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SHAUGHNESSY NO.

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EEB REVIEW

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PETITION OR EXP. PERMIT NO.

DATE OF SUBMISSION 11/14/85

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TYPE PRODUCT(S): I, D, H, F, N, R, S Herbicide

DATA ACCESSION NO(S). 40003710, 40003711

PRODUCT MANAGER NO. R. Taylor (25)

PRODUCT NAME(S) Arsenal

COMPANY NAME American Cyanamid Company

SUBMISSION PURPOSE Proposed Registration of Forestry Use

SHAUGHNESSY NO.	CHEMICAL & FORMULATION	% A.I.
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

EEB REVIEW

Pesticide Name

Imazapyr

100.0 Submission Purpose and Label Information

100.1 Submission Purpose and Pesticide Use

Submission of data to support full registration of forestry use, site preparation, and release of loblolly pine.

100.2 Formulation Information

ACTIVE INGREDIENT

Isopropylamine salt of Imazapyr(2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid)*	53.1%
INERT INGREDIENTS	46.9%
TOTAL	<u>100.0%</u>

*Equivalent to 43.3% 2-[4,5-dihydro-4-methyl-4(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid or 4 pounds acid per gallon.

100.3 Application Methods, Directions, Rates

ARSENAL® herbicide APPLICATORS CONCENTRATE is an aqueous solution to be mixed in water and applied as a spray for control of most annual and perennial grasses, broadleaf weeds, and hardwood trees for site preparation and release of loblolly pine stands.

A postemergence application of ARSENAL is recommended for control of most annual and perennial grasses, broadleaf weeds, and hardwood trees in release of loblolly pine stands or in site preparation prior to planting loblolly pines. Some pine phytotoxicity and tip burn may occur after application, but pine survival is excellent. ARSENAL may be applied at any time during the growing season after leaves have emerged and before leaf fall. Pine phytotoxicity may be greater from spring application than from summer or fall application when the candles have hardened off.

Mix the proper amount of ARSENAL in water in the spray tank with the agitator running. Increased control of herbaceous and hardwood weeds with decreased loblolly pine tolerance can be obtained by adding a nonionic surfactant such as SURFACTANT WK** or Ortho*** X-77 at the rate of 1 quart per 100 gallons (1 qt/100 gal) of spray. This provides optimum wetting and/or contact activity. To minimize drift, a drift control agent may be added at the

recommended label rate. A foam-reducing agent may be added at the recommended label rate, if needed.

Uniformly apply with properly calibrated backpack sprayers, fixed-wing, or rotary-wing aerial or ground equipment in 5 to 20 gallons of water per acre (gal/water/A) with a spray pressure of 20 to 50 psi.

ARSENAL herbicide APPLICATORS CONCENTRATE will provide postemergence control with residue control of the following target vegetation species at the rates listed.

GRASSES

Apply 1 to 1.5 pints per acre (pt/A)

Annual bluegrass (Poa annua)
Broadleaf signalgrass (Brachiaria platphylla)
Canada bluegrass (Poa compressa)
Downy brome (Bromus tectorum)
Fescue (Festuca spp.)
Foxtail (Setaria spp.)
Italian ryegrass (Lolium multiflorum)
Johnsongrass (Sorghum halepense)
Kentucky bluegrass (Poa pratensis)

Lovegrass (Eragrostis spp.)
Orchardgrass (Dactylis glomerata)
Paragrass (Brachiaria mutica)
Quackgrass (Agropyron repens)
Sandbur (Cenchrus spp.)
Smooth brome (Bromus inermis)
Vaseygrass (Paspalum urvillei)
Wild oats (Avena fatua)
Witchgrass (Panicum capillare)

Apply 1.5 to 2 pt/A

Beardgrass (Andropogon spp.)
Cheat (Bromus secalinus)
Crabgrass (Digitaria spp.)
Fall panicum (Panicum dichotomiflorum)

Goosegrass (Eleusine indica)
Prairie threeawn (Aristida oligantha)
Torpedograss (Panicum repens)
Wild barley (Hordeum spp.)

Apply 2 to 3 pt/A

Bahiagrass (Paspalum notatum)
Bermudagrass (Cynodon dactylon)
Big bluestem (Andropogon gerardi)
Cattail (Typha spp.)
Dallisgrass (Paspalum dilatatum)

Guineagrass (Panicum maximum)
Prairie cordgrass (Spartina pectinata)
Sand dropseed (Sporobolus cyptandrus)
Timothy (Phleum pratense)
Wirestem muhly (Muhlenbergia frondosa)

BROADLEAF WEEDS

Apply 1 to 1.5 pt/A

Burdock (Arctium spp.)
Camphorweed (Heterotheca subzillaris)
Carpetweed (Mullugo verticillata)
Carolina geranium (Geranium carolinianum)
Clover (Trifolium spp.)
Common chickweed (Stellaria media)
Common ragweed (Ambrosia artemisiifolia)
Dandelion (Taraxacum officinale)

Mullein (Verbascum spp.)
Nettleleaf goosefoot (Chenopodium murale)
Oxeye daisy (Chrysanthemum leucanthemum)
Pepperweed (Lepidium spp.)
Pigweed (Amaranthus spp.)
Plantain (Plantago spp.)
Smartweed (Polygonum spp.)
Sorrel (Rumex spp.)

Dogfennel (Eupatorium capillifolium)
Filaree (Erodium spp.)
Fleabane (Erigeron spp.)
Hoary vervain (Verbena stricta)
Horseweed (Conyza canadensis)
Indian mustard (Brassica juncea)
Kochia (Kochia scoparia)
Lambsquarters (Chenopodium album)
Lespedeza (Lespedeza spp.)
Miners lettuce (Montia perfoliata)

Sunflower (Helianthus spp.)
Sweet clover (Melilotus spp.)
Tansymustard (Descurainia pinnata)
Western ragweed (Ambrosia psilostachya)
Wild carrot (Caucus carota)
Wild lettuce (Lactuca spp.)
Wild parsnip (Pastinaca sativa)
Wild turnip (Brassica campestris)
Wollyleaf bursage (Ambrosia gravi)
Yellow woodsorrel (Oxalis stricta)

Apply 1.5 to 2 pt/A

Bull thistle (Cirsium vulgare)
Cocklebur (Xanthium strumarium)
Dock (Rumex spp.)

Pokeweed (Phytolacca americana)
Purslane (Portulaca spp.)
Yellow starthistle (Centaurea solstitialis)

Apply 2 to 3 pt/A

Canada thistle (Cirsium arvense)
Giant ragweed (Ambrosia trifida)
Little mallow (Malvapar viflora)
Milkweed (Asclepias spp.)

Primrose (Oenothera Kunthiana)
Silverleaf nightshade (Solanum elaeagnifolium)
Sowthistle (Sonchus spp.)
Texas thistle (Cirsium texanum)

VINES AND BRAMBLES

Apply 1 to 1.5 pt/A

Field bindweed (Convolvulus arvensis)

Wild buckwheat (Polygonum convolvulus)

Apply 1 to 1.5 pt/A

Greenbriar (Smilax spp.)

Poison ivy (Rhus radicans)

Honeysuckle (Lonicera spp.)

Redvine (Brunnichia cirrhosa)

Morningglory (Ipomoea spp.)

Wildrose (Rosa spp.)

Apply 2 to 3 pt/A

Blackberry (Rubus spp.)

Trumpet creeper (Campsis radicans)

Dewberry (Rubus spp.)

Virginia creeper

Kudzu (Pueraria lobata)

(Pathenocissus quinquefolia)

Hedge bindweed (Calystegia sepium)

Wildgrape (Vitis spp.)

BRUSH SPECIES

Apply 2 to 3 pt/A

Ash (Fraxinus spp.)
Cherry (Prunus spp.)
Dogwood (Cornus spp.)
Hawthorn (Crataegus spp.)
Hickory (Carya spp.)
Maple (Acer spp.)
Mulberry (Morus spp.)
Oak (Quercus spp.)

Popla (Populus spp.)
Privet (Ligustrum vulgare)
Red Maple (Acer rubrum)
Sassafras (Sassafras albidum)
Sumac (Rhus spp.)
Sweetgum
(Liquidambar styraciflua)
Willow (Salix spp.)

The higher rates should be used where heavy or well established infestations occur. The degree of control is species dependent. Some Rubus species may not be controlled at this rate.

100.4 Target Organisms

Annual and perennial grasses, broadleaf weeds, and hardwood trees. See section 100.3 for a complete list of species.

100.5 Precautionary Labeling

DO NOT use on food or feed crops. DO NOT apply where runoff water may flow onto agricultural land as injury to crops may result. Keep from contact with fertilizers, insecticides, fungicides, and seeds. DO NOT apply or drain or flush equipment on or near desirable trees or other plants, or on areas where their roots may extend, or in locations where the chemical may be washed or moved into contact with their roots. DO NOT use on lawns, walks, driveways, tennis courts, or similar areas. Prevent drift of spray to desirable plants. DO NOT use in California.

Thoroughly clean all traces of ARSENAL® from application equipment immediately after use. Flush tank, pump, hoses, and boom with several changes of water after removing nozzle tips and screens (clean these parts separately).

DO NOT apply directly to any body of water. DO NOT contaminate water by cleaning of equipment or disposal of waste.

101.0 Hazard Assessment

101.1 Discussion

Imazapyr is currently registered for use on noncrop areas such as railroad, utility, and pipeline rights-of-way, industrial sites, storage yards, and nonagricultural fencerows. A ditchbank use is also registered (NPIRS - March 26, 1987).

This amendment will allow use of Imazapyr for site preparation and release of loblolly pine plantings.

Since loblolly pine (Pinus taeda) is the principal commercial pine species grown in the southeastern United States, the potential exists for several million acres of forestland to be exposed.

Rates of application range from 0.5 to 1.5 lb/ai/A applied during the growing season of the target species.

101.2 Likelihood of Adverse Effects to Nontarget Organisms

Terrestrial

The toxicity data available suggest that Imazapyr is practically nontoxic to mammals based on an acute oral LD₅₀ of > 5000 mg/kg (both sexes). The rabbit systemic NOEL is 400 mg/kg/day HDT (technical). With an LD₅₀ of > 2150 mg/kg for bobwhite quail and mallard duck, Imazapyr may be characterized as practically nontoxic on an acute oral basis. The chemical also has a low order of toxicity on a dietary basis for avian species (LC₅₀ > 5000 ppm for bobwhite quail and mallard duck).

The material was nontoxic to honey bees at the highest dosage tested (100 ug/bee) in an acute contact test.

Following a single application of 3 pt/Arsenal/A (1.5 lb/ai) maximum expected residues would range from 360 ppm on short rangegrass to 87 ppm on forage (insects). These values are significantly below avian LC₅₀ values.

Aquatic

Imazapyr is practically nontoxic to freshwater fish and aquatic invertebrates with LC₅₀ values > 100 ppm. Assuming a direct application to water at 1.5 lb/ai, the concentration in 6 A/ft of water would be 92 ppb. This level is substantially below that necessary to adversely affect aquatic organisms.

Plants

As indicated on the label, applications where runoff water may flow onto agricultural land should be avoided. Spray drift onto nontarget plants should also be avoided.

Imazapyr is a broad-spectrum herbicide that is readily absorbed through the foliage and roots and is translocated rapidly throughout the plant. Plants stop growing soon after spray application.

Chlorosis appears first in the newest leaves, and necrosis spreads from this point. In perennials, the herbicide is translocated into and kills underground storage organs. Chlorosis and tissue necrosis may not be apparent in some plant species until 2 weeks after application. Complete kill of plants may not occur for several weeks.

The no-effect level from a soil-applied 53.1% salt formulation was reported to be 0.014 lb/ai/a for corn; 0.007 lb/ai/a for cotton, sunflower, and soybean; 0.0036 lb/ai/a for sorghum; 0.0018 lb/ai/a for wheat and barley; and < 0.0018 lb/ai/a for sugar beet.

At current application rates (0.5 to 1.5 lb/ai/a) all species tested would be adversely affected.

No-effect levels are not available for the aquatic species in Subdivision J of the EPA Guidelines. However, Chara spp., Cladophera spp., and lemon bacopa (Bacopa caroliniana) were not affected at rates equivalent to 1.0 lb/ai/a. Water hyacinth (Eichhornia crassipes), water-lettuce (Pistia stratiotes), egeria (Egeria densa), elodea (Elodea canadensis), hydrilla (Hydrilla verticillata), southern naiad (Najas guadalupensis), and duckweed (Spirodela polyrhiza) were controlled at 0.5 lb/ai/a. Acceptable alligatorweed control (Alternanthera philoxeroides) occurs at 0.75 lb/ai/a. Control of fanwort (Cabomba caroliniana), coontail (Ceratophyllum demersum), and watermilfoil (Myriophyllum spicatum) with AC 252,925 was described as less effective.

101.3 Endangered Species Consideration

No significant impact is expected to any endangered or threatened animal from the use of Arsenal for site preparation or loblolly pine release because of the low order of toxicity. However, the chemical is phytotoxic to a broad spectrum of plant species and could adversely affect endangered plants growing near the site of application.

The Office of Endangered Species (OES) has provided Ecological Effects Branch (EEB) with a biological opinion for pesticides used in forests. In this opinion a number of terrestrial and aquatic plant species are listed as being at jeopardy from the use of herbicides. EEB is assuming that jeopardy will also occur from the use of Arsenal in forests.

OES will be notified in writing of EEB's assumption of jeopardy from the use of Arsenal.

101.4 Adequacy of Toxicity Data

Two phytotoxicity studies were submitted with this amendment. Data in EEB files have been reviewed previously.

The following is a brief summary of the phytotoxicity studies:

1. The Effect of Arsenal Herbicide on Aquatic Plant Growth. R.M. Herrick. July 1, 1986. American Cyanamid Company.

Information submitted provides a summary on the effect of AC 252,925 on several aquatic plants. Species tested are not those recommended in Subdivision J of the Guidelines. The study does not fulfill the requirement for aquatic plant phytotoxicity (§158.150, 122-2, or 123-2).

2. The Effect of Arsenal on Seed Germination, Seedling Emergence, and Vegetative Vigor. Report No. DIS-P Vol. 6-15. T. Malefyt. August 4, 1986. American Cyanamid Company.

Information submitted provides a summary on the phytotoxic effect of AC 252,925 on eight terrestrial plants (corn, cotton, sunflower, soybean, sorghum, wheat, barley, and sugar beet). The study, as submitted, does not meet the Guideline requirements outlined in Subdivision J, §158.150, 122-1, or 123-1.

101.5 Adequacy of Labeling

The following endangered species labeling is required:

"Arsenal Endangered Species Labeling For Forest Uses

"Endangered Species Restrictions

"The use of any pesticide in a manner that may kill or otherwise harm an endangered or threatened species or adversely modify their habitat is a violation of federal laws. The use of this product is controlled to prevent death or harm to endangered or threatened species that occur in the following counties or elsewhere in their range.

"Before using this pesticide in the following counties you must first contact the Endangered Species Specialist in the appropriate Regional/Field Office of the U.S. Fish and Wildlife Service (FWS) indicated below. Specific information describing the locations of areas to be treated must be provided to the FWS. Use of this product in the range of endangered species, as described by FWS, is prohibited.

"Contact FWS Field Offices at the following numbers:

ALABAMA (Jackson, Mississippi, 601-960-4900)

Counties of Cherokee, De Kalb, Etowah, Jackson, Marshall and St. Clair

ARKANSAS (Jackson, Mississippi, 601-960-4900)

Counties of Clay, Jackson, Lawrence, and Woodruff

CONNECTICUT (Concord, New Hampshire, 603-224-2585)

County of Litchfield

FLORIDA (Jacksonville, Florida, 904-791-2580)

Counties of Clay, Gadsden, Gulf, Liberty, Marion, Jackson, Orange, and Volusia

GEORGIA (Jacksonville, Florida, 904-791-2580)

Counties of Decatur, Towns, Brantley, Wayne, Habersham, Rabun, Stephens, Dooley, Lee, Floyd, Gordon, Walker, Baker, and Wheeler

ILLINOIS (Bloomington, Indiana, 309-793-5800)

County of Randolph

IOWA (St. Paul, Minnesota, 612-725-7131)

Counties of Allamakee, Clayton, Delaware, Dubuque, and Jackson

MAINE (Concord, New Hampshire, 603-224-2585)
 Counties of Aroostook, Cumberland, Kennebec, and York

MASSACHUSETTS (Concord, New Hampshire, 603-224-2585)
 Counties of Hampshire and Essex

MICHIGAN (E. Lansing, Michigan, 517-337-6650)
 County of Berrien

MINNESOTA (Twin Cities, Minnesota, 612-725-3276)
 Counties of Goodhue and Rice

MISSISSIPPI (Jackson, Mississippi, 601-960-4900)
 Counties of Sharkey and Sunflower

MISSOURI (Twin Cities, Minnesota, 612-725-3276)
 County of Ripley

NEW HAMPSHIRE (Concord, New Hampshire, 603-224-2585)
 Counties of Belknap, Carroll, Merrimack, Rockingham,
 and Strafford

NEW JERSEY (State College, Pennsylvania, 814-234-4090)
 County of Sussex

NEW YORK (Cortland, New York, 607-753-9334)
 Counties of Delaware, Sullivan, and Ulster

NORTH CAROLINA (Asheville, North Carolina, 704-259-0321)
 Counties of Burke, Haywood, Henderson, Macon, Avery,
 Mitchell, Scotland, Clay, Bladen, Brunswick, Carteret,
 Cumberland, Hoke, Pender, and Scotland

OHIO (Columbus, Ohio, 614-231-3416)
 Counties of Portage and Summit

PENNSYLVANIA (State College, Pennsylvania, 814-234-4090)
 County of Centre

RHODE ISLAND (Concord, New Hampshire, 603-224-2585)
 County of Providence

SOUTH CAROLINA (Asheville, North Carolina, 704-259-0321)
 Counties of Oconee, Bamberg, Barnwell, Clarendon, Colleton,
 Lee, Orangeburg, Richland, and Berkeley

TENNESSEE (Asheville, North Carolina, 704-259-0321)
 Counties of Hamilton and Carter

VIRGINIA (Annapolis, Maryland, 301-269-5448)
 Counties of Smyth, Caroline, James City, and Prince William

WISCONSIN (Green Bay, Wisconsin, 414-465-2682)
 Counties of Grant, Iowa, Monroe, Richland, Sauk, and Vernon"

102.0 Classification

Unclassified, conditional registration (NPIRS - March 27, 1987).

103.0 Conclusions

EEB is unable to complete an assessment 3(c)(5) for the proposed use of Arsenal for site preparation and release of loblolly pine.

This use will significantly enlarge the potential acreage that could be exposed to the chemical. Based on available data, Imazapyr does not increase the acute risk to avian or aquatic species. No conclusions can be reached at this time concerning the chronic hazard. In order to address this hazard, EEB requires the final review from Exposure Assessment Branch (EAB) concerning the persistence of Imazapyr in the environment. Results of this review may necessitate submission of avian reproduction studies, 71-4; fish early life stage and aquatic invertebrate life cycle studies, 72-4; and residue monitoring.


Phytotoxicity data are also inadequate to complete the assessment. However, based on information available, there is a probability that terrestrial endangered plant species would be adversely affected and a potential for aquatic endangered plant species to be impacted. Labeling in Section 101.5 of this review is required and is adequate to avoid jeopardy to endangered plants.



Charles Lewis, Agronomist
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5/29/87

Michael Slinak, Chief
Ecological Effects Branch
Hazard Evaluation Division (TS-769C)

DATA EVALUATION RECORD

1. Chemical: Isopropylamine Salt of Imazapyr
2. Test Material: Arsenal AC 252,925 53.1% ai
3. Study/Action Type: Phytotoxicity Evaluation - Seed Germination, Seedling Emergence, Vegetative Vigor
4. Study ID: The Effect of ARSENAL® on Seed Germination, Seedling Emergence and Vegetative Vigor. Report No. DIS-P Vol. 6-15, August 4, 1986, American Cyanamid Company. (Unpublished study received November 14, 1986; submitted by American Cyanamid Company under Accession Nos. 40003710 and 40003711).

5. Reviewed By: Charles Lewis
Agronomist
EEB/HED

Signature: *Charles Lewis*
Date: February 18, 1987

6. Approved By: Douglas Urban
Section Head
EEB/HED

Signature: *Douglas Urban*
Date: *2/20/87*
APR 2 1987

7. Conclusions:

The study is scientifically sound but does not fulfill the EPA Guideline requirement for nontarget plants: Seed Germination/Seedling Emergence and Vegetative Vigor. Results of the test were presented in summary form; raw data were not available to determine 50 percent effect levels. In addition, number of seeds per replicate, percentage seed germination, and identification of cultivars tested were not included. The test was also conducted on a end-use product rather than the technical grade active ingredient.

8. Recommendations: N/A.
9. Background: N/A.
10. Discussion of Individual Tests or Studies:

11. Materials and Methods (Protocols):

The studies were conducted in a cyroglass greenhouse maintained at 24 ± 5 °C. Photoperiod was 14 hours of daylight. Plants tested were corn, sorghum, barley, wheat, soybean, sunflower, cotton, and sugar beet. Seeds of these eight crops were planted in the top 2.5 cm of 120 cm² fiber cups. Soil used was a sassafras sandy loam with 1.7 percent organic matter. AC 252,925 was dissolved in a 1:1 solution of acetone and water (v/v) and sprayed at 400 L/ha using a laboratory belt sprayer. Rates tested were 0.5, 0.25, 0.125, 0.063, 0.032, 0.016, 0.008, 0.004, and 0.002 kg/ha. Each rate was replicated three times. Observations and measurements were made for seedling emergence, plant height, and herbicide injury. A final evaluation was made for phytotoxicity on day 34.

12. Reported Results:

The following results were copied directly from the study.

"Corn

"5 DAT (Days After Treatment)

"At 4 g/ha and above the corn was slightly shorter than the untreated check. Leaves were wider and showed slight chlorosis.

"9 DAT

"At 8 g/ha the veins were red and the plants were showing signs of chlorosis. At 63 g/ha, the plants were much shorter and have wider leaves than the lower rates.

"12 DAT

"From 2-32 g/ha leaves showed slight anthocyanin (reddish) expression. Some chlorosis was evident at 8 g/ha and higher. At a rate of 63 g/ha and above, the corn was very short and the tips of the leaves were necrotic.

"21 DAT

"From 2-8 g/ha the corn appeared completely normal. From 16-32 g/ha the corn also appeared normal except for a slight anthocyanin expression in veinal tissue. At 63 g/ha and above the corn plants had stopped growing, were extremely stunted, and some had died.

"Sorghum

"5 DAT

"Seedlings were stunted in comparison to the untreated plants at all rates.

"9 DAT

"At 4-8 g/ha seedlings were slightly stunted and showed veinal chlorosis. Stunting was greater at rates of 63 g/ha and above.

"12 DAT

"Little effect was noted at 2 g/ha, however, at 4 g/ha slight stunting was evident. Veinal chlorosis was evident at 4 g/ha and became pronounced at 16 g/ha. Plants had stopped growing at 63 g/ha.

"21 DAT

"Sorghum plants had a normal appearance from 2-8 g/ha, however, slight stunting was seen. Higher rates show clear anthocyanin expression in veinal tissue. Leaf tip burning occurred at 32 g/ha. Sorghum died at 63 g/ha.

"Wheat and Barley

"5 DAT

"Seedlings were stunted in comparison to the untreated plants at all rates.

"9 DAT

"Seedlings were slightly stunted at ≤ 4 g/ha. At higher rates, chlorosis was evident and plants had fewer leaves.

"12 DAT

"Barley seemed slightly more sensitive than wheat with slight stunting at 2 g/ha in barley and at 8 g/ha in wheat. From 8-32 g/ha plants had fewer and shorter leaves and showed significant stunting in comparison to the untreated check. At 63 g/ha and above, plants had stopped growing.

"21 DAT

"From 2-8 g/ha plants appeared very similar to the untreated plants. Some stunting was evident in barley even at the lowest rate. Stunting for both wheat and barley

increased as the rate increased until 63 g/ha, where the plants had died.

"Soybean

"5 DAT

"Slight stunting was evident at 250-500 g/ha. Anthocyanin expression was present in veinal tissue at 32 g/ha and above.

"9 DAT

"Unifoliate leaves appear unaffected at 32 g/ha; however, the emergence of the first trifoliate was delayed. No stunting was evident at lower rates. All treated plants show branching from the cotyledonary node, whereas this was not the case for the untreated plants.

"12 DAT

"Slight chlorosis was noted in the first trifoliate starting at 2 g/ha, but noticeable retardation of growth occurred only at \geq 32 g/ha.

"21 DAT

"There were no noticeable effects at 32 g/ha. Plants overcame the chlorosis noted at 12 DAT. Stunting and narrow leaves were evident at 63 g/ha and above.

"Sunflower

"5 DAT

"Anthocyanin expression was noted in the veinal tissue of the first leaves at 16-32 g/ha. At 125 g/ha, cotyledons unfolded, but no further growth was evident from the apical meristem.

"9 DAT

"Chlorosis was noted in the new leaves at 16-32 g/ha. No effects were noted at rates below 16 g/ha.

"12 DAT

"No effects on leaf color were evident up to 63 g/ha, but the leaves were smaller and thinner as rates increased. At 32 g/ha the leaves were approximately one fourth the size of the untreated control.

"21 DAT

"Little to no effect was observed at 16 g/ha. Stunting and smaller leaves were noted at 32 g/ha. At 63 g/ha growth was completely inhibited after the cotyledons emerged.

"Cotton

"5 DAT

"Plants were just beginning to emerge.

"9 DAT

"Cotyledons were present on all emerged plants. No differences could be observed between treatments.

"12 DAT

"At 8 g/ha, chlorosis of new leaves is very evident. At 32 g/ha, only cotyledons were developed. At 63 g/ha, the cotyledons were beginning to shrivel and showed burning at the tips.

"21 DAT

"Chlorosis in the new leaves was evident at 16 g/ha and growth of the apical meristem completely inhibited at 63 g/ha. No effects were noted at 8 g/ha.

"Sugarbeets

"5 DAT

"Plants were just beginning to emerge.

"9 DAT

"Untreated plants had 2-4 leaves, while treated plants remained in the cotyledon stage at 4 g/ha.

"12 DAT

"At 2 g/ha, plants were smaller than the untreated plants. New leaves were thin and shriveled from 2-8 g/ha. Plants were dead at 63 g/ha.

"21 DAT

"At 2 g/ha, sugarbeets were still much smaller than the untreated plants. Sugarbeets were the most sensitive crop in the test. Stunting increased up to 32 g/ha, at

which level most of the plants had died and were completely necrotic."

Herbicidal Activity of AC 252,925 on Selected Crop Species

AC 252,925 (kg/ha)	<u>Sugar Beet</u>	<u>Cotton</u>	<u>Sunflower</u>	<u>Soybean</u>	<u>Wheat</u>	<u>Barley</u>	<u>Corn</u>	<u>Sorghum</u>
<u>Mean Rating</u>								
0.500	9.0	8.0	8.3	8.0	9.0	9.0	9.0	9.0
0.250	9.0	8.0	8.0	7.0	9.0	9.0	9.0	9.0
0.125	9.0	8.0	8.0	7.0	9.0	9.0	9.0	9.0
0.063	8.3	7.0	7.0	6.3	9.0	9.0	8.3	8.7
0.032	8.7	3.0	3.0	2.0	6.7	8.3	3.3	5.0
0.016	7.0	1.0	1.7	0.3	5.0	5.7	0.0	3.3
0.008	6.7	0.0	0.0	0.0	3.3	4.0	0.0	0.7
0.004	6.7	0.0	0.0	0.0	1.7	3.0	0.0	0.0
0.002	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

<u>Rating*</u>	<u>Meaning</u>	<u>% Control</u>
9	Complete Kill	100
8	Approaching Complete Kill	91-99
7	Good Herbicide Effect	80-90
6	Herbicidal Effect	65-79
5	Definite Injury	45-64
4	Injury	30-44
3	Moderate Effect	16-29
2	Slight Effect	6-15
1	Trace Effect	1-5
0	No Effect	0

* Mean rating for three replicates.

13. Study Author's Conclusions/Quality Assurance Measures:

1. AC 252,925 at 63 g/ha or less has little or no effect on the seedling emergence of the crop species tested. Higher levels of AC 252,925 delayed or significantly reduced seedling emergence.
2. AC 252,925 is a potent inhibitor of plant growth. AC 252,925 at 63 g/ha severely inhibited the growth or killed all species tested.
3. Differences were noted in tolerance between the crop species tested with sugar beets being the most susceptible and soybeans being the most tolerant.

4. Applications of AC 252,925 at commercial use rates to nontarget areas will result in reduced vegetative vigor or death of most plant species found in the area. Seedling growth in these areas would be affected until the compound dissipated sufficiently.

No quality assurance statements were provided.

14. Reviewer's Discussion and Interpretation of Study Results:

- a. Test Procedures - As reported by the authors this is a modified Tier II test on a range of species. Procedures followed appear to be satisfactory; however, the results have been summarized and some information has not been included in the report as specified in Subdivision J, i.e., number of seeds per replicate, number of seeds germinated per dose level for each replicate, percent germination, cultivars of the species tested.

In Figure 1-4, it is unclear what value is expressed by plant emergence (average of three replicates).

Subdivision J recommends six species of dicotyledonene, one of which is soybean and one which is a root crop, representing four families and four species of monocotyledonene, one of which is corn, representing two families. This study was conducted on four species of dicotyledonene representing four families and four species at monocotyledonene representing one family.

A formulated product was tested rather than the TGAI.

- b. Statistical Analysis - Raw data for percent control and emergence are required for statistical analysis. A preliminary analysis indicates the following:

Approximate EC₅₀(kg/ha) on day 21

Sugar beet	0.0038
Cotton	0.04
Sunflower	0.04
Soybean	0.048
Wheat	0.013
Barley	0.0098
Corn	0.037
Sorghum	0.026

- c. Discussion/Results - Data submitted provide a summary on the effect of AC 252,925 on germination and emergence for eight species of terrestrial plants (corn, sorghum, barley, wheat, soybean, cotton, sugar beet, and sunflower).

The vegetative vigor data were a continuation of the emergence study. The Guidelines require that plants be 1 to 4 weeks postemergent at time of application with a foilar application.

The no-effect level for corn is 0.016 kg/ha; 0.008 kg/ha for cotton, sunflower, and soybean; 0.004 kg/ha for sorghum; 0.002 kg/ha for wheat and barley; and < 0.002 kg/ha for sugar beet.

d. Adequacy of Study

- 1) Classification - Supplemental.
- 2) Rationale: Refer to Section 14a.
- 3) Repairability: Submission and clarification of data may result in upgrading the germination and seedling emergence part of the study. The vegetative vigor requirement has not been satisfied.

15. Completion of One-Liner for Study:

16. CBI Appendix: N/A.

DATA EVALUATION RECORD

1. Chemical: Isopropylamine salt of Imazapyr (2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid
2. Test Material: Arsenal AC 252,925,53.1% ai
3. Study/Action Type: Aquatic Plant Growth - Phytotoxicity Evaluation
4. Study ID: The Effect on Arsenal® Herbicide on Aquatic Plant Growth. American Cyanamid Company, Agricultural Research Division. (Unpublished study received November 14, 1986; submitted by American Cyanamid Company under Accession Nos. 40003710 and 40003711).

5. Reviewed By: Charles Lewis
Agronomist
EEB/HED

Signature: *Charles Lewis*
Date: February 17, 1987

6. Approved By: Douglas Urban
Section Head
EEB/HED

Signature: *Douglas Urban*
Date: 5/28/87
APR 2 1987

7. Conclusions:

The report does not satisfy the EPA Guideline requirement for nontarget plants: Growth and Reproduction of Aquatic Plants. The required species were not tested and the information provided is in summary form. In addition, a formulated product was tested.

8. Recommendations: N/A.
9. Background: N/A.
10. Discussion of Individual Tests or Studies:

11. Materials and Methods (Protocols):

The study was conducted in growth chambers maintained at 23 to 25 °C. Light intensity was 9.3 to 11.2 lux for 12 hours per day. Algae (Chara and Cladophora) and duckweed Spirodela polyrhiza were grown in 50 mL petri dishes. Other test species, water hyacinth Eichhornia crassipes, waterlettuce Pistia stratiotes, alligatorweed Alternanthera philoxeroides, lemon bacopa Bacopa caroliniana, egeria Egeria densa, elodea Elodea canadensis, hydrilla Hydrilla verticillata, southern naiad Najas guadalupensis, fanwort Cabomba caroliniana, coontail Ceratophyllum demerson, and watermilfoil Myriophyllum spicatum were grown from cuttings in 1 L glass jars.

Two weeks after stocking, growth was evaluated and jars were placed in growth chambers and allowed to acclimate for 1 week. Following acclimation the appropriate concentration of AC 252,925 was injected into the nutrient solution. Each treatment was replicated three times. Rates used were equivalent to 0.5, 0.75, and 1.0 lb/ai/A.

Percent kill and percent population reduction (algae) as determined by spectrophotometric technique were evaluated at 2-week intervals for 10 weeks.

Method of statistical analysis was not reported.

12. Reported Results:

Algae

Chara and Cladophora were resistant to AC 252,925 at all rates applied.

Floating Species

Ten weeks after treatment, AC 252,925 at 0.5 lb/ai/A provided 98 to 100 percent control at water hyacinth, waterlettuce, and duckweed.

Emersed Species

At 0.75 lb/ai/A commercially acceptable control (> 85%) of alligatorweed was obtained at 8 weeks. Lemon bacopa was unaffected.

Submersed Species

Egeria, elodea, hydrilla, and southern naiad were controlled at 0.5 lb/ai/A at 10 weeks. AC 252,925 was much less effective against fanwort, coontail, and watermilfoil.

Treatment	Rate (lb/ai/A)	WAR1/	% PR2/		% K1113/												
AC 252,925	0.50	2	0	0	50	25	67	0	25	0	2	0	12	70	0	3	0
	0.75		0	0	70	31	70	0	32	0	5	0	10	85	0	7	0
	1.00		0	0	70	33	90	10	32	0	8	0	10	97	0	23	0
AC 252,925	0.50	4	0	0	50	67	92	48	47	0	18	0	50	90	15	13	10
	0.75		0	0	80	73	97	60	60	0	27	7	55	100	20	25	40
	1.00		0	0	80	73	98	67	70	0	53	20	60	100	25	40	45
AC 252,925	0.50	6	0	0	50	93	95	75	43	0	32	8	80	100	28	20	57
	0.75		0	0	80	95	100	83	75	0	37	33	80	100	40	53	85
	1.00		0	0	80	97	100	90	85	0	70	33	85	100	58	57	97
AC 252,925	0.50	8	0	0	50	95	95	96	47	0	37	17	97	100	40	37	98
	0.75		0	0	80	98	100	100	88	0	40	33	100	100	68	57	100
	1.00		0	0	80	98	100	100	90	0	73	50	100	100	70	63	100
AC 252,925	0.50	10	0	0	50	97	95	100	57	0	57	30	100	100	100	60	100
	0.75		0	0	80	100	100	100	88	0	63	55	100	100	100	70	100
	1.00		0	0	80	100	100	100	92	3	73	82	100	100	100	80	100

1/Weeks after treatment.
 2/Percent population reduction.
 3/Data represent the mean of three replications.

<u>Algae</u>	<u>Floating</u>	<u>Emerged</u>	<u>Submersed</u>
<u>Chara</u> spp.			
<u>Cladophora</u> spp.			
<u>Azolla</u> spp.			
<u>Eichhornia</u> <u>crassipes</u>			
<u>Pistia</u> <u>stratiotes</u>			
<u>Spirodela</u> <u>polyrhiza</u>			
<u>Alternanthera</u> <u>phyloxeroides</u>			
<u>Bacopa</u> <u>caroliniana</u>			
<u>Calomba</u> <u>caroliniana</u>			
<u>Ceratophyllum</u> <u>demersum</u>			
<u>Egeria</u> <u>densa</u>			
<u>Elodea</u> <u>canadensis</u>			
<u>Hydrilla</u> <u>verticillata</u>			
<u>Myriophyllum</u> <u>spicatum</u>			
<u>Najas</u> <u>guadalupensis</u>			

13. Study Author's Conclusions/Quality Assurance Measures:

"The results presented in Table 1 demonstrate that, depending on species, AC 252,925 shows promise as a broad-spectrum herbicide for control of floating and submersed weeds. As under terrestrial conditions, all plants controlled by AC 252,925 died slowly. This slowness of kill is a definite attribute for an aquatic herbicide since biological O₂ demand would be at a low level."

No quality assurance statements were provided.

14. Reviewer's Discussion and Interpretation of Study Results:

- a. Test Procedures - The study does not follow the protocol outlined in Subdivision J; Hazard Evaluation: Nontarget Plants. Among the discrepancies are: the required test organisms were not utilized, i.e., duckweed (Lemna gibba), marine diatom (Skeletonema costatum), blue-green alga (Anabaena flos-aquae), freshwater green alga (Selenastrum capricornutum) and a freshwater diatom (unspecified species). For those species that were tested, information is provided in summary only. A formulated product was tested rather than the TGAI. Concentrations in test vessels were unclear and should be reported as ppm rather than lb/ai/A. Insufficient concentrations were tested to provide 50 percent detrimental effect levels.
- b. Statistical Analysis - Raw data were not available for analysis.
- c. Discussion/Results - Information submitted provides a summary on the effect of AC 252,925 on several aquatic plants. Data are insufficient to establish 50 percent effect levels.
- d. Adequacy of the Study
 - 1) Classification: Invalid.
 - 2) Rationale: Refer to Section 14a.
 - 3) Reparability: May be upgraded to Supplemental with submission of complete data.

15. Completion of One-Liner for Study:

16. CBI Appendix: N/A.