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Allelopathic Effects of *Sisymbrium irio* L. and *Descurainia sophia* (L.) Schur on the Germination of Wheat (*Triticum aestivum* L.)

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***Abstract*—**An experiment was conducted under controlled conditions to study the effect of water extract of leaves, shoots and roots of either *Sisymbrium irio* L. =SISIR and/or *Descurainia sophia* (L.) Schur =DESSO on the germination and primary growth of wheat. A split-split plot experiment in CRD with three replications was used. The main plots were the type of weed: i.e. SISIR and DESSO and the sub-plots were type of organ: i.e. leaf, stem and root and, the sub-sub plots were concentration of the water extract of each organ of the weeds: i.e. 0, 2, 4 and 8 % w/v. The plant materials were cut in 2-3 cm pieces and then were ground in a blender. The crushed materials were weighed according to experimental protocol and the final volume was reached to 100 ml in distilled water in dark bottles. All bottles were put on a shaker for 24 hours. The solutions were filtered by muslin cloth. Whatman paper, 9 cm in diameter, were put in petri dishes and twenty seeds of wheat were put on it and 5 ml distilled water or water extract of weeds were added to each petri dish. All petri dishes were put in constant temperature of 15 ^{0}C incubator.

The results showed that the SISIR water extract had a greater inhibitory effects on germination and primary growth of wheat than those of DESSO water extract. The water extracts of the leaves of both weeds had the greatest inhibitory effects on germination and primary growth of wheat, compared to those of stems and roots. Increasing the concentration of water extract of leaves, stems and roots of both weeds up to 8 % caused the greatest inhibitory effects to wheat and reduced the germination rate and primary growth of it linearly.

***Keywords*—**Allelopathy, DESSO, SISIR, wheat

I. Introduction

INTERACTIONS between plants are called interference and include positive, negative, and neutral effects on each other [1]-[2]-[3]. interference has two components-competition and allelopathy. Weed can affect the crops by allelopathic effect as well as they compete them for water, nutrients and light [4]-[5]-[6]. When these two effects occur concomitantly, the harm caused becomes even greater. Allelopathy is one plant's directly affecting another plant's growth. weeds can also affect a crop's growth by releasing allelochemicals into the growing environment.

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All plant parts of the weed including leaf, stem, root, and fruit have allelopathic potential. However, various parts of weeds show different behavior in exerting their allelopathic effects on crops. Weeds also exert allelopathic effects on crop seed germination and growth by releasing water-soluble compounds into the soil [7]-[8]. Many phytotoxic chemical substances are known to be exuded by plants to suppress emergence or growth of the other plants. Some over 10 thousand chemicals are estimated to be produced by the plants to protect themselves against, deceases, pests and other plants, especially weeds. As the knowledge on these substances advances, these substances may be used as herbicide, which will be very beneficial for environment. The weeds have allelopathic superiority over crops besides their competition superiority. In allelopathy, relations between weeds and crops, between weeds and weeds and between crops and crops are been examined and the means to benefit from these relations have been studied[5].

The term allelopathy was coined by Molisch (1937) to refer to biochemical interactions between all types of plants, including microorganisms [9]-[10]-[11]-[12]. Allelopathy is defined as the direct or indirect harmful or beneficial effects of one plant on another through the production of chemical compounds that escape into the environment. Many of the phytotoxic substances that are suspected of causing germination and growth inhibition have been identified from plant tissues and soils. These substances are termed allclochemics or, more commonly, allelochemicals. Allelochemicals usually are called secondary plant products or waste products of the main metabolic pathways in plants [13]-[14]-[15]. Allelopathy and autotoxicity are influenced by many environmental factors. Allelochemicals may be transported through the soil and can be transformed, metabolized, or become bound to organic matter during this process. Inconsistent allelopathic effects suggest that the severity and duration of field autotoxicity may vary with environment and geographic location [16]. allelopathic potential and can severely affect crop survival and productivity[17]. Allelochemicals produced by plants may be released into the surrounding environment in sufficient amounts with enough persistence to affect neighboring and succession species [18]. Allelochemicals are present in all types of plants and tissues and are released into the soil rhizosphere by a variety of mechanisms, including decomposition of residues, volatilization and root exudation. [19]-[3]. However, the inhibitory materials may be auto inhibitory or hetero inhibitory, some can be highly selective, and their effect is concentration dependent [18]. Two

common winter weed species occurring in small grain production areas are SISIR and DESSO. These weeds are presumed to antagonize growth of crops, by their competitive and allelopathic effects. In the present study, we tried to compare the allelopathic effects of water extracts of different plant parts on the germination and primary growth of wheat.

II. Materials and Methods

A pot experiment was conducted under laboratory conditions at the College of Agricultural Sciences, Islamic Azad University, Shiraz, Iran in 2009. A split-split plot experiment in CRD with three replications was used. The main plots were the type of weed: i.e. SISIR and DESSO, the sub-plots were type of organ: i.e. leaf, stem and root and the sub-sub plots were concentration of the water extracts of each organ of the weeds: i.e. 0, 2, 4 and 8 % w/v. The plant materials were cut in 2-3 cm pieces and dried then were ground in a blender. The crushed materials were weighed according to experimental protocol and the final volume was reached to 100 ml in distilled water in dark bottles. All bottles were put on a shaker for 24 hours. The solutions were filtered by muslin cloth. Whatman paper , 9 cm in diameter, were put in petri dishes and twenty seeds of wheat were put on it and 5 ml distilled water or water extract of weeds were added to each petri dish. All petri dishes were put in constant temperature of 15 ^{0}C in an incubator. On days 5, 7 and 10, germination percentages of each petri dish was determined. Plants were harvested after 10 days. Plumule and radicle lengths were measured and fresh and dry weights were determined. The data were subjected to analysis of variance by computer facilities, using SAS program.

III. Results and Discussion

The effects of water extracts of different parts of SISIR and DESSO on the growth parameters of wheat seedlings after 10 days are shown in Tables I, II and III.

Increasing the concentrations of water extracts of leaves, stems and roots of both weeds up to 8 % caused more inhibition and reduced the germination rate of wheat linearly. As a whole, the root water extracts of both weeds caused the least reductions in the emergence and seedling growth of wheat as compared to those of leaves and stems. with the other extract. The results indicated that the water extracts of leaves of both leaves had the greatest inhibitory effect on the growth of wheat as compared to those of stems and roots. More delay in seed germination and lower germination index with other plant part extracts could of attributed to a more inhibitory effect of allelochemicals present in leaves [6]. SISIR water extracts had a greater inhibitory effect on germination and primary growth of wheat than that of DESSO water extracts.

It is difficult to apply our results to a production situation directly, because the concentration of inhibitory substances in aqueous extracts is probably greater than what would be observed under natural condition. However, the results of the present study and previous work [5]-[18]-[20] show the potential of allelopathic plant extracts should be investigated to exploit its benefit in crop production.

TABLE I
EFFECT OF WATER EXTRACTS OF THE LEAVES, STEMS AND ROOTS OF SISIR AND DESSO ON THE PLUMULE AND RADICLE FRESH WEIGHTS OF WHEAT AFTER 10 DAYS (MEAN OF 3 REPLS.)

Conc.		Plumule fresh Weight (mg)	Radicle fresh Weight (mg)
DESSO			
Leaf	0	1270ab	780abc
	2	1300ab	790cdefg
	4	1331ab	792defgh
	8	980abcd	400gh
Stem	0	1360ab	870ab
	2	1390ab	410cdefgh
	4	1370ab	470bcdefg
	8	1000ab	440cdefgh
Root	0	1100ab	590abcde
	2	1080ab	550fgh
	4	1070abcd	520efgh
	8	1010bcde	470fgh
SISIR			
Leaf	0	1460a	730abcd
	2	670bcde	310efgh
	4	280cde	170fgh
	8	90e	70gh
Stem	0	1140ab	870a
	2	860abcd	730abcde
	4	790abcd	550bcdef
	8	190de	90h
Root	0	1160abcd	860a
	2	1170ab	870abcd
	4	950abc	770bcdefg
	8	930abc	740cdefgh

In each column, the numbers with similar letter have no significant difference by Duncan Multiple Range Test (DMRT) at 5 % level.

TABLE II
EFFECT OF WATER EXTRACTS OF THE LEAVES, STEMS AND ROOTS OF SISIR AND DESSO ON PLUMULE AND RADICLE DRY WEIGHTS OF WHEAT AFTER 10 DAYS (MEAN OF 3 REPLS.)

Conc.		Plumule dry Weight (mg)	Radicle dry Weight (mg)
DESSO			
Leaf	0	130abcd	80ab
	2	140abcde	85ab
	4	144bcde	90b
	8	90cde	50b
Stem	0	120abcd	90ab
	2	110abcd	70a
	4	90abcde	60ab
	8	80bcde	40b
Root	0	150abc	90ab
	2	140abcd	85ab
	4	120abcde	60ab
	8	83bcde	45ab
SISIR			
Leaf	0	170a	100ab
	2	50de	20b
	4	20e	10ab
	8	10e	1b
Stem	0	130abcd	100ab
	2	70bcde	40ab

	4	40de	20b
	8	20e	10b
Root	0	150ab	100ab
	2	152bcde	40ab
	4	80bcde	30b
	8	50de	10b

In each column, the numbers with similar letter have no significant difference by Duncan Multiple Range Test (DMRT) at 5 % level.

TABLE III
EFFECT OF WATER EXTRACT OF LEAVES, STEM AND ROOTS OF SISIR AND DESSO ON PLUMULE AND RADICLE LENGTH OF WHEAT AFTER 10 DAYS(MEAN OF 3 REPLS.)

Conc.		Plumule length (mm)	Radicle length (mm)
DESSO			
Leaf	0	102abc	110abc
	2	110cdef	118cdefg
	4	118efg	120defg
	8	75ghi	79jk
Stem	0	96abcd	120bcde
	2	94abcde	100acde
	4	93abcd	95abcd
	8	70defg	81fghi
Root	0	103ab	113abcd
	2	93bcdef	95bcdef
	4	84defg	88defg
	8	69fg	72efgh
SISIR			
Leaf	0	105ab	117ab
	2	16hi	4lkl
	4	5i	1ll
	8	2.5j	5l
Stem	0	108a	116a
	2	64fgh	74ghij
	4	57gh	59hij
	8	10j	15l
Root	0	100abc	112ab
	2	39abcd	100abcd
	4	62fgh	63ji
	8	74hi	52jk

In each column, the numbers with similar letter have no significant difference by Duncan Multiple Range Test (DMRT) at 5 % level.

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