# Numerical Data

## Effect of different concentration of Nickel Chloride on growth performance of *Acacia nilotica* at 90 DAS.

| Treatments | Shoot length (cm) | Collar diameter (mm) | Leaf number plant$^{-1}$ | Root length (cm) | Nodules No./ plant | Dry weight gm plant$^{-1}$ | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Leaves | Above ground | Below ground | Total | Shoot /root |
| $T_1$ (0 ppm) | 72.61 | 6.37 | 48.12 | 57.10 | 33.29 | 3.62 | 9.20 | 3.95 | 13.15 | 2.32 |
| $T_2$ (100 ppm) | 67.83 | 6.08 | 47.21 | 53.08 | 31.83 | 3.46 | 8.86 | 3.75 | 12.62 | 2.36 |
| $T_3$ (200 ppm) | 64.61 | 5.97 | 45.47 | 49.71 | 29.81 | 3.22 | 8.12 | 3.66 | 11.78 | 2.21 |
| $T_4$ (500 ppm) | 62.68 | 5.77 | 43.06 | 49.02 | 28.03 | 2.88 | 7.53 | 3.48 | 11.01 | 2.16 |
| $T_5$ (700 ppm) | 59.89 | 5.50 | 40.58 | 46.96 | 25.74 | 2.60 | 6.91 | 3.13 | 10.04 | 2.20 |
| $T_6$ (1000ppm) | 57.28 | 4.84 | 37.72 | 44.26 | 23.97 | 2.29 | 6.26 | 2.78 | 9.04 | 2.25 |
| $T_7$ (2000 ppm) | 48.84 | 4.10 | 35.25 | 41.48 | 21.10 | 1.88 | 5.55 | 2.33 | 7.89 | 2.38 |
| SE(m)± | 0.53 | 0.03 | 0.14 | 0.57 | 0.34 | 0.02 | 0.05 | 0.03 | 0.07 | |
| SE(d)± | 0.74 | 0.04 | 0.20 | 0.81 | 0.49 | 0.03 | 0.07 | 0.04 | 0.09 | |
| CD at 5% | 1.60 | 0.09 | 0.43 | 1.73 | 1.05 | 0.05 | 0.16 | 0.08 | 0.20 | |

Source: http://www.isca.in/AGRI_FORESTRY/Archive/v5/i7/1.ISCA-RJAFS-2017-021

## Yield of maize, field bean and lettuce (g growing container$^{-1}$)

| Ni dose (mg Ni dm$^{-3}$) | Maize *Zea mays* L. | | | | | Field bean *Vicia faba* L. (partim) | | | | | Lettuce *Lactuca sativa* L. var. capitata | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Leaves | Stems | Above ground parts | Roots | Total | Leaves | Stems | Above ground parts | Roots | Total | Above ground parts | Roots | Total |
| 0 | 81.1$^{h*}$ | 72.8$^{e}$ | 153.9$^{g}$ | 35.5$^{e}$ | 189.4$^{g}$ | 24.9$^{f}$ | 16.2$^{e}$ | 41.1$^{e}$ | 20.3$^{e}$ | 61.4$^{d}$ | 7.4$^{b}$ | 2.4$^{ab}$ | 9.8$^{b}$ |
| 0.5 | 60.5$^{g}$ | 51.4$^{d}$ | 111.9$^{f}$ | 24.9$^{d}$ | 136.8$^{f}$ | 21.9$^{e}$ | 15.3$^{e}$ | 37.2$^{d}$ | 19.3$^{e}$ | 56.5$^{c}$ | 7.4$^{b}$ | 3.0$^{bcd}$ | 10.4$^{b}$ |
| 2.5 | 40.9$^{f}$ | 27.4$^{c}$ | 68.3$^{e}$ | 15.0$^{c}$ | 83.3$^{e}$ | 13.3$^{d}$ | 11.7$^{d}$ | 25.0$^{c}$ | 9.1$^{d}$ | 34.1$^{b}$ | 10.6$^{d}$ | 3.1$^{cd}$ | 13.7$^{d}$ |
| 5.0 | 35.2$^{e}$ | 25.3$^{c}$ | 60.5$^{d}$ | 13.5$^{bc}$ | 74.0$^{d}$ | 12.0$^{cd}$ | 10.2$^{cd}$ | 22.2$^{b}$ | 7.4$^{abc}$ | 29.6$^{ab}$ | 10.9$^{d}$ | 3.4$^{d}$ | 14.3$^{d}$ |
| 7.5 | 28.8$^{d}$ | 13.5$^{ab}$ | 42.3$^{c}$ | 12.6$^{b}$ | 54.9$^{c}$ | 10.6$^{bc}$ | 10.0$^{bc}$ | 20.6$^{b}$ | 8.1$^{cd}$ | 28.7$^{ab}$ | 10.4$^{d}$ | 2.8$^{bcd}$ | 13.2$^{d}$ |
| 8.0 | 24.2$^{c}$ | 14.4$^{b}$ | 38.6$^{bc}$ | 11.9$^{b}$ | 51.5$^{c}$ | 10.9$^{bc}$ | 10.8$^{cd}$ | 21.7$^{b}$ | 8.2$^{cd}$ | 29.9$^{ab}$ | 10.2$^{d}$ | 3.1$^{cd}$ | 13.3$^{d}$ |
| 8.5 | 23.8$^{bc}$ | 12.0$^{a}$ | 35.8$^{bc}$ | 10.3$^{a}$ | 46.1$^{b}$ | 9.6$^{ab}$ | 8.3$^{ab}$ | 17.9$^{a}$ | 6.8$^{ab}$ | 24.7$^{a}$ | 8.9$^{c}$ | 2.9$^{bcd}$ | 11.8$^{c}$ |
| 9.0 | 23.0$^{bc}$ | 12.1$^{a}$ | 35.1$^{b}$ | 9.7$^{a}$ | 44.8$^{b}$ | 8.9$^{a}$ | 8.3$^{ab}$ | 17.2$^{a}$ | 6.4$^{a}$ | 23.6$^{a}$ | 7.8$^{b}$ | 2.8$^{bcd}$ | 10.6$^{bc}$ |
| 9.5 | 21.3$^{b}$ | 11.6$^{a}$ | 32.9$^{ab}$ | 8.7$^{a}$ | 41.6$^{ab}$ | 8.9$^{a}$ | 8.5$^{ab}$ | 17.4$^{a}$ | 6.4$^{a}$ | 23.8$^{a}$ | 6.0$^{a}$ | 2.1$^{a}$ | 8.1$^{a}$ |
| 10.0 | 18.8$^{a}$ | 11.3$^{a}$ | 30.1$^{a}$ | 9.0$^{a}$ | 39.1$^{a}$ | 8.3$^{a}$ | 8.1$^{a}$ | 16.4$^{a}$ | 6.5$^{a}$ | 22.9$^{a}$ | 5.7$^{a}$ | 2.0$^{a}$ | 7.7$^{a}$ |

Nickel bioaccumulation by the chosen plant species, *Acta Physiologiae Plantarum*, 2016, 38:40

Source: https://link.springer.com/article/10.1007/s11738-016-2062-5

**Comparative of plant growth parameters in the pot experiments (± 1 S.E.) (Data for each treatment regime are the mean of 10 observations with SE in parenthesis; CD (******P** <0.05) extracted from ANOVA**

| Parameters | Pot experiment with isolate-I as inoculum | | | | | |
|---|---|---|---|---|---|---|
| | Uninoculated Nickel blank | Inoculated Nickel blank | Uninoculated Nickel stressed | Inoculated Nickel stressed | MS | CD (at 5%) |
| **Shoot length (cm)** | 33.218 (±0.169) | 48.527 (±0.419) | 23.130 (±0.598) | 37.110 (±0.745) | 6.527 | 2.205 |
| **Root length (cm)** | 17.560 (±0.227) | 22.718 (±0.664) | 6.990 (±0.152) | 15.470 (±0.290) | 2.380 | 1.380 |
| **Wet weight (gm)** | 2.160 (±0.063) | 2.740 (±0.092) | 1.360 (±0.017) | 2.108 (±0.059) | 0.056 | 0.211 |
| **Dry weight (gm)** | 0.460 (±0.018) | 0.510 (±0.013) | 0.260 (±0.019) | 0.390 (±0.012) | 0.004 | 0.042 |
| **Chlorophyll content (mg gm-1)** | 2.280 (±0.089) | 2.770 (±0.027) | 1.480 (±0.036) | 2.220 (± 0.033) | 0.027 | 0.147 |

Source: Int.J.Curr.Microbiol.App.Sci (2016) 4(1): 765-772

## Effect of N, Ni and Bio-Fertilizer Application on Nutrient Content and Uptake by Grain

| Treatment | N Content (%) | Ni content (MG KG-1) | N Uptake (G POT-1) | Ni Uptake (G POT-1) |
|---|---|---|---|---|
| Nitrogen levels (kg ha-1) (N) | | | | |
| **N1- 120 RDN (3 splits)** | 1.76 | 8.74 | 0.056 | 0.028 |
| **N2- 120 (4 equal splits)** | 1.81 | 8.79 | 0.066 | 0.032 |
| **N3- 100 (4 equal splits)** | 1.77 | 8.82 | 0.063 | 0.031 |
| **N4- 80 (4 equal splits)** | 1.72 | 8.89 | 0.058 | 0.030 |
| **S. Em. ±** | 0.01 | 0.20 | 0.001 | 0.001 |
| **C.D. (P=0.05)** | 0.04 | NS | 0.003 | 0.003 |
| **Nickel levels (mg kg-1) (Ni)** | | | | |
| **Ni0- Control** | 1.68 | 8.41 | 0.057 | 0.028 |
| **Ni2- 5 mg Ni kg-1** | 1.85 | 9.20 | 0.065 | 0.033 |
| **S. Em. ±** | 0.01 | 0.14 | 0.001 | 0.001 |
| **C.D. (P=0.05)** | 0.03 | 0.41 | 0.002 | 0.002 |
| **Bio-fertilizer inoculation (B)** | | | | |
| **B0- Control** | 1.75 | 8.70 | 0.059 | 0.029 |
| **B1o- 10 ml *Azospirillum* kg-1 seed** | 1.78 | 8.92 | 0.063 | 0.031 |
| **S. Em. ±** | 0.01 | 0.14 | 0.001 | 0.001 |
| **C.D. (P=0.05)** | 0.03 | NS | 0.002 | 0.002 |
| **Interaction** | | | | |
| **N x Ni** | NS | NS | NS | NS |
| **N x B** | NS | NS | NS | NS |
| **B x Ni** | NS | NS | NS | NS |
| **N x Ni x B** | NS | NS | NS | NS |
| **C.V. %** | 2.9 | 7.9 | 7.38 | 9.39 |

Source: Mukesh Kumar Pnachal & V. P. Raman (2016), International Journal of Agricultural Science and Research (IJASR)

**Nickel effects on enzymatic activity**

| Enzyme | Process | Concentration Ni, mM | Enzyme activity | Plant species |
|---|---|---|---|---|
| **Rubisco** | CO2 fixation | 0.5; 1 | Decrease | *C. cajan* |
| **Glyceraldehyde 3-phosphate dehydrogenase** | Calvin cycle | 0.5; 1 | Decrease | *C. cajan* |
| **3-Phosphoglycerate kinase** | Calvin cycle | 0.5; 1 | Decrease | *C. cajan* |
| **Fructose 1,6-bisphosphatase** | Calvin cycle | 0.5; 1 | Decrease | *C. cajan* |
| **NADP- and NAD-** | Calvin cycle | 0.5; 1 | Decrease | *C. cajan* |
| **Aldolase** | Calvin cycle | 0.5; 1 | Decrease | *C. cajan* |
| **Nitrate reductase** | Nitrate reduction | 1 | Decrease | *B. vulgaris* |
| **$H^+$- ATPase** | Ion transport | 0.5 | Increase | *O. sativa* |
| **Glutamine synthetase** | Glutamine synthesis | 1 | Decrease | *B. vulgaris* |
| **Alanine aminotransferase** | Transformation of alanine into pyruvate | 0.2 | Decrease | *Glycine max* |
| **IAA oxidase** | IAA oxidation | >0.05<br><0.05 | Increase<br>Decrease | *O. sativa* |
| **Glutathione reductase** | Glutathione reduction | 0.01–1 | Increase | *Allysum maritimum*<br>*A. argenteum* |

Source: Int. J. Environ. Sci. Technol (2016) 10:112

## Ni concentrations in soil in the rooting zone

| Family | Species | N | Foliar Ni (µg g$^{-1}$) Range | Foliar Ni Mean | Total Soil Ni (µg g$^{-1}$) Range | Total Soil Ni Mean | Soil ML-3 Ni (µg g$^{-1}$) Range | Soil ML-3 Ni Mean |
|---|---|---|---|---|---|---|---|---|
| Meliaceae | *Walsur ef. Pinnata* | 2 | 1870 – 4580 | 3226 | 676 – 1015 | 845 | 95 – 30 | 112 |
| Monimiaceae | *Kibara cosiacea* | 1 | | 4150 | | 1510 | | 94 |
| Phyllanthaceae | Actephila sp. nov. | 3 | 6795 – 11 520 | 9125 | 1000 – 2530 | 1786 | 109 – 157 | 132 |
| Phyllanthaceae | Glochidion sp. undet | 13 | 882 – 9000 | 3778 | 185 – 2545 | 672 | 22 – 188 | 101 |
| Phyllanthaceae | *Phyllanthus balgoogi* | 10 | 1073 – 8290 | 3550 | 624 – 3415 | 1931 | 19 – 172 | 66 |
| Phyllanthaceae | *Phylanthus cf. securinegoides* | 8 | 319 – 23300 | 10,400 | 782 – 2490 | 1729 | 55 – 150 | 90 |
| Rubiaceae | *Phychotri sarmentosa comblex* | 5 | 7205 – 20600 | 12,790 | 1962 – 5100 | 3496 | 19 – 213 | 89 |
| Salicaceae | *Flacourita kinababiensis* | 2 | 1229 -3990 | 2610 | 473 – 1215 | 844 | 57 – 133 | 95 |
| Salicaceae | *Xylosma bezonensis* | 3 | 1315 – 4970 | 3705 | 1717 – 2865 | 2344 | 80 – 112 | 100 |
| Sapindaceae | *Mischocarpus sundaicus* | 2 | 555 – 3120 | 1838 | 2135 – 3260 | 2697 | 70 – 138 | 104 |
| Violaceae | *Rinorea bengalensis* | 5 | 3730 – 8470 | 6130 | 887 – 4255 | 2220 | 19 – 221 | 110 |
| Violaceae | *Rinorea javanica* | 3 | 6090 - 9680 | 7385 | 1860 – 3060 | 2608 | 51 - 149 | 97 |

Note: Table shows summarised elemental concentrations in foliage and associated soils in a range of hyperaccumulators. On average, foliar Ni is three times higher than soil Ni.

Source: Antony et al. 2015

## Pot Experiment: Effect of Ni on maize

| S. No. | Treatment of Ni (mg $Kg^{-1}$) | Shoot length (cm) | Dry wt of shoot (g) | Ni content in shoot (mg $Kg^{-1}$) |
|---|---|---|---|---|
| 1 | Control | 40 | 18.35 | 28 |
| 2 | 50 | 36 | 18.01 | 32 |
| 3 | 100 | 31 | 17.18 | 38 |
| 4 | 150 | 28 | 16.26 | 42 |
| 5 | 500 | 26 | 13.87 | 44 |
| 6 | 600 | 23 | 10.84 | 62 |

Note: The effect of dry- matter production to Ni application generally decreased with increasing rate of Ni dose applied in soil (r= - 0.975).

Source: Rathor et al. 2014.

## Hoogland experiment: Effect of Ni on maize

| S. No. | Treatment of Ni (mg $L^{-1}$) | Dry wt. of shoot (g) | Dry wt. of root (g) | Ni content in shoot (mg $Kg^{-1}$) | Ni content in root (mg $Kg^{-1}$) |
|---|---|---|---|---|---|
| 1 | Control | 0.460 | 0.168 | 19 | 39 |
| 2 | 10 | 0.196 | 0.124 | 287 | 1514 |
| 3 | 20 | 0.165 | 0.100 | 509 | 1637 |
| 4 | 30 | 0.150 | 0.096 | 1164 | 3311 |
| 5 | 40 | 0.120 | 0.012 | 1445 | 4139 |

Note: The effect of dry-matter production to Ni application generally decreased with increasing rate of Ni dose applied in water (table 4). Higher level of Ni decreased the crop growth as compared to control. Also decreased the shoot and root dry weight with the increasing the Ni concentration in water (r= -0.832 and r= -0.944 respectively).

Source: Rathor et al. 2014