Section 2

INTRODUCTION

1. INTRODUCTION

The National Registration Authority for Agricultural and Veterinary Chemicals (NRA) has reviewed the active ingredient endosulfan, all products containing endosulfan and associated labels.

The purpose of this section is to provide a summary of the data evaluated and of the regulatory decisions reached, as a result of the review of endosulfan.

1.1 Regulatory Information

1.1.1 Initiating a Review

The NRA has statutory powers to reconsider the approval of active constituents, the registration of chemical products or the approval of labels for containers at any time. The basis for a reconsideration is whether the NRA is satisfied that the requirements prescribed by the regulations for continued approval are being met. These requirements are that the use of an active constituent or product, in accordance with the recommendations for its use:

- would not be an undue hazard to the safety of people exposed to it during its handling or people using anything containing its residues; and
- would not be likely to have an effect that is harmful to human beings; and
- would not be likely to have an unintended effect that is harmful to animals, plants or things or to the environment; and
- would not unduly prejudice trade or commerce between Australia and places outside Australia.

1.1.2 Obligations To Submit Data And Other Information On Chemicals Under Review

On initiating a review, the NRA has to notify relevant approval holders and registrants of the matters it intends to reconsider and its reasons for doing so, and to invite them to make written submissions on those matters. These people are also requested to submit all existing information and data on the chemical under review, regardless of age or confidentiality. The NRA also notifies the community of the review through national and local newspapers, inviting them to make submissions.

In addition to inviting public submissions, the NRA may consult with persons, organisations or government agencies with relevant knowledge or interests, for the purposes of obtaining information or advice relating to the reconsideration.

Once a review is underway, the NRA may request additional information from approval holders and registrants. If such a request is denied, the NRA may suspend or cancel the relevant approval or registration.

1.1.3 Outcomes of Reviews

There are three possible outcomes to an ECRP review:

1. The NRA is satisfied that the chemical under review continues to meet the prescribed requirements for the initial approval or registration and confirms the approval or registration.

2. The NRA is satisfied that the conditions to which the approval or registration is currently subject can be varied in such a way that the requirements for continued approval or registration will be complied with and varies the conditions of approval or registration.

3. The NRA is not satisfied that the conditions continue to be met and suspends or cancels the approval or registration.

The NRA must notify the approval holders, registrants and the community of the outcomes of these reviews.

2. PROTECTED INFORMATION

The NRA maintains a protected information program. The objectives of this program are:

- to grant protection to providers of certain information relating to agricultural and veterinary chemicals to provide an incentive for the development of products and data applicable to Australian or local conditions;
- to encourage the availability of overseas products and data; and
- to provide reciprocal protection for Australian products and data under overseas' PRRD systems.

In general, the NRA designates information as "protected information" for a "protection period" of two to seven years if it:

- is requested by the NRA for the purposes of reviewing a product,
- is relevant to the scope of the review and
- relates to the interaction between the product and the environment of living organisms or naturally occurring populations in ecosystems including human beings.

If the NRA proposes to use the same information to determine whether to register or to continue registration of another chemical product, the NRA must not use the information until the parties come to an agreement as to terms for compensation, unless the protection period has expired or the NRA is satisfied that it is in the public interest to use the information.

3. REASONS FOR THE ENDOSULFAN REVIEW

Endosulfan was selected from the Priority Candidate Review List after scoring highly against the agreed selection criteria for public health, occupational health and safety, environment, efficacy and quality and trade issues. In summary, the concerns raised in relation to the chemical were:

- limited evidence of human poisonings
- high potential acute risk
- high potential chronic risk
- surface and ground water contamination
- fish kills
- use scenarios for workers that require new restrictions on endosulfan
- some damage on lima beans and alfalfa crops
- residue violations in domestic produce
- MRL inconsistencies with Codex for meat and rice
- possibility that stock food MRL is too low to cover use in crops (Note: The primary feed commodity MRL for endosulfan was increased by a factor of 10 to 0.3 mg/kg during the course of the review as a result of activity initiated in response to the presence of illegal residues of endosulfan in beef)

Whilst the selection process ranked endosulfan highly due to certain issues, the review was not confined only to those issues, but covered **all aspects** of the conditions of registration and approval.

4. COMMUNITY CONSULTATION ACTIVITIES

As a result of the NRA’s nation-wide advertised call for written public submissions concerning endosulfan, sixty seven (67) submissions were received early in the review process and considered in the complete ECRP review of endosulfan. The views expressed covered a broad scope ranging from environmental and health concerns to agronomic, economic and trade issues. Any assessable data included in the public submissions were forwarded to the appropriate agencies for assessment.

A summary of the early public submissions can be found in Attachment 2 near the end of this section (Section 2). A summary of later public submissions, which were in response to the 22 December 1998 draft review report, can be found in Attachment 1 at the end of Section 1.

4.1 Responses from Growers

Growers emphasised that, in most cases, endosulfan use was not indiscriminate but that it was essential for the success of integrated pest management and resistance management strategies in many crops. It is thus not generally used as a programme spray. In fact, this type of pest control strategy is considered to be not good agricultural practice by most growers and authorities in relation to use of endosulfan. The advantages of endosulfan for integrated pest management and resistance management are that it is cheaper than many other chemicals, it is softer on beneficial insects, mites etc. than other chemicals, it is less phytotoxic than alternative chemicals and it belongs to a different chemical group of insecticides. In addition, in some crops it is the only chemical registered or approved for particular pests.

Attention was also drawn to the chemical nature of endosulfan which, although it is a cyclodiene organochlorine insecticide, does not exhibit the typical characteristics of this group of insecticides to the same extent as other members of the group. Thus, it does not build up in the fat of mammals to the same extent, and neither does it persist in the environment for decades after it has been deposited.

It was further emphasised that considerable research had been carried out in relation to the major use of endosulfan in cotton production to enable growers to minimise the impact of endosulfan use on the community and the environment. Various strategies had been, or were being, adopted by the industry to implement the research outcomes. These included containment of irrigation tail waters on farm, computerisation and global positioning systems for aerial spraying operations and use of EC formulations as opposed to ULV formulations to minimise drift as a result of small droplet formation.

State agricultural authorities generally supported growers and grower organisations in their contentions in relation to the essential nature of endosulfan for the production of a number of Australia’s major export crops as well as a number of crops with a mainly domestic focus. A significant number of spray programs recommended by State agricultural authorities included endosulfan as an integral and essential part.

Growers also emphasised the fact that producers were demonstrating their stewardship of chemicals in that there had been a considerable response among their numbers to the availability of chemical safety training and accreditation. In some areas such as the Goulburn Valley in Victoria, the participation rate in these courses was very high.

4.2 Responses From The Community

Community responses were mainly related to concerns regarding the environmental and health impacts of use of large quantities of endosulfan in farming operations.

Use of endosulfan in the cotton industry was particularly highlighted in the responses, with respondents drawing attention to environmental impacts associated with this use. These included fish kills, as well as official water quality data which showed endosulfan levels in surface and ground water above ANZECC guidelines.

Particular emphasis was placed on the practice of aerial distribution of endosulfan as a means of contamination of surface and ground water, both through off-target drift of spray and through the loading, mixing, filling and disposal operations associated with aerial spraying.

Concerns were expressed from the Gunnedah area in relation to the health effects resulting from the use of endosulfan and other pesticides in the production of cotton. Allergies and chemical sensitivities were attributed by respondents to direct contamination through spray drift, as well as contamination of drinking water.

Also from a health point of view, other respondents were concerned that endosulfan may be carcinogenic or that it may disrupt the human hormonal/reproductive and/or immune systems.

4.3 Endosulfan Survey

The NRA also surveyed various groups involved as advisers, users and registrants of endosulfan to gather information on use, performance, changed agricultural practices, adverse effects and trade and residues. The results form part of the efficacy and trade reports which are presented in section 4 of this report.

5. CHEMICAL AND PRODUCT DETAILS

5.1 History of Registration

Endosulfan was first registered in Australia as the Hoechst product Thiodan around 1960. This first registration was for fruit and vegetables in NSW. It was first registered for use in cotton in NSW in 1965, this crop being included for Queensland in 1968.

5.2 Use Pattern

By far the major use of endosulfan is in cotton production (approximately 70% of product). In this crop, endosulfan is generally applied in accordance with the Insecticide Resistance Management Strategy (Cotton Pests and Pest Management) which is kept under review by an expert committee, which includes members from NSW Agriculture, CSIRO, Avcare and the Cotton Research and Development Corporation.

In this strategy, endosulfan use is primarily aimed at control of native budworm (*Helicoverpa punctigera*) which is still susceptible to the chemical. It is therefore only applied early in the crop to avoid cotton bollworm (*Helicoverpa armigera*) which is highly resistant to this endosulfan. Growers are encouraged to use the LepTon Test Kit to determine which *Helicoverpa* species is present in the crop. In addition, spraying is only initiated when the pre-flowering *Helicoverpa* threshold (2 small or 1 medium larva/metre, monitor first position fruit retention) is reached. Spraying cotton crops with endosulfan is discontinued at a date (which is kept under review) towards the end of January. By this stage damaging *Helicoverpa* populations consist mainly of the endosulfan resistant *Helicoverpa armigera*. Growers indicate that under this regime, between 4 and 6 endosulfan sprays per season are applied to cotton crops. However, data available to the Australian Cotton Research Institute indicate that the number of endosulfan sprays has been decreasing over time such that the average number of sprays for the 96/97 season was 2.5 (average numbers of sprays in particular areas varied upwards to almost 7).

This use of endosulfan conserves the populations of natural enemies for as long as possible and prevents the flaring of secondary pests such as mites, aphids and whitefly. It is also useful for suppression of early season sucking pests such as mirids. The alternative products for all these pests (the pyrethroids, organophosphates and the carbamates) are considered ‘hard’ on beneficials and the early season use of all these products has been clearly demonstrated to cause mid/late season flare of secondary pests (particularly mites).

In relation to other broadacre crops, similar use patterns are adopted. However, it should be noted that cereal crops such as maize and sorghum mainly attract the resistant *Helicoverpa armigera* and endosulfan is therefore not generally a viable *Helicoverpa* control option in these crops.

Use in vegetables accounts for approximately 20% of the use of endosulfan. Information supplied by growers indicates that integrated pest management and resistance management practices are being adopted by the majority of growers in recognition of growing resistance problems. Spraying in response to damaging pest populations determined by crop monitoring is becoming the dominant use pattern in vegetable production. State departments of agriculture and other research organisations are assisting growers to calculate economic thresholds to enable them to make informed decisions about when spray application will be most effective.

The remaining 10% of uses of endosulfan are divided between oilseeds, pome and stone fruits, exotic fruits and other crops such as pulses and ornamentals. Most of these uses, particularly in orchards, involve endosulfan in some kind of integrated pest management or resistance management programs.

For example, Queensland and NSW have indicated that endosulfan is essential for IPM in tropical and sub-tropical fruits, citrus and apples while Tasmania has indicated that it is essential for apple production.

5.2.1 Other Uses

There are also a number of miscellaneous uses included on some labels. They include treatment of hides, post-harvest dipping of export pineapples (quarantine treatment) and pot plant earthworm treatments. None of these miscellaneous uses have been nominated as essential by State agricultural authorities.

5.3 Application Methods

Significant quantities of endosulfan are applied by air, since the major crop on which endosulfan is used is cotton which is cultivated in very large continuous areas. Difficulties have been encountered from time to time with movement of endosulfan off target with significant consequent effects on aquatic organisms.

In response to these difficulties, strategies to minimise drift have been developed, including more use of large capacity boom sprayers and use of formulations for aerial application which are less likely to result in drift. Use of EC formulations instead of ULV formulations is being examined in the light of drift associated with aircraft spraying operations.

Strategies to minimise movement of dust, storm water and irrigation tail waters have also been developed and are being implemented by some growers.

Endosulfan is widely used in IPM programs in orchards and, in common with many other older chemicals, endosulfan recommendations for use in orchards are given as a high volume rate per 100L. However, many orchardists are now using low volume (in some cases electrostatic ultra low volume) equipment to apply endosulfan, whereas original rates of use in orchard crops (and possibly, MRL determinations) were based on high volume application methods.

The main difficulty posed by this development stems from the fact that there are no directions on the label in relation to the amount of water which should be used in high volume applications to the various fruit crops specified on the labels. In relation to pome and stone fruit orchards, most estimates of spray volume fall between 1500-3000 L/ha. Thus, amounts of chemical between 997.5 - 1995 gai/ha could be applied during a high volume application. Growers are then taking these rates and applying them in a markedly reduced volume of water. Volumes of water applied during low volume application in orchards vary between 180-500 L/ha. Where electrostatic sprayers are used, volumes between 50-80 L/ha are applied.

In a high volume operation, there is a loss of chemical because of run-off (up to 50% according to some estimates). In a low volume spraying operation, the reduction in run-off (almost to non-existence in some cases), and better efficiency of equipment mean that there is a better rate of deposition of spray onto the target. It is therefore apparent that rates of use could be examined both from a standardization point of view and with a view to reducing the amount of chemical applied per hectare.

This could be achieved by reducing the rates of application of current products. Alternatively, in consultation with the registrant chemical companies, it may be possible to produce formulations of endosulfan which could be used at lower rates of use or which contain a lower concentration of endosulfan.

Growers who were surveyed indicate that in the IPM programs, sprays are only applied as a result of orchard monitoring, often by professional crop monitoring services, for pest pressure. In fact, there is evidence to suggest that even growers who do not plan to use a full IPM program apply sprays in response to pest monitoring. They further indicate that when sprays are applied, they are applied according to the current label directions.

Trial work has been carried out in citrus by State departments which shows that rates of use of endosulfan for IPM systems to control major pests can be significantly reduced compared with recommended label rates. For example, NSW Agriculture advises that a rate of 10 mL/100L can be used as opposed to the label rate of 57 mL/100L. This has the effect of reducing endosulfan usage in citrus orchards from 1596 gai/ha to 280 gai/ha, assuming an average spray volume in this type of orchard of 8000L/ha. In this regard advice has been received that spray volumes for high volume spraying of citrus are between 8000-10000L/ha because of the density of the foliage and the consequent difficulty of wetting the whole canopy. The Queensland Department of Primary Industries has developed a per hectare rate for citrus of 1L/ha, or 350 gai/ha which, although higher than the NSW rate when a water volume of 8000L is assumed, is identical if water volume of 10000L/ha is assumed.

It is therefore to be expected that lower rates of use may also be possible in other IPM applications.

The majority of vegetables tend to be cultivated in smaller plots and therefore conventional boom sprays are the major method of application for endosulfan in these crops.

5.4 Formulations

The endosulfan products included in the review are either 350 g/L emulsifiable concentrate (EC) or 240-250 g/L ultra low volume (ULV) formulations.

5.5 Packaging

Container sizes of the EC products where provided were 1 L, 5 L, 20 L or 200 L. The container size of the ULV product is 200 L or 1000 L.

6. OVERSEAS REGULATORY STATUS

Endosulfan is registered in many countries in the world including those listed in the following table:

Some Overseas Countries in which endosulfan is registered

Argentina	New Zealand	Korea
Austria	Greece	Portugal
Bangladesh	India	Taiwan
Belgium	Hungary	Romania
Bolivia	Indonesia	Russian Federation
Brazil	Malaysia	South Africa
Canada	Poland	USA
China	Luxembourg	Spain
Czechoslovakia	Italy	Switzerland
Finland	Israel	Great Britain
France	Norway	Ireland
Pakistan	Japan	

Australian agriculture covers a wide range of geographical regions and climatic types and a correspondingly wide range of agricultural and horticultural crops. The registered uses and limitations applied in Australia compare with those countries with corresponding crops.. There is some variation in withholding periods, both longer and shorter, but generally they are of the same order.

With respect to regulatory activity in overseas countries, information available to the NRA suggests that endosulfan has been banned in The Netherlands and suspended in Sweden. The NRA is also aware of activity to limit the use of chemicals which have a certain level of toxicity in the Philippines, and that the toxicity of endosulfan results in it being excluded from use based on its current formulations.

ATTACHMENT 2: SUMMARY OF CONTENT OF PUBLIC SUBMISSIONS

In the early stages of the endosulfan review, the NRA sought comments from the community regarding any issue or concern related to endosulfan use. Sixty seven submissions were received from members of the community including growers, people involved with other aspects of the agricultural industry, individuals with environmental or health concerns and representatives of groups involved with agricultural, environmental or community issues.

In the sections which follow, most of the public comments have been summarised and organised into similar categories where possible. Where two or more submissions raised the same or closely related points, they have been consolidated for the sake of presentation. Where practical, the wording used by the respondent has been preserved. In most cases, respondents made statements and presented views without supporting documentation. Therefore, no supporting references will be noted with the summaries below unless it was supplied with the original submission.

It is important to note that the opinions contained in the submissions summarised below are not necessarily those of the NRA. In addition, any information asserted as fact in the descriptions below has not been verified by the NRA and remains as an assertion of the individual correspondent.

The identities of the sources of public submissions have been kept confidential. The numbers enclosed in parentheses in the text of this Attachment are NRA reference numbers each of which represents a submission. Consequently those numbers serve as an indication of the number of submissions addressing each issue.

The issues have been organised into five general categories:

1. **Environmental Impacts** includes comments on environmental contamination and potential unintended toxicity to wildlife or farm stock.

2. **Health Risks** includes concerns over health risks to the general public and to agricultural workers.

3. **Appropriate Use of the Chemical** includes discussion of practices influencing risk such as adequate user training, farm holding areas to reduce chemical runoff and methods to reduce total chemical application.

4. **Effects on Beneficial Organisms** includes comments concerning the effects on bees, on predators or parasites of pests and on Integrated Pest Management programmes.

5. **Agronomic Issues** includes matters of efficacy, perceived need for the chemical, effect on chemical resistance management programmes and economic issues.

Within each category, submissions are presented first from the general public. Following those comments are issues and comments on the same topic submitted by state and regional government agencies.

1. Environmental Impacts

1.1 General Public Submissions

Five respondents explicitly stated that contamination of surface and ground water by legal effluent from farms and pollution of waterways by inappropriate storage, mixing or disposal practices are points of concern. (1, 16,59,60,b). Four stated that large fish kills have been observed when the pesticides have been improperly used or have drifted over water (1,59,a,b)

A respondent in north-west NSW said that according to a Department of Land and Water Conservation water audit for the region, all sites within irrigated agricultural areas failed at some time during the November-March spray season to meet current ANZECC guidelines for endosulfan. Three reported fish kills could not be definitively attributed to the presence of chemical pollutants; however, this submission claimed that chemical pollution is the most likely explanation. (36)

A different individual in the Gunnedah area of NSW advised that four of the last five years have been drought years. With the resumption of more normal rain, flooding by stormwater runoff from cotton fields to adjacent grazing and residential property has brought contaminated water containing alarming levels of endosulfan and endosulfan sulphate. The effects of endosulfan contamination are already weighing heavily upon the local community and individuals with chemical sensitivities are suffering from exposure to endosulfan and unknown other chemicals. While these chemicals are registered for use and a system of self regulation is in place, misuse and abuse will continue to occur and innocent people will continue to be affected. This submission contended that the NRA should carefully consider the true cost of pesticide use to the whole community. (60)

Another stated that endosulfan is known to be toxic to aquatic organisms at low concentrations and over short duration. Fish accumulate the chemical directly from the surrounding water and concentrate it in the liver for detoxification. Endosulfan residues in catfish livers showed a significant increase during the summer months in wild catfish sampled from the Gwydir River in NSW. (40) Two other respondents expressed the belief that endosulfan has a high persistence and is capable of accumulating in the ecosystems of treated regions as well as in areas many hundreds of miles away. (59,b)

In contrast to the above remarks, several respondents expressed strong support for continued registration of endosulfan because, in their view, it is extremely important to the agricultural industry of Australia and the chemical has been shown (30-40 years of use in Australia and overseas) not to have any long term environmental risk to fish and other aquatic animals or plants and because it does not accumulate in the environment. (8,18,29) Three other submissions stated that endosulfan breaks down relatively rapidly (7,8,9) and another three that endosulfan does not apparently accumulate in living organisms the way other organochlorine pesticides do. (16,41,43). A different respondent stated that endosulfan does not seem to have a detrimental effect on bird life. (29)

One person observed that farming, by nature, is disruptive to the environment but that insecticide use is generally only a small component of the total environmental impact. (16)

Four respondents associated with the cotton growing industry said that, unlike most other organochlorine insecticides, endosulfan is a relatively short-lived chemical in the environment. Both endosulfan isomers breakdown rapidly and endosulfan sulphate, a breakdown product which can bind tightly to the organic component of soil, breaks down in soil within 11 - 12 months after spraying. All forms disappear much more rapidly in water, in the range of several weeks. Thus, they claim there is no long-term problem of accumulation of endosulfan residues as toxic forms on cotton farms. It was stated that the industry is addressing the problem of surface water runoff from farms to stop or minimise contamination of riverine environments. The industry is also investigating other potential avenues of unintended contamination such as aerial drift, volatilisation and dust born transport and is engaged in research to mitigate these problems. (54,55,56)

Two other submissions stated that the cotton growing industry has taken initiatives to improve use practices such as encouraging the storage of tail and storm water runoff water within farm boundaries to prevent pesticide release, adoption of soon-to-be available endosulfan test kits for determination of safe water release times and use of global positioning systems by aerial operators to increase their awareness of spray conditions and drift problems. One of the two said that the NRA should carefully consider the impact of their decisions on what is a responsible industry. (11,48)

1.2 Submissions from Government Agencies

A respondent involved in irrigation water supply stated that detection of endosulfan in the Murrumbidgee Irrigation Area drainage system has raised concern over liability in the irrigation water supply business. The environmental impact and the cost of monitoring are likely to become prohibitive for the business, and this person recommends discontinuing the product. (5)

Another stated that pesticide residue analysis in the catchments of the Macquarie, Namoi, Gwydir, Macintyre and Barwon Rivers in NSW show that endosulfan is widely detected. Endosulfan appears in surface waters during summer associated with its use on cotton which is the dominant irrigated crop in the area. To date, however, no deleterious impacts on the macroinvertebrate communities used as an indicator can be reliably attributed to the presence of endosulfan. Variables such as river flow rates and low water during summer confound the problem of assigning effects. (10)

A third respondent pointed out that the Darwin Rural Area Water Quality Survey, PAWA/WRD Report no 45/92, Sept. 1992, found no concentrations of chemicals from an agricultural source from 10 surface water locations and 24 groundwater sampling locations in the Darwin rural area, a major horticultural area. (20)

By contrast, a respondent from the Fitzroy catchment of central Queensland, which constitutes about 10% of the agriculturally productive land of the state, pointed out that during the summer cotton growing season, endosulfan is sometimes detected downstream from cotton growing areas in the Nogoa and Dawson Rivers. When detected, endosulfan levels are 10 to 100 times higher than the current environmental guideline of 0.01 μg/L. As yet, however, there are no reports of fish kills resulting from these detected concentrations of endosulfan. (24)

Finally, a submission from NSW advised that in a survey of NSW rivers in 1994 and 1995 looking for endosulfan contamination by the Department of Land and Water Conservation, 80% of water samples were above the ANZECC (1992) guideline of 10 ng/L during the irrigation season and 26% exceeded the guideline out of season. Evidence suggests that endosulfan persists in soils and sediments causing ongoing exposure. Nevertheless, at this stage, their view is that there is no data to indicate that the current ANZECC water quality guideline of 10 ng/L needs to be revised. (47)

2. Health Risks

2.1 General Public Submissions

One submission pointed out that disagreement between regulatory bodies in different countries over what is an appropriate acceptable daily intake (ADI) suggests that there is inadequate knowledge about real hazards. (1) Several respondents stated that longitudinal studies of sufficient duration have not yet been completed to assure the public that carcinogenic and teratogenic effects are not likely. (1,e,f) Another asserted that at low levels of exposure, endosulfan has adverse effects on the immune system. (59) Finally, four submissions raised concerns that reductions in human fertility and hormone disruption effects may also be an outcome of a rising level of exposure. (1,40,59,f)

Two respondents expressed a general concern over the lack of information available concerning spray schedules and locations of contamination stating that people have a right to be told when they are being involuntarily exposed to toxic chemicals. (36,f)

Three submissions stated that endosulfan has many positive attributes and has only a moderate toxicity to mammals. (41,42,43) Six other respondents expressed the opinion that endosulfan is a relatively low hazard chemical for users and spray operators (7,15,28,32,44,58).

Two additional submissions pointed out that all synthetic pesticides can result in unintended harmful effects if misused and went on to say that risks of continued use should be compared with the risks of alternative products and not with “no use” because growers will necessarily need to use alternatives. (16,17)

A respondent associated with the cotton growing industry stated that the cotton industry has reacted to studies revealing possible exposure problems for field workers by implementing management regimes which included extension of exclusion periods from fields, use of gloves and appropriate clothing and mandatory provision of washing facilities. (56)

2.2 Submissions from Government Agencies

A submission from the Darwin area advised that there have been no accidental poisonings with endosulfan reported to the Poisons Information Centre of the Royal Darwin Hospital during the last 2 years (the period of record keeping). The respondent expressed the opinion that restrictions to the availability of endosulfan could cause increased risk to public health as growers resorted to either illegal use or frequent use of other toxic chemicals. (20)

One submission referred to a study of pesticide exposure to cotton chippers in north-western NSW conducted in 1991 and 1992, which found that field workers could not be assured that the exposure levels of pesticide they encountered in their work under current practices would not harm their long term health. The study recommended that improved protective measures needed to be implemented such as better protective clothing, provision of hand washing facilities, avoidance of working in recently sprayed crops wet with dew, adequate minimum re-entry periods following pesticide application, improved coordination between aerial spray operators, property owners and chipping contractors and provision of emergency shower or other washdown and change facilities in the event of accidental overspraying as actually happened once during the course of the study. (61)

3. Appropriate Use of the Chemical

3.1 General Public Submissions

One respondent cautioned that overuse in calendar spraying programmes is a point of concern. (16)

Another submission expressed the opinion that many farmers have difficulty understanding the label instructions and, therefore, often apply chemicals improperly. It went on to say that they should be required to pass a training course and maintain current accreditation before being permitted to purchase agricultural and veterinary chemicals. (6)

By contrast, a submission from a respondent involved in lawn seed production stated that label instructions for the use of endosulfan are very clear and simple to follow and that those using the chemical do so responsibly. (18) Two other respondents pointed out that there are hazards related to the use of all synthetic pesticides, but these can be managed if users are adequately trained. (16,38)

One submission advised that in South Australia, the National Farm Chemical Users Training Program has been attended by over 6,000 farmers since its inception 3 years ago and that growers are very aware of the dangers of and the proper use of agricultural chemicals. (52) In a similar vein, two respondents involved in pomefruit and stonefruit production claimed that growers are very much aware of the precautions necessary, spraying only when needed and practising strict methods of proper application, storage and disposal to minimise any possible contamination or hazard to the public, animal stock or wildlife. (33,49)

Finally with respect to application methods, one respondent asserted that endosulfan does not have a propensity to travel off target through air movement and can be formulated to avoid spray drift from aircraft. (29) Another stated that while there has been some concern over aerial application of endosulfan, there has been no evidence of unintended environmental contamination because of ground application in commercial crops. (44)

3.2 Submissions from Government Agencies

One agency representative from the Northern Territory expressed the opinion that personal protection equipment specifications on the endosulfan label are adequate and that Northern Territory industry is participating in the National Farm Chemical User Training Program. (20)

With respect to proper use of the chemical, another submission stated that incidents of water contamination in the Maroochy River in Queensland have not necessarily been due to the legitimate agricultural use of endosulfan. (21)

4. Effects on Beneficial Organisms

4.1 General Public Submissions

In this section, a single submission stated that endosulfan is harmful to bees and other friendly insects unless it is used quite carefully. (2)

By contrast, a large number of very strongly supportive statements were expressed for endosulfan with respect to its value to beneficial insects and Integrated Pest Management programs. Numerous submissions elaborated in substantial detail the specific pests controlled by endosulfan while at the same time permitting the survival of bees and also parasites and predators of pest species.

Twenty eight submissions expressed the view that endosulfan is recognised as a “soft” option for the preservation of beneficial insect and is thus important in Integrated Pest Management (IPM) programs. They further stated that loss of endosulfan would force growers to substitute more dangerous and often less effective chemicals leading to a collapse of their IPM programs and to a greater overall use of more dangerous pesticides.
(2,9,11,12,14,15,16,17,19,26,30,33,29,34,37,41,42,43,44,46,48,49,53,54,55,56,57,58)

Eight submissions went on to state that in spite of endosulfan’s broad spectrum of activity against a wide range of pests in cotton, oilseeds, legumes, cereals, fruit and vegetables, it is relatively safe to many beneficial predator and parasite populations because of its short persistence and that it rarely causes secondary pest outbreaks experienced with pyrethroids and some organophosphates and carbamates. (16,37,46,48,54,55,56,57)

Five other submissions pointed out the value of endosulfan as an early season treatment for the control of *Helicoverpa* spp. The early season use endosulfan conserves the populations of natural enemies of pests for as long as possible and has a suppressive effect on early season sucking pests such as mirids. The alternative products (synthetic pyrethroids, organophosphates and carbamates) are much harder on beneficial insects and their early season use has been clearly shown to cause mid-late season flare of secondary pests such as aphids, whiteflies and particularly mites. The respondents went on to say that the potential of a new pest, the B type silver white fly (*Bemisia tabaci*) makes endosulfan even more important and that loss of endosulfan would inevitably result in an increased use of harder insecticides and an increased overall use of chemicals concurrent with the failure of IPM programs. (26,54,55,56,57)

Two respondents associated with the tomato growing industry advanced the same points as above and went on to state that the use of endosulfan reduces their total insecticide use by 50% to 60% by allowing their IPM programs to remain intact, and that expensive miticides are usually not required at all. (26,30)

Very similar points were made by seven submissions from various fruit growers in Tasmania, Western Australia, South Australia, Victoria, New South Wales and Queensland. They stated that endosulfan was vital for control of, for example, fruit spotting bugs, thrips and aphids while maintaining mite control through IPM programs. They specifically mentioned that endosulfan allowed the survival of predatory mite species, parasitic wasps, ladybird beetles and lacewing larvae while effectively controlling economically serious pests. Several also said that there is no current satisfactory substitute for endosulfan and that substitution of synthetic pyrethroids would harm the overall situation by killing beneficial insects. (12,14,19,33,46,49,58)

Two submissions expressed concern over the exceptional importance of endosulfan in IPM programs for the cotton growing industry. They stated that endosulfan is vital early in the growing season to control *Helicoverpa* spp. and to place additional pressure on other destructive insect groups. It is expected that endosulfan will still be required in IPM programs after the introduction of transgenic Bt cottons and envirofeast food sprays. They asserted that the loss of endosulfan would seriously jeopardise the cotton industry. (11,48)

Concerning bees and other pollinators, sixteen submissions made the point that endosulfan does not harm bees when properly used and is less damaging to beneficial insects than any other suitable alternative chemical. (4,7,34,37,41,42.43,44,46,49,53,54,55,56,57) One respondent, describing the viewpoint of professional bee pollinators, went on to state that in most cases, beekeepers will refuse service to fields sprayed with insecticides other than endosulfan. The submission further stated that alternative organophosphate and carbamate insecticides have been responsible for massive bee kills and that loss of endosulfan and substitution of other chemicals would result in substantial economic loss and hardship to beekeepers. Finally, nonmanaged feral bees and other native beneficial insects would also suffer to the detriment of the agricultural industry since the estimated annual value of crops requiring honeybee pollination is currently 1.2 billion dollars with a dramatic increase predicted for the future. (22)

4.2 Submissions from Government Agencies

A submission from an agency involved in tropical pest management stated that endosulfan is a very valuable integrated pest management tool in both horticulture and broad-acre grain legumes which will be needed in the foreseeable future. In the case of thrips and fruit spotting bugs, there is no effective alternative that would not substantially disrupt IPM programs. It also emphasised that endosulfan is relatively safe to bees and other beneficial insects and is often used when horticultural crops are flowering. (21)

Two other submissions from Queensland stressed the value of endosulfan in IPM programs and its value in preserving pollinators and predators. They also advised that bee pollination is essential to the production of hybrid seed crops such as canola, sunflower, lucerne and vegetables such as onions and brassicas as well as numerous other broadacre and horticultural crops. It stated that bee deaths from endosulfan are minimal and far less than any other alternative insecticide. (25,50)

5. Agronomic Issues

5.1 General Public Submissions

Two respondents expressed a concern for the wine and dried fruit industry that endosulfan residues might cause problems with export of wine and dried fruit overseas if residues are found to exceed MRLs of overseas markets. (c,d)

There were numerous, often very detailed and all very supportive, public submissions related to the economic benefits to agriculture and benefits to trade of endosulfan use. For example, one respondent appealed to those who make decisions to deregister chemicals “to consider the bigger picture”(2). Another stated that the agricultural industry has been through a difficult period with very small margins and that any production losses now, due to the withdrawal of a vital tool such as endosulfan, would severely impact on the economic viability of the industry. (52) Numerous others stressed the low cost, the effectiveness and the safety of endosulfan. A number also stressed its compatibility with other products in tank mixes. Because of the great number and length of the submissions for this section, they are summarised and grouped largely by general crop sector which will allow for repetition of common views expressed for different applications.

The point mentioned most often dealt with the management of pesticide resistance in target pests through the rotational use of different pesticides. Twenty one submissions expressed the view that endosulfan is the only member of the cyclodiene (an organochlorine) class of pesticides still registered for use in broadacre insect control in

Australia and as such is a critical component of the insecticide resistance management (IRM) strategy which relies on the rotation of different chemical classes and non-use time windows to minimise the development of resistance in target pests. Currently it is rotated with synthetic pyrethroids, organophosphates and carbamates. There is no current substitute for endosulfan in the rotation program and its withdrawal would make IRM, through the rotation of chemical groups, virtually unworkable. (3,7,9,11,16,26,27,34,35,37,44,45,46,48,51,53,54,55,56,57,58)

Several extremely detailed submissions pointed out that endosulfan is the only chemical either registered for or effective against many important pests which seriously damage a wide range of broadacre and horticultural crops. (37,44) For example, three respondents stated that endosulfan is a key product for legume growers where it is the only means of control of sucking pests such as adult *Riptortus* species and green vegetable bugs. (9,37,46) Another submission advised that endosulfan is the most effective insecticide against podsucking bugs such as *Nezara viridula*, *Piezodorus hybnere*, *Mirperus scutellaris* and *Riptortus serripes* which are major pests of grain legumes reducing both yield and seed quality. It went on to say that a number of synthetic pyrethroids and methomyl are registered for podsucking bug control in grain legumes but do not always give satisfactory control in the South Burnett area of Queensland. (23)

Several other submissions stated that endosulfan is important in seasonal crop rotations between legume and brassica crops in western Australia and is especially useful because of its compatibility in tank mixes for combined operation application. (13, 16) It was pointed out that endosulfan is also used in a rotation cycle in Western Australia to prevent the buildup of resistance in *Helicoverpa punctigera* and *Helicoverpa amigera*. Used selectively, it has reduced the use of hard chemicals in sweet corn and cucurbit crops. (34)

Four submissions from Victoria and New South Wales advised that endosulfan is used against native budworm in grain legumes and against *Heliothis* in tobacco and sweet corn. Additionally, approximately 300,000 ha of pasture are sprayed annually in Victoria alone to control red legged earth mite. The respondents also said that in Victoria and NSW, endosulfan is the least costly control for red-legged earthmite which has the potential to wipe out a canola crop. Prior to its adoption, many farmers suffered great crop losses and needed to incur the cost of repeated application of other more expensive and less effective post emergent insecticides. (35,46,51,58)

A submission from the macadamia growing industry stated that endosulfan is integral to the IPM program used on Macadamia in Australia and that its benefits include high efficacy at low rates of active ingredient and superior effectiveness against the Macadamia Nut Borer (*Cryptophlebia ombrodelta*), the twig grinder and the flower caterpillar. It also pointed out that endosulfan, being an organochlorine, does not induce early season resistance to organophosphate insecticides or synthetic pyrethroids which are required later in the season for other pests. (7)

Two submissions from the avocado industry of Queensland and NSW and another referring to subtropical fruit growing in Queensland stated that endosulfan is registered to control the banana spotting bug, brown looper, grey looper, fruitspotting bug

(*Amblypelta nitada*) greenhouse thrip, redbanded thrips, redshouldered leaf beetle, swarming leaf beetles and yellow peach moth. The two species of fruitspotting bugs cause the greatest economic loss if not efficiently controlled. Fruitspotting bugs attack some 24 fruit and nut crops in Australia. Fruitspotting bug infestation and their damage is not normally detected until it is too late, and therefore, regular pesticide applications are applied to minimise the economic loss. Non-chemical control methods (mainly good husbandry practices) have no more than a marginal effect in controlling the pest. Endosulfan is the only approved chemical which gives the degree of control necessary for commercial viability; there is no preferable alternative. Anecdotal evidence suggests that up to half the avocado crop is rendered unmarketable without chemical control. The submissions also said that the industry is involved in R&D for the development of substitute pesticides and biocontrol methods; however, until an effective replacement is registered, the avocado industry must rely on endosulfan to control fruit spotting bugs. (12,16,31)

A different respondent from NSW stated that endosulfan is the only registered chemical for use against the fruit spotting bug which damages apples in early development and makes them unmarketable. (4) Six other respondents stressed that the loss of endosulfan would have a major and potentially catastrophic result to the apple industry of South Australia, Western Australia, Victoria and New South Wales where it is required to control the apple dimple bug and thrips. There is currently no alternative to endosulfan for apple dimple bug control, either chemical or biological. Since the insecticide is sprayed on trees in a large orchard setting during spring and summer, leaching into surface and ground water is thought to be minimal. They also advised that the apple and pear industry is practising a “Pesticide Charter” with the Australian Consumers Association to reduce chemical pesticide use by 75% by the year 2000. (14,35,46,49,51,58)

A submission from Tasmania pointed out that, for apple and pear production, endosulfan is relied upon for the control of woolly aphid, an especially important requirement for export fruit. (33) Another submission described the importance of endosulfan to the South Australian stonefruit industry for the control of thrip, Rutherglen bug and other sucking insects. It also said that endosulfan is used to control spined citrus bug and katydids and is very effective at very low rates. (15)

Again mentioning the Rutherglen bug, another submission stated that at certain times of the year, endosulfan is the only chemical which will control the Rutherglen bug in flowers for cut flower production in the Carbrook, Queensland area. As with other crops, this submission also described how endosulfan is important for use in rotation with other chemicals to reduce the buildup of insecticide resistance. (27)

For the production of greenhouse tomatoes in Tasmania, two respondents advised that endosulfan is the only chemical registered for control of whitefly, one of the major greenhouse pests which can reduce marketable fruit yields by one third. The insecticide is usually only needed twice during the life of each crop and since all applications are within enclosed greenhouses, there is no problem with drift or rainwater runoff. (28,32)

Five submissions from respondents involved with the cotton growing industry stressed endosulfan's importance to cotton production. They said that with increasing resistance to carbamates, it is vital that they retain the use of endosulfan. With the withdrawal of Helix, choice is further limited. The loss of such an important insecticide as endosulfan would create a large gap in the insecticide armoury "which would threaten the viability of the cotton industry. It is unlikely that resistance to other chemical groups could be contained to an effective level." They went on to say that endosulfan is exceptionally cheap and flexible to use, since it is compatible with many other products in bulk handling systems. They also advised that a recent review by the Cotton Research and Development Corporation estimated that the loss of endosulfan would cost the Australian cotton industry about $60 million in increased production costs and a 5% yield loss would cost an additional $45 million. (48,54,55,56,57)

Finally three other submissions pointed out that most countries to which Australia would export berryfruit have an established minimum residue level for endosulfan and therefore use of endosulfan does not pose a threat to trade. (41,42,43)

5.2 Submissions from Government Agencies

Five submissions from state agency representatives echoed most of the views expressed above. For example, one stressed that endosulfan is used in the management of a wide variety of horticultural and broad acre crops in the Northern Territory and is especially effective against the difficult to manage sap sucking insects and caterpillars. In particular, endosulfan is the only effective chemical against the exotic pest, the poinsettia whitefly which is resistant to the common organophosphates. It is also very important against the red banded thrip, a major pest of mangoes, and provides cheap and effective control of *Heliothis* on sorghum and leaf roller on sesame and mung bean. The respondent stated that the loss of endosulfan would significantly harm the development of the NT's major horticultural industry. (20)

Four submissions emphasised that endosulfan, as a non-persistent organochlorine pesticide, is an essential resistance management tool which should not be lost. It plays a pivotal role in the management of insecticide resistance to chemicals from the carbamate, the organophosphate and pyrethroid groups. Loss of endosulfan would severely disrupt insecticide resistance management programs throughout eastern and northern Australia. Without it, pest problems would escalate and growers would need to use alternatives. In terms of efficacy, environmental impact, ecological balance and consumer safety, there is no proven alternative more appropriate than endosulfan. (20,21,25,50)

Two submissions pointed out endosulfan's usefulness as an essential chemical in the production of broad-acre grain legumes(soybeans, navy beans and mung beans) in north-east Australia. Continued registration is imperative as there is no obvious alternative control for the green vegetable bug and the brown bean bug which are the major pests of all these legumes,. It is also used in dozens of horticultural crops to control caterpillars, thrips and fruit spotting bugs. Although some Bt formulations can act as possible alternatives for caterpillars, control is not adequate under periods of high population pressure and there is no effective alternative for thrips and fruit spotting bugs. (21) On certain crops and for a number of serious pests, such as maize leafhopper, whiteflies, loopers, Rutherglen bug, cucumber moth, cucumber shield bug, and eggfruit caterpillar, endosulfan is the only registered chemical. For numerous others, such as apple dimpling bug, thrips, fruitspotting bug, native budworm, green vegetable bug and podsucking bug, endosulfan is either the only registered chemical in a particular crop or is the far superior choice due to a combination of efficacy, lack of harm to important beneficial insects and lack of phytotoxicity. (50)

Another respondent stated that endosulfan is critical to the economic survival of the Australian cotton industry, certainly before and for sometime after the introduction of transgenic cottons. In particular, its availability during the early growing season allows avoiding the use of “hard” insecticides, thus avoiding any induced secondary pest problems later in the season, particularly for mites at present but also critically for whitefly in the future. It is also especially important in IPM programs in horticultural crops where it provides an economical control of a wide range of pests with a relatively mild impact on beneficial predators and parasites. The respondent also said endosulfan is important in the control of earthmites in establishing crops and pastures, being the only effective bare earth treatment available. (57)

Finally, a submission from Tasmania stressed that minor crop growers and emerging industries in particular need to be remembered when making judgements about possible deregistration of chemicals essential for economic viability of those industries. With stringent enough use constraints and enforcement, public risks can be reduced to an acceptable level. The respondent also said that given the option of losing a chemical completely, industry will accept and abide by such constraints. State governments are in a position to enforce such restrictions and should be consulted before any decisions are made. (39)

ATTACHMENT 3: PRODUCTS AND TGACS AFFECTED BY THIS REVIEW

Registered products containing endosulfan

Product Name	Applicant
Campbell Endosulfan 350 EC Insecticide	Colin Campbell (Chemicals) Pty Ltd
Endosan ULV Insecticide	Crop Care Australasia Pty Ltd
Endosan Emulsifiable Concentrate Insecticide	Crop Care Australasia Pty Ltd
Davison Endosulfan 350 EC Insecticide	Davison Industries Pty Ltd
Davison Endosulfan 250 ULV Insecticide	Davison Industries Pty Ltd
Farm-oz Endosulfan 240 ULV Insecticide	Farmoz Chemicals Pty Ltd
Farm-oz Endosulfan 350 EC Insecticide	Farmoz Chemicals Pty Ltd
Thiodan ULV Insecticide	Hoechst Schering AgrEvo Pty Ltd
Thiodan Insecticide	Hoechst Schering AgrEvo Pty Ltd
Thiodan EC Insecticide	Hoechst Schering AgrEvo Pty Ltd
Thionex 350 EC Insecticide Spray	Makhteshim-Agan (Aust) Pty Ltd
Nufarm Endosulfan ULV 240 Insecticide	Nufarm Ltd (Laverton)
Nufarm Endosulfan 350 EC Insecticide	Nufarm Ltd (Laverton)
350 EC Bar Insecticide by Sanonda	Sanonda (Australia) Pty Ltd
240 ULV Bar Insecticide by Sanonda	Sanonda (Australia) Pty Ltd

***Approved sources of endosulfan* TGAC**

Endosulfan	Farmoz Pty Ltd	E.I.D. Parry (India) Limited Thane-Belapur Road Thane Maharashtra State INDIA	44288
Endosulfan	Hoechst Schering AgrEvo Pty Ltd	Hoechst Schering AgrEvo GmbH Werk Greisheim Stroofstrasse 27 D65933 Frankfurt am Main GERMANY	44305
Endosulfan	Makhteshim-Agan (Australia) Pty Ltd	Makhteshim Chemical Works Ltd New Industrial Estate Beer-Sheva 84100 ISRAEL	44093
Endosulfan	Pivot Limited	Excel Industries Ltd 6/2 Ruvapari Road Bhavnagar - 364001 Bombay 4000102 INDIA	44012

Products included in the review that are no longer registered

Product Name	Applicant
ICI Crop Care Endosan ULV Insecticide	Crop Care Australasia Pty Ltd
Crop King Endosulfan 240 ULV Insecticide	Crop Care Australasia Pty Ltd
Rhone-Poulenc Endosulfan Insecticide	Rhone-Poulenc Rural Aust Pty Ltd
Rhone-Poulenc Endosulfan ULV Insecticide	Rhone-Poulenc Rural Aust Pty Ltd
Velsicol Endosulfan 250 Emulsifiable Concentrate Insecticide	Velsicol Australia Ltd