IDAHO CROP PROFILES

Barley

Production Facts

- Idaho ranks second in the U.S. in barley production.
- Idaho produces 20.3% of the total U.S. barley crop (2000-'02 average).
- 53,960,000 bushels were produced in 2002 with an estimated value of $165 million.
- 69% of the 2002 crop was malting barley varieties and 31% was feed types.
- Production costs averaged $221 per acre in 1999-2001.

Production Regions

Barley is grown throughout Idaho, in 42 of the state's 44 counties. At least 55% of Idaho's barley crop is grown in the southeastern region, with Bonneville County being the top-producing county in the state at 5.2 million bushels. Other regions include: southcentral (28%), southwestern (5%), and northern Idaho (12%).

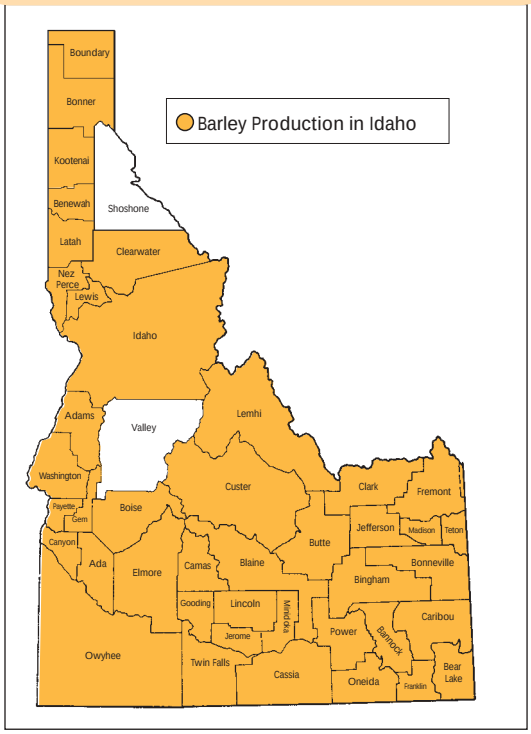
There are essentially nine different barley production zones in the state of Idaho, which vary by elevation, temperature, growing degree days and soil types. Barley varieties are tested thoroughly in all of these zones for agronomic performance.

Cultural Practices

The majority of Idaho barley acres are spring planted starting in late February through mid-May, depending on the region. Nearly two-thirds (62%) of Idaho's barley production is irrigated, with the remaining 38% of the acreage planted to varieties with adaptation to higher elevation, dryland conditions. Early seeding at depths of 1 to 1 1/2 inches results in the highest grain yields. Spring barley requires a moderately fine but firm seedbed that promotes rapid, uniform germination. Maintaining a moderate amount of crop residue on the soil surface reduces erosion and preserves soil moisture. Pre-plant fertilizer and herbicide applications are made before final seedbed tillage operations.

Integrated Pest Management

Idaho barley producers employ specific cultural practices to reduce agrichemical inputs for weed, insect and disease control. These include cultivation, crop rotation, planting of pest-resistant varieties, manipulation of planting date, modification of fertility and irrigation scheduling, field scouting, use of economic thresholds to determine when chemical control is needed, and use of less-toxic pesticides and biocontrols.



According to a 1997 survey by the University of Idaho, 89% of Idaho grain producers surveyed used crop rotation to control weeds, 69% to control insects and 70% to control disease. Ninety-eight percent used herbicides, and 61% used pesticide rotation to reduce the development of resistance to specific herbicides. Only 2% reported using insecticides and fungicides on a regular basis. Seventy-three percent routinely used field scouting to determine pest levels.

In addition to the above mentioned cultural practices, judicious use of selected pesticides is still a major part of Idaho barley integrated pest management (IPM) programs.

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Insect Pests

At least 20 insect species can attack barley grown in Idaho. The most commonly encountered pests include aphids, cereal leaf beetles, thrips and wireworms.

Aphids

The primary pests of concern cause greater economic loss than all other insect pests in Idaho barley. Six aphid species are known to cause infestations of economic significance at least occasionally. The Russian wheat aphid (*Diuraphis noxia*), English grain aphid (*Sitobion avenae*) and greenbug (*Schizaphis graminum*) are most commonly associated with significant yield loss. Greenbugs damage spring barley through the transmission of barley yellow dwarf virus, particularly in the high mountain valleys of eastern Idaho, and by feeding on stems beneath the emerging head in the boot stage.

The rose grass aphid (*Metopolophium dirhodum*), corn leaf aphid (*Rhopalosiphum maidis*) and bird cherry-oat aphid (*Rhopalosiphum padi*) can spread barley yellow dwarf virus; however, these species normally do not require chemical control unless populations develop during the first- or second-leaf stage.

Chemical Control

Di-sulfoton (Di-syston)—The primary aphidicide used on Idaho barley is applied as a foliar spray on less than 10% of total Idaho acreage. The application rate is 1 pound active ingredient per acre, with a 30-day pre-harvest restriction. A 15% granular formulation is used occasionally on barley acreage that borders rangeland infested by grasshoppers. Due to the toxicity of this compound, aerial applicators are refusing to apply di-sulfoton in areas that are adjacent to housing developments, confined dairy and livestock operations and bee hives. This constrains malting barley production in south-central Idaho due to a lack of alternative products. Additionally, EPA plans to increase the re-entry interval to 3 days, and eventually to cancel all uses in barley within 3 years.

Imidacloprid (Gaucho)—This chemical is used as a seed treatment on less than 5% of Idaho's barley seed to control early aphid onset. The application rate is 1 fluid ounce per 100 cwt seed, with a 45-day pre-harvest restriction.

Lambda-Cyhalothrin (Warrior)—This insecticide is the only synthetic pyrethroid currently used on barley. It has been used under Section 18 emergency exemption provisions of FIFRA and is applied to 2% of the barley acres in Idaho. The application rate is 0.03 pound active ingredient per acre. No more than 0.06 pound active ingredient per acre can be applied per season. The pre-harvest restriction is 30 days. The IR-4 program is in the process of petitioning EPA for a tolerance for Warrior on barley to subsequently obtain a full registration.

Malathion—This chemical is used as a back-up protection tool primarily for aphids and cereal leaf beetles, but is used on less than 5% of Idaho acreage and has limited effectiveness for control of infestations in barley. The application rate is 1 pound active ingredient per acre with a 7-day pre-harvest restriction.

Methyl Parathion—This chemical is used on less than 5% of the barley acreage to control Russian wheat aphids. The application rate is 0.6 pound active ingredient per acre with a 15-day pre-harvest restriction. The same constraints for di-sulfoton apply to this compound.

Zeta-cypermethrin (Fury, Mustang)—IR-4 is considering this synthetic pyrethroid as an alternative to organophosphate insecticides to control aphids in barley. It is already registered in wheat and is awaiting approval from EPA for use on barley.

Biological Control

Fungal diseases, parasitoids and predators such as ladybugs are naturally occurring and have also been introduced. However, these biological control agents often will not take over until after the damage to the barley plants is done. Growers in areas with frequent aphid infestations often will augment the existing ladybug populations to enhance control.

Cereal Leaf Beetle, *Oulema melanopus*

Cereal leaf beetles (CLB) are a more recent (1992) pest concern in Idaho barley, but they now infest at least 29 of the state's 44 counties. Barley and oats are the preferred host plants. Economic damage can be caused by larvae or adults, but larvae are the most damaging, and are the target of control measures. Overwintering adults are heavy feeders, consuming up to 3.5 times their body weight in a single day. Females may lay up to 300 eggs, with larval populations peaking in mid to late June. For each acre of land, one location should be sampled to determine the level of infestation. At each location, 10 plants should be examined for the presence of CLB eggs or larvae. The economic threshold for control is three larvae per plant, three eggs per plant, or both. After boot stage, the threshold becomes one larva per leaf.

Chemical Control

Malathion—This chemical is used as a back-up protection tool for aphids and CLB, but is used on less than 5% of Idaho acreage. The application rate is 1 pound active ingredient per acre, with a 7-day pre-harvest restriction.

Spinosad (Success, Tracer)—Spinosad was registered in 2000 for suppression of CLB. Pre-harvest restriction is 21 days (14 days for grazing or straw).

Zeta-cypermethrin (Mustang)—IR-4 is considering this synthetic pyrethroid as an alternative to organophosphate insecticides to control CLB in barley. It is already registered in wheat and is awaiting approval from EPA for use on barley.

Biological Control

USDA APHIS, in cooperation with affected states, introduced a successful parasitoid control program in the 1960s in the midwestern and eastern regions of the country. This program involves the release of one egg parasitoid and three larval parasites into the host environment. The egg parasitoid, *Anaphes flavipes*, was released in two locations in Idaho in 1993, 1994 and 1997 but so far has not successfully established. More egg and larval parasite releases are planned. The larval parasitoid (*Tetrastichus julis*) has been introduced throughout the Snake River plain and has been recovered in Bonneville and Cassia counties.

There appears to be some question as to whether western CLB species are the same as those found in the midwestern and eastern states. APHIS is now considering scaling back its CLB identification and parasite rearing and release programs in order to free up resources for other priority biological control efforts across the country.

Barley Thrips, *Limothrips denticornis*

Barley thrips were first detected in the higher elevation Snake River valley in southeastern Idaho in 1990 and caused extensive damage to fewer than 40,000 acres that year. Thrips have continued to cause economic damage in that region of Idaho, particularly in drought years when plant stress has made plants more susceptible to adult and nymphal feeding.

Chemical Control

Di-sulfoton (Di-syston)—This chemical is used to control most barley insect pests in Idaho, including thrips, with use on a maximum of 10% of total barley acres. The application rate is 1 pound active ingredient per acre, with a 60-day preharvest restriction. A 15% granular formulation is used occasionally (on less than 1% of treated acreage) on barley acreage that borders rangeland that is experiencing grasshopper infestations. The same constraints apply as described in the aphid section. EPA plans to increase the re-entry interval to 3 days, and to cancel all uses in barley within 3 years.

Methyl Parathion—This chemical is used on less than 5% of the barley acreage to control Russian wheat aphids and thrips. The application rate is 0.6 pound active ingredient per acre, with a 15-day preharvest restriction. The same constraints apply as described in the aphid section.

Zeta-cypermethrin (Mustang)—IR-4 is considering this synthetic pyrethroid as an alternative to organophosphate insecticides to control barley thrips. It is already registered in wheat and is awaiting approval from EPA for use on barley.

Biological Control

There are no known biological control agents that effectively control barley thrips because of the cryptic nature of the pest. The exceptions would be general predators and other thrips species that prey on barley thrips.

Wireworms, *Limonius* spp.

Wireworms are the larval stage of click beetles whose eggs are laid in the soil during the spring. Wireworms emerge from the eggs and begin feeding on seeds and underground plant parts after they have sprouted. They are early season, spotty pests that are difficult to predict. This results in great uncertainty regarding the economic value of seed treatments, which are the only labeled chemical control. Eastern Idaho production areas will experience occasional concentrations that can cause economic loss.

Chemical Control

Imidacloprid (Gaucho)—This chemical is used as a seed treatment on less than 5% of Idaho's barley seed to control early wireworm onset. The application rate is 1 fluid ounce per 100 pounds of seed, with a 45-day pre-harvest restriction.

Lindane—This chemical is used as a seed treatment on less than 20% of Idaho's barley seed to control wireworms. The application rate is 1.3 fluid ounces per 100 pounds of seed.

Thiamethoxam (Cruiser)—This chemical is used as a seed treatment. The application rate is 0.75 to 1.33 fluid ounces per 100 pounds of seed.

Cutworms and Armyworms (several species)

Cutworms and armyworms are the larval stage of noctuid moths. The adults, eggs and pupae of these moths are similar in appearance. Adults are dusky-brown to gray miller moths and are commonly observed flying around lights during the warmer seasons. Larvae are soil-dwelling caterpillars up to 2 inches long when mature and are the only damaging stage. Cutworms either cut off stems at or below ground level or strip the foliage during the growing season.

Chemical Control

Control programs are aimed only at seriously damaging infestations because chemical control is difficult and natural enemies generally hold the populations in check. If chemical control is necessary, broadcast granular or foliar-applied insecticides may be effective. A crisis exemption was granted by EPA for lambda-cyhalothrin (Warrior) in 2003 because Idaho faced an economically damaging infestation and had no available control mechanisms. Weed control in previous crops and along field edges also aids in reducing cutworm damage.

Haanchen Barley Mealybug, *Trionymus haancheni* McKenzie

The Haanchen barley mealybug was discovered for the first time in Idaho in 2003. It has been detected in five Idaho counties: Bingham, Bonneville, Caribou, Jefferson and Madison. It feeds aggressively on barley plants of different varieties (Arabian, Harrington and Baronesse), mostly under dryland production. The first signs of mealybug presence are ovisacs (cottony clusters of eggs) at the base of the plants. Both nymphs and adults are damaging; they feed with sucking mouthparts and reduce the amount of chlorophyll in the leaves, causing extensive yellowing and browning of the foliage. In addition to direct feeding injury to barley plants, the Haanchen barley mealybug can indirectly damage the crop by producing honeydew, which has the potential to reduce grain quality and to clog combines at harvest.

Chemical Control

It is likely that the Haanchen mealybug has been present in Idaho for several years but simply went unrecognized. Outbreaks could be related to the elimination of mealybug parasitoids due to insecticide applications directed at other barley pests. The most basic elements of an integrated pest management program for this pest are lacking. Formal recommendations for field scouting do not exist, nor are there established economic thresholds. However, observational studies in the lab at Aberdeen with field-collected adult females showed that 10 mealybugs per plant can cause leaf-yellowing symptoms within a week. No insecticides currently are registered for use against this insect in barley.

Grasshoppers, *Melanoplus sanguinipes* and *Camnula pellucida*

Grasshoppers are pests of barley and other grain crops only during years when they migrate out of uncultivated areas. Usually their populations are small and their damage is inconsequential. However, during outbreak years they can defoliate barley. Outbreaks are most severe in fields that border arid rangelands that have been treated for grasshoppers; the grasshoppers then move to green barley fields and begin feeding. Eggs hatch from March to June depending upon weather conditions and grasshopper species. Nymphs resemble adults but are smaller and do not have wings; both cause economic damage. They feed on foliage, heads, and often on stems just beneath the heads, causing them to drop.

Chemical Control

Control programs need to be initiated only when populations increase and significant defoliation (10 to 15%) occurs. Strip spraying along the field margin where an infestation begins is usually adequate to prevent losses. In outbreak years, area-wide programs are more effective than field-by-field treatment for grasshoppers. EPA granted a crisis exemption for diflubenzuron (Dimilin 2L) to control grasshoppers (*Camnula pellucida*) in 2003 because the infestation had reached economically damaging levels and Idaho growers had no other pest management tools.

Stored Grain Pests

Lesser Grain Borer, *Rhyzopertha dominica*

The lesser grain borer attacks a variety of stored small grains. Both the larvae and the adults are pests; adults bore into the kernels and the larvae develop inside the grain. Prevention of lesser grain borers, as well as of other stored grain insect pests, includes maintaining well-aerated, low-moisture, low-temperature grain bins. Temperatures below 60°F slow the reproduction, feeding and subsequently the survival of insect pests. It is imperative to clean grain bins, trucks and other equipment through which grain passes or in which it is stored. Old grain, broken kernels, dirt and grain mixed with green weed seeds encourage stored grain pests and should be separated from new grain prior to storage. Inspecting grain once a month also ensures that pest problems are not well-developed before control measures can be implemented.

Chemical Control

Chlorpyrifos-methyl and Cyfluthrin (Storcide)—Storcide is used to fumigate grain, bins and warehouses to protect against lesser grain borer. The use of this insecticide is permitted only if the stored barley is intended for domestic use; barley fumigated with Storicide or stored in bins that have been treated with Storcide cannot be exported. Additionally, stored malting barley cannot be directly fumigated with Storcide, though it may be stored in grain bins that were treated with Storcide prior to storage. Not more than one application should be made to stored seed or to an empty grain bin.

Weeds

A University of Idaho integrated pest management survey of Idaho grain producers in 1997 revealed that 98% regularly used herbicides to control weeds in cereal crops. According to a 1993 USDA/NASS survey of barley chemical usage in Idaho:

- Eighty percent of herbicide applications on barley are made after weeds emerge. Eighty-seven percent of malting barley applications are made after emergence, compared with 74% for feed barley.
- Forty-nine percent of the barley producers applied herbicides early to reduce the amount of chemical used.

Weed control in irrigated spring barley is critical for grain yield and crop quality. Wild oat (*Avena fatua*), kochia (*Kochia scoparia*), common lambsquarters (*Chenopodium album*), redroot pigweed (*Amaranthus retroflexus*) and various mustards are the annual weeds commonly found in irrigated barley. Canada thistle (*Cirsium arvense*) and quackgrass (*Agropyron repens*) are the most common perennial weeds.

Successful and economical weed control depends on the integration of the best cultural and chemical control strategies. Cultural practices include rotating crops, maintaining field borders free of weeds, planting weed-free barley seed into properly prepared seedbeds and using agronomic practices that promote a healthy, competitive crop.

Chemical Control

Correct identification of weed species is necessary for proper herbicide selection, application rate and timing. A 1993 USDA/NASS chemical survey determined which herbicides are most commonly used to control annual and perennial weeds in Idaho barley (based on 770,000 acres of production) (table 1). The survey results were reconfirmed in a 1998 Idaho Barley Commission survey of more than 200 Idaho barley producers.

The majority of these herbicides are applied for broadleaf control. Due to varying climatic conditions and crop rotation restrictions, many of these herbicides are not available or are not effective on barley grown in some areas of Idaho. This is particularly true for wild oat control products. For example, difenzoquat (Avenge) is not effective by itself in several barley production areas. Imazamethabenz (Assert) cannot be used in many areas due to rotation concerns, and weeds will develop resistance if triallate (Far-Go) is used exclusively, as documented recently in barley fields in eastern Idaho. Fortunately, two new herbicides have recently been registered for wild oat (and other annual grasses) control in barley. Fenoxaprop (Puma) and tralkoxydim (Achieve) can be used post-emergence when barley plants are still small.

Table 1. Herbicide use in Idaho barley.

Chemical	**Acres treated** (%)	**Rate** (active ingredient per acre)
Thifensulfuron + tribenuron (Harmony Extra)	14	0.36 oz
2,4-D	24	0.8 lb
Triallate (Far-Go Granular 10)	9	1.0 lb
(Far-Go 4EC)	8	1.0 lb
Imazamethabenz (Assert 2.5 EC)	7	0.47 lb
MCPA	8	0.6 lb
Bromoxynil + MCPA (Bronate 4EC)	7	0.8 lb
Difenzoquat (Avenge 2L)	3	0.8 lb
Clopyralid + 2,4-D amine (Curtail 2.4EC)	2	0.65 lb
Tribenuron (Express DF)	2	0.25 oz
All other herbicides	16	

Source: 1993 USDA/NASS Chemical Survey

Diseases

Disease control in barley depends largely on preventive measures. Chemical controls for most barley diseases are either unavailable or not economically feasible after infection has occurred. Crop rotations that reduce inoculum levels, early seeding dates, tillage operations that fragment crop residues and encourage decomposition, pathogen-free seed and disease-resistant varieties reduce the impact of disease on barley production in Idaho.

At least 20 diseases can affect Idaho barley. The most common diseases are barley stripe rust (new), barley yellow dwarf, bacterial leaf streak, scald, powdery mildew and common root rot. According to the 1993 NASS chemical usage survey, 77% of barley seed planted in Idaho is treated (table 2).

Barley Stripe Rust

Barley stripe rust (BSR) is a relatively new disease that was introduced into the state in 1993. It has the potential to cause large economic losses due to the susceptibility of commercially available barley varieties. BSR is caused

Table 2. Seed treatments for Idaho barley seed (used on 77% of Idaho barley seed).

Thiram + carboxin (Vitavax 200)	most common
Tebuconazole + thiram (Raxil-Thiram)	
Thiram (42S)	
Captan	less than 5%
Imazalil	less than 5%

by the fungus *Puccinia striiformis* f. sp. *hordei* and is spread by windblown spores.

Producers have been encouraged to employ specific crop management strategies to avoid heavy BSR infections and yield losses. These strategies include planting earlier and using seed treatments in highly vulnerable areas, using optimal seeding rates and nutrients to avoid overly dense foliage, scheduling irrigation to avoid overwatering and to achieve deep irrigation wherever possible to stretch out intervals, and scouting fields frequently throughout the growing season for orange-yellow striped barley leaves. In western regions, six row barley is more susceptible to foliar diseases than two row barley. Idaho released a new feed barley variety in 1996 that exhibits BSR tolerance.

Chemical Control

Azoxystrobin (Quadris)—This is a newly registered fungicide available to Idaho barley growers.

Propiconazole (Tilt)—This fungicide is available for use on barley through the late jointing stage only. It is used on less than 5% of Idaho barley.

Pyraclostrobin (Headline)—Headline is a recently registered fungicide that can be used if rust severity is greater than 5%. Applications are targeted to protect the flag leaf stage but should not be made later than 50% head emergence.

Tebuconazole (Folicur)—Folicur is a new fungicide that is currently awaiting risk assessment and approval by EPA. Once registered, it will provide later season control of BSR, particularly during the boot to milk stages.

Triadimenol (Baytan)—This is a seed treatment that provides good early season protection but does not provide control all season. It is used on less than 3% of Idaho barley.

Barley Yellow Dwarf

Barley yellow dwarf (BYD) is usually not a significant disease threat to spring-planted barley, but insecticide seed treatments are used in cases of serious aphid infestations for vector control. Gaucho is used on less than 3% of planted barley seed.

Scald

Chemical control is occasionally needed if severe infections are detected in early plant growth stages. Propiconazole (Tilt) is labeled but used on less than 5% of barley acreage.

Powdery Mildew

Some barley varieties show resistance against this disease for which chemical controls are not recommended.

Rodent Pests

Rodent pests, such as meadow voles (*Microtus* spp.) and field mice (*Peromyscus* spp.) are common pests of barley grain and barley hay.

Chemical Control

Zinc Phosphide—Zinc phosphide has been used in Idaho under a Section 18 exemption since 2000, including a crisis exemption for barley, wheat, sugarbeets and potatoes in 2003 (June 2 to October 1). A maximum of two applications are allowed per season with a maximum rate of 0.12 pound active ingredient per acre.

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IDAHO CROP PROFILES

Barley

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This publication is also available at http:// info.ag.uidaho.edu/pdf/cis/cis1096.pdf

Using Pesticides

Pesticide Residues—Any recommendations for use are based on currently available labels for each pesticide listed. If followed carefully, residues should not exceed the established tolerances. To avoid excessive residues, follow label directions carefully with respect to rate, number of applications, and minimum interval between application and reentry or harvest.

Groundwater—To protect groundwater, when there is a choice of pesticides, the applicator should use the product least likely to leach.

Trade Names—To simplify information, trade names have been used. No endorsement of named products is intended nor is criticism implied of similar products not mentioned.

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