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ALLELOCHEMICALS EFFECTS OF SOME WEEDS ON ASSOCIATED PLANTS AND RHIZOBACTERIA

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ABSTRACT

The present work was carried out to investigate the allelochemical characteristics of common dandelion (Taraxacum officinale), black nightshade (Solanum nigrum L.), mallow (Malva parviflora) in El-Jabel Al-khdar region, Libya. The effects of these plants exudates were examined in associated naturally occurring rhizosphere bacteria communities. Aqueous extracts were bioassayed on wheat (Triticum aestivum L.), faba bean (Vicia faba) and lolium grass (Lolium multiflorum) seed germination and growth parameters. As regard to the effect of water extract, the calculated EC_{50} values of T. officinale were 17.5, 10.5 and 13.6g 100ml^{-1} (T. aestivum), 7.0, 3.20 and 2.80g 100ml^{-1} (L. multiflorum) against germination, root length and shoot length, respectively. Meanwhile, M. parviflora had a least EC_{50} values by 2.5, 1.2 and 5.0 mg ml^{-1} (T. aestivum), 2.50, 2.0 and 1.80g 100ml^{-1} (L. multiflorum) against germination, root length and shoot length, respectively. Finally, the S. nigrum EC_{50} values were 6.8, 5 and 5.0 g100 ml^{-1} (T. aestivum), 5.9, 6.5 and 10.2 g 100 ml^{-1} (L. multiflorum) against germination, root length and shoot length, respectively. Organic extracts by ethyl acetate and chloroform of T. officinale, S. nigrum and M. parviflora exhibited prominent herbicidal activity as compared to hexane extract on L. multiflorum weeds and T. aestivum. The highest allelopathic activity against the tested plants achieved from M. parviflora was followed by S. nigrum. However, the lowest phytotoxicity was achieved from T. officinal. Root exudates exhibited marked effects in total counts of rhizosphere bacteria than non rhizosphere soils, while S. nigrum and M. parviflora had a strikingly allelopathy activity against tested plants which colonized with higher number of rhizobacteria as compared with T. officinale which has lower allelopathic activity and rhizobacteria counts. These results offered a great potential of allelopathic weeds towards both the weeds control and crop growth.

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INTRODUCTION

Weeds are well known to interfere with crop plants' growth causing serious damages through either competition or allelopathy. Allelopathy is the release of chemicals by one plant into the environment. These secreted allelochemicals may be a critical component in the process of signaling and recognition that occurs between the plants and others organisms (Rice, 1984).

Broadleaf weeds; *Taraxacum officinale*, *Malva parviflora* and *Solanum nigrum* are growing fast and compete for resources, it considered a major problem and substantially reduce crops yield and quality. *T. officinale*, often simply called "dandelion", is a flowering herbaceous perennial plant of the family Composite. *T. officinale* is considered a weed, especially in lawns and along roadsides, but it is sometimes used as a medical herb and in food preparation. *T. officinale* is a vigorous weed in Europe with diploid sexual populations in the southern regions and triploid or tetraploid apomicts in the central and northern regions (Van-Baarlen *et al*., 2000). Dandelion is a common weed that infests terrestrial habitats with widely variable environments. It is a noxious weed in pastures, forages, orchards, lawns, golf courses, municipal parks, and road sides, and it is known to reduce the yields of several crops (Holm *et al.,* 1991). Among wild plants, the common dandelion (*T. officinale*) has received attention as bio-indicator plant (Królak, 2003; Simon *et al*., 1996), and has also been suggested in remediation projects (Turuga *et al*., 2008), given its ability to uptake and store heavy metals in the aerial tissues. The *T. officinale* is a very common specie, widely diffused in Central and Southern Europe, easy to identify and greatly adaptable to every substrate (Keane *et al.*, 2001). Moreover, this specie is commonly collected to be used in cooking as fresh salad or boiled vegetable, and is also used in ethno botany and traditional pharmacopoeia (Rosselli *et al*., 2006). Therefore, when grown on heavily contaminated soils, it may be potentially harmful if introduced in dietary food as happens in many countries.

Mallow *M. parviflora L*. is an annual medicinal herb belonging to the family Malvaceae, this weed is abundant in Egypt (Shaltout *et al*., 2010), is famous for medicinal properties. Its leaf extracts possess anti-inflammatory and antioxidant activities (Bouriche *et al*., 2011).

Common mallow *M. parviflora* weed has deterrent effects on a number of plant species, including barley crop. *Malva* weed species affect many plant species by reducing the germination rates and seedling growth (Qasem, 1992; Zahedi and Ansari, 2011). The extracts of *M. parviflora* L. and *Malvastrum coromandelianum* L. showed similar patterns of antibacterial activity against *Escherichia coli* but slight variations in the antibacterial response against *Proteus vulgaris, Bacillus subtilis* and *Staphylococcus aureus* (Islam *et al*., (2010).Photosynthesis was also inhibited by aqueous extract of the two weeds, with more effect being with *Chenopodium murale* compared with *Malva parviflora* AL-Johani, *et al.* (2012).

Solanum nigrum L. (SNL), belonging to the nightshade of the Solanaceae family, is an herbal plant which commonly grows in temperate climate zones. The plant has been traditionally used as hepatoprotective agent in India. Fruit of plant is also used as a nervous tonic in the Mexican medicine. Chemically, solasodine, solasonine and solanidine have been identified from plant Perez *et al*., (1998). *Solanum*, a wide spread plant genus of the family Solanaceae, has over 1000 species worldwide with at least 100 indigenous species in Africa and adjacent islands; these include a number of valuable crop plants and some poisonous ones Jaeger and Hepper (1986). *Solanum nigrum* is an annual weed that grows up to 60 cm tall, is branched and usually erect, growing wild in waste land sand crop fields Kirtikar and Basu (1987). *S. nigrum* is a widely used plant in oriental medicine where it is considered to be antitumorigenic, antioxidant, anti-inflammatory, hepatoprotective, diuretic, and antipyretic. Black nightshade is a serious agricultural weed when it competes with other crops (Keeley and Thullen, 1991). Parts of this plant can be toxic to livestock and humans, and it's considered as weed. Nonetheless, ripe berries and cooked leaves of edible strains are used as food in some locales; plant parts are used as a traditional medicine (Mohyuddint *et al*., 2010). The maximum rhizosphere effect (507 cfu / ml) of gram negative bacteria was observed in *Solanum nigrum* and the minimum (95cfu/ml) of gram negative bacteria effect was seen in *Leucas aspera*. The bacterial colonies were characterized and observed the dominance of gram positive. There is a specificity of microbes towards the differentiated medicinal plants, because of their exchange of metabolites (Ramesh *et al*., 2012).The present work aimed to study the allelochemicals characteristics of common dandelion *T.officinale,* black nightshade *S. nigrum* L. (SNL), mallow *M. parviflora* against other lolium gras*s Lolium multiflorum* and wheat *Triticum aestivum L*. as well as faba bean *Vicia faba* crops. The effect of the tested plants root exudates was estimated on rhizospheric bacteria total counting. Dose-response relationships between allelochemicals concentrations of

water and organic extracts and the tested species growth parameters were evaluated.

MATERIALS AND METHODS

Parts of Dandelion (*Taraxacum officinale*), black nightshade (*Solanum nigrum* L.), and mallow (*Malva parviflora* L.) were collected during April to July, 2014, whereas seeds of wheat *(Triticum aestivum* L.) and faba bean (*Vicia faba*) as well as lolium grass *(Lolium multiflorum*) also obtained from the Faculty of Agriculture Farm, Omar Al-Mukhtar Univ. Libya. Samples were identified according to Flora of Libya (1976).

Water Extracts

T. officinale, S. nigrum, *M. parviflora* plants were washed, air dried at room temperature and grounded to fine powder. One hundred grams of air dried powder tissues of all plant parts were extracted with 1000 ml D. water in a rotary shaker for 5 hours at lab temperature. The mixture was filtered through two layers of cheeth cloth to remove fibers, and was filtrated again through Whatman No # 4 paper. The filtrate was considered as a 100 g dry wt./liter solution, and diluted to different concentrations 0, 2.5, 5, 10, 15 g/100ml for bioassayed on *V. faba*, *T. aestivum* and *L. multiflorum* using glass petri dishes.

Organic Extracts

The fine plant powders (500 grams) were successively extracted by soaking over night then, mechanically shaking for 5h.with 2.5 liter of hexane, chloroform and ethyl acetate. The crude extract of each solvent was filtered and subsequently evaporated by rotary evaporator till dryness. The resulting crude extracts bioassayed with concentrations (0, 200, 400 and 800 µg ml^{-1}) for *T. officinale* (0, 50, 100 and 200 µg ml^{-1}) for *M. parviflora* and *S. nigrum* respectively to *T. aestivum* and *L.multiflorum* seeds.

Bioassay with Filter Paper Technique

Seeds were sterilized using sodium hypochlorite (0.3% V/V) for 3 min and washed in sterile distilled water. The sterilized seeds of lolium grass*,* wheat and faba bean were placed on filter papers in 9-cm petri-dish. Aliquot (10ml/dish for water extracts and 5 ml/dish organic extracts) from each concentration and the control treatments used the same solvent without the extract. Petri dishes were kept under room temperature (25^0C±3) in three replications whereas each experiment was repeated three times in the same conditions, whereas each experiment considered one replicate.

Bacterial Counting on Rhizosphere and Non-Rhizosphere (bulk) Soils Associated to the Selected Plants

Thirty Soil samples from six locations were collected from Faculty of Agriculture Farm, Omar Al-Mukhtar Univ. at El Beida city,

Libya, during 2014 for adjacent stands of Dandelion (*Taraxacum officinale*), black nightshade (*Solanum nigrum* L.) and Mallow (*Malva parviflora*). Soil texture was sandy loam, with PH (7.5) and EC 135 (m mohs/ cm) , while Cation; Na+ (136),K+ (5.1),Ca^{+2} (8.2) ppm and Anion; CO_3^{-2} (87),HCO^{-3} (110),CL^{-1} (35),SO_4^{-2} (173) ppm as described by Black (1973), Jackson 1967and Rowell (1994).The selected plant roots were shaken several times to remove the attached rhizosphere soil particles. One gram from rhizosphere and non-rhizosphere soils samples were taken and stored at - 4^0C and subsequently used for microbiology analysis through the dilution plate technique (Johnson *et al.,* 1959). Nutrient agar was used for the enumeration of bacteria with five replications, while the petri dishes were incubated at 27 ±1C for 24 h for bacteria. Data were expressed as Colony Forming Units (CFU) /g soils (Parkinson *et al.,* 1971).

Data analysis

Seeds germination (G %), shoot and root lengths of plant seedlings were recorded after 7 days of incubation .The relative reduction (R%) of the growth trait was calculated as follows: R% = $C-T/C\ x100$ Where the growth trait value is(C), in control and (T) in treatments. The effective dose (ED50 values) (that provided 50 % reduction in plant trait) was calculated according to Finney (1971). Vigour index (VI) = this was calculated according to Kharb *et al*. (1994) using the formula: (VI) = (MRL+MSL) $_X$ G% = (Mean root length+ Mean shoot length) x Germination percentage. Data of Randomized Complete Block Design experiments were statistically analyzed by ANOVA, according to Snedecor and Cochran (1990) and treatment means were separated and compared by LSD test at 5% level of probability.

RESULTS AND DISCUSSIONS

Taraxacum officinale

The aqueous extracts of *T. officinale* at 10 and 15 g 100 ml^{-1} significantly reduced *V. faba* germination by 38.46 and 38.46 %, shoot length 66.6 and 78.16% and root lengths 48.0, and 64.0% respectively as compared to the control. The water extracts of *T. officinale* revealed that these extracts at 10 and 15 g 100 ml^{-1} were inhibited significantly *T. aestivum* seeds germination by 60.0 and 60.0 %, shoot lengths 59.52 and 64.29% and root length 30.56 and 75.0% respectively as compared to the control. In this test, aqueous extract was greatly affected *L. multiflorum* at 5 and 10 g 100 ml^{-1} conc. and caused reduction up to 46.6 and 60.0% (germination), 61.6 and 97.6% (shoot length) and 55.86 and 76.5% (root length) respectively, in comparison with the control. The calculated EC_{50} values of *T. officinale* were 17.5, 10.5 and 13.6 g 100 ml^{-1}*T. aestivum*, 7.0, 3.20

and 2.80 g 100 ml^{-1} *L. multiflorum* for germination, root length and shoot length, respectively (Table-1).

The phytotoxine substances of *T. officinale* were extracted by hexane, chloroform and ethyl acetate and then were bioassayed in four concentrations 0, 200,400 and 800 µg ml^{-1} for both *T. aestivum* and *L. multiflorum* seeds incubated at 25°C±3 for 7 days under laboratory conditions. The effect of hexane and chloroform extracts at 800 µg ml^{-1} of *T. officinale* was investigated where the highest concentration caused a reduction in *L. multiflorum* germination reached, 59.97 and 60.55%, shoot length by 33.33 and 47.83% and root length by 16.3 and 40.39% respectively. On the other hand, ethyl acetate extracts of *T. officinale* at 400 and 800 (µg ml^{-1}) reduced all the studied traits of *L. multiflorum* by 70.0 and 90.0% for germination, 22.22 and 88.89%(shoot length) and 37.82 and 79.27%(root length), respectively in the comparison to the control. The results presented in (Table 2) revealed that the highest reduction in *T. aestivum* plant reached, 36.17 and 61.27% for germination, 56.3 and 60.83% for shoot length and 59.46 and 57.38% for root length, respectively, as a result of applied 800 µg/ml of *T. officinale* hexane and chloroform extracts. On the other hand, ethyl acetate extract of *T. officinale* at 400 and 800(µg/ml) reduced *T. aestivum* germination by 62.48 and 87.43%, shoot length by 28.95 and 70.79% and root length by 19.08 and 53.6%, respectively as compared the controls (Table-2).

Malva parviflora

The obtained results from *M. parviflora* aqueous extracts activity had adverse impact on *V. faba*, *T. aestivum* crops and *L. multiflorum* weeds. The water extract at 5, 10 and 15 g 100 ml^{-1} significantly reduced *V. faba* germination by 38.4, 38.4, and 38.4 % respectively. Meanwhile, these extracts had a slight effect on the shoot length and a markedly inhibiting effect on root length at 10 and 15 g 100 ml^{-1} by 21.34 and 36.09% respectively as compared to the control. Meanwhile, water extracts of 10 and 15 g 100 ml^{-1} were strongly inhibited *T. aestivum* seeds germination and growth parameters. While, these extracts at 2.5 and 5% reduced *T. aestivum* germination by 66.67 and 91.67 % respectively after 7 days from treatment. The extracts of 5 g 100 ml^{-1} decreased the shoot length significantly by 84.21% as compared to the control. In this test, aqueous extract greatly affected *L. multiflorum* at 5, 10, 15 g 100 ml^{-1} concentration and caused a complete inhibition on germination and seedling growth by 100%. *M. parviflora* had EC_{50} values by 2.5, 1.2 and 5.0 g 100 ml^{-1} *T. aestivum*, 2.50, 2.0 and 1.80 g 100 ml^{-1} *L. multiflorum* with respect to germination, root length and shoot length, respectively.

The evaluation of aqueous and organic extracts poses activity toward the selected plants proportional to the concentration of the extract. It was found that, the phytotoxicity of the studied aqueous extracts was higher in *V. faba* shoot length than other growth criteria, while the *T. aestivum* roots length was more sensitive than shoot length and seeds germination. *L. multiflorum* shoot length, however, was more sensitive than their root length and seed germinations (Table-1).

Isolation of *M. parviflora* phytotoxin substances which responsible for their allelopathic effects was performed using hexane, chloroform and ethyl acetate and bioassayed against the tested plants growth. The highest concentration of hexane (200 µg ml^{-1}) of *M. parviflora* extract completely suppressed *L. multiflorum* seed germination and seedling growth, while hexane extract of 50 µg/ml inhibited germination, shoot and root length by 66.6, 85.2, and 87.1% respectively. On the other hand, chloroform and ethyl acetate extracts of *M. parviflora* of 100 and 200 µg ml^{-1} were completely inhibited germination and seedling growth of lolium grass. The extracts at 200 µg ml^{-1} caused a reduction in seed germination by 73.6 and 72.17 %, shoot length by 69.4and 78.07 % root length by 62.9 and 80.65 % respectively in comparison to its controls (Table-3).

The highest concentrations of hexane, chloroform and ethyl acetate extract of *M. parviflora* of 200 µg ml^{-1} completely inhibited *T. aestivum* germination and seedling growth. These extracts of chloroform and ethyl acetate at 100 µg ml^{-1} caused reduction in *T. aestivum* germination by 85.36 and 75.05 %, shoot length by 74.1 and 74.5 % and root length by 58.9 and 87.32 % respectively in comparison to the controls. Ethyl acetate extracts had a stronger activity compared to both chloroform and hexane extracts on *T. aestivum* and *L. multiflorum*.

Solanum nigrum

The aqueous extract of *S. nigrum* parts was tested on *V. faba*, *T. aestivum* and *L. multiflorum* seeds germination and seedling growth. The extracts at 5, 10 and 15 g 100 ml^{-1} inhibited all the studied criteria of *T. aestivum* which recorded reduction by 33.3, 60.0 and 100 % for seeds germination, 31.82, 43.9, 52.73 and 100% for shoot lengths respectively after 7 days from treatment. While, root lengths were affected significantly by the extract at 10 and 15 g 100 ml^{-1} and reduced by 55.0 and 100.0% respectively as compared to the control. When, using lolium grass in the bioassays of *S. nigrum* at 2.5,5,10,15 g 100 ml^{-1} concentration, their germination were significantly inhibited by 38.46, 69.23, 84.6 and 92.31% respectively. The aqueous extract greatly decreased *L. multiflorum* grass at 10 and 15% g 100 ml^{-1} by 57.14 and 47.62% (shoot lengths) and 52.94 and

100% (root lengths) respectively, as compared to the control. *S. nigrum* gave EC_{50} values 6.8, 5and 5.0 g 100 ml^{-1} *T. aestivum*, 5.9, 6.5 and 10.2 g 100 ml^{-1} *L. multiflorum* seeds germination, root length and shoot length, respectively (Table-1).

The highest concentration of hexane extract of *S. nigrum* caused a reduction in *L. multiflorum* reached up to100% while 200 µg ml^{-1} caused a reduction by 77.83 % (germination), 44.4 % (shoot length) and 57.14 % (root length) respectively. On the other hand, the most effective crude extract were chloroform and ethyl acetate extracts at 50,100, 200 µg/ml which completely suppressed *L. multiflorum* seed germination and seedling growth for all the tested concentrations. The *S. nigrum* hexane crude extracts at 50, 100 and 200 µg ml^{-1} caused a reduction in *T. aestivum* reached, 50.0, 50.0 and 57.14% for germination, 17.24 and 6.9 %for shoot length and 21.43 and 17.86 %for root length respectively. On the other hand, chloroform extracts of *S. nigrum* at 50, 100 and 200 (µg ml^{-1}) reduced *T. aestivum* germination by 64.29, 81.0 and 92.80%, shoot length by 43.85, 52.65 and 82.9 % and root length by 16.8, 52.86 and 78.57 % respectively as comparison to the control. Finally, ethyl acetate extract of *S. nigrum* at 50 ,100 and 200 (µg ml^{-1}) reduced wheat germination by 52.8,66.6 and 75.0 %, shoot length by 11.1, and 40.74 %,root length by 30.36 and 64.29 %, respectively as the compared to the control. Chloroform extracts were the most active extracts as compared to ethyl acetate and hexane extracts (Table-4).

According to the estimated activity, it was shown that, the most susceptible plants were *L. multiflorum* and *T. aestivum* which showed highly positive responses to both water and organic soluble compounds extracts in comparison to *V. faba*. Whereas, *L. multiflorum* was more sensitive to *S. nigrum* water soluble compounds than *T. aestivum* and vice versa. Root length of the tested species may be too sensitive in both water and organically soluble extracts that is may be due to the direct contact with the phytotoxic than other growth parameters, while seedling shoot length was more responsive than germination to extract allelochemicals. The vigour index of faba ban was higher after treating with both *S. nigrum* and *M. parviflora* than *T. officinale* aqueous extracts after treated with sequences concentration. Otherwise, *L. temulentum* recorded the lowest viguor *index* in all treatments followed by *T. aestivum* (Fig. 1).

Bacterial accounting on rhizosphere and bulk soils associated with the selected plants:

The bacterial communities associated with the tested plants rhizosphere and bulk soils (non rhizosphere soils) were examined using dilution plate assay technique. The obtained results indicated the presence of microbe's counts of bacteria were higher in rhizosphere

than in non rhizosphere soils (Table-5). In this respect, the lowest total number of bacterial colony was resulted in *T. officinale* rhizosphere soils and non rhizosphere soil by 27.0×10^5 and 9.0×10^5 CFU/g respectively. Nevertheless, the highest count of bacteria observed in *M. parviflora* rhizosphere soils by 39.00×10^5 CFU/g. However, the highest total count of bacteria was found associated to *S. nigrum* bulk soils by 17.00×10^5 CFU/g. The variation in total microbial counts was even greater in rhizosphere and non rhizosphere soils. It could be concluded that root exudates exhibit markedly effects on bacterial total counts of rhizosphere than non rhizosphere soils.

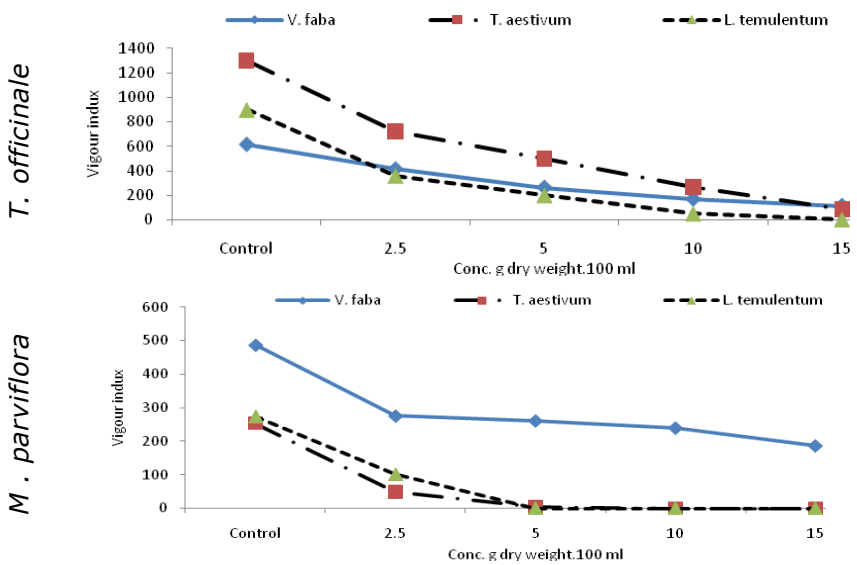
The above results showed an allelopathic activity of *T. officinale*, *S. nigrum, M. parviflora* weeds against *V. faba*, *T. aestivum* and *L. multiflorum* through both type of extracts aqueous and organic extracts with varied pattern effect proportional to the extract concentrations. The obtained results presented that *V. faba* was less sensitive to the allelochemicals of liberated from aqueous extracts than *T. aestivum,* while *L. multiflorum* weed was the most sensitive plant according to ED_{50} and Vigour Index values (Fig. 1). In this respect, responses indices revealed the inhibition of root growth parameters of seedlings was more pronounced than that of seed germination. The hexane extracts was slightly phytotoxic than chloroform and ethyl acetate crude extracts achieved the highest reduction activity against *T. aestivum* and *L. multiflorum* seeds germination and seedling growth. This results appeared that *S. nigrum* and *M. parviflora* have a markedly allelopathy activity against tested plants. These finding supported by Shehata and Galal (2014) they indicated the presence of active compounds including: saponin, flavonoids, alkaloids and phenols in both wild and cultivated of *M. parviflora* plants, while tannins were not detected in the former ones. Prakash and Jain (2011) and Modilal *et al*., (2015) revealed the presence of alkaloids, flavonols, flavones, flavanols, saponins and steroid in *S. nigrum*.

The higher activity of *S. nigrum* and *M. parviflora* plants colonized with higher number of rhizobacteria as compared with *T. officinale* which has lower allelopathic activity and rhizomicrobes counts. It may be this allelopathic plants associated with specific rhizosphere bactria in comparison with non-rhizosphere soil bacteria. These results are in agreement with (Katznelson 1946; 1965); while, Inderjit (2005) confirmed the significant role of soil microorganism in allelopathic expression. Menon and Williams (1957) also report that the microflora associated with different crops appeared to be specific. Result of these studies give a clearer understanding of the underground regulation between the allelopathic plants and rhizosphere microbial communities, it may be controlling number of rhizomicrobes types and regulate its allelopathic activity. This

investigation also, clearly explained the vigorous growth of these weeds in infested crops. Further studies were needed o identify these microbes and exploiting their beneficial roles in increasing crops productivity.

Table-1. Effect of *T. officinale* , *M . parviflora* and *S. nigrum* aqueous extract on plant germination and seedling growth.

	T. officinale								
	V. faba			*T. aestivum*			*L. temulentum*		
	G%	SL(Cm)	RL (Cm)	G%	SL(Cm)	RL (Cm)	G%	SL(Cm)	RL (Cm)
Control	86.67	2.90	4.17	100.00	7.00	6.00	100.00	4.17	4.83
2.5	73.33	1.93	3.70	60.00	6.00	6.00	73.33	1.97	2.93
5	66.67	1.93	2.00	60.00	2.83	5.50	53.33	1.60	2.13
10	53.33	0.97	2.17	40.00	2.50	4.17	40.00	0.10	1.13
15	53.33	0.63	1.50	40.00	0.63	1.50	0.00	0.00	0.00
LSD (0.05)	20.40	0.98	1.20	40.54	1.75	2.32	45.70	2.80	2.25
	M . parviflora								
Control	86.67	2.23	3.39	80.00	3.17	2.83	80.00	2.67	3.43
2.5	53.33	1.67	3.50	26.67	1.83	2.17	46.67	2.83	2.17
5	53.33	1.90	3.00	6.67	0.50	0.00	0.00	0.00	0.00
10	53.33	1.83	2.67	0.00	0.00	0.00	0.00	0.00	0.00
15	53.33	1.33	2.17	0.00	0.00	0.00	0.00	0.00	0.00
LSD (0.05)	21.54	NS	1.89	23.53	1.55	1.63	48.45	1.43	2.34
	S. nigrum								
Control	93.33	1.87	3.50	100.00	3.67	3.33	86.67	3.50	2.83
2.5	66.67	1.57	2.67	100.00	2.50	2.83	53.33	3.00	2.33
5	66.67	1.17	3.30	66.67	2.06	1.90	26.67	1.50	2.00
10	66.67	1.67	3.23	40.00	1.73	1.50	13.33	1.83	1.33
15	60.00	1.33	2.17	0.00	0.00	0.00	6.67	0.67	0.67
LSD (0.05)	NS	NS	NS	20.34	0.35	1.31	24.56	1.41	1.14
G% = Germination percentage				SL= shoot length			RL= root length		



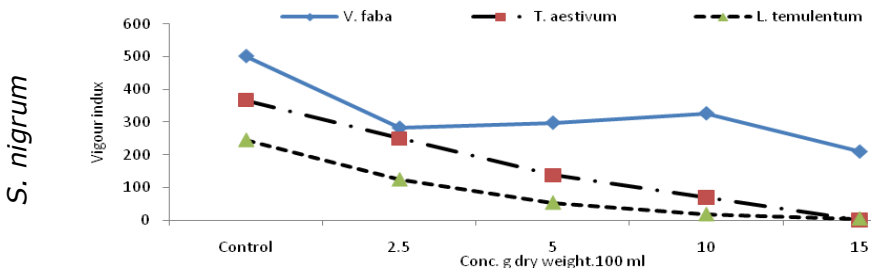


Figure 1. Effect of *T. officinale*, *M . parviflora* and *S. nigrum* water extracts different concentration on plant vigour index (VI)= (MRL+MSL)X G%

Table-2. Effect of *T. officinale* organic extract on *T. aestivum* and *L. temulentum* seed germination and seedling growth

		T. aestivum			*L. temulentum*		
		G%	RL (Cm)	SL(Cm)	G%	RL (Cm)	SL(Cm)
Hexane	Control	60.00	5.53	6.17	66.70	2.50	3.17
	200	55.00	5.17	5.17	40.00	2.25	3.00
	400	43.30	3.67	4.40	30.00	1.50	3.15
	800	38.30	2.42	2.50	26.70	1.67	2.65
	LSD $_{(0.05)}$	18.90	2.01	1.73	10.50	0.39	NS
Chloroform	Control	55.00	6.00	4.97	55.00	3.07	3.38
	200	45.00	5.57	4.07	35.00	1.83	3.05
	400	26.70	3.00	2.67	30.00	1.85	2.87
	800	21.30	2.35	2.12	21.70	1.60	2.02
	LSD $_{(0.05)}$	11.60	3.25	1.10	NS	1.24	0.79
Ethyl acetate	Control	53.30	6.33	5.07	50.00	2.25	3.22
	200	25.00	5.75	5.00	25.00	2.08	2.83
	400	20.00	4.50	4.10	15.00	1.75	2.00
	800	6.70	1.85	2.35	5.00	0.25	0.67
	LSD $_{(0.05)}$	7.80	1.37	1.82	8.20	0.24	0.63

Table-3. Effect of *M. parviflora* organic extract on *T. aestivum* and *L. temulentum* seed germination and seedling growth.

		T. aestivum			*L. temulentum*		
		G%	RL (Cm)	SL(Cm)	G%	RL (Cm)	SL(Cm)
Hexane	Control	60.00	6.00	5.70	60.00	5.63	5.17
	50	35.00	5.80	4.43	20.00	2.85	2.25
	100	31.70	4.83	3.50	13.30	0.83	0.67
	200	0.00	0.00	0.00	0.00	0.00	0.00
	LSD $_{(0.05)}$	25.50	3.98	2.69	35.50	3.78	3.93
Chloroform	Control	56.70	4.18	3.25	63.30	4.63	4.50
	50	33.30	3.22	3.17	16.70	1.42	1.67
	100	8.30	1.08	1.33	0.00	0.00	0.00
	200	0.00	0.00	0.00	0.00	0.00	0.00
	LSD $_{(0.05)}$	21.50	2.87	2.45	41.50	3.55	3.52
Ethyl acetate	Control	53.30	4.92	5.92	60.00	3.80	5.60
	50	30.00	3.57	4.00	16.70	0.83	1.08
	100	13.30	1.25	0.75	0.00	0.00	0.00
	200	0.00	0.00	0.00	0.00	0.00	0.00
	LSD $_{(0.05)}$	15.40	2.35	2.94	35.40	2.46	3.85

Table-4. Effect of *S. nigrum* organic extract on *T. aestivum* and *L. temulentum* seed germination and seedling growth.

		T. aestivum			*L. temulentum*		
		G%	RL (Cm)	SL(Cm)	G%	RL (Cm)	SL(Cm)
Hexane	Control	70.00	4.83	4.67	86.6	3.00	2.33
	50	35.00	4.67	4.00	73.4	3.00	1.67
	100	35.00	4.00	3.67	60	2.67	1.33
	200	30.00	4.50	3.83	23.3	1.67	1.00
	LSD $_{(0.05)}$	NS	NS	NS	2.011	1.01	0.76
Chloroform	Control	70.00	4.40	5.83	73.40	3.17	2.67
	50	25.00	2.50	4.85	26.60	1.50	2.50
	100	13.30	2.08	2.75	6.60	0.83	1.00
	200	5.00	0.75	1.25	0.00	0.00	0.00
	LSD $_{(0.05)}$	25.10	1.97	2.81	20.11	1.62	1.021
Ethyl acetate	Control	60.00	4.50	5.60	66.60	4.20	2.10
	50	28.30	4.08	5.00	0.00	0.00	0.00
	100	20.00	4.00	3.90	0.00	0.00	0.00
	200	15.00	2.67	2.00	0.00	0.00	0.00
	LSD $_{(0.05)}$	18.00	1.47	1.74	25.5	2.64	1.27

Table-5: Total numbers of bacteria (CFU/g) as mean $\times 10^5$ collected from rhizosphere and non rhizosphere soil of the selected plants

	Dilutions	Rhizosphere soil	Non rhizosphere soil
T. officinale	10^{-5}	27.00	9.00
M. parviflora		39.00	11.00
S. nigrum		36.00	17.00
LSD (0.05)		1.83	2.63

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