

Chapter 1 Weed Science and Weeds

Discuss weed science as compared with other disciplines; is weed science a discipline?
Compare with entomology and plant pathology

Weed Science → relatively new area

Bible makes references to weeds/undesirable plants

1940 - start of Weed Science with the introduction of the herbicide 2,4-D [2,4-dichlorophenoxyacetic acid]

Pokorny - developed 2,4-D; has growth regulating properties; used in grass crops for broadleaf weed control

Dr. John B. Baker, LSU in 1952 was one of the first to evaluate 2,4-D in rice

Two Universities have Departments where “Weed Science” is in the department name:

New Mexico State University - Department of Entomology, Plant Pathology, and Weed Science

Virginia Tech University (formerly Virginia Polytechnic Institute and State University - VPI) - Department of Plant Pathology, Physiology, and Weed Science

Most of time Weed Scientists are housed in Agronomy or Plant and Soil Sciences Departments

Weed Science - study of ecology, life cycle, and management of weeds

Ecology - relationship between weeds and the environment in which it is grown

Management of weeds; “squirt and rate” or “spray and pray”

Many people have no appreciation for weed science yet, weeds are the major pest problem limiting production of most crops

Definitions of Weeds:

“A plant out of place or growing where it is not wanted.” Blatchley 1912
e.g. a cotton plant in a corn field would be considered a weed

“A plant that is growing where it is desired that something else shall grow.” Georgia 1916

“These obnoxious plants are known as weeds.” Robbins et al. 1942

“Those plants with harmful or objectionable habits or characteristics which grow where they are not wanted, usually in places where it is desired that something else should grow.” Muenscher 1946

“Higher plants which are a nuisance.” Harper 1960

“A plant growing where we do not want it.” Salisbury 1961

“A plant growing where it is not desired; or a plant out of place.” Klingman 1961

Other Non-Weed Scientist Definitions:

“A plant whose virtues have not yet been discovered.” Emerson 1912

“Weeds have always been condemned without a fair trial.” King 1951

“Herbaceous plant not valued for use or beauty, growing wild and rank, and regarded as cumbering the ground or hindering the growth of superior vegetation.” Oxford English Dictionary 1973

“A weed is but an unloved flower.” Unknown

Weeds as Pests:

Weeds are classified as pests along with insects, diseases, and nematodes

In 1991, estimated average annual monetary loss caused by weeds in 46 crops grown in the U.S. was 4.1 billion.

Some "weeds" are useful, e.g., dandelions - sheep - New Zealand, but in most cases weeds have a negative connotation

Weeds affect everyone in some way

Weed with absolutely no use:

Poison ivy - allergic reactions

Ragweed either giant or common - lots of pollen, allergies, hay fever

Weeds that are not always weeds:

- Garlic - spice, but also a problem in wheat (garlicky wheat)
- Bermudagrass - major forage crop and turf species, but also a major weed problem in many crops
- Johnsongrass - forage crop, but a major weed problem in crops and roadsides
- Morningglory - ornamental used by home owners vs. weed in crops

- Huisache (pronounced wee-sach) - Austin, TX a shade tree similar to a mesquite bush but major problem in South Texas rangelands
- Kudzu - introduced in the U.S. at the 1876 Centennial Exposition in Philadelphia, PA in the Japanese exhibit; Kudzu is corruption of kuzu (koozoo); used for soil erosion control and for livestock forage; grows over a foot a day; tremendous problem along Highway 61 in Louisiana and Mississippi where it covers power lines and trees

Weeds can be classified as:

Annuals – completes life cycle in one year (i.e., germinates from seed, grows, flowers, produces seed, and dies in the same season); summer and winter annuals

Biennials – produces leaves and stores food the first year (vegetative), and produces fruits and seeds (reproductive) the second year; completes life cycle in less than 2 years (examples include wild carrot, bull thistle, common mullein, plantains)

Perennials – lives from year to year; in most cases, in cold climates, stem and foliage die, but roots persist; does not depend on seed production for survival but produces rhizomes, stolons, tubers, fleshy roots, etc., that store food reserves for regrowth (examples include field bindweed, dandelion, Canada thistle, johnsongrass, bermudagrass, nutsedges, leafy spurge)

History of Weed Control

10,000 B.C. - hand labor, substituted fingers with a sharp stick to remove weeds; Centuries later metal hoe developed

1000 B.C. - Animals used in cultivation (horses/oxen)

100 A.D. - Romans used sea salt as a herbicide (first herbicide)

1731 - Jethro Tull wrote a book on "Horse-Hoeing Husbandry". He advocated planting crops in rows to allow horse to pull a plow to "hoe out" weeds, i.e., plow the middle out

1908 - Bolley in the U.S. selectively controlled winter annual weeds with table salt (NaCl), iron sulfate, copper sulfate (CuSO₄), and sodium arsenite. This was a selective weed control procedure, a major breakthrough. He stated:

“When the farming public has accepted this method of attacking weeds ... the gain to the country at large will be much larger in monetary consideration than that which has been afforded by any other single piece of investigation applied to field work in agriculture.”

1920 - Started using tractors substituted for mules

1941 - 2,4-D synthesized providing selective control of certain broadleaf weeds in grass crops.

1944 - Selectivity and use of 2,4-D postemergence in turf was reported (Marth and Mitchell in U.S.) - dandelion and plaintain and other broadleaf weeds

1945 - Principle of preemergence selective weed control was established (Templeman in England)

1950 - 25 herbicides available for public use

1956 - Weed Science Society of America established

1960's - Preemergence herbicides trifluralin (Treflan) and atrazine labeled. Use example of teaweed (prickly sida/iron weed control). This weed not a problem in cotton until Treflan was used. Some farmers thought teaweed seed came in the Treflan can and were observed to strain Treflan through cheese cloth to remove teaweed seeds. This occurrence was due to the removal of grass competition with the herbicide providing space for the teaweed to flourish.

1970's - glyphosate (Roundup) labeled as preplant nonselective herbicide

1980's - overtop grass herbicides, sulfonyleurea and imidazolinone herbicides labeled

1990's - transgenic herbicide resistant crops available

Weed science has progressed more in the last 50 years that in the previous 100 centuries especially so in the last 20 years (I have been fortunate to be a part of that period of change)

Corresponding Changes in Efficiency of Agriculture

| | |
|---|-------|
| 10,000 B.C. - one farmer fed one Person | 1X |
| 1000 B.C. - doubles food production | 2X |
| 1731 - Tull's book doubled production again | 4X |
| 1920 - doubled again, fed 8 people | 8X |
| 1940 - doubled production again | 16X |
| 1980 - one person fed 38 | 38X |
| Today - over 180 herbicides | >100X |

Banning of pesticides is in the limelight; discuss rigorous registration process required by EPA

New products may take 8-12 years to develop at a price of 80 million dollars

Address the organic agriculture issue in regard to food safety, yield limitations, etc.

Americans spend 10-15% of their expendable income for food

Japanese spend 40-50% of their income for food

Africa - Weeds - AIDS: Weeds may have a greater effect on human survival that the AIDS virus (T or F); witchweed, a parasitic weed, can completely devastate a corn crop

Weed Development over Time

Plant succession - an orderly change in plant community over time

Climax vegetation - the highest level of vegetation that an area will support

Following land disturbance, annual and perennial herbaceous plants are the first stage in plant succession

Louisiana climax vegetation would be hardwoods, oak, hickory, etc. (deciduous forests)

In Iowa the climax vegetation would be short/tall grass prairies, black/fertile soils

In the north western states - conifers

If you abandon land over time it will revert back to the climax vegetation. The normal succession would be:

Annuals → Perennials → Short woody shrubs → Bushes → Trees

Farming practices disrupt the normal plant succession, i.e. with farming we are fighting a normal progression toward a climax vegetation and we are maintaining the plant community at early succession stages.

With the shift toward no-till or reduced till practices weed shifts have occurred with more perennial weeds becoming problems

World's worst weed – **purple nutsedge** (Holm et al. 1977)

Why is purple nutsedge considered the world's worst weed? It is a serious competitor in more crops and in more countries worldwide than any other weed

Purple nutsedge - propagates from tubers (not seed) – a single tuber produced the equivalent of 3.1 million plants per acre and 4.4 million tubers per acre during a full season of growth

Growth process of purple nutsedge - tuber sprouts and produces a vertical rhizome and shoot. The shoot forms a basal bulb and emerges from the soil. The basal bulb produces rhizomes from which new plants originate. Rhizomes produce multiple tubers (dark, shaggy-looking) in a chain rather than singly as in yellow nutsedge

Yellow nutsedge - propagates from both tubers and seeds – a single tuber produced 146 tubers within 14 weeks after planting, infesting an area 6.5 ft in diameter, equivalent to a yield of 8.9 tons/A of new tubers. During the first year of growth, this single tuber was responsible for the development of 1,918 plants and 6,864 tubers

Growth process of yellow nutsedge - tuber sprouts and produces a vertical rhizome and shoot. The shoot forms a basal bulb and emerges from the soil. The basal bulb produces rhizomes from which new plants originate. Rhizomes can also produce new tubers, but in all cases only a single tuber (smooth, light-colored) is produced per rhizome.

Direct/Indirect Effect of Weeds

1. Competition with crops for light, nutrients, water, and space

Mother Nature: "**The most aggressive plant species survives**"; survival of the fittest, i.e. the one that gets the head start will be more competitive and more efficient at utilizing available resources

Weeds are naturally strong competitors otherwise they would not be weeds

Of the crops, corn is 4x more competitive with weeds than soybean, which is 4x more competitive than cotton

This is why preemergence herbicides are especially important in cotton production to give the crop a head start

Ragweed plant needs 3X as much water as corn

Wild mustard vs. Oats

2X – N and P uptake; 4X - K uptake; 4X - H₂O uptake

In general crops have been bred for yield **not** competitiveness

Direct/Indirect Effect of Weeds (continued)

2. Decrease animal yield - decreased forage production and quality e.g. smutgrass in pastures
3. Hosts for diseases and insects - wild oats host for black stem rust in wheat, oats, barley and weed hosts for aerial blight in soybeans
4. Lower quality of harvested product - increased moisture, foreign matter, etc.
5. Poor field drainage - alligatorweed in bayous and poppingweed (Equisetum sp., scouring rush) around sugarcane fields
6. Human poisoning, dermatitis, and allergies - poison ivy, etc.