Available online freely at www.isisn.org

Bioscience Research

Print ISSN: 1811-9506 Online ISSN: 2218-3973

Journal by Innovative Scientific Information & Services Network

RESEARCH ARTICLE BIOSCIENCE RESEARCH, 2017 14(3): 473-477. **OPEN ACCESS**

Comparative effect between *Casuarina equisetifolia* root extract and Gesaprim on corn and associated weeds

Amira Sh. Soliman[1], Lina Al Bitar[2], Mahmoud El Shokary[1]

[1]Natural Resources Department, Institute of African Research and Studies, Cairo University**, Egypt.**
[2]Organic Agriculture Division, Mediterranean Agronomic Institute of Bari**, Italy.**

.
***Correspondence: shokary@gmail.com** **Accepted:** 03 July 2017 **Published online:** 23 August 2017

The present study was carried out at the experimental field in the Dr. Hazem El- Mahdy farm, Abo Ghalab area, Giza. Egypt, during two successive seasons of 2014 and 2015. The objective of this study was to compare the effect of different concentrations of root water extract for *Casuarina equisetifolia* at 25, 37 and 50 % and the chemical herbicide, Gesaprim (2.5 kg/ha) on growth, yield and associated weeds of corn. All concentration of *Casuarina equisetifolia* root extract treatments inhibited the weed density/m^2 as compared to the control and Gesaprim of corn plants. The most effective dose in the two seasons is 50% of *Casuarina equisetifolia* root extract. *Casuarina equisetifolia* root extract treatments at a concentration of 25 and 37% increased significantly the number of ears/5 plants and the total yield. Treatment with all concentration of *Casuarina equisetifolia* root extract reduced significantly the nutrient contents of nitrogen, phosphorus and potassium of corn leaves plants as compared to the control and Gesaprim in both seasons. *Casuarina equisetfolia* water root extracts displayed highly significant biological suppressing effect on associated seasonal weed in corn which induced a significantly increase in growth and total yield.*Casuarina equisetfolia* water root extracts could be used as a natural herbicide with low cost, easily of availability and low toxicity for maize plants.

Keywords: Gesaprim, *Zea mays* L., plant extract, *Casuarina equisetifolia*.

INTRODUCTION

Casuarinas are a very distinctive group of plants and superficially resemble coniferous with their wire like foliage and woody fruiting structures, with thin crowns of drooping branches and leaves reduced to scales (Johanson and Wilson, 1989) Atrazine (Gesaprim) is registered for use in controlling weeds in numerous crops, including corn (*Zea mays* L.) and various range grasses (Reed 1982). Atrazine phytotoxicity had been reported (Reinhardt, 1993). Allelopathy is often described as the chemical reaction between plants or between plants and microbes, as described by Weir et al. (2004), phytotoxic substances exuded by many tree species are known to retard the growth of associated crop species (Suresh and Rai, 1987). Allelopathy can significantly reduce crop seedling establishment (Weston, 1990). Some biochemical or secondary metabolites, when applied in laboratory environments to seed and seedlings, suppress seed and seedling germination and growth plants (Callaway and Ridenour, 2004; Weir et al. (2004) and Blanco, 2007). Weeds have been a persistent problem for farmers ever since the beginning of agriculture as weeds cause economic losses for farmers by reducing crop yields and quality and, increasing costs of production (Bhuler et al. 1998). They often cause a total crop failure (Islam and Molla, 2001). Research is also underway to

identify, extract and synthesize plant chemicals to create natural herbicides for suppressing weed growth that could be used in organic farming (Duke et al. 2002).Very poor vegetation is seen under the canopy of *Casuarina equisetifolia* plantations compared to the adjoining open area (Batish and Singh, 1998). In organic agriculture, farmers struggle to develop effective and economic weed management practices. Farmers rank weeds as the number one barrier to organic production (Walz, 1999).

MATERIALS AND METHODS

Plant materials

The corn (*Zea mays*) (30 N 11) were obtained from pioneer company sown by rate 20 kg/ha, seeds are treated by seed treatment fungicide.

Chemical herbicide

Chemical herbicide Gesaprim 900 WG (900 g/kg Atrazine) produced by Syngenta Company for maize associated weeds were used at 2.5 kg/ha.

Extraction preparation

Fresh roots were collected from 10 years old *Casuarina equisetifolia* from organically certified farm Center of Development of Ecosystems and Communities in Khataba area, Cairo-Alexandria desert road area. By digging around the tree on distance 1-2 meter approximately and 10-30 cm depth. The roots were shredded to fine parts by shredding machine, the fine parts of root were weight was soaked one liter of distilled water and stand for two days in the refrigerator, after that the mixture was filtered to obtain the extraction without any plant tissue.

Experiment layout

The layout of the experiment was a randomized complete block design. The seeds were sown in rows, the distance between seeds 20 cm. the distance between rows was 50 cm in plots which was 4×2 m for the plot, Sowing date 10/6/2014 and 15/6/2015 harvest day 10/10/2014 and 15/10/2015 in the 1st season and second season, respectively (120 days). Compost was applied at 5000 kg/ha during soil preparation.

Chemical and physical properties of the soil.

A chemical and physical property of the soil was conducted using the methods described by Jackson (1973) and shown in Table (1).

Data recorded.

At the end of the experiment, the following data was recorded: weed density (plant/m^2), plant height (cm), number of ear/5 plants, total yield (kg/ha) and macronutrients (N, P and K %) which determined according to (cottenie et al. 1982).

Statistical analysis.

The recorded data for each treatment were subjected individually to the ANOVA test by using CoStat computer software (Steel and Torrie, 1980).

Table (1): **Some characteristics of soils used in the experiment.**

Characteristics	**Clay loam**	**Soluble cations (mg Kg^{-1})**	
Sand (%)	41.3	Na^+	25.3
Slit (%)	17.3	Ca^{++}	123.8
Clay (%)	40.9	Mg^{++}	15.2
pH	7.6	K^+	24.3
EC (dSm^{-1})	3.1	**Soluble anions (mg Kg^{-1})**	
Total N (mg g^{-1})	4.44	HCO_3	66.8
Total C (mg g^{-1})	92.3	Cl^-	30
C/N	20.79	SO_4^-	88.7
P (mg Kg^{-1})	38.9	Organic matter (%)	25.2

RESULTS

Weed density (plant/m2) and Plant height (cm).

All concentration of *Casuarina equisetifolia* root extract treatments inhibited the weed density/m^2 as compared to the control and gesaprim of corn plants. The most effective dose in the two seasons is 50% of *Casuarina equisetifolia* root extract (Table 2). The data shown in table (2) showed that *Casuarina equisetifolia* root extract treatments at a concentration of 25 and 37% increased significantly the plant height and gesaprim decreased significantly the plant height as compare to the control plant in 1st and second seasons respectively. Meanwhile, *Casuarina equisetifolia* root extract at 50% decreased significantly the corn height in 1st and second seasons respectively.

Number of ears/5 plants and Yield (kg/ha).

Casuarina equisetifolia root extract treatments at a concentration of 25 and 37% increased significantly the number of ears/5 plants and the total yield. Meanwhile, the concentration

Table 2. Effect of *Casuarina equisetifolia* root extract and Gesaprim in weed density and Plant height at maturity of corn plants.

Treatment	Weed density/m^2		Plant height (cm)	
	1st season	2nd season	1st season	2nd season
Control	102.67[a]	105.00[a]	221[bc]	220.76[bc]
Gesaprim	75.33[c]	78.67[c]	205.5[c]	203.54[c]
Root extract 25%	91.00[b]	97.33[b]	238.73[b]	233.69[ab]
Root extract 37%	75.67[c]	83.00[c]	250.25[a]	242.35[a]
Root extract 50%	1.3[d]	2.33[d]	188.00[d]	180.29[d]
LSD at 0.05	10.04	10.08	19.17	19.22

*Means followed by different letters in the respective column are significantly different at 5 % probability level according to LSD test.

Table 3. Effect of *Casuarina equisetifolia* root extract and Gesaprim in number of ears/5 plants and total yield of corn plants.

Treatment	Number of ears/5 plants		Yield (kg/ha)	
	1st season	2nd season	1st season	2nd season
Control	7.67[c]	7.00[c]	8400[c]	8380.8[c]
Gesaprim	7.00[c]	6.29[c]	8184[c]	8160[c]
Root extract 25%	9.00[b]	8.25[b]	9012[b]	8940[b]
Root extract 37%	10.33[a]	10.00[a]	9840[a]	9818.4[a]
Root extract 50%	5.75[d]	5.33[d]	7824[d]	7809.6[d]
LSD at 0.05	1.23	1.13	449.06	444.76

*Means followed by different letters in the respective column are significantly different at 5 % probability level according to LSD test.

Table 4. Effect of *Casuarina equisetifolia* root extract and gesaprim in nutrient contents of N, P, and K (mg/kg) of corn plants.

Treatment	N		P		K	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	2.02[a]	1.98[a]	0.36[a]	0.39[a]	2.96[a]	3.01[a]
Gesaprim	1.63[b]	1.72[b]	0.29[bc]	0.30[bc]	2.42[c]	2.51[c]
Root extract 25%	2.02[a]	1.98[a]	0.35[ab]	0.36[ab]	2.65[b]	2.61[b]
Root extract 37%	1.75[b]	1.79[b]	0.30[b]	0.33[b]	2.30[cd]	2.38[cd]
Root extract 50%	1.57[c]	1.61[c]	0.17[c]	0.18[c]	1.41[d]	1.35[d]
LSD at 0.05	0.0171	0.0175	0.0171	0.0175	0.061	0.063

*Means followed by different letters in the respective column are significantly different at 5 % probability level according to LSD test**.**

of *Casuarina equisetifolia* root extract at 50% significantly decreased the number of ears/5 plants and the total yield as compared to the control and gesaprim treated corn plants in both seasons Table (3).

Nutrient contents.

The results presented in table (4) showed that treatment with all concentration of *Casuarina equisetifolia* root extract reduced significantly the nutrient contents of nitrogen, phosphorus and potassium of corn leaves plants as compared to the control and gesaprim in both seasons.

DISCUSSION

Our results were in agreement with Batish and Singh (1998) and Batish et al. (2001) proving that *Casuarina* trees employ allelopathy to eliminate competing plant species. Liu *et al*. (2007) found that, *Casuarina* has a self-inhibitory effect commonly observed in *Casuarina* colonies as many autotoxins are released suppressing root growth of its own seedlings. By testing the extracts we found some chemicals like Kaempferol and Quercetin from flavonoids which are supposed to be responsible of allelopathic effect in *Casuarina* (Jian et al. 2013 and Deng et al. 1996). In addition, hydroxybenzoic acid, vanillic acid, benzoic acid from phenols were found which are active allelochemicals according to Ishikura et al. (2001). Phenolics, terpenoids were reported as active allelochemicals in *Casuarina* trees (Batish and Singh, 1998 and Buehler, 2010). *Casuarina equisetfolia* water root extracts displayed highly significant biological suppressing effect on associated seasonal weed in corn which induced a significantly increase in growth and total yield (Duke and Lydon, 1987 and Duke et al. 2002).

Casuarina root extract modify the growth, morphological and yield contributing characteristics of plants that lead to better yield and quality of seeds (Malik *et al*. 1986b and Setia *et al*. 1989).

CONCLUSION

Casuarina equisetfolia water root extracts displayed highly significant biological suppressing effect on associated seasonal weed in corn which induced a significantly increase in growth and total yield. *Casuarina equisetfolia* water root extracts could be used as a natural herbicide with low cost, easily of availability and low toxicity for maize plants.

CONFLICT OF INTEREST

The present study was performed in absence of any conflict of interest.

ACKNOWLEGEMENT

Authors would like to thank Institute of African Research and Studies, Cairo University, Egypt. Mediterranean Agronomic Institute of Bari, Italy, for their support and cooperation to accomplish this work.

AUTHOR CONTRIBUTIONS

ASS, LA and, ME designed and performed the experiments. ASS and ME carried out the experiments, ME also wrote the manuscript, ASS and LA reviewed the manuscript. All authors read and approved the final version.

REFERENCES

Batish DR and Singh HP, 1998. Role of allelopathy in regulating understorey in *Casuarina equisetifolia* In: K. Sassa (ed.), Envi- ronmental Forest Science, Vol. 54, Kluwer - ers, Netherlands, pp. 317-323

Batish DR, Singh HP, Kohli RK, 2001. Vegetation exclusion under *Casuarina equisetfolia* L.: Does allelopathy play a role. Comm. Ecol. 2 (1):93-100.

Bhuler DD, Netzer DIA, Riemenschneicer DE and Hartzler, RG, 1998.Weed management in short rotation poplar and herbaceous perennial crops grown for biofuel production. Biomass and Bioenergy 14(4), 385-394.

Blanco JA, 2007. The representation of allelopathy in ecosystem-level forest models. Ecological Modeling. 209:65-77.

Callaway RM and Ridenour WM, 2004. Novel weapons: invasive success and the evolution of increased competitive ability. Frontiers of

the Ecological Environment. 2(8): 436-443.
Cottenie, A. M. Verloo, L. Kiekens, G. Velgh and R. Camerlynck (1982). Chemical Analysis of Plants and Soils. P 44-45. State Univ. Ghent Belgium, 63
Deng LG, Kong CH and Luo SM, 1996. Isolation and Identification of extract from Casuarina equisetifolia branchlet and its allelopathy on seedling growth. Chinase J. Appl. Ecol. 7:145-149.
Duke SO and Lydon J, 1987. Herbicides from natural compounds. Weed Tech. 1:122–128.
Duke SO, Dayan FE, Rimando AM, Schrader KK, Aliotta G, Oliva A and Romangi JG, 2002. Chemicals from nature for weed management. Weed Science. 50:138-151.
Ishikura Y, Kojima Y and Terazawa M, 2001. Effects of phenolic compounds on seed germination of shirakamba birch,betula platyphylla var.japonica. eurasian j. for. res. 2: 17-25.
Islam MJ and Molla HR, 2001. Economic weeding method for irrigated rice production in Bangladesh. Agricultural water management.46, 267-276.
Jackson ML, Lee SY, Brown JL, Sachs IB and Syers JK, 1973. Scanning electron microscopy of hydrous metal oxide crusts intercalated in naturally weathered micaceous vermiculite. Soil Sci. Soc. Am. Proc. 37:127-131
Jian L, Yi L, Chengzhen W, Tao H, Yongming L, Han L, Can C and Wei H, 2013. Effect of two allelochemicals of Casuarina equisetifolia L. on chlorophyll fluorescence parameters in hydroponically cultured seedling. Chin. J. App. Environ. Biol. 5:781-786.
Johanson LAS and Wilson K.L, 1989. Casuarinaceae: synopsis.In. Evolution systematic and fossil history of the Hamelidae.Higher Hamamelidae, Systemic Association, Special volume No 40 B. Calarendon press Oxford, 2:17-188.
Liu Yh, Zeng RS, Chen S, Liu DL, Luo SM, Wu H and An, M 2007. Plants autotoxicity in Southern China. Allelopathy J. 19 (1): 61-74.
Malik CP, Singh P, Seth RC, Seth N and Bhatia DS, 1986b. Controlling plant biology and enhancing food production with phenolic compounds; in Hormonal Regulation of Plant Growth and Development Vol 111 pp.371-415 ed S S Purohit (Bikaner: Agro Botanical Publishers)
Reed D, 1982. Atrazine. (Unpubl. mimeo.) Available from U. S. Food and Drug Administration, Bureau of Foods, Washington, DC. 6 pp.
Reinhardt CF, 1993. Biological activity and persistence of Atrazine. PhD thesis university of Pretoria.
Setia N, Kaur D and Malik CP, 1989. Effect of some phenolic compounds on yield components in lentil; Lens Newsiest 16 36-39
Steel RGD and Torrie JH, 1980. Principles and Procedures of Statistics. McGraw Hill Book Co.,Inc. New York. 481. pp.
Suresh KK and Rai RSV 1987. Studies on the allelopathic effect of some agroforestry tree crops. International Tree Crop Journal, 4:109-115.
Walz E, 1999. Third Biennial National Organic Farmers' Survey. Santa Cruz, CA: Organic Farming Research Foundation.
Weir TL, Park SW and Vivanco JM, 2004. Bio chemicals and physiological mechanisms mediated by allelochemicals. Current Opinion in Plant Biology. 7:472-479.
Weston LA, 1990. Cover crop and herbicide influence on row crop seedling establishment in no-tillage culture. Weed Science. 38:166-171.
Buehler CP (2010). Soil modification and potential allelopathy: An investigation into how the invasive Casuarina equisetifolia L. (Australian pine) modify their environment. M.S. Thesis. Mississippi State University, P. 115, Publication number 1475010. Online at: http://gradworks.umi.com/14/75/1475010.html .