EFFECTS OF THE ROOT DEBRIS OF *Tithonia diversifolia* ON THE GROWTH OF *Zea mays* IN SOUTH-WESTERN NIGERIA

Ilori, O. J.
Biology Department, Adeyemi College of Education, Ondo, Nigeria
E-mail: olasupoilori@yahoo.com

Ilori, O. O.
Biology Department, Osun State College of Education, Ilesa, Nigeria
E-mail: kemi_akinloye@yahoo.com

Olajuyigbe, A. O.
Biology Department, Adeyemi College of Education, Ondo, Nigeria
E-mail: femolaj60@yahoo.co.uk

Sanni, R. O.
Biology Department, Adeyemi College of Education, Ondo, Nigeria
E-mail: zaytoon_02@yahoo.co.uk

ABSTRACT

This study investigated the allelopathic effect of Tithonia diversifolia root debris on the growth of Zea mays. Three hundred grams of ground dried roots debris of Tithonia diversifolia were added to plastic pots containing humus soil. The pots with no Tithonia diversifolia root residues were included as controls. The seeds of Zea mays were sown in the pots which were laid out in a completely randomized design. Results showed that the shoot lengths of the test crop were significantly enhanced by the root debris of Tithonia diversifolia. However, the root length of the test crop planted in the soil treated with root debris was significantly lower than those of the control regime. It was suggested that Tithonia diversifolia plant residues could be incorporated into soil to enhance the growth of cultivated crops.
Keywords: *Residue, dry weight, fresh weight, humus, allelopathic, cultivated crops.*

INTRODUCTION

Evidence of allelopathy has accumulated in the literature over many years and many kinds of allochemicals have been isolated and characterized from various plants (Duke, 1986; Putnam, 1988; Gross and Pathier, 1994; Seigler, 1996). *Tithonia diversifolia* (Hemsl) A. Gray commonly referred to as Mexican sunflower is a member of the family Asteraceae. It is an annual or perennial broad-leaved weed, which grows to about a height of five meters or more and varies from highly branched low population variety to unbranched high population variety. Ayeni, Lordbanjou and Majek (1997) stated that Tithonia diversifolia is an aggressive weed with high invasive capacity and the ability to compete successfully with agricultural crops

Allelochemicals from *Cytisus scoparius* accumulated in soils with low Organic Matter (OM) and inhibited lettuce seedling emergence. However, the allelochemicals did not accumulate and did not affect seedling emergence in high OM soils (Horrie, Nemoto and Nishimura, 1989). Sorgoleones also had limited activity because they are lypophilic and readily bound to OM in the soil (Chang, Netzly and Buttler, 1986; Hess, Ejeta and Buttler, 1992). Clay type may also affect adsorption. Dalton, Blum and Weed, (1989) detected 20% adsorption of ferulic acid on kaolin or gibbsite, 70% adsorption on goethite and 100% adsorption on histossol. They explained that the increased adsorption in these two last soil components was in part due to increased surface area, and in part due to the presence of Iron (Fe) and Aluminium (Al) oxyhydroxides (Dalton et al., 1989).

In the soil environment there are many supposed allelochemicals. Kimber (1973) indicated that in nature, the concentrations range from inhibitory for some allelochemicals to stimulatory for other allelochemicals and the resultant net effect in plants may be lower inhibition or stimulation or no effect at all. Daizy, Harminder, Nipunika and Ravinder (2006) reported that aqueous leachate of *(Chenopodium album)* plant parts (root, whole plant and leaf) inhibited the germination, plant height, growth and biomass of *Cassia occidentalis*. Rawat *et al*. (2002) stated that aqueous extract of root of Helianthus annus delayed and inhibited the germination and seedling growth of linseed *(Linum usitatissium L)* and mustard *(Brassica juncea)*. Aqueous extracts from the leaves of *Helianthus tubarosus L. Xanthium occidentale,*

Luctuca sativa and *Cirsium japonica* all in the Asteraceae family inhibited the root growth of lucerne (Chon, Kin and Kee, 2003). Javed and Asghari (2008) stated that the leaf extract of *Helianthus annus* inhibited the rate of germination of wheat seedlings.

Qasem and Abu-Irmaileh (1995) observed that the dried shoot extract of *Amaranthus gracilis* increased shoot and root dry weights of wheat seedlings. Sassad et al. (2007) stated that senna extract promoted the growth of *Avena fatua, Dectyloctenium aegyptium* and *Echinocloa colona.* Corn dry weight increased by 20 to 75% when legume debris was placed on the soil surface and incorporated debris had very little effect on corn emergence or dry weight (Randall, White, Douglas and Udo, 1989).

Randall et al. (1989) also stated that the emergence and growth of corn and cotton were not affected when planted into soil samples, containing root biomass and possible leaf and root exudates, collected from beneath field-grown hairy vetch and crimson clover plants. However, morning glory dry weight increased by 35% in the presence of legume root debris (Randall et al., 1989). *Tithonia diversifolia* associates with common crops like vegetables, cassava, yam, rice, sorghum, soyabean etc becomes a dominant plant where it is present (Tongma, Katsuichiro and Kenji, 1998). *Tithonia diversifolia* has been reported to contain some allelochemicals therefore; this study was aimed to investigate the effect of *Tithonia diversifolia* root debris on the growth of *Zea mays*

MATERIALS AND METHODS

Good humus top soil was collected besides the Faculty of Agriculture, Obafemi Awolowo University, Ile-Ife and the soil was put into plastic pots. Three hundred grams of ground dried roots of *Tithonia diversifolia* was added to plastic pots. The pots with no *Tithonia diversifolia* residues were included as controls. The seeds of *Zea mays* were sown in the pots which were laid out in a completely randomized design. The test crop was watered with 400 ml of tap water every morning. The experiment was kept weed-free by hand weeding throughout the growing period. Harvesting of the seedlings was on weekly interval for a period of five weeks. The shoot height was measured as the distance between the bases of shoot at soil level and the upper point of the terminal bud of the seedling. The root system

was carefully excavated and the root was washed free of soil and the lengths of the roots were measured as distance between the base of plant and root tip. Five seedlings were randomly harvested in each regime. Each seedling was separated into shoot and root. The fresh shoot and root were weighed on a metler Toledo balance to obtain the fresh weight of the plants parts. Also, shoot and root were packaged separately in envelopes and dried to constant weight at 80^{o}C in a GallenKamp (Model IH-150) .The dried plant parts were weighed on a metler Toledo balance to obtain the dry weight of the plants parts.

RESULTS AND DISCUSSION

The effect of the root debris of Tithonia diversifolia on the shoot and root length of Zea mays is shown on Table 1. The shoot lengths of the test crop were significantly ($P < 0.05$) enhanced by the presence of the root debris of Tithonia diversifolia in the soil in which the crop was planted. However, the root length of the test crop in the pot containing the root debris was significantly lower than those of the control regime. Incorporation of the root debris into the soil increased the fresh weight of the shoot and root of the test crop in the latter part of the experiment (Table 2).The dry weights of the shoot and root of Zea mays planted in the soil containing root debris were significantly higher than those of the plants in the control regime (Table 3). Once entered into the soil the bioactive concentration of allelochemicals is determined through the adsorption, fixation, leaching and chemical and microbial degradation (Blum, 1999 and Inderjit et al, 1999). Soil chemical, physical and biological characteristic to a great extent are responsible for detoxification on further enhancement of the allelopathic activities of the plant diffusates (Cheng, 1995). The results from this study indicated that the root length of Zea mays was inhibited by the root debris. This was consistent with the work of Ilori, Otusanyav and Adelusi (2007) who stated that the radical growth of Oryza sativa was inhibited by aqueous extract of Tithonia diversifolia. The shoot height, fresh and dry weights of the shoot and root treated with the root debris of Tithonia diversifolia were higher than those of the plants in the control regime. These indicated that the root debris of Tithonia diversifolia enhanced these growth parameters. This was contrary with the finding of Rawat et al. (2002) who stated that aqueous extract of root of

Helianthus annus delayed and inhibited the germination and seedling growth of linseed (Linum usitatissium L) and mustard (Brassica juncea). However, the result agreed with the work of Randall et al. (1989) who stated that Corn dry weight increased by 20 to 75% when legume debris was placed on the soil surface. Also, Sassad et al. (2007) reported that senna extract promoted the growth of Avena fatua, Dectyloctenium aegyptium and Echinocloa colona. These observations might be due to low concentration of allelochemical present in the residues or degradation of the allelochemicals present in the root debris. The stimulatory effects of the root debris on some of the growth parameter of Zea mays suggested that Tithonia diversifolia plant residues could be incorporated into soil to enhance the growth of cultivated crops.

Table 1: Effect of Tithonia diversifolia debris on the shoot height and root length of Zea mays

	Shoot Height (cm)				Root Length(cm)			
Weeks	Control	Treated	F	Sig	Control	Treated	F	Sig
1	6.38	8.24	8.257	.021	13.26	6.24	55.80	.000
2	8.76	10.90	3.529	.097	13.90	10.92	3.13	.115
3	9.16	13.84	33.42	.000	25.20	19.00	160.16	.000
4	17.74	20.18	38.41	.000	62.10	54.00	22.45	.002
5	21.16	23.93	5.16	.053	65.50	51.80	34.03	.000

Source: Experimentation, 2009

Table 2: Effect of Tithonia diversifolia debris on the Fresh shoot weight and Fresh root weight of Zea mays.

	Fresh shoot weight (g)				Fresh root weight (g)			
Wks	Control	Treated	F	Sig	Control	Treated	F	Sig
1	1.74	1.64	.06	.816	.14	.35	88.89	.000
2	3.44	6.00	32.90	.000	.88	1.16	1.52	.253
3	3.36	8.25	586.79	.000	.86	2.75	428.19	.000
4	6.58	8.10	27.05	.001	1.29	1.56	22.21	.002
5	8.57	9.56	6.13	.038	1.85	2.21	9.20	.016

Source: Experimentation, 2009

Table 3: Effect of Tithonia diversifolia debris on the shoot dry weight and root dry weight of Zea mays.

Shoot dry weight (g)					Root dry weight (g)			
Wks	Control	Treated	F	Sig	Control	Treated	F	Sig
1	.17	.22	2.38	.161	.05	.07	3.12	.115
2	.31	.57	1.09	.329	.10	.10	.00	.989
3	1.24	1.4	57.6	.000	.14	.50	164.16	.000
4	1.32	1.57	8.16	.021	.14	.37	163.64	.000
5	1.87	2.21	17.31	.003	.26	.44	6.94	.030

Source: Experimentation, 2009

CONCLUSION

The study was conducted to investigate the allelopathic effect of Tithonia diversifolia root debris on the growth of Zea mays in South-Western Nigeria. The results showed that the shoot lengths of the test crop were significantly enhanced by the root debris of Tithonia diversifolia. However, the root length of the test crop planted in the soil treated with root debris was significantly lower than those of the control regime. The root debris increased the fresh weight of the shoot and root of the test crop. The dry weights of the shoot and root of Zea mays planted in the soil containing root debris were significantly higher than those of the plants in the control regime. Conclusively, it was suggested that Tithonia diversifolia plant residues should be incorporated into the soil to enhance the growth of cultivated crops in the study area.

REFERENCES

Ayeni A. O., Lordbanjou D. T. and **Majek B. A.** (1997). Tithonia diversifolia (Mexican sunflower) in South-Western Nigeria. Occurrence and growth habit. *Weed Research*,37(6),443-449

Blum, U. (1999) *Designing Laboratory Plant-debris Soil Bioassays: Some Reflections.* In Inderjit K.M., Dakshini M. and Foy C. L. (eds) *Principle Sand Practices of Plant Ecology.* Florida: CRC Press, Bocaration.

Chang, M., Netzly, N. H. and **Buttler, L. G.** (1986). Chemical regulation of distance; characterization of the first natural host germination stimulant for Striga

Asiatica. *Journal of the American Chemical Society, Easton,* 108, 7858-7860.

Cheng, H. H. (1995). Characterization of the mechanisms of allelopathy: Modelling and experimental approaches. In Inderjit, K.M.C., Dakshini and F.A Einhellig (Eds) Allelopathy, organisms, process and applications. American Chemical Society, Washington, 132,141.

Chon S. U., Kin Y. and **Kee J. C.** (2003). Herbicidal potential and quantification of causative allelochemicals from several compositae weeds. European Weed Research Society. *Weed Research,* 43, 444-450.

Daizy, R. P., Harminder, S., Nipunika, R. and **Ravinder, K. K.** (2006). Assessment of Allelopathic interference of Chenopodium album Through its leachates, debris extracts, rhizophere and amended Soil. *Architecture Agronomy and Soil Science,* 52, 705,715.

Dalton B. R., Blum U. and **Weed S. B.** (1989). Plant phenolic acids in soils: sorption of ferulic acid by soil and soil components sterilized by different techniques. *Soil Biology and Biochemistry,* 21, 1011,1018.

Duke, S. O. (1986). Naturally occurring chemical compounds as herbicides. *Rev. Weed Science,* 2, 15,44.

Gross, D. and **Parthier, B.** (1994). Novel natural substances acting in plant growth regulation. *Journal of plant growth regulation,* 13, 93,114

Hess D.E., Ejeta G. and **Buttler L.G.** (1992). Selecting Sorghum Genotypes Expressing: A Quantitative Biosynthetic Trait That Confers Resistance to Striga. *Phytochemistry,* 31, 493,497.

Horrie H., Nemoto, M. and **Nishimura, N.** (1989). Dynamics of allelochemicals from broom (Cytisus scoparius) and their accumulation in soil. Weed Research, Oxford, 34, p. 47,56,

Ilori O .J., Otusanya O. O. and **Adelusi A. A.** (2007) Phytotoxic Effects of Tithonia diversifolia on Germination and Growth of Oryza sativa. Research Journal of Botany 2,1, 23,32.

Inderjit, K.M., Darkshini, M. and **Chester, L.** (1999). *Principles and practices in plant Ecology. Allelochemical Interactions.* New York: Foy eds.

Javed, K. and **Asghari, B.** (2008). Allelopathic Potential of Sunflower (Helianthus annus) on Soil Metals and its Leaves Extract on Physiology of Wheat *(Triticum aetivum L.)* Seedlings. *African Journal of Biotechnology,* 7,18.

Kimber, R. W. L. (1973). Phytotoxicity From Plant Residues: The effect of time of rotting of straw from some grass and legumes on the growth of wheat seedlings. Plant and Soil, The Hague, V. 38, 347,361.

Putnam, A.R. (1988). Allelochemicals from plants as herbicides. *Weed Technology* 2, 510,518.

Qasem, J. R. and **Abu-Irmaileh, B. E.** (1985). Allelopathic effect of Salvia syriaca L. *(Syrian sage)* in wheat. *Weed Research,* 25, 47,52

Randall, H. White, A. Douglas, W. and **Udo, B.** (1989) Allelopathic Potential of Legume Debris and Aqueous Extracts. *Weed Science,* 37,5, 674,679

Rawat, L. S., Rawat, D.S.K., Narwal, S.S, Palaniraj, R. and **Sati, S.C.** (2002). Allelopathic effects of aqueous extracts of sunflower (Helianthus annus L.) root on some winter oil seed crop. *Geobies (Jodhpur),* 29,4, 225,228.

Sassad, H., Sadar U. S., Shahida, K., Atif J., Abdul Q. and **Zahoor A.** (2007) Allelopathic potential of senna (Cassia angustifolia Vahl) on germination and seedling characters of some major cereal crops and their associated grassy weeds. *Pakistan Journal of Botany,* 39 ,4, 1145,1153.

Seigler, D. S. (1996) Chemistry and mechanisms of allelopathic interactions. *Agronomy Journal,* 88, 876,885.

Tongma, S., Katsuichiro K., and **Kenji, U.** (1998). Allelopathic activity of Mexican sunflower (*Tithonia diversifolia* in soil). *Weed Science,* 46,4, 432,437.