IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES
ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 2, Apr 2022

HERBICIDE RESISTANCE AND THEIR MANAGEMENT

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ABSTRACT

Farmers have struggled with the presence of weeds in their fields since the beginning of agriculture. Any chemical used in the field to kill weeds and any unwanted plant in the crop field is called herbicide. Herbicides are good tools for effective weed control. The use of these chemicals reduced the labours. The continuous use of same chemical with same mode of action for several years develops the resistance. A weed which is initially controlled by applying herbicide but no longer controlled by same herbicide is called herbicide resistance. First, wild carrot resistance to 2, 4-D in Canada, 1964 and common groundsel resistance to atrazine in Washington, 1970.Herbicide resistant weeds have been reported in 93 crops in 70 countries. In North-West India, *Phalaris minor* first resistant to isporoturon in 1990. More recently, *Phalaris minor* is showing resistance to fenoxaprop, clodinafop and sulfosulfuron and pinoxadenin Punjab. In north-west India, *Rumexdentatus* against metsulfuron-methyl. Resistance management requires both preventive as well as integrated approaches. Prevention will include suitable combinations of weed management methods such as cultivation practices, crop rotations and herbicide rotations. In integrated approaches involving combinations of cultural, mechanical and biological methods.

KEYWORDS: Herbicide resistance, Resistant weeds, Cultural, Mechanical and Biological control

INTRODUCTION

A weed may be defined as undesirable and unwanted plants growing out of their proper place. Weeds are controversial plants that are neither all bad nor all good. In other words it can be said that all weeds are unwanted plants but all unwanted plants may not be called weeds. In this sense, it is very important that plants listed as weed are qualified by the situations in which they adversely affect human welfare. Chemicals that are used to kill the plants or weeds called herbicide. The opposition offered by one thing, force etc., to another is called resistance.

Herbicide resistance is a inherited change in weed flora due to overdose or continuous use of same group of herbicides. The use of chemical weed management dates back to the late 19th century when copper sulphate, a constituent of Bordeaux mixtures was found to kill some weeds present between the vines. In ancient time, weed management through hand weeding and animal drawn cultivation system. Major advances in chemical weed management was from the period of 1941 to 1968 when 2,4-D was developed in America in 1941.Worldwide, first wild carrot resistance from 2,4-D in Canada, 1964 and Common Groundsel resistance to atrazine in Washington, 1970 (Yadav and Malik, 2005).

After that *Phalaris minor* was found to be resistant to Isoproturon in Punjab and Haryana (1997-98) after some yearsfenoxaprop, clodinafop and sulfosulfuron and pinoxaden resist after that pyroxasulfon effective for *Phalaris minor*. Weeds resistance to herbicides isn't a unique phenomenon because first report of insects resistant to insecticides found in 1908 and first report of plant pathogens resistant to fungicides in 1940.

By 1991,120 weed biotypes were resistant to triazine herbicides and 15 other herbicide families were documented throughout the world. There are currently 505 unique cases of herbicide resistant weeds globally, with 259 species. In which 151 dicots and 108 monocots. Herbicide resistant weeds have been reported in 93 crops in 70 countries (Heap, 2019). In north-west India, *Rumex dentatus* against resist to metsulfuron-methyl (Chhokar*et al.*2017) and *Avena ludoviciana* resist to clodinafop (Singh, 2016). Mainly, there are three types of herbicide resistance. First, resistance to only one herbicide is called single herbicide resistance. Second, resistance to two or more herbicide families with same mechanism of action is called cross herbicide resistance. e.g. common ragweed (*Ambrosia artemisiifolia*). Third is the multiple herbicide resistance, in which a weed is resistant to two or more herbicides having different mechanism of action. e.g, *Amaranthusrudis.* Highly herbicide resistance group is ALS inhibitors which have 95 biotypes resist from chlorsulfuron (Telar) and lowest herbicide resistance group is organoarsenicals which have one resistance biotype from MSMA (www. weedscience.org, 2018).

Herbicide resistance is an evolutionary process. Due to variation in weed population and selection pressure herbicide resistance occur. The major factors which influence the herbicide resistance are intensity of

selection pressure, initial frequency of resistant individuals and impact of weed biology on evolution of resistance. Other factors of herbicide resistance are the repeated use of one or more herbicides, seed dispersal mechanism and fertile seed production and weed populations with wide genetic diversity may develop resistance rapidly because of single mode of action. Resistance develop through different mechanism of action which are altered site of action, enhanced metabolism and sequestration.

There are many conditions which lead to fast development of resistance mainly these are high persistence of the herbicide, high initial frequency of herbicide resistance gene and single mode of action. Resistance biotypes increase quickly due to seeds of few resistant biotype remains in soil under favorable condition these seeds have ability to grow and at maturity of resistant biotype high amounts of pollen distribution over long distance these transfer resistant character in another biotype.

Management of herbicide resistance is necessary. It can be done through various measures i.e., selecting and using herbicides correctly, rotate herbicides with different mechanisms of action and apply herbicides evenly and accurately and use labelled application rates. Recognize weed characteristics that promote resistance. e.g. annual weed such as Canadian thistle can have several generations in growing season and are more prone to resistance. Also, manage fields, farms or sites wisely. Some weed control practices also help from herbicide resistance which are physical, mechanical and biological methods.

REVIEW OF LITERATURE

Rajkumara and Kumar (2007) observed in a field experiment at Dharwad, India that the over dependence on one or few herbicides has resulted in the development of herbicide resistance in many weeds. Resistance in crops available for different groups of herbicides like sulfonylureas, imidazolinones, triazines, glyphosate etc. Integrated weed management (IWM) approach is required to prolong the life of herbicide resistant crops. Rotate herbicides, rotate crops, different mode of action and other agronomic practices for effective weed control, better yield and prevention of herbicide resistance development. Hence, this study showed that weed management in herbicide resistant crops should involve integrated weed management practices for retaining long term potential of herbicides like glyphosate.

Duary (2008) found at Sriniketen, West Bengal that herbicides are the most effective and economic among the weed management practices. Development of resistance against herbicides increased at an alarming rate. Almost one dozen species reported to be resistant against monsanto's very potent broad spectrum herbicide glyphosate. Hence, this study showed that herbicide used in rotation or as a mixture and other alternative tools including manual, cultural and other practices should be used.

Bhullar *et al*. (2014) conducted an experiment at Ludhiana, Punjab reported that little seed canary grass (*Phalaris minor* Rtez.) is dominant weed in wheat especially in rice-wheat cropping system. It is resistance to isoproturon in early 1990's. Alternate herbicides like clodinafop, sulfosulfuron and fenoxaprop were recommended. But complaints of poor efficacy of these alternatives herbicides and development of cross resistance in *Phalaris minor*. Proper and regular monitoring is necessary of all these herbicides. Hence, this study showed that the development of cross resistance in *Phalaris minor* in clodinafop to a large extent and sulfosulfuron also likely to meet the fate in the near future.

Reddy and Jha (2016) found in USA that the herbicide contributed to increase the yield of crop. Over reliance on herbicides for control weeds led to evolution of herbicide resistant weeds. Increase awareness of herbicides resistance and adoption of diversified weed control measures help the farmer to manage herbicide resistant weeds. It must include the chemical and non-chemical methods as well as management practices used for prevent evolution of herbicide resistant weeds. Hence, this study showed that diversify weed management approaches used for controlling the herbicide resistant weeds in which cultural, mechanical, chemical and biological measures involves to disrupt the evolving and spreading of resistant weeds.

Bhullar *et al.* (2017) conducted an experiment at Ludhiana, Punjab found that repeated use of herbicides with similar mode of action for weed control in wheat has result in evolution of multiple resistance in *Phalaris minor*. Discovery of new herbicide modes of action has slowed, all effort should be made to increase the effective life of existing herbicides and make weed management cost effective and efficient. Early detection of resistance helps to minimize the financial impact on farmers. Hence, this study showed that evolution of multiple herbicide resistance in *Phalaris minor* has been a major problem in wheat, where it has the potential to threaten the sustainability of rice-wheat cropping system.

Upasani and Barla (2018) reported at Jharkhand, India integrated approaches involving judicious combinations of cultural, mechanical, biological and herbicide and crop rotations must be adopted to reduce the dependence on herbicides. Tillage method, planting time, method of herbicides application, optimum dose, steal bed and zero tillage are some of the short duration management strategies. Hence, this study showed that continuous use of the same herbicide or herbicides having same mode of action in monoculture with minimum tillage has major cause of herbicides resistance. Herbicide resistance mitigate through the reducing the selection through diversification of weed control techniques.

Kaur *et al*. (2019) found at Ludhiana, Punjab that pyroxasulfone at 127.5 g/ha recorded effective control of *Phalaris minor*and its biomass and gave the highest wheat grain yield (4.87, 4.80 and 5.43 t/ha) during 2011-12, 2012-13 and 2013-14. Also, at farmer's field, pyroxasulfone found effective against the resistant populations of *Phalaris* with 5.37 and 5.42 t/ha grain yield. Hence, this study showed that the post emergence application of pyroxasulfone at 127.5 g/ha would be a suitable option for the control of resistant populations of *Phalaris minor* in wheat in Punjab.

Conclusion

Repeated use of herbicides strictly responsible for herbicide resistance. Once a weeds are resistance to particular herbicide, then it is possible for it to show resistance to another herbicide with same or different mode of action. Due to herbicide resistance in weed, increase cost of weed management, reduce yield of crop and also reduce field productivity. Therefore, management is necessary i.e. IWM approach and other strategies like adoption of herbicide and crop rotation.

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