ances could be spelled out. The tolerance petitions from industry are based on scientific evidence and in many cases manufacturers found that they were in need of additional scientific data to support their petitions to FDA. Some manufacturers have probably not yet completed processing their scientific data for presentation to FDA. In addition to the problem of accumulation of scientific evidence there has been the normal, or natural, problem associated with any new government-industry project: how is it going to work? The forms and procedures for filing petitions had to be worked out, and it required a certain amount of "shaking down" for a routine to be established.

Certification of usefulness, responsibility of USDA, has not proved to be difficult. USDA has generally been able to certify the usefulness of a specific chemical based on evidence presented for registration under the Federal Insecticide, Fungicide, and Rodenticide act. The FDA on the other hand has had the fundamental problem of determining whether or not the tolerance proposed by the manufacturer reasonably reflects the amount of residue likely to result from the proposed use of the chemical.

In many cases there has not been sufficient residue data on a particular crop use to serve as a sound basis for quantitative estimates of the amounts likely to be encountered. Where there is no data on the amount of residue likely on a particular crop, results on other crops of the same family can sometimes be transferred to related crops.

There has, apparently, been a certain amount of shifting and modification in the requirements regarding residue data on the tolerance petitions. Originally FDA wanted experimental data on residues resulting on crops grown under different climatic conditions, however in cases where manufacturers have been unable to supply experimental data they have interpolated results from one region to predict climatic differences in residue.

Another problem has been the tendency of manufacturers to propose tolerances on the basis of comparative toxicology—petitioners have asked for a tolerance based on that previously established for a chemical with the same order of toxicity, with no consideration of differences of application rates or residues likely to result.

Another problem but perhaps not completely understood is that the FDA by the tolerance procedure is, in effect, certifying that pesticides are safe for use on food. The fundamental responsibility of FDA is to the consumer of the agricultural commodity. But residue tolerances could also serve as a useful evidence for the pesticides industry to rebut those who claim it is poisoning our food.

Continuous drainage of fields is necessary on many farms. Ditches are often choked with cattails, which catch debris, impeding drainage. Formerly, ditch would have to be re-excavated, at great expense, leaving banks of mud

Water Weeds

Costly problem over large areas has had relatively minor attention. New products now appearing, but many answers remain to be found

Aquatic weeds, expensive nuisances, have been plaguing the coastal and irrigated areas of the country so long they are accepted in some quarters as a problem that has to be lived with. But chemical control is possible and is in use. Producers of agricultural chemicals are becoming much more visibly aware of the potential rewards lying in the bullrushes.

Expense to irrigation farming appears to be the biggest area of loss. Some years ago the Bureau of Reclamation estimated the annual losses in the 17 western states at $25 million. Weeds not only prevent proper quantities of water from reaching the crops, but they can seriously disrupt drainage systems, collect silt, increase evaporation losses, and, by raising the water level, markedly accelerate water losses by overflow and seepage.

In the Gulf and Atlantic Coast states, especially Louisiana and Florida, water hyacinth is the predominating nuisance, particularly in water control canals and in navigation channels, where weeds can reduce flow capacities by as much as 50%. Stagnation of water is increased, and swimming, fishing, and boating are obstructed if not completely prevented.

Varieties Complicate Problem

The problem of aquatic weed control is complicated by the fact that the weeds fall into several categories, each of which may require special methods of handling. One variety consists of submersed or submerged weeds (coontail, naiad, pondweed) which grow entirely under water. Another type includes the emergent or emersed weeds (cattail, water sedge, alligator weed) which although rooted in the soil, extend above the water's surface. The surface or floating aquatics (water hyacinth, water primrose, water lettuce) that move about freely with the surface currents comprise a third type. Also widely prevalent are ditchbank weeds (cotton wood, Johnson grass, water hemlock) that grow rife along the edges of the water.

Control of submersed weeds can be a ticklish problem since it may involve injecting a chemical into a large volume of water, where its effectiveness may depend on the turbulence and velocity of the water, its temperature, salt content, and other factors. And the possibility that the weed killer may be hazardous to fish, wild life, or farm crops must be considered.

One of the most widely employed agents in the control of submersed weeds is aromatic solvent mixtures, often containing a high percentage of methylated benzenes in addition to an emulsifier. The fish problem is distinctly secondary

Irrigation ditches present two problems—water weeds that clog and a tendency to transport seeds of land weeds to uninfested crops

and these solvents cause no important injury to farm crops. Thus they find widespread application in the irrigation waters of the West. Perhaps the simplest solvent type material is gasoline mixtures.

Also used extensively to control submersed weeds in irrigation water are mixtures of chlorinated benzenes, usually the di- and trichloro compounds. Polychlorobenzenes also find use.

On the other hand, where the saving of fish is imperative, such as in fish hatchery ponds, sodium arsenite often is used in concentrations of about 4 p.p.m. (fish will tolerate up to about 12 p.p.m.). Rosin amine D acetate, which originally made a name for itself agriculturally in the control of algae, is effective in fish ponds.

When it comes to the control of emergent, floating, or ditchbank weeds, dramatic results have been obtained with 2,4-D, usually used in the amine form because of its lower hazard to sensitive crops. In the eradication of water hyacinth enough 2,4-D is ordinarily sprayed on by airplane or by boat—or truck-mounted equipment so that weeds are not only killed but sufficiently macerated to sink within a few weeks. Emergent, floating or ditchbank weeds can also be controlled with 2,4,5-T, sodium TCA (sodium trichloroacetate), sodium arsenite, and ammonium sulfamate.

Newer Herbicides

Actually, most of the aquatic herbicides now in use have been known for at least five years. However, some new materials being tested show promise.

Tests in Massachusetts, Connecticut, and New Jersey indicate that Naugatuck's Phygon (2,3-dichloro-1,4-naphthaquinone) is useful against various rooted aquatic weeds. Du Pont's Karmex W (a formulation containing CMU or 3 - [*p* - chlorophenyl] - 1,1 - dimethylurea) gives outstanding results in the control of weeds on irrigation and drainage ditchbanks. Dow's dalapon (the sodium salt of 2,2-dichloropropionic acid) is effective in controlling cattail and giant reeds that infest drainage ditches and other water channels. Because of its special promise, American Cyanamid's amino triazole (3-amino-1,2,4-triazole) is being carefully tested.

Although mechanical procedures, such as dredging or dragging a chain to break the weeds, are sometimes less expensive when it comes to controlling weeds in large volumes of water, the use of chemicals is generally much more economical, especially where small canals are involved. United Gas Pipe Line found that use of 2,4-D instead of conventional mechanical methods permitted a 92% saving in the cost of removing water hyacinth in waterways of southern Louisiana. Chemicals ordinarily give quicker, better, longer lasting results, besides permitting control in areas inaccessible to mechanical weed-killing equipment.

Even with promising new agents coming along, there are tough problems left. No effective chemical except sodium arsenite, which is highly poisonous to warm-blooded animals, is cheap enough for use in large volumes of water. All herbicides in use for irrigation ditches are too costly for general use except where carload lots are required. Chemicals now available kill only leaves and stems, which means temporary control; something better is needed to kill roots and tubers. Effective agents that will not harm fish will find a good market, as would better agents for killing weeds in irrigation ditches without harming crops.

Demand is mounting from crop growers, sportsmen, conservationists, legislators, and others. Use of effective chemicals certainly is in for an increase and the leveling-off point doesn't seem to be in sight.

Advantages and Disadvantages of Some Leading Aquatic Herbicides

Chemical	*Advantages*	*Disadvantages*
Aromatic solvents	Acute toxicity to aquatic weeds within short contact time Not toxic to crops irrigated with treated water at concentrations used against water weeds Not toxic to farm livestock or wild game Less expensive than chlorinated benzenes	Extremely toxic to fish and other aquatic animals Low specific gravity makes chemical relatively ineffective in static water Some fire hazard involved
Chlorinated benzenes	High specific gravity makes these materials effective where aromatics are ineffective Not flammable	Too expensive for extensive use Extremely toxic to fish Toxic to some crops irrigated with treated water
Mixtures of gasolines and polychlorobenzenes	Much less expensive than pure benzene derivatives	Require relatively long exposure time and thus not effective in fast moving water Toxic to fish Fire hazard necessitates special application equipment
2,4-D	Relatively inexpensive Easily applied Not toxic to fish or warm-blooded animals	Hazards to sensitive crops from drift Effective only on floating and emergent species but not on submerged water weeds
Sodium arsenite	Inexpensive Effective against many submersed water weeds at concentrations not harmful to fish	Poisonous to humans and warm-blooded animals
Rosin amine D acetate	Effective against water weeds, algae at concentrations not toxic to fish	Not effective in hard waters containing high concentrations of some salts