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ALLELOPATHIC ARRANGEMENT OF THE NOXIOUS WEED; PHALARISMINOR RETZ. GROWING IN TRITICUM AESTIVUM L. FIELDS

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Abstract:-
The present investigation aims to study the biological activity of concentration (40%) of Deverra tortuosa (DTSCP) and Haplophyllum tuberculatum (HTSCP) shoot crude powder as well as a mixture (w/w) of both donor species on Free amino acids, free proline, total antioxidant content and DPPH free radical scavenging assay of Triticum aestivum (crop species) and Phalaris minor (weed species) in pure and mixed cultures. In generalthe two plants exhibit a tendency to accumulate amino acids and free proline. The increase in free amino acids was higher in T .aestivumgrown in mixed culture compared to seedlings grown in pure culture. Treatment with both DTSCP and HTSCP caused an increase in free amino acid content in P. minor seedlings grown in mixed culture compared to seedlings grown in pure culture. Control T. aestivum seedlings grown in mixed culture had higher total antioxidant content compared to seedlings grown in pure culture. There was a significant increase in antioxidant in T. aestivum seedlings treated with 40% DTSCP. This showed that seedlings grown in mixed culture scavenge more free radicals compared to those grown in pure culture.

Keywords:- *Deverra tortuosa, Haplophyllum tuberculatum, free amino acids, free proline, DPPH free radical scavenging.*

INTRODUCTION

Allelopathy is a biological phenomenon by which an organism produces one or more bio-chemical's that influence the growth, survival and reproduction of other organisms. These bio-chemicals are known as allele-chemicals which released from plant parts by leaching, root exudation, volatilization, residue decomposition and other processes in both natural and agricultural systems. Allelopathy also involves chemical interactions at all levels of complexity, from microorganisms to higher plants [1].

Weeds compete for light, nutrients, moisture and space with the crop and thus cause severe losses to yield. Losses in wheat due to weeds range from 17 to 25%[2] and in economic terms it may be as high as around 28 billion[3].The reduction in crop yield may also be attributed to the allelopathic property exhibited by a number of weeds, especially, the aggressive ones. Such species of weeds, because of their growth habit, make agricultural operations more difficult. Furthermore, the crop contaminated with the weed seeds, is considered to be of poor quality such as seeds of *Avenafatua*and *Phalaris minor* in wheat and barley seeds [4].

The biological solution to minimize the perceived hazardous impacts from herbicides and insecticides in agriculture production lies in the field of allelopathy. The harmful impact of allelopathy can be exploited for pest and weed control [5 and 6]. Much research has documented the potential of allelopathic plants to affect weed emergence. The question of what allelopathic plants should be selected, how they are applied, and their benefits should be seen as a requisite before introducing them to the farmers for field usage [7]. In this regard, the use of crops having allelopathic properties can reduce the dependency on synthetic herbicides and increase crop yields [8].

Wheat (*Triticum aestivum* L., Poaceae) is considered the main cereal crop in Most of the world. Management must be designed to find a long-term method of control of canary grass (*Phalaris minor* Retz. Poaceae); annual croplands weed. It is found predominantly in fields cultivated for wheat. It is indigenous to the Mediterranean region and was introduced to Australia, Africa, Hawaii, India, and Pakistan and since then to many countries of the world [9]. Therefore, the purpose of the present study was to carry out an evaluation on the biological activity of *Deverra tortuosa* (Desf.) DC. (Apiaceae) and *Haplophyllum tuberculatum* (Forssk.) A. Juss. (Rutaceae) crude powders of their aerial shoot on some growth and physiological parameters of the most problematic weed in *T. aestivum* L. fields; *P. minor*. We hope that the study will provide information about the possibilities of using the two donor species as bioherbicides.

MATERIALS AND METHODS

Plant materials and experimental design

Shoots of the two target species (*Deverra tortusa*and *Haplophyllum tuberculatum*) have been collected from Mersa Matruh 260 km west of Alexandria city during the vegetative stage**.** The plant materials were dried in shade then ground in a Wiley Mill to coarse uniform texture and stored in glass jars until use. Seeds of the weed (*Phalaris minor*) and crop species (*Triticum aestivum* cv. Gemmiza 10) were purchased from the International Research Center, El-Dokki, and Giza, Egypt.

The soil samples were finally sterilized at (90ºC for 48 h) to remove any microorganisms and weed seeds. Twenty seeds of each of the weed and crop species were sown in plastic pots (16 cm in diameter) in pure and mixed culture practices with about 1500 g of sandy loam soil thoroughly mixed (w/w) with 40 % of electrically crushed crude powder of the shoots of the target species.

One treatment was run as control with zero percent of crude powder. Treatments were arranged in a completely randomized block design with three replicates. The plants were watered every two days on the average with normal tap water. The amount of water corresponding to average soil–plant evapotranspiration calculated from weight loss over a 24 –hour interval. The experiment was performed under normal laboratory conditions (20±2°C temperature, 75±2% relative humidity, and 14/10 h light/dark photoperiod).

After 21 days, the homogenous seedling were carefully collected from each treatment, washed with tap water to remove the adhering soil particles, and then, by distilled water, gently blotted with filter paper. The seedlings were separated into shoots and roots for the determination of seedling fresh weight as well as seedling length. Additionally, leaf area of the two recipient species was also evaluated. Other samples were dried at 65ºC till constant weight to determine the seedling dry weight.

Free amino acids analysis

The method of Moore and Stein **[10]** was adopted for the estimation of total free amino acids.

Determination of proline

Proline content was measured as described by Bates *et al.***[11].**

RESULTS

Allelopathic potential of *Deverra tortuosa* shoots crude powder (DTSCP), *Haplophyllum tuberculatum* shoots crude powder (HTSCP) and a mixture (w/w) of both on some growth parameters of *Triticum aestivum* and *Phalaris minor in* pure and mixed cultures, twenty one days after sowing.

There was an increase in proline content of *T. aestivum* seedlings subjected to DTSCP. In control *T. aestivum* seedlings the proline content was about 0.86 .The values reached 1.19 and 1.44 in pure and mixed cultures, respectively. This accounts to an increase of about 38% in both pure and mixed cultures. **Free proline (Table 1 and Figure 1).** In control *T. aestivum* seedlings the proline content was about 0.86 and 0.89 mg/g in pure and mixed cultures respectively. Treatment with HTSCP caused an increase in free proline content in both pure and mixed cultures. The percent increase was 34.8% and 39.4% in pure and mixed cultures, respectively. Similarly, there was a significant increase in proline content of *T. aestivum* seedlings subjected to both DTSCP and HTSCP. In control *T. aestivum* seedlings the proline content was about 0.86 and 0.89 mg/g in pure and mixed cultures respectively. Treatment with both DTSCP and HTSCP caused an increase in free proline content in both pure and mixed cultures. It reached 1.45 and 1.71 mg/g dry weight. In pure and mixed cultures, respectively .The percent increase was 40.6% and 48% in pure and mixed cultures respectively.
Treatment with DTSCP caused an increase in free proline content of *T. aestivum* seedlings. It reached 1.78 and 2.14 mg/g dry weight in pure and mixed cultures, respectively. The percent increase was 30 and 31% in pure and mixed cultures, respectively.

The proline content of control *P. minor* seedlings was about 1.24 and 1.46 mg/g in pure and mixed cultures, respectively. Treatment with 40% HTSCP caused an increase in free proline content of seedlings grown in both pure and mixed cultures. It reached 1.95 and 1.88 mg/g d.wt. In pure and mixed cultures, respectively .The percent increase was about 57% in pure and 22% in mixed cultures, respectively. Applying 40% DTSCP and HTSCP also caused an increase in free proline content. It reached 2.17 and 2.54 mg/g d.wt. In pure and mixed cultures, respectively .The percent increase was about 75% in pure and 74% in mixed cultures, respectively.

Free amino acids (Table 1 Figure 2).

There was a significant increase in free amino acids in *T. aestivum* seedlings treated with DTSCP .The increase in free amino acids was higher in *T. aestivum* seedlings grown in mixed culture compared to seedlings grown in pure culture. Free amino acid content of *T. aestivum* seedlings in pure culture treated with DTSCP was 17.94, while the value was 20.73 mg/g d.wt.in mixed culture. The percent increase in free amino acids content was 36.4% in pure culture and 54% in mixed culture (Table 1).

Free amino acid content of *T. aestivum* seedlings in pure culture treated with HTSCP was 17.55, while the value was 22.74 mg/g d.wt.in mixed culture. The percent increase in free amino acids content was 33.4% in pure culture and 69% in mixed culture. Free amino acid content of *T. aestivum* seedlings in pure culture treated with both DTSCP and HTSCP was 18.35 mg/g d.wt.in pure culture, while the value was 20 mg/g d.wt.in mixed culture. The percent increase in free amino acids content was 40% in pure culture and 48.5% in mixed culture.

The free amino acids of control *P. minor* seedlings reached 10.22 and 11.04 mg/gd.wt. In pure and mixed cultures .There was a significant increase in free amino acids in *P. minor* during treated with DTSCP. The increase in free amino acids was higher in *T. aestivum* seedlings grown in mixed culture compared to seedlings grown in pure culture. Free amino acid content of *P. minor* seedlings in pure culture treated with DTSCP was 13.84 mg/g d.wt.in pure culture, while the value was 15.99 mg/g d.wt.in mixed culture. The percent increase in free amino acids content was 35.4% in pure culture and 45% in mixed culture.

Free amino acid content of *P. minor* seedlings in pure culture treated with HTSCP was 13.54 mg/g d.wt.in pure culture, while the value was 17.53 mg/g d.wt.in mixed culture. The percent increase in free amino acids content was 32.4% in pure culture and 58.7% in mixed culture.
Treatment with 40% DTSCP and HTSCP also caused an increase in free amino acid content. The increase in free amino acids was higher in *P. minor* seedlings grown in mixed culture compared to seedlings grown in pure culture. Free amino acid content of *P. minor* seedlings in pure culture was 14.15 mg/g d.wt.in pure culture, while the value was 15.43 mg/g d.wt.in mixed culture. The percent increase in free amino acids content was 38.5% in pure culture and 40% in mixed culture.

Table 1. Variation in free proline and free amino acids of *Triticum aestivum* and *Phalaris minor* seedlings in pure and mixed cultures as affected by different concentrations of *Deverra tortuosa* shoots crude powder (DTSCP), *Haplophyllum tuberculatum* shoots crude powder (HTSCP) and both of (w/w), twenty one days after sowing and at maximum crude powder concentration (40%). Data are means of three replicates.
Different letters within each column indicate a significant difference at probability level ≤ 0.05 according to ONE WAY ANOVA

Parameter	Control		DTSCP		HTSCP		DTSCP + HTSCP	
	Pure	Mixed	Pure	Mixed	Pure	Mixed	Pure	Mixed
	Triticum aestivum							
Free proline(b)	0.86^{a}	0.89^{a}	1.19^{a}	1.44^{a}	1.32^{a}	1.47^{a}	1.45^{a}	1.71^{b}
Free amino acids(b)	13.1 5^{c}	13.46^{c}	17.94^{c}	20.73^{c}	17.55^{c}	22.74^{d}	18.35^{c}	20.00^{d}
P. value*	0.327		0.261		0.329		0.252	
	Phalaris minor							
Free proline(b)	1.24^{a}	1.46^{a}	1.78^{a}	2.14^{b}	1.95^{b}	1.88^{b}	2.17^{b}	2.54^{b}
Free amino acids(b)	10.2 2^{c}	11.04^{c}	13.84^{c}	15.99^{c}	13.54^{c}	17.53^{d}	14.15^{c}	15.43^{d}
P. value*	0.289		0.240		0.170		0.233	

*P-value was considered significant at ≤ 0.05 probability level according to paired t-test.

DISCUSSION

Our results showed that, the increase in free amino acids was higher in *T. aestivum* seedlings grown in mixed culture compared to seedlings grown in pure culture. Free amino acids content of seedlings grown in pure culture treated with DTSCP increased to about 36.4% in pure culture and 54% in mixed culture. *T. aestivum* seedlings grown in HTSCP showed a percent increase in free amino acids content of about 33% in pure culture and 69% in mixed culture.

[12]Reported that total free amino acids content in Cicer*arietinum*increased with increasing the concentrations of *Moringaoleifera*leaves extract. Relatively low amino acids content was found at 2.5% concentration and further increased thereafter. The increase in amino acids content might be due to rapid hydrolysis of proteins, which results in release of free amino acids.

Proline is one of the most important water soluble amino acids and is supposed to play an important role in osmotic adjustment with regard to reduction of osmotic potential due to net accumulation of solutes **[13 and 14]**. Plants accumulate osmolytes like proline in response to abiotic stresses to protect the macromolecules of cells **[15 and 16]**. Proline is also known to occur widely in higher plants and normally accumulates in large quantities in response to environmental.

Stresses **[17]**. Over accumulation of osmolytes may help plants to tolerate against stress by improving their ability to maintain osmotic balance within the cell **[18]**. The high level of proline may be protecting plants from stress conditions **[19]**. The present investigation showed that accumulation of proline increased significantly in wheat leaves in response to the application of the different crude powders (DTSCP, HTSCP or both). Treatment with HTSCP caused an increase in free proline content in both pure and mixed cultures. The percent increase was 34.8% and 39.4% in pure and mixed cultures respectively. Similarly, treatment with 40% HTSCP caused an increase in free proline content of *P. minor* seedlings grown in both pure and mixed cultures. The percent increase was about 57% in pure and 22% in mixed cultures respectively. Applying 40% DTSCP and HTSCP also caused an increase of about 75% in pure and 74% in mixed cultures respectively.

The increase in proline content in response to allelochemicals has been reported.**[20]**concluded that with application of heliotrope leaves extracts, level of proline significantly increased in leaves of Dodder. The increased accumulation of proline content in response to drought and salt stresses has also been reported by **[21 and 22]**. The current investigation showed that increased accumulation of proline in response to HTSCP and DTSCP might reveal that these crude powders gave some sort of osmotic stress to *T.*
aestivum and *P. minor* which resulted in increased accumulation of stress oriented proline.

CONCLUSION

Based on the results of this study, the species with the strongest allelopathic potential, *Haplophyllum tuberculatum* must be examined for its selective action on other field conditions. Analysis of possible allelochemicals is also required. The isolation and characterization of growth inhibitors, which might be responsible for the strong allelopathic potential, are needed. There is possibility of using these allelochemicals for the discovery and development of environmental friendly herbicides to control weeds.

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