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# Herbicide residue in soil, crop produce and in underground water: A review

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**Abstract**
At present, herbicides are widely used in agriculture all over the world because of expanding input cost, decision of use of herbicides because of quick weed control in cropped and non-cropped areas. In India, herbicides are used up to 30% during the recent 10 years. Herbicides kill the weeds but they also effect on soil, crop, underground water, plants, animals, humans and cause pollution of soil and environment. Some herbicides are reside in the soil and water and they effect on the microbes in soil, effect on the next crop, reside in grain and straw, damage flora and fauna of water and spread the diseases.The herbicides monitored were Fluroxypyr, Methabenzthiazuron, Imazamethabenz, Linuron, Aclonifen, Diclofopmethyl, Pendimethalin, Propyzamide, Trifluralin, Metolachlor, Chlortoluron, 2,4-DB, MCPA, Atrazine, Simazin, Terbuthylazine, Metoxuron, Monuron, Diuron, Metobromuron, Tribenuron-methyl, Mecoprop, Chloroxuron, 2,4,5-TB, Neburon, Prometryn, Metribuzin, Cyanazin etc. All of them are responsible for toxicity to humans and animals as well as these leave residues in soil and crop produce.

**Keywords:** Herbicide, Water, Crop, Depletion, Soil, Residue

## Introduction
Herbicides are the chemical compounds that is phytotoxic to weed and safe to crop. They derived from two words i.e. herbs mean grass or weed and cide mean suicide that is kill the weeds or herbs. The long term use of herbicides results in resistance to weeds, shift in weed flora, residue in soil, water pollution and health hazard to humans. The use of herbicide at global level 44% followed by insecticide 22%, fungicide 27%, others 7% (Sondhia Shobha 2014) [24]. 2,4-D was first herbicide used in 1942 by Zimmerman and Hitchcoak on broadleaf weeds in cereals during 1946.

**A. Herbicide residue in soil:** The period of time that a herbicide stays dynamic in soil, water is called persistence of herbicide. The continous and unpredictable utilization of herbicide in different crops may result in harmful buildup of herbicide in soil, underground water and crop produce. Adsorption and aggregation of herbicide in soilfavor its perseverance. The leftover action of herbicides might be negative to the climate, requiring examination of the diligent buildups in the dirt and water (Bzour *et al*. 2019) [4]. A few herbicides have a long leftover. The lingering is not equivalent to the half-life. In spite of the fact that the measure of synthetic in the dirt may separate to a large portion of the first sum quickly, what remains can be industrious for significant stretches, for example sulfonylureas.

### Classification of herbicide based on persistence
1. **Short persistent:** They persist in the soil less than one month. e.g. Phenoxy group.
2. **Medium persistent:** They persist in soil from one to three month. e.g. Alachlor, Pendimethalin, metalachlor.
3. **Highly persistent:** They remain in the soil from three to tweleve month. e.g. Triazine, Substituted urea group.

**Table 1:** Herbicide persistence in soil

| Name of herbicide | Reside in soil (days) |
|---|---|
| Metribuzin | 20-100 |
| Thiobencarb | 28-60 |
| Atrazine | 45-90 |
| Butachlor | 100 |
| Metolachlor | 40-190 |
| Dithiopyr | 90-150 |
| 2,4-D | 45-90 |
| Oxadiazon | 56-125 |
| Metoxuron | 80 |
| Oxyflourfen | 60-80 |
| Pendimethalin | 60-200 |
| Imazethapyr | 90-240 |
| Fluzifop-p-butyl | 30-90 |
| Pretilachlor | 30-60 |
| Tralcoxydim | 28-45 |
| Pyrazosulfuron-ethyl | 35-60 |
| Imazosulfuron | 60 |
| Alachlor | 60-80 |
| Isoproturon | 90-120 |

*Source*: Sondhia Shobha 2014 [23]

Bzour *et al*. 2019 [4] observed that IMI (Imidazolinone) herbicides are persistent in the soil, and their residues remain for up to 85 days after application in rice.
Helander *et al*. 2019 [10] noticed that the soil contain 0.91mg/kg glyphosate and potato tuber 0.02mg/kg glyphosate. Sondhia 2019 [23] reported that the half-lives of herbicide in soil was 57-71 days ofimidazoline, 13-60 days forphenylureas, 13-147 days sulfonylurea, 12-58 days triazines, 50-60 days chloroacetinalides, 12-77 days dinitroanilines, 19-29 days diethylether, 19-24 days for thiocarbamates. Mahanta *et al*. 2019 noticed that the butachlor and pretilachlor in rice at application of 1.5 and 0.75kg/ha and they persist in soil up to 30 days and they are also present in grain and straw.

### B. Effect of different herbicide on surface and groundwater

Luo *et al*. 2019 [13] observed that groundwater is a fundamental freshwater asset for drinking water creation in numerous districts of the world. Groundwater contamination are of two kinds i.e. common and antropogenic.
In any case, groundwater quality is progressively undermined by natural micropollutants, particularly pesticides. 2,4-dichlorophenoxyacetic acid (2,4-D), 2,6-dichlorobenzamide (BAM), mecoprop-p (MCPP) and bentazone were bought from Sigma-Aldrich (USA). These mixes have a high ecological versatility (high solvency) and subsequently are as often as possible identified in groundwater. Exhaustion of groundwater assets and proceeded with decrease in groundwater quality is a reason for concern since enormous human population around the globe utilizes groundwater as a source of drinking water. Groundwater contamination because of natural pollutants especially of insecticides, herbicides, and foreign substances is of developing concern. Contamination because of inorganic toxins, for example, arsenic and other heavy metals explored with specific accentuation on locales that have detailed a fundamentally higher frequency of these poisons in groundwater. As herbicides are compound in nature and in this way inordinate and rehashed use may present buildup issues, phytotoxicity to edit plants, leftover impact on defenseless between crops or succeeding yields or nontargets life forms and eventually wellbeing risks because of amassing of herbicide deposits in the dirt, crop produce and ground water (Kurwadkar 2019) [11]. Numerous herbicides are found as bound deposits which make them inaccessible to the objectives as well as dirtying the dirt environment in various manners. There is a need to screen herbicide deposits in different items to survey development, biomagnifications and bioaccumulation of buildups and unfavorable impacts assuming any Bruggen *et al*. 2018 [3] showed that glyphosate accumulate in the environment and carcinogenic to humus and breakdown the aminomethyl/phosphonic acid(AMPA) in soil, water and toxic to micro amd macro organism.
Rendom *et al*. 2017 revealed that glyphosate present in bottle drinking water, ground water, urine of subsistence farmers.
Sodhia 2009 examied that the maximum concentration ofdmetsulfuron from 0-20 cm depth in both sandyloam and clay loam soil. Cohem *et al*. 2009 noticed that DBCP (1,2-dibromo-3-chloropropane) appear mostly in well water and value within 5µg/L in contaminated well. Sagratini *et al*. 2007 [19] observed that the most commonly detected herbicides were Atrazine, Fluroxypyr, Metolachlor, and Terbuthylazine in irrigation wells and toxicity to crop. Mamy *et al*. 2005 [14] examined that the low amount of metazachlor, sulcotrione, metamitron, trifluralin, glyphosate and its metabolites residue in soil after application of 140 days. Chand *et al*. 2004 [7] remarked that the halosulfuron methyl (HM) residue effect on succeeding crops like black gram, maize, cucumber after sugarcane. Rice *et al*. 2003 [18] observed thatmetoalachlor and atrazine degradation is surface water and to evaluate the contribution of sediment to their dissipation.
Camazano *et al*. 2003 [5] observed that the atrazine and alachlor present in both surface and ground water and they pose to the human health.

### C. Effect on crop produce

**Table 2:** Maximum residue limit (MRL) permitted in various field crops

| Crop | Herbicide | MRL |
|---|---|---|
| Rice | 2,4-D | 0.1 |
| | Butachlor | 0.5 |
| | Oxyflourfen | 0.2 |
| | Oxadiazon | 0.05 |
| | Penoxsulam | 0.02 |
| | Pyrazosulfuronethyl | 0.5 |
| | Imazosulfuron | 0.5 |
| Wheat | 2,4-D | 2.0 |
| | Ethoxysulfuron | 0.2 |
| Corn | 2,4-D | 0.05 |
| | Simazine | 0.2 |
| | Atrazine | 0.25 |
| | MCPA | 0.01 |
| Sugarcane | 2,4-D | 0.05 |
| | Simazine | 0.2 |
| | Atrazine | 0.25 |
| | Alachlor | 0.1 |
| | Diuron | 0.2 |
| | Metribuzin | 0.5 |
| | Metalachlor | 0.1 |
| Soybean | Clomazone | 0.05 |
| Potato | Trifluralin | 0.05 |
| | Metribuzin | 0.6 |
| Garlic | Clethodim | 0.5 |
| Onion | Clethodim | 0.5 |
| | Metalachlor | 0.1 |
| | Cycloxydim | 3.0 |
| Pea | Metalachlor | 0.3 |
| Tomato | Diuron | 0.2 |
| | Pendimethalin | 0.05 |

*Source*: Walia 2018

Hatterman *et al*. 2017 [9] revealed that the glyphosate and dicamba injury to dry edible pea from 0-13%, dry edible bean

0-53%, potato from 0-50%. Bonfleur *et al*. 2015 [2] showed that the mixture of glyphosate and atrazine decreases the soil microbial biomass within 21 days. Sondhia 2013 [21] observed that the pendimethalin at harvest in tomato, cauliflower, radish 0.008, 0.001, 0.014 milligram/gram respectively. Stempvoort *et al*. 2013 [22] revealed that the glyphosate and metabolite aminomethylphosphonic acid (AMPA) present in groundwater.

## Conclusion

From this reviews, I concerned the herbicide are used to kill the weeds but they are reside in the soil and effect on the next crop, damage the soil flora and fauna. They spread the diseases and also effect on the water fishes and other fauna. They are directly or indirectly effect on the soil, crop and water. They effect on the population of microbes, type of soil, properties and chemistry of soil. They indirect effect on plant species, diversity of plants and wildlife. Overall study the herbicide kill the weeds and increase the productivity but they are great pose to human, plant, animals, environment etc.

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