



Allelopathic effect of Beetroot (*Beta vulgaris* L) on germination and growth *Zea mays* and *Vigna umbellata*

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Abstract

Laboratory and pot experiments were conducted to evaluate the allelopathic potential of Beetroot (*Beta vulgaris* L) on the germination and growth for both *Zea mays* and *Vigna umbellata*. *Zea mays* and *Vigna umbellata* were subjected to different concentrations (0, 1, 5, 10, and 15) of Beetroot (*Beta vulgaris* L) extract. Our results indicated that extracts from beetroot (*Beta vulgaris* L) greatly improved corn seed germination and growth at all concentrations when compared with a water control. In conclusion, the beetroot (*Beta vulgaris* L) extract can be used to improve the germination and growth of many crops such as *Zea mays* and *Vigna umbellata*.

Keywords: corn, beetroot, allelopathy, *Vigna umbellata*

Introduction

Allelopathy is described as the direct or indirect toxic or helpful results of a plant on the other through the liberation of chemical compounds into the environment (Turk and Tawaha, 2002c; Turk and Tawaha, 2003a; Turk and Tawaha, 2003b; Turk *et al.*, 2003c; Turk *et al.*, 2005; Al-Tawaha and Odat, 2010) [34, 35, 37, 36, 39, 6, 11]. Plant tissues contain many toxic substances that inhibit the germination and growth of other plants (Turk and Tawaha, 2002c; Turk and Tawaha, 2003a; Turk and Tawaha, 2003b; Turk *et al.*, 2003c; Turk *et al.*, 2005; Al-Tawaha and Odat, 2010 a) [34, 37, 39, 6, 11]. Macias *et al.* (2003) reported that allelochemicals can encourage or reduce plant germination and growth, and authorize the growth of plants with little phytotoxic residue amounts in water and soil, therefore easing wastewater handling and reprocessing (Turk *et al.*, 2005; Al-Tawaha and Odat, 2010) [15, 11]. Beetroot (*Beta vulgaris*) is an herbaceous biennial belongs to *Chenopodiaceae* family and has several varieties based on root color. Sugar beet (*Beta vulgaris* L.) is known to be allelopathic against weeds (Hegab *et al.*, 2008; Dadkhah, 2012). Hegab *et al.*, (2008) reported that allelopathic activity of sugar beet has been recognized to phenolic acids and other chemical compounds. On the other hand, many researchers have pointed out that aqueous beetroot extracts showed stimulatory effects on wheat seed germination. Crop growth and productivity is affected by many biotic and abiotic factors (Turk and Tawaha 2001; Tawaha and Turk, 2002a; Tawah and Turk, 2002b; Turk and Tawaha 2002a; Turk and Tawaha 2002b; Turk and Tawaha 2002c; Tawaha *et al.*, 2003; Turk *et al.*, 2003a; Turk *et al.*, 2003b; Turk *et al.*, 2003c; Nikus *et al.*, 2004; Al-Rifae *et al.* 2004; Musallam *et al.*, 2004; Tawaha and Turk, 2004; Turk *et al.*, 2004; Abera *et al.*, 2005; Lee *et al.*, 2005; Supanjani, *et al.*, 2005; Sulpanjani *et al.*, 2006; Assaf *et al.*, 2006; Abu-Darwish *et al.*, 2009; Al-Tawaha *et al.*, 2010; Al-Tawaha and Seguin 2006; Al-Tawaha *et al.*, 2006; Al-Tawaha *et al.*, 2007; Tawaha and Odat, 2010; Abu Obaid *et al.* 2018; Al-Tawaha

et al. 2018a; Tawaha *et al.* 2018b; Al-Tawaha *et al.*, 2018a; Al-Tawaha *et al.*, 2018b; Al-Tawaha *et al.* 2018c; Al-Tawaha *et al.*, 2018d) [31, 27, 28, 32, 33, 34, 29, 35, 36, 39, 38, 41, 21, 23, 7, 8, 14, 9, 10, 11, 16, 17, 2, 19, 20, 18, 20]. Thus in the current study, Aqueous and methanolic extracts of beetroot was used and tested for their effects on seed germination and growth of Maize and *Vigna* plants.

Material and Methods

Beetroot (*Beta vulgaris* L) fresh roots were obtained from local supermarket at Yanbu province Kingdom of Saudi Arabia (KSA). The roots of Beetroot (*Beta vulgaris* L) were peeled, divided into small discs and stored overnight at -20°C. 100 g frozen. Beetroot (*Beta vulgaris* L) discs were then crashed in an electric mixer either with 150 ml dist. H₂O (Aqueous extract) or 150 ml 80% methanol (Methanolic extract). Extracts were then filter through whatman no.1 filter papers (100% stock extracts) and stored at 4 °C. Different concentrations (0, 1, 5, 10, and 15%) were prepared and used for maize seed germination test. The effect of the whole beetroot extract was tested on the initial germination, epicotyl, and radicle length of maize (*Zea mays*). Variable concentrations of both beetroot extracts were applied to maize seeds placed on a whatman no.1 filter paper in 25 cm glass Petri dishes. 4 days after applications of extracts, epicotyle and hypocotyle lengths were recorded. Additionally the experiment was extended to test the effect of both beetroot extracts, applied to soil, on the growth of maize and rice bean (*Vigna umbellata*).

Results and Discussion

Our results indicated that extracts from beetroot (*Beta vulgaris* L) greatly improved corn seed germination at all concentrations when compared with a water control. Germination percentage of maize seed based on the application of both beetroot extracts, results represented in Fig.1 show that 5% and 10% of aqueous extract. Beetroot extracts increase maize germination rate compared to

control (i.e. 100% vs 89%). However, Methanolic extract of beetroot has no clear effects on germination percentage of maize seeds. This may be attributed to presence methanol remains in the applied extracts. Mack *et al.*, (2007) reported that sugar beet (*Beta vulgaris*) is rich in sugars and glycine betaine (GB) was first exposed in its juice. Makela (2004)^[23] reported that glycine betaine (GB) enhanced the water retention of plant cells by defensive from osmotic inactivation (Makela, 2004)^[23]. Craig (2004)^[21] reported that glycine betaine(GB) acts as an osmolyte to protect cells from abiotic stresses. Crop growth and productivity is considered very important issue in the world. For this reason many strategies have been proposed, one of which is the use of species that have good germination and growth under stress condition. (Tawaha *et al.*,2001; Tawaha *et al.*, 2002; Turk and Tawaha 2002; Al-Jamali *et al.*, 2002; Turk *et al.*2003a; Turk *et al.*,2003b; Al-Tawaha *et al.*,2005; Tawaha *et al.*,2005; Al-Ajlouni *et al.*,2009; Al-Tawaha and and Al-Ghzawi 2013)^[31, 4, 4, 35, 6, 15,3, 12]. Extracts from Beetroot (*Beta vulgaris* L) greatly improved of both radical and epicotyle of maize seedlings at all concentrations when compared with control.

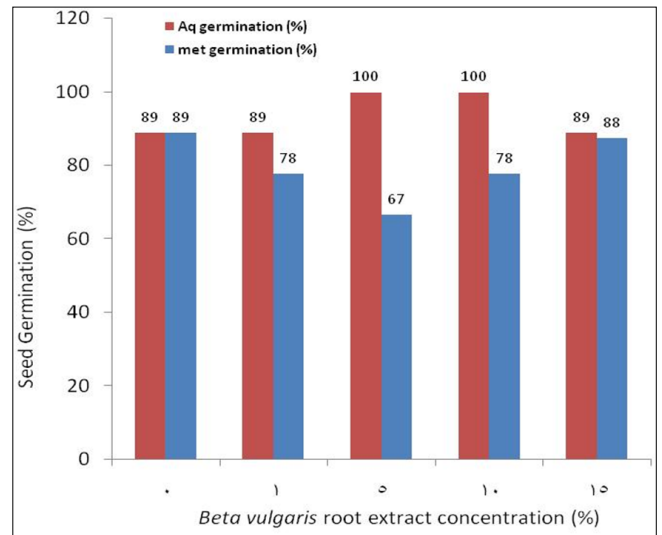


Fig 1: Effect of aqueous and methanolic beetroot extracts on maize seed germination rate

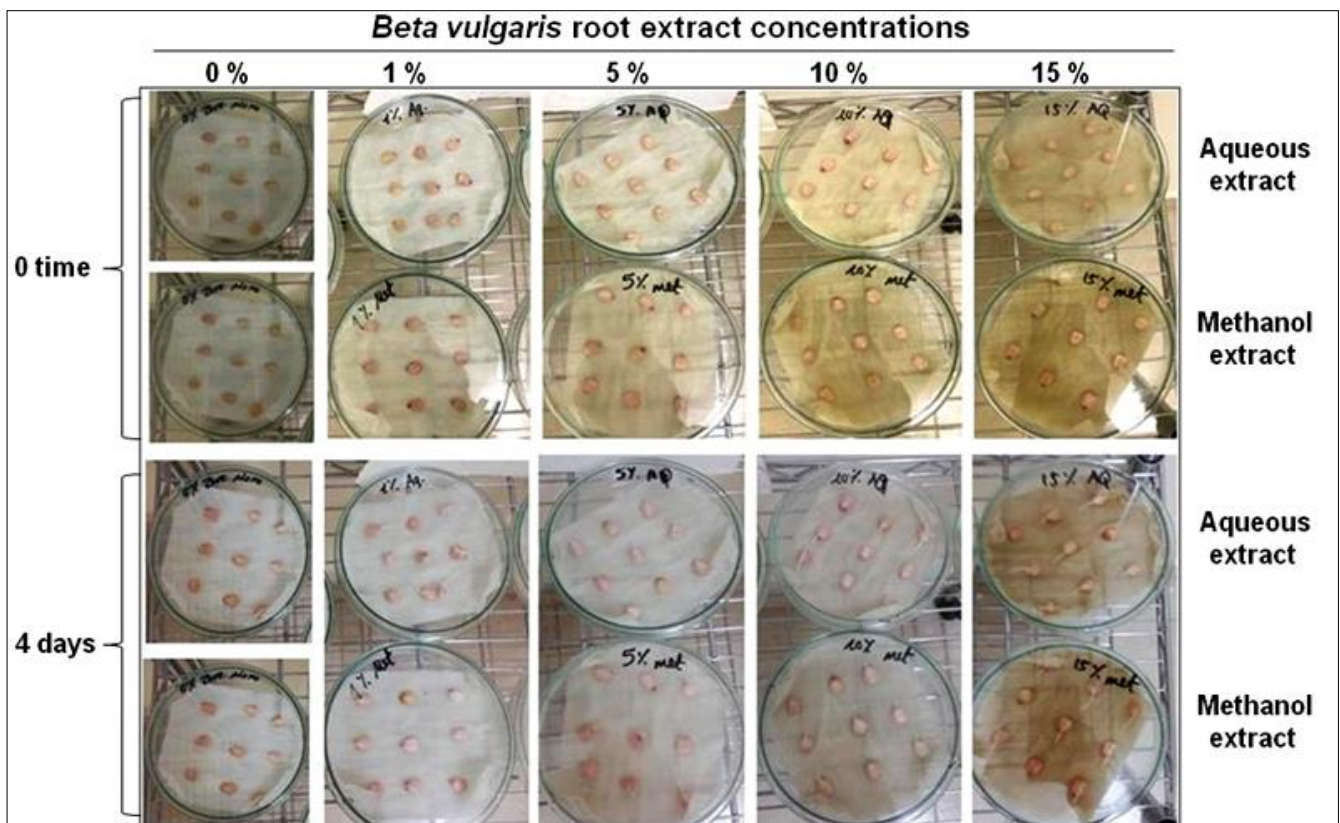


Fig 2: Representative photograph showing Maize seeds before and after 4 days from the application of variable concentration of beetroot extracts (Aqueous & Methanolic)

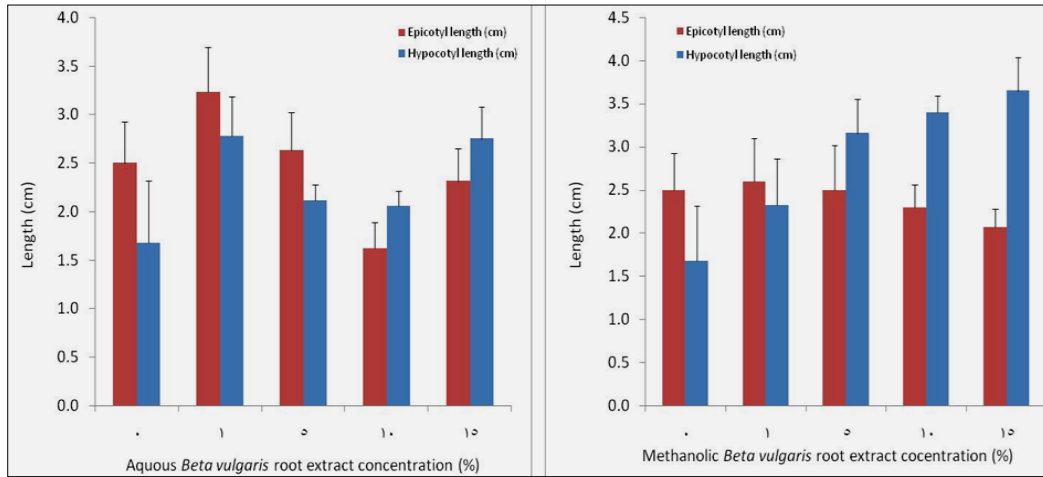


Fig 3: Effect of aqueous and methanolic beetroot extracts on maize seedling growth

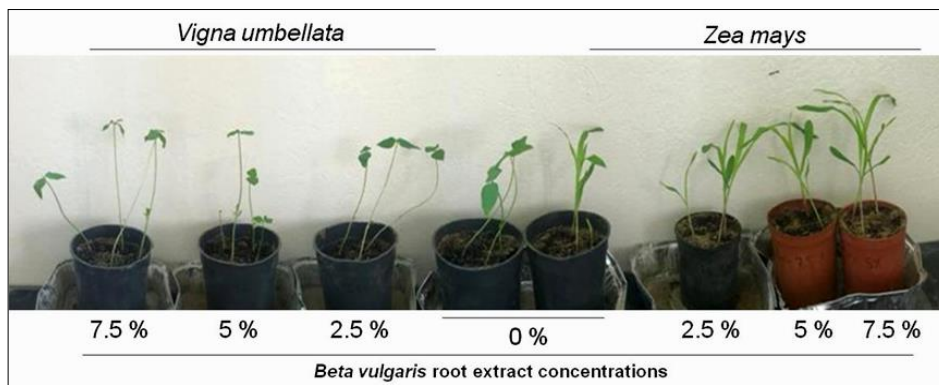


Fig 4: Effect of beetroot extracts on growth of Maize and Ricebean plants

In case of aqueous extracts, concentrations of 1% and 15% were superior for induction of hypocotyle length. A concentration dependent stimulation of hypocotyle growth is obvious for methanolic extracts. However, no significant variations in epicotyle lengths were observed for maize seedlings compared to control seedlings. On the other hand, variable concentrations of aqueous beetroot extract was also applied to soil grown maize and *Vigna umbellata* plants for 2 weeks at 4 days intervals. We found that In this study, the beetroot extract improved the growth of *Zea mays* and *Vigna umbellata* (Fig 5).

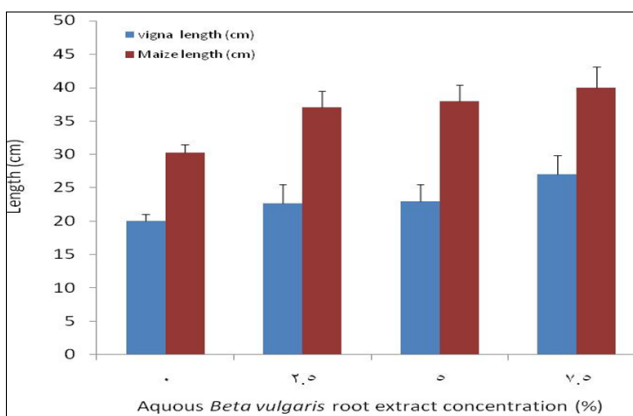


Fig 5: Effect of aqueous beetroot extracts on growth of *Zea mays* and *Vigna umbellata* plants

In conclusion, the beetroot (*Beta vulgaris* L) extract can be used to improve the germination and growth of many crops such as *Zea mays* and *Vigna umbellata*.

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