# Effect of Phosphorous on Arsenic Accumulation in Two Basil Cultivars

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**Abstract:** In order to evaluate the effects of Phosphorous fertilizers on arsenic toxicity in two varieties of basil, a factorial experiment was conducted using Completely Randomized Block Design. Studied factors included two varieties of keshkeniluvelouand local of Zabol seed as the first factor and triple super phosphate fertilizer at three levels of 50, 150 and 250 mg (P).kg soil$^{-1}$ as the second factor. Fixed amount of 15 mg.kg soli $^{-1}$ arsenic sulphate was added to all pots' soil. Analysis of variance showed significant effect of variety, P fertilizer with arsenic and their interactive effects on absorbed phosphorous from soil, while effect of P fertilizer level with arsenic and their interactive effect was statistically significant. Evaluation of relationship between P and Asshow that with increase in applied P content in both varieties As concentration in the aerial parts is reduced.
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## 1. Introduction

Basil (Ocimumbasilicum L.), a member of the Lamiaceae family, is used both as a culinary and ornamental herb. The genus Ocimum contains between 50 and 150 species of herbs and shrubs found in the tropical regions of Asia, Africa, and Central and South America. Traditionally basil has been used as a medicinal plant in the treatment of headaches, coughs, diarrhea, constipation, warts, worms, and kidney malfunctions. Externally, basil can be used as an ointment for insect bites, and its oil is applied directly to the skin to treat acne (Javanmardi et al, 2002). Environmental pollution to a variety of organic and inorganic chemical compounds due to the rapid development of chemical industry and the entry of toxic and hazardous compounds to natural resources has become a serious threat.Arsenic is a metalloid that exists everywhere in the earth's crust and is found in both inorganic and organic forms, which its organic form is more toxic than the inorganic one (Mokgalaka-Matlala et al, 2009).Arsenic in plants by attacking cell membranes and preventing their regular actions will cause their death (Ozturket al., 2010). This element is mainly found in the forms of arsenite and arsenate. Arsenate is the dominant form of inorganic arsenic which is mainly absorbed by plants (Wang et al., 2001). Interaction of arsenic and phosphorous in soil and its uptake by plants is complex. As and P species compounds similarities in the soil causes the soil to be competitive in their absorption. Phosphate and arsenate show similar physiological behaviors and are in direct competition to be absorbed in the soil (Cao et al., 2003). P could be replaced by As in plants, but As is not able to play role of phosphorus as an energy carrier. So the presence of arsenic in plants growth media results in plants response to phosphorous deficiency. With increase in As content in plant tissues, phosphate may be replaced by excess As in plants (Cao et al., 2009).

In order to evaluate the effect of phosphorous fertilizer on the uptake and accumulation of arsenic in two varieties of basil herb, a factorial experiment was conducted in the research greenhouse of Zabol University in an isolated environment with controlled temperature, light, humidity and other environmental factors where experimental design was Completely Randomized Block design. Studied factors included two varieties of basil inbred seeds (keshkeniluvelouand local of Zabol) as the first factor and three fertilizers levels of 50, 150 and 250 mg (P).kg Soil -1 for each variety as the second factor. Fixed amount of 15 mg.kg soil -1 Arsenic Sulphate was added to all pot soils. Seeds were sown in 20 cm height and 15 cm diameters pots and after that pots were placed randomly in the greenhouse, and when seedling were grown to 3 cm height plants in the pots were thinned up to five plant in each pot. During the experiment pots were irrigated once every three days. Phosphorous measurement was done using spectrometer (Spectrumlab 54) at 470nm and digestion method using dry burning and combination with HCl was used for extract preparation for atomic absorption (Pu9100x-Philips).

## Results and discussion

Analysis of variance showed that effect of variety and P fertilizers with As was significant at 1% of probability for As concentration in vegetative parts, but their interaction effect was not statistically

significant (Table 1). Main effects means comparison of two varieties showed that As accumulation in aerial parts of keshkenilolowas significantly different from local variety, which in addition to its better compatibility to the studied environmental area, could be another reason for better growth of local variety thankeshkenilolovarity (Table 2). Means comparsion of P fertilizer with As effect showed that highest and lowest As content in vegetative parts were at 50 and 250 mg.kg (P) soil-1, respectively (Table 3).

Studying the interaction between variety and fertilizer showed that in P and As relation, keshkeniloloabsorbed and accumulate greater As content in the aerial parts which is the evidence of higher potency of local variety in preventing As entry into aerial parts through plants root. The survey results show consistency in both cultivars, so that increased P levels resulted in As absorption in aerial parts of both varieties. Faviga (2005) expressed that for phytoremdiation, one of necessary requirements of plant selection is its compatibility with the region. In keshkenilolo lowest As content in the aerial parts was observerd at 150 mg.kg soil-1, while in local variety this happened at 50mg.kg soil-1. Comparison of control treatment in both varieties showed that local variety is more able to prevent As entry to aerial parts.

**Table 1.** Analysis of variance of elements on basil affected by P fertilizers with As

| SOV | DF | Shoots P | Roots P | As |
|---|---|---|---|---|
| | | Means Square | | |
| **Replication** | 2 | 0.04 | 0.006 | 192.77 |
| **Variety** | 1 | 0.72 * | 0.06 ** | 11857.4 ** |
| **Fertilizer** | 6 | 0.19 ** | 0.09 ** | 1152.6 ** |
| **Variety×Fertilizer** | 6 | 0.12 ** | 0.07 ** | 213.7 ns |
| **Error** | 26 | 0.01 | 0.04 | 202.9 |
| **C.V. (%)** | | 18.09 | 14.41 | 9.62 |

ns, * and ** not significant, significant at 5 and 1%, respectively.

**Table 2.** Means comparison of element in basil

| Variety | Shoots P (%) | Roots P (%) | As (ppb) |
|---|---|---|---|
| **'Kahkani LOLO'** | 0.75 a | 0.50 a | 164.844 a |
| **'Local'** | 0.49 b | 0.42 b | 131. 238b |

Means with similar letter are not significant at the 5% probability level

**Table 3.** Means comparison of elements affected by P fertilizer with As

| Treatment | Shoots P (%) | Roots P (%) | As (ppb) |
|---|---|---|---|
| **P 50** | 0.53 bc | 0.55 b | 173.55 a |
| **P 150** | 0.55 bc | 0.52 b | 156.48 b |
| **P 250** | 0.42 c | 0.32 c | 137.15 c |
| **K 50** | 0.63 b | 0.40 c | 153.85 bc |
| **K 150** | 0.58 b | 0.39 c | 137.9 bc |
| **K 250** | 0.65 b | 0.37 c | 138.6 bc |
| **Control** | 0.99 a | 0.67 a | 138.75 bc |

Means with similar letter are not significant at the 5% probability level

Competition between As and P is also effective on phosphorous uptake from soil, so that in keshkenilolohighest P uptake was observed at 50 mg.kg soil -1 which has the lowest competency with As and the lowest absorbed P observed at 250 mg.kg soil -1 which has the highest competency with As. This trend in local variety was inverse, which was due to greater competency in this variety, so that P absorption rate at each three levels was lower than the other variety which resulted to higher stored P content in roots than shoots.

Reay and Asher (1979) first demonstrate the competition between P and As. Their results showet that Phosphate is a potent inhibitor of As uptake, through fixing this element. The results of this study were consistent with those achieved from Scutellariabaicalensis. In this plant increased P levels resulted in lower As concentration in aerial parts and increased As content in roots. This means that low P fertilizers application rates could increase As absorption by roots (Cao et al., 2009). In another research on Nugget marigold (Tagetespatula×Tageteserecta) with the addition of P

fertilizer to the soil, As accumulation significantly increased (Chintakovid et al., 2007). The effect of phosphorous on arsenic absorption may be related to the following factors:

1- Planting conditions, for example, research results on fern as a superabsorbent plant (Pterisvittata) in hydroponic condition showed that phosphorous prevent As uptake at all concentrations, but in soil culture, adding P to the soil increased plants As content (Tu and Ma, 2003).

2- This may vary from plant to plant, for instance in Atriplexvesicara and Maireanageorei increased P level resulted in lower As uptake from soil. In contrast, in SennaP lanitiicola, with adding P to the soil As concentration increased in plants dry weight (Costello *et al*., 2003).

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