Docket Identification Number: EPA-HQ-OPP-2010-1021

Re: Response to the EPA Federal Register Notice (FR Vol. 76, No. 61, Pg. 17645, Wednesday, March 30, 2011) Requesting Public Comments on EPA's Receipt of an Application to Register an End-Use Product Containing Aldicarb.

To Whom It May Concern:

MEY Corporation is submitting comments on EPA's receipt of Ag Logic LLC's application to register a pesticide product containing aldicarb. Ag Logic LLC is a subsidiary of MEY Corporation.

Since Bayer Crop Science, the only U.S. aldicarb registrant, requested the voluntary cancellation of all aldicarb registrations effective in 2012, Ag Logic's registration application is most timely. It is extensively and thoroughly documented with original and proprietary registration data generated by MEY. If approved, it assures continued availability of MEYMIK 15 G, the equivalent of Temik 15 G, a truly remarkable food and fiber production tool, to producers who have no equivalent alternative. MEY proposes to continue and support the recently amended registration for aldicarb that EPA granted to Bayer beyond the 2012 voluntary cancellation proposed by Bayer.

Bayer's withdrawal from the market, is a management strategic decision which Bayer indicated applies to all WHO Class I products in its portfolio. Bayer's strategic decision to focus on selling its patented new products, increases the justification for approval of the proposed registration of Ag Logic's generic aldicarb product.

As explained below, our registration is fully justified and supported by recent regulatory decisions made by the Environmental Protection Agency, by detailed submissions made by the current registrant, Bayer CropScience, and by our application for registration of MEYMIK 15 G.

Additionally, during the past few years EPA has requested and received numerous comments and testimonials to the public docket (EPA-HQ-OPP-2005-0163) that strongly support the continued registration of aldicarb. Growers need this product because it is effective, relatively low cost and simply because for many uses, there are no comparable alternatives to aldicarb.

RECENT EPA REGULATORY DECISIONS

The Environmental Protection Agency's "Reregistration Eligibility Decision for Aldicarb", dated September 2007, states the following:

Page 8, under the heading Abstract:
"The Agency has therefore determined that products containing the active ingredient aldicarb are eligible for reregistration provided that the risk mitigation measures outlined in this document are adopted and label amendments are made to reflect these measures."

Page 10, under the heading Introduction:
"A cumulative risk assessment, which evaluates exposures based on a common mechanism of toxicity, was conducted to evaluate risk from food, drinking water, residential use, and other non-occupational exposures resulting from registered uses of N-methyl carbamate pesticides, including aldicarb. EPA has concluded that the cumulative risks associated with the N-methyl carbamate pesticides are below the Agency's level of concern. With this determination, the Agency has concluded the reassessment process for aldicarb tolerances mandated by section 408(q) of the FFDCA."

Page 14, under the subheading Human Health:
"Four drinking water (from ground water sources) concentration scenarios were modeled for aldicarb: three ground

water scenarios for use on peanuts/cotton in Georgia with an assumption of a 300 ft., 500 ft., and 1000 ft. setback, as well as an additional scenario in Florida for aldicarb use on citrus with a 1000 ft. setback. The estimated risks at the 99.9th percentile are below the Agency's level of concern for all four scenarios, and for all population subgroups except for infants under the Georgia 300ft. scenario (139% - 147% of the acute population adjusted dose (aPAD)). For all other scenarios, risk is not of concern to the Agency."

Page 18, under the subheading Determination of Registration Eligibility:
"Based on its evaluation of aldicarb, the Agency has determined that products containing the active ingredient aldicarb, unless labeled and used as specified in this document, would present risks inconsistent with FIFRA and FFDCA. Accordingly, should a registrant fail to implement any of the risk mitigation measures identified in this document, the Agency may take appropriate regulatory action to address the risk concerns from the use of aldicarb. If all changes outlined in this document are incorporated into the product labels, then all current risks for aldicarb will be adequately addressed for the purposes of this determination under FIFRA."

Page 19, under the subheading "Risk Cup" Determination:
"As part of the FQPA tolerance reassessment process, EPA assessed the risks associated with aldicarb. The Agency has concluded that, with the risk mitigation measures outlined in this document, the aggregate risk from food and drinking water exposures to aldicarb is within its own "risk cup." The Agency has determined that the human health risks from these combined exposures are within acceptable levels and that, considering every issue other than the cumulative impacts of exposure to other n-methyl carbamate pesticides, the established tolerances for aldicarb, with label amendments and changes as specified in this document, meet the safety standards under the FQPA amendments to Section 408(b)(2)(C) and 408(b)(2)(D) of the FFDCA. In reaching these determinations, EPA has considered the available information on the special sensitivity of infants and children."

Page 19, under the subheading Determination of safety to U.S. Population (including Infants and Children):
"The Agency has determined that there is a reasonable certainty that no harm will result to the general U.S. population, infants, children, or other major identifiable subgroups of consumers, from the use of aldicarb. The safety determination considers factors such as the toxicity, use practices and exposure scenarios, and environmental behavior of aldicarb. In determining whether or not infants and children are particularly susceptible to toxic effects from exposure to residues of aldicarb, the Agency considered the completeness of the hazard database for developmental and reproductive effects, the nature of the effects observed, and other information."

Page 20, under the subheading Cumulative Risks:
"Aldicarb is a member of the N-methyl carbamate class of pesticides, which share a common mechanism of toxicity by affecting the nervous system via cholinesterase inhibition. A cumulative risk assessment, which evaluates exposures based on a common mechanism of toxicity, was conducted to evaluate risk from food, drinking water, residential use, and other non-occupational exposures resulting from registered uses of N-methyl carbamate pesticides, including aldicarb. EPA has concluded that the cumulative risks associated with the N-methyl carbamate pesticides are below the Agency's level of concern."

Page 22, under the subheading Dietary Risk Mitigation (Drinking Water):
"Four ground water scenarios were modeled for aldicarb. The estimated risks at the 99.9th percentile are below the Agency's level of concern for all four scenarios, and for all population subgroups except for infants under the Georgia 300 feet peanut scenario. For all other scenarios, risk is not of concern to the Agency."

"Therefore, in order to mitigate potential drinking water concerns in the peanut growing regions in the states of Georgia, Alabama, South Carolina, and Florida, an increased well set-back from 300 to 500 feet is required for wells not encased to a depth of 100 feet in vulnerable soils, and a shallow depth to ground water (less than 25 feet)."

Page 23, under the subheading Aggregate Risk Mitigation:
"As previously discussed, food and drinking water are below the Agency's level of concern with the mitigation for ground water in the Southeastern states of Alabama, Georgia, South Carolina, and Florida. There are no residential exposures, therefore, no additional mitigation is needed to address aggregate risk. Label changes and language necessary for reregistration are specified in Table 5 in Section V."

Page 23, under the subheading Occupational Risk Mitigation:

"As discussed in Section 10 of the human health risk assessment there are no risks of concern to workers performing tasks such as mixing, loading, and applying, based on current labeling. Moreover, since aldicarb is applied to soil when little foliage is present, there are no re-entry risks, given the current Restricted-Entry Intervals (REIs). Therefore, no additional mitigation is necessary."

Page 24, under the subheading Mitigation Summary and Crop-Specific Analyses:
"As a general matter, the Agency has determined that although there is potential for harm to wildlife because of use of aldicarb, that harm will generally be limited in time and space. The Agency also determined that these risks are often outweighed by the benefits expected from use of aldicarb instead of existing alternatives. The Agency was also mindful in this analysis that aldicarb does not pose risks of concerns to pesticide applicators or to farm workers generally."

Page 29, under the heading Cotton:
"The Agency has determined that there are benefits of aldicarb use on cotton and, as specified above, losing its use would involve additional costs to growers, some of which can be quantified directly. Aldicarb has advantages to cotton growers for which EPA cannot estimate dollar values, such as simplicity of management, confidence in the level of control in the face of unexpected infestation, and cost effectiveness when considering the full range of pests and duration of control."

"Aldicarb provides control of insects, including nematodes, in portions of cotton production areas. Alternative pesticides, which can be used to control insect pests (e.g., thrips), are not effective in controlling multiple pests. Aldicarb also provides protection for a longer period of time than any of the alternatives. As stated above, because of its long residual activity, in many cases growers can apply one treatment of aldicarb, rather than multiple treatments of other chemicals for equivalent insect control. Also, potential worker risks from multiple foliar applications of these alternative products are not insignificant. Therefore, the use on cotton is eligible for reregistration."

Page 31, under the heading Dry Beans:
"The Agency has determined that there are benefits of aldicarb use on dry bean and that losing its use would involve additional costs to growers. Aldicarb has advantages to dry bean growers for which EPA cannot estimate dollar values, such as simplicity of management, confidence in the level of control in the face of unexpected infestation, and cost effectiveness when considering the full range of pests and duration of control. Therefore, the use on dry bean is eligible for reregistration."

Page 33, under the heading Peanuts:
"The Agency has determined that there are benefits of aldicarb use on peanut (both the at-planting and at-pegging use) and that losing its use would involve additional costs to growers, as quantified above. Aldicarb also has advantages to peanut growers for which EPA cannot estimate dollar values, such as simplicity of management, confidence in the level of control in the face of unexpected infestation, and cost effectiveness when considering the full range of pests and duration of control. Therefore, the use on peanut is eligible for reregistration."

Page 37, under the heading Soybean:
"The Agency has determined that there are benefits of aldicarb use on soybeans in Georgia, North Carolina and South Carolina, and that losing its use would involve additional costs to growers. Aldicarb also has advantages to soybean growers for which EPA cannot estimate dollar values, such as simplicity of management, confidence in the level of control in the face of unexpected infestation, and cost effectiveness when considering the full range of pests and duration of control. Therefore, the Agency finds the use on soybeans eligible for reregistration."

Page 39, under the heading Sugar Beet:
"As discussed above, the Agency has determined that there are benefits of aldicarb use on sugar beets in certain states (California, Colorado, Idaho, Montana, Nebraska, Oregon, Washington and Wyoming) and that losing its use would involve substantial costs to growers. Aldicarb also has advantages to sugar beet growers for which EPA cannot estimate dollar values, such as simplicity of management, confidence in the level of control in the face of unexpected infestation, and cost effectiveness when considering the full range of pests and duration of control. Therefore, the Agency finds the use on sugar beet eligible for reregistration."

Page 41, under the heading Sweet Potato:

"As discussed above, the Agency has determined that there are benefits of aldicarb use on sweet potatoes in certain states (Louisiana and Mississippi) and that losing its use would involve substantial costs to growers. Aldicarb also has advantages to sweet potato growers for which EPA cannot estimate dollar values, such as simplicity of management, confidence in the level of control in the face of unexpected infestation, and cost effectiveness when considering the full range of pests and duration of control. Therefore, the Agency finds the use on sweet potatoes eligible for reregistration."

Following publication of the Reregistration Eligibility Decision for Aldicarb, the Agency issued a Generic Data Call-In for the additional studies that were listed as requirements in the RED (see page 43 of Aldicarb RED).

It is our understanding that the registrant, Bayer CropScience, satisfied all data and label mitigation requirements that were specified in the RED and DCI. Additionally, it is our understanding that upon submission, EPA reviewed the Comparative Cholinesterase Assay, and issued a Memorandum, dated July 14, 2010. This Memorandum, based on the CCA study, effectively revised the FQPA uncertainty factor for aldicarb from 2X (Page 19, Aldicarb RED) to 4.8X for infants and children.

As a result of this revision aldicarb exceeded the risk cup for infants and children. In order to protect infants and children the registrant agreed to voluntarily cancel the two crop registrations with the greatest contribution to the risk cup – citrus and potato. EPA agreed that upon cancellation of citrus and potato and upon the inclusion of the additional label mitigation measures that were specified and required in the Memorandum of Agreement, dated August 16, 2010, the remaining crops (cotton, dry beans, peanuts, soybeans, sugar beets, and sweet potato) did not pose unreasonable adverse effects to the environment or to infants and children. All changes required by the MOA are incorporated in Bayer's current label for Temik 15G and in our label for MEYMIK 15 G. .

JUSTIFICATION FOR THE REGISTRATION OF MEYMIK 15 G.

Although aldicarb has been registered for crop use for more than 40 years it is worth repeating the benefits and emphasizing the benefits to growers that want to continue using this valuable product. Most of the information contained in this document is well known and has been taken from public records, published literature, and actual EPA documents.

Aldicarb products are sold and used exclusively as granules containing 15% active ingredient by weight. Aldicarb is offered only in granular formulations in order to maximize the nematicidal and systemic properties of the product while minimizing the potential hazards from dermal or inhalation overexposure.

Proposed Crop Registrations

MEY Corporation is proposing registration of aldicarb on six crops: cotton, dry beans, peanuts, soybeans, sugarbeets, and sweet potatoes.

Application and Use Characteristics

Aldicarb will be applied with tractor-mounted granular applicators and appropriate tillage equipment. The granules are placed beneath the soil surface, where moisture releases the active ingredient. In addition to providing optimum pest control, this placement and application method reduces the risk of exposure to applicators and field workers. Placement of granules beneath the soil surface also minimizes hazards to birds and other wildlife.

Pesticidal Activity

Aldicarb offers broad-spectrum insect, mite, and nematode control, an important advantage over other pesticides. No other single product controls all three of these major pest classes. Aldicarb provides long-lasting, systemic protection against sap-feeding pests, including aphids, mites, thrips, leafhoppers, and whiteflies, and against several important species of leaf-feeding beetles and the boll weevil.

Many of the pests effectively controlled by aldicarb are difficult to control with foliar sprays. This is due partly to inadequacy of foliar spray coverage, allowing pests to feed in areas where the spray failed to reach. Difficulties in pest detection or high pest mobility may result in improper timing of foliar spray applications, and inclement weather often interferes with proper timing of spray applications against thrips, aphids, and other early-season pests. The systemic action of aldicarb cannot be washed off, resulting in continuous protection and reducing the need for additional applications of foliar pesticides following rain.

In addition to controlling foliage-feeding insects and mites, aldicarb controls several important pests that damage roots. Examples include rootknot nematode in cotton, peanuts, and sugarbeet, sugarbeet root maggot, and sugarbeet cyst nematode. By effectively controlling nematodes, aldicarb promotes a healthy root system, enabling plants to better utilize water and nutrients and tolerate adverse weather conditions. Convenience, cost-effectiveness, and control of both foliar pests and nematodes have made aldicarb the nematicide of choice for nematicide treatment of the majority of the cotton and peanut acres. Aldicarb is the only non-fumigant nematicide registered for a number of crops due to the label cancellations of a number of alternative nematicides. Soil fumigation with 1, 3- dichloropropene or metam sodium requires specialized application equipment and poses significant storage, transport, and use risks.

DIRECT BENEFITS OF ALDICARB

Increased Crop Yield and Profit

Increases in yield (and resultant net profit) are the most readily quantified benefits of aldicarb.

INDIRECT BENEFITS OF ALDICARB

Reduction in Number of Pesticides and Applications Required

Aldicarb provides longer systemic protection against pests than do alternative pesticides. Control from a single aldicarb application normally lasts six weeks or longer saving two to four foliar pesticide sprays per season. With alternative systemic products (either granular or seed treatment), one to two foliar sprays would be needed in addition to the systemic treatment to give protection equal in duration to one aldicarb treatment. Because no other single alternative product controls insects, mites, and nematodes, aldicarb often replaces two or more different classes of pesticides. For example, a cotton grower who elects not to use aldicarb may need to apply a nematicide such as 1,3-dichloropropene for nematodes plus one or more additional products to control early-season insects or mites. Growers unable to use aldicarb would very likely need to apply a narrow spectrum nematicide to control nematodes, followed by one or more applications of foliar miticides and an insecticide to protect fruit and/or foliage. The impact of multiple foliar applications could result in considerable mortality to beneficial arthropods.

Easier Coordination of Management Practices

By reducing the need to make multiple pesticide applications, use of aldicarb facilitates scheduling and allows growers to place greater emphasis on other crop management activities. By reducing the number of trips through the field, use of aldicarb saves labor, equipment wear, fuel, and minimizes soil compaction. The dependable systemic pest protection provided by aldicarb also saves time and expense by reducing the need for field scouting in some crops.

Improved Crop Quality and Reduced Virus Disease

Treatment with aldicarb improves crop quality both directly, by preventing pest damage, and indirectly, by controlling pests that transmit disease organisms. By controlling insects and nematodes that serve as plant pathogen vectors, aldicarb reduces the incidence of disease in many crops. The extreme mobility of many insect vectors of plant viruses (e.g., aphids, leafhoppers, psyllids and whiteflies) makes it almost impossible to completely control them with foliar sprays before they have had an opportunity to feed and transmit disease pathogens. The continuous systemic activity of aldicarb is generally more effective in controlling these pests and potentially reducing the transmission and spread of diseases.

In cotton, aldicarb enhances early maturity, resulting in earlier harvest, increased yield, and higher quality. Improved quality and early maturity achieved through the use of aldicarb enhances the growers ability to

sell their products in competitive markets and to receive maximum prices per unit and net-profit returns per acre.

Foundation to Integrated Pest Management

Aldicarb is an important component of integrated pest management programs for cotton and peanuts. This results from aldicarb possessing the selective ability to control pests while having minimal adverse effects on beneficial predators, parasitoids, and pollinators. Many pesticides applied as sprays are nonselective to both pests and beneficials coming in contact with spray droplets or dry residues on leaf surfaces. Because aldicarb is translocated systemically within leaves, stems, and other plant tissues, only those pests that feed on treated plants are killed. Repeated use of synthetic pyrethroids may cause outbreaks of aphids and mites; outbreaks of these secondary pests following treatment with aldicarb are rare.

Increased Plant Growth and Vigor

The excellent pest protection provided by aldicarb commonly results in improved plant growth and vigor. Treated plants are often taller and greener, have denser foliage and increased yield. By promoting rapid, vigorous growth aldicarb increases plant tolerance to attack by insects, nematodes, and diseases, thus reducing competition from weeds by hastening shading between rows. An earlier height differential between aldicarb-treated cotton and weeds allows more efficient application of post-emergence directed herbicides. Aldicarb also promotes earlier cotton maturity, and enables growers to increase their revenues by initiating and completing harvest sooner.

ECONOMIC BENEFITS OF ALDICARB

A total annual economic benefit to growers from the use of aldicarb is estimated to exceed $375 million. The $375 million estimate of total benefits from the use of aldicarb is conservative because it does not account for many of the benefits that are difficult to quantify (i.e., it does not consider benefits such as improvement in quality; convenience; savings in time and labor; improved coordination of management practices; improved earliness in cotton; facilitation of weed control on registered crops other than cotton; or reduced soil compaction). Although these specific benefits of aldicarb are difficult to convert to economic value, they are, nevertheless, extremely important to farmers.

Estimated annual economic benefits to growers (Million $)

- Cotton --. 315
- Peanuts – 50
- Sugarbeets – 9
- Dry beans – 2
- Soybeans – 0.5
- Total benefit all crops 376.5

SUMMARY OF ALDICARB BENEFITS

The principal advantages of and reasons for using aldicarb are summarized as follows:

1. Aldicarb provides more effective broad-spectrum control of insects, mites, and nematodes than do alternative pesticides. Because no single alternative product controls all three of these major pest classes, treatment with aldicarb often replaces application of two or more different types of pesticides.

2. A single treatment with aldicarb provides a longer period of control than do other products, reducing the number of pesticide applications needed per season and reducing total pesticide use.

3. Application of aldicarb is convenient and is almost always combined with planting or other cultural operations.

4. Aldicarb stimulates plant growth and vigor, resulting in faster grow-off, earlier fruiting, higher yields, and better crop quality. The positive growth response from aldicarb results from superior pest control and (under certain conditions) direct effects on the plant's physiology.

5. Aldicarb facilitates better weed control by promoting vigorous early crop growth and early canopy development. Rapid growth of aldicarb-treated plants permits more effective application of post-emergence directed herbicides.

6. Aldicarb provides greater yield increases (and higher net profits) than nearly all other competitive products.

7. Aldicarb increases quality in a number of crops, including citrus, potatoes, cotton, and pecans. Improvement in quality occurs directly, as a result of pest damage prevention, or indirectly, by control of insect or nematode vectors of plant disease.

8. Aldicarb fits well into integrated pest management programs, being less disruptive to beneficial insects than foliar sprays and less likely to cause outbreaks of secondary pests such as aphids and mites.

9. Aldicarb controls pests resistant to most other classes of pesticides. It is an important resistance management tool for the control of several pests.

10. Aldicarb poses little risk to birds, fish, and other wildlife, because it is applied below the soil surface.

ALDICARB FORMULATION

Aldicarb will be marketed and sold only as a low-dust granular product containing 15% active ingredient by weight. The granular inert carrier for the active ingredient is either corncob or gypsum. Aldicarb is offered only in granular formulations in order to exploit the nematicidal and superior systemic properties of the product and to minimize the potential hazards of dermal or inhalation over-exposure.

APPLICATION PRACTICES

Aldicarb is handled and applied by or under the direct supervision of Certified Applicators who are trained in the use of Restricted Use pesticides. To provide maximum performance and minimize hazard to birds and other wildlife, the granules are placed into, incorporated with, or covered with soil. Aldicarb granules are applied and incorporated with tractor-mounted granular applicators and appropriate tillage equipment.

The appropriate placement and method of application of aldicarb depends on the crop, cultural practices, and pests to be controlled. Aldicarb generally is used as an in-furrow or a band treatment at planting, depending on the pest for which control is desired. For foliar insect control, in-furrow application of aldicarb is simple and effective. If crop protection is not needed until later in the season, a post emergence side-dress application may, in some cases, be used. Normally, a single application of aldicarb is made per crop. On certain crops, such as cotton, peanuts and sugarbeets, aldicarb may be applied both at planting and after emergence. Granular formulations of aldicarb are easy to apply. Because no mixing is required, no water is necessary for dilution, and less labor is involved in application. The loader simply opens the package, pours the entire contents into the mechanical applicator, closes the cover, and begins application. Aldicarb usually is applied during other cultural operations such as planting or cultivation, thus saving time, fuel, labor, and wear and tear on machinery.

ALDICARB EFFICACY

When aldicarb is placed into moist soil, the active ingredient is released from the carrier and dissolved in soil water, and a portion is rapidly absorbed by germinating seedlings or by established plant roots. The toxicant moves upward through the vascular system to all plant parts by systemic action. Pesticidal effects are often noticeable within hours in established plants or upon emergence of treated seedlings.

Recommended dosages cause no adverse effects on plant growth or vigor; in fact, treated plants often appear healthier than untreated ones.

Extensive published literature indicate that, worldwide, aldicarb effectively controls more than 75 species of insects and mites and at least 40 species of plant-parasitic nematodes. No other single registered product controls all of these three major pest classes. The systemic activity of aldicarb effectively controls many insects and mites that are difficult to control with foliar sprays because of their habits. Pests feeding on the upper or lower surfaces of leaves or within plant tissues are equally susceptible to the toxic action of aldicarb. Sap-feeding pests such as leafhoppers, mealybugs, plant bugs, scales, spider mites, thrips, and whiteflies are rapidly killed by consuming relatively low concentrations of the pesticide. Several leaf-feeding beetles and leaf miners also are very susceptible to aldicarb. Aldicarb protects new plant growth often unprotected by foliar sprays. Aldicarb also is effective against strains of pests that have become resistant to other recommended treatments.

Aldicarb controls juveniles and adults of many economically important nematode species by contact action when they are free in the soil and by systemic action when they feed in or on root tissues above the point of absorption. Aldicarb also provides plant protection from nematodes through nematistatic action by preventing their feeding on or entering roots and by interfering with the reproductive process through disorientation of male nematodes. The presence of Aldicarb in the root, even at low concentrations, can inhibit root invasion by nematodes and their subsequent development within roots.

Persistence of pesticidal activity depends on several interacting variables, including application rate, pest species, and level of infestation, soil type, and amount of irrigation or rainfall. For highly susceptible insects such as aphids, leaf miners, and whiteflies, residual control can exceed 12 weeks. With more tolerant pests like the boll weevil, leafhoppers, and mites control usually lasts four to six weeks. Aldicarb protects plant roots during the critical early weeks when injury by soil pests, such as nematodes, and foliar pests, such as thrips, is economically important. Plant-parasitic nematodes in the soil are controlled during the six-week period optimal for root-system development. During this period, plants often grow sufficiently to withstand the increase in nematode populations that can occur after the chemical has dissipated.

Because aldicarb controls pests for several weeks, the product normally is applied only once per season. The long-lasting, systemic activity of aldicarb allows flexibility in the timing of pesticide applications, enabling the grower to combine that activity with other activities to increase operating efficiencies. Because the systemic pesticidal activity cannot be washed off, there is no need to re-apply aldicarb after a rainfall, as is sometimes necessary with foliar pesticides.

Through its control of insects, mites, and nematodes, aldicarb not only increases yields, but also improves quality in a number of crops such as citrus, cotton, and potatoes. In several plant species, use of aldicarb also is associated with increased vigor and growth. Furthermore, because various viral and bacterial diseases of plants are transmitted by certain insects or nematodes, control of these pests by aldicarb often results in disease suppression, with corresponding increases in yield and improvement in crop.

CROP SAFETY AND COMPATIBILITY

Aldicarb has been shown to be nonphytotoxic to over 200 genera of plants. Because aldicarb at recommended application rates is not harmful to most seeds or transplants, the product can be applied at the time of planting; in contrast to many fumigant nematicides, no waiting period is required.

No interactions have been reported when aldicarb is applied in conjunction with most commonly used fungicides, other soil and foliar insecticides, acaricides, nematicides, plant growth regulators, or fertilizers. However, because aldicarb is rapidly degraded by alkaline products, it should not be applied with lime.

USE OF ALDICARB ON COTTON

Aldicarb was first registered by Union Carbide for use on cotton in 1970. Aldicarb controls a broader spectrum of early-season cotton pests than any other registered product. Depending on rate a single application at planting can provide up to six weeks of continuous protection against insects, mites, and nematodes, reducing the need for foliar sprays. Aldicarb also improves yield, quality, and earliness of maturity and facilitates weed control by promoting vigorous early growth. Aldicarb has minimal impact on nontarget organisms and reduces the likelihood of secondary pest buildups of aphids and mites. Eliminating or greatly reducing the need for foliar spray applications early in the season. These properties have made aldicarb an important component of integrated cotton pest management and best management programs.

Aldicarb is used to treat about 4.5 million acres of cotton each year. The increase in net profits average about $70 per acre due to control of insects, mites and nematodes. Based on the average acres treated and the average increase in net profit, the total economic benefit to cotton growers due to the use of aldicarb is estimated to be about $315 million per year.

The application rate for aldicarb on cotton varies depending on (1) primary pest target, (2) geographical location, (3) application method (in-furrow at planting versus side-dress), and (4) soil texture and organic matter content. In-furrow applications at planting constitute more than 90% of all product usage. Application rates for in-furrow treatment range from 0.3 to 1.05 lb ai/A. Side-dress applications of aldicarb at 2.1 lb ai/A are utilized from time of first squaring through early bloom in California to control mid- to late-season infestations of plant bugs, mites, cotton leaf perforators, and whiteflies.

SPECTRUM OF ACTIVITY ON COTTON

Thrips

One of the most detrimental influences on crop uniformity, earliness and the season-long crop management system is thrips. These pests can reduce cotton yields by 70 percent or more. Controlling thrips may have more impact upon profitability than any other single input or practice during the first six weeks of crop management. Choices made at-planting to reduce inputs on early season pest management can result in higher costs for insect control throughout the season, delayed maturity, a higher overall production cost at season's end, lower yields, lower fiber quality and a higher breakeven per pound of production.

Thrips infest cotton in all major cotton-producing states and usually predominate on seedling plants. Two or more species may be found in the same cotton field, often on the same plant, although one species usually predominates in a population. Some species, such as onion thrips and eastern flower thrips, occur across the entire Cotton Belt. Tobacco thrips are confined to approximately the eastern half of the United States. The western flower thrips, until recently confined to the western half of the Cotton Belt, has now spread into the Mid- South and the Atlantic Coast States.

The Cotton Aphid

The cotton aphid, *Aphis gossypii*, occurs wherever cotton is grown. Severe infestations stunt young plants and yield losses may be expected in the absence of control when cotton aphid infestations exceed economic thresholds. When heavy infestations occur during the main fruiting period (from early-bloom to full-bloom), the older leaves turn yellow and are shed, causing premature opening of bolls and development of immature fiber. Light infestations of aphid early in the season and moderate-to-heavy populations of aphid during the peak fruiting period can significantly reduce yield. Also, honeydew secretions from the aphids drop on the fiber, making it sticky. A fungus often develops in the honeydew deposits, which causes the plants to appear black or sooty. Fiber picked from such plants is stained, sticky, and of low quality; seeds are low in viability and light in weight. Sticky fiber is a major concern of the cotton mill in spinning cotton fibers. Aldicarb applied for thrips will provide effective control of aphids during the seedling stage of plant development Aphids may be difficult to control with foliar sprays and pesticide resistance in this pest is suspected.

Lygus Bugs

Lygus bugs are the principal insect pests of cotton in Western Areas of the United States. They are especially destructive where extensive alfalfa hay and seed crops are produced near cotton fields, and where large pasture areas dry up in early summer. In the South, lygus bugs often become abundant on weeds and leguminous crops, and may move to nearby cotton and cause severe damage. Lygus bug infestations result from migrations from nearby native, crop and weed hosts as these plants mature, or are harvested. Lygus bugs are key insect pests of cotton because they usually attack plants in the early fruiting stage. Lygus damage reduces yield and fiber quality. It causes the lint to be spotted and lower in grade. Injured plants develop abnormally, become tall and whip like and have fewer fruiting branches.

Aldicarb is used in anticipation of lygus bug infestations during the early-to midseason fruiting stage of cotton plant development. These side-dress applications may be made at layby, or before the plants have become sufficiently tall to be damaged by the tractor.

Spider Mites

A number of species of this pest group attack cotton and often cause serious damage. Outbreaks of spider mites are most likely to occur following application of a pesticide that destroys the predaceous insects and mites The entire U.S. cotton production area is exposed to attacks of spider mites. Historically mite problems have occurred in the West. However mites are becoming more of a problem where the use of aldicarb has been replaced with seed treatment insecticides which do not control mites and in some cases may actually flare mites. The use of certain foliar sprays have been shown to flare mites. Aldicarb applied at planting controls early season insects and mites reducing the need for remedial sprays, thus reducing the risk of mite flares. Aldicarb applied at planting time or as a fruiting stage side-dress, provides control or suppression of spider mites for 3 to 5 weeks after application.

Nematodes

Infections by nematodes and seedling diseases are often inter-related and can be very detrimental to root development, vigor and earliness. With the potential for significant loss of yield, fiber quality and earliness at the end of the season, the need for prevention is paramount. It was noted that nematodes are much more serious than recognized by growers and that the rapidly expanding Reniform nematode has cost the industry more than $1 billion over the past five years. The Reniform can populate any soil type, making it a threat to all cotton producers especially those in southeastern and delta states.

Aldicarb is the only non-fumigant systemic nematicide currently available to growers. Aldicarb kills nematodes and nematode eggs in the soil by contact action and it kills nematodes in roots by systemic action when they feed on root tissue above the point of absorption. The indirect effects of aldicarb on nematoes include prevention from feeding or entering roots as well as interfering with reproduction and disorientation of males.

BENEFITS TO COTTON

Increase in Yield.

Early-season cotton pests are widely distributed and occur predictably from year to year. This is especially true of thrips, which are the most frequent target pests for which growers use preventive applications of aldicarb on cotton. Injury from thrips alone, or combined injury from thrips and disease, may reduce or destroy stands of young plants. A heavy infestation may retard plant growth and delay fruiting and crop maturity. Economic populations of other early-season insects and mites, although generally less predictable than thrips from field to field or year to year, can nevertheless severely reduce grower profits. The cumulative damage caused by two or more of these pests, each occurring at sub-economic levels, can together cause economic damage. This may partly explain why yield increases often are documented with aldicarb even when early-season pest populations are reported to below established economic thresholds.

Plant growth effects

Because aldicarb provides continuous protection against insects, mites, and nematodes from the time of seedling emergence, aldicarb-treated cotton usually grows off faster than cotton left untreated or treated

with alternative products. This is significant, because seedling vigor is considered an important physiological factor contributing to earliness.

Benefits to crop management

Treatment of cotton with aldicarb promotes faster grow-off and a healthy, vigorous stand and influences crop management from the standpoint of weed control. The vigorous growth promoted by aldicarb allows more efficient application of post-emergence herbicides by promoting a greater height differential between young cotton plants and weeds. A differential in height is important to minimize the risk of crop injury from the herbicide treatment. By promoting plant growth early in the season, aldicarb also reduces weed problems by hastening formation of the crop canopy and shading between rows.

Because aldicarb is systemic, the terminal bud, early squares, and other vulnerable plant tissues receive continuous protection from insect damage. Aldicarb provides continuous protection against insects, mites, and nematodes from the time of seedling emergence. Aldicarb-treated cotton usually grows off faster than cotton left untreated or treated with alternative products. This is significant, because seedling vigor is considered an important physiological factor contributing to earliness. Cotton that can be harvested earlier weighs more, is of higher quality, and can be harvested more efficiently than a crop that is delayed by early-season insects.

Delays in maturity and initiation of harvest can have a devastating impact on economic returns. The impacts on economic returns caused by delays in maturity and harvesting result from decreases in harvesting efficiency and the fact that cotton bolls lose lint weight each day they are open. In the Midsouth, and throughout much of the Cotton Belt, delays in initiation of harvest increase the likelihood of adverse weather during the harvest period. Rainfall during this two-to three-month period reduces the number of days suitable for harvest and lowers lint grade.

Impact on beneficial arthropods

Scientific evaluation and commercial experience indicate that aldicarb has minimal impact on beneficial predators and parasitoids. Results from field trials conducted on cotton in the Midsouth, Texas, and California indicate only minor effects on beneficials, which are usually transitory and much less severe than in fields sprayed with foliar insecticides. The absence of secondary pest outbreaks (e.g., aphids and mites) from use of aldicarb at labeled rates is further evidence that aldicarb is non-disruptive to natural enemies of such pests. By conserving the existing natural enemy complex in cotton fields, aldicarb is a valuable component of integrated pest management programs.

ALTERNATIVES TO USING ALDICARB ON COTTON

U.S. cotton producers currently must rely on chemical pesticides to grow cotton profitably. Growers have four basic chemical alternatives to aldicarb: (a) seed treatments, (b) alternative soil-applied granular systemics, (c) soil fumigants, or (d) foliar sprays. Because aldicarb provides a wide spectrum of control versus insects, mites and nematodes any field that is infested with two or more of these pests would require a combination of alternatives and frequently multiple applications.

Seed Treatments Insecticides

Although seed treatments are available for use against certain of the cotton insect pests controlled by aldicarb, these treatments are inferior in terms of spectrum, level, and duration of pest control. Most of the cottonseed which is treated with insecticide in the U.S. is treated with acephate, imidacloprid or thiamethoxam. Seed treatments with acephate, imidacloprid or thiamethoxam are primarily used to control aphids and thrips. Control usually does not last beyond two weeks. Compared with the residual protection afforded by aldicarb, one to three foliar sprays is required to obtain early season control of aphids and thrips if growers rely on seed treatments rather than aldicarb. In fact the product label for the thiamethoxam products recommend automatic over sprays with a foliar insecticide at the first true leaf stage of growth.

In contrast to aldicarb seed treatments have limited effects on plant bugs and are limited in their spectrum of activity versus the variety of thrips attacking cotton seedlings. The increase in the use of seed treatments in the past few years has not come with out its drawbacks. In the Mid-South where spider mites in cotton have historically been a relative non-issue, there has been a recent change in the intensity and frequency of mite problems on seedling cotton. Mites are becoming an issue in the Mid-South because of the movement away from aldicarb to seed treatments. After the widespread adoption of Cruiser® and Gaucho® seed treatments mite problems began to intensify because Cruiser® and Gaucho® do not control mites.

Foliar Sprays

Foliar spray products labeled for control of early-season insects and mites include dimethoate, dicrotophos, acephate, methamidophos, dicofol, propargite, abamectin and a variety of synthetic pyrethroids. Most of these products are labeled for control of thrips, aphids, and plant bugs, but foliar sprays as a group have several inherent limitations relative to a single application of aldicarb. Proper timing of application is difficult, and economic thresholds on which to base treatment recommendations for thrips, aphids, and other early-season pests are poorly defined. Infestations of early-season insects are difficult to detect before visible damage has occurred, and remedial treatments made after damage has already occurred have generally proven ineffective.

Soil-Applied Granular Systemics

Since the mid-1990s the number of granular insecticide alternatives to aldicarb have been reduced. The recent elimination of cotton from the disulfoton label has left only phorate as an alternative. The spectrum, duration, and degree of pest control of phorate are inferior to that provided by aldicarb. While phorate is an important thrips management tool in peanuts, the use of phorate in cotton is very limited primarily due to the high potential for seedling phytotoxiciy.

Soil Fumigant Nematicides

The use of fumigant nematicides in cotton is limited by a lack of registered cost-effective materials. With the loss of DBCP and EDB, TELONE® (1,3-dichloropropene) and Vapam® (metam sodium) are the only remaining fumigant nematicides registered for use on cotton. Because of a high treatment cost use of 1,3-dichloropropene is limited to heavily infested soils. In contrast to aldicarb, 1,3- dichloropropene must be applied separately prior to planting, and at a significantly greater health risk to the applicator. Supplemental applications of foliar insecticides are usually required, because 1,3-dichloropropene controls only nematodes. In some situations of extremely heavy nematodes, growers will employ the use of soil fumigants for nematode control. Because these materials do not provide insect or mite control aldicarb or other materials are used in tandem with fumigants.

USE OF ALDICARB ON PEANUTS

Union Carbide registered aldicarb for use on peanuts in the U.S. in 1974. No other product registered for use on peanuts controls all three pest groups: insects, mites, and nematodes. Aldicarb provides 5 to 8 weeks of effective pest control and results in enhanced plant vigor and yield.

Peanuts constitute one of the most important food and oil crops grown in the U.S. About 4.8 billion pounds of peanuts are produced on 1.6 million acres with a production value of 845 million dollars. Aldicarb is used to treat about 620,000 acres of peanuts each year. The increase in net profits average about $80 per acre due to control of insects, mites, and nematodes. Based on the average acres treated and the average increase in net profit, the total economic benefit to peanut growers due to the use of aldicarb is estimated to be about $50.0 million per year.

The loss in recent years of peanut pest management tools such as ethoprop, disulfoton, carbofuran, and fenamiphos leave aldicarb as one of the few remaining preventative pest management options available to peanut growers. Aldicarb is one of about three at-plant insecticidal products and the only non-fumigant product for nematodes. The reduction in available management tools and the increased adoption of

varieties resistant to tomato spotted wilt virus make aldicarb more valuable to growers today than almost any point in its 36-year history.

SPECTRUM OF ACTIVITY ON PEANUTS

Thrips

The most important benefits realized from the use of aldicarb are an accelerated rate of seedling growth in the first 30-days after planting, and a reduction in risk for thrips and aphid transmission of viruses such as peanut stunt virus, tomato spotted wilt virus, and peanut stripe virus. Outbreaks of these viruses have been sporadic in regions across the U.S. and tomato spotted wilt virus has caused heaviest crop damage and losses of yield in recent years. The potential for tomato spotted wilt virus to cause devastating losses of yields in peanut is a major concern throughout the U.S. peanut industry.

Applications of aldicarb at planting have been observed to enhance early-season growth as a result of thrips control, early-season suppression of nematode injury and PGR effects. The in-furrow application of aldicarb at 1.05 Ib a.i./acre is generally considered superior to alterative insecticides for thrips and nematode control and stimulation of early season growth.

Because thrips attack peanuts as soon as the seedlings emerge, the easiest way to obtain effective control is with a treatment at planting. Thrips-control treatments are effective only if they protect the plants early in the growing season. Foliar materials such as must be applied at the correct time to prevent thrips damage and significant loss of yield.

Secondary Insect Pests

Secondary benefits of aldicarb applications to peanut include control and/or suppression of aphids, leafhoppers, and spider mites. The importance of aphids attacking peanut is related to their role as vectors of certain viruses. The potato leafhopper has been reported to cause injury to foliage and heavy infestations can cause significant reductions of yield. Spider mites are especially destructive to peanuts during hot, dry weather and have been reported to cause considerable yield loss in some years.

Nematodes

Yield losses to nematodes in peanut production have been well documented in throughout the peanut production areas. The principal nematodes causing economic losses of yield and quality have been root-knot, lesion, sting, and ring nematodes. The distribution and occurrence of damaging numbers of nematodes in peanut soils varies considerably, however, yield-reducing infestations of one or more species are common in most production areas. Yield losses to root-knot nematode have been reported to range from 20 to 90 percent. Accurate predictions of yield loss to root-knot and other nematodes have been difficult, because of the significant interaction of nematode injury with other factors. Frequently, bacteria and fungi colonize damaged root and pod tissues and further reduce yield, quality, and value of the crop.

BENEFITS TO PEANUTS

Increase in Yield

The primary benefits peanut growers receive from the use of aldicarb are effective broad-spectrum pest control, increased yields, and higher profits. Enhanced plant vigor and growth are other benefits associated with the use of aldicarb on peanuts.

Additional Benefits

The plant growth stimulatory effects that are often observed on other crops also occur on peanuts. Most of the enhanced growth in commercial peanut production is assumed to be due to effective pest control. Aldicarb treatments increase shoot growth allowing plants to better tolerate damage by pests and withstand adverse growing conditions. Aldicarb does not adversely affect beneficial predator or parasitoids in peanuts nor does it impact beneficial soil microorganisms essential to peanut production.

ALTERNATIVES TO USING ALDICARB ON PEANUTS

Pest management tools such as fenamiphos, ethoprop, disulfoton and carbofuran are no longer available for use on peanuts in the U.S. Aldicarb remains one of the few preventative pest management tools available to peanut producers for management of early season insects, nematodes and mites. Aldicarb is one of only three at-plant insecticidal products for thrips control; one of only three options for nematode control, and the only non-fumigant product for nematode control in peanuts. Aldicarb provides unique benefits for use on peanuts, because a single at-planting application controls three major groups of pests: insects, mites, and nematodes. Fumigant nematicides such as 1,3-dichloropropene and metam sodium do not control early-season foliar insects, and the required waiting period between application and planting makes fumigants less convenient for growers to use. The other recommended granular systemic compounds, phorate and acephate, do not control nematodes or mites. Alternative foliar insecticide materials are not nematicidal and require an additional equipment and trips in the field for application.

At-plant Systemic Insecticides

Granular systemic insecticides are effective for control of early-season insects such as thrips and leafhoppers and are used extensively throughout the peanut-growing areas. In various peanut- producing states, at-plant systemics are recommended as the most effective treatment for controlling thrips. The major alternative products to aldicarb recommended for thrips control are acephate and phorate.

Foliar Insecticides

Because thrips attack peanuts as soon as the seedlings emerge, the easiest way to obtain effective control is with a treatment at planting. Thrips-control treatments are effective only if they protect plants early in the growing season. Foliar applied materials such as acephate and methomyl must be applied at the correct time to prevent thrips damage and the resulting significant decrease in yield.

Nematicides

Aldicarb controls all the major plant-parasitic nematodes that damage peanuts, including all of the root-knot species. Aldicarb as the only nonfumigant product for use against nematodes.

USE OF ALDICARB ON SUGARBEETS

Over 30 years of commercial use on sugarbeets in the U.S. have shown that aldicarb effectively controls sugarbeet cyst nematode, sugarbeet root maggot, aphids, leaf miners and the sugarbeet leafhopper, a vector of the potentially devastating curly top virus disease. Aldicarb is effective in preventing below ground damage by these pests and in protecting above ground portions of the plant from attack by aphids, leafhoppers, and leaf miners. Aphids and leafhoppers stress the development of young sugarbeets directly through feeding and indirectly as vectors of potentially devastating infectious yellows and curly top virus diseases

Aldicarb is the only granular product registered for control of sugarbeet cyst nematode and the only chemical alternative to fumigation. Control of sugarbeet root maggot with aldicarb has been outstanding and has proven superior to most alternative treatments in years when pest infestation is severe. Additionally, aldicarb is the only registered carbamate that provides consistent control of root maggot throughout all sugarbeet producing regions of the U.S. This makes aldicarb an important class-to-class rotational treatment for resistance management.

Aldicarb is used to treat about 125,000 acres of sugarbeets each year. The increase in net profits average about $70 per acre due to control of insects and nematodes. Based on the average acres treated and the average increase in net profit, the total economic benefit to cotton growers due to the use of aldicarb is estimated to be about $9 million per year.

SPECTRUM OF ACTIVITY AND BENEFITS

Aldicarb is the only granular product registered for control of sugarbeet cyst nematode and the only chemical alternative to fumigation. Also, it is the only registered product that controls the three major

sugarbeet pests: nematodes, root maggot and the sugarbeet leafhopper, a vector of the potentially devastating curly top virus disease.

Sugarbeet Root Maggot

Root maggot injury is manifest in several ways. The most severe is plant death. Plant death is possible when maggot populations are high and the plants are young with small roots. Injury may also be expressed as wilted small plants that may or may not recover. Even the least noticeable injury can affect plants because they are not as thrifty as unaffected plants. Heavy root maggot infestations early in the season, when the beets are small, can be severe enough to kill the young plants because the tap root is cut off. Injury is reduced if the plants are larger when the maggot eggs hatch because the roots have penetrated the soil much deeper and the larvae are feeding above the root tip so they do not cut the tap root off. However, if the infestation is severe enough the damaged plants may still wilt and die later in the season.

Leaf miner

The spinach leaf miner is a common insect pest of sugarbeets. Certain Northwest growing areas have experienced heavy infestations in recent years, resulting in potential for economic loss. While first generation spinach leaf miner larvae are most injurious to sugarbeets, all generations are capable of causing damage. Maggots feed inside the leaf making slender, winding mines. These mines become enlarged as the maggots grow, forming blisters and blotches on infested leaves. Affected leaf area may become a limiting factor for photosynthesis, ultimately affecting sugarbeet quality and yield potential. Aldicarb provides excellent control of the spinach leaf miner.

Virus Suppression

In addition to controlling nematodes and root maggot below ground, aldicarb protects above-ground portions of the plant systemically from aphids, leafhoppers, and leaf miners. Although feeding of these pests alone can stress the development of young sugarbeets, a more important consideration is that aphids and leafhoppers are primary vectors of infectious yellows and curly top virus diseases. Primary vectors of the virus yellows complex are the green peach aphid and the bean aphid. Curly top virus is transmitted by the beet leafhopper. Virus-infected sugarbeets may suffer a 30% or greater loss in yield and a drop in sugar content of 3 to 4%. It is very important to minimize virus transmission while sugarbeets are young; older beets are better able to withstand infection and still produce a profitable crop. By maintaining aphid and leafhopper populations at low levels throughout the critical early stages of plant development, aldicarb reduces the incidence of disease and increases beet yield.

Nematodes

Sugarbeet cyst nematode damage is manifest as patches of plants exhibiting poor vigor. Symptoms include stunted growth, yellow leaves, wilting, and dead plants. Storage roots of infected plants are small and may develop excessive fibrous roots. Early infection by nematodes may result in severe branching of the storage root, a condition called sprangling. Entire stands of sugarbeet seedlings can be lost from high pre-plant populations of cyst nematodes.

Crop Safety

Maximizing sugarbeet yield and quality begins with good stand establishment and early crop vigor. However, this process can be hampered by pests, soil conditions, wet or cold weather, variety, and a multitude of other issues. Many times a significant factor that reduces seedling stand is intolerance of sugarbeet seedlings to crop protection chemicals. Research conducted over the past decade clearly shows that aldicarb is the safest at-planting sugarbeet insecticide.

ALTERNATIVES TO USING ALDICARB ON SUGARBEETS

Nematicides

Although soil fumigation with 1,3-D provides excellent control of sugarbeet cyst nematode, it has several important disadvantages relative to aldicarb. Usually, 1,3-D is applied in the fall and allowed to dissipate before planting in the spring. Because treatment cost is approximately twice that of aldicarb, the treatment

is difficult to justify except under severe cyst infestations. Fall application of an expensive input such as 1,3-D is not feasible for growers when sugarbeet company contracts have not yet been negotiated and approved and when cash flow is limited. Wet weather can prevent appropriate timing of fumigant application in the fall. Although 1,3-D can also be applied in the spring, a two- to four-week dissipation period is required before planting, which shortens the growing season and reduces yield potential.

Insecticides

Soil insecticides are essential for control of the sugarbeet root maggot. Foliar sprays targeted at the adult fly are impractical, because oviposition normally extends over a period of at least one month. Aldicarb is very effective in preventing root maggot damage and is the only product that can be used in a curative manner after severe root maggot injury is noted in a field. Aldicarb apply topically and water incorporated will stop feeding and kill the maggots in less than a week. Because of the plant safety and consistent root maggot control, aldicarb it has become the standard to which all other products are measured.

USE OF ALDICARB ON DRY BEANS

Aldicarb has been registered for use on dry beans since 1978 and has proven to be effective in controlling aphids, leafhoppers, lygus bugs, Mexican bean beetle, and nematodes. Approximately 1.3 million acres of dry beans are grown in the U.S. annually. Aldicarb is the only non-fumigant nematicide registered for use on dry beans and is used on approximately 20,000 acres in the states of Colorado, Oregon, Washington, Idaho and Michigan. The increase in net profits average about $100 per acre. Based on the average acres treated and the average increase in net profit, the total economic benefit to dry bean growers is estimated to be about $2 million per year.

SPECTRUM OF ACTIVITY AND BENEFITS

Aldicarb controls a broader spectrum of economically important pests on dry beans than any other registered product. Pests controlled include aphids, leafhoppers, lygus bugs, seed corn maggot, Mexican bean beetle, mites, and nematodes.

Nematodes

Nematodes are unevenly distributed throughout the dry bean acreage, and some fields are severely affected. The two most common nematodes to infect dry edible beans are the root-knot nematode and the lesion nematode. Stand loss for each can be severe ranging from 10-80% for the lesion nematode and 45-90% for the root-knot nematode.

ALTERNATIVES TO USING ALDICARB ON DRY BEANS

Foliage-feeding insects on dry beans can be controlled with foliar sprays; however, certain pests such as leafhoppers and lygus bugs are highly mobile, and several well timed insecticide sprays may be required. When mites are an economic problem, supplemental treatment with a selective miticide is also needed. Foliar insecticide alternatives include acephate dimethoate, esfenvalerate, parathion, carbaryl, and a wide array of pyrethroids.

There are very few other available nematicides labeled for use in dry beans. Ethoprop is labeled in certain states for the use in dry beans. The fumigant metam sodium is available to some growers, however, aldicarb is easier to handle, less expensive, and more readily available than fumigants for cost-effective nematode control in dry beans.

Aldicarb is an important pest-management tool in many dry bean production areas. In areas of Michigan and Idaho with nematode infestations, aldicarb provides both nematode and foliar insect control. Much of the aldicarb applied to dry beans in the northwestern U.S. is used for mite, nematode, and lygus bug control. In Michigan, aldicarb is used for a combination of pests, including nematodes, seed corn maggot, and Mexican bean beetle. The systemic activity of aldicarb minimizes damage from migrating insects and prevents population buildup.

USE OF ALDICARB ON SOYBEANS

Aldicarb was registered for use on soybeans in 1978. Aldicarb provides broad-spectrum control of all economically important plant-parasitic nematodes (soybean cyst, root-knot, lance, lesion, and sting), as well as insects such as thrips, Mexican bean beetle and bean leaf beetle. Excellent growth responses and increased yields are commonly associated with aldicarb control of nematodes.

Aldicarb is used on approximately 25,000 acres in the states of in Georgia, North Carolina, South Carolina and Virginia. The increase in net profits average about $20 per acre due to control of insects, mites and nematodes. Based on the average acres treated and the average increase in net profit, the total economic benefit to soybean growers due to the use of aldicarb is estimated to be about $500,000 per year.

SPECTRUM OF ACTIVITY AND BENEFITS

Insects

Aldicarb controls insects such as thrips, Mexican bean beetle, bean leaf beetle, and three-cornered alfalfa hopper. While aldicarb effectively controls many species of aphids in other crops, the onset of infestations of soybean aphids tend to be later in the season beyond the window of effectiveness of aldicarb. In general insects cause occasional problems on soybean in some states, however, insect damage is sporadic and is far less serious than nematode damage.

Nematodes

Nematodes are the primary target pests for aldicarb applications on soybean. Several nematode species attack soybean, but the soybean cyst nematode (SCN) is the most widespread and damaging. Root-knot nematodes rank second to the cyst nematode in terms of damage and importance. Yield losses caused by nematode infestation are difficult to document due to varied growing and environmental conditions from year-to-year but losses may range from 5 to 100 percent. Excellent growth responses and increased yields are commonly associated with aldicarb control of nematodes.

ALTERNATIVES TO USING ALDICARB ON SOYBEANS

Soybean growers use nematicides, resistant varieties, and crop rotation for nematode control. Aldicarb effectively controls both insects and nematodes with a single application at planting. It is primarily used as a nematicide to control all races of the soybean cyst nematode. Aldicarb is an effective tool for integrated pest management programs because it can be used in conjunction with SCN-resistant and susceptible varieties to reduce the chance of nematode resistance resulting from a shift in SCN races.

Nematicides

Aldicarb is the only granular nematicide available to soybean growers. The fumigant 1,3-dichloropropene is an alternative treatment available for nematodes, however, application requires a one week preplant application. The use of 1,3-dichloropropene provides effective nematode control, but does not provide insecticidal or miticidal activity.

Resistant Varieties

Resistant varieties are used to manage SCN populations. However, selection pressure on SCN by the continued use of certain resistant cultivars can change the SCN race structure in a field population. Subsequent years would require the use of a different resistant variety. Sometimes, resistant varieties are not as well adapted nor do they yield as well as susceptible varieties. Use of low rates (less than labeled rates) of a nematicide with SCN-resistant varieties may offset such effects.

BENEFITS OF ALDICARB IN PRODUCTION MANAGEMENT

The use of aldicarb in crop production management offers benefits in addition to broad-spectrum pest control and increased yield and quality. These benefits can be summarized as follows: (a) convenience in pest control and elimination of pesticide sprays, (b) risk reduction relative to other pesticides, and (c) improved coordination in other production practices--equipment use, weed control, and fertility management. The relatively certain and long residual pest control with aldicarb replaces multiple pesticide

applications and allows better coordination and timing of other production operations. Because plant growth and final yield are more predictable with aldicarb, use levels of other crop production inputs can be more precisely planned in less management time.

Rationale for Preventive Pest Control

Farmers rely upon two basic strategies for controlling agricultural pests with pesticides: corrective and preventive. Both approaches have merit, and each is intended to prevent economic damage. Corrective pest control strategies are initiated when pest populations reach or exceed economic threshold levels. This "wait and see" approach is commonly used when applying foliar pesticide sprays. Preventive pest control strategies are organized systems of control designed to manage pest populations before they reach economically damaging levels. At-planting or early-season sidedress applications of aldicarb are often characterized as "pre-scheduled" or "preventive." Preventative pest control has gained widespread popularity for crops and in areas where economic infestations of pests occur predictably almost every year.

Pest infestation records from previous years and environmental conditions conducive to overwintering pest populations are good indicators of whether pests are likely to occur and whether preventive treatments are justified. In the case of plant-parasitic nematodes, it is possible to predict whether population densities will be at levels sufficient to cause crop damage by sampling the field population the previous year.

Although it is more difficult to predict whether insects or mites will reach economic threshold levels, certain crops and fields have a history of damaging pest levels every season. For example, a cotton grower knows that the probability is high that thrips will infest his cotton, especially when the cotton is planted in an area surrounded by wheat or other small grains. (Small grains are an important early-season host for thrips, which migrate out of grain and into cotton as the grain matures.)

A preventive application of aldicarb usually provides superior insect and mite control and higher net profits than corrective programs relying upon foliar sprays. This is partly because foliar spray applications require precise timing in order to be effective. Improper timing of foliar spray applications results from (a) difficulties in pest detection, (b) pest migration into and out of fields, (c) delays caused by inclement weather, and (d) scheduling conflicts with other farming operations. Corrective application of foliar sprays also depends upon reliable economic treatment thresholds. For certain pests, such as early-season insects in cotton, treatment thresholds are poorly defined. This is particularly true for complexes of two or more pests (e.g., insects and nematodes) occurring simultaneously within the same field.

To effectively control nematodes with nematicides, treatments must be applied before crop emergence. Salvage or corrective treatments applied after crop emergence are impractical and do not provide the early protection needed to support vigorous root growth.

Reduced Soil Compaction

Trips through the field for agronomic or maintenance purposes usually can be scheduled when soil moisture is low enough to minimize soil compaction. However, regardless of soil conditions, pesticide sprays must be applied at a critical time to prevent crop damage from growing pest populations. If ground application equipment is used when soil moisture is excessive, soil compaction problems can be severe. Aldicarb provides continuous early- to mid-season pest control from a single at-planting application, eliminating the need for multiple pesticide trips through the field. Wheel traffic, such as pulling a sprayer through a field, can compact soils and dramatically affect productivity of root crops, such as sugarbeets and peanuts.

Facilitated Weed Control

Aldicarb contributes to a successful weed control program by promoting vigorous crop growth and early canopy development. The crop canopy shades the soil surface and reduces the likelihood that weeds will

germinate and become established. The early growth response to aldicarb is also apparent in cotton, where aldicarb promotes faster grow-off and a uniform, vigorous stand

Improved Response to Fertility Inputs

By minimizing pest damage, aldicarb improves crop response to fertility programs. A well-developed root system is essential for optimum crop production. Aldicarb protects plant roots from nematode damage early in the season, allowing efficient absorption and transport of essential nutrients. By restricting foliar insect and mite populations to low levels, aldicarb maximizes the photosynthetic efficiency of leaves and the storage of carbohydrates.

Aldicarb allows a grower to obtain the maximum return from each unit of fertilizer he applies. By protecting cotton plants from early insect damage, aldicarb allows the plant to set and keep a large proportion of its early fruit. Enhanced fruit set early in the season enables cotton growers to water and fertilize more intensively and to produce higher yields.

STEWARDSHIP OF ALDICARB

Reduced Hazard Through Formulation

Aldicarb is an acutely toxic pesticide. However, in evaluating the hazard of aldicarb to human health, the likelihood and consequences of exposure to the formulated pesticide should be the major consideration, because it is the formulated rather than the technical product that is sold to and used by growers. The health hazard of aldicarb has been greatly reduced by the formulation into granular end-use products. For agricultural use, gypsum or corncob grit granules are impregnated with aldicarb, along with a bonding agent that helps prevent dustiness. This formulation process results in a material that minimizes inhalation and dermal exposure during handling and application. For example, whereas technical aldicarb has a dermal LD50 of 20 mg/kg (rabbit), the formulated product containing 15% aldicarb by weight has a dermal LD50 of >2000 mg/kg (rabbit).

Mode of Action

As a carbamate, aldicarb provides important advantages over organophosphate compounds. Both carbamates and organophosphates inhibit acetylcholinesterase, an enzyme that is essential for normal nerve function. The effect of aldicarb on acetylcholinesterase is rapidly reversible. Removal of an individual from exposure to aldicarb usually results in rapid recovery (usually within a few hours). In contrast, inhibition of acetylcholinesterase by most organophosphates is not readily reversible, and the overexposed person may require days or weeks to regenerate adequate amounts of acetylcholinesterase for normal body function. Another advantage of aldicarb is that symptoms of overexposure occur very rapidly, before lethal levels are reached. In many cases, typical symptoms of organophosphate poisoning occur slowly. The slow, cumulative toxicity resulting from organophosphate exposure may decrease acetylcholinesterase to critically low levels before the individual is aware of his condition.

Extensive laboratory studies have shown that repeated exposures to aldicarb result in no adverse chronic health effects. Aldicarb does not cause cancer, mutations, or birth defects, nor does it adversely affect reproduction. The only neurological effect is reversible acetylcholinesterase inhibition; there is no delayed neurological damage.

Placement and Application

The placement and method of application of aldicarb reduces the risk of applicators or workers becoming overexposed. To achieve optimum results, aldicarb granules are placed into and covered with soil, where underground moisture releases the active ingredient. Because the granules are dispensed close to the soil surface and incorporated or covered with soil, material cannot drift onto the applicator or other field workers nearby.

Product Stewardship Program

Product stewardship and service are important in achieving an outstanding safety record. Servicing should be a major priority for the registrant. A product stewardship program should be comprised of the following components:

• Stewardship agreement:
-- Agreement is legal and financial bond between the registrant and distributors for distribution and service of the product in their areas.

-- Program provides rewards for distributors who comply with the provisions and penalties for those who do not.

• Distributor/grower product training meetings:
-- Meetings should be conducted periodically to inform distributors and growers of the proper application methods and safe handling of aldicarb.

• Product tracking system:
-- Distributors should be required to keep detailed records of customer purchases, including names, addresses, phone numbers, and related information.

• Product stewardship communications.
-- Communicates the concept of proper use and the importance of following label directions when applying agricultural chemicals and informs distributors and growers about stewardship programs and available assistance.

• Product stewardship guide:
-- The guide emphasizes the proper use of pesticides, significance of reading the label carefully, and ways to prevent worker exposure and avoid pesticide misuse.

• Product stewardship kit:
-- Kit includes a written speech, slides, flip charts, and brochures for distributors to promote the proper use and application of aldicarb.

• Product and Medical Support services:
-- Maintain a dedicated team of professionals to provide 24/7 support for any product related incidents. This includes medical toxicologists, environmental incident response teams, and product stewardship technical support.

When used according to label directions, aldicarb has a minimal risk to the worker and the environment. Sustained product stewardship on the part of all those involved with aldicarb reduces the number of overexposures, prevents misuse, and generally ensures that use of this important agricultural tool complies with label directions.