# Effect of soil salinity on germination and growth of *Cicer arietinum* , *Phaseolus vulgaris* and *Vigna sinensis*

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**Abstract :**

Sandy soil in pots were used to study the effect of four levels (1,3,9,15 $ds.m^{-1}$) of soil salinity on germination percentage , shoot and root lengths , shoot and root dry weights and leaf area of three legume plants *Cicer arietinum* , *Phaseolus vulgaris* and *Vigna sienensis* . The results showed that increasing soil salinity significantly reduces all the growth parameters mentioned above and for the three legume plants. *Vigna sinensis* showed more tolerance to salinity stress than the other two legume plants .

**Introduction :**

The salinity has anegative effect on the plant physiological activities for large number of crops (Zidan,1991) . Agricultural productivity is severly affected by soil salinity and the damaging effect of salt accumulation in agricultural soils has become an important environmental concern (Jallel, *et al*, 2008). The deleterious effect of salinity on plant growth is attributed to the decreased osmotic potential of growing medium , specific ion toxicity , and nutrient ions deficiency (Luo & Liu , 2005) . The high sodium levels disturb potassium (K) nutrition and when accumulated in cytoplasm it inhibits many enzymes (Sharma , 1997). The salinity interferes with water and nutrient uptake , physico-chemical properties of soil , thus reducing productivity (Munns, 2006) .

The legumes are one of the most important foods for the human and animal especialy *Phaseolus vulgaris* , *Vigna sinensis* and *Cicer arietinum* .These are a good source of plant proteins and carbohydrates (Williams &Singh, 1987) .

Akhtar and Hussain (2009) indicated that increasing of soil salinity levels from 5 to 15 $ds.m^{-1}$ reduced the germination percentage of *Vicia faba* . Wong et al (2009) found that 50 mM of Nacl treatment resulted in asignificant decrease in the germination and growth of *Medicago sativ*a . Singla andGary (2005) observed that salinity significantly reduced dry matter accumulation in both roots and leaves in chickpea (*Cicer arietinum* ) .Bayueto et al (2008) found that the salinity stress reduced the growth of *Phaseolus vulgaris* .

Dhanapackiam and Muhammed (2010) found that the fresh and dry weight of roots and leaves in the *Sesbania grandiflorra* were reduced with increasing salinity levels.

This study aimed to identify the effect of soil salinity levels on the germination and growth of three species of legume plants (*Cicer arietunum* , *Vigna sinensis* and *Phaseolus vulgaris* ) .

**Material and methods :**

Sandy soils (>90% sand) were used to prepare four soils salinity levels 1,3,9,15 $ds.m^{-1}$ . Saline water was prepared by adding Nacl to the irrigation water. The required soil salinity levels was obtaind by leaching the soil with the fixed saline water. One kilograme of soil was packed in each pot before leaching . The seeds of *Cicer arietinum* , *Phaseolus vulgaris* and *Vigna sinensis* were collected from the market and sterilized in sodium hypochloride (Martin , 1990) for 5min . Then thoroughly washed with tap water . The seeds were pre-soucked in 500 ml of distilled

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water. Fifteen seeds of each plant were swon in each pot. Irrigation water (1 $ds.m^{-1}$) was used to raise the soil moisture to field capacity after depletion of 75% of available water. Gravimetric method was used in irrigation. The plant were uprooted after 25 days to estimate germination percentage and growth parameters. The completely randomized design (CRD) with three replicates was used. Least significant difference was used in the comparison between the averages (Snedicor and cochran,1989).

**Results and discussion :**

Increasing soil salinity to 9 $ds.m^{-1}$ caused aprevension of seed germination of *Cicer arietinum* and *Phaseolus vulgaris* where as increasing soil salinity to 15 $ds.m^{-1}$ caused adecrease in germination percentage of *Vigna sienensis* from 80% to 37%.This indicates that *Vigna sienensis* seeds were more tolerant to soil salinity than *Cicer arietinum* and *Phaseolus vulgaris* (table 1). The reduction in germination percentages due to increasing soil salinity may be attributed to membrane damage and stimulate formation of ROS such as super oxid, hydrogen , hydroxyl radical (Wong et al , 2009). Akhtar and Hussain (2009) also observed areduction in the germination percentage of *Vicia faba* seeds due to increasing soil salinity from 5 to 15 $ds.m^{-1}$ . Wong et al (2009) found that 50mM of Nacl treatment resulted in asignificant decrease in the germination percentage for Medicago sativa seeds .

Increasing soil salinity from 1$ds.m^{-1}$ to 3 $ds.m^{-1}$ caused decrease in shoot lengths by ( 20% , 33% ,14% ) and root lengths by ( 46% , 18% , 9% ) and dry weight of shoot by ( 30% , 57% , 36% ) and dry weights of roots by ( 41% , 50% , 42% ) for *Cicer arietinum* , *Phaseolus vulgaris* and *Vigna sinensis* respectively while increasing soil salinity to 9 and 15 $ds.m^{-1}$ only permits *Vigna sinensis* to grow. Increasing soil salinity to 15 $ds.m^{-1}$ caused adecrease by ( 43%, 50% , 83% , 69% ) in shoot length , root length , shoot weight , root weight respectively . (tables 2,3,4,5) . Similar decrease in growth was found in *Withania somifera* under salt stress ( Jaleel et al,2008) . Salinity stress imposes additional energy requirement on plant cells and diverts metabolic carbon to storage pools so that less carbon available for growth . Deleterious effect of salinity on plant growth is attributed to the decreased osmotic potential of growing medium and nutrient ion deficiency (Lue and Liu , 2005) .

Asignificant reduction in dry matter accumulation in both roots and leaves in chickpea was observed by Singla and Gray (2005).

Increasing soil salinity from 1 to 3 $ds.m^{-1}$ reduced the leaf area from 6.3 $cm^2$ to 3.7$cm^2$ and from 11.5 $cm^2$ to 4.4 $cm^2$ for *Cicer arietinum* and *Phaseolus vulgaris* respectively , while increasing soil salinity from 1 to 15 $ds.m^{-1}$ reduced the leaf area of Vigna sinensis from 11.3 to 6.1 $cm^2$ .

Due to abiotic stress from salt that lead the plants to cope with the situation by decrease the leaf area and conserving energy . Significant reduction in leaf area of *Sorghum bicolr* due to increasing soil salinity attained by Netondo et al.(2004). Zhoa et al. (2007) found a decrease in leaf area of *Avena sativa* with the increase of soil salinity .



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**Conclusion :**

Increasing soil salinity decreased germination percentage , shoot and root lengths , shoot and root weights and leaf area of *Cicer arietinum* , *Phaseolus vulgaris* and *Vigna sinensis* . Vigna sinensis was found to be more tolerant to salinity than the other two legume plants .

**Table (1): The effect of soil salinity levels on the percentage of germination (%) of *Cicer arietinum,Phaseolus vulgaris , Vigna sinensis***

| Percentage of germination (%) | | | |
|---|---|---|---|
| **EC ds.m$^{-1}$** | ***Cicer arietinum*** | ***Phaseolus vulgaris*** | ***Vigna sinensis*** |
| **1** | **77** | **70** | **80** |
| **3** | **50** | **57** | **67** |
| **9** | **0.0** | **0.0** | **63** |
| **15** | **0.0** | **0.0** | **37** |

**L.S.D. 0.05 Plant type 11.38 EC 23.28 Intraction (plant *EC) 1.2**

**Table(2): The effect of soil salinity levels on the shoot length of *Cicer arietinum,Phaseolus vulgaris,Vigna sinensis***

| Shoot length (cm) | | | |
|---|---|---|---|
| **EC ds.m$^{-1}$** | ***Cicer arietinum*** | ***Phaseolus vulgaris*** | ***Vigna sinensis*** |
| **1** | **14.7** | **17.7** | **20.8** |
| **3** | **11.7** | **11.8** | **17.7** |
| **9** | **0.0** | **0.0** | **15.8** |
| **15** | **0.0** | **0.0** | **11.7** |

**L.S.D. 0.05 Plant type 4.642 EC 4.503 Intraction (plant*EC) 3.035**

**Table(3)The effect of soil salinity levels on the root length of *Cicer arietinum,Phaseolus vulgaris,Vigna sinensis***

| Root length (cm) | | | |
|---|---|---|---|
| **EC ds.m$^{-1}$** | ***Cicer arietinum*** | ***Phaseolus vulgaris*** | ***Vigna sinensis*** |
| **1** | **11.3** | **14.3** | **12.5** |
| **3** | **6.0** | **11.6** | **11.3** |
| **9** | **0.0** | **0.0** | **7.2** |
| **15** | **0.0** | **0.0** | **6.2.** |

**L.S.D. 0.05 Plant type *(not significant) EC 2.473 Intraction (plant*EC) 2.291**



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**Table(4): The effect of soil salinity levels on the shoot dry weight of *Cicer arietinum,Phaseolus vulgaris,Vigna sinensis***

| Dry weight of shoot (g) | | | |
|---|---|---|---|
| **EC ds.m$^{-1}$** | ***Cicer arietinum*** | ***Phaseolus vulgaris*** | ***Vigna sinensis*** |
| **1** | **0.81** | **1.4** | **1.2** |
| **3** | **0.56** | **0.6** | **0.82** |
| **9** | **0.0** | **0.0** | **0.76** |
| **15** | **0.0** | **0.0** | **0.2** |

**L.S.D. 0.05 Plant type 0.297 EC 0.360 Intraction (plant*EC) 0.194**

**Table(5): The effect of soil salinity levels on the root dry weight 0f *Cicer arietinum,Phaseolus vulgaris,Vigna sinensis***

| Dry weight of root (g) | | | |
|---|---|---|---|
| **EC ds.m$^{-1}$** | ***Cicer arietinum*** | ***Phaseolus vulgaris*** | ***Vigna sinensis*** |
| **1** | **1.2** | **0.52** | **0.26** |
| **3** | **0.7** | **0.26** | **0.15** |
| **9** | **0.0** | **0.0** | **0.11** |
| **15** | **0.0** | **0.0** | **0.08** |

**L.S.D. 0.05 Plant type 1.75 EC 0.49 Intraction (plant*EC) 0.062**

**Table(6):The effect of soil salinity levels on theleaf area of *Cicer arietinum,Phaseolus vulgaris,Vigna sinensis***

| Leaf area (cm$^2$) | | | |
|---|---|---|---|
| **EC ds.m$^{-1}$** | ***Cicer arietinum*** | ***Phaseolus vulgaris*** | ***Vigna sinensis*** |
| **1** | **6.3** | **11.5** | **11.3** |
| **3** | **3.7** | **4.4** | **7.9** |
| **9** | **0.0** | **0.0** | **9.2** |
| **15** | **0.0** | **0.0** | **6.1** |

**L.S.D. 0.05 Plant type 2.428 EC 2.582 Intraction (plant*EC) 1.419**



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