | | Yes |
| MNaPPO | Metham sodium; Propylene Oxide | | Yes |
| MNaRootshld | Metham sodium; Rootshield | | Yes |
| MNaSol | Metham sodium; Solarization; | | Yes |
| MNaTel | Metham sodium; 1,3-Dichloropropene | Yes | Yes |

Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation

| Treatment Code | Treatment Description | Tomatoes | Strawberries |
|----------------|--|----------|--------------|
| MNaTelNap | Metham sodium; 1,3-Dichloropropene; Napropamide | | Yes |
| MNaTelPeb | Metham sodium; 1,3-Dichloropropene; Pebulate | | Yes |
| MNaTelSol | Metham sodium; 1,3-Dichloropropene; Solarization | | Yes |
| Multi | Multiguard Protect | Yes | Yes |
| MycCom | Compost; Mycorrhizal | | Yes |
| NaN3 | Sodium azide | Yes | |
| NoTr | NoTreatment | Yes | Yes |
| NoTrPebNap | NoTreatment; Pebulate; Napropamide | Yes | |
| Oxa | Oxamyl | Yes | |
| Pic | Chloropicrin | Yes | Yes |
| PicCal | Chloropicrin; Calcium cyanamide | | |
| PicDazEnz | Chloropicrin; Dazomet; Enzone | | Yes |
| PicDMDS | Chloropicrin; Dimethyl disulphide | | Yes |
| PicEC | Chloropicrin EC | Yes | Yes |
| PicECDaz | Chloropicrin EC; Dazomet | | Yes |
| PicECDazEnz | Chloropicrin EC; Dazomet; Enzone | | Yes |
| PicECMNa | Chloropicrin EC; Metham Sodium | | Yes |
| PicECMNaDiTera | Chloropicrin EC; Metham Sodium; DiTera ES | | Yes |
| PicECMNaEnz | Chloropicrin EC; Metham Sodium; Enzone | | Yes |
| PicECMNaFos | Chloropicrin EC; Metham Sodium; Fosthiazate 500 EC | | Yes |
| PicECMNaHM0 | Chloropicrin EC; Metham Sodium; HM0122 | | Yes |
| PicEnzPeb | Chloropicrin; Enzone; Pebulate | Yes | |
| PicFosNap | Chloropicrin; Fosthiazate 500 EC; Napropamide 50WG; | | Yes |
| PicFosPeb | Chloropicrin; Fosthiazate; Pebulate | Yes | |
| PicMNa | Chloropicrin; Metham Sodium | Yes | Yes |
| PicMNaDiTera | Chloropicrin; Metham Sodium; DiTera DF | | Yes |
| PicMNaEnz | Chloropicrin; Metham Sodium; Enzone | Yes | Yes |
| PicMNaFos | Metham Sodium; Chloropicrin; Fosthiazate 500 EC | Yes | |
| PicMNaNap | Metham Sodium; Chloropicrin; Napropamide | | Yes |
| PicMNaPeb | Metham Sodium; Chloropicrin; Pebulate | Yes | |
| PicMNaSol | Metham Sodium; Chloropicrin; Solarization | | Yes |
| PicNap | Chloropicrin; Napropamide | | Yes |
| PicPeb | Chloropicrin; Pebulate | Yes | |
| PicTel | Chloropicrin, 1,3-Dichloropropene | Yes | Yes |
| PicTelNap | Chloropicrin; 1,3-Dichloropropene; Napropamide | | Yes |
| PicTelPebNap | Chloropicrin; 1,3-Dichloropropene; Pebulate; Napropamide | Yes | |
| PPNap | PlantPro 45B EC; Napropamide 50WG; | | Yes |
| PPFosNap | PlantPro 45B; Fosthiazate 500 EC; Napropamide 50WG | | Yes |
| PPO | Propylene oxide | | Yes |
| Quil | Quillaja Sapanaria | Yes | |
| SheepPoul | SheepManure; PoultryManure | | Yes |
| Sol | Solarization | Yes | Yes |
| SolBio | Solarization; Biofumigation | | Yes |
| SolCab | Solarization; Cabbage residue | | Yes |
| SolFert | Solarization; Chicken Manure | | Yes |
| SolSoil | Solarization; SoilGard | Yes | |
| TC17 | 1,3-Dichloropropene (17%) | Yes | Yes |
| TC17MNa | TC17; Metham Sodium | Yes | |
| TC17Nap | TC17; Napropamide | | Yes |
| TC17Peb | TC17; Pebulate | Yes | Yes |
| TC17PicNap | TC17; Chloropicrin; Napropamide | | Yes |
| TC25 | 1,3-Dichloropropene (25%) | Yes | |

Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation

| Treatment Code | Treatment Description | Tomatoes | Strawberries |
|----------------|---|----------|--------------|
| TC35 | 1,3-Dichloropropene (35%) | Yes | Yes |
| TC35Daz | TC35; Dazomet | Yes | Yes |
| TC35Nap | TC35; Napropamide | | Yes |
| TC35EC | TC35 EC | Yes | Yes |
| TC35ECDaz | TC35 EC; Dazomet; | Yes | Yes |
| TC35ECMNa | TC35 EC; Metham Sodium | | Yes |
| TC35ECPicECDaz | TC35 EC; Chloropicrin; Dazomet | | Yes |
| TC35ECTrefNap | TC35 EC; Treflan; Napropamide | Yes | |
| TC35MesTref | TC35; Messenger; Treflan | Yes | |
| TC35MNa | TC35; Metham Sodium | | Yes |
| TC35MNaOrgFung | TC35; Metham Sodium; <i>Bacillus subtilis</i> | | Yes |
| TC35Nap | TC35; Napropamide | | Yes |
| TC35Peb | TC35; Pebulate | Yes | Yes |
| TC35PebNap | TC35; Pebulate; Napropamide | Yes | |
| TC35Pic | TC35; Chloropicrin | | Yes |
| TC35PicPebNap | TC35; Chloropicrin; Pebulate; Napropamide | Yes | |
| TC35PicPebTrif | TC35; Chloropicrin; Pebulate; Trifluralin | Yes | |
| TC35PicTrefNap | TC35; Treflan; Napropamide; Chloropicrin | Yes | |
| TC35Sol | TC35; Solarization | | Yes |
| TC35Tviride | TC35; <i>Trichoderma viride</i> | Yes | |
| Tel | 1,3-Dichloropropene | Yes | Yes |
| TerraK | TerraKleen | Yes | |
| Tviride | <i>Trichoderma viride</i> | Yes | |
| TvirideFert | <i>Trichoderma viride</i> ; Straw; Urea | Yes | |
| Vrlx | Vorlex CP | | Yes |

APPENDIX II-1 Relationship for treatment x nutsedge interaction between number of trials, number of observations, treatments and the estimated relative means for strawberry yields compared to the standard MB treatment (MB/Pic 67:33) from the complete meta-analysis (Y1)

STRAWBERRY - Treatments x nutsedge (3 levels: 1-5, 6-30 and >30)

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|-----------------|-----------|----------------|-----------|
| 2 | 1-5 PicFosNap | 82.7 | 109.9 | 146 |
| 1 | 1-5 PicECMNa | 69.9 | 102.4 | 149.9 |
| 1 | 1-5 PicMNaEnz | 68.9 | 101.7 | 150.2 |
| 1 | 1-5 TC35Sol | 74.2 | 100.4 | 135.7 |
| 3 | 1-5 MB67 | 78.4 | 100 | 127.5 |
| 1 | 1-5 TC35Nap | 73.7 | 99.6 | 134.7 |
| 1 | 1-5 MNaTelNap | 17.3 | 98.8 | 564.3 |
| 1 | 1-5 PicECMNaHM0 | 70.7 | 98.4 | 136.8 |
| 1 | 1-5 PicNap | 76.1 | 98.1 | 126.4 |
| 1 | 1-5 MI60 | 72 | 97.7 | 132.6 |
| 1 | 1-5 TC35 | 71.7 | 97.7 | 133.2 |
| 1 | 1-5 DazNap | 84.5 | 96.6 | 110.3 |
| 2 | 1-5 MNa | 48.1 | 96.4 | 193.1 |
| 2 | 1-5 PicMNa | 66.4 | 96.3 | 139.8 |
| 1 | 1-5 PPO | 66.1 | 95.7 | 138.5 |
| 1 | 1-5 TC17Peb | 67.9 | 95.3 | 133.8 |
| 1 | 1-5 TC35Daz | 67.9 | 95 | 132.9 |
| 3 | 1-5 PPNap | 55.9 | 95 | 161.3 |
| 1 | 1-5 MNaNap | 68.3 | 91.5 | 122.7 |
| 1 | 1-5 TC35Peb | 65.1 | 91.5 | 128.4 |
| 1 | 1-5 Sol | 55 | 87.6 | 139.7 |
| 1 | 1-5 MNaTelSol | 15.3 | 87.3 | 498.1 |
| 3 | 1-5 NoTr | 45.7 | 74.5 | 121.5 |
| 1 | 1-5 MNaTelPeb | 12.5 | 72 | 415.4 |
| 1 | 6-30 TC35 | 95.6 | 131.5 | 180.9 |
| 1 | 6-30 MI30 | 87.9 | 120.4 | 164.8 |
| 3 | 6-30 MB67 | 79.6 | 102 | 130.7 |
| 2 | 6-30 PicNap | 76.7 | 98.5 | 126.6 |
| 1 | 6-30 DazNap | 84.5 | 96.6 | 110.3 |
| 2 | 6-30 TC35Nap | 72.5 | 95.5 | 126 |
| 1 | 6-30 DazSol | 67.6 | 94.5 | 132.2 |
| 2 | 6-30 MI60 | 69.9 | 94.4 | 127.6 |
| 2 | 6-30 TC17Nap | 71 | 93.6 | 123.3 |
| 2 | 6-30 PicMNaSol | 60.6 | 82.4 | 112.1 |
| 2 | 6-30 MNaNap | 56.2 | 73.7 | 96.7 |
| 2 | 6-30 PicMNaNap | 53.2 | 72.3 | 98.4 |
| 3 | 6-30 NoTr | 40.9 | 67 | 109.7 |
| 3 | 6-30 Sol | 37.3 | 51.9 | 72.2 |
| 1 | >30 MNaTelPeb | 17.6 | 101.8 | 589.7 |
| 2 | >30 TC17Peb | 74 | 101 | 137.9 |
| 1 | >30 MNaTelNap | 17.5 | 100.4 | 575.8 |
| 3 | >30 MB67 | 76.8 | 99.8 | 129.8 |
| 4 | >30 TC35Peb | 73.5 | 98.8 | 132.9 |
| 1 | >30 MNaNap | 71.8 | 97.6 | 132.6 |
| 1 | >30 DazNap | 84.5 | 96.6 | 110.3 |
| 1 | >30 TC35Nap | 67 | 91.9 | 126 |
| 1 | >30 MNaTelSol | 15.6 | 89.2 | 511.6 |
| 1 | >30 TC35Sol | 64.6 | 88.5 | 121.4 |
| 1 | >30 MNaPeb | 61.9 | 87.2 | 122.9 |
| 1 | >30 PicNap | 60.5 | 79.1 | 103.5 |
| 1 | >30 Sol | 47.8 | 77 | 124.1 |

| | | | | |
|---|----------|------|------|------|
| 3 | >30 NoTr | 33.1 | 54.7 | 90.4 |
|---|----------|------|------|------|

APPENDIX II-2 Relationship for treatment x fungal interaction between number of trials, number of observations, treatments and the estimated relative means for strawberry yields compared to the standard MB treatment (MB/Pic 67:33) from the complete meta-analysis (Y1)

STRAWBERRY - Treatment x fungi (2 levels: Presence and Not specified)

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|--------------------|-----------|----------------|-----------|
| 2 | Yes MNaTelNap | 81.9 | 100.8 | 123.9 |
| 23 | Yes MB67 | 88 | 100 | 113.6 |
| 3 | Yes TC17Peb | 83.5 | 99.1 | 117.5 |
| 2 | Yes DazNap | 78.6 | 98 | 122.3 |
| 1 | Yes MB30Cal | 73.8 | 97.9 | 130 |
| 5 | Yes TC35Peb | 82.4 | 96.6 | 113.2 |
| 1 | Yes MB50Cal | 72.6 | 96.4 | 127.9 |
| 1 | Yes DazSol | 71.7 | 96.1 | 128.7 |
| 1 | Yes TC35MNa | 75 | 95.2 | 120.9 |
| 10 | Yes MB30 | 83.6 | 95.1 | 108.2 |
| 4 | Yes TC35Nap | 80.2 | 94 | 110.2 |
| 4 | Yes PicNap | 80.2 | 93.3 | 108.5 |
| 2 | Yes TC17Nap | 77.1 | 92.8 | 111.6 |
| 11 | Yes TC35 | 79.9 | 91.3 | 104.5 |
| 5 | Yes MB50 | 79.9 | 91.3 | 104.3 |
| 1 | Yes TC35MNaOrgFung | 71.8 | 91.1 | 115.7 |
| 3 | Yes PicMNa | 73.5 | 90.8 | 112 |
| 1 | Yes PicCal | 74 | 89.6 | 108.3 |
| 2 | Yes MNaTelSol | 72.7 | 89.4 | 109.9 |
| 2 | Yes TC35Sol | 73.5 | 88.4 | 106.4 |
| 3 | Yes PicDaz | 76.1 | 88.2 | 102.3 |
| 15 | Yes Pic | 77.3 | 87.8 | 99.8 |
| 1 | Yes MNaPeb | 66 | 86.5 | 113.3 |
| 2 | Yes MNaTelPeb | 69.7 | 85.9 | 105.9 |
| 9 | Yes Daz | 73 | 84 | 96.7 |
| 1 | Yes TC35ECMNa | 65.6 | 83.3 | 105.7 |
| 2 | Yes DazLime | 66.5 | 82.3 | 101.9 |
| 4 | Yes MNaNap | 69.4 | 82.3 | 97.7 |
| 2 | Yes PicMNaSol | 58.8 | 81.7 | 113.5 |
| 4 | Yes MI30 | 68.4 | 80.2 | 94 |
| 1 | Yes PicTelNap | 61.4 | 77.9 | 98.9 |
| 1 | Yes TC17PicNap | 60.9 | 77.3 | 98.2 |
| 16 | Yes MNa | 59.9 | 76.1 | 96.6 |
| 1 | Yes MnaCal | 58 | 74.9 | 96.9 |
| 2 | Yes MnaLime | 61.1 | 74.4 | 90.6 |
| 2 | Yes MNaTel | 57.9 | 72.4 | 90.5 |
| 2 | Yes PicMNaNap | 51.6 | 71.7 | 99.6 |
| 4 | Yes EDN | 59.5 | 71.3 | 85.3 |
| 1 | Yes DazCal | 53.4 | 70.9 | 94.1 |
| 2 | Yes Lime | 56.9 | 70.4 | 87.1 |
| 3 | Yes Cal | 61.5 | 69 | 77.5 |
| 5 | Yes Sol | 47.8 | 59.2 | 73.4 |
| 21 | Yes NoTr | 47.8 | 58.1 | 70.5 |
| 5 | NS TC35Daz | 107.6 | 120.4 | 134.8 |
| 1 | NS MI30 | 98.2 | 119.9 | 146.4 |
| 7 | NS TC35MNa | 104.4 | 116 | 128.9 |
| 1 | NS PicECDaz | 88.1 | 114.5 | 148.9 |
| 2 | NS PicDazEnz | 93 | 112.4 | 135.9 |
| 1 | NS PicMNaDiTera | 72 | 112.3 | 175.4 |
| 2 | NS PicECDazEnz | 91.7 | 110.9 | 134.2 |
| 4 | NS Compost | 73.3 | 110.1 | 165.4 |

Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|-------------------|-----------|----------------|-----------|
| 2 | NS TC35ECDaz | 93.8 | 109 | 126.5 |
| 6 | NS PicFosNap | 97.2 | 107.7 | 119.3 |
| 5 | NS TC35ECPicECDaz | 95.6 | 106.9 | 119.6 |
| 3 | NS SolCab | 89.7 | 106.9 | 127.3 |
| 3 | NS TC17 | 92.9 | 104.6 | 117.8 |
| 51 | NS TC35 | 96 | 104.5 | 113.7 |
| 18 | NS MI60 | 95.3 | 104.5 | 114.5 |
| 21 | NS MB50 | 95.7 | 104.4 | 113.8 |
| 1 | NS MycCom | 78.7 | 104.2 | 137.8 |
| 28 | NS PicEC | 95.5 | 104 | 113.4 |
| 102 | NS MB67 | 95.8 | 104 | 113 |
| 51 | NS TC35EC | 95.2 | 103.7 | 113 |
| 4 | NS PicECMNaDiTera | 91.5 | 103.4 | 116.9 |
| 20 | NS TC35ECMNa | 93.7 | 102.6 | 112.4 |
| 2 | NS PicDMDS | 90.2 | 102.5 | 116.6 |
| 1 | NS TC35Nap | 83.6 | 101.9 | 124.3 |
| 52 | NS Pic | 93.7 | 101.9 | 110.8 |
| 1 | NS TC35Nap | 82.4 | 101.6 | 125.2 |
| 1 | NS MNaTelNap | 78.6 | 100.7 | 129.1 |
| 1 | NS TC35Pic | 84.1 | 100.5 | 120.2 |
| 9 | NS PicECMNaFos | 90.7 | 100.5 | 111.4 |
| 1 | NS PicNap | 83.6 | 100 | 119.5 |
| 1 | NS PicTel | 82.8 | 99.4 | 119.3 |
| 13 | NS PicMNa | 88.7 | 99.3 | 111.3 |
| 13 | NS PicECMNa | 89.1 | 99.1 | 110.3 |
| 3 | NS MB67Sol | 84.6 | 99 | 115.9 |
| 1 | NS DazNap | 74.8 | 98.4 | 129.5 |
| 10 | NS SolFert | 85.6 | 98.3 | 112.9 |
| 23 | NS Daz | 89.3 | 97.9 | 107.3 |
| 2 | NS TC35Sol | 83.5 | 97.3 | 113.3 |
| 1 | NS MB50Sol | 73.1 | 95.1 | 123.7 |
| 14 | NS MNaSol | 85.9 | 93.9 | 102.6 |
| 1 | NS MNaNap | 72.8 | 93.3 | 119.5 |
| 4 | NS DMDS | 80.4 | 92.9 | 107.4 |
| 5 | NS MB30 | 84.1 | 92.7 | 102.3 |
| 4 | NS PicECMNaHM0 | 81.3 | 91.9 | 103.9 |
| 5 | NS MI100 | 79.9 | 91.3 | 104.2 |
| 7 | NS PPO | 80.2 | 90.2 | 101.5 |
| 1 | NS SolBio | 68.8 | 89.3 | 115.9 |
| 1 | NS MNaTelSol | 69.4 | 88.9 | 113.9 |
| 12 | NS Sol | 76.9 | 87.6 | 99.9 |
| 5 | NS Vrix | 75.7 | 85.5 | 96.5 |
| 11 | NS PicECMNaEnz | 76.6 | 84.7 | 93.7 |
| 2 | NS Tel | 69.7 | 84.3 | 101.9 |
| 1 | NS MNaRootshld | 65.4 | 82.9 | 105 |
| 3 | NS BioFum | 71.6 | 80.4 | 90.2 |
| 64 | NS MNa | 70.7 | 80 | 90.6 |
| 4 | NS MNaPPO | 69.8 | 79.8 | 91.3 |
| 2 | NS PicMNaEnz | 58.5 | 79.4 | 107.6 |
| 1 | NS MNaMes | 62.1 | 78.5 | 99.3 |
| 6 | NS MNaPPFos | 67.6 | 76.1 | 85.8 |
| 15 | NS MNaPP | 67.5 | 74.5 | 82.3 |
| 4 | NS MNaHelp | 64.4 | 73.5 | 83.9 |
| 2 | NS Cal | 59.7 | 72.1 | 87 |
| 3 | NS Multi | 59.3 | 69.8 | 82.1 |
| 68 | NS NoTr | 61.5 | 68.8 | 76.9 |

Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|--------------|-----------|----------------|-----------|
| 2 | NS EMF | 53.7 | 64.7 | 78 |
| 4 | NS PPFosNap | 29.2 | 52.7 | 95.1 |
| 2 | NS Chick | 22 | 40 | 72.7 |
| 2 | NS SheepPoul | 22 | 39.9 | 72.6 |
| 10 | NS PPNap | 27.5 | 39.2 | 55.8 |

APPENDIX II-3 Relationship for treatment x nematode interaction between number of trials, number of observations, treatments and the estimated relative means for strawberry yields compared to the standard MB treatment (MB/Pic 67:33) from the complete meta-analysis (Y1)

STRAWBERRY - Treatments x nematode (2 levels: Presence and Not specified)

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|-------------------|-----------|----------------|-----------|
| 1 | Yes MI30 | 90.1 | 113.4 | 142.8 |
| 2 | Yes TC35Daz | 87.5 | 108.2 | 133.7 |
| 2 | Yes TC35MNa | 84 | 106.2 | 134.4 |
| 4 | Yes PicFosNap | 88.7 | 105.8 | 126.1 |
| 2 | Yes MNaTelNap | 83.8 | 102.5 | 125.2 |
| 6 | Yes TC35 | 87.2 | 102.2 | 119.7 |
| 2 | Yes PicECMNa | 79.7 | 101.8 | 130.1 |
| 3 | Yes Pic | 86 | 100.9 | 118.5 |
| 12 | Yes MB67 | 86.2 | 100 | 116.1 |
| 3 | Yes MB50 | 85.2 | 99.8 | 116.9 |
| 1 | Yes DazNap | 74.2 | 99.7 | 134.3 |
| 3 | Yes TC17Peb | 81.5 | 99.4 | 121.2 |
| 2 | Yes PicDMDS | 83.6 | 99.1 | 117.5 |
| 1 | Yes TC35Nap | 75 | 97.8 | 127.4 |
| 1 | Yes PicECMNaHMO | 74.7 | 96.5 | 124.7 |
| 5 | Yes TC35Peb | 80 | 96.5 | 116.5 |
| 4 | Yes MI60 | 80.3 | 95.6 | 113.9 |
| 2 | Yes TC35Nap | 76.1 | 94.9 | 118.2 |
| 2 | Yes MNaNap | 76.1 | 94.3 | 116.9 |
| 4 | Yes Daz | 77 | 93.2 | 112.7 |
| 4 | Yes MNa | 57.3 | 92.5 | 149.1 |
| 2 | Yes MNaTelSol | 74.4 | 90.9 | 111.1 |
| 7 | Yes PicMNa | 74.4 | 90.7 | 110.7 |
| 2 | Yes PicNap | 74.9 | 90.6 | 109.6 |
| 1 | Yes TC35Pic | 71.3 | 90.5 | 115.1 |
| 2 | Yes TC35Sol | 72.2 | 89.9 | 112 |
| 1 | Yes MNaPeb | 66.5 | 86.6 | 112.9 |
| 5 | Yes PPO | 71.9 | 86.4 | 103.9 |
| 2 | Yes MNaTelPeb | 70.6 | 86.2 | 105.3 |
| 1 | Yes TC35ECMNa | 64.7 | 84.8 | 111.4 |
| 2 | Yes DMDS | 67.3 | 84.5 | 106.1 |
| 1 | Yes TC35EC | 60.3 | 76.6 | 97.3 |
| 2 | Yes PicMNaEnz | 54.7 | 76.3 | 106.4 |
| 2 | Yes Sol | 52.1 | 74.2 | 105.8 |
| 2 | Yes Cal | 61.8 | 69.6 | 78.4 |
| 12 | Yes NoTr | 49.3 | 63.3 | 81.2 |
| 6 | Yes PPNap | 35.7 | 54.7 | 83.7 |
| 3 | NS MB98 | 110.6 | 130.9 | 155.1 |
| 3 | NS TC35Daz | 97.7 | 112.3 | 129.2 |
| 1 | NS PicECDaz | 78.9 | 101 | 129.3 |
| 6 | NS TC35MNa | 89.2 | 99.8 | 111.8 |
| 1 | NS PicMNaDiTera | 64.6 | 99.6 | 153.6 |
| 2 | NS PicDazEnz | 81.9 | 98.1 | 117.5 |
| 2 | NS PicECDazEnz | 80.7 | 97.8 | 118.5 |
| 2 | NS TC35ECDaz | 82.3 | 96.9 | 114 |
| 4 | NS Compost | 64.4 | 94.5 | 138.8 |
| 5 | NS TC35ECPicECDaz | 83.5 | 93.8 | 105.7 |
| 14 | NS MI60 | 85.5 | 93.8 | 103 |
| 1 | NS MycCom | 70.2 | 92 | 120.7 |
| 6 | NS PicMNa | 78.7 | 92 | 107.7 |
| 111 | NS MB67 | 84.7 | 91.8 | 99.6 |

Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|-------------------|-----------|----------------|-----------|
| 4 | NS PicECMNaDiTera | 80.8 | 91.4 | 103.3 |
| 50 | NS TC35EC | 83.7 | 91.4 | 99.6 |
| 28 | NS PicEC | 83.4 | 90.9 | 99.2 |
| 3 | NS TC17 | 80.3 | 90.6 | 102.4 |
| 3 | NS SolCab | 76.5 | 90.5 | 107.3 |
| 3 | NS PicNap | 80.3 | 90.5 | 102 |
| 2 | NS PicFosNap | 79.4 | 90.2 | 102.3 |
| 20 | NS TC35ECMNa | 82.2 | 90.1 | 98.8 |
| 21 | NS MB50 | 82.6 | 90.1 | 98.2 |
| 57 | NS TC35 | 82.6 | 89.7 | 97.6 |
| 1 | NS DazSol | 69.3 | 89.5 | 115.6 |
| 3 | NS TC35Nap | 77.1 | 89.2 | 103.1 |
| 9 | NS PicECMNaFos | 79.9 | 88.7 | 98.5 |
| 2 | NS DazNap | 73.6 | 88.6 | 106.6 |
| 1 | NS TC35MNaOrgFung | 69.9 | 88 | 110.7 |
| 1 | NS MNaTelNap | 72.8 | 87.9 | 106 |
| 2 | NS TC17Nap | 74.1 | 87.6 | 103.7 |
| 59 | NS Pic | 80.5 | 87.5 | 95.1 |
| 1 | NS PicTel | 71.2 | 86.3 | 104.6 |
| 11 | NS PicECMNa | 77 | 86 | 96 |
| 13 | NS MB30 | 78.7 | 86 | 94.1 |
| 10 | NS SolFert | 73.9 | 85.7 | 99.3 |
| 2 | NS DMDS | 71.2 | 85.5 | 102.8 |
| 3 | NS MB67Sol | 73.6 | 85.5 | 99.4 |
| 2 | NS TC35Sol | 71.8 | 84.7 | 99.7 |
| 5 | NS Vrlx | 73.6 | 84.3 | 96.4 |
| 26 | NS Daz | 74.6 | 81.9 | 89.8 |
| 14 | NS MNaSol | 74.8 | 81.6 | 89.1 |
| 1 | NS MB50Sol | 63.3 | 81.2 | 104 |
| 5 | NS MI100 | 71.2 | 80.8 | 91.7 |
| 2 | NS PPO | 65.9 | 80.4 | 98 |
| 4 | NS MI30 | 69.9 | 79.2 | 89.9 |
| 3 | NS Tel | 67.8 | 78.9 | 91.8 |
| 3 | NS PicECMNaHM0 | 68.9 | 78.8 | 90.2 |
| 4 | NS Vrlx | 67.6 | 78 | 90 |
| 1 | NS MNaTelSol | 64.3 | 77.6 | 93.6 |
| 2 | NS Tel | 64.8 | 77.4 | 92.5 |
| 2 | NS PicMNaSol | 57.1 | 77.1 | 104.2 |
| 1 | NS SolBio | 60.1 | 77 | 98.6 |
| 1 | NS PicTelNap | 59.8 | 75.2 | 94.7 |
| 11 | NS PicECMNaEnz | 67.7 | 75 | 83.1 |
| 1 | NS TC17PicNap | 59.3 | 74.7 | 93.9 |
| 3 | NS MNaNap | 63.4 | 72.9 | 83.9 |
| 1 | NS MNaRootshld | 58.8 | 72.5 | 89.3 |
| 4 | NS MNaPPO | 61.9 | 70.6 | 80.4 |
| 4 | NS EDN | 60.6 | 70.4 | 81.8 |
| 3 | NS BioFum | 61.8 | 69.6 | 78.4 |
| 73 | NS MNa | 61.6 | 69.4 | 78.1 |
| 2 | NS MNaTel | 57.6 | 69.3 | 83.5 |
| 15 | NS Sol | 61 | 69.3 | 78.8 |
| 1 | NS MNaMes | 56.3 | 69.2 | 85.1 |
| 2 | NS PicMNaNap | 50.1 | 67.8 | 91.6 |
| 6 | NS MNaPPFos | 59.2 | 66.7 | 74.9 |
| 15 | NS MNaPP | 59.2 | 65.4 | 72.2 |
| 4 | NS MNaHelp | 56.9 | 64.4 | 72.7 |
| 3 | NS Multi | 52 | 61.8 | 73.5 |

Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|--------------|-----------|----------------|-----------|
| 75 | NS NoTr | 52.7 | 58.7 | 65.4 |
| 2 | NS EMF | 47 | 56 | 66.9 |
| 4 | NS PPFosNap | 28 | 45.9 | 75.3 |
| 2 | NS Chick | 20 | 35.2 | 61.7 |
| 2 | NS SheepPoul | 19.9 | 35.1 | 61.6 |
| 4 | NS PPNap | 11.9 | 19.6 | 32 |

APPENDIX II-4 Relationship for treatment x application method interaction between number of trials, number of observations, treatments and the estimated relative means for strawberry yields compared to the standard MB treatment (MB/Pic 67:33) from the complete meta-analysis (Y1)

STRAWBERRY - Treatments x application method (5 levels: Injection, Drip, Spray, Spread and Not specified)

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|--------------------------|-----------|----------------|-----------|
| 3 | Injection MB98 | 123.9 | 144.4 | 168.3 |
| 2 | Injection TC35Daz | 105.4 | 122.3 | 141.9 |
| 1 | Injection PicMNaDiTera | 70.1 | 108.1 | 166.8 |
| 2 | Injection PicDazEnz | 90.8 | 107.1 | 126.2 |
| 4 | Injection TC35MNa | 90.8 | 101.9 | 114.4 |
| 4 | Injection PicFosNap | 91.4 | 100.3 | 110 |
| 3 | Injection TC35ECPicECDaz | 88.6 | 100.1 | 113.1 |
| 122 | Injection MB67 | 94.3 | 100 | 106.1 |
| 3 | Injection MNaTelNap | 90.9 | 99.4 | 108.8 |
| 3 | Injection TC17Peb | 87 | 99.3 | 113.3 |
| 3 | Injection TC17 | 89.3 | 99.1 | 110 |
| 13 | Injection MI60 | 91.7 | 99.1 | 107 |
| 62 | Injection TC35 | 92.9 | 98.8 | 105 |
| 24 | Injection MB50 | 92.5 | 98.6 | 105.1 |
| 1 | Injection TC35Nap | 78.6 | 97.2 | 120.2 |
| 2 | Injection PicDMDS | 87 | 96.9 | 107.9 |
| 3 | Injection DazNap | 84.1 | 96.5 | 110.7 |
| 5 | Injection TC35Peb | 85.3 | 96 | 108.1 |
| 1 | Injection PicECMNaHM0 | 78.2 | 96 | 117.7 |
| 62 | Injection Pic | 90.3 | 96 | 102 |
| 2 | Injection TC35ECMNa | 82.3 | 95.3 | 110.4 |
| 1 | Injection DazSol | 74.9 | 95.2 | 121.1 |
| 5 | Injection TC35Nap | 85.6 | 95 | 105.5 |
| 1 | Injection TC35Pic | 79.4 | 94.7 | 113 |
| 13 | Injection MB30 | 88.2 | 94.4 | 101 |
| 1 | Injection TC35MNaOrgFung | 75.6 | 94.3 | 117.6 |
| 5 | Injection PicNap | 86.4 | 94.2 | 102.6 |
| 2 | Injection TC17Nap | 80.3 | 93.5 | 109 |
| 1 | Injection PicTel | 77.9 | 93.5 | 112.1 |
| 5 | Injection MI30 | 84.1 | 93.2 | 103.2 |
| 5 | Injection Vrlx | 82.3 | 92.7 | 104.4 |
| 10 | Injection PicMNa | 81.3 | 91.2 | 102.3 |
| 28 | Injection Daz | 83.6 | 89.8 | 96.5 |
| 4 | Injection MI100 | 79.5 | 89.5 | 100.8 |
| 4 | Injection DMDS | 77.8 | 87.8 | 99.1 |
| 1 | Injection MNaPeb | 70.7 | 86.4 | 105.5 |
| 2 | Injection MNaTelPeb | 77.3 | 86.2 | 96.3 |
| 3 | Injection Tel | 75.3 | 86.1 | 98.5 |
| 7 | Injection PPO | 77.8 | 85.7 | 94.5 |
| 5 | Injection MNaNap | 76.3 | 84 | 92.6 |
| 32 | Injection MNa | 73.5 | 82.8 | 93.2 |
| 2 | Injection PicMNaSol | 61.3 | 82.4 | 110.6 |
| 1 | Injection PicTelNap | 64.6 | 80.6 | 100.5 |
| 1 | Injection TC17PicNap | 64.1 | 80 | 99.7 |
| 1 | Injection MNaSol | 70.2 | 79.3 | 89.5 |
| 4 | Injection EDN | 68.9 | 78.6 | 89.7 |
| 2 | Injection PicMNaEnz | 56.7 | 75.9 | 101.5 |
| 9 | Injection NoTr | 59.3 | 75.2 | 95.4 |
| 2 | Injection MNaTel | 63.4 | 75.1 | 89 |
| 2 | Injection PicMNaNap | 53.9 | 72.3 | 97.1 |

Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|-----------------------|-----------|----------------|-----------|
| 2 | Injection Cal | 57.9 | 68.1 | 80.1 |
| 2 | Injection MNaHelp | 57.6 | 65.8 | 75.2 |
| 1 | Injection MNaPPO | 48.1 | 57.4 | 68.6 |
| 3 | Injection Sol | 41 | 52 | 66.1 |
| 4 | Injection PPFosNap | 33.5 | 50.2 | 75 |
| 7 | Injection PPNap | 18.9 | 25.3 | 33.9 |
| 5 | Drip MI60 | 92.8 | 101.7 | 111.4 |
| 28 | Drip PicEC | 92.6 | 98.8 | 105.5 |
| 51 | Drip TC35EC | 92.5 | 98.6 | 105.2 |
| 16 | Drip TC35ECMNa | 89.8 | 96.7 | 104.2 |
| 13 | Drip PicECMNa | 86.9 | 94.6 | 102.9 |
| 3 | Drip PPNap | 57.2 | 92.7 | 150.1 |
| 1 | Drip MNaPPO | 77.2 | 92.1 | 109.8 |
| 41 | Drip MNa | 74.2 | 82.6 | 92.1 |
| 1 | Drip TC35 | 68.5 | 81.9 | 97.8 |
| 1 | Drip MI100 | 62.9 | 79.3 | 100.1 |
| 1 | Drip MNaMes | 63.9 | 76.6 | 91.8 |
| 3 | Drip Multi | 57.3 | 67 | 78.4 |
| 2 | Spray TC35MNa | 99.7 | 116 | 134.9 |
| 3 | Spray PicMNa | 86.7 | 105.7 | 128.7 |
| 3 | Spray TC35ECMNa | 89.7 | 101.4 | 114.7 |
| 4 | Spray PicECMNaDiTera | 89.3 | 99.2 | 110.1 |
| 9 | Spray PicECMNaFos | 88.7 | 96.5 | 105.1 |
| 3 | Spray PicECMNaHM0 | 76 | 85.5 | 96.1 |
| 2 | Spray MNaPPO | 72.3 | 82.3 | 93.6 |
| 11 | Spray PicECMNaEnz | 74.6 | 81 | 88 |
| 1 | Spray MNaRootshld | 65.9 | 79.2 | 95.1 |
| 2 | Spray MNaHelp | 66.2 | 75.4 | 85.9 |
| 6 | Spray MNaPPFos | 66.3 | 72.9 | 80.2 |
| 15 | Spray MNaPP | 65.9 | 71.2 | 76.9 |
| 4 | Spray MNa | 12.7 | 18.1 | 25.7 |
| 2 | Spread TC35Daz | 106.3 | 123.4 | 143.2 |
| 2 | Spread PicECDazEnz | 90.6 | 108.2 | 129.2 |
| 2 | Spread TC35ECPicECDaz | 90.5 | 104.8 | 121.5 |
| 2 | Spread TC35ECDaz | 89 | 103.4 | 120.1 |
| 2 | Spread SolFert | 75.9 | 101.5 | 135.7 |
| 1 | Spread Daz | 68.3 | 88.1 | 113.8 |
| 2 | Spread Chick | 22.1 | 38.4 | 66.8 |
| 2 | Hotgas TC35MNa | 99.8 | 115.9 | 134.5 |
| 1 | NS PicECDaz | 88.5 | 111.7 | 141 |
| 2 | NS PicFosNap | 93.7 | 107.2 | 122.6 |
| 3 | NS SolCab | 85.7 | 99.9 | 116.4 |
| 1 | NS Daz | 73.9 | 95.5 | 123.5 |
| 3 | NS MB67Sol | 81.9 | 93.5 | 106.8 |
| 1 | NS TC35Daz | 74.9 | 92.7 | 114.8 |
| 6 | NS SolFert | 77.7 | 91.1 | 106.8 |
| 4 | NS TC35Sol | 80.5 | 90 | 100.6 |
| 11 | NS MNaSol | 84.1 | 90 | 96.2 |
| 1 | NS MB50Sol | 70.7 | 89.3 | 112.8 |
| 3 | NS MNaTelSol | 80.5 | 88.1 | 96.4 |
| 1 | NS SolBio | 66.6 | 84.1 | 106.2 |
| 14 | NS Sol | 72.8 | 81.1 | 90.4 |
| 2 | NS Compost | 45.9 | 79.8 | 138.5 |
| 1 | NS MycCom | 56.7 | 76.1 | 102.1 |
| 1 | NS MB67 | 66.7 | 75.9 | 86.4 |
| 3 | NS BioFum | 66.7 | 75.9 | 86.4 |

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|--------------|-----------|----------------|-----------|
| 69 | NS NoTr | 56.4 | 61.8 | 67.7 |
| 2 | NS EMF | 51.9 | 61 | 71.6 |
| 2 | NS SheepPoul | 22.1 | 38.4 | 66.6 |

APPENDIX II-5 Relationship for treatment x plastic seal interaction between number of trials, number of observations, treatments and the estimated relative means for strawberry yields compared to the standard MB treatment (MB/Pic 67:33) from the complete meta-analysis (Y1)

STRAWBERRY - Treatments x plastic seal (2 levels: Barrier film and Non Barrier film)

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|------------------------|-----------|----------------|-----------|
| 2 | Barr TC35ECMNa | 75.7 | 154.4 | 315.2 |
| 8 | Barr PicEC | 111.4 | 146 | 191.2 |
| 2 | Barr PicECMNa | 28.7 | 141.9 | 701.7 |
| 8 | Barr TC35EC | 89.2 | 140.3 | 220.7 |
| 2 | Barr NoTr | 40.5 | 112 | 310 |
| 22 | Barr MB67 | 72.6 | 100 | 137.8 |
| 7 | Barr TC35 | 50 | 81.8 | 134.1 |
| 2 | Barr PicDMDS | 13 | 81.3 | 507.5 |
| 2 | Barr PPO | 8.9 | 79.2 | 708.4 |
| 4 | Barr Pic | 43.5 | 78.5 | 141.8 |
| 2 | Barr PicMNa | 10.4 | 77.3 | 576 |
| 4 | Barr MB50 | 41.3 | 72.6 | 127.6 |
| 7 | Barr Daz | 41.4 | 70.9 | 121.4 |
| 2 | Barr DMDS | 36.7 | 70.6 | 135.7 |
| 1 | NonBarr TC35Pic | 67.5 | 239.5 | 849.7 |
| 2 | NonBarr TC35ECDaz | 87.1 | 183.1 | 385.1 |
| 5 | NonBarr TC35ECPicECDaz | 100 | 160.3 | 256.9 |
| 9 | NonBarr PicECMNaFos | 89 | 146.7 | 242 |
| 5 | NonBarr MI100 | 92.8 | 140.5 | 212.9 |
| 4 | NonBarr PicECMNaDiTera | 66.8 | 137.8 | 284.2 |
| 20 | NonBarr PicEC | 105.8 | 137.2 | 177.9 |
| 19 | NonBarr TC35ECMNa | 98.4 | 135.5 | 186.6 |
| 43 | NonBarr TC35EC | 97.8 | 131.7 | 177.5 |
| 1 | NonBarr PicECDaz | 56 | 129 | 297 |
| 2 | NonBarr PicECDazEnz | 69.1 | 124.9 | 226 |
| 3 | NonBarr Multi | 73.9 | 121.8 | 200.7 |
| 15 | NonBarr MNaPP | 80.8 | 107.9 | 144 |
| 6 | NonBarr MNaPPFos | 73.1 | 102 | 142.3 |
| 1 | NonBarr MNaRootshld | 54.9 | 99.8 | 181.5 |
| 8 | NonBarr TC35MNa | 65.8 | 98.3 | 146.7 |
| 5 | NonBarr Vrlx | 59.2 | 98.1 | 162.5 |
| 11 | NonBarr PicECMNaEnz | 59.2 | 95.7 | 155 |
| 1 | NonBarr DazSol | 39.8 | 95.4 | 228.6 |
| 2 | NonBarr TC17Nap | 43.9 | 93.6 | 199.3 |
| 1 | NonBarr MNaMes | 48.6 | 88.5 | 160.9 |
| 5 | NonBarr TC35Nap | 52 | 88.2 | 149.6 |
| 3 | NonBarr MNaTelNap | 50.9 | 87.8 | 151.4 |
| 5 | NonBarr PicNap | 29 | 87.4 | 263.3 |
| 3 | NonBarr TC17Peb | 41.1 | 86.9 | 184 |
| 18 | NonBarr MI60 | 55.1 | 86.2 | 134.9 |
| 1 | NonBarr TC35Nap | 30.4 | 85.1 | 237.7 |
| 3 | NonBarr TC17 | 41.9 | 84.8 | 171.6 |
| 1 | NonBarr MycCom | 20 | 83.7 | 349.7 |
| 5 | NonBarr TC35Peb | 43.3 | 83.7 | 161.7 |
| 101 | NonBarr MB67 | 64.1 | 83.5 | 108.7 |
| 2 | NonBarr PicMNaSol | 11.8 | 82.4 | 576.4 |
| 3 | NonBarr MB98 | 46.9 | 81.6 | 142.2 |
| 13 | NonBarr MB30 | 55.3 | 80.4 | 117 |
| 5 | NonBarr MNaNap | 51.7 | 78 | 117.5 |
| 2 | NonBarr MNaTelPeb | 38.3 | 77.6 | 157.3 |
| 11 | NonBarr PicECMNa | 39.6 | 74.8 | 141.1 |

Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|------------------------|-----------|----------------|-----------|
| 3 | NonBarr MB67Sol | 44.8 | 74.1 | 122.5 |
| 1 | NonBarr TC35MNaOrgFung | 25.3 | 74.1 | 216.9 |
| 2 | NonBarr PicMNaNap | 10.3 | 72.3 | 506.1 |
| 3 | NonBarr DazNap | 41.4 | 72.1 | 125.5 |
| 1 | NonBarr MNaPeb | 32.8 | 71.6 | 156.5 |
| 58 | NonBarr Pic | 53.8 | 71.4 | 94.7 |
| 56 | NonBarr TC35 | 53.2 | 70.6 | 93.7 |
| 23 | NonBarr Daz | 49.5 | 69.6 | 97.7 |
| 5 | NonBarr MI30 | 29.6 | 69.3 | 162.4 |
| 10 | NonBarr SolFert | 50.7 | 69.1 | 94 |
| 20 | NonBarr MB50 | 49.3 | 68.7 | 95.8 |
| 1 | NonBarr SolBio | 29.3 | 68 | 157.7 |
| 1 | NonBarr TC35Sol | 23.9 | 67.3 | 189.8 |
| 14 | NonBarr MNaSol | 51.1 | 66.8 | 87.5 |
| 77 | NonBarr MNa | 47.1 | 63.8 | 86.3 |
| 1 | NonBarr PicTelNap | 21.6 | 63.4 | 185.5 |
| 2 | NonBarr DMDS | 32.9 | 63.3 | 121.7 |
| 1 | NonBarr TC17PicNap | 21.5 | 62.9 | 184.1 |
| 2 | NonBarr MNaTel | 31.2 | 61.5 | 121.3 |
| 1 | NonBarr PicTel | 14.6 | 60.7 | 251.7 |
| 4 | NonBarr MNaPPO | 42 | 60.5 | 87.2 |
| 4 | NonBarr EDN | 33.1 | 59.1 | 105.3 |
| 3 | NonBarr BioFum | 35.4 | 58.6 | 96.9 |
| 1 | NonBarr PicMNaDiTera | 3.3 | 57.3 | 1002.3 |
| 2 | NonBarr Cal | 29.7 | 57.1 | 109.9 |
| 3 | NonBarr SolCab | 32.4 | 56.5 | 98.4 |
| 14 | NonBarr Sol | 41.8 | 56.1 | 75.3 |
| 1 | NonBarr MB50Sol | 24 | 55.7 | 129.1 |
| 85 | NonBarr NoTr | 39.1 | 51.5 | 67.8 |
| 4 | NonBarr MNaHelp | 35.5 | 51.2 | 73.7 |
| 2 | NonBarr EMF | 26.9 | 49.2 | 89.8 |
| 2 | NonBarr PicDazEnz | 25.9 | 46.8 | 84.7 |
| 4 | NonBarr PicECMNaHM0 | 17.6 | 36.4 | 75.4 |
| 3 | NonBarr Tel | 21.1 | 35 | 58.1 |
| 4 | NonBarr Compost | 19.1 | 34.1 | 60.7 |
| 5 | NonBarr TC35Daz | 19.1 | 30.8 | 49.5 |
| 5 | NonBarr PPO | 8.4 | 30.3 | 109 |
| 2 | NonBarr Chick | 13 | 29.1 | 65.1 |
| 2 | NonBarr SheepPoul | 13 | 29.1 | 65 |
| 11 | NonBarr PicMNa | 13.1 | 28.2 | 60.9 |
| 4 | NonBarr PPFosNap | 7.7 | 21.9 | 62.2 |
| 6 | NonBarr PicFosNap | 5.5 | 14.4 | 38 |
| 2 | NonBarr PicMNaEnz | 0.9 | 6 | 41.3 |
| 10 | NonBarr PPNap | 3.1 | 5.9 | 11.2 |

APPENDIX II-6 Relationship for treatment x production system interaction between number of trials, number of observations, treatments and the estimated relative means for strawberry yields compared to the standard MB treatment (MB/Pic 67:33) from the complete meta-analysis (Y1)

STRAWBERRY - Treatments x production system (2 levels: Greenhouse and Open field)

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|------------------------|-----------|----------------|-----------|
| 3 | Greenhouse BioFum | 18.9 | 36.9 | 72 |
| 2 | Greenhouse Cal | 13.6 | 36 | 95.2 |
| 13 | Greenhouse Daz | 20.6 | 46.3 | 104.3 |
| 4 | Greenhouse DMDS | 17.6 | 42.1 | 100.9 |
| 2 | Greenhouse EMF | 12.2 | 31.2 | 79.5 |
| 18 | Greenhouse MB50 | 22.8 | 49.3 | 106.5 |
| 1 | Greenhouse MB50Sol | 11.3 | 34.7 | 107 |
| 19 | Greenhouse MB67 | 22.6 | 48.5 | 104.1 |
| 3 | Greenhouse MB67Sol | 19.3 | 46.1 | 110.3 |
| 4 | Greenhouse MNa | 11 | 36.9 | 123.2 |
| 8 | Greenhouse MNaSol | 20.3 | 41.9 | 86.5 |
| 13 | Greenhouse NoTr | 15.2 | 35 | 80.1 |
| 11 | Greenhouse Pic | 22 | 48.6 | 107.3 |
| 2 | Greenhouse PicDMDS | 6.9 | 51.3 | 378.2 |
| 2 | Greenhouse PicMNa | 5.7 | 48.7 | 416.1 |
| 4 | Greenhouse PPO | 9.5 | 46.8 | 230.1 |
| 6 | Greenhouse Sol | 16.5 | 35.3 | 75.7 |
| 1 | Greenhouse SolBio | 13.8 | 42.3 | 129.7 |
| 4 | Greenhouse SolFert | 18.7 | 41.2 | 90.9 |
| 2 | Greenhouse TC17 | 16.6 | 52.1 | 163.7 |
| 16 | Greenhouse TC35 | 23.6 | 51.7 | 113.3 |
| 2 | Open Field Chick | 18.3 | 35.7 | 69.7 |
| 4 | Open Field Compost | 21 | 39 | 72.5 |
| 17 | Open Field Daz | 47.8 | 73 | 111.4 |
| 3 | Open Field DazNap | 45.3 | 79.7 | 140.1 |
| 1 | Open Field DazSol | 45.7 | 109.9 | 264.3 |
| 4 | Open Field EDN | 31.4 | 58.2 | 107.9 |
| 13 | Open Field MB30 | 56.7 | 86.6 | 132.3 |
| 6 | Open Field MB50 | 29.5 | 50.7 | 86.9 |
| 104 | Open Field MB67 | 72.6 | 100 | 137.8 |
| 3 | Open Field MB98 | 52.9 | 95.3 | 171.6 |
| 5 | Open Field MI100 | 100.6 | 158.3 | 249.1 |
| 5 | Open Field MI30 | 29.2 | 70.1 | 168.5 |
| 18 | Open Field MI60 | 59.7 | 97.3 | 158.7 |
| 73 | Open Field MNa | 50.5 | 72.3 | 103.7 |
| 4 | Open Field MNaHelp | 38.2 | 57.7 | 87.2 |
| 1 | Open Field MNaMes | 53.2 | 99.7 | 187.1 |
| 5 | Open Field MNaNap | 55.8 | 86.5 | 134.2 |
| 1 | Open Field MNaPeb | 37.8 | 84.1 | 187.1 |
| 15 | Open Field MNaPP | 86.3 | 121.7 | 171.8 |
| 6 | Open Field MNaPPFos | 78.3 | 115 | 168.9 |
| 4 | Open Field MNaPPO | 45.2 | 68.2 | 103.1 |
| 1 | Open Field MNaRootshld | 60 | 112.5 | 211 |
| 6 | Open Field MNaSol | 57.8 | 82.6 | 118 |
| 2 | Open Field MNaTel | 34.9 | 69.9 | 140 |
| 3 | Open Field MNaTelNap | 54.2 | 95 | 166.5 |
| 2 | Open Field MNaTelPeb | 42.8 | 90.7 | 192.4 |
| 3 | Open Field MNaTelSol | 48.1 | 84.2 | 147.5 |
| 3 | Open Field Multi | 81 | 137.6 | 233.5 |
| 1 | Open Field MycCom | 24.6 | 100.2 | 408.5 |
| 74 | Open Field NoTr | 41.5 | 58 | 81.2 |

Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|---------------------------|-----------|----------------|-----------|
| 51 | Open Field Pic | 55.7 | 78.8 | 111.4 |
| 2 | Open Field PicDazEnz | 28.6 | 52.8 | 97.5 |
| 28 | Open Field PicEC | 111.9 | 154.1 | 212 |
| 1 | Open Field PicECDaz | 63.2 | 145.4 | 334.9 |
| 2 | Open Field PicECDazEnz | 76.3 | 140.9 | 260.1 |
| 13 | Open Field PicECMNa | 50.2 | 91.8 | 168 |
| 4 | Open Field PicECMNaDiTera | 73.6 | 155.6 | 329 |
| 11 | Open Field PicECMNaEnz | 64.4 | 108.3 | 182.1 |
| 9 | Open Field PicECMNaFos | 96.7 | 165.6 | 283.7 |
| 4 | Open Field PicECMNaHMO | 19.4 | 41.1 | 87.2 |
| 6 | Open Field PicFosNap | 6.1 | 16.3 | 43.5 |
| 11 | Open Field PicMNa | 14 | 30.7 | 67.4 |
| 1 | Open Field PicMNaDiTera | 3.8 | 64.6 | 1102.6 |
| 2 | Open Field PicMNaEnz | 1 | 6.8 | 46.1 |
| 2 | Open Field PicMNaNap | 12 | 83.3 | 577.1 |
| 2 | Open Field PicMNaSol | 13.7 | 94.8 | 657.3 |
| 5 | Open Field PicNap | 32.2 | 97 | 292.1 |
| 1 | Open Field PicTel | 14.1 | 58.7 | 244.5 |
| 1 | Open Field PicTelNap | 25.1 | 71.8 | 206 |
| 10 | Open Field PPNap | 3.4 | 6.6 | 13 |
| 4 | Open Field PPFosNap | 8.6 | 24.7 | 70.9 |
| 3 | Open Field PPO | 4 | 19.7 | 95.7 |
| 2 | Open Field SheepPoul | 15.3 | 35.7 | 83.3 |
| 11 | Open Field Sol | 46.6 | 67.9 | 98.9 |
| 3 | Open Field SolCab | 36.6 | 65.9 | 118.6 |
| 6 | Open Field SolFert | 58.6 | 88.1 | 132.5 |
| 1 | Open Field TC17 | 24.7 | 95.9 | 372.5 |
| 2 | Open Field TC17Nap | 50 | 107.7 | 232.1 |
| 3 | Open Field TC17Peb | 47.6 | 101.7 | 217.3 |
| 1 | Open Field TC17PicNap | 24.9 | 71.3 | 204.4 |
| 47 | Open Field TC35 | 53.8 | 76.1 | 107.5 |
| 5 | Open Field TC35Daz | 21 | 34.8 | 57.6 |
| 1 | Open Field TC35Nap | 35 | 96 | 263.5 |
| 51 | Open Field TC35EC | 104.5 | 147.9 | 209.4 |
| 2 | Open Field TC35ECDaz | 98.1 | 207.2 | 437.7 |
| 21 | Open Field TC35ECMNa | 106.5 | 153.3 | 220.8 |
| 5 | Open Field TC35ECPicECDaz | 109.4 | 180.9 | 299.1 |
| 8 | Open Field TC35MNa | 71.2 | 110.5 | 171.6 |
| 1 | Open Field TC35MNaOrgFung | 29.3 | 84 | 240.9 |
| 5 | Open Field TC35Nap | 56.9 | 97.9 | 168.3 |
| 5 | Open Field TC35Peb | 49.8 | 98 | 192.9 |
| 1 | Open Field TC35Pic | 75.3 | 266.6 | 944.4 |
| 4 | Open Field TC35Sol | 49 | 86.4 | 152.6 |
| 3 | Open Field Tel | 22.4 | 38.3 | 65.5 |
| 5 | Open Field Vrlx | 59.7 | 102.3 | 175.3 |

APPENDIX II-7 Relationship for treatment x soil type interaction between number of trials, number of observations, treatments and the estimated relative means for strawberry yields compared to the standard MB treatment (MB/Pic 67:33) from the complete meta-analysis (Y1)

STRAWBERRY - Treatments x soil type (4 levels: Sand, Clay, Loam and Not specified)

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|----------------|-----------|----------------|-----------|
| 2 | sand SolFert | 71.1 | 103.8 | 151.5 |
| 1 | sand Pic | 77.3 | 101 | 132 |
| 10 | sand MB67 | 80.9 | 100 | 123.6 |
| 2 | sand MNaTelNap | 78.8 | 99.7 | 126.2 |
| 3 | sand TC17Peb | 76.9 | 99 | 127.4 |
| 1 | sand DazNap | 87 | 97.4 | 109.1 |
| 5 | sand TC35Peb | 75.4 | 96.2 | 122.7 |
| 1 | sand TC17Nap | 70.5 | 95.6 | 129.7 |
| 5 | sand TC35 | 74.6 | 94.4 | 119.5 |
| 3 | sand TC35Nap | 73.2 | 92.7 | 117.5 |
| 2 | sand MNaSol | 73 | 92.7 | 117.6 |
| 2 | sand MNaTelSol | 69.9 | 88.5 | 112 |
| 3 | sand PicNap | 70.8 | 88 | 109.3 |
| 3 | sand TC35Sol | 69.1 | 87.6 | 111.1 |
| 1 | sand MNaPeb | 62.9 | 86.3 | 118.4 |
| 2 | sand MNaTelPeb | 66.6 | 85.9 | 110.8 |
| 3 | sand MNaNap | 65.3 | 82.8 | 105 |
| 5 | sand Sol | 62 | 81.9 | 108.3 |
| 1 | sand PicMNaSol | 41.6 | 79.3 | 151.3 |
| 1 | sand PicMNaNap | 30.5 | 58.1 | 110.8 |
| 10 | sand NoTr | 40.8 | 55.7 | 76.1 |
| 9 | clay TC35 | 101.1 | 116.6 | 134.4 |
| 1 | clay Tel | 83.5 | 109 | 142.3 |
| 5 | clay MB50 | 92.3 | 106.7 | 123.3 |
| 2 | clay MB67 | 89.1 | 105 | 123.6 |
| 9 | clay Pic | 91 | 104.5 | 119.9 |
| 1 | clay PicMNa | 68.3 | 103.2 | 156.1 |
| 5 | clay Vrix | 86.5 | 102.2 | 120.7 |
| 6 | clay MB30 | 87.3 | 100.7 | 116.3 |
| 8 | clay Daz | 87 | 97.4 | 109.1 |
| 4 | clay MI30 | 81.5 | 96.2 | 113.6 |
| 2 | clay MNa | 48.1 | 94.4 | 185.2 |
| 4 | clay EDN | 71 | 85.5 | 102.8 |
| 10 | clay NoTr | 64.4 | 83.1 | 107.2 |
| 2 | loam PicNap | 85.7 | 103.7 | 125.5 |
| 1 | loam TC35Sol | 75.6 | 99 | 129.5 |
| 2 | loam TC35Nap | 78.7 | 98.1 | 122.2 |
| 2 | loam MB67 | 80.9 | 97.6 | 117.7 |
| 1 | loam DazSol | 72.9 | 97.6 | 130.7 |
| 1 | loam MNaTelNap | 76.7 | 97.5 | 123.8 |
| 2 | loam DazNap | 87 | 97.4 | 109.1 |
| 1 | loam TC17Nap | 70.1 | 91.8 | 120.1 |
| 1 | loam PicMNaNap | 48.4 | 90.3 | 168.6 |
| 1 | loam MNaTelSol | 67.7 | 86.1 | 109.3 |
| 1 | loam PicMNaSol | 46 | 85.8 | 160.2 |
| 2 | loam MNaNap | 68.5 | 85.4 | 106.5 |
| 2 | loam NoTr | 40.9 | 72.5 | 128.4 |
| 3 | loam Sol | 41.7 | 56 | 75.2 |
| 3 | NS MB98 | 154.9 | 183.2 | 216.7 |
| 5 | NS TC35Daz | 131 | 147.7 | 166.5 |
| 1 | NS MI30 | 122.3 | 146.6 | 175.7 |

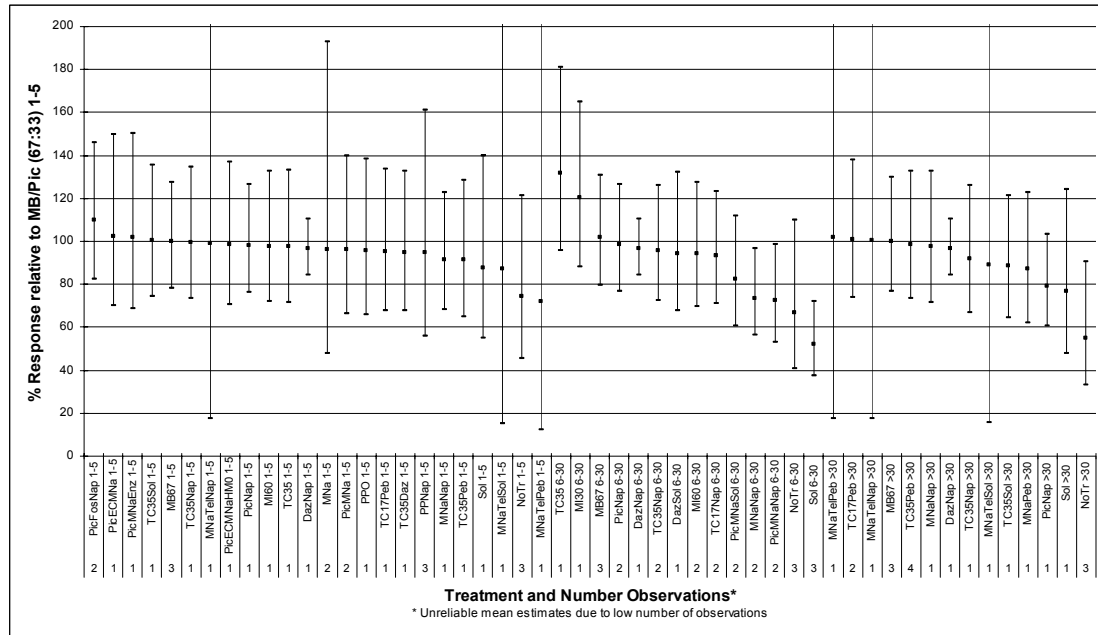
Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|-------------------|-----------|----------------|-----------|
| 1 | NS PicECDaz | 110.1 | 140.1 | 178.3 |
| 8 | NS TC35MNa | 125.6 | 140 | 156 |
| 1 | NS PicMNaDiTera | 76.4 | 138.9 | 252.4 |
| 2 | NS PicDazEnz | 115.4 | 137.8 | 164.5 |
| 2 | NS PicECDazEnz | 112.4 | 135.7 | 163.9 |
| 2 | NS TC35ECDaz | 113.9 | 134 | 157.5 |
| 4 | NS Compost | 90.1 | 131.6 | 192.1 |
| 6 | NS PicFosNap | 118 | 130.8 | 145 |
| 5 | NS TC35ECPicECDaz | 116 | 130.6 | 147.2 |
| 1 | NS MycCom | 98.6 | 128.4 | 167.2 |
| 18 | NS MI60 | 116.9 | 128.2 | 140.6 |
| 109 | NS MB67 | 117.8 | 128.2 | 139.4 |
| 4 | NS PicECMNaDiTera | 112.1 | 126.8 | 143.5 |
| 3 | NS SolCab | 107.1 | 126.7 | 149.9 |
| 3 | NS TC17 | 112 | 126.6 | 143.3 |
| 19 | NS MB50 | 115.8 | 126.5 | 138.3 |
| 28 | NS PicEC | 115.6 | 126.4 | 138.2 |
| 51 | NS TC35EC | 115.4 | 126.1 | 137.9 |
| 49 | NS TC35 | 114.8 | 125.1 | 136.4 |
| 21 | NS TC35ECMNa | 113.5 | 124.7 | 137 |
| 1 | NS TC35Nap | 100.1 | 124.5 | 154.8 |
| 2 | NS PicDMDS | 110 | 124.2 | 140.2 |
| 9 | NS PicECMNaFos | 110.9 | 123.3 | 137.2 |
| 52 | NS Pic | 112.7 | 122.8 | 133.9 |
| 1 | NS TC35Pic | 101.8 | 122.7 | 148 |
| 1 | NS TC35MNaOrgFung | 97.8 | 122.6 | 153.6 |
| 7 | NS MB30 | 111.4 | 122.5 | 134.7 |
| 12 | NS PicMNa | 106.6 | 121 | 137.4 |
| 13 | NS PicECMNa | 108.8 | 121 | 134.6 |
| 1 | NS PicTel | 99.4 | 120.4 | 145.8 |
| 3 | NS MB67Sol | 103 | 119.5 | 138.7 |
| 8 | NS SolFert | 99.8 | 116.8 | 136.6 |
| 22 | NS Daz | 105 | 115.6 | 127.2 |
| 1 | NS MB50Sol | 89.3 | 113.8 | 145 |
| 12 | NS MNaSol | 103.6 | 113.5 | 124.2 |
| 4 | NS PicECMNaHM0 | 99.4 | 112.5 | 127.3 |
| 4 | NS DMDS | 97.9 | 112.4 | 129.1 |
| 5 | NS MI100 | 98.6 | 112 | 127.2 |
| 7 | NS PPO | 97.6 | 109.7 | 123.3 |
| 1 | NS SolBio | 84.4 | 107.5 | 136.9 |
| 1 | NS PicTelNap | 83.6 | 104.8 | 131.4 |
| 1 | NS TC17PicNap | 83 | 104 | 130.4 |
| 11 | NS PicECMNaEnz | 93.5 | 103.7 | 115.1 |
| 2 | NS Tel | 85.8 | 102.5 | 122.5 |
| 9 | NS Sol | 87 | 101.2 | 117.6 |
| 1 | NS MNaRootshld | 81.2 | 100.8 | 125.2 |
| 4 | NS MNaPPO | 85.8 | 98.2 | 112.4 |
| 3 | NS BioFum | 87 | 97.4 | 109.1 |
| 75 | NS MNa | 86.3 | 97.3 | 109.7 |
| 2 | NS PicMNaEnz | 64.6 | 96.7 | 145 |
| 2 | NS MNaTel | 80.5 | 96.7 | 116 |
| 1 | NS MNaMes | 77.5 | 96.1 | 119.1 |
| 6 | NS MNaPPFos | 82.2 | 92.7 | 104.6 |
| 15 | NS MNaPP | 82.2 | 91 | 100.7 |
| 4 | NS MNaHelp | 79.2 | 89.9 | 102 |
| 2 | NS Cal | 73.2 | 87.3 | 104.1 |

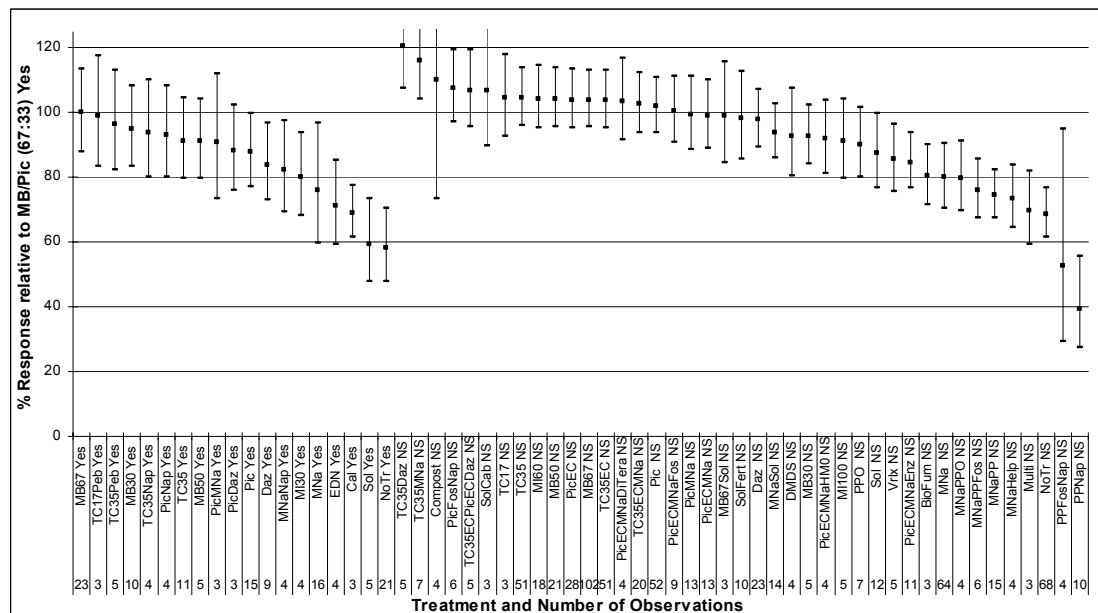
Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|--------------|-----------|----------------|-----------|
| 3 | NS Multi | 72.4 | 85.9 | 101.9 |
| 65 | NS NoTr | 72.3 | 81.1 | 90.8 |
| 2 | NS EMF | 66 | 78.5 | 93.3 |
| 4 | NS PPFosNap | 36.3 | 64.5 | 114.6 |
| 2 | NS SheepPoul | 28.1 | 48.9 | 85.1 |
| 2 | NS Chick | 28.1 | 48.9 | 85.2 |
| 10 | NS PPNap | 33.8 | 47.8 | 67.5 |

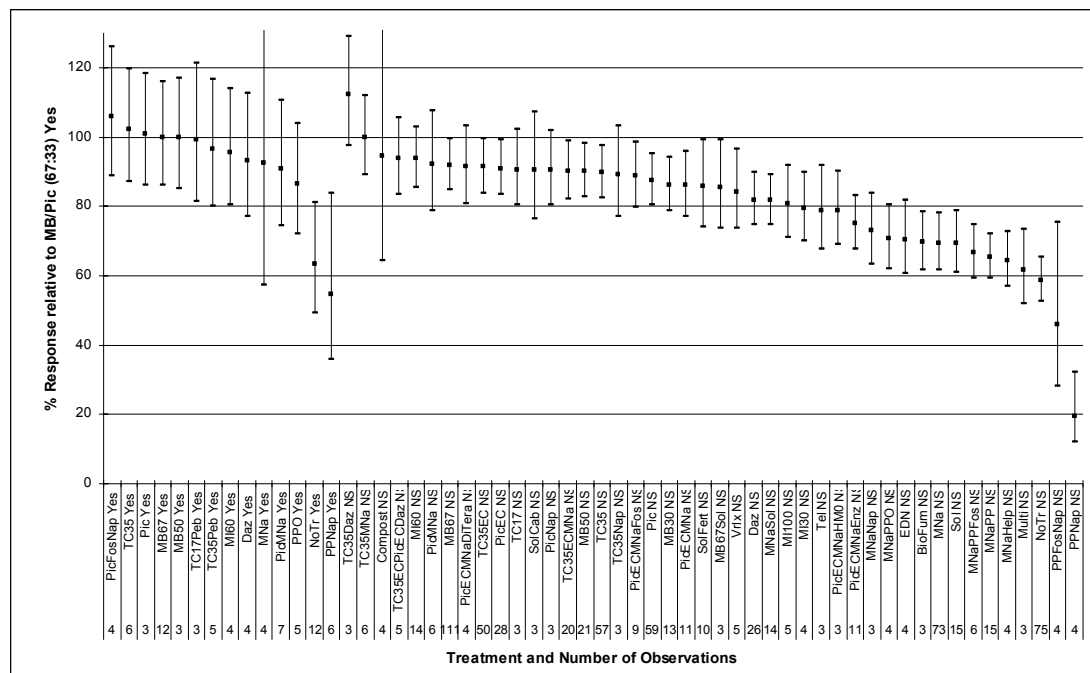
APPENDIX III-1. Relative yield data from the meta-analyses (treatment x nutsedge levels) and LSI intervals for alternatives to methyl bromide from international research studies in strawberry crops from 1997 to 2005 (All observations)



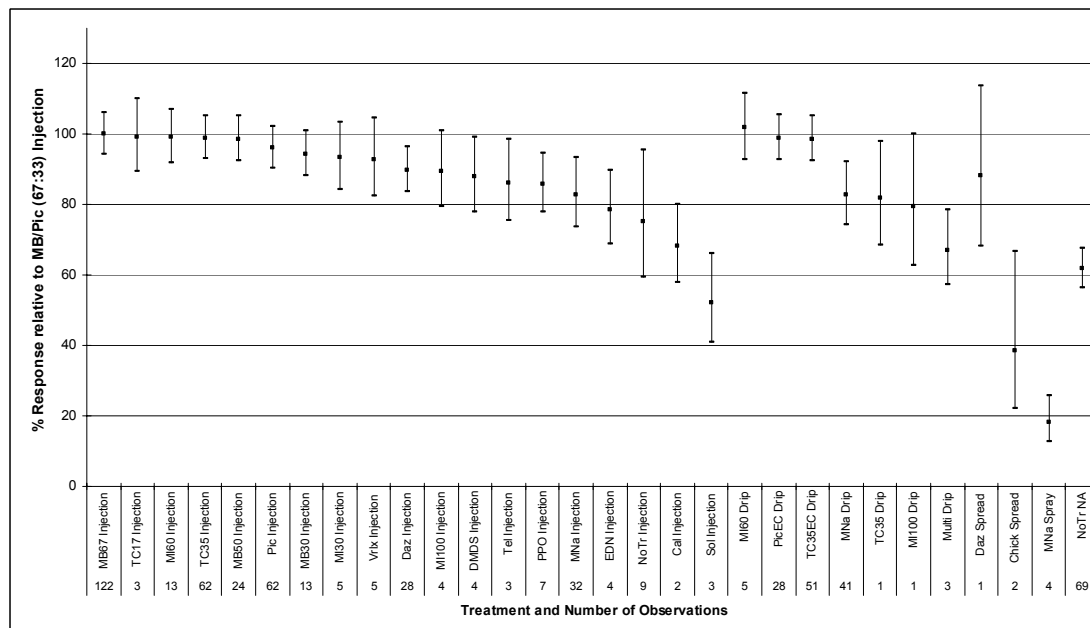
APPENDIX III-2. Relative yield data from the meta-analyses (treatment x fungal presence) and LSI intervals for alternatives to methyl bromide from international research studies in strawberry crops from 1997 to 2005. Note: >2 observations for an alternative were required before inclusion in the figure below.



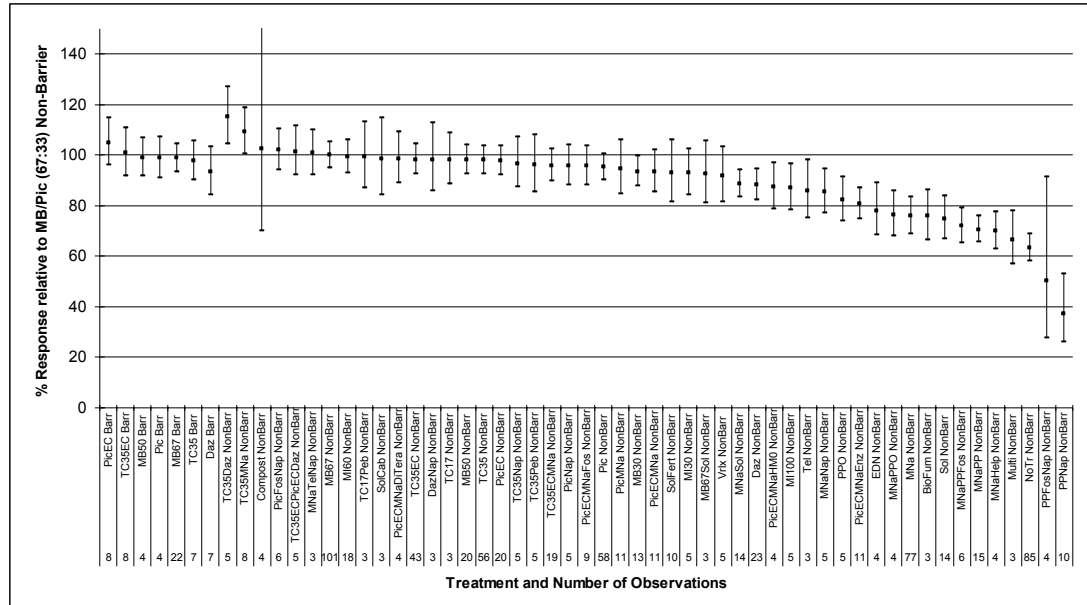
APPENDIX III-3. Relative yield data from the meta-analyses (treatment x nematode) and LSI intervals for alternatives to methyl bromide from international research studies in strawberry crops from 1997 to 2005. Note: >2 observations for an alternative were required before inclusion in the figure below.



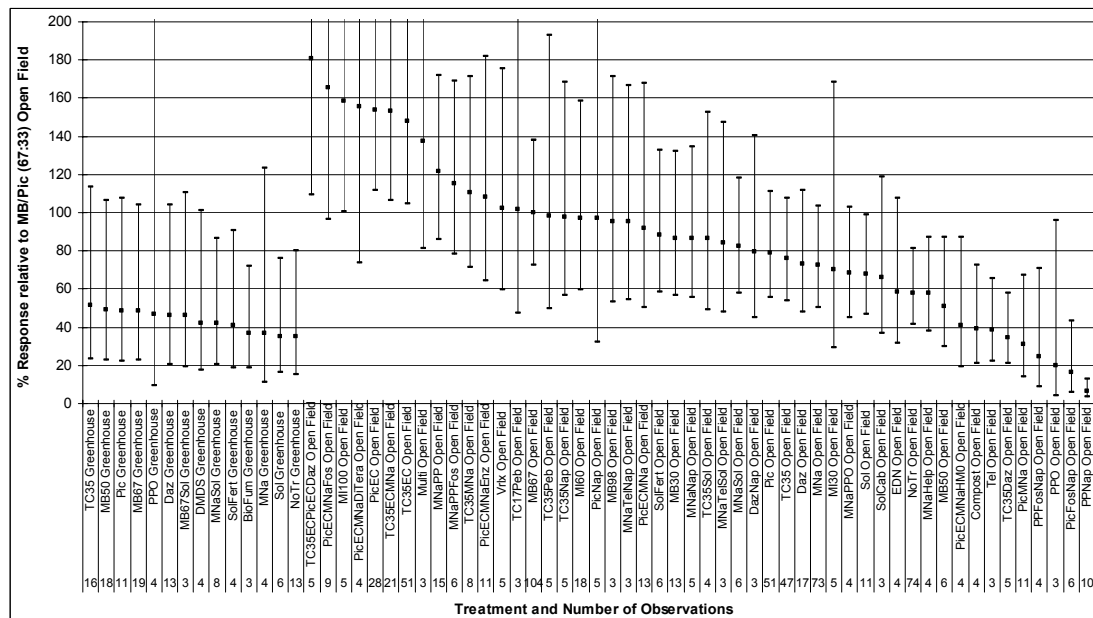
APPENDIX III-4. Relative yield data from the meta-analyses (treatment x application method) and LSI intervals for alternatives to methyl bromide from international research studies in strawberry crops from 1997 to 2005. Note: Observations were only for single treatments



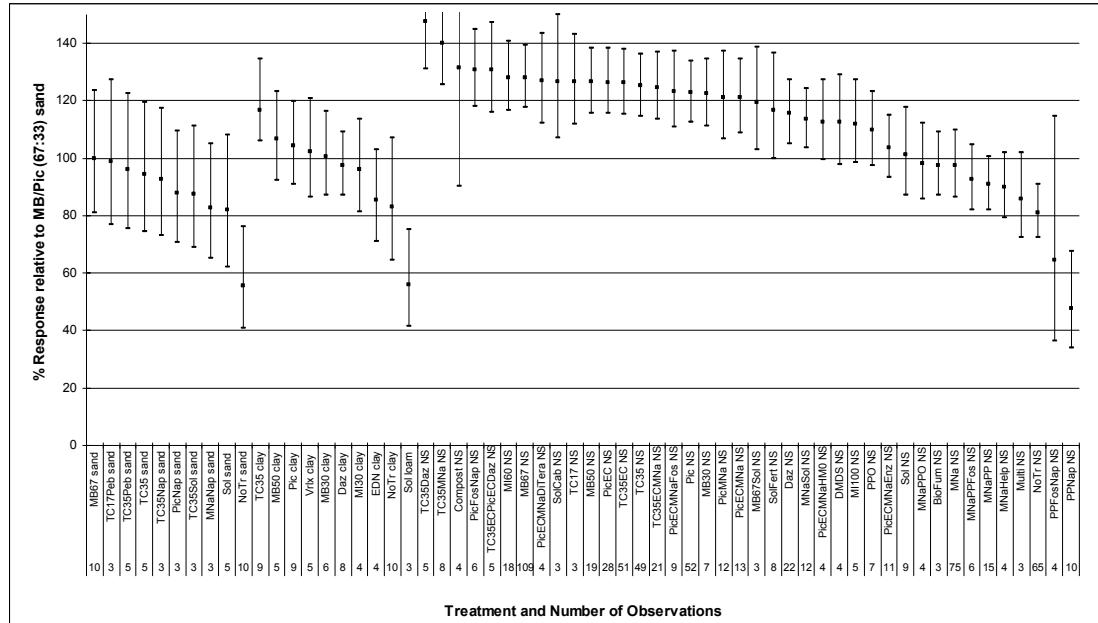
APPENDIX III-5. Relative yield data from the meta-analyses (treatment x plastic seal) and LSI intervals for alternatives to methyl bromide from international research studies in strawberry crops from 1997 to 2005. Note: >2 observations for an alternative were required before inclusion in the figure below.



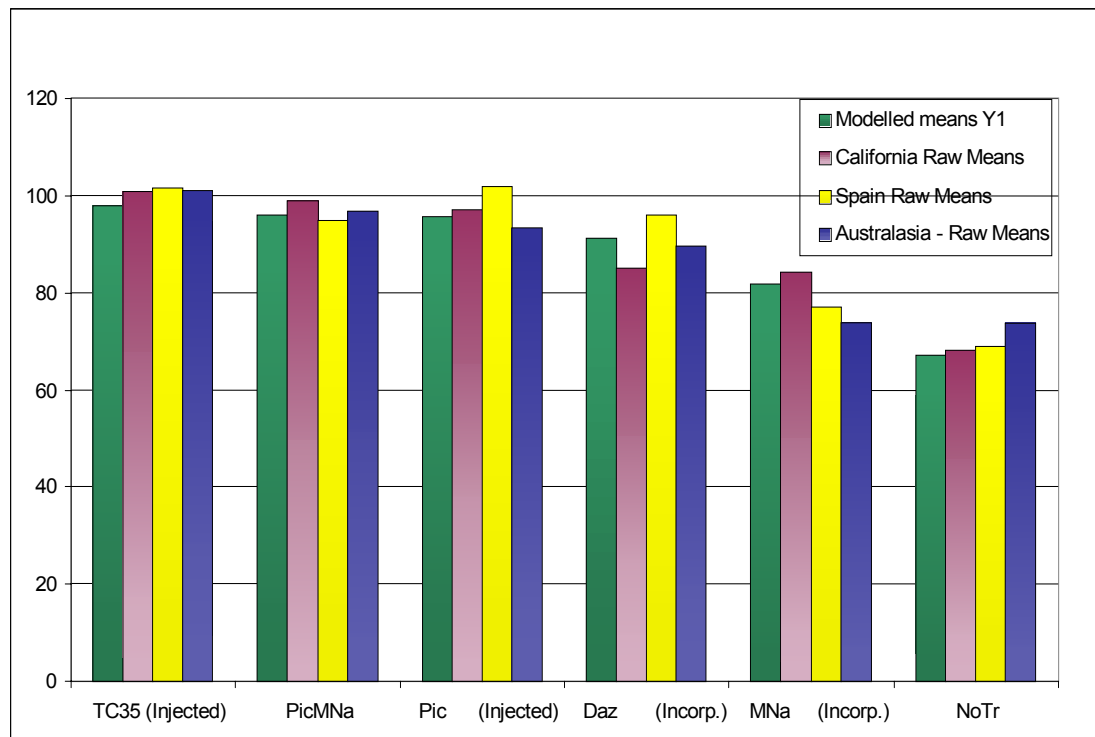
APPENDIX III-6. Relative yield data from the meta-analyses (treatment x production system) and LSI intervals for alternatives to methyl bromide from international research studies in strawberry crops from 1997 to 2005. Note: >2 observations for an alternative were required before inclusion in the figure below.



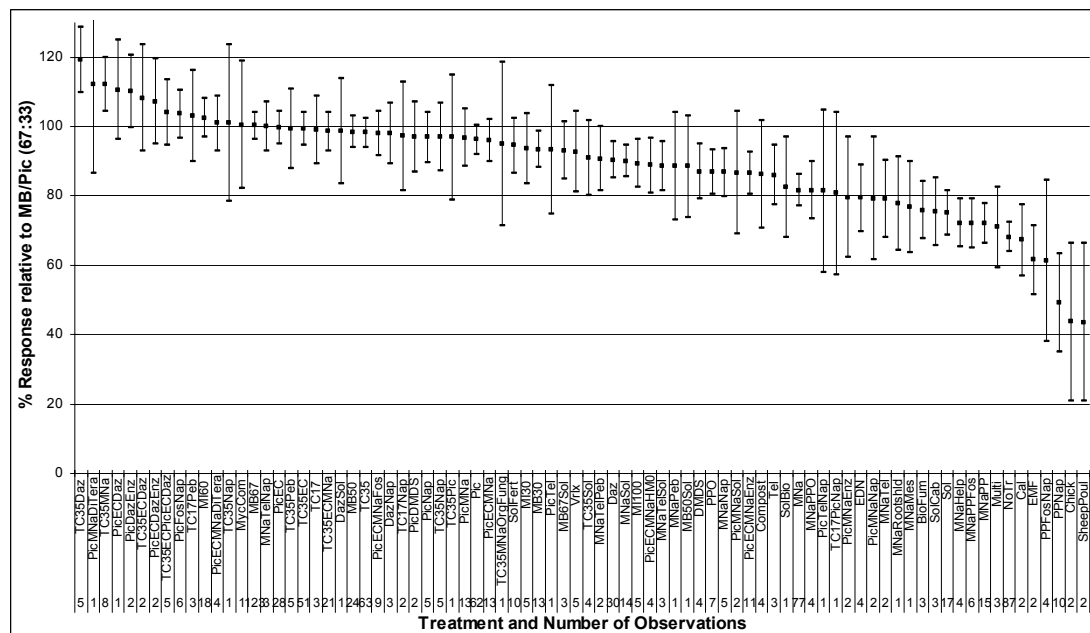
APPENDIX III-7. Relative yield data from the meta-analyses (treatment x soil type) and LSI intervals for alternatives to methyl bromide from international research studies in strawberry crops from 1997 to 2005. Note: >2 observations for an alternative were required before inclusion in the figure below.



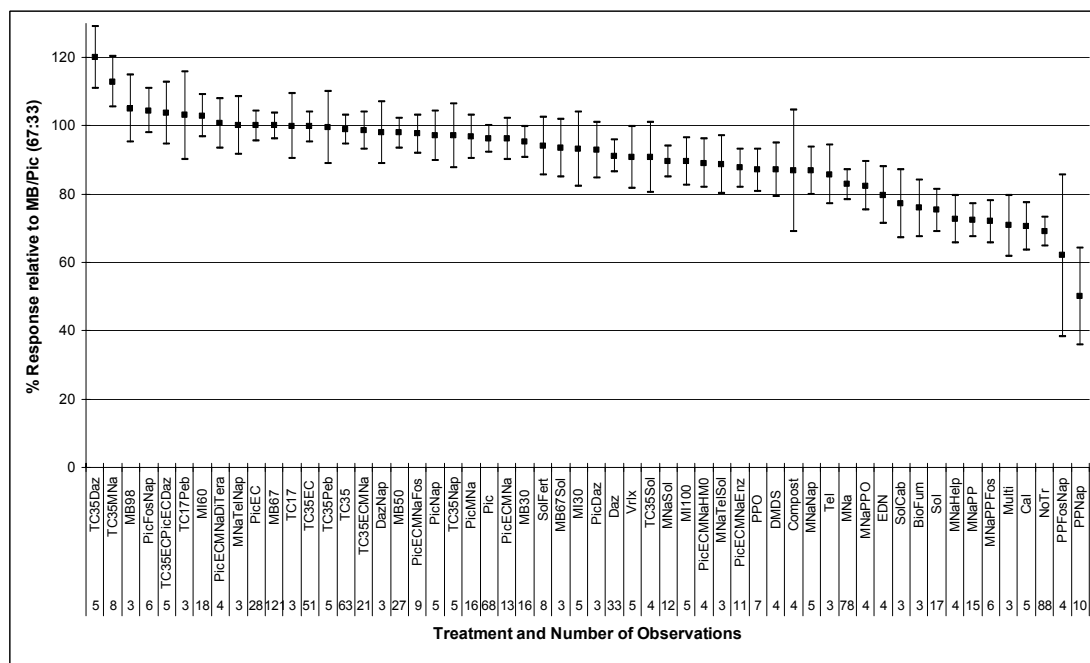
APPENDIX III-8. Comparison of raw means and modelled estimated means from the meta-analysis for the major alternatives to methyl bromide from international research studies from three regions in strawberry crops from 1997 to 2005



APPENDIX III-9. Relative yield data from the partial meta-analyses^A and LSI intervals for alternatives to methyl bromide from international research studies in strawberry fruit crops from 1997 to 2005. ^A Note: Relative means determined by comparison to the methyl bromide treatment from the same study.



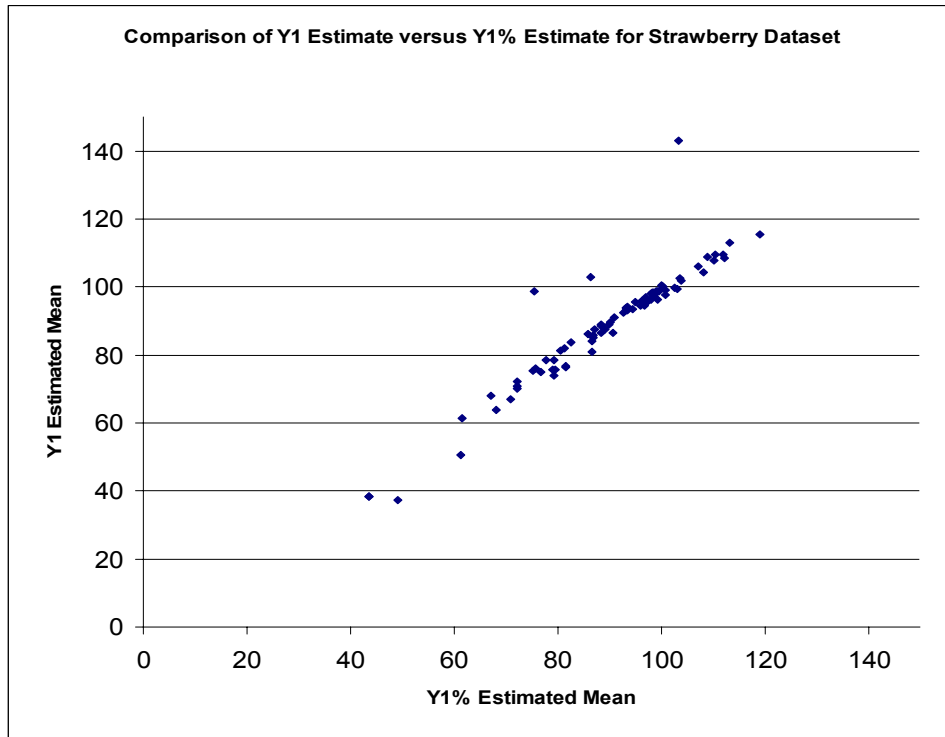
APPENDIX III-10. Relative yield data from the partial meta-analyses^A and LSI intervals for alternatives to methyl bromide from international research studies in strawberry fruit crops from 1997 to 2005. ^A Note: Relative means determined by comparison to the methyl bromide treatment from the same study, and >2 observations for an alternative were required before inclusion in the figure below.



APPENDIX III-11. Correlation between estimated means from the full meta-analysis (Y1) and the partial meta-analysis (Y1%) for MB and alternatives from international research studies in

strawberry fruit crops from 1997 to 2005 for treatments with greater than two observations.

Note: In the full meta-analysis the means were fully modelled means whereas in the partial meta-analysis the means are relative to the methyl bromide treatment from the same study. The plot enables identification of outliers.



APPENDIX IV-1 Relationship for treatment x nutsedge interaction between number of trials, number of observations, treatments and the estimated relative means for tomato yields compared to the standard MB treatment (MB/Pic 67:33) from the complete meta-analysis (Y1)

TOMATOES - Treatments x nutsedge (3 levels: 1-5, 6-30 and >30)

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|-----------------|-----------|----------------|-----------|
| 5 | 1-5 MB67 | 56.1 | 62.4 | 69.5 |
| 4 | 1-5 TC35PebNap | 49 | 59.6 | 72.5 |
| 1 | 1-5 TC17Peb | 40.3 | 54.7 | 74.1 |
| 1 | 1-5 SolSoil | 26.8 | 37.2 | 51.8 |
| 5 | 1-5 NoTr | 9.8 | 14.6 | 21.6 |
| 3 | 6-30 TC17Peb | 112.3 | 136.3 | 165.4 |
| 1 | 6-30 MNaPebFos | 81.5 | 107.5 | 141.6 |
| 1 | 6-30 MNaPeb | 78.9 | 107.3 | 145.7 |
| 5 | 6-30 MNa | 72.7 | 100.7 | 139.6 |
| 6 | 6-30 MB67 | 76.7 | 100 | 130.4 |
| 5 | 6-30 TC35 | 72.7 | 96.5 | 128.1 |
| 2 | 6-30 PicPeb | 80.1 | 96.3 | 115.9 |
| 3 | 6-30 TC35EC | 66.9 | 90 | 121.1 |
| 2 | 6-30 Daz | 56.1 | 62.4 | 69.5 |
| 7 | 6-30 NoTr | 32.8 | 48.7 | 72.2 |
| 5 | >30 Daz | 56.1 | 62.4 | 69.5 |
| 3 | >30 Pic | 44.1 | 49.9 | 56.4 |
| 2 | >30 PPO | 37.2 | 46.7 | 58.6 |
| 6 | >30 MNa | 37.3 | 46.3 | 57.5 |
| 6 | >30 TC17Peb | 73.3 | 84 | 96.2 |
| 1 | >30 MNaPebFos | 56.8 | 73.7 | 95.6 |
| 1 | >30 PicTel | 53.9 | 67.6 | 84.7 |
| 5 | >30 MI60 | 52.7 | 62.3 | 73.7 |
| 14 | >30 MB67 | 51.2 | 59.9 | 70.1 |
| 1 | >30 PicPeb | 48.7 | 57.9 | 68.8 |
| 4 | >30 PicMNa | 47.8 | 56.1 | 65.8 |
| 2 | >30 TC35NapHal | 44.1 | 54.5 | 67.4 |
| 5 | >30 TC35Peb | 45.6 | 54.2 | 64.5 |
| 2 | >30 PicFosPeb | 44.9 | 53.8 | 64.5 |
| 2 | >30 PicMNaPeb | 44.2 | 53.2 | 64 |
| 7 | >30 MNaPeb | 45.4 | 53 | 61.8 |
| 2 | >30 TC35MetTrif | 42.8 | 52.9 | 65.4 |
| 1 | >30 TC17 | 42 | 51.1 | 62.2 |
| 1 | >30 MI100MNa | 37.2 | 49.8 | 66.5 |
| 7 | >30 TC35 | 41.3 | 49.2 | 58.7 |
| 2 | >30 NaN3 | 29.4 | 36.8 | 46.1 |
| 12 | >30 NoTr | 16.8 | 21.8 | 28.3 |

APPENDIX IV-2 Relationship for treatment x fungal interaction between number of trials, number of observations, treatments and the estimated relative means for tomato yields compared to the standard MB treatment (MB/Pic 67:33) from the complete meta-analysis (Y1)

TOMATOES - Treatment x fungi (2 levels: Presence and Not specified)

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|-------------------|-----------|----------------|-----------|
| 1 | Yes PicTel | 92.8 | 117.8 | 149.5 |
| 1 | Yes TC35PicPebNap | 82 | 113.3 | 156.5 |
| 7 | Yes TC17Peb | 95 | 110.9 | 129.5 |
| 2 | Yes MI60 | 93.1 | 110.4 | 131 |
| 1 | Yes PicTelPebNap | 76 | 104.9 | 145 |
| 17 | Yes MB67 | 86 | 100 | 116.3 |
| 6 | Yes TC35PebNap | 79 | 99.1 | 124.1 |
| 1 | Yes PicPeb | 79.5 | 97.5 | 119.5 |
| 1 | Yes MB67PebNap | 67.4 | 96.6 | 138.5 |
| 9 | Yes TC35Peb | 82.4 | 96.3 | 112.6 |
| 6 | Yes PicMNaPeb | 79.5 | 93 | 108.8 |
| 2 | Yes Sol | 67.9 | 90.6 | 120.8 |
| 1 | Yes Tviride | 67.1 | 90.5 | 122.2 |
| 6 | Yes PicMNa | 76.9 | 89.3 | 103.8 |
| 2 | Yes TC35NapHal | 72.7 | 88.7 | 108.2 |
| 2 | Yes PicFosPeb | 74 | 87.6 | 103.6 |
| 2 | Yes TC35MetTrif | 70.5 | 86 | 105 |
| 5 | Yes TC35 | 72.3 | 85.6 | 101.4 |
| 10 | Yes MNaPeb | 73.4 | 85.6 | 99.8 |
| 1 | Yes TC35Tviride | 65.1 | 84.3 | 109.2 |
| 1 | Yes DazTviride | 60.3 | 84.2 | 117.7 |
| 4 | Yes Daz | 72.4 | 82.8 | 94.7 |
| 3 | Yes TC35EC | 67.1 | 81.8 | 99.6 |
| 2 | Yes PPO | 60.7 | 75.9 | 95 |
| 16 | Yes PicEC | 61.9 | 75.1 | 91.1 |
| 1 | Yes IndmusTviride | 52.5 | 73.4 | 102.5 |
| 1 | Yes TvirideFert | 51.9 | 72.5 | 101.3 |
| 1 | Yes SolSoil | 51.2 | 69.9 | 95.5 |
| 8 | Yes Pic | 57.8 | 67.1 | 77.9 |
| 5 | Yes MNa | 51.1 | 65.6 | 84.2 |
| 2 | Yes NaN3 | 48.5 | 60.1 | 74.5 |
| 29 | Yes NoTr | 35.8 | 44.2 | 54.6 |
| 1 | Yes NoTrPebNap | 30.2 | 43.3 | 62.1 |
| 8 | NS TC17Peb | 95.1 | 110.7 | 128.9 |
| 1 | NS TC35ECTrefNap | 86.7 | 108.2 | 134.9 |
| 2 | NS TC35PebNap | 80.2 | 108 | 145.3 |
| 2 | NS TC35PicPebTrif | 83.5 | 106.4 | 135.5 |
| 2 | NS TC35Peb | 78 | 105 | 141.3 |
| 7 | NS MNaCad | 86.3 | 100.5 | 117 |
| 3 | NS PicMNa | 86.5 | 99.4 | 114.2 |
| 5 | NS MI60 | 85.4 | 98.2 | 112.8 |
| 27 | NS MB67 | 85.3 | 97.1 | 110.5 |
| 8 | NS MI100 | 84.9 | 96.9 | 110.7 |
| 4 | NS PicFosPeb | 84.1 | 96.4 | 110.4 |
| 3 | NS TC17 | 79.7 | 95.9 | 115.3 |
| 2 | NS MNaPebFos | 75.2 | 92.7 | 114.2 |
| 2 | NS TC35Daz | 77.5 | 92.6 | 110.7 |
| 1 | NS TC35ECDaz | 73.5 | 92.1 | 115.5 |
| 15 | NS NaN3 | 80.2 | 91.7 | 104.8 |
| 1 | NS PicTel | 71.4 | 91.4 | 117.1 |
| 2 | NS PicEnzPeb | 79.1 | 91.3 | 105.4 |

Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|-------------------|-----------|----------------|-----------|
| 8 | NS Multi | 78.7 | 91.1 | 105.5 |
| 2 | NS MNaFos | 74.5 | 91 | 111.2 |
| 3 | NS TC35PicTrefNap | 77.2 | 90.8 | 106.9 |
| 1 | NS TC35MesTref | 72.6 | 90.7 | 113.2 |
| 15 | NS TC35 | 78.1 | 89.2 | 101.8 |
| 9 | NS MNaPP | 77.2 | 89 | 102.5 |
| 4 | NS TC35EC | 74.4 | 87.2 | 102.1 |
| 16 | NS MNa | 72.6 | 84.8 | 99 |
| 2 | NS MNaTel | 68.9 | 84.6 | 103.8 |
| 1 | NS PicMNaEnz | 68.8 | 83.9 | 102.3 |
| 9 | NS Cad | 72.4 | 82.8 | 94.7 |
| 1 | NS TC25 | 64.3 | 81.5 | 103.4 |
| 2 | NS Fos | 65.3 | 80 | 97.9 |
| 1 | NS MI100MNa | 59.5 | 78.5 | 103.6 |
| 2 | NS Tel | 63.4 | 78.3 | 96.8 |
| 2 | NS Pic | 65.8 | 77.2 | 90.5 |
| 2 | NS PicPeb | 63.6 | 74.9 | 88.2 |
| 1 | NS Fen | 55.8 | 74 | 98.2 |
| 6 | NS Daz | 60.8 | 74 | 90.1 |
| 1 | NS Oxa | 53.2 | 70.5 | 93.5 |
| 3 | NS DMDS | 55.7 | 67.2 | 81.1 |
| 1 | NS Quil | 44.4 | 58.1 | 75.9 |
| 3 | NS TerraK | 45.5 | 54.7 | 65.8 |
| 23 | NS NoTr | 37 | 45.8 | 56.7 |

APPENDIX IV-3 Relationship for treatment x nematode interaction between number of trials, number of observations, treatments and the estimated relative means for tomato yields compared to the standard MB treatment (MB/Pic 67:33) from the complete meta-analysis (Y1)

TOMATOES - Treatments x nematode (2 levels: Presence and Not specified)

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|--------------------|-----------|----------------|-----------|
| 1 | Yes TC35PicPebNap | 84.1 | 117.1 | 163 |
| 5 | Yes TC35Peb | 98.6 | 115.3 | 134.9 |
| 8 | Yes TC17Peb | 99.2 | 114.1 | 131.3 |
| 2 | Yes TC35PicPebTrif | 86.3 | 109.5 | 139.1 |
| 3 | Yes PicMNaPeb | 93.9 | 108.5 | 125.4 |
| 1 | Yes PicTelPebNap | 77.9 | 108.5 | 151.1 |
| 2 | Yes Sol | 79.7 | 105.5 | 139.6 |
| 2 | Yes MNaPebFos | 86.5 | 104.3 | 125.9 |
| 8 | Yes TC35PebNap | 85.9 | 102.4 | 122 |
| 7 | Yes MNaCad | 87.3 | 101 | 116.8 |
| 32 | Yes MB67 | 89.2 | 100 | 112.1 |
| 1 | Yes MB67PebNap | 71.9 | 99.9 | 138.8 |
| 2 | Yes TC17 | 80.8 | 97.5 | 117.7 |
| 4 | Yes MI60 | 84.4 | 96.2 | 109.6 |
| 2 | Yes MNaPeb | 79.7 | 94.9 | 113.1 |
| 4 | Yes PicMNa | 83.4 | 93.6 | 105.1 |
| 2 | Yes TC35NapHal | 76.2 | 91.9 | 111 |
| 1 | Yes MNaTel | 71.1 | 90.8 | 115.9 |
| 4 | Yes PicFosPeb | 81 | 90.8 | 101.8 |
| 1 | Yes PicTel | 72.8 | 90.3 | 112.1 |
| 2 | Yes TC35MetTrif | 73.9 | 89.2 | 107.7 |
| 1 | Yes TC35Daz | 68.1 | 87.2 | 111.6 |
| 19 | Yes TC35 | 76.9 | 86.4 | 97.1 |
| 3 | Yes PicPeb | 74.2 | 84.6 | 96.5 |
| 12 | Yes MNa | 72 | 84.4 | 98.9 |
| 7 | Yes MI100 | 74.1 | 83.9 | 95.1 |
| 1 | Yes TC35MesTref | 65.4 | 83.7 | 107.1 |
| 6 | Yes TC35EC | 72.7 | 83.3 | 95.3 |
| 9 | Yes Cad | 72.9 | 83 | 94.4 |
| 1 | Yes TC35PicTrefNap | 64 | 81.9 | 104.8 |
| 5 | Yes Daz | 65.9 | 79.4 | 95.6 |
| 2 | Yes PPO | 65.3 | 78.7 | 94.8 |
| 3 | Yes MNaPP | 66.5 | 77.8 | 91.1 |
| 2 | Yes Tel | 63.6 | 77.3 | 93.9 |
| 1 | Yes MI100MNa | 59.7 | 77.2 | 99.9 |
| 1 | Yes PicEnzPeb | 68.1 | 76.5 | 86 |
| 1 | Yes TC25 | 60.7 | 75.6 | 94.2 |
| 2 | Yes Multi | 60.9 | 74.5 | 91.3 |
| 1 | Yes Fen | 55 | 73 | 96.8 |
| 8 | Yes NaN3 | 60.8 | 69.8 | 80.1 |
| 1 | Yes Pic | 59.4 | 69.8 | 82 |
| 1 | Yes Oxa | 52.4 | 69.5 | 92.2 |
| 1 | Yes SolSoil | 51.4 | 68.7 | 91.8 |
| 2 | Yes Fos | 56 | 68.3 | 83.3 |
| 3 | Yes DMDS | 48.6 | 57.9 | 69 |
| 1 | Yes Quil | 38.2 | 49.1 | 63.2 |
| 3 | Yes TerraK | 38.9 | 46.3 | 55.1 |
| 1 | Yes NoTrPebNap | 32.2 | 44.8 | 62.2 |
| 33 | Yes NoTr | 36.2 | 43.1 | 51.3 |
| 7 | NS TC17Peb | 100.3 | 118.4 | 139.8 |
| 1 | NS TC35ECTrefNap | 79.9 | 105.2 | 138.5 |

Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|-------------------|-----------|----------------|-----------|
| 1 | NS PicTel | 82.4 | 103.2 | 129.1 |
| 9 | NS NaN3 | 82.4 | 98.1 | 116.7 |
| 1 | NS PicEnzPeb | 83.8 | 97.8 | 114.1 |
| 3 | NS MI60 | 80.7 | 94.6 | 111 |
| 1 | NS TC35ECDaz | 70.7 | 94.2 | 125.4 |
| 5 | NS PicMNa | 80.4 | 93.7 | 109.2 |
| 1 | NS TC35EC | 73.7 | 93.1 | 117.7 |
| 2 | NS MNaFos | 74.5 | 93 | 116.2 |
| 6 | NS Multi | 77.1 | 92.7 | 111.4 |
| 1 | NS MI100 | 76.1 | 92.5 | 112.4 |
| 3 | NS PicMNaPeb | 77.2 | 92.1 | 109.8 |
| 2 | NS PicFosPeb | 78.8 | 91.8 | 107.1 |
| 6 | NS MNaPP | 76.5 | 91.1 | 108.4 |
| 12 | NS MB67 | 77.7 | 90.9 | 106.2 |
| 2 | NS TC35PicTrefNap | 71.7 | 89.4 | 111.3 |
| 1 | NS TC35Daz | 67 | 88.2 | 116.1 |
| 6 | NS TC35Peb | 73.7 | 87.8 | 104.7 |
| 1 | NS Tviride | 61.9 | 86.6 | 121.2 |
| 1 | NS PicMNaEnz | 68.2 | 85.8 | 107.9 |
| 1 | NS DazTviride | 60.7 | 84.8 | 118.7 |
| 5 | NS Daz | 72.9 | 83 | 94.4 |
| 8 | NS MNaPeb | 69.2 | 81 | 94.9 |
| 1 | NS TC35Tviride | 57.6 | 80.7 | 113 |
| 1 | NS TC35 | 59 | 79 | 105.8 |
| 16 | NS PicEC | 61.5 | 76.1 | 94.1 |
| 9 | NS MNa | 61.1 | 75.3 | 92.8 |
| 1 | NS IndmusTviride | 52.8 | 73.9 | 103.4 |
| 1 | NS TC17 | 59.5 | 73.7 | 91.4 |
| 1 | NS TvirideFert | 52.2 | 73 | 102.1 |
| 9 | NS Pic | 62.2 | 71.9 | 83.2 |
| 1 | NS MNaTel | 53.8 | 70.7 | 92.9 |
| 19 | NS NoTr | 38.4 | 48.9 | 62.2 |

APPENDIX IV-4 Relationship for treatment x application method interaction between number of trials, number of observations, treatments and the estimated relative means for strawberry yields compared to the standard MB treatment (MB/Pic 67:33) from the complete meta-analysis (Y1)

TOMATOES - Treatments x application method (4 levels: Injection, Drip, Spray and Not specified)

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|--------------------------|-----------|----------------|-----------|
| 15 | Injection TC17Peb | 109.7 | 121 | 133.5 |
| 1 | Injection TC35PicPebNap | 85.2 | 117.6 | 162.5 |
| 2 | Injection TC35PicPebTrif | 87.1 | 109.5 | 137.7 |
| 1 | Injection PicTelPebNap | 78.9 | 109 | 150.5 |
| 2 | Injection PicTel | 92.5 | 106.3 | 122.2 |
| 3 | Injection PicMNaPeb | 94 | 106.2 | 120 |
| 8 | Injection TC35PebNap | 87.8 | 102.9 | 120.6 |
| 7 | Injection MI60 | 93.7 | 102.6 | 112.4 |
| 1 | Injection DazTviride | 76.6 | 102 | 135.8 |
| 1 | Injection PicEnzPeb | 93 | 101.3 | 110.3 |
| 1 | Injection MB67PebNap | 73.5 | 100.3 | 137 |
| 11 | Injection TC35Peb | 90.6 | 100.3 | 111.1 |
| 37 | Injection MB67 | 92 | 100 | 108.7 |
| 8 | Injection MI100 | 90.8 | 100 | 110.1 |
| 1 | Injection MNaTel | 79.3 | 98.7 | 122.9 |
| 5 | Injection PicMNa | 90.3 | 98.4 | 107.2 |
| 1 | Injection TC35Tviride | 74.5 | 96.7 | 125.5 |
| 2 | Injection TC35NapHal | 81.6 | 96.4 | 113.8 |
| 4 | Injection PicFosPeb | 87.6 | 95.2 | 103.4 |
| 3 | Injection TC17 | 83.3 | 94.6 | 107.3 |
| 14 | Injection TC35 | 86.3 | 94.3 | 103.2 |
| 1 | Injection TC35PicTrefNap | 74.6 | 93.8 | 118 |
| 2 | Injection TC35MetTrif | 79.1 | 93.5 | 110.5 |
| 2 | Injection TC35Daz | 78.9 | 93.1 | 109.9 |
| 5 | Injection MNaPeb | 80.6 | 90.1 | 100.7 |
| 7 | Injection MNa | 73.8 | 89.2 | 107.7 |
| 1 | Injection Fos | 69.4 | 88.7 | 113.4 |
| 1 | Injection TvirideFert | 65.9 | 87.7 | 116.9 |
| 3 | Injection PicPeb | 79 | 87.4 | 96.7 |
| 1 | Injection TC35ECDaz | 60.3 | 87 | 125.7 |
| 10 | Injection Daz | 76.6 | 86.7 | 98.2 |
| 2 | Injection PPO | 70.4 | 82.5 | 96.6 |
| 1 | Injection MI100MNa | 65.3 | 81.9 | 102.6 |
| 9 | Injection Cad | 70.5 | 81.7 | 94.7 |
| 2 | Injection MNaCad | 64.4 | 81.2 | 102.4 |
| 2 | Injection Tel | 67.1 | 80.3 | 96.1 |
| 1 | Injection TC25 | 66.9 | 80.2 | 96.1 |
| 1 | Injection PicMNaEnz | 57.6 | 79.2 | 109.1 |
| 10 | Injection Pic | 68.7 | 75.5 | 83 |
| 1 | Injection Fen | 54 | 71.9 | 95.6 |
| 1 | Injection Oxa | 51.4 | 68.4 | 91.1 |
| 2 | Injection NaN3 | 54.8 | 64.6 | 76.2 |
| 3 | Injection NoTr | 26 | 46.5 | 83.3 |
| 1 | Drip TC35ECTrefNap | 86.6 | 109 | 137.1 |
| 2 | Drip MNaPebFos | 91.6 | 107.9 | 127.2 |
| 5 | Drip MNaCad | 91.1 | 107 | 125.7 |
| 2 | Drip MNaPeb | 81.4 | 95.4 | 111.9 |
| 13 | Drip NaN3 | 85.8 | 94.8 | 104.7 |
| 4 | Drip Multi | 82.2 | 93.8 | 107 |

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| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|---------------------|-----------|----------------|-----------|
| 1 | Drip TC35PicTrefNap | 72.7 | 91.4 | 115 |
| 6 | Drip TC35EC | 78.7 | 87.9 | 98.2 |
| 2 | Drip MNaPP | 63.9 | 87.3 | 119.4 |
| 2 | Drip MNaFos | 62.9 | 86 | 117.6 |
| 7 | Drip MNa | 66.2 | 79.8 | 96.2 |
| 3 | Drip DMDS | 60 | 69.7 | 80.9 |
| 16 | Drip PicEC | 57.6 | 69.2 | 83.2 |
| 1 | Drip Quil | 48.5 | 60.7 | 75.8 |
| 3 | Drip TerraK | 49.4 | 57.1 | 66.1 |
| 7 | Hotgas MB98 | 70.3 | 82.5 | 96.9 |
| 4 | Spray PicMNa | 85.7 | 94.2 | 103.6 |
| 3 | Spray PicMNaPeb | 82.6 | 93.4 | 105.7 |
| 6 | Spray MNaPP | 80.8 | 90 | 100.3 |
| 3 | Spray MNaPeb | 68.6 | 79 | 91 |
| 1 | Spray Fos | 60.9 | 78.1 | 100.1 |
| 7 | Spray MNa | 63.7 | 76.9 | 92.8 |
| 1 | Spray MNaTel | 59.1 | 73.3 | 90.9 |
| 2 | NS Sol | 93.1 | 116.7 | 146.2 |
| 1 | NS Tviride | 81.1 | 103.9 | 133.1 |
| 2 | NS PicFosPeb | 90.1 | 98.7 | 108.1 |
| 1 | NS TC35MesTref | 72 | 91 | 114.9 |
| 1 | NS TC35PicTrefNap | 70.5 | 89 | 112.4 |
| 1 | NS IndmusTviride | 66.7 | 88.8 | 118.3 |
| 2 | NS NaN3 | 62.9 | 86.7 | 119.5 |
| 1 | NS TC35EC | 62.1 | 86 | 119.2 |
| 4 | NS Multi | 63.6 | 85.8 | 115.8 |
| 1 | NS PicEnzPeb | 75.9 | 83.2 | 91.3 |
| 1 | NS MNaPP | 52.8 | 74.9 | 106.3 |
| 1 | NS SolSoil | 54.4 | 71.3 | 93.3 |
| 42 | NS NoTr | 39.1 | 45.1 | 52.1 |
| 1 | NS NoTrPebNap | 32.9 | 45 | 61.4 |

APPENDIX IV-5 Relationship for treatment x plastic seal interaction between number of trials, number of observations, treatments and the estimated relative means for tomato yields compared to the standard MB treatment (MB/Pic 67:33) from the complete meta-analysis (Y1)

TOMATOES - Treatments x plastic seal (2 levels: Barrier film and Non Barrier flim)

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|------------------------|-----------|----------------|-----------|
| 3 | Barr MB67 | 100.9 | 114.9 | 130.7 |
| 4 | Barr TC35 | 85.5 | 94.9 | 105.2 |
| 1 | Barr NoTr | 17.3 | 52.2 | 157.5 |
| 15 | NonBarr TC17Peb | 108.1 | 117.6 | 127.9 |
| 1 | NonBarr TC35PicPebNap | 86.6 | 116.8 | 157.6 |
| 2 | NonBarr TC35PicPebTrif | 89.5 | 109.5 | 134.1 |
| 1 | NonBarr PicTelPebNap | 80.2 | 108.2 | 146 |
| 1 | NonBarr TC35ECTrefNap | 86.1 | 107 | 132.9 |
| 2 | NonBarr PicTel | 90.5 | 102.9 | 117 |
| 2 | NonBarr Sol | 79.7 | 102.8 | 132.7 |
| 2 | NonBarr MNaPebFos | 87.3 | 102.2 | 119.7 |
| 8 | NonBarr TC35PebNap | 89.3 | 102.1 | 116.9 |
| 7 | NonBarr MI60 | 92.9 | 100.4 | 108.4 |
| 41 | NonBarr MB67 | 93.5 | 100 | 106.9 |
| 1 | NonBarr MB67PebNap | 72.8 | 99.6 | 136.2 |
| 11 | NonBarr TC35Peb | 90.2 | 98.6 | 107.7 |
| 7 | NonBarr MNaCad | 85.2 | 98.5 | 113.8 |
| 6 | NonBarr PicMNaPeb | 89.7 | 98 | 107 |
| 2 | NonBarr TC35NapHal | 83 | 97.2 | 113.7 |
| 1 | NonBarr Tviride | 74.4 | 97.2 | 127 |
| 9 | NonBarr PicMNa | 89.9 | 96.6 | 103.8 |
| 6 | NonBarr PicFosPeb | 88.9 | 95.8 | 103.2 |
| 3 | NonBarr TC17 | 84.4 | 94.7 | 106.4 |
| 8 | NonBarr MI100 | 87 | 94.3 | 102.2 |
| 2 | NonBarr TC35MetTrif | 80.5 | 94.3 | 110.4 |
| 1 | NonBarr TC35ECDaz | 73.5 | 92.1 | 115.5 |
| 2 | NonBarr TC35Daz | 79 | 92 | 107.2 |
| 1 | NonBarr DazTviride | 66.5 | 91.7 | 126.6 |
| 2 | NonBarr MNaFos | 78.1 | 91 | 106.1 |
| 17 | NonBarr NaN3 | 82.1 | 90.8 | 100.3 |
| 2 | NonBarr PicEnzPeb | 83 | 90.7 | 99.2 |
| 16 | NonBarr TC35 | 84.1 | 90.6 | 97.6 |
| 1 | NonBarr TC35MesTref | 72.8 | 90.5 | 112.6 |
| 1 | NonBarr TC35Tviride | 70.3 | 90.5 | 116.5 |
| 8 | NonBarr Multi | 81.6 | 90.1 | 99.4 |
| 3 | NonBarr TC35PicTrefNap | 79.2 | 90.1 | 102.5 |
| 9 | NonBarr MNaPP | 81.2 | 88.6 | 96.6 |
| 7 | NonBarr TC35EC | 79.9 | 87.4 | 95.6 |
| 10 | NonBarr MNaPeb | 80.1 | 87.1 | 94.6 |
| 16 | NonBarr PicEC | 74.1 | 85.2 | 97.9 |
| 3 | NonBarr PicPeb | 76.9 | 84.9 | 93.8 |
| 2 | NonBarr MNaTel | 71.4 | 84.1 | 99 |
| 1 | NonBarr PicMNaEnz | 71.4 | 83.9 | 98.6 |
| 10 | NonBarr Daz | 74.2 | 83.6 | 94.1 |
| 2 | NonBarr PPO | 70.3 | 83.2 | 98.3 |
| 21 | NonBarr MNa | 73.5 | 81.9 | 91.3 |
| 9 | NonBarr Cad | 70.7 | 81.2 | 93.4 |
| 1 | NonBarr IndmusTviride | 57.9 | 79.9 | 110.3 |
| 1 | NonBarr MI100MNa | 62.7 | 79.9 | 101.8 |
| 2 | NonBarr Tel | 66.6 | 79.9 | 96 |
| 1 | NonBarr TC25 | 66.7 | 79.4 | 94.5 |

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| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|---------------------|-----------|----------------|-----------|
| 1 | NonBarr TvirideFert | 57.2 | 78.9 | 108.9 |
| 2 | NonBarr Fos | 65.1 | 77.2 | 91.7 |
| 10 | NonBarr Pic | 69.9 | 75.8 | 82.2 |
| 1 | NonBarr Fen | 56 | 74 | 97.6 |
| 1 | NonBarr Oxa | 53.4 | 70.4 | 93 |
| 1 | NonBarr SolSoil | 52.5 | 69.2 | 91.2 |
| 3 | NonBarr DMDS | 55.9 | 65 | 75.6 |
| 1 | NonBarr Quil | 44 | 56 | 71.3 |
| 3 | NonBarr TerraK | 45.5 | 52.8 | 61.1 |
| 51 | NonBarr NoTr | 41.4 | 47 | 53.3 |
| 1 | NonBarr NoTrPebNap | 32.7 | 44.7 | 61.1 |

APPENDIX IV-6 Relationship for treatment x production system interaction between number of trials, number of observations, treatments and the estimated relative means for tomato yields compared to the standard MB treatment (MB/Pic 67:33) from the complete meta-analysis (Y1)

TOMATOES - Treatments x production system (2 levels: Greenhouse and Open field)

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|---------------------------|-----------|----------------|-----------|
| 15 | Open Field TC17Peb | 107.4 | 117.2 | 128 |
| 1 | Open Field TC35PicPebNap | 86.6 | 116.4 | 156.4 |
| 2 | Open Field TC35PicPebTrif | 90 | 109.5 | 133.3 |
| 1 | Open Field PicTelPebNap | 80.2 | 107.8 | 144.9 |
| 1 | Open Field TC35ECTrefNap | 85.5 | 106.3 | 132.2 |
| 2 | Open Field MNaPebFos | 87.1 | 101.9 | 119.3 |
| 8 | Open Field TC35PebNap | 89.1 | 101.8 | 116.2 |
| 2 | Open Field PicTel | 88.2 | 100.9 | 115.5 |
| 44 | Open Field MB67 | 93 | 100 | 107.5 |
| 7 | Open Field MI60 | 91.7 | 99.6 | 108.1 |
| 1 | Open Field MB67PebNap | 72.4 | 99.3 | 136.2 |
| 11 | Open Field TC35Peb | 89.5 | 98.3 | 107.8 |
| 6 | Open Field PicMNaPeb | 89.1 | 97.7 | 107.2 |
| 1 | Open Field Tviride | 73.3 | 96.4 | 126.9 |
| 2 | Open Field TC35NapHal | 81.9 | 96.1 | 112.6 |
| 9 | Open Field PicMNa | 88.9 | 96 | 103.7 |
| 3 | Open Field TC17 | 84.5 | 95.3 | 107.5 |
| 6 | Open Field PicFosPeb | 87.8 | 95.1 | 103 |
| 8 | Open Field MI100 | 85.9 | 93.6 | 102.1 |
| 2 | Open Field TC35MetTrif | 79.5 | 93.2 | 109.3 |
| 1 | Open Field TC35ECDaz | 73.6 | 92.3 | 115.8 |
| 1 | Open Field DazTviride | 65.9 | 91.5 | 127 |
| 2 | Open Field TC35Daz | 78.3 | 91.4 | 106.8 |
| 2 | Open Field MNaFos | 78.1 | 91.2 | 106.6 |
| 17 | Open Field NaN3 | 81.8 | 91.2 | 101.8 |
| 2 | Open Field PicEnzPeb | 82.1 | 90.2 | 99 |
| 1 | Open Field TC35MesTref | 72.3 | 89.9 | 111.9 |
| 8 | Open Field Multi | 81 | 89.8 | 99.6 |
| 1 | Open Field TC35Tviride | 69.7 | 89.8 | 115.5 |
| 20 | Open Field TC35 | 82.9 | 89.6 | 96.9 |
| 3 | Open Field TC35PicTrefNap | 78.5 | 89.5 | 102.2 |
| 9 | Open Field MNaPP | 80.6 | 88.3 | 96.7 |
| 7 | Open Field TC35EC | 79.4 | 87.3 | 96 |
| 10 | Open Field MNaPeb | 79.5 | 86.8 | 94.7 |
| 3 | Open Field PicPeb | 76.6 | 84.7 | 93.8 |
| 17 | Open Field MNa | 74.8 | 84.4 | 95.2 |
| 1 | Open Field PicMNaEnz | 71.4 | 84.1 | 98.9 |
| 2 | Open Field MNaTel | 70.4 | 83.5 | 99 |
| 9 | Open Field Daz | 73.4 | 82.7 | 93.2 |
| 2 | Open Field PPO | 69.1 | 82.2 | 97.8 |
| 1 | Open Field IndmusTviride | 57.4 | 79.7 | 110.6 |
| 1 | Open Field MI100MNa | 61.6 | 79.1 | 101.6 |
| 1 | Open Field TvirideFert | 56.7 | 78.7 | 109.2 |
| 2 | Open Field Fos | 64.5 | 76.7 | 91.2 |
| 10 | Open Field Pic | 69.9 | 76.1 | 83 |
| 1 | Open Field Tel | 56.1 | 73 | 95.1 |
| 2 | Open Field PicEC | 53.8 | 72.5 | 97.9 |
| 1 | Open Field SolSoil | 51.7 | 68.3 | 90.3 |
| 3 | Open Field DMDS | 55.2 | 64.6 | 75.5 |
| 1 | Open Field Quil | 43.4 | 55.6 | 71.3 |
| 3 | Open Field TerraK | 44.9 | 52.4 | 61.1 |

Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|-------------------|-----------|----------------|-----------|
| 42 | Open Field NoTr | 39.9 | 45.9 | 52.8 |
| 2 | Greenhouse Sol | 77.9 | 106.4 | 145.4 |
| 7 | Greenhouse MNaCad | 85.8 | 99.8 | 116 |
| 1 | Greenhouse Daz | 62.2 | 96.3 | 149.1 |
| 14 | Greenhouse PicEC | 73.2 | 91.5 | 114.4 |
| 1 | Greenhouse Tel | 65.3 | 89.8 | 123.5 |
| 9 | Greenhouse Cad | 73.4 | 82.7 | 93.2 |
| 1 | Greenhouse Fen | 57.3 | 78.4 | 107.1 |
| 1 | Greenhouse Oxa | 54.6 | 74.6 | 102 |
| 4 | Greenhouse MNa | 55.9 | 73.3 | 96.1 |
| 10 | Greenhouse NoTr | 37.7 | 53 | 74.5 |

APPENDIX IV-7 Relationship for treatment x soil type interaction between number of trials, number of observations, treatments and the estimated relative means for tomato yields compared to the standard MB treatment (MB/Pic 67:33) from the complete meta-analysis (Y1)

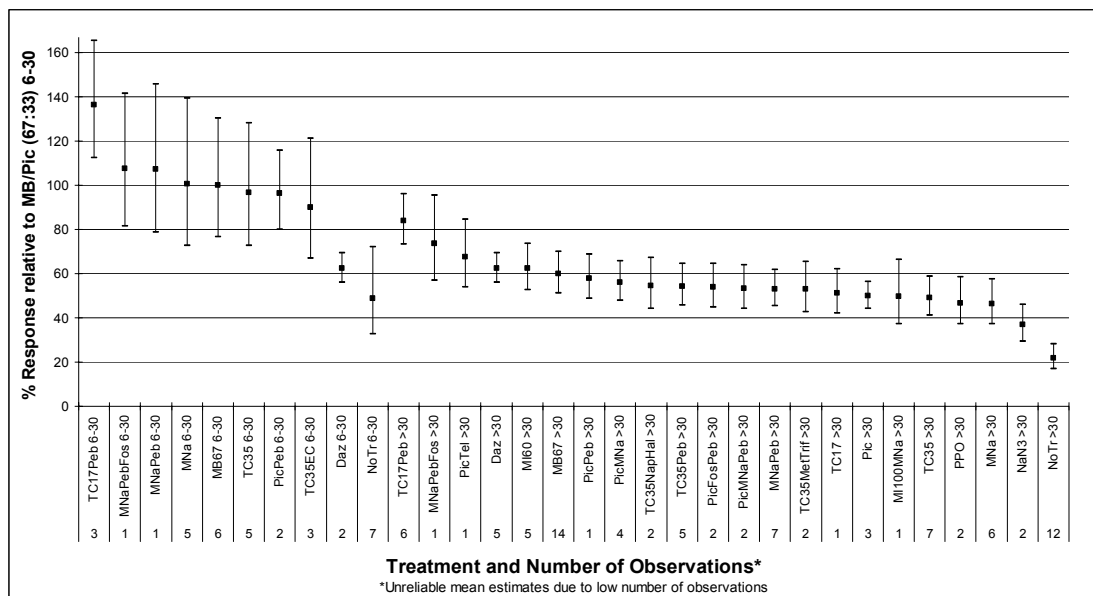
TOMATOES - Treatments x soil type (4 levels: Sand, Clay, Loam and Not specified)

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|---------------------|-----------|----------------|-----------|
| 11 | sand TC17Peb | 110 | 122.7 | 136.8 |
| 1 | sand PicTel | 98 | 118.1 | 142.3 |
| 1 | sand TC35PicPebNap | 86.7 | 115.9 | 154.9 |
| 2 | sand MI60 | 97.3 | 110.7 | 125.9 |
| 2 | sand Sol | 85.5 | 110.6 | 143.2 |
| 2 | sand TC35PicPebTrif | 89.9 | 109.5 | 133.4 |
| 1 | sand PicTelPebNap | 80.3 | 107.4 | 143.5 |
| 2 | sand MNaPebFos | 89 | 105.2 | 124.3 |
| 1 | sand Tviride | 78.6 | 103.3 | 135.8 |
| 8 | sand TC35PebNap | 87.6 | 101.3 | 117.2 |
| 11 | sand TC35Peb | 89.8 | 100.9 | 113.3 |
| 23 | sand MB67 | 90.4 | 100 | 110.7 |
| 1 | sand MB67PebNap | 72.3 | 98.8 | 135.1 |
| 6 | sand PicMNaPeb | 87.7 | 98.6 | 110.7 |
| 2 | sand TC35NapHal | 82.4 | 98.1 | 116.7 |
| 1 | sand DazTviride | 71.4 | 98.1 | 134.7 |
| 2 | sand PicFosPeb | 85.2 | 96.9 | 110.1 |
| 1 | sand TC35Tviride | 75 | 96.2 | 123.3 |
| 6 | sand PicMNa | 86.2 | 96.1 | 107.2 |
| 6 | sand MI100 | 84.4 | 95.8 | 108.8 |
| 10 | sand TC35 | 85.8 | 95.8 | 107 |
| 2 | sand TC35MetTrif | 80 | 95.2 | 113.2 |
| 6 | sand TC35EC | 79.5 | 89.8 | 101.4 |
| 10 | sand MNaPeb | 80.2 | 89.7 | 100.3 |
| 3 | sand PicPeb | 78.1 | 87.7 | 98.5 |
| 9 | sand Daz | 77.7 | 85.5 | 94 |
| 1 | sand IndmusTviride | 62.2 | 85.4 | 117.4 |
| 1 | sand TvirideFert | 61.4 | 84.4 | 115.9 |
| 2 | sand Multi | 69 | 84 | 102.4 |
| 2 | sand PPO | 69.5 | 84 | 101.5 |
| 1 | sand TC17 | 66.7 | 80.1 | 96.3 |
| 8 | sand MNa | 66.2 | 79.5 | 95.5 |
| 8 | sand NaN3 | 68.8 | 78.2 | 88.7 |
| 2 | sand Fos | 63.5 | 77.1 | 93.6 |
| 3 | sand Pic | 69.2 | 77.1 | 85.8 |
| 1 | sand SolSoil | 52.1 | 68.6 | 90.2 |
| 3 | sand DMDS | 54.8 | 65.5 | 78.2 |
| 1 | sand Quil | 42.7 | 55.4 | 71.9 |
| 3 | sand TerraK | 43.8 | 52.2 | 62.2 |
| 28 | sand NoTr | 38.9 | 46.9 | 56.5 |
| 1 | sand NoTrPebNap | 32.4 | 44.3 | 60.6 |
| 2 | clay MNaCad | 98.3 | 119.4 | 145 |
| 3 | clay NaN3 | 25.9 | 103.9 | 416.2 |
| 1 | clay Daz | 66.8 | 103.5 | 160.5 |
| 1 | clay Tel | 71.2 | 96.6 | 131 |
| 4 | clay Cad | 77.7 | 85.5 | 94 |
| 1 | clay Fen | 62.2 | 84.2 | 114 |
| 2 | clay MNa | 57.4 | 84.1 | 123.3 |
| 1 | clay Oxa | 59.3 | 80.2 | 108.5 |
| 3 | clay NoTr | 24.9 | 53.2 | 113.3 |
| 1 | clay MB67 | 13.1 | 52.8 | 212.6 |

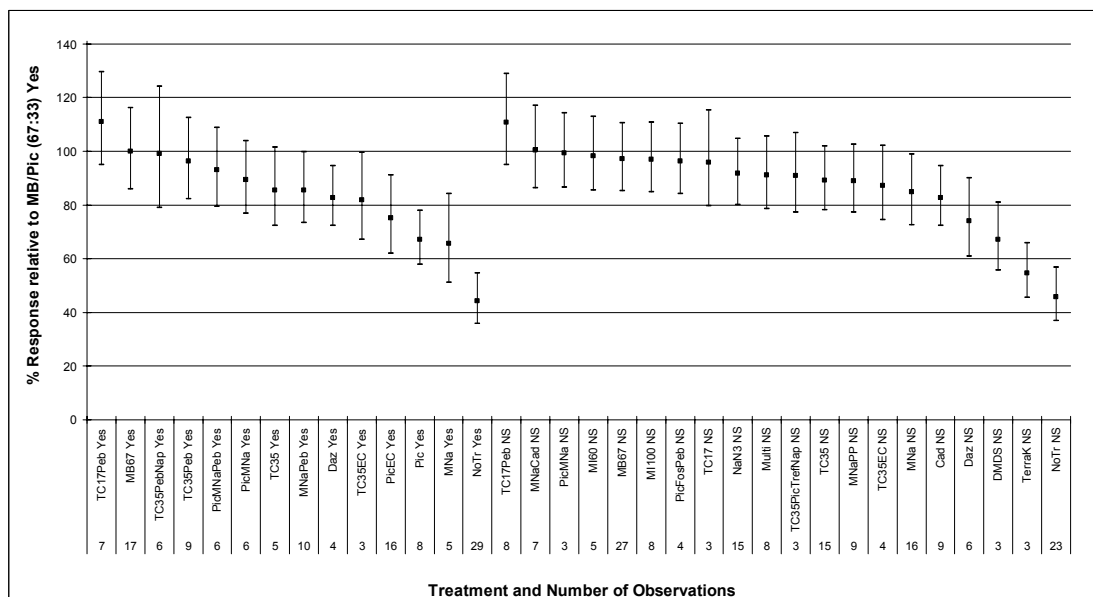
Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation

| Obs | Treatment | Lower LSI | Estimated Mean | Upper LSI |
|-----|-------------------|-----------|----------------|-----------|
| 6 | loam Pic | 74 | 96.5 | 125.9 |
| 5 | loam MNaCad | 82.1 | 95.2 | 110.4 |
| 16 | loam PicEC | 69.5 | 87.7 | 110.5 |
| 5 | loam Cad | 77.7 | 85.5 | 94 |
| 2 | loam MNa | 47.1 | 68.6 | 99.9 |
| 9 | loam NoTr | 36.9 | 53.8 | 78.4 |
| 4 | NS TC17Peb | 79.7 | 92.1 | 106.5 |
| 1 | NS TC35ECTrefNap | 70.9 | 88.6 | 110.6 |
| 20 | NS MB67 | 77.7 | 85.5 | 94 |
| 2 | NS TC17 | 70.8 | 83.6 | 98.7 |
| 3 | NS PicMNa | 72.4 | 81.4 | 91.5 |
| 5 | NS MI60 | 71.5 | 80 | 89.4 |
| 1 | NS TC35ECDaz | 63.1 | 79.3 | 99.6 |
| 4 | NS PicFosPeb | 70.5 | 78.9 | 88.3 |
| 1 | NS TC35EC | 65.1 | 78.4 | 94.4 |
| 2 | NS MNaFos | 65.9 | 78.3 | 93.2 |
| 6 | NS Multi | 68.2 | 78 | 89.2 |
| 2 | NS TC35Daz | 64.1 | 75.8 | 89.7 |
| 6 | NS NaN3 | 66.9 | 75.7 | 85.8 |
| 9 | NS MNa | 63.1 | 75.2 | 89.6 |
| 2 | NS PicEnzPeb | 66.2 | 74.8 | 84.5 |
| 3 | NS TC35PicTrefNap | 64.1 | 74.4 | 86.3 |
| 1 | NS TC35MesTref | 59.4 | 74.2 | 92.8 |
| 9 | NS MNaPP | 65.9 | 74.1 | 83.2 |
| 2 | NS MI100 | 64.8 | 73.6 | 83.6 |
| 1 | NS PicMNaEnz | 60.4 | 72.2 | 86.3 |
| 1 | NS PicTel | 58.7 | 71.7 | 87.6 |
| 10 | NS TC35 | 63.4 | 70.5 | 78.5 |
| 2 | NS MNaTel | 57.6 | 69.3 | 83.3 |
| 1 | NS TC25 | 53.2 | 64.8 | 79 |
| 1 | NS MI100MNa | 49.4 | 63.8 | 82.3 |
| 1 | NS Pic | 52.1 | 59.8 | 68.7 |
| 1 | NS Tel | 43.5 | 56.7 | 74 |
| 12 | NS NoTr | 28.5 | 37.7 | 49.8 |

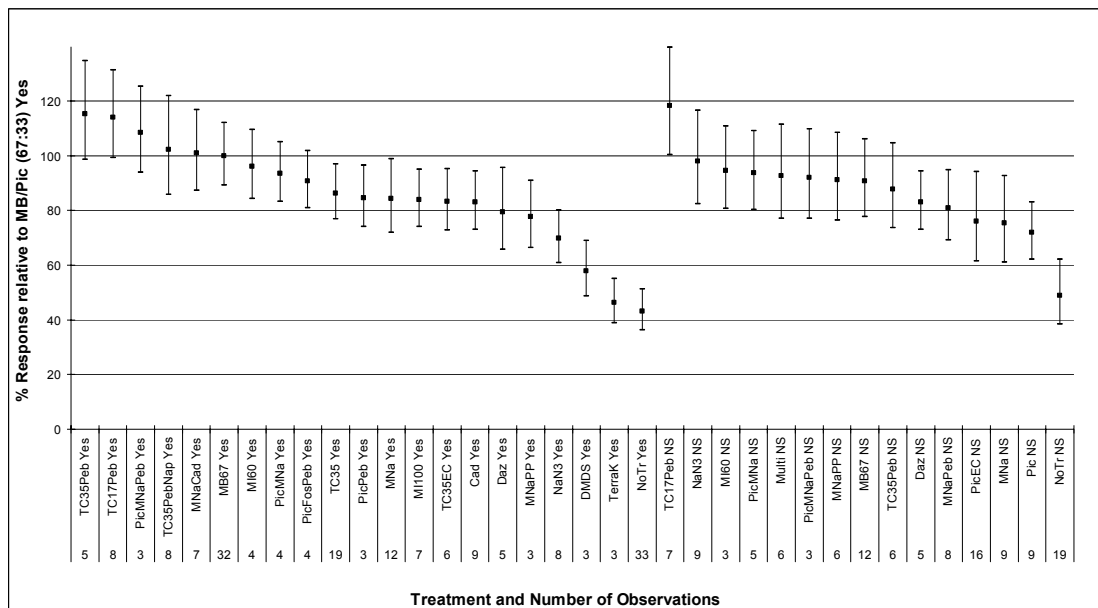
APPENDIX V-1. Relative yield data from the meta-analyses (treatment x nutsedge groupings) and LSI intervals for alternatives to methyl bromide from international research studies in tomato crops from 1997 to 2005.



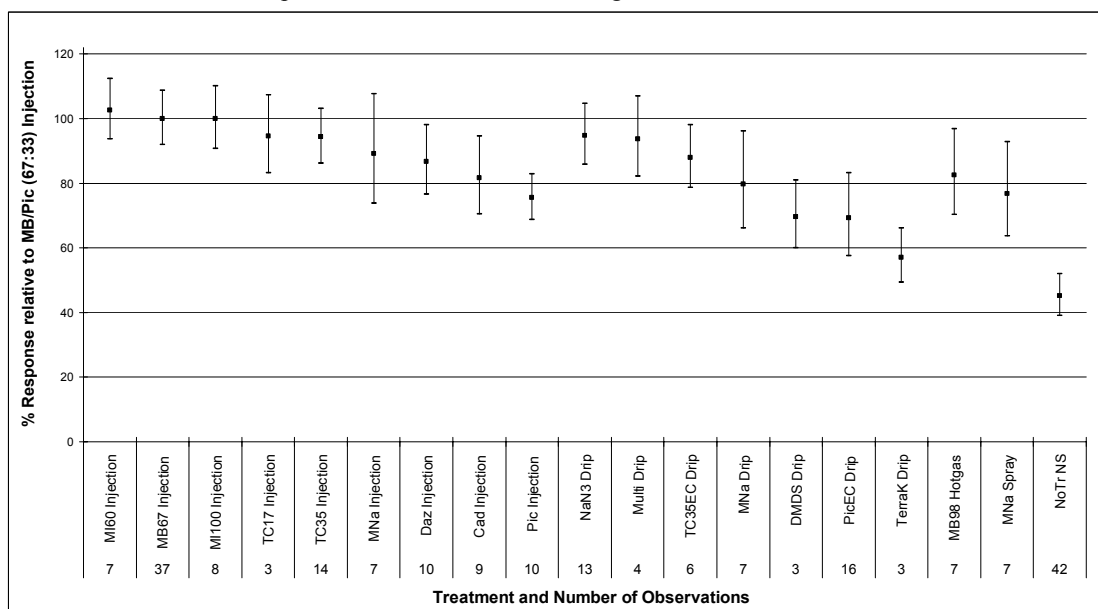
APPENDIX V-2. Relative yield data from the meta-analyses (treatment x fungal presence) and LSI intervals for alternatives to methyl bromide from international research studies in tomato crops from 1997 to 2005. Note: >2 observations for an alternative were required before inclusion in the figure below.



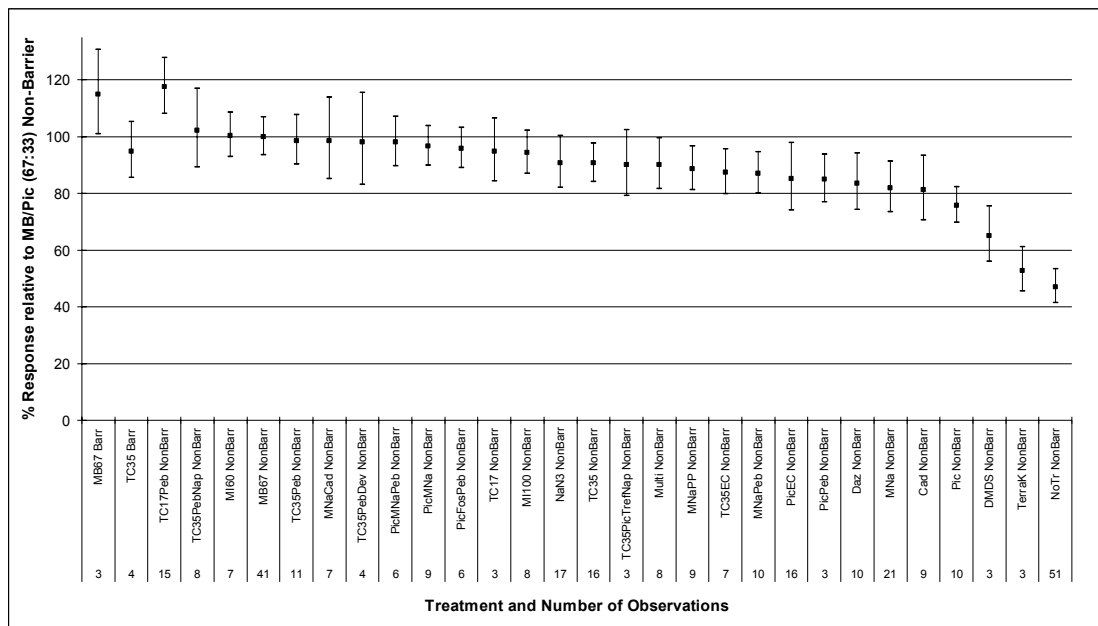
APPENDIX V-3. Relative yield data from the meta-analyses (treatment x nematode presence) and LSI intervals for alternatives to methyl bromide from international research studies in tomato crops from 1997 to 2005. Note: >2 observations for an alternative were required before inclusion in the figure below.



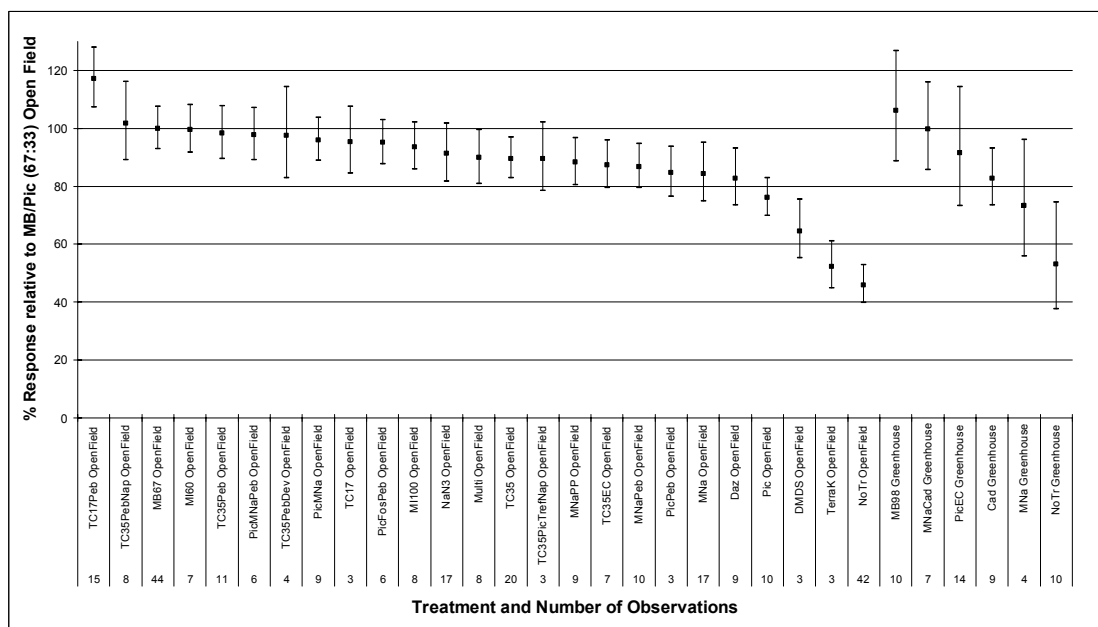
APPENDIX V-4. Relative yield data from the meta-analyses (treatment x application method) and LSI intervals for alternatives to methyl bromide from international research studies in tomato crops from 1997 to 2005. Note: Observations only for a single chemical and >2 observations for an alternative were required before inclusion in the figure below.



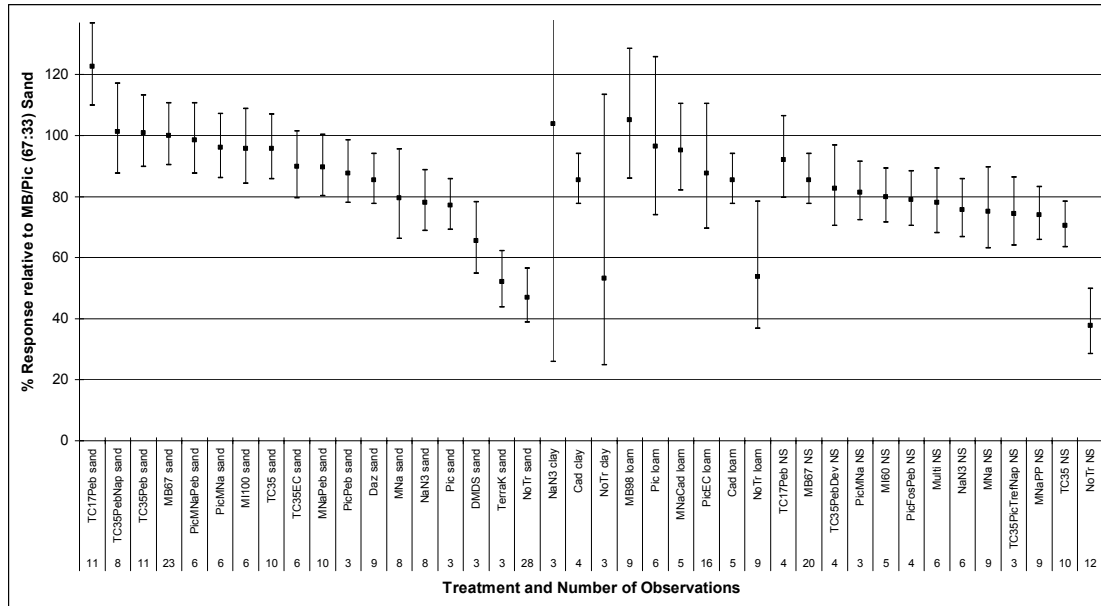
APPENDIX V-5. Relative yield data from the meta-analyses (treatment x plastic seal) and LSI intervals for alternatives to methyl bromide from international research studies in tomato crops from 1997 to 2005. Note: >2 observations for an alternative were required before inclusion in the figure below.



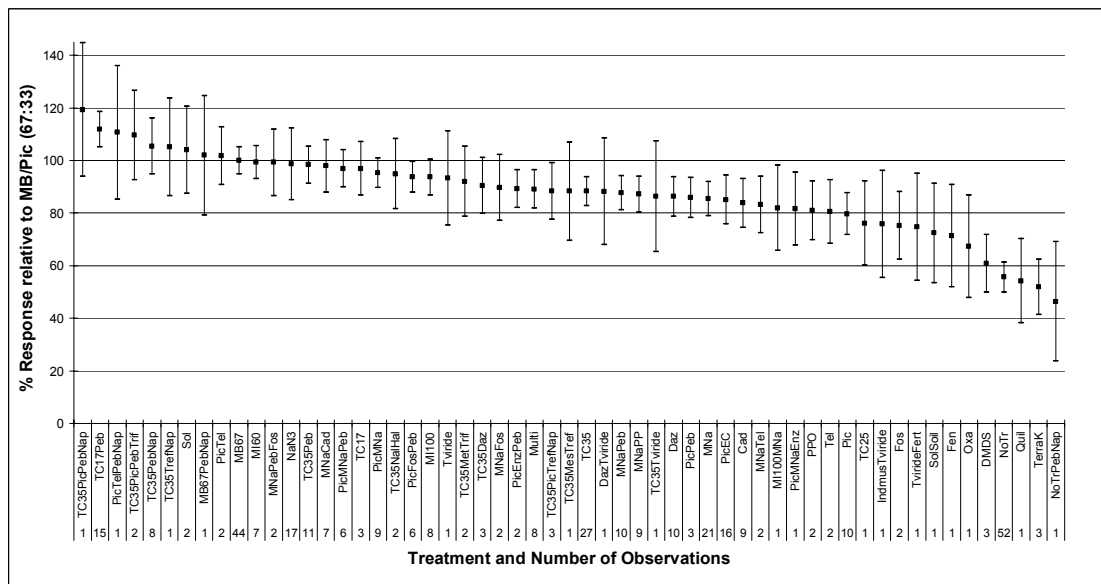
APPENDIX V-6. Relative yield data from the meta-analyses (treatment x production system) and LSI intervals for alternatives to methyl bromide from international research studies in tomato crops from 1997 to 2005. Note: >2 observations for an alternative were required before inclusion in the figure below.



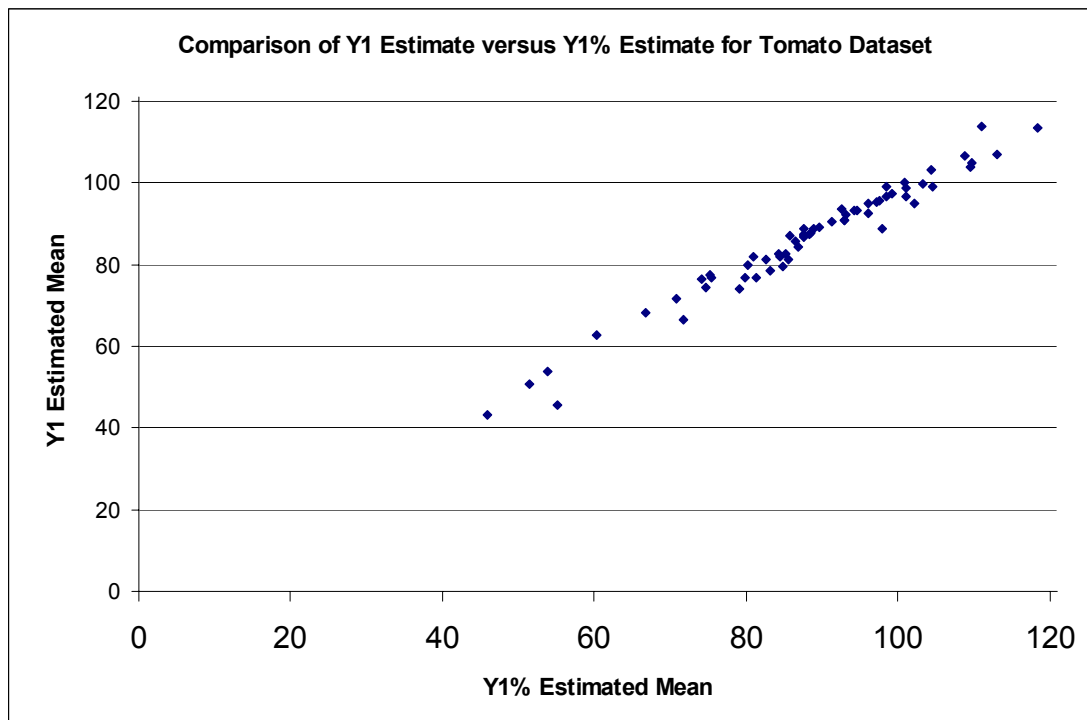
APPENDIX V-7. Relative yield data from the meta-analyses (treatment x soil type) and LSI intervals for alternatives to methyl bromide from international research studies in tomato crops from 1997 to 2005. Note: >2 observations for an alternative were required before inclusion in the figure below.



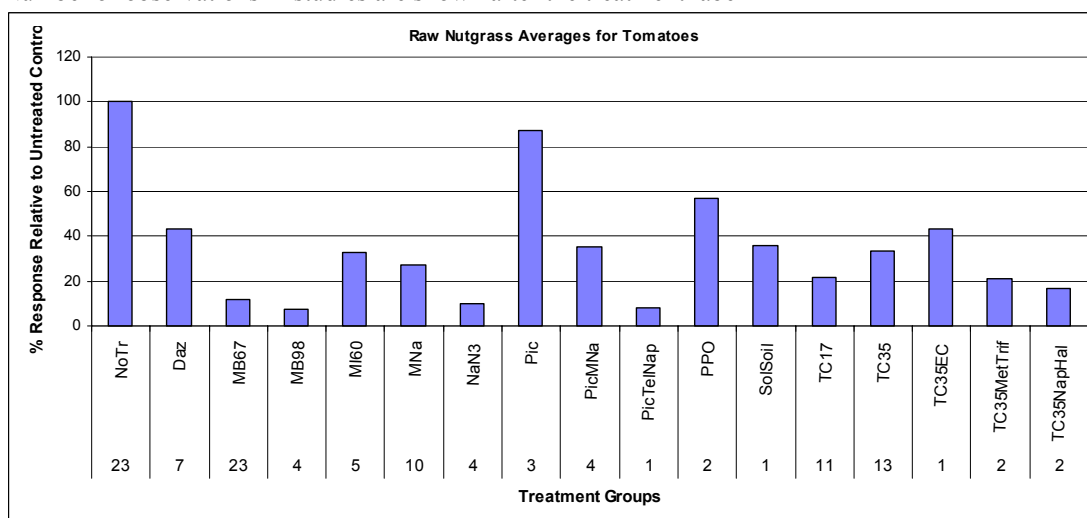
APPENDIX V-8. Relative yield data from the partial meta-analyses^A and LSI intervals for alternatives to methyl bromide from international research studies in tomato crops from 1997 to 2005. ^ANote: Relative means determined by comparison to the methyl bromide treatment from the same study



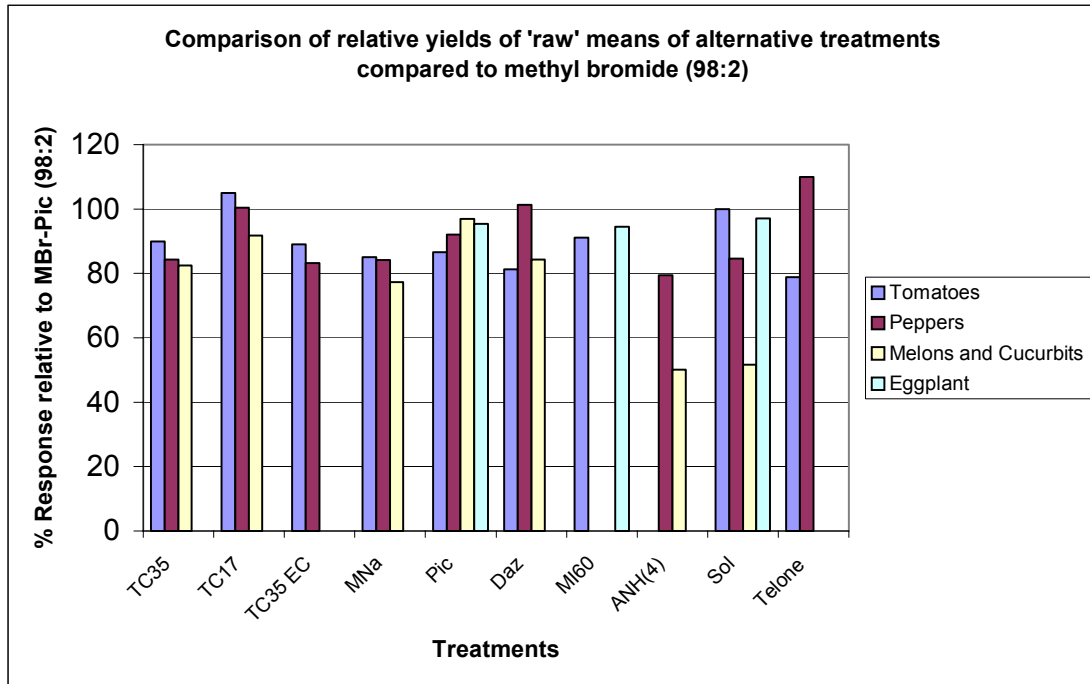
APPENDIX V-9. Correlation between estimated means from the full meta-analysis (Y1) and the partial meta-analysis for MB (Y1%) and alternatives from international research studies in tomato fruit crops from 1997 to 2005 for treatments with greater than two observations. Note: In the full meta-analysis the means were fully modelled means whereas in the partial meta-analysis the means are relative to the methyl bromide treatment from the same study. The plot enables identification of outliers.



APPENDIX V-10. Relative ('averaged' raw means) of nutsedge control for treatments in international studies (ie. population densities quoted in studies) relative to the untreated control. Note: There were insufficient studies of this parameter to do a full representative meta-analysis. Number of observations in studies are shown after the treatment label



APPENDIX VI: Comparison of the ‘raw’ means (not meta-analysed) from four crops averaged across international studies from trials conducted from 1997 –2005. Note: There were insufficient studies on peppers, melons and cucurbits and eggplant to do a full meta-analysis



APPENDIX VII - Modelled Analysis Parameters Strawberries

| Term | Levels | Wald statistic | chi pr | Unanalysed levels |
|---------------------------------|--|----------------|--------|-------------------|
| Main effect | | | | |
| TrtGrp1a (TG) | See Table 6 | 382.4 | <0.001 | |
| Interactions | | | | |
| TG x FungiBase | NS 736, Yes 145 | 14.65 | 0.745 | Unknown 8; No 6 |
| TG x Nematodes | NS 779, Yes 116 | 22.8 | 0.696 | |
| TG x NutBase | 1-5 33, 6-30 27, >30 22 | 30.63 | 0.08 | NS 813 |
| TG x Sealing | Non Barrier 812, Barrier 74, | 2.69 | 0.999 | Irclear 9 |
| TG x Applctn | Drip 164, Hotgas 2, Injection 503, Spray 65, Spread 13 | 65.35 | <0.001 | NA 122, NS 26 |
| TG x Production Practice | Greenhouse(tunnel) 138, Open Field 757** | 38.0 | 0.077 | |
| TG x SoilTyp | Clay 66, Loam 22, Sand 66 | 21.7 | 0.794 | NS 741 |

NS – Not specified; NA - Not Available; Irclear – Thermofilm clear;

* *- Unspecified studies were assumed to be open field studies

Model for Treatment Groupings 1a

REML variance components analysis

Response variate: LOG(Y1)
 Fixed model: Constant + TrlNo + TrtGrp1a
 Random model: TrlNo.TrtGrpAtom
 Number of units: 895 (2 units excluded due to zero weights or missing values)

Separate residual terms for each level of experiment factor: VarianceGrp

Sparse algorithm with AI optimisation

Estimated variance components

| Random term | component | s.e. |
|------------------|-----------|---------|
| TrlNo.TrtGrpAtom | 0.00424 | 0.00092 |

Residual model for each experiment

Experiment factor: VarianceGrp

| Experiment | Term Factor | Model(order) | Parameter | Estimate | s.e. |
|-------------|-------------|--------------|-----------|----------|---------|
| Grouped | Residual | Identity | Variance | 0.0203 | 0.0075 |
| Daz | Residual | Identity | Variance | 0.0238 | 0.0074 |
| MBPic | Residual | Identity | Variance | 0.00254 | 0.00061 |
| MIPic | Residual | Identity | Variance | 0.00973 | 0.00458 |
| MNa | Residual | Identity | Variance | 0.324 | 0.054 |
| MNaOther | Residual | Identity | Variance | 0.0148 | 0.0052 |
| MNaSolar | Residual | Identity | Variance | 0.00247 | 0.00393 |
| MNaTelOther | Residual | Identity | Variance | 0.00197 | 0.00586 |
| NoTr | Residual | Identity | Variance | 0.232 | 0.037 |

Validating the Yield Performance of Alternatives to Methyl Bromide for Pre-Plant Fumigation

| | | | | | |
|---------------|----------|----------|----------|---------|---------|
| OrgFert | Residual | Identity | Variance | 0.238 | 0.156 |
| Pic | Residual | Identity | Variance | 0.00352 | 0.00100 |
| PicEC | Residual | Identity | Variance | 0.00395 | 0.00148 |
| PicECMNa | Residual | Identity | Variance | 0.0280 | 0.0140 |
| PicECMNaOther | Residual | Identity | Variance | 0.0142 | 0.0053 |
| PicMNa | Residual | Identity | Variance | 0.0518 | 0.0227 |
| PicMNaOther | Residual | Identity | Variance | 0.0707 | 0.0629 |
| PicOther | Residual | Identity | Variance | 0.00494 | 0.00402 |
| PicTel | Residual | Identity | Variance | 0.00931 | 0.00188 |
| PicTelOther | Residual | Identity | Variance | 0.0154 | 0.0038 |
| PP | Residual | Identity | Variance | 0.520 | 0.215 |
| PPO | Residual | Identity | Variance | 0.0219 | 0.0163 |
| Solar | Residual | Identity | Variance | 0.0787 | 0.0240 |

Wald tests for fixed effects

Sequentially adding terms to fixed model

| Fixed term | Wald statistic | d.f. | Wald/d.f. | chi pr |
|------------|----------------|------|-----------|--------|
| TrtNo | 214716.48 | 95 | 2260.17 | <0.001 |
| TrtGrp1a | 382.44 | 84 | 4.55 | <0.001 |

Dropping individual terms from full fixed model

| Fixed term | Wald statistic | d.f. | Wald/d.f. | chi pr |
|------------|----------------|------|-----------|--------|
| TrtGrp1a | 382.44 | 84 | 4.55 | <0.001 |
| TrtNo | 176655.53 | 95 | 1859.53 | <0.001 |

APPENDIX VIII - Modelled Analysis Parameters Tomatoes

| Term | Levels | Wald statistic | chi pr | Unanalysed levels |
|---------------------------------|---------------------------------------|----------------|--------|------------------------|
| Main Effect | | | | |
| TrtGrp1b (TG) | See Table 7 | 266.0 | <0.001 | |
| Interactions | | | | |
| TG x FungiBase | NS (221), Yes (181) | 19.4 | 0.197 | |
| TG x Nematodes | NS (158), Yes (244) | 35.2 | 0.050 | |
| TG x NutBase | 1-5 (24), 6-30 (36), >30 (96) | 41.5 | <0.001 | NS 246 |
| TG x Sealing | Non Barrier (393), Barrier (9) | 1.2 | 0.759 | |
| TG x Applctn | Drip 64, Injection 217, Spray 27 | 29.1 | 0.357 | NA 52, NS 31, hotgas 8 |
| TG x Production Practice | Greenhouse(tunnel) 60, Open Field 342 | 2.4 | 0.788 | |
| TG x SoilTyp | Clay 21, Loam 52, Sand 208 | 33.3 | <0.001 | NS 121 |

NS – Not specified; Not Available

Model for Treatment Group 1b

REML variance components analysis

Response variate: LOG(Y1)
 Fixed model: Constant + TrINo + TrtGrp1b
 Number of units: 402 (29 units excluded due to zero weights or missing values)

Separate residual terms for each level of experiment factor: VarianceGrp

Sparse algorithm with AI optimisation

Residual model for each experiment

Experiment factor: VarianceGrp

| Experiment | Term Factor | Model(order) | Parameter | Estimate | s.e. |
|-------------|-------------|--------------|-----------|----------|---------|
| RagBag | Residual | Identity | Variance | 0.0262 | 0.0141 |
| Daz | Residual | Identity | Variance | 0.0564 | 0.0296 |
| MB | Residual | Identity | Variance | 0.0350 | 0.0134 |
| MBPic | Residual | Identity | Variance | 0.0146 | 0.0049 |
| MI100 | Residual | Identity | Variance | 0.00775 | 0.00478 |
| MIPic | Residual | Identity | Variance | 0.00484 | 0.00350 |
| MNa | Residual | Identity | Variance | 0.108 | 0.036 |
| MNaOther | Residual | Identity | Variance | 0.0185 | 0.0058 |
| NaN3 | Residual | Identity | Variance | 0.0762 | 0.0324 |
| Nematicide | Residual | Identity | Variance | 0.0264 | 0.0101 |
| NoTr | Residual | Identity | Variance | 0.398 | 0.080 |
| Pic | Residual | Identity | Variance | 0.00311 | 0.00272 |
| PicEC | Residual | Identity | Variance | 0.0141 | 0.0059 |
| PicMNa | Residual | Identity | Variance | 0.00556 | 0.00395 |
| PicMNaOther | Residual | Identity | Variance | 0.0106 | 0.0075 |
| PicOther | Residual | Identity | Variance | 0.00454 | 0.00292 |
| PicTel | Residual | Identity | Variance | 0.0130 | 0.0040 |
| PicTelOther | Residual | Identity | Variance | 0.0220 | 0.0058 |

Deviance: -2*Log-Likelihood

| | |
|----------|------|
| Deviance | d.f. |
| -529.21 | 266 |

Note: deviance omits constants which depend on fixed model fitted.

Wald tests for fixed effects

Sequentially adding terms to fixed model

| Fixed term | Wald statistic | d.f. | Wald/d.f. | chi pr |
|------------|----------------|------|-----------|--------|
| TrtNo | 85753.57 | 55 | 1559.16 | <0.001 |
| TrtGrp1b | 266.01 | 62 | 4.29 | <0.001 |

Dropping individual terms from full fixed model

| Fixed term | Wald statistic | d.f. | Wald/d.f. | chi pr |
|------------|----------------|------|-----------|--------|
| TrtGrp1b | 266.01 | 62 | 4.29 | <0.001 |
| TrtNo | 33657.04 | 55 | 611.95 | <0.001 |