

## 28. HERBICIDES – MODE OF ACTION – CLASSIFICATION OF ORGANIC HERBICIDES CHARACTERISTICS –

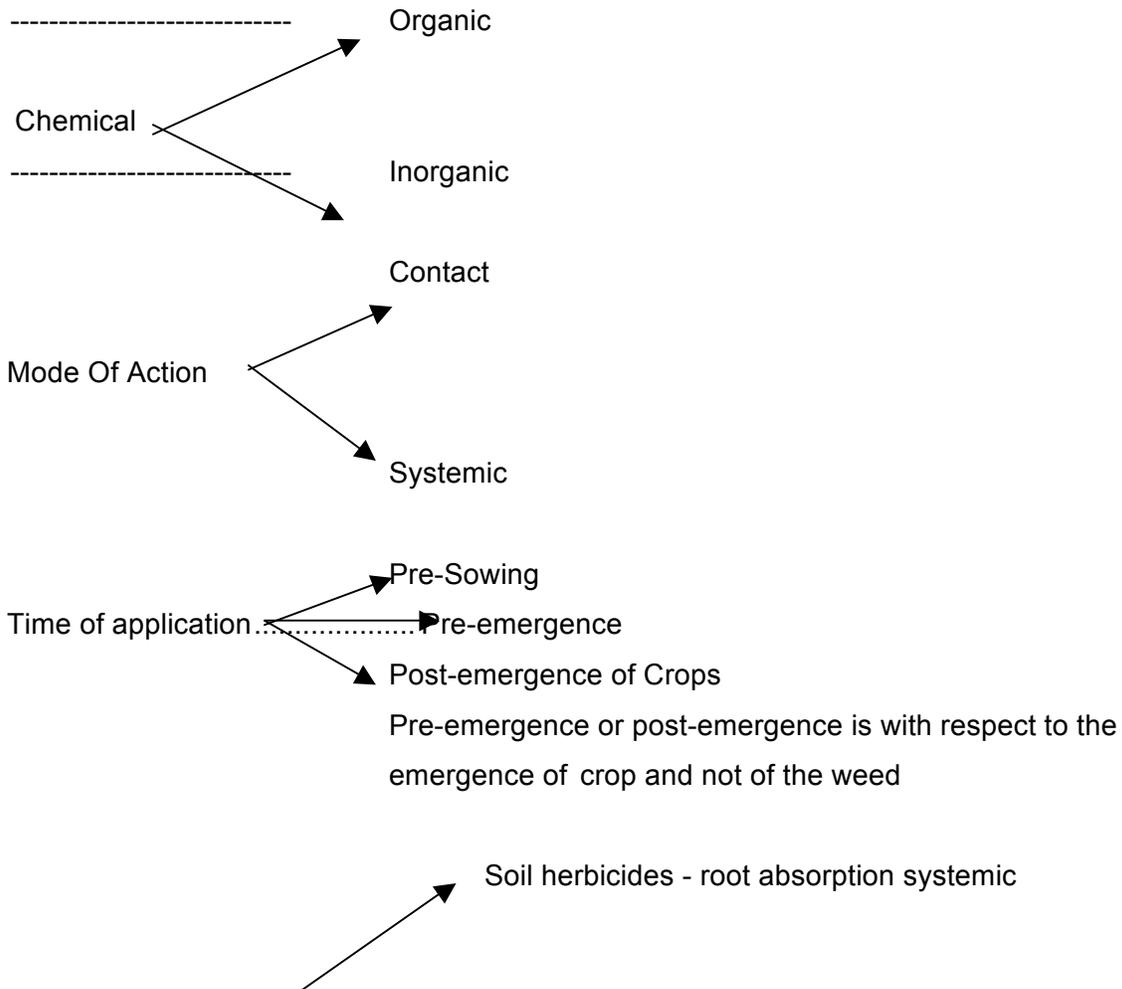
### Introduction

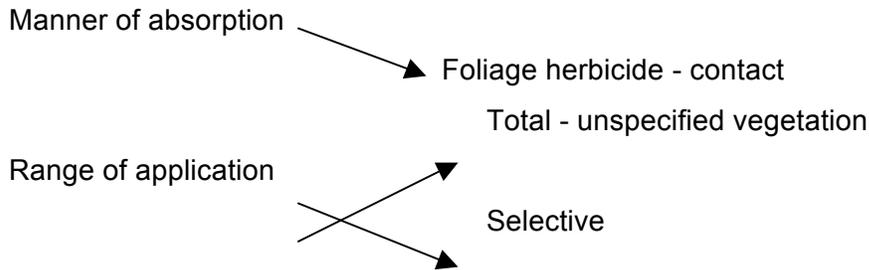
A herbicide in the broadest sense is any compound that is capable of killing or severely injuring plants and may be used for elimination of plant growth.

A weed is an plant, wild or cultivated that is undesired in that particular place. In Agriculture and horticulture weeds are thus any ant other than the specific crop being grown. On railway tracks, industrial sites, air port paths, open spaces and the like the entire vegetation can be regarded as weeds.

Weeds are conveniently divided into dicotyledonous plants, termed broad leaf weeds and monocotyledonous plants, termed grass weeds. Weeds completed with plants for water, light, food and above and below the surface. The yield loss due to weeds is estimated to be 9-10%. Also herbicide economies or helps in crop production by reducing the cultural operations.

Herbicides may be classified based on one or more common characteristics such as chemical composition or mode of action or time of application etc.





### **Aromatic-Carboxylic**

a) 2, 4-D : 2,4-Dichlorophenoxy acetic acid

LD<sub>50</sub>: 375

2, 4-D can be used for destruction of dictotyledonous plants and it is well tolerated by many monocotyledonous crop plants.

2, 4-D is used as a selective herbicide particularly in cereals. The great advantages are cheap manufacture and relatively low mammalian toxicity. It is a systemic herbicide.

b) 2,4,5, T : 2,4,5, Trichlorophenoxy acetic acid

LD<sub>50</sub>: 500

2,4,5, T has particularly high activity against woody plants and usually used in combination with other herbicides for control of trees, shrubs and control of otherwise intractable broad leaf weeds.

Structural analogues of IAA such as NAA or 2,4-D promote growth in lower doses but have a herbicidal effect at higher concentrations. 2,4,5, T is more persistent in soil than 2,4-D or MCP A (2-methyl-4-chlorophenoxy acetic acid).

### **Mode of Action**

- Interference with nucleic acid metabolism
- Disruption of translocation system

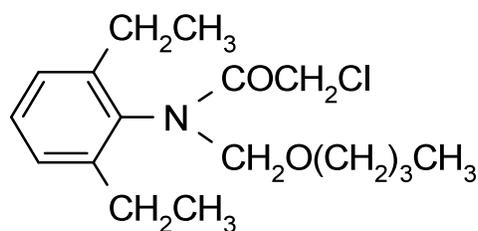
### **Anilides**

The type of activity and the range of weed control vary greatly within this group some being used post-emergence while others are active through the soil.

In 1965, 1966 and 1969 Monsanto introduced three anilides for pre-emergence control of annual weeds.

- (1) ( $\alpha$ -chloro-N-isopropyl acetanilide) as 'Ramrod' which shows a high degree of specificity for annual grass weeds and certain

broad- leaved weeds in maize, soybeans, sugarcane, peanuts and certain vegetables. (ii) **Alachlor** ( $\alpha$ -chloro-2',6'-diethyl-Nimethoxy methyl acetamide) as 'Lasso' for use in maize, cotton, soybeans, sugarcane, peanuts and certain vegetable crops where it shows very good activity against annual grasses, particularly *Echinochloa crus-galli*, *Setaria* Spp. and *Digitaria* Spp. (iii) **Butachlor** (N-[butoxymethyl]-chloro-2',6'-diethyl acetanilide) as 'Machete' for the control of most annual grasses, certain broad-leaved species in transplanted rice. In 1974, Ciba Geigy introduced **metolachlor** (2-chloro-6'-ethyl-N- [2-methoxy-1-methylethyl] acet-o-toluidide) as 'Dual', a pre- emergence germination inhibitor, active mainly on grasses for use in maize, soybeans and groundnut.



Butachlor

oxyfluorfen

### **Thiocarbamates**

**EPTC** (S-ethyl-N,N-dipropylthiocarbamate). 'Eptam', was introduced by Stauffer in 1954. It kills germinating seeds, a number of annuals and inhibits bud development in the underground organs of perennial weeds such as couch grass (*Agropyron repens*) and sedges (*Cyperus* Sp.). It may be used soil incorporated 3 weeks before planting potatoes, field beans, sugar beet and others. Monsanto introduced **di-allate** as 'Avadex' (S-2,3-dichloroallyl-N,N-di-isopropyl (thiocarbamate)), a volatile herbicide for pre-plant control of *Avena fatua* and *Alopecurus myosuroides* in brassica and beet crops in 1960; and **tri-allate** (S-[2,3,3'- trichloroallyl]-di-

isopropyl (thiocarbamate)) in for the control of these grasses and others in cereals and peas.

In 1970 **thiobencarb** (S-4-chlorobenzyl diethyl thiocarbamate) was introduced. It is an important herbicide for the control of weeds in rice showing very high selectivity between rice and barnyard grass (*Echinochloa crus-galli*). In addition it controls many other grass cyperaceous and broadleaved weeds.

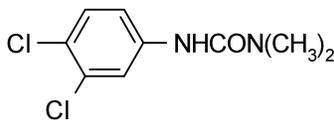
Thiobencarb



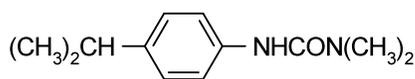
### Substituted Ureas

**Diuron** (3-[3,4-dichlorophenyl]-1,1-dimethylurea) as 'Karmex', was introduced by Du Pont in 1954 and **Fenuron** (1,1-dimethyl-3-phenyl urea) as 'Dybar' was introduced in 1957 and is used for the control of woody plants by basal application.

**Fluometuron** (1, I –dimethyl-3-[ $\alpha$ -trifluoro-m-tolyl]urea) as 'Cotoran'. was introduced by Ciba Geigy and is used for the control of weeds in cotton. Another very important herbicide for the control of annual, grasses including *Alopecurus myosuroides*, *Avena fatua* and *Poa annua* and many annual broadleaved weeds in cereals was **isoproturon** (3-[4-isopropyl-phenyl]- 1, I –dimethyl urea) marketed by three companies - Hoechst (as 'Arelon'), Ciba Geigy (as 'Graminon') and Rhone-Poulenc (as 'Tolkan') in 1972.



Diuron

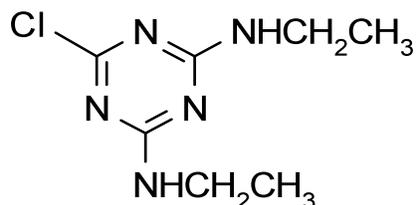


Isoproturon

## Heterocyclic Nitrogen Compounds

### Triazines

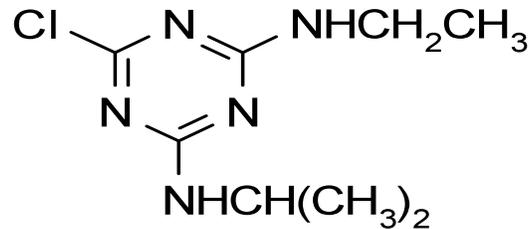
In general triazines have little effect on germination and they are taken up by the roots or leaves. Due to an inhibition of the Hill reaction of photosynthesis, affected plants turn yellow and necrotic symptoms develop. With a few exceptions, the symmetrical triazines have got substituted amino groups at two of the carbon atoms while the third carbon has a chloro, a thioether or a methoxy function. The chloro compounds (CI) end in azine, the thioethers (-S-) end in tryne (e) and the methoxy ones (CH<sub>3</sub>O) in ton. In the list of herbicides which follows all were introduced by Ciba Geigy unless stated otherwise. The first commercial triazine, *simazine* (2-chloro-4,6-bis[ethyl-amino]-1,3,5-triazine) was introduced as 'Gesatop' in 1956 for the selective residual pre-emergence control of a great many annual grass and broadleaved weeds in a variety of deep-rooted crops (including citrus fruits, coffee, tea and cocoa), due to its low solubility in water (3.5 mg l<sup>-1</sup> at 20°C). It is also used for the control of most annual and perennial weeds in non-crop areas. It is remarkably selective for use on maize because of the ability of this crop to degrade it non-enzymically to the non-active hydroxy derivative.



#### Simazine

The second introduction *atrazine* (2-chloro-4-ethylamino-6-isopropylamino-1,3,5-triazine), introduced as 'Gesaprin' and 'Primatol' in 1958, is both foliar and soil acting being taken up both by leaves of emerged weeds and by the roots of weed seedlings emerging after spraying. In maize, where it is also degraded in, a manner similar to

simazine, it is preferred to the latter especially in dry years. Being more water soluble (30mg l<sup>-1</sup> at 20°C) it is more suitable for the dry soils on which this crop is grown where it will effectively control couch grass (*Agropyron repens*) and other perennial grasses. It is also used in roses, for selective use in coniferous forests and for non-selective use on non-crop land and industrial sites.

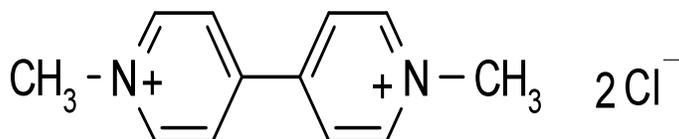
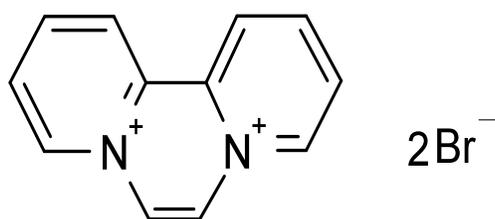


Atrazine

### Pyridines

In 1957 and 1958 I.C.I. introduced two very important bipyridillium quaternary herbicides. Both are broad spectrum, rapidly acting causing wilt and desiccation, and are translocated to a certain extent. **Diquat** (1,1'-ethylene-2,2'-bipyridillium ion formulated as dibromide) under various trade names 'Reglone', 'Weedol', 'Path clear' is used for potato haulm desiccation, for seed crop desiccation and for aquatic weed control. The Chapman Chemical markets it as 'Aquacide'. **Paraquat** (1,1'-dimethyl-4,4'-bipyridilium ion formulated as dichloride) as 'Gramoxone' destroys photosynthetic tissues and is used for a variety of purposes including stubble cleaning, inter-row weed control, desiccation of various crops and killing out of old pastures which can then be resown without ploughing.

It is very fast acting, the first effects being noticeable after a few hours and kill is usually completed in 3-4 days. It is quickly absorbed on to soil (particularly clay) particles so that sowing can follow soon after application.



Diquat

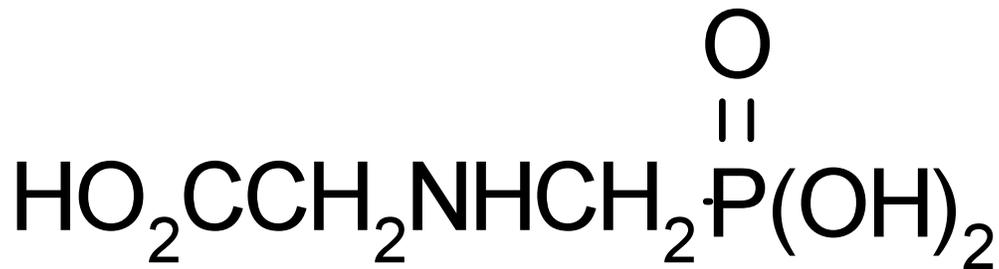
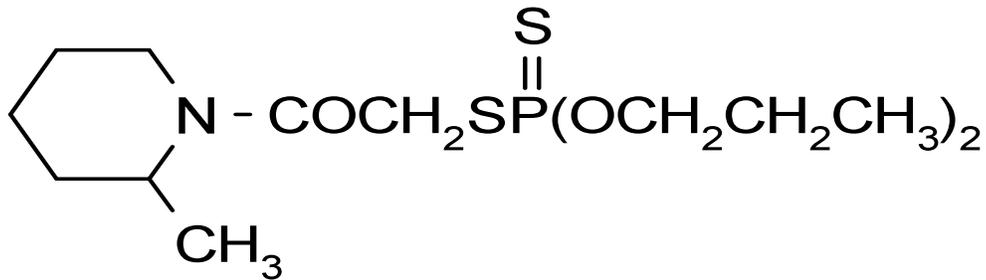
Paraquat

The Dow chemical has introduced three foliar-applied, selective, growth-regulatory herbicides which produce symptoms on susceptible plants very similar to those produced by the auxin type herbicides, namely tissue proliferation, epinasty, leaf curling and production of adventitious roots.

### **Organophosphorus Compounds**

The organophosphorus compounds include: (1) *bensulide* (0,0-diisopropyl-S-2-phenyl-sulphanyl aminoethyl phosphorodithioate) which was introduced by Stauffer in 1964 as 'Prefair' for pre-plant pre-emergence use on cucurbits, brassicas, lettuce and cotton, and as 'Betasan' for pre-emergence control of annual grasses and broad-leaved weeds in lawns. (2) *Piperophos* (S-2-methylpiperidino-carbonyl methyl-0,0-dipropyl phosphorodithioate) was introduced by Ciba Geigy in 1969. It can be used pre-emergence in rice, maize, cotton, soybeans and groundnuts for the control of many monocotyledonous weeds including *Cyperus* Sp., *Echinochloa* Sp., *Trianthema portulacastrum* and *Monochoria vaginallis*. *Glyphosate* (N-[phosphonomethyl] glycine) a derivative of the amino acid, glycine, was introduced by Monsanto as 'roundup' in 1971. It is used post-emergence and is rapidly absorbed by the leaves and translocated from vegetative parts to underground parts, rhizomes or

stolens of perennial grass and broad-leaved weed species giving good control of both above-ground and underground organs *Agropyron repens* is very sensitive. Glyphosate is inactivated on contact with the soil. It provides excellent weed control in pre-tillage of post-harvest treatments of annual crops or when applied as a direct spray in woody crops such as vineyards, deciduous fruit, rubber, coffee, citrus, tea and oil palm. It can also be used in non-agricultural areas and for bush control in forestry.



Piperophos

Glyphosate