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Global Crisis of Weed Resistance to Herbicides

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ABSTRACT: In this paper, at first was introduced a short history of herbicide-resistance weeds in many agricultural products. Then, the main types of herbicide-resistance weeds in Iran and in various parts of the world was studied and compared. About 30 years ago, for the first time, the resistance of weeds against the Triazine herbicide is reported. This report was a prologue to the next researches in the examination of intricate mechanism of herbicide resistance weeds against crops. According to the diversity of weeds and various ecosystems in various parts of the world, there is not a unique solution for suppressing the herb weeds. Close cooperation among agricultural academies, industry and farmers is an essential tool for achieving the unique management strategy for the control of herbicide-resistance weeds.

Keywords: History of Herbicide – Agricultural crop – Weeds Control - Triazine

INTRODUCTION

Farmers always face problem of weed resistance to herbicides in the farms. Weed control technique was started since thousands years ago by weeding by hand and gradually later agricultural tools and machinery were also used so that finally it led to biological and chemical control.

In 1347 the first 2,4 – dichlorophenoxy and MCPA herbicides were produced which had considerable effects on increasing agricultural crops trend (Avery, 1995). Using herbicides in consecutive years and competition between agricultural varieties caused that population of Short leg yielding crop varieties was increased (Piment, 1997).

Insecticide, fungicide and bacteria before weeds were resistant to herbicides. Weed resistance to herbicides is because of the durability and stability of pesticides in the environment and mutations in the weeds (Roush and Mac kenize, 1987).

Constant use of the herbicide against population of weeds causes resistance in them. The initial herbicides widely used were 2, 4 – dichloro phenoxy and MCPA. These herbicides are among Auxins which create resistance in weeds in long term exposure (Gressel and Byron, 1992).

A. Review of Weeds Resistant to Herbicides

Prior to 1989 there were a few quantitative reports on resistance of weeds to herbicides and it was less considered by the scholars. The first resistance of weeds to Triazine herbicides was observed in 1960 in Washington State in USA. In this case, *Senecio vulgar* is plant showed resistance to Triazine (Hoim *et al.,* 1997). It was a start for a new period in discussion of herbicides under title of weeds resistance. If resistance to Triazine was not controlled, weeds were quickly multiplied and significant damage would incur on the farms (Machado, 1982; Scott and Putwain, 1981).

In 1976, Radosevich could separate chloroplast of *Senecio vugar* is resistant to Triazine and found that in presence of Simazine, it is able to consistently perform photosynthesis. They also reported that resistance to Triazine is due to change in the location of the target (Radosevich and Appleby, 1973). In 1980, 32 weeds resistant to Triazine were introduced (26 Dicotyledonous species and 6 Monocotyledons species). In 2009 in an international estimate in 47 countries, 339 types of weeds belonging to 189 species were introduced including 113 Dicotyledonous species and 76 Monocotyledons species (Heap *et al.,* 2009). Table 1 gives the number of weeds resistant to herbicides in different corps.

Table 1: Number of weeds resistant to herbicides in different corps.

Crop	Number of weeds resistant to herbicides
Wheat - barley	57
Corn	50
Rice	24
Soybean	22
Cotton	5
Sugar beet	4
Vegetables	23
Clover and alfalfa pastures	16

(Heap *et al.,* 2009)

B. Types of resistant weeds in important crops in the world

Wheat. Fifty-seven species of weeds resistant to herbicides have been reported in wheat and barley farms. Grasses are resistant to Accase inhibitor herbicides and Dicotyledonous resistant to ALS inhibiting herbicides. These are two classes of weeds resistant to herbicides in wheat and barley farms. Resistance of different species of Ayena to Accase inhibitor herbicides is observed in almost wheat and barley farms of different parts of the world. 24 biotypes of existing weeds in wheat and barley farms show resistance to ALS inhibiting herbicides. *Kochia scoparia* and *Salsola iberica* invade 60 percent of northern farms of USA (Heap *et al.,* 2009).

Rice. *Echinochloa* is one of the common weeds in rice farms. This specie resists against various groups of herbicides (Leath *et al.,* 1999).

Two types of gali and *Echinochloa colona* and *Echinochloa crus-gali* showed resistance against propanil herbicides in USA (Carey *et al.,* 1997). E-Phyllopogon and E-orzoides show resistance to several groups of herbicides including Molinat and Tiobenocarb and propanil, etc. (Fischre *et al.,* 2000). Some herbicide-resistant weeds in rice farms in different points of the world are as follow: *Plantago aquatica* and *Cyperus difformis* and *Sagittaria montevidensis* in Australia and USA, and Lindernia in Asia (Hung and Gressel, 1997).

Corn. There are 50 types of weeds which are resistant to herbicides in corn farms of the world, 11 types of which show resistance to herbicides of Triazines group. *Chenopodium album* and *Amaranthus* SP show resistance in 18 countries of the world toward Triazines herbicides and provide various problems for farmers.

Various types of *Amaranthus* show resistance alternatively to Triazines and ALS inhibitors (Gressel, 1996).

Soya. Twenty-two types of weeds resistant to herbicides have been reported in soya farms. 16 types of herbicide are resistant weeds are resistant to ALS inhibitors. Corn farms of South America and farms of western parts of America are susceptible to invasion of *Amaranthus* SP which shows resistance to ALS inhibitors (Gressel, 1996).

C. Main herbicide resistant weeds

Monocotyledonous weeds that are resistant to herbicides from several groups are shown in Table 2. Main Dicotyledonous weeds resistant to herbicides are given in Table 3.

Table 2: Main Monocotyledonous weeds resistant to herbicides.

No.	Scientific name of weed	Number of resisted herbicides	Number of countries invaded by weeds
1	*Echinochloa crus- galli*	6 groups	10 countries
2	*Lolium rigidum*	8 groups	12 countries
3	*Poaanua*	6 groups	9 countries
4	*Alopecurus myosuroides*	5 groups	10 countries
5	*Avena fatua*	6 groups	15 countries

Table 3: Main Dicotyledonous weeds and number of invaded countries.

No.	Scientific name of weed	Number of countries invaded by weeds
1	*Chenopodium album*	18 countries
2	*Amaranthus retroflexus*	15 countries
3	*Conyza canadensis*	14 countries
4	*Senecio vulgaris*	12 countries
5	*Solanum nigrum*	12 countries

Overall species of *Amaranthus* show resistance to types of herbicides. For example, in most cases, they show resistance to herbicides of group of urea Triazine, Dinitroanilines and ALS inhibitors. Currently weeds of *Kochia scoparia* and *Salsola iberica*, which include a wide area of northern parts of USA are resistant to herbicides of ALS inhibitors (Heap *et al.,* 2009)

D. Most important herbicide-resistant weeds in Iran

According to International Weed Science Society, 6 species of weeds resistant to herbicides have been reported in Iran, which are all from monocotyledons of grass family (Graminae). Table 4 indicates scientific and Persian name of weeds, group of resistant herbicides, farms with weeds, and number of countries invaded by weeds and lands invaded by weeds in Iran and world.

Table 4: Herbicide-resistant weeds in Iran.

No.	Number of countries invaded by weeds	Hectares resistant to herbicides in world	Hectares resistant to herbicides in Iran	Invaded product	Group of resistant herbicides	Persian name	Scientific name of weed
1	10	>10000000	1000	Wheat	Inhibiting cycle of acetyl Coenzyme A	Hollow oat – hollow Oatmeal	*Avena fatua*
2	1	10	10	Wheat	Ethyl Acetate inhibitor	oat – Oatmeal	*Avena strilis*
3	5	>140000	50	Wheat	Inhibiting cycle of acetyl Coenzyme A	oat – Oatmeal	*Avena strilis*
4	4	>120000	100000	Winter wheat	Inhibiting cycle of acetyl Coenzyme A	Iranian oat	*Avena ludoviciana*
5	13	>2500000	500	Winter wheat	Inhibiting cycle of acetyl Coenzyme A	Fragile Ryegrass	*Lolium rigidum*
6	6	>2000000	200	Wheat	Inhibiting cycle of acetyl Coenzyme A	Canary seed	*Phalaris minor*
7	5	>22000	500	Winter wheat	Inhibiting cycle of acetyl Coenzyme A	Unusual canary seed	*Phalaris paradoxa*

(Heap *et al.*, 2009)

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