NUMERICAL DATA

The effects of nickel applications on the growth of cocklebur (*xanthium strumarium l.)* Plant (2019)

The effects of different doses of Ni on the chlorophyll content, dry weight, GSH and Ni concentrations of *Xanthium strumarium L.* (n = 3)

	Ni (mg kg^{-1})	Chlorophyll (SPAD Unit)		Dry weight (g $plant^{-1}$)	GSH (µg mL^{-1})	Ni concentration (mg kg^{-1})
		Old leaf	**Young leaf**			
***Xanthium strumarium* L.**	0	30.7 a	32.5 a	6.61 a	266 b	**5.03 e**
	50	28.6 b	31.6 ab	6.50 a	281 ab	**10.7 d**
	100	28.5 b	30.3 b	5.88 b	269 b	**21.7 c**
	200	28.4 b	31.4 ab	5.61 bc	336 a	**49.5 b**
	400	22.4 c	32.4 a	5.25 c	225 b	**101 a**
Dose	**F**	**53.2****	**5.92****	**21.0****	**4.82***	**3411****

**$p \le 0.01$ statistically significant within error bounds

*$p \le 0.05$ statistically significant within error bounds

SPAD: Soil-Plant Analyses Development

GSH: Glutathione

The Ni applications cause a reduction in dry weights of *Xanthium strumarium L.* plant and likewise, chlorophyll contents were also decreased with those applications ($p \le 0.01$). The increased application doses of Ni on the plant resulted with the lowest GSH concentration in the control group as 266 µg mL^{-1} and the highest as 336 µg mL^{-1} at 200 mg Ni kg^{-1} dose in the plant. The GSH concentrations were decreased with Ni applications. The Ni concentration of the *Xanthium strumarium L.* plant increased (5.03-101 mg kg^{-1}) with increasing Ni doses.

Source:
https://www.researchgate.net/publication/331553049_The_effects_of_nickel_applications_on_the_growth_of_cocklebur_Xanthium_Strumarium_L_Plant

The effect of different doses of Ni on N, P, K, Ca and Mg concentration of *Xanthium strumarium L.* (n = 3)

	Ni	N	P	K	Ca	Mg
	(mg kg^{-1})	**(g kg^{-1})**				
***Xantium strumarium* L.**	0	32.2 a	10.3 a	57.5 a	33.9 a	**1.26 a**
	50	28.7 b	10.2 ab	48.4 b	30.7 b	**1.22 b**
	100	28.2 b	9.74 bc	48.3 b	29.5 b	**1.20 bc**
	200	27.6 bc	9.62 c	47.8 b	28.7 b	**1.19 c**
	400	26.2 c	9.55 c	46.6 b	28.7 b	**1.19 c**
Dose	**F**	**22.5 ****	**4.9 1***	**55.7 ****	**11.9 ****	**12.1****

**p ≤ 0.01 statistically significant within error bounds

*p ≤ 0.05 statistically significant within error bounds

The effects of increasing doses of Ni on N, K, Ca and Mg concentrations of the plant were found statistically significant (p ≤ 0.01). Compared to the control application the macro (N, P, K, Ca and Mg) element concentrations of plants were reduced with Ni applications.

The effect of different doses of Ni on Fe, Zn, Cu, and Mn concentrations in *Xanthium strumarium L.* (n = 3)

	Ni	Fe	Zn	Cu	Mn
	(mg kg^{-1})	**(mg kg^{-1})**			
***Xantium strumarium* L.**	0	49.0 a	15.7 a	43.0 c	**116 a**
	50	48.3 a	15.3 ab	45.3 c	**111 ab**
	100	45.7 a	13.7 bc	45.7 c	**107 b**
	200	45.0 a	12.9 c	54.3 b	**107 b**
	400	35.0 b	10.9 d	63.3 a	**106 b**
Dose	**F**	**11.1****	**13.06****	**15.7****	**5.58****

**p ≤ 0.01 statistically significant within error bounds

It was observed that the effects of Ni applications on microelement concentrations of *Xanthium strumarium L.* plant were statistically significant (p ≤ 0.01). When the rise in Ni doses was compared with the control group on the microelements (Fe, Zn, and Mn) of the plants, it was found that the concentration of these elements was decreased, while the Cu element concentration was increased.

Source:
https://www.researchgate.net/publication/331553049_The_effects_of_nickel_applications_on_the_growth_of_cocklebur_Xanthium_Strumarium_L_Plant

Nickel toxicity in plants: reasons, toxic effects, tolerance mechanisms, and remediation possibilities - a review (2019)

Effect of Ni toxicity on plant physiological processes

Toxicity level	Crop/plant	Effects	References
200 mg/L	Sunflower	Reduction in carotenoids and protein content and increase in the sugar accumulation	Hassanpour and Rezayatmand (2015)
50 mM	*Catharanthus roseus*	The activity of the catalase enzyme and proline accumulation increased, while the amount of protein and pigments, and the efficiency of photosystem II were decreased	Arefifars et al. (2014)
100 μM	Wheat	The decrease in chlorophyll content and the rate of photosynthesis	Yusuf et al. (2010)
100 μM	*Brassica juncea*	The decrease in chlorophyll content and rate of photosynthesis	Alam et al. (2007)
40 mg L^{-1}	Mungbean	Reduction in chlorophyll content and chlorophyll a and b ratio	Ahmad et al. (2007)
500 mM	Barley	Reduction in chlorophyll contents	Shalygo et al. (1999)

Source: https://link.springer.com/article/10.1007/s11356-019-04892-x

Nickel phytoextraction through bacterial inoculation in *Raphanus sativus* (2018)

‡Values are presented as means of four replicates ± SD, means sharing similar superscript letters within column are statistically non-significant according to HSD Tukey test at $p < 0.05$.

Nickel concentration	Bacterial inoculation	Shoot length	Root length	Shoot dry biomass	Root dry biomass	Root girth
mg kg^{-1} soil		cm		g $plant^{-1}$		cm $plant^{-1}$
Ni-0	Control	‡14.9 ± 0.08^{f}	19.9 ± 0.13^{f}	3.1 ± 0.08^{e}	6.9 ± 0.13^{e}	6.8 ± 0.28^{e}
	CIK-516	18.9 ± 0.13^{a}	25.1 ± 0.25^{a}	4.7 ± 0.07^{a}	9.1 ± 0.13^{a}	10.1 ± 0.22^{a}
	CIK-517Y	17.2 ± 0.22^{c}	23.2 ± 0.22^{c}	3.4 ± 0.05^{d}	7.2 ± 0.17^{cd}	8.9 ± 0.17^{b}
Ni-50	Control	14.1 ± 0.17^{g}	19.0 ± 0.17^{g}	2.9 ± 0.06^{f}	5.9 ± 0.17^{g}	6.1 ± 0.09^{f}
	CIK-516	18.2 ± 0.17^{b}	23.8 ± 0.54^{b}	4.4 ± 0.05^{b}	8.3 ± 0.22^{b}	8.9 ± 0.17^{b}
	CIK-517Y	16.6 ± 0.78^{d}	21.9 ± 0.13^{d}	3.1 ± 0.08^{e}	6.9 ± 0.21^{e}	8.2 ± 0.13^{c}
Ni-100	Control	13.0 ± 0.41^{h}	18.5 ± 0.89^{h}	2.5 ± 0.09^{h}	5.3 ± 0.21^{h}	5.2 ± 0.24^{g}
	CIK-516	17.4 ± 0.30^{c}	22.8 ± 0.24^{c}	3.9 ± 0.13^{c}	7.3 ± 0.13^{c}	8.2 ± 0.13c
	CIK-517Y	16.0 ± 0.15^{e}	20.5 ± 0.82^{e}	2.9 ± 0.06^{f}	6.5 ± 0.13^{f}	7.3 ± 0.25^{d}
Ni-150	Control	12.3 ± 0.21^{i}	16.9 ± 0.11^{i}	2.2 ± 0.13^{i}	4.2 ± 0.13^{i}	5.0 ± 0.05^{g}
	CIK-516	16.1 ± 0.18^{de}	21.6 ± 0.47^{c}	3.4 ± 0.08^{d}	7.0 ± 0.08^{de}	7.3 ± 0.25^{d}
	CIK-517Y	15.1 ± 0.45^{f}	19.5 ± 0.13^{g}	2.6 ± 0.06^{g}	6.2 ± 0.13^{g}	6.9 ± 0.15^{e}

Table: Bacterial inoculation improves R. sativus biomass in Ni contaminated soil.

Nickel contamination caused significant reduction in shoot/root length and dry biomass. Increasing the concentration of Ni resulted into a significant decrease in radish growth. However, the maximum reduction in growth was observed at 150 mg Ni kg^{-1} soil. Root girth of radish also decreased in response to application of Ni with the maximum reduction at the highest Ni contamination. It is noteworthy that the negative impact of Ni was mitigated in the plants inoculated with bacteria (Table). Inoculation with both bacterial strains (CIK-516 and CIK-517Y) improved radish dry biomass and root/shoot growth significantly in normal as well as in Ni contaminated soils as compared to their respective un-inoculated controls. However, the strain CIK-516 performed better than CIK-517Y and resulted into 31, 28, 54, 68 and 44% increase in shoot length, root length, shoot dry biomass, root dry biomass and root girth, respectively, as compared to un-inoculated plants grown at 150 mg Ni kg^{-1} soil.

Source: https://www.sciencedirect.com/science/article/pii/S0045653517315102#tbl2

‡ Values are presented as means of four replicates ± SD, means sharing similar superscript letters within column are statistically non-significant according to HSD Tukey test at $p < 0.05$.

Nickel concentration	**Bacterial inoculation**	**Chlorophyll *a***	**Chlorophyll *b***	**Carotenoids**	**Total chlorophyll**
mg kg^{-1} soil		**mg g^{-1} fresh biomass**			
Ni-0	Control	‡5.10 ± 0.22^{bc}	1.83 ± 0.12^{ef}	0.63 ± 0.06^{cde}	7.56 ± 0.31^{cd}
	CIK-516	6.60 ± 0.26^{a}	2.86 ± 0.07^{a}	0.95 ± 0.05^{a}	10.41 ± 0.16^{a}
	CIK-517Y	5.43 ± 0.14^{b}	2.22 ± 0.09^{c}	0.87 ± 0.07^{ab}	8.52 ± 0.06^{b}
Ni-50	Control	3.80 ± 0.14^{de}	1.70 ± 0.18^{fg}	0.60 ± 0.06^{de}	6.10 ± 0.13^{g}
	CIK-516	5.20 ± 0.22^{bc}	2.50 ± 0.10^{b}	0.85 ± 0.05^{ab}	8.55 ± 0.25^{b}
	CIK-517Y	4.11 ± 0.10^{d}	2.16 ± 0.07^{cd}	0.78 ± 0.03^{bc}	7.05 ± 0.08^{de}
Ni-100	Control	3.30 ± 0.18^{f}	1.55 ± 0.11^{g}	0.52 ± 0.06^{de}	5.37 ± 0.28^{h}
	CIK-516	4.90 ± 0.18^{c}	2.20 ± 0.11^{c}	0.78 ± 0.08^{bc}	7.88 ± 0.19^{c}
	CIK-517Y	3.70 ± 0.14^{def}	1.99 ± 0.08^{cde}	0.60 ± 0.08^{de}	6.29 ± 0.24^{fg}
Ni-150	Control	2.50 ± 0.12^{g}	1.20 ± 0.11^{h}	0.49 ± 0.06^{e}	4.19 ± 0.08^{i}
	CIK-516	4.13 ± 0.23^{d}	1.90 ± 0.08^{def}	0.65 ± 0.03^{cd}	6.68 ± 0.31^{ef}
	CIK-517Y	3.40 ± 0.18^{ef}	1.85 ± 0.12^{ef}	0.52 ± 0.05^{de}	5.77 ± 0.24^{gh}

Table: Bacterial inoculation improves chlorophyll contents of R. sativus in Ni contaminated soil.

The nickel stress negatively affected the chlorophyll contents and nitrogen contents of radish. The negative impacts of Ni were intensified with increasing levels of Ni in the soil. Interestingly, the negative effects of Ni stress were diluted in response to bacterial inoculation. Bacterial inoculation significantly improved chlorophyll contents of radish at all levels of Ni-contamination. However, the most prominent results were observed by the inoculation of bacterial strain CIK-516, which enhanced chlorophyll a, b, carotenoids, and total chlorophyll contents by 29, 56, 51, and 38%, respectively, as compared to un-inoculated control in the normal soil and 65, 58, 33, and 59%, respectively, in the soil containing 150 mg Ni kg^{-1} soil. Similarly, shoot and root N contents of radish were also significantly improved upon bacterial inoculation both in normal and Ni contaminated soils. In contrast to chlorophyll contents, N contents were significantly improved up to 50 mg Ni kg^{-1} soil, however, further addition of Ni (100 and 150 mg Ni kg^{-1} soil) caused significant reduction in N contents, as compared to their respective controls. The maximum N contents (32 in shoot and 37 mg g^{-1} dry weight in root) were observed upon inoculation of bacterial strain CIK-516 in soil containing 50 mg Ni kg^{-1} of soil.

Source: https://www.sciencedirect.com/science/article/pii/S0045653517315102#tbl2

Effect of different concentration of Nickel Chloride on growth performance of Acacia nilotica at 90 DAS. (2017)

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) (2016)

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}	2.8bcd	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}

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 (2016)

	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 (2016)

Nitrogen levels (kg ha^{-1}) (N)				
N1- 120 RDN	1.76	8.74	0.056	0.028
(3 splits)				
N2- 120	1.81	8.79	0.066	0.032
(4 equal splits)				
N3- 100	1.77	8.82	0.063	0.031
(4 equal splits)				
N4- 80	1.72	8.89	0.058	0.030
(4 equal splits)				
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	1.78	8.92	0.063	0.031
Azospirillum				
kg^{-1} seed				
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 (2016)

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

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

Ni concentrations in soil in the rooting zone (2015)

Family	Species	Foliar Ni ($\mu g Ng^{-1}$)			Total Soil Ni($\mu g\ g^{-1}$)		Soil ML-3 Ni ($\mu g g^{-1}$)	
			Range	Mean	Range	Mean	Range	Mean
					676 –			
Meliaceae	Walsur ef. Pinnata	2	1870–4580	3226	1015	845	95 – 30	112
Monimiaceae	Kibara cosiacea	1	6795 – 11	4150		1510		94
					1000 –			
Phyllanthaceae Actephila sp. nov.		3	520	9125	2530	1786	109 – 157	132
	Glochidion sp.				185 –			
Phyllanthaceae	undet	1 3	882 – 9000	3778	2545	672	22 – 188	101
	Phyllanthus				624 –			
Phyllanthaceae	balgoogi	1 0	1073–8290	3550	3415	1931	19 – 172	66
					782 –			
Phyllanthaceae	Phylanthus cf.	8	319 – 23300	10,400	2490	1729	55 – 150	90
	securinegoides							
	Phychotri		7205 –		1962 –			
Rubiaceae	sarmentosa	5	20600	12,79 0	5100	3496	19 – 213	89
	comblex							
	Flacourita				473 –			
Salicaceae	kinababiensis	2	1229 -3990	2610	1215	844	57 – 133	95
	Xylosma				1717 –			
Salicaceae	bezonensis	3	1315 – 4970	3705	2865	2344	80 – 112	100
	Mischocarpus				2135 –			
Sapindaceae	sundaicus	2	555 – 3120	1838	3260	2697	70 – 138	104
	Rinorea				887 –			
Violaceae	bengalensis	5	3730 – 8470	6130	4255	2220	19 – 221	110
					1860 –			
Violaceae	Rinorea javanica	3	6090 - 9680	7385	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 (2014)

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 (2014)

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