

Some integrative management strategies to decrease doses of herbicides in agriculture

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ABSTRACT

Overdose using of herbicides is one of the major problems in crops and horticulture productions. Human food safety and economical production of agricultural products are the main target of new agronomy and plant scientists. Integrative management is one of the new programs for reducing herbicide doses in agriculture. This program includes many physiological and physicochemical methods for controlling herbicide uses in farms and orchards. This article explains some of these methods such as using surfactants, water quality in spraying, using magnetic fields, controlling the nitrogen content of soil, using a suitable formulation and powerful cultivars and genotypes in agriculture and the effects of this reduction in herbicide doses on plants behavior and weeds controlling. According to this method, integrative management can be beneficial in crop production and farmers must be using of this management method in their farms.

KEY WORDS: Dose reduction, herbicides, integrative management, magnetic fields, surfactants

INTRODUCTION

Overusing of herbicide results in some damage to the environment and imposes heavy costs to farmers. On the other hand, some plants have shown resistance to these chemical components. The best way to control weeds is to use minimum dose of herbicides (Kudsk and Streibig, 2003; Hanwen, 2013). Some herbicides such as atrazine, breaks up easily in the environment, and cause surface water polluted, and there for, have adverse effects on human and animals (Theng *et al.*, 1999). Growth of weeds, which are resistant to herbicides, is one of the main concerns of farmers. Understanding the ecological conditions and main factors, that affect herbicides intake, is very important. The integrative management systems should be used against weeds (Kirkland *et al.*, 2000). Response to decreased dose method is used to investigate the relation between plant response and used amount of herbicide, and therefor, it is possible to estimate weeds response to high or low concentrations, comparing with optimum dose (Seefeldt *et al.*, 1995). In this article, we are discussion about how we can reduce herbicide usage in agricultural farms, and effects of these strategies on plant behaviors.

ADVERSE EFFECTS OF OVERDOSE USING

Recent efforts to the improvement of agricultural products caused to increase the use of herbicides, as a result, there are adverse effects not only on resuscitative and living things but also on the productivity of crops (Cooper and Kavlock, 1997). Some herbicides such as sulfonyl ureas are very persistent and leave negative effect to environment. Their residuals were between 0.10 and 0.07 mg/g at soil, and there for, it can limit the growth of arable species (Moyer, 1995). Moyer *et al.* (1990) has shown that the growth of alfalfa, lentil, chickpea, potato, beets, can be affected by sulfosulfuron and triasulfuron, but there is not any negative effect on the barley, bean and wheat growth. Results of research in Canada showed that lentil was affected by residual of sulfuron after 8 years (Moyer *et al.*, 1990). Effect of glufosinate ammonium on insects was also investigated, and results showed that it was toxic in 540 ppm, especially to lady-bugs (Ahn *et al.*, 2001). Decrease in insect population can lead to main ecological effects, for example, an overuse of herbicides in England caused the population of gray partridge to decrease (Freeman and Boutin, 1995). Negative effects of herbicides, as simazin, atrazine, and propazine on humans are documented by several studies (Sanderson *et al.*, 2000).

INTEGRATIVE MANAGEMENT

Integrative management is a useful method in decreasing dose of herbicides and at the same time, increasing the gain and products (Muniyappa *et al.*, 2005). In this way, efforts are concentrate on minimizing the negative effects of chemicals. Integrative management consists of physical (such as rotivator), chemical (herbicides), and biological controls (such as using powerful cultivars) (Baghestani *et al.*, 2007). Researches have shown that, in the absence of herbicide, rotivator can only control 50% of herbs, but in combination with herbicide, it can control up to 90% of weeds. There is less biomass in integrative method, compared to individual treatments. Hence, integrative management is the best way in controlling weeds (Forcella, 2000). The efficiency level of these methods depends on several factors such as herbs species, amount and height of sprays on raw, type and times of applying rotivator (Bellinder *et al.*, 2000). In sweet corn, roltivator function can be affected by soil type, rainfall and green cover level of the plant (Colquhoun *et al.*, 1999). The performance of this method is equal to control degree of metribuzin, but the advantage of this system is that level of herbicides can be reduced up to 66% (Jahedi *et al.*, 2005). The competitive capability of plants can be also affected by changes in arable plants cultivation, which can increase cultivation density (Zand *et al.*, 2008).

STRATEGIES TO DECREASE DOSES OF HERBICIDES

Using Surfactants

Surface morphology and kinetic energy of herbicide drops are the main factors that keep herbicide drops on the leaves. Resistance and infiltration of herbicides can be increased by surfactants, so they can be used to increase the performance of herbicides and also to decrease their used contents on leaves (Penner, 2000; Bellinder *et al.*, 2003). A study showed that the effects of clodinafop – propargyl and cyclo sodium against weeds such as phalaris and wild oat are increased by applying some olive and castor oils. Surfactant sitogate and colza oil, when used in combination with herbicide, can be helpful on increasing the effects of herbicides (Mehdizadeh *et al.*, 2013). Similar results shown on some spaces of grass with pinoxaden and clodinafop (Mousavinik *et al.*, 2009).

Using Suitable Water in Spraying

Interaction of herbicides with soluble ions strongly depends on chemical properties, content and type of minerals in herbicide. It is observed the different response

of herbicides to cations in a solution (Istvan and Endre, 2009). Effects of concentrations of sodium carbonate, along with ammonium sulfate in water on herbicide behavior has been studied, and results showed that they were useful in increasing the effects of nicosulfuron and glyphosate on weeds, such as abutilon and barnyard grass. Increasing in calcium carbonate content can result in an increase in survival percent, herb height, leaf surface, and dry weight of top organs. However, the effect of calcium on glyphosate is higher than the effect of nicosulfuron (Hajmohammadnia *et al.*, 2011). Harmful effects of water hardness can be reduced by adding some ammonium sulfate. Ammonium sulfate causes pH and solvability of nicosulfuron to increase, respectively, from 4.6 to 4.7 and from 12% to 16%; hence, this procedure increases function of this herbicide. In general, climatic conditions can affect intake and infiltration of herbicides (Green and Cahill, 2003).

Using Magnetic Fields

Effect of magnetic field on water drops adhesion has been explored in research. In this study, surfactant free gate was used, along with magnetic field and results showed that an increase in a number of pass from the field accompanied by a decrease in free gate solution adhesion. The magnetic field increases the efficiency of herbicides. There are very little researches in this subject and much attention must be make on this matter (Mohassel and Aliverdi, 2010).

Controlling the Nitrogen Content of soil

Soil productivity and water quality among all environmental factors are the main ones that affect herbicides performance. Using of herbicides, considering soil productivity level, also is beneficial method in performance increasing. In this method, understanding the herbicides responses to soil productivity is necessary and very important. Nitrogen is one of the main components in plants structure, as it is a basic element in leaf structure, and is effective in uptake and leaf permeability (Cathcart *et al.*, 2004). An increase in nitrogen content leads to an increase in herbicide translation through plant (Kim *et al.*, 2006). Using glyphosate on chenopodium album along with increased content of nitrogen can result in better effects, which is due to increase in uptake and permeability of leaves (Azad *et al.*, 2013).

Using Suitable Formulation

There are different formulations for each herbicide in the world, which knowledge about them is helpful in decreasing usage doses. For example, there are three

formulations for tribenuron methyl includes Iranian, China, and French, recommended dose of Iranian and French is 10 g/ha for a decrease of 80% in mustard, however, for the same decrease and it is necessary to use 19 g/ha of the China formulation (Nezamabadi *et al.*, 2007).

Using Powerful Cultivars and Genotype

Competitive cultivars can be used to decrease herbicides doses, without any decrease in quality and performance of arable products. In a research conducted in relation to wheat, it was observed that some cultivars in competition with Arugula by increasing their harvest index or preventing decrease in this index have the capability to prevent their product losses and to tolerate herbs with this method we could reduce of 2-4D doses up to 25% on wheat farms similar results has been reported to cotton (Bayley *et al.*, 1992; Bonsall *et al.*, 1997).

Plants Response to Decreased Dose of Herbicides

Using decreased dose herbicides is one of the main ways to control entrance of these materials to environment. A research was conducted to explore the effects of decreased dose of mezotiridin, nicosulfuron, topamezon, and combination of mezotiridin with nicosulfuron. The decreases, observed for nicosulfuron with integrative management in 2010 and 2011 are, respectively, 50 and 33% and decreases for mezotiridin in 2010 and 2011 are 50% and 67%. Corresponding decreases in combination of mezotiridin and nicosulfuron in these years are shown to be, respectively, 67% and 33%. These herbicides in recommended concentrations can lead to complete control of weeds, but with 67% increase in this content, again similar effects can be observed, indicating that their doses can be decreased to 67%, without any decreasing in their efficiency. Using these four herbicides with recommended concentrations result in effective control of grass. The results have shown that the concentration of nicosulfuron and combination of it with mezotiridin can be reduced by 33%. About topamezon, this dose can be reduced up to 67%. Mezotiridin, alone, can not show any control on grass (Khan, 1980). Another research has been conducted in soya farm. When the density of *Xanthum stramarium* is 2 plant in each square meter, herbicide percent can be reach to 45% of recommended level. Increasing this density to 4 and 8 plant in each square meter, this content can be increased to 50% and 65% (Mortezapour *et al.*, 2010). Studies in wheat lands also investigated the effect of mezosulfuron – methyl + sodium and iodosulfuron methyl. The results showed that 25% and 50 % decrease in usage doses had not any meaningful effect on herbicide performance. This reduction has no effect on the yield of

most varieties. (Travlos, 2012) using diclofop in 160 g on hectare on katonga varieties of wheat has similar effect when we used 280 and 560 g/ha of this herbicide on other varieties of wheat (Lemerle *et al.*, 1996).

CONCLUSION

The use of chemical herbicides is helpful in controlling the growth of weeds. However, due to environmental pollution, there is necessary to decrease usage dose of them. To this aim, there are some beneficial ways such as integrative management methods and using surfactants. Decrease in dose also help to better control of weeds, and at the same time, be economically efficient.

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