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Research Article

DETERMINATION OF ALLELOPATHIC EFFECT OF PURPLE NUTSEDGE (*CYPERUS ROTUNDUS L.*) ON GERMINATION AND INITIAL DEVELOPMENT OF TOMATO (*LYCOPERSICUM ESCULENTUM*)

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ABSTRACT
Weeds are the most severe and widespread biological constraint to crop production and cause invisible damage till the crop is harvested. The present study was conducted to investigate the allelopathic effect of Purple nutsedge (*Cyperus rotundus L.*) on seed germination, germination rate and seedling growth characters of tomato (*Lycopersicum esculentum*). Aqueous extracts of weeds (10, 20, 30 and 40%) showed both inhibitory and stimulatory influence on percent seed germination and seedling growth of tomato. Our experimental results revealed that the shoot extracts of C.rotudus were inhibitory to the seedling length, fresh and dry weight of tomato seedlings. The degree of inhibition was concentration dependent. Most inhibition of seedlings growth was recorded in 30 and 40% concentration of tuber extracts.

Keywords: *Germination, Seedling, Allelopathy, Tomato, Purple Nutsedge*

INTRODUCTION
Tomato is a widely distributed annual vegetable crop which is consumed fresh, cooked or after processing by canning, making into juice, pulp, paste, or as a variety of sauces; being a rich source of phytochemicals such as lycopene, β-carotene, flavonoids, vitamin C and essential nutrients (Beutner *et al.*, 2001). Weeds are undesirable plants which compete with main crops in the growth media for nutrients, moisture, space, light and hamper the healthy growth ultimately reducing the growth and yield both qualitatively and quantitatively. Its influence causes immediate losses to the plantation crop through allelopathy and through competition for water, nutrients and light, causing limitations in availability of the latter to the plantation crop. (Qasem and Foy, 2001) (Morvillo *et al.*, 2011) (Junaedi *et al.*, 2009). Allopathy is a harmful effect generated as a result of the secretion of biochemical substances by a given plant on a receiver plant (Rice, 1984). In specific conditions allochemical substances are exuded into the environment; they can effect germination, root and stem growth, numbers of soil micro organisms and other reactions (Putnam, *et al.*, 1988). Allelopathic substances are most commonly found in plant extracts and in plant residues of soil, some are found in live plant exudates and as volatile gases liberated from leaves and rhizome. Weeds are known to exhibit allelopathy by releasing water- soluble allelochemicals from leaves, stems, roots, rhizomes, flowers, fruits and seeds (Batish *et al.*, 2007). These chemicals products mainly affect plants at seed emergence and seedling levels (Alam and Islam, 2002; Hussain *et al.*, 2007; Naseem *et al.*, 2009). The phytotoxicity of C. rotundus was tested against the growth of number of crop plants. Aqueous tuber extracts of C. rotundus reduced seed germination and seedling growth of rice, corn, cucumber, tomato, sorghum, and onion (Meissner *et al.*, 1979). C.rotundus infested soil also reduced the seedling growth of barley (Horowitz and Friedman, 1971). Batish *et al.*, (2007) conducted experiment using residue of Chenopodium murale on the growth of chickpea and pea and found that their root and shoot length significantly decreased. This experiment was carried out to determine the allelopathic effect of Cyperus rotundus L. (purple nutsedge) shoot aqueous extract on seed germination and initial growth of Tomato (*Lycopersicum esculentum*) seedlings.

MATERIALS AND METHODS
The experiment was conducted in the Crop laboratory, Agriculture Department of Islamic Azad University, Shirvan Branch. The experiment was performed with 4 different concentrations of extract (10,

20, 30, 40%) and a control (0%). The matured weed plants *Cyperus rotundus L.* were collected from the crop fields, Department of Agriculture, Shirvan Branch, Shirvan. Iran. The weeds were separated in to shoot and tubers and shoot dried under shade. The dried weed shoot samples were ground into fine powder and stored in sealed plastic containers and kept at room temperature until required. Extract of purple nutsedge shoot concentration of 100% was prepared by crushing fresh shoot and immersing them in distilled water for 24 hours with a 1:1 weight/volume ratio, filtered three times using filter paper, then diluted with distilled water to achieve extract concentrations of 20, 40, 60, 80%. The test units were petri dishes (diameter 9cm and depth 3cm). To prevent growth and activity of variant microbes, both seeds and dishes were disinfected, then 10 seeds were placed on two layers and 15 cc was added to each dish. Petri dishes were placed in the growth room in completely darkness both day and night at 25^0C. In order to neutralize evaporation and changes to the various extracts the caps of the Petri dishes were closed firmly. In final counting of shoot and root length, shoot and root fresh weight, seed vigor, mean germination time, germination percentage and rate was measured. Seeds were considered germinated when the emergent root reached 2 mm length. Rate of germination, germination percentage and mean germination time were calculated using the following formulas (Mostafavi, 2011) The germination rate was calculated by equation:

$$GR = \frac{x_1}{y_1} + \frac{x_2 - x_1}{y_2} + \ldots + \frac{x_n - x_{n-1}}{y_n}$$

Where "x_n" is the number of the seeds that germinated in the last day, n is number of day, and "y_n" is the number of the days from the beginning of the experiment to the last day of the experiment.
The angular transformation of $Arc\ sin\ \sqrt{x}$ was used for the normalizing of the data. Means obtained by studying all mentioned qualities were compared based on the Duncan's multiple range tests at 1% probability level.

RESULTS AND DISCUSSION

The allelopathic effect of purple nutsedge shoot extracts on the germination and initial growth of tomato is show in table 1, and Figure 1 to 5. It is showed that tomato seedlings deteriorate after purple nutsedge shoot extract treatment. This is indicated by decreased germination percentage, germination rate, seedling wet weight, seedling dry weight and shoot length and Radical length. Extract of purple nutsedge shoot caused a decrease in germination percentage. Treatment of the extract at concentration of 10, 20, 30 and 40% was significantly decreased germination percentage compared with control (Table1). It is shows a trend that the higher the concentration of the extract, the greater the decrease of the germination percentage value.

Table 1: Mean comparison of different levels of tuber extract

Concentration of tuber extract	Germination Rate	Germination Percentage	shoot length (mm)	Radical length (mm)	Dry Matter
Control	7.82 a	98 a	3.5 a	3 a	0.28 a
20%	6.86 ab	33.36 b	2.8 b	1.78 b	0.2 b
40%	5.55 b	15.5 c	1.9 bc	1.56 b	0.18 b
60%	4.31 bc	6.6 d	1.33 c	0.46 c	0.15 c
80%	1.73 c	2.3 e	1 d	0.36 c	0.05 d

Statistically, there is no significant difference among the means with the same letter in each column in Duncan's test (p = 5%)

Other seedling measured character was speed germination, so the higher this value, the longer the time needed for the seeds to germinate. This was shown in the result of this experiment, which indicated that beginning with a concentration level of 10%, there was already an effect of decrease in the speed of germination, and the higher the concentration, the longer the time needed to begin to germinate (Figure 2). These results are similar to the finding of Verma *et al.*, (2002) that found the extracts of C.rotundus adversely inhibited the seed germination, seedling growth and biomass production of Brassica and tomato. Mandal *et al.*, (2005), found that the higher concentrations of Populus deltoids plant extract were adversely inhibited seed germination, seedling growth and reduction in the content of sugar, proteins in three varieties of green gram. The result of the experiment shows that treatment with purple nutsedge shoot extract significantly reduced the shoot and root length and dry matter of cucumber seedlings value. As the concentration increased, the seedling growth and seedling fresh and dry weight decreased. Similar results were obtained by Alsaadawi and Salih (2009), in which, they reported the root exudates of C. rotundus significantly reduced the root and shoot growth of tomato and cucumber plants. The reduction in the dry matter and seedling growth may be due to imbalance in water uptake or osmotic balance of the tissues for germination and growth by the allelochemical toxicity of the extracts (Blum *et al.*, 1999). Figure 3-5 show the comparison between seedlings as a result of allelopathic influence.

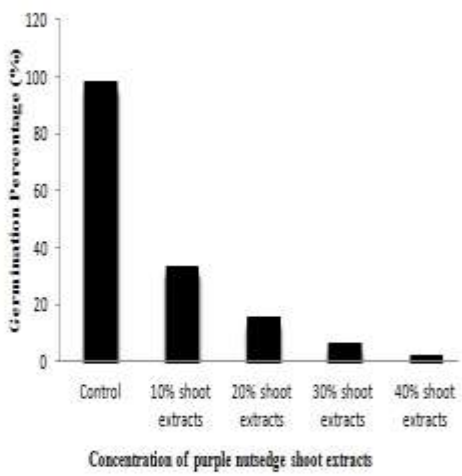

Figure 1: Effect of different concentration of purpule nutsedge shoot extract on tomato seed germination percentage

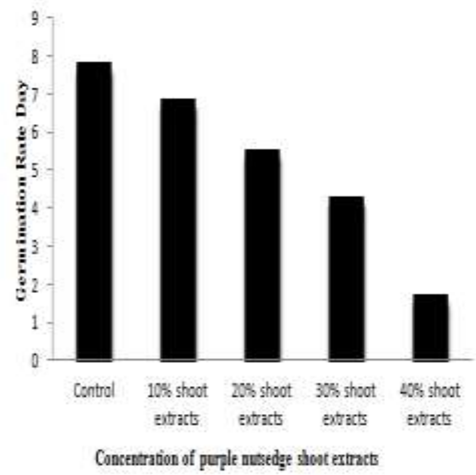

Figure 2: Effect of different concentration of purpule nutsedge shoot extract on tomato seed germination rate

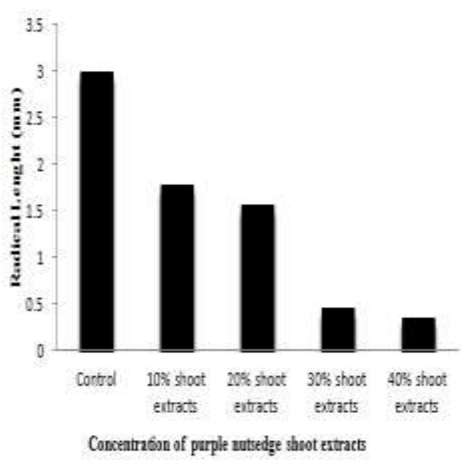

Figure 3: Effect of different concentration of purpule nutsedge shoot extract on tomato seedling radical lenght

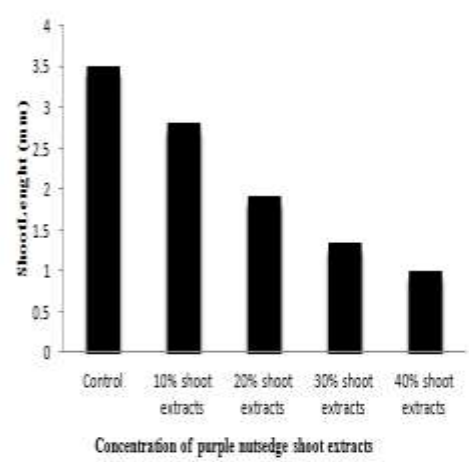

Figure 4: Effect of different concentration of purpule nutsedge shoot extract on tomato seedling shoot lenght

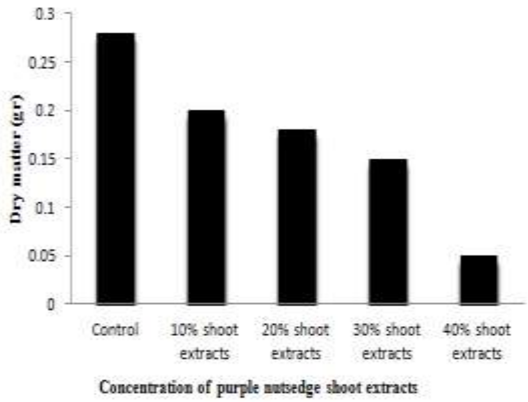

Figure 5: Effect of different concentration of purpule nutsedge shoot extract on tomato seedling dry matter

Conclusion

The chemical exudates from allelopathic plants are proposed to play a major role in the allelopathic mode of action. Allelopathic effect of these compounds is often observed to occur early in the life cycle causing inhibition of seed germination and/or seedling growth. The compounds exhibit a wide range of mechanisms of action, affect on DNA (alkaloids), photosynthetic and mitochondrial function (quinines), phytohormone activity, ion uptake and water balance. Allelopathic effect mainly caused by phenolic compounds, Rokiek *et al.*, (2010) reported that the water extract of purple nutsedge tubers contains cafeic acid, ferulic acid, fanilic, acid, hydrobenzoic acid and chlorogenic acid. Allelochemicals also cause decrease in activity of the H+ATPase enzyme, degradation of the sulfhydryl protein group, decrease in trans-membrane electrochemical potency, and depolarisation of membranes which causes change in membrane structure and change in non-specific anion and cathion efflux (Hejl and Koster, 2010).

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