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Mycophytoremedial Prospective of Arbuscular Mycorrhizal Fungi (Amf) For Chromium (Cr) Polluted Soil and Growth and Yield of Black Gram (*Vigna Mungo* L.)-A Biotechnological Approach

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ABSTRACT
The environment is contaminated with Heavy Metals (HMs) with increasing HM pollution due to various human and natural processes. An Arbuscular Mycorrhizal Fungi (AMF) is the large amount pervasive soil vegetative symbiotic fungus in the terrene environment and mitigates the noxious property of discrete contaminants on both natural and agricultural crop plants. In addition to AMF also repress various antagonistic and assistance bacteria such as root pathogens, PGPR including free-living and symbiotic N_2-fixers, and pinch-hitting as microbial fertilizers, and microbial degraders. The experiments were carried out of the black gram seeds were sown in pots, the pots containing 5 kg of soil with AMF inoculation and adding different proportion of Cr [(Potassium dichromate (VI), $K_2Cr_2O_7$]. Three repeats were maintained for each level. Under these investigational conditions the morphological parameters like shoot and root length, number of leaves, total leaf area was inspected with 15, 30, 60 and 75th DAS and yield parameters like number of pods/plants, amount of seeds/plants and 250 seeds weight was recorded. The nutrient content such as N, P, K, Ca, Zn, Fe and Cr of black gram was recorded in 75th DAS of dry plants. The end of the results Cr contaminated soils were decreased the growth, nutrient contents and yield parameters when compared to AMF inoculated plants. Additionally, the profitable effects of the AMF observed in this study aroused an interest in considering the role of AMF in plant-based strategies of protection of highly Cr-polluted soils.
Keywords: Chromium, AMF, *Vigna mungo* L., Growth and Yield.

INTRODUCTION
Heavy Metals (HMs) pollution is released into the environment by a variety of anthropogenic activities, which are the main sources of causing pollution. The glut centralization of HMs in soils has precipitated

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the decrease in natural land ecosystem. HMs is usual constituents that can be inaugurated at different soaring scenario stage in contrastive locations around the globe (Srivastava *et al.,* 2013). HMs is constantly and undetectable from the environment. The high background level of the industrial process emerge when their accessibility is towering due to agricultural products, mining and other human activities, and the soil is heavily contaminated with HMs. Soils contaminated with HMs threaten the environment and human health. HMs can be toxic to macro and micro organisms by having a direct influence on biochemical and physiological process (Ashraf *et al.,* 2011).

Chromium (Cr) is ruminating on as a strong toxic element. Cr ions are tense bound to humus and clay particles and are more or a lesser amount of impenetrable in the soil. Its accessibility in plants as a result, customarily squat but ability and availability are comparatively subsiding with the intensifying pH. Cr interferes with several metabolic processes that can be toxic to plants as demonstrated by reduced root growth and chlorosis photosynthesis (Anjum *et al.,* 2017).

Bioremediation is the operation of bring into play an organism to hammering or eradicate hazardous chemicals that accumulate in the soil. Bacteria, fungi, Algae, Plankton, Protozoa and plants are important organisms. Naturally organisms take place and can be used once the gene has been modified. Organisms may annihilate organic chemicals but they can abolish our transforming HMs into a reliable form. We can testify the momentary of soil microorganisms for plants in effectual promulgation connecting AMF and plants (Karimi *et al.,* 2011)

AMF can create a symbiosis of with respect to 80% each and every one terrestrial plant. These AMF have well-known culmination on plant nutrition, and seems to have played a paramount cameo when plants colonized the soil 400 million years ago (Krishnamoorthy *et al.,* 2019). AMF are salient soil microbes that perform a main function in accelerating the nutrient uptake of crops in discrete agro ecosystems, exceptionally in the diminutive insert farming systems, and the regeneration and rhizomerediation procedure. It is extensively accepted that AMF enact an assistance cameo in intensifying of the depths mobile ions, in phosphate (PO_4^{3-}), ammonium (NH_4^+) parts. AMF not only accretions assess of nutrient transmit from the roots to the host plant, but they also augmentation opposition to biotic and abiotic pressure (Begum *et al.,* 2019). The pivotal ramifications of AMF symbiosis can be give an outline as pursues, take a turn for the excellent quality of soil composition, make immense rooting and plant formation, augmenting uptake of low mobile ions, enrich plant community diversity, ameliorate soil nutrient cycling, and improve plant toleration to biological and abiotic emphasize (Smith and Read 2008).

AMF creating symbiotic relationship with plants mature in extreme ecosystems, incorporate HMs polluted soil. By intensifying the uptake of phosphate, water and micronutrient, it revives plant enlargement and accentuate toleration. Correspondingly, HMs is also move by the fungal hypha and transferral to the plants. Consequently, in a number of studies AMF plants can evidence soaring of HMs uptake and root to shoot migrate 'phytoextraction' while in other cases AMF immobilize the HMs in soil 'phytostabilization'. AMF act as an intermediary phytoextraction and phytostabilization be contingent on the plant-fungus and HMs coalition in adulterated place (Shi *et al.,* 2020).

Botanical explanation of black gram (*Vigna mungo* L.) is in the right place to the Fabaceae or Leguminosae family. It has a tap root structure. Stem is slightly ridged, enclosed with brown hairs and much branched from the base. Leaves are substantial, trifoliate and hairy with purplish tinge. The leaflets are 5-10 cm long and ovate. Inflorescence consists of a cluster of 5-6 flowers at the top. Pods are lengthy and cylindrical and 4-6cm elongated. Every pod surrounds 4-10 seeds which are black or dark brown. Accordingly the present research work the effect of Cr and AMF inoculation on the growth, nutrient content and yield of black gram (*Vigna mungo* L.).

MATERIALS AND METHODS

Collection of seeds

The experimental seeds of black gram (*Vigna mungo* L.) cultivar ADT-3 are in the right place to the family Fabaceae is one of the essential pulses of Tamilnadu, India. Seeds utilized in the testing were acquired from Tamil Nadu Seeds Farm, Panruti. Seeds with uniform size, colour and weight were elected for my research principle. The seeds were exterior clean with 0.1 percent $HgCl_2$ and cleanse systematically with normal water and then with purified water.

Pot culture experiment

The experimentation was carried out in the Department of Botany, Tiru kollnjiappar Government Arts College, Virudhachalam, Tamilnadu. Black gram cultivar (ADT-3), seeds were sown in pots in untreated soil as control, AMF alone only and different concentrations of Cr had been applied with or without of AMF like *viz.,* 5Cr, 5Cr+AMF, 10Cr, 10Cr+AMF, 15Cr, 15Cr+AMF, 20Cr, 20Cr+AMF, 25Cr, 25Cr+AMF mg/kg^{-1} soil). The inside surface of pots were lined with a polythene cover. Every pot enclosed 5 kg of air dried soil. The Cr was application to the surface soil and carefully assorted with the soil. And the AMF species *Glomus mosseae* was appointed. The inoculum used consisted of soil restraining spores 850 to 1000/150g dry soil, hyphal disintegrate and elegant roots of onion infected with *Glomus mosseae.* 30 seeds were sown in each pot.

Irrigation schedule

Pre-sowing irrigation was provided to ensure uniform germination. Irrigation was agreed at 2 days with apt succor to abstain surfeit flooding of water. Sampling plants were randomly collected at 15, 30, 45, 60 and 75th DAS of plants and they were used for interpretation of morphological parameters like root and shoot length, number of leaves total leaf area and utilized for dry plants to analysis the nutrient content of the black gram seedlings.

Weed management

Hand weeding was done two times at 20th, 50th DAS after sowing to remove weeds from the pots for the research periods.

Seedling length (cm/seedling)

Five seedlings were without direction elected on the all intervals of each treatment, the shoot and root growth was measured using centimeters scale and their values were documented.

Estimation of macro and micronutrient contents

The dry plant samples were collected and estimation of nutrient content *viz.,* Total Nitrogen (Jackson, 1958 quoted by Yoshida *et al.,* 1972), Phosphorus (Black, 1965 quoted by Yoshida *et al.*,1972), Potassium (Williams and Twine, 1960), Calcium, Magnesium (Yoshida *et al.,* 1972), Zinc, Iron and Chromium (DeVries and Tiller, 1980).

RESULT AND DISCUSSION

The effects of alternate application of Cr and AMF at discrete stages of shoot and root length, number of leaves, total leaf area of black gram (var. ADT 3) are granted in (Table 1, 2, 3, 4). The greatest shoot length (55.2cm/plant), root length (23.7cm/plant), number of leaves (45.8), total leaf area (54.8 cm^2) was documentation in AMF inoculation treatment on 75th DAS. Least of shoot length (24.2 cm/plant), root length (7.8 cm/plant), number of leaves (26.8), total leaf area (34.5 cm^2) was register in Cr polluted plants. The AMF inoculated plants proved higher values when compared to the Cr application plants.

Growth decrement as a result of transition in shoot and root length, number of leaves, total leaf area in black gram plants growing on various levels of Cr polluted soils has been noted. The deplete shoot and root length in black gram plants was due to Cr stress and inhibited root cell segregation incapable roots to suck up water (Datta *et al.,*2011). The Cr ions persist in the cytosol of cells upon infiltrate the plant prior to stimulation the formation of 'phytochelatins' as a findings of phytochelatin synthase and this extreme amassing of metal in the cytosol detain the sprouting of leaves (Srivastava *et al.,* 2007). Abatement in the leaf area in black gram applied with an HM substantiates this matter in this experiment. The mitochondrial formation is destroyed in the plants exposed to the extortionate application of noxious HMs and so their energy-seeking actions are injure (Emamverdian *et al.,* 2015).

Table. 1 Effect of Cr +AMF on Shoot length of black gram *Vigna mungo* (L.) Hepper

Cr mg/kg^{-1} With AMF Application	Shoot length (cm)				
	Days after sowing (DAS)				
	15	30	45	60	75
Control	18.2 ± 0.91	31.6 ± 1.58	42.4 ± 2.12	51.3 ± 2.565	56.5 ± 2.815
AM only	21.6 ± 1.08	34.2 ± 1.71	46.8 ± 2.34	55.2 ± 2.86	58.2 ± 2.95
5 mgCr	15.3 ± 0.765	27.5 ± 1.375	38.5 ± 1.925	45.4 ± 2.27	52.6 ± 2.63
5 mg Cr + AMF	18.6 ± 0.93	30.1 ± 1.505	41.3 ± 2.065	49.6 ± 2.48	55.0 ± 2.84
10 mg Cr	13.4 ± 0.67	24.8 ± 1.24	33.8 ± 1.69	39.2 ± 1.96	48.4 ± 2.42
10 mg Cr + AMF	15.8 ± 0.79	28.2 ± 1.41	37.0 ± 1.85	44.5 ± 2.225	53.5 ± 2.675
15 mg Cr	10.2 ± 0.51	19.5 ± 0.975	28.2 ± 1.41	33.4 ± 1.67	41.3 ± 2.065
15 mg Cr + AMF	13.6 ± 0.68	24.7 ± 1.235	31.4 ± 1.57	37.8 ± 1.89	46.4 ± 2.32
20 mg Cr	7.5 ± 0.375	16.9 ± 0.845	23.2 ± 1.16	29.2 ± 1.46	36.5 ± 1.825
20 mg Cr + AMF	9.8 ± 0.49	19.5 ± 0.975	25.8 ± 1.29	33.5 ± 1.675	40.2 ± 2.01
25 mg Cr	5.4 ± 0.27	13.4 ± 0.67	18.5 ± 0.925	24.2 ± 1.21	30.0 ± 1.50
25 mg Cr + AMF	6.8 ± 0.34	16.2 ± 0.81	22.6 ± 1.13	28.6 ± 1.43	33.5 ± 1.675

± Standard deviation

Table. 2 Effect of Cr + AMF on root length of black gram *Vigna mungo* (L.) Hepper

Cr mg/kg^{-1} With AMF Application	Root length (cm)				
	Days after sowing (DAS)				
	15	30	45	60	75
Control	7.2 ± 0.36	9.8 ± 0.49	13.9 ± 0.695	17.3 ± 0.865	19.5 ± 0.975
AM only	9 ± 0.45	12.5 ± 0.625	16.8 ± 0.84	20.5 ± 1.025	23.7 ± 1.185
5 mgCr	6.5 ± 0.325	8.1 ± 0.405	12.4 ± 0.62	15.2 ± 0.76	16.6 ± 0.83
5 mg Cr + AMF	8.9 ± 0.445	10.2 ± 0.51	15.3 ± 0.765	18.8 ± 0.94	19.8 ± 0.99
10 mg Cr	5.1 ± 0.255	7 ± 0.35	10.5 ± 0.525	12.1 ± 0.605	13.4 ± 0.67
10 mg Cr + AMF	7.4 ± 0.37	9.6 ± 0.48	13 ± 0.65	14.9 ± 0.745	17.2 ± 0.86
15 mg Cr	4.2 ± 0.21	5.8 ± 0.29	8.6 ± 0.43	10.1 ± 0.505	10.5 ± 0.525
15 mg Cr + AMF	6.5 ± 0.325	6.9 ± 0.345	11.2 ± 0.56	13.3 ± 0.665	15.8 ± 0.79
20 mg Cr	3.8 ± 0.19	4.6 ± 0.23	5.4 ± 0.27	7.5 ± 0.375	9.8 ± 0.49
20 mg Cr + AMF	5.4 ± 0.27	5.9 ± 0.295	9.8 ± 0.49	8.9 ± 0.445	12.4 ± 0.62
25 mg Cr	3.1 ± 0.15	4.0 ± 0.2	5.0 ± 0.25	6.8 ± 0.34	7.8 ± 0.39
25 mg Cr + AMF	4.9 ± 0.245	5.5 ± 0.275	6.7 ± 0.335	7.4 ± 0.37	10.2 ± 0.51

± Standard deviation

Table. 3 Effect of Cr + AMF on number of leaves of black gram *Vigna mungo* (L.) Hepper

Cr mg/kg^{-1} With AMF Application	Number of Leaves Days after sowing (DAS)				
	15	30	45	60	75
Control	15.6 ± 0.78	24 ± 1.2	32.2 ± 1.61	36 ± 1.8	42.6 ± 2.13
AM only	18.2 ± 0.91	27.2 ± 1.36	35.6 ± 1.78	39.2 ± 1.96	45.8 ± 2.29
5 mgCr	12.6 ± 0.63	21.2 ± 1.06	29.4 ± 1.47	33.6 ± 1.68	39.2 ± 1.96
5 mg Cr + AMF	13.8 ± 0.69	23.4 ± 1.17	31.5 ± 1.575	36.4 ± 1.82	42.8 ± 2.14
10 mg Cr	12 ± 0.6	18.4 ± 0.92	26.8 ± 1.34	31.4 ± 1.57	36.5 ± 1.825
10 mg Cr + AMF	12.5 ± 0.625	21.2 ± 1.06	28.6 ± 1.43	32.5 ± 1.625	39.8 ± 1.99
15 mg Cr	10.5 ± 0.525	15.2 ± 0.76	23.2 ± 1.16	28.4 ± 1.42	32.8 ± 1.64
15 mg Cr + AMF	11.8 ± 0.59	18.9 ± 0.945	26.5 ± 1.325	30.6 ± 1.53	34.8 ± 1.74
20 mg Cr	9.2 ± 0.46	15.4 ± 0.77	22.8 ± 1.14	27.6 ± 1.38	30.2 ± 1.51
20 mg Cr + AMF	10.8 ± 0.54	17.8 ± 0.89	25.7 ± 1.285	29.5 ± 1.475	33.0 ± 1.65
25 mg Cr	5.5 ± 0.275	10.8 ± 0.54	15.6 ± 0.78	20.4 ± 1.02	26.8 ± 1.34
25 mg Cr + AMF	6.2 ± 0.31	12.4 ± 0.62	17.6 ± 0.88	21.8 ± 1.09	28.4 ± 1.42

± Standard deviation

Table: 4 Effect of Cr + AMF on total leaf area of black gram *Vigna mungo* (L.) Hepper

Cr mg/kg^{-1} With AMF Application	Total leaf area Days after sowing (DAS)				
	15	30	45	60	75
Control	19.6 ± 0.98	36.3 ± 1.81	42.4 ± 2.12	48.5 ± 2.425	50.3 ± 2.51
AM only	23.4 ± 1.17	40.5 ± 2.02	46.8 ± 2.34	51.8 ± 2.59	54.8 ± 2.74
5 mgCr	17.2 ± 0.86	30.8 ± 1.54	39.5 ± 1.97	46.2 ± 2.31	48.5 ± 2.42
5 mg Cr + AMF	20.2 ± 1.01	33.4 ± 1.67	42.6 ± 2.13	48.6 ± 2.43	52.4 ± 2.62
10 mg Cr	14.8 ± 0.74	25.2 ± 1.26	36.0 ± 1.8	42.5 ± 2.12	44.8 ± 2.24
10 mg Cr + AMF	18.7 ± 0.93	28.6 ± 1.43	39.2 ± 1.96	45.3 ± 2.26	47.5 ± 2.37
15 mg Cr	11.4 ± 0.57	22.1 ± 1.10	31.5 ± 1.57	38.7 ± 1.93	40.8 ± 2.04
15 mg Cr + AMF	13.6 ± 0.68	24.8 ± 1.24	34.4 ± 1.72	41.8 ± 2.09	42.7 ± 2.13
20 mg Cr	9.2 ± 0.46	19.4 ± 0.97	28.1 ± 1.40	32.4 ± 1.62	38.4 ± 1.92
20 mg Cr + AMF	11.0 ± 0.55	22.6 ± 1.13	30.3 ± 1.515	36.5 ± 1.82	40.6 ± 2.03
25 mg Cr	8.2 ± 0.41	15.2 ± 0.76	24.2 ± 1.21	30.2 ± 1.51	34.5 ± 1.72
25 mg Cr + AMF	10.5 ± 0.52	18.3 ± 0.91	26.8 ± 1.34	32.3 ± 1.615	35.7 ± 1.78

± Standard deviation

A smaller number of leaves predicts exhibition of growth retarding hormones to generate senescence in pretentious plants while minus leaf area federated with anomalous leaf cell dividing and proliferation. Both parameters persist impervious to like control and AMF inoculated pots when compared to Cr deal with pots. The ecbatic show that AMF outstandingly stimulate the root and shoot length, number of leaves, and lea area. This may be due to the contraption that AMF plants might lesser quantity acquire of Cr. AMF alliance also enlarged secure of essential nutrients specifically P. The augmentation of P material and additional nutrients such as N, Mg, Ca and K in M plants also elevated the proficiency of plants. The AMF mass-production of plant enlargement assisting stuff *e.g.,* phytohormones like IAA, GA, AA, and secretion of specific enzymes *e.g.,* 1-aminocyclopropane-1-carboxylate deaminase, underneath HMs pressure situation of soil (Ullah *et al.,* 2019).
So these extremities designate that the AMF had the potentiality ameliorate plant viability and maturation and defend the plant from Cr. This might be due to the fact that species of AMF isolated

from Cr polluted soil are more liberal and resistant to metals as compared to the other species that are less tolerant. The another point of view insoluble a peculiar glycoprotein glomalin construct by hyphae of AMF obligation in cloister oneself HMs exterior the mycelium (Leung *et al.,* 2006). Amass HMs by AMF cross the threshold to plants and expel from there by divergent organs.

The external mycelium of AMF allocates an extensive scrutiny of soil proportions by stretch outside the root expedition region, thus pledge entry to immense quantity of HMs bestow in the rhizosphere (Gong and Tian 2019). A massive proportion of metals are also accumulating in the AMF shape in the root and in spores. A huge quantity of HMs is also stored in the AMF structures in the root and in spores. For example, applications of over 1200 mg kg^{-1} of Zn have been acknowledgment in fungal tissues of *Glomus mosseae* and over 600 mg kg^{-1} in *G. versiforme* (Chen *et al.,* 2001).

Data obtained in (Table 5) is obvious, the nutrient content such as Nitrogen, Phosphorus and Potassium, Calcium, Zinc, Iron, Manganese and chromium undertake (mg/g^{-1} and µg g^{-1}dry weight) of black gram plants in the appearance and non-appearance of AMF with Cr applications at 75th DAS. The AMF inoculated plants confirm soaring nutritional values when differentiate to the Cr application plants. The proficiency of Cr adulterated site expansion with the presence of lofty proportion of HM inimical to AMF occupants in the soil, which may expected, conferred an improved nutritional absorption and defensive result on plants (Doelman1985). Nutrient riveting AMF accelerate the hyperaccumulators to suck up extremity minerals and nutrients from the impure soil as well as adroit in hiking the fertility of HMs polluted soil (Navarro-Noya *et al.,* 2012). Knock down metal instigate toxicity alteration metal accessibility through adaptation of soil pH and influence metal translocation (Osama *et al.,* 2018).

Table 5. Effect of Cr + AMF on Yield of black gram *Vigna mungo* (L.) Hepper

Cr mg/kg^{-1} With AMF Application	Yield parameters		
	Yield Stage		
	Number of pods	Number of seeds	250 Seed weight (g)
Control	11.60 ± 0.58	88.2± 4.4	8.10 ± 0.41
AM only	14.20 ±0.70	113.6 ± 5.7	11..20 ± 0.56
5 mgCr	9.19 ± 0.50	64.4 ± 3.2	7.14 ± 0.36
5 mg Cr + AMF	10.8 ± 0.54	86.4 ± 4.3	8.95 ± 0.44
10 mg Cr	8.40 ± 0.42	58.8 ± 2.9	6.39 ± 0.32
10 mg Cr + AMF	9.67 ± 0.48	67. 2± 3.4	7.40 ± 0.37
15 mg Cr	7.69 ± 0.39	53.9 ± 2.7	6.18 ± 0.30
15 mg Cr + AMF	8.10 ± 0.41	56.7 ± 2.8	7.72 ± 0.35
20 mg Cr	6.22 ± 0.31	43.4 ± 2.2	4.20 ± 0.21
20 mg Cr + AMF	7.79 ± 0.39	54.6 ± 2.7	5.23 ± 0.26
25 mg Cr	5.45 ± 0.28	30.5 ± 1.5	4.00 ± 0.20
25 mg Cr + AMF	6.55 ± 0.33	41.2 ± 2.1	4.80 ± 0.24

± Standard deviation

The AMF plants and polluted with Cr explain the more content of N, P, K and additional nutrients than the non AMF ones, this is accredited to AMF mycelium which afford an augmented exterior area for nutrient save and in turn ameliorate the nutrient acquirement of the hostess plants. The hyphae are also capable to enter tiny micro sites that are inaccessible, to the much prickly plant roots. The abundance of the external hyphae produced by the fungus may be involved in capturing the HM by the AMF and thereby leading to plant security. This would, however, depend on the biological alteration of the AMF involved to the presence of toxic HMs. AMF could play an imperative role in reinstatement of soils polluted with HMs by affording defense to plants from them (Kanwal *et al.,* 2015).

The crucial character of AMF on hostess plant is to elevate nutrient mobilization. AMF occupy plant roots and ramify into the surrounding proportions soil expanding the root consumption territory encircling the root structure which deliver water and mineral nutrients from the soil to the plants. AMF are well known to make larger the inclusion of all the nutrients have need for growth of plants such as all macro, micro nutrients and trace elements. Hyphae of the AMF can also take up amino acids and orthophosphate, intensify of AMF on water extraction and nitrogen mineralization from organic residue are well chronicle (Kour *et al.,* 2019).

Yield is the final revealment of morphological, physiological and biochemical attributes of a crop, which is contingent choice of biological factors, restrain water and nutrition. The Cr application plants were excruciating stricken the yield and productivity of black gram (Table 6). The yield parameters like number of pods/plant, number of seeds/plant, 250 seed weight and their total yield was exorbitant at AMF inoculated pots when contrast to Cr application pots. The toxic nature of Cr terminate in lower plant water impending through altering the root cells membrane formation and minimize the water inclusion intensity that has a pessimistic contact on physiological operation such as photosynthesis, transpiration, and respiration and in the end knock down the yield of black gram. This is illustrated by the potential role of AMF in establishing black gram seedlings in Cr contaminated soil. This is in agreement with the Saleh and Al-Garni (2006) findings that dual inoculation of AMF and symbiotic N_2 fixing *Rhizobium* enhanced plant maturation and yield, indicating increased HMs tolerance of Cow pea plants.

Table. 6 Effect of Cr + AMF on uptake nutrient content of black gram *Vigna mungo* (L.) Hepper

Cr mg/kg^{-1} With AMF Application	Total leaf area							
	(mg g^{-1}dry weight)			(µg g^{-1} dry weight)				
	N	P	K	Ca	Zn	Fe	Mn	Cr
Control	51.18±2.56	65.05±3.25	33.26±1.70	18.22±0.10	16.44±0.82	126.4±6.3	13.8±0.70	-
AM only	64.73±3.23	77.16±3.85	46.29±2.31	22.43±1.12	21.68± 1.10	174.2±8.7	17.2±0.90	-
5 mgCr	40.35±2.01	53.81±2.70	27.11±1.40	16.56±0.82	15.02±0.76	110.3±5.5	11.6±0.60	7.52±0.40
5 mg Cr + AMF	45.89±2.30	61.97±3.10	29.25±1.50	18.03±0.90	16.12±0.80	119.8±6.0	12.8±0.64	2.98±0.15
10 mg Cr	31.48±1.60	44.94±2.24	21.2±1.06	14.30±0.72	13.14±0.66	98.5±4.9	9.4±0.47	12.10±0.60
10 mg Cr + AMF	36.28±1.81	49.20±2.50	25.8±1.29	15.22±0.76	14.73±0.74	100.0±5.0	10.2±0.51	5.31±2.30
15 mg Cr	28.20±1.41	37.03±1.85	17.33±0.90	12.19±0.60	11.10±0.56	92.3±4.6	7.7±0.39	16.38±0.81
15 mg Cr + AMF	31.85±1.60	40.79±2.03	20.0±1.00	13.42±0.70	12.28±0.61	94.8±4.7	8.5±0.43	7.28±0.36
20 mg Cr	22.24±1.11	30.78±1.54	13.18±0.70	11.02±0.56	8.33±0.42	85.6±4.3	4.3±0.22	21.06±1.10
20 mg Cr + AMF	25.3±1.23	34.10±1.70	15.10±0.80	12.30±0.61	9.24±0.46	87.3±4.4	5.2±0.26	9.83±0.50
25 mg Cr	18.46±0.92	20.10±1.00	11.26±0.60	8.21±0.41	7.25±0.40	70.3±3.5	3.6±0.18	27.18±1.40
25 mg Cr + AMF	20.80±1.04	22.86±1.14	12.65±0.63	9.03±0.45	8.11±0.41	73.8±3.7	4.1±0.21	12.26±0.61

CONCLUSION

AMF materialize in the soil of most ecological unit, encompass HMs polluted soils. By receiving P, micronutrients and water and commit a segment to their hosts they augment the nutritional condition of their hosts. In this trial Similarly, Cr is receive up *via* the fungal hyphae and can be migrate to the plant. But in some cases AMF plants can show build up Cr uptake and root-to-shoot transport 'phytoextraction' in other cases AMF bestow to Cr arrest within the soil 'phytostabilization'. The end of the result of AMF immunized pots, increasing shoot and root length, number of leaves, total leaf area and yield parameters such as number of pods/plants, amount of seeds/ plants, 250g seed weight. And another point plant protection and clean-up of Cr polluted soils be conditional on the plant-fungus-Cr coalition and is have an impact on by soil circumstances. The momentary of AMF in soil remediation has recently been documented.

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