EFFECT OF RAPESEED RESIDUE REMAINING ON THE SOIL SURFACE ON NON-CHEMICAL INVASIVE PLANTS MANAGEMENT IN SUBSEQUENT CROP ROTATIONS

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Abstract- Changes in the weed seed-bank due to crop production practices are an important determinant of subsequent weed problems. Bio-herbicides can play a major role in non-chemical controlling strategies of invasive plants in fields. Rapeseed (*Brassica napus*) is cultivated as a spring crop in Iran and redroot pigweed (*Amaranthus retroflexus* L.) grows along with different field crops, and is a main factor in yield loss of summer crops.In order to study allelopatic effect of rapeseed residue on germination and growth of redroot pigweed an experiment was conducted in laboratory and greenhouse. Studied factors were water extract of above-ground, root and total parts of rapeseed (included distilled water as control) harvested at three growth stages included early stem elongation, blooming and ripening. Results indicated that when the weed seeds were irrigated with aqueous extract of above-ground, root and total parts of rapeseed, its germination rate with reducing value of 15%, 34% and 22% ranged from 4 germination per day to 3.4, 2.6 and 3.1, respectively, as compared with control. Rapeseed harvesting at blooming and ripening stages could reduce germination rate and seedling dry weightof pigweed up to 39% and 21%, respectively, in comparison with control. Pigweed seedling vigor index was 6.5% lower than control, when seeds treated with root extract harvested at ripening stage. It is concluded that remaining of rapeseed residue on the soil as a bioherbicide may decrease herbicide use and negative effect of pigweed in summer plants. These kinds of studies clearly show guidelines for biotechnologists in synthesis of natural herbicides.

Keywords- Bio-Herbicide, Biotechnology, Rapeseed Residue, Redroot Pigweed.

INTRODUCTION

Bio-herbicides can play a major role in non-chemical controlling strategies of invasive plants in fields. Rapeseed is used frequently as a prior crop to summer plants in conventional agriculture, which the yield damaged by summer weeds such as redroot pigweed (*Amaranthus retroflexus*) that grows along with different field crops. *Amaranthus retroflexus* is especially a main factor in yield loss of summer crops.

Several crucifer species were reported to have a phytotoxic potential, such as the case of rapeseed (*Brassica napus* L.), which reduced wild barley (*Hordeum spontaneum* Koch.) growth [1]. Four phenolic acids (ferulic, p-hydroxybenzoic, p-coumaric and m-coumaric), extracted from rice hull, reduced seed germination and seedling dry weight of barnyard grass [*Echinochloa crus-galli* (L.) Beauv.], with an increasing effect as the concentration of phenolic acids gets higher [2]. In rotation recently in Iran cotton plant after rapeseed is common and also sometimes growers have to incorporate rapeseed with soil before harvesting in 4 or 5 leaved stage due to its bad germination. Often, they have to plant cotton or soybean instead of rapeseed, thus survey of the effect of rapeseed on cotton and other crops in Iran is necessary. In an experiment conducted by John *et al*. [3], within the no-tillage treatment, rye or hairy vetch residue reduced total weed density an average of 78% compared to the treatment without cover crop when cover crop biomass exceeded 300 g m^{-2} and when residue covered more than 90% of the soil. Goosegrass, stinkgrass, and carpetweed densities were reduced by cover crop residue in at least 1 year whereas large crabgrass was unaffected. Common lambsquarters density increased where rye was grown as a cover crop prior to conventional tillage. Despite differences in weed density among treatments, weed biomass was equivalent in all treatments during the last 2 year. In a research study performed by Alan *et al*. [4], a variety of crops, cultivars, and accessions have been evaluated over the past six years for superior capability to suppress weed growth. The most successful of these approaches has been to grow cover crops of rye (*Secale cereale*), wheat (*Triticum aestivum*), sorghum (*Sorghum bicolor*), or barley (*Hordeum vulgare*) to a height of 40–50 cm, desiccate the crops by contact herbicides or freezing, and allow their residues to remain on the soil surface. Often, up to 95% control of important agro-ecosystem weed species was obtained for a 30- to 60-day period following desiccation of the cover crop. The plant residues on the soil surface exhibit numerous physical and chemical attributes that contribute to weed suppression. Physical aspects include shading and reduced soil temperatures which were similarly achieved using poplar (*Populus*) excelsior as control mulch. Chemical aspects apparently include direct release of toxins, as well as production of phytotoxic microbial products. Numerous chemicals appear to work in concert or in an additive or synergistic manner to reduce weed germination and growth. The main objective of this study was to evaluation of effects of water extract of

Brassica napus on some studied variables in *Amaranthus retroflexus*.

MATERIALS AND METHODS

The experiment was carried out at the Research Station of Islamic Azad University, Tabriz, Iran during 2012 Tabriz is located in the north-west of Iran; the climate is semi-arid and cold and average annual precipitation is 270 mm. The soil was sandy-loam with EC of 0.72 ds m^{-1} and pH of 7.9.

Studied factors were water extract of above-ground, root and total parts of rapeseed (included distilled water as control) harvested at three growth stages included early stem elongation, blooming and ripening. The recorded data were germination rate (GR), final germination percentage (FGP), seedling dry weight or biomass (SDW) and seedling vigor index (SVI).

FGP was calculated as the cumulativenumber of germinated seeds with normal radicles, as described by Larsen and Andreasen [5]:

FGP= Σn /N × 100

Where, n is number of seeds that had germinatedat each counting and N is total seeds in each treatment.

SVI was calculated accordingto Abdul-Baki and Anderson [6] equation as below:

GP= SDW × SVI

Where,SDW is seedling dry weight.

All data were statistically analyzed as a factorial experiment using MSTAT-C software. The means of the treatments were compared using the least significant difference test at a significant level of 95%.

RESULTS AND DISCUSSION

Analysis of variance of studied factors has been indicated in Table 1. Effect of harvested stages and parts of rapeseed on GR, FGP, SDW and SVI was significant. Results indicated that when the weed seeds were irrigated with extract of above-ground, root and total parts of rapeseed, its germination rate with reducing value of 15%, 34% and 22% ranged from 4 germination per day to 3.4, 2.6 and 3.1 germination per day, respectively, as compared with control (Fig.1). Rapeseed harvesting at blooming and ripening stages could reduce germination rate (Fig.2) and seedling dry weight (Fig.3)of redroot pigweed up to 39% and 21%, respectively, in comparison with control.

The use of allelopathic cover crops in reduced tillage cropping systems may provide an ecologically sound and environmentally safe management strategy for weed control. Some of farmers often plant winter rye (*Secale cereale* L.) for increased soil organic matter and soil protection. Spring-planted living rye reduced weed biomass by 93% over plots without rye. Residues of fall-planted/spring-killed rye reduced total weed biomass over bare-ground controls. Rye residues also reduced total weed biomass by 63% when poplar excelsior was used as a control for the mulch effect, suggesting that allelopathy, in addition to the physical effects of the mulch, did contribute to weed control in these systems. In greenhouse studies, rye root leachates reduced tomato dry weight by 25–30%, which is additional evidence that rye is allelopathic to other plant species [7].

Table 1. Variance analysis ofallelopatic effect of rapeseed residue on germination and primary growth of redroot pigweed.

	df	GR	FGP	SDW	SVI
		Mean squares			
Harvested stages of rapeseed (A)	4	15.99*	2.11**	79.58*	3.225**
Parts of rapeseed (B)	3	18.87*	4.58**	151.25**	3.60*
A×B	12	11.29	0.691	35.69	1.225
Error	38	5.15	0.39	33.00	0.674
CV%	-	22.02	13.29	15.48	13.20

* *,** indicate significant at 5% and 1% probability levels, respectively.

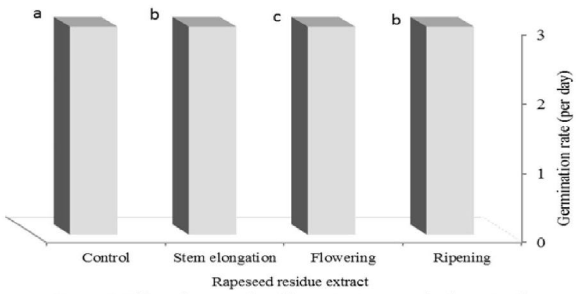

Figure 1. Effect of rapeseed residue extract on germination rate of redroot pigweed .

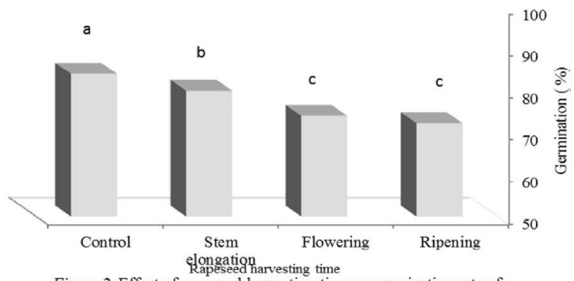

Figure 2. Effect of rapeseed harvesting time on germination rate of redroot pigweed.

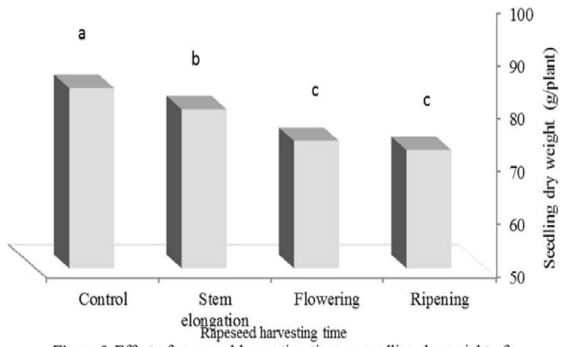

Figure 3. Effect of rapeseed harvesting time on seedling dry weight of redroot pigweed.

Pigweed seedling vigor index was 6.5% lower than control, when seeds irrigated with root extract harvested at ripening stage. Reduced growth of crops and weeds is often reported following addition of *Brassica* residues to soil or following *Brassica* spp. [8-9].

CONCLUSION

It is concluded that remaining of rapeseed residue on the soil as a bioherbicide may decrease herbicide use and negative effect of pigweed in summer plants. These kinds of studies clearly show guidelines for biotechnologists in synthesis of natural herbicides.

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