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Review
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Review on Economic Impacts and Herbicide Selectivity of Selected Cereal Weeds

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ABSTRACT
Weeds interfere with cereal crops and can reduce growth, yield components and yields. Hence different weed management options were taken to alleviate its competition to hasten crop interfere, especially herbicidal. In this regard, herbicide selectivity has a great sensitivity for effective control of cereal weeds. Therefore, herbicides should be properly select based on selectivity criteria in weed management. Various research papers were reviewed in this article.
Keyword: *Cereal; Herbicide Selectivity and Weeds*

INTRODUCTION
It is important to stress that the use of chemical pesticides is undesirable and should be completely avoided wherever possible. All options for using alternative, non-chemical methods of crop protection should be explored first. Only if no other options are possible should chemical control be considered as a last resort. Remember that pesticides are poisons, and have a damaging effect on people and the environment [3].
Where agricultural labor is scarce or expensive, herbicides can save farmers' time by replacing laborious manual weed control. Herbicides and insecticides have become popular among farmers for controlling weeds and insect pests, including storage pests. Unfortunately, many farmers and extension agents lack the technical skills for proper and effective use of pesticides [11]. This has had many unfortunate consequences, including human and livestock exposure to pesticide poisoning, crop injuries, soil degradation, and environmental pollution. Many accidents, and even deaths, have occurred due to improper use of herbicides. Therefore, herbicides should be properly select based on selectivity criteria in weed management

1. Effects of weeds on crop plants
Weeds can directly damage crops and cause yield losses in many ways. Weeds compete with crops for nutrients, air and space, and may parasitize or contaminate crop seeds [10].

3.Herbicide recommendations
Herbicides are a type of pesticide used for controlling weeds in different crops (see Table 1 for some of the recommended herbicides). There are three groups of weeds: grass weeds, broadleaf weeds, and sedges. Herbicides are classified by the way they act. Some herbicides kill weeds only when the weeds have emerged and others suppress the germination of weed seeds. Different herbicides contain different active ingredients and so they are applied at different times [1]. Herbicides that are applied before planting or before land preparation are referred to as pre-planting herbicides and are mainly aimed at land preparation and killing troublesome weeds that are already growing. Herbicides that are applied after planting but before germination of the seeds planted and before the germination of weed seeds are called pre-emergence herbicides [2]. Herbicides that are applied after the germination of the seeds planted and after the germination of weed seeds are called post-emergence herbicides. Clay soils require higher herbicide application rates than loamy or sandy soils. You need to adjust the amount of herbicide you apply, according to the type of soil. For example, when researchers or chemical manufacturers indicate a recommended dosage of 3–5 liters per hectare, it means that farmers should apply 5 liters/hectare in clay soils, 4 liters/ hectare in loamy soils and 3 liters/hectare in sandy soils. The level of moisture in the soil, the weather conditions, and the type of sprayer used have an effect on the results of using herbicides applied.

Table 1: Some Important, Primary Biochemical Modes of Action of Herbicides Biochemical action	Examples of herbicides implicated in the action
1. Interference with photosynthetic process	
(i) Electron transport blockage (ii) electron transport deflection (iii) Photo-phosphorylation	(i) Triazines, ureas, pyraxon, hydroxybenzo-nitriles, dinoseb, and propanil. (ii) Quaternary ammoniums (iii) Perfluidone and ethers
2. Interference with normal respiration	
(i) Uncouplers of phosphorylation (ii) Inhibition of glycolysis	(i) Dinoseb, ethers (ii) Copper and arsenical compounds
3. Interference with plant growth	
(i) Mitotic poisons or disrupters (ii) Cell proliferation (iii) Anti-geotropism	(i) MH, carbamates, oryzalin, pronamide, CDAA, and DCPA (= chlorthal dimethyl) (ii) Phenoxy alkanoic acids, picloram and bensulide

	(iii) Naptalam
4. Interference with biosynthetic reactions	
(i) Protein synthesis inhibition (ii) Lilpid synthesis inhibition (iii) Loss of cell membrane permeability features (iv) Carotenoid synthesis inhibition	(i) Aliphatic acids, chloroacetamide and endothail (ii) EPTC (iii) Dinoseb, aliphatic acids, ethers, acrolein, and petroleum oils (iv) Triazoles
5. Enzyme inhibitors	
(i) ALS inhibitors (ii) AHAS inhibitors (iii) ACCase inhibitors (iv) EPSP synthase inhibitors	(i) Sulfonylureas (ii)Sulfonylureas; Imidazolinones; Triazolopyrimidines. (iii) Cyclohexypropionic acids (iv) Glyphosate
6. Peroxidisers	Ethers
7. Other actions	
(i) Inhibition of enzyme activity in seeds (ii) Denaturation of plant proteins	(i) Endothail (ii) Sodium chlorate

Different Plants Spp respond differently to same herbicide and same plant spp respond differently to different herbicides. This is a foundation for phenomenal achievement in modern chemical vegetation (weed) management where objective is to kill weeds and retain others at the same time and place. But Selectivity is unwanted within weed species of mixed population this resulted in buildup of the tolerant species [8]. The differential response of plants to the herbicide is called selectivity of herbicide. In other words herbicides harm or kill weeds whereas crop plants are not affected due to selectivity. The fundamental principle is that more toxicant should reach the site of action in active form inside the target plants than in the non target plants.

4. The selective mechanism may occur due to "4" aspects.

Differential rate of absorption of herbicides, Differential rate of translocation of herbicides, Differential rate of deactivation of applied herbicides and Protoplasmic resistance to the specific herbicide [6].

4.1.Differential absorption of herbicides

In a study to find out the absorption patterns of 2, 4-D in the tolerant wild cucumber (*Sicyos angulatus*), in comparison to the susceptible cultivated cucumber (*Cucumis sativus*), it was found that 2, 4-D absorption in wild cucumber was so slow that it kept pace with its metabolism easily thus the plant proved tolerant. Similarly, bigleaf maple (*Acer macrophyllum*) was tolerant to amitrole due to its faster absorption while, bean and lucerne plants were susceptible due to slow absorption of the herbicide by them. Under field conditions, differential absorption of herbicides may occur due to many reasons [7]. 1.Plant spp may differ in their morphology and growth habits.2 Herbicides may be applied at different times by different methods. 3 Use of antidotes and adsorbents to prevent herbicide absorption by non target plants. And Herbicide formulations may differ in their ability to contact with non target plants. The selectivity may be due to one or combination of processes.

Use of adsorbents and antidotes (Induced selectivity)

Adsorbents: These are the materials having ability to adsorb herbicides which are placed near crop seed. Activated charcoal is strong absorbent of 2,4-D, EPTC, 2, 4, 5-T, propham, propachlor, pyrazon, trifluralin, chloramben, diuron, butachlor, simazine etc. When a germinating seed is surrounded by a layer of activated charcoal, then seed is prevented from absorption of soil applied pre-emergence herbicides. Mostly in horticultural crops activated charcoal is placed dibble over the crop seeds. Activated charcoal is first used as an adsorbent of 2,4-D.In transplanted horticultural crops, roots of seedlings are dipped in a charcoal before transplanting. Seed pelleting with charcoal has been developed in recent years using gum/ PVA (poly vinyl acetate) for increasing the selectivity of ETPC to maize and cowpea, and of chloramben, butachlor and EPTC to rice [14].

2,4-D to 2,4,6-T on tomato plants. By 1969 he discovered and reported **NA** (1, 8 Naphthalic anhydride) as highly successful safener of EPTC and butylate in maize. Effective dose is 0.5g per kg seed. It should be applied as seed dress. Later maize specific safener of EPTC and butylate, namely **R-25788** (N, N - dially 1-2, 2, dichloroacetamide) was discovered. The dose of the soil applied R-25788 is 0. 6 kg/ha. It has further been found an antidote of metachlor, alachlor in protecting maize seedlings. A seed coating has been found to provide protection to cultivated oat against pre-emergence alachlor and maize and sorghum against perfluidone and diclofop.CGA-43089 provide safety to sorghum against metalachlor by seed treatment @1-1.5kg per ha. The granules filters through crop foliage leaving very little for absorption, then settle over ground where the weeds will absorb and has low leach ability. The important desirable character of herbicide granules is, it should have low leach ability in soils [13].

4.2 Differential rates of translocation of herbicides

Plants can translocate herbicide through the plant as much herbicide it absorbs. When equal amounts of herbicides are absorbed by plants and weeds but translocation rates are different. For example 2, 4 ,5-T is more toxic to *Cucumis trigonus* than 2,4-D because it was translocated much more rapidly than the latter compound inside plants. Likewise differences in the selectivity between sugarcane (tolerant) but beans (susceptible) to 2,4-D on the basis of its slow translocation in sugarcane and rapid translocation in beans. Always * faster translocation does not mean quick killing. In certain cases it will help the plants is escaping specific herbicide action. For instance, diphenamide selective to *Convolvulus arvensis* because it translocated the herbicide very rapidly from shoots to the roots where it gets metabolized very rapidly than in *Avena sativa*. (it fails to transmit very rapidly from roots to shoots) [15].

4.3.Differential rates of deactivation of herbicides

Selectivity is primarily a function of differential rate of deactivation. Herbicide selectivity is governed not only by differential absorption & differential translocation but also due to differential rates of deactivation of herbicides by the target and the non target plants. A tolerant plant species deactivates the herbicide molecule rapidly, whereas a susceptible species deactivates it slowly [4]. This deactivation may be a process of i) metabolism ii) Reverse metabolism iii) conjugation. Reverse metabolism is important mode of herbicide dissipation. Conversion of active herbicide to inactive form is metabolism where as conversion of inactive to active herbicide form is reverse metabolism.

Metabolism

It involves a change in molecular structure of applied herbicides inside the plants yield on phytotoxic compounds. Eg. *Ribes nigrum* is susceptible to 2,4-D. (It metabolises the 2% of herbicide applied in 96 hours). Whereas *Ribes sativum* is tolerant to 2,4-D (metabolizes 50% of applied amount within 96 hours). Selectivity of terbacil between *Mentha piperata* (tolerant) and Ipomea hederaceae (susceptible). *Mentha piperata* metabolised the herbicide rapidly and shown temporary fall in photosynthesis but in *Ipomea hederaceae* herbicide persisted for long time to inhibit photosynthesis. Rice is tolerant to bensulfuron due to rapid metabolism in inside the plant [15].

Reverse Metabolism; (inactive to active)

This is an enzymatic beta oxidation process. Intermediate chemical compounds are more Phytotoxic than original Compounds (parent compounds).Even number carbon ω Phenoxy Alkanoic acid compounds (2,4-DB, MCPB) these are non toxic but in plants they are converted to 2,4-D, MCPA (these are more toxic). This is due to enzymatic oxidation occurs in non-leguminous plants. But in legumes like lucerne, berseem, peas and clovers lack B-oxidation tolerant to 2,4-DB and MPCB. Coupling of intact herbicide molecule with some plant cell constituents in living plants. Tolerance of grasses and *Convolvulus arvensis* to 2,4-D, this conjugate with glucose and form glucoside, ß- D glucose ester of 2,4-D. Binding of 2,4-D on certain protein films in tolerant graminaceous members eg. Sugarcane. It takes toxic herbicide concentration out of the main stream and makes tolerant. In Soybean chloramben- translocate rapidly to roots and conjugated with glucose molecules forming N-glucosyl chloramben and an unknown compound Chloroamiben –X ([10].

Differential protoplasmic resistance

Protoplasm of different plant species differing in withstanding abnormal deficiencies or excess constituents, that may be induced in the presence of some specific herbicide molecules. Eg. Plant show tolerance to dalapon can withstand pantothenic acid deficiency and resist precipitation of cell protein. Buffering mechanism of protoplasm of plants is affected differently by different herbicides. Eg. Tolerance of mustard, groundnut and cotton to trifluralin and nitriles is due to their inherent protoplasmic resistance. Tolerance of rice plants to molinate is due to protoplasmic tolerance [5].

4.4.Multi modes of selectivity

Selectivity of linuron against parsnip in comparison to tomato was due to lower absorption rates and lower pace of metabolism in the parsnip. Selectivity of flurodifen between resistant peanut and susceptible cucumber was found to be due to limited translocation from roots to leaves as well as more rapid metabolism of herbicide that reach the peanut leaves before it could enter the chloroplast. In cucumber flurodifen translocation was fast but its metabolism was slow. Wheat is tolerant to Ioxynil and bromaxynil due to limited spray retention, **s**low translocation and rapid metabolism. Limited spray retention is the first line defence. Distribution of herbicide molecules within the plant is also important factor in the selectivity [6]. Perfluidone and picloram accumulate at the site of action in susceptible plants and equally distributed in tolerant plants.

4.5.Other selectivity components

Even if a plant posses some mechanisms to exhibit tolerance to a given herbicide but two important aspects that are to be considered are. (I) Rate of herbicide (II)Stage of the plant at the time of application in inducing selectivity. Rate of Herbicides: It is important to consider how much and when to apply in obtaining the desired volume of weed control. Under rates improve selectivity to crops at the cost of satisfactory weed control. Over rates decreases the selectivity and cause variable crop injury. In physiologically selective herbicides, range of selective rates is much greater than that is needed for effective weed control. Narrow in case of other herbicides. Most of herbicides loose selectivity at over rates at 0.5-1 kg/ha. Some of herbicides like Dicamba and metamitron loose selectivity even by few grams per ha [13].

RICE

Rice is grown by direct and transplanted conditions. Weed competition is more in direct seeded rice. Reduction in yield to the tune of 34% in transplanted rice, 45% in direct seeded low land rice and 67% in upland rice are reported. Weed competition in direct seeded rice is greatest during the first three weeks .The critical period for weed free condition for higher productivity is reported to be 30 – 35 days in transplanted rice where as direct seeded low land and upland condition the weed free period ranges from 40-60 days. The major weeds observed in rice crop are grasses which includes *E.colonum,E. crusgalli, Eleusine indica, Setaria glauc, Cynodon dactylon*, the sedges *Cyperus rotundus and Fimbristylisspp* and the broad leaved weeds and aquatic weeds *Trianthema portulacastrum, Cynotis axillaries, Digeria arvensis, Euphorbia hirta, Phyllanthus niruri, Eclipta alba and Chara spp [14].*

Wheat

The weeds reduce grain yield up to 10-40% and competition is during first 30-40 days after sowing the crop. The common weeds found in winter grains are broad leaved: *C. album, Fumaria spp, Vicia, Melilotus, Lathyrus spp. Anagalis arvensis. C. Oxycantha, C. Arvense. Besides broad leaved weeds* grasses like *P. minor, A. fatua, Lolium temulentum. L. rigidum; Polypogon monspeliensis, Poa annua.Cynodon dactylon.* Hand weeding twice at 15 days interval because of narrow row spacing is recommended Several herbicides are used in conjunction with good crop husbandry to control specific weeds. Pre emergence: Diuron and linuron @ 0.5 -1.0 kg kg/ha are effective to control grasses, broad leaved weeds, where as linuron is effective to control sedges also. Pendimethalin and trifluralin @1.0 &0.5 -1.0 kg/ha respectively to control grasses, broad leaved weeds. Post emergence: Sodium and amine salts of 2,4-D and MCPA @ 0.75 kg -1.0kg a.e /ha should be sprayed at CRI for dwarf wheat varieties, where as for tall varieties 40-50 day after sowing that is at active tillering stage or 5-6 leaf stage @ 2.0kg a.e /ha of sodium and 1.5kg a.e/ha of amine form and 0.75kg a.e/ha of easter form. Irrigation should be given before sowing. It is to avoid the leaching of herbicide to the crop roots. The roots of grain crops are very sensitive to the phenoxy herbicides[8].

Maize & Millets

Critical period of weed competition is up to 40-45 DAS. Maize yield was reduced as much as 25-80%. Weeds associated with maize are: *Panicum colonum, Cyperus rotundus, Cyperus esculentus. Cynodon dactylon, Celosia argentia, Commelina* *bengalensis, Phyllanthus niruri and Amaranthus viridis.*

Selective crop stimulation: 1-2 row cultivations twice at 25 and 40DAS. It should be started with 15 cm crop whorl height and continue up to 60 cm crop height. Pre-plant incorporation of butylate or EPTC @ 3-4 kg/ha, (G + BLW) mixed with 0.5 kg/ha of atrazine or simazine controls nut grass and many annual grasses [6]. Treat the seed with NA or add R25788 to spray tank. EPTC formulation containing R25788 is available in the market. Butylate should not be used on high pH soils. Pre-emergence application of atrazine & simazine @ 1-2 kg/ha to control grasses and broad leaved weeds. In dry conditions where less moisture in field occurs atrazine is preferred over simazine. Atrazine herbicide can be applied at any stage of crop i.e pre (or) post emergence as atrazine dissolves easily in water. Alachlor & metolochlor @1-2 kg/ha as pre-emergence effective against annual grasses but these are weak on broad leaf. Pendimethalin @ 1-1.5 kg ai/ha for control of grasses, broad leaved weeds and Sedges.

4.6. Herbicide Mode and Site of Action

To be effective, herbicides must (1) adequately contact plants, (2) be absorbed by plants, (3) move within the plants to the site of action without being deactivated, and (4) reach toxic levels at the site of action. The term “mode of action” refers to the sequence of events from absorption into plants to plant death, or, in other words, how an herbicide works to injure or kill the plant. The specific site the herbicide affects is referred to as the site or mechanism of action. Understanding herbicide mode of action is helpful in knowing what groups of weeds are killed, specifying application techniques, diagnosing herbicide injury problems, and preventing herbicide-resistant weeds. A common method of grouping herbicides is by their mode of action. Although a large number of herbicides are available in the marketplace, several have similar chemical properties and herbicidal activity. Herbicides with a common chemistry are grouped into families. Also, two or more families may have the same mode of action and can thus be grouped into classes [1].

5. Conclusion

This review highlighted some of the difficulties that face researchers when they attempt to estimate the costs of herbicides selectivity and the benefits of weed control. Quantifying the impacts of cereal weeds is an especially difficult task. It would also be necessary to consider the cumulative effects of the steady replacement of a large number of different herbicides by a small number of selectivity over time, and not simply take each case study on its own the latter approach seldom provides an adequate reflection of impacts. Weeds interfere with cereal crops and can reduce growth, yield components and yields. Hence different weed management options were taken to alleviate its competition to hasten crop interfere, especially herbicidal. In this regard, herbicide selectivity has a great sensitivity for effective control of cereal weeds. Therefore, herbicides should be properly select based on selectivity criteria in weed management.

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