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J Plant Physiol Pathol 2019, Volume 7
DOI: 10.4172/2329-955X-C2-033

Effects of cadmium stress, nitrogen distribution and antioxidant response of Vigna unguiculata L. (Cowpea) genotypes

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Nigeria is ranked the highest producer and consumer of cowpea producing 61% in Africa and 58% worldwide. Unfortunately, improvement in legumes crop yields have not kept pace with those of cereals. Reduction in agricultural productivity is affected by industrialization, encroachment of arable lands and environmental stress such as heavy metals. This study investigated the nitrogen assimilation and antioxidant response to V. unguiculata (Fabaceae) to cadmium induce stress. The seeds of the various genotypes were sown in Cd– polluted soils. Pollution in the soil was elevated 2.5 and 5 times respectively on the basis of the Ecological Screening Value (ESV). The control (0ESV) soil was free of cadmium. The following enzymatic and non-enzymatic antioxidants in the genotype leaves were quantify namely; Superoxide Dismutase (SOD), Catalase (CAT), Malondialdehyde (MDA), Ascorbate (ASA), tocopherol, nitrogen-nitrate and nitrogen-ammonia distribution. From the result, the effect cadmium stress on the SOD activity resulted in a difference of 0.3 unit/g FW in TVu-91 as compared to 0.5 unit/g FW in TVu-92 between Cd-5ESV and control. Cadmium exposure increased the CAT activity of Cd-2.5ESV to 1.1 unit/g when compared to 0.7 unit/g Fw in control of TVu-95. There was variability in the tocopherol content of the genotypes. TVu-92 increased from 0.42 to 0.68 µM as compared to a decrease from 0.33 to 0.29 µM in TVu-96 while ASA content increased in all TVu's genotype with TVu-95 having a value of 0.018 µM (0ESV) and 0.030 µM (Cd-5ESV) with increase in cadmium concentration. Cadmium exposure resulted in a foliar Nitrate-N composition difference of 1068.89 ppm, 128.17 ppm and 907.85 ppm between the Cd-5ESV and control of TVu-91, 93 and 95 respectively while foliar Ammonia-N composition of TVu-91 from 9.54 to 11.07 ppm and 14.23 to 12.11 ppm in TVu-95 between the Cd-5ESV and control. Cadmium exposed reduced the root Nitrate-N of TVu-96 from 306.13 ppm to 256.87 ppm with the highest reduction difference of 499.36 ppm between the Cd-5ESV and control of TVu-91. The plant distributed more Nitrate-N in the leaves as compare to the root irrespective of accession type or treatment. For instance, TVu-93 had a foliar Nitrate-N distribution of 1081.33, 939.76 and 953.16 ppm as compared to 202.12, 187.45 and 192.21 ppm root Nitrate-N distribution in the control, Cd-2.5ESV and Cd-5ESV respectively. In conclusion, although cadmium increased the SOD and CAT activities of the studied genotypes, some genotypes were more resistant to cadmium pollution than others however, them both assimilated nitrogen more in the form of nitrate than form and mainly in the leaves.

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