



Allelopathic effect of *Rhazya stricta* extract on seed germination and seedling growth of *Zea Mays* (Maize)

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Abstract

Rhazya stricta, an evergreen poisonous shrub is rapidly invading large areas of rangelands in Saudi Arabia. A laboratory study was conducted to investigate the allelopathic potential of *Rhazya stricta* on seed germination and seedling growth of *Zea Mays*. Aqueous extract of *R. stricta* showed inhibitory effect on *Z. mays* germination percentages and seedling growth particularly at the high concentrations of *Rhazya* extract.

Keywords: allelochemicals, allelopathic, aqueous extract, seedling growth, germination.

Introduction

Plants live association groups depending upon the ecological requirements; they have generally similar structural and morphological adaptations. Whenever two or more plants occupy the same niche in nature, they compete with each other for various life support requirements (Khan *et al.*, 2011a, p. 81). Allelopathy is a biological process in which plants synthesize allelochemicals that affect the physiological properties, development and survival of other plants

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(Alqarawi *et al.*, 2018, p 1263). Allelopathy refers to the beneficial or harmful effects of one plant on another one, both crop and weed species, by the release of chemicals from plant parts by leaching, root exudation, volatilization, residue decomposition, and other processes in both natural and agricultural systems. In agroecosystems, allelopathic effects between living weeds and crops, crops in mixtures, plant straw residue and succeeding crops during decomposition of residue are also well documented. Allelopathy is expected to be an important mechanism in the plant invasion process because of the lack of co-evolved tolerance of resistant vegetation to new chemicals produced by the invader. This phenomenon could allow the new introduced species to overlook natural plant communities (Khan *et al.*, 2011b, p. 6392).

Rhazya stricta Decne, (Apocynaceae) is a perennial plant locally known as Harmal. It is widely distributed throughout Western Asia from Yemen to Arabia, to the North West Province of India and abundantly found in various regions of Pakistan (Baeshin *et al.*, 2009, p. 986). *R. stricta* like other plants is competing with the main crops for nutrients and other resources and hamper the healthy growth of crops ultimately, reducing the yield both qualitatively and quantitatively (Mutawakil., 2012, p.11). (Al-Yahya *et al.*, 1990, p. 123) have reported the presences of alkaloids, glycosides, triterpenes, tannins and volatile bases in the leaves of this plant.

Zea mays is a principal annual cereal crop that occurs as a main component in the crop rotations in Egypt and other Mediterranean



countries. Maize, a member of the poaceae family, is the third-largest cereal crop produced worldwide after wheat and rice (Salama *et al.*, 2021).

Material and Methods

Plant materials

Plant material of *Rhazya stricta* was collected from its natural habitats in central Saudi Arabia. The plants were air dried, then ground into a fine powder and stored in refrigerator until used. The seeds of radish were obtained from the Agricultural Research Center, Vegetables Department, Egypt.

Preparation of *Rhazya* extract

Aqueous extracts of *Rhazya stricta* were prepared by shaking dry powdered tissue with distilled water for 24 hours at room temperature. Mixture was filtered through a suction filtration. The clear supernatant was brought to the original volume with distilled water to obtain the extract concentrations 0.05, 0.1, 0.5, 1, 2, 3, 4 % (w/v). These water extracts were used in the bioassay tests.

Bioassay tests

Effects of *Rhazya* extracts on seed germination and seedling growth of *Zea mays* were performed in the laboratory in covered glass Petri dish (9cm diameter) lined with one layer filter paper. In every dish 10 radish seeds and 10 ml of the test extract were used. Distilled water was applied in the control treatment. The dishes were incubated in a dark growth chamber, at room temperature. Four replicates per treatment were used. Tests were terminated after 10 days. The final germination was calculated as percentage of control. The radical and



plumule lengths of the seedlings were measured. Root/shoot length ratio were calculated.

Statistical analysis

The data obtained were analyzed with (SPSS) one-way ANOVA.

Results

Effect of plant extracts on germination and seedling growth

The effects of *Rhazya* extract concentrations on the germination of *Z. mays*, calculated as a percentage of their controls, are shown in (Table1). Generally no significant differences in the germination percentages occurred at low concentrations of *Rhazya* extract, but at high concentration a significant reduction was observed. Growth of *Z. mays* seedling treated with *Rhazya* aqueous extract, during the germination period, are shown in Table (1). The treatments at low concentrations of *Rhazya* extract increased the length of *Z. mays* plumule over the control, while the high concentrations produced significant growth reduction. The highest plumule length inhibition reached 3.90 cm at concentration 4%. The length of radicle, showed significant difference by *Rhazya* extract except at 0.1% extract concentration which showed significant increase in length of radicle of treated plants.

Concerning root/shoot length ratios, the results suggest that stimulatory and inhibitory effects of the plant extract of concentration (Figures 1). The high concentrations of *Rhazya* extract decreased root/shoot length ratio at concentrations up to 0.5% then increased at



higher concentrations (Figure 1). Stimulated root/shoot length ratio of *Z. mays* was significant above concentration 4% of *Rhazya* extract (Figure1).

Table 1. Effect of different concentrations of *Rhazya stricta* plant aqueous extract on germination percentage and some growth criteria of *Zea Mays*.

Growth Criteria			
Extract Concentrations (%)	% of germination	Length of Plumule (cm)	Length of Radicle (cm)
0	100 ± 0.00	6.56 ± 0.66 ^c	19.18 ± 1.7 ^e
0.05	90 ± 0.00	7.12 ± 0.7 ^{cd}	18.39 ± 2.34 ^e
0.1	100 ± 0.00	6.93 ± 0.67 ^{cd}	21.48 ± 0.71 ^f
0.5	85 ± 0.00	8.06 ± 0.88 ^d	18.74 ± 0.22 ^e
1	95 ± 0.00	6.4 ± 0.33 ^c	15.28 ± 0.98 ^d
2	85 ± 0.00	4.55 ± 0.33 ^{ab}	11.47 ± 0.97 ^c
3	85 ± 0.00	5.67 ± 1.27 ^{bc}	7.45 ± 1.12 ^b
4	85 ± 0.00	3.9 ± 0.9 ^a	2.92 ± 0.73 ^a

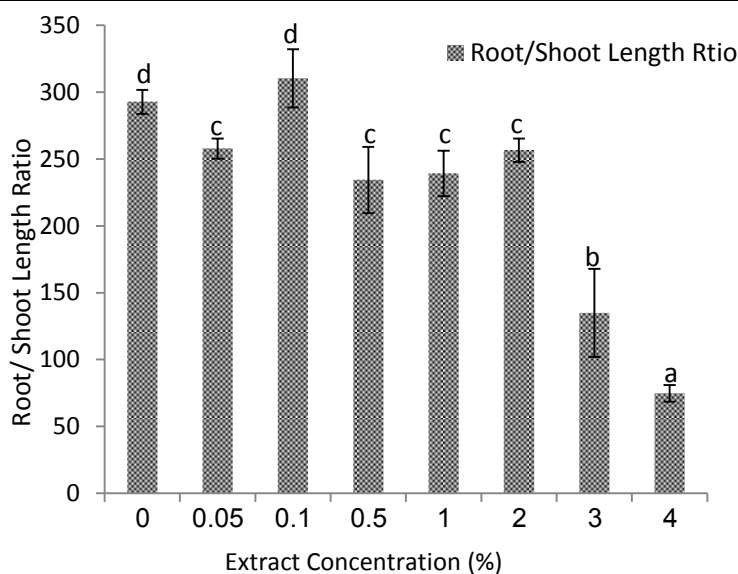


Fig.1. Effect of different concentrations of *Rhazya stricta* plant aqueous extract on root/shoot length ratio of *Zea Mays*.



Discussion

The results of the present study showed that the aqueous extracts of *Rhazya stricta* differed in their effects on germination and seedling growth of Maize (*Zea mays*) plant. The *Rhazya* extract was not significantly affecting on germination percentage of *Z. mays* at low concentrations of *Rhazya* extract. The results showed that allelochemicals in the extract of *Rhazya* could have harmless effect on seed germination of *Z. mays*. This result agrees with the earlier study of (Moosavi *et al.*, 2011, p 115) who demonstrated that allelopathic effect of different concentrations of water extract of *sorghum* was not significant for germination percentage of *Vigna radiata L.* Whereas germination percentage of *Z. mays* at high concentrations of *Rhazya* extract a significant reduction was observed, The results showed that allelochemicals in the extract of *Rhazya* have harmful effect on seed germination of *Z. mays*. Similarly, Alagesaboopathi, (2011) showed the aqueous leaf, stem and root extracts of *Andrographis paniculata* Nees produce inhibitory effects on seed germination of *Seasmum indicum L.*

The extracts of *Rhazya* stimulated significantly the plumule length of *Z. mays* particularly at the low concentrations, whereas at high concentrations produced inhibitory effect. This finding is in agreement with that of (abad, . 2019, p48) showed, the treatments at low concentrations of *Rhazya* extract increased the length of *R. sativus* radicle and plumule over the control, while the high concentrations produced significant growth reduction. This indicated



that allelochemicals in the extract of *Rhazya* may have stimulating effect on seedling growth of *Z. mays*. On the other hand, the inhibition was correlated to the concentration of the inhibitory chemicals present in high concentrations for *Rhazya* extract. Similarly, (Mutlu & Atici, 2009, p 90) demonstrated, both root and leaf extracts significantly increased the seedling growth of wheat, especially at the lower concentrations. The biological activity of the identified allelochemicals from *Vulpia myuros* toward test plant was stimulatory at low concentrations, and inhibitory at high concentrations (An *et al.*, 2001, p 383).

The length of radicle and root/shoot length ratio were negatively affected by allelochemicals. Allelochemicals were reported to influence several physiological processes during seed germination such as inhibiting amylase activity and delaying the translocation of food reserve (Politycka & Gmerek, 2008, p 230).

The effect on growth suggests that leaves and stem of *Rhazya* can act as a source of allelochemicals after decomposition that in-turn negatively affects the neighboring or successional plants. The observed phytotoxicity difference of *Rhazya* may be attributed to the presence of variable amount of phytotoxic substances in different parts that leach out under natural conditions. Some modern investigations indicating the allelopathic/ phytotoxic determine of aqueous extracts of weeds contain include *Raphanus raphanistrum* (Norsworthy, 2003, p 307), *Andrographis paniculata* (Alagesaboopathi, 2011, p 147). These studies strongly showed the release of phototoxic chemicals during the preparation of aqueous extracts.



Conclusion

The allelopathic activity of *Rhazya stricta* is depending on the amount and type of allelochemicals released from the decomposed shoot, as well as the uptake of these compounds by plant roots of the target species

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الأثر الأيلوباثي لمستخلص نبات الحرمل (*Rhazya stricta*) علي إنبات ونمو بادرات نبات الذرة (*Zea mays*)

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الملخص:

الحرمل شجرة دائمة الخضرة سامة تحتل مساحات كبيرة من المراعي في المملكة العربية السعودية. تمت الدراسة المعملية للإمكانية الأيلوباثية لنبات الحرمل (*Rhazya stricta*) علي الإنبات ونمو بادرات الذرة. أوضح المستخلص المائي لنبات الحرمل تأثيرا مثبطا على نسبة الإنبات ونمو بادرات نبات الذرة خاصة في التركيزات العالية.

الكلمات الدالة: المواد الأيلوكيميائية، أيلوباثي، المستخلص المائي، نمو البادرات، الإنبات.

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