Effect of Magnetized Water on Some Growth Characteristics of Cowpea (*Vigna unguiculata* L.)

Olfat F. Saeed, Elnasri M. Mutwali*

Department of Biology, Faculty of Education,
Alzaiem Alzhari University. Khartoum, Sudan

*Corresponding author's email: elnasrishaheen [AT] yahoo.com

ABSTRACT--- ***Two pot experiments were carried out at Faculty of Education, Alzaiem Alazhari University, Khartoum, to study the effect of magnetized water on some growth characteristics of cowpea. The experiments were et as a completely randomized design with three replications and four treatments. The treatments were water passed through magnetic funnel either, once, two, four or six times, compared with control (tap water). The results indicated significant differences in germination plant height, number of leaves, leaf area, fresh and dry weight of shoot and root. Results also showed significant difference in chlorophyll content (a and b) and phosphorus and potassium content. Results indicated that magnetized water is an effective method for high yield of cowpea.***

Keywords---- Cowpea, Magnetized water, Chemical constituents, Germination

1. INTRODUCTION

Now days, with the proposal of the rational use of agricultural land, greater importance is attributed to some physical methods of treatment of seeds and water, which are commonly regarded as being friendlier to the environment. These physical factors often only modify the course of some physiological processes in the seed, which increase their vigour and contributes to the improved development of the plant [1]. Enhancement of seed vigour and germination of different species by treating seeds and water with magnetic field has been confirmed by many scientists [2, 3].

Cowpea is an important crop in the semi arid regions across Africa and other countries. It requires very few inputs, as the plants root nodules are able to fix atmospheric nitrogen, making it available crop for resource for poor farmers and well-suited to intercropping with other crops The crop is mainly grown for its seeds, which are extremely high in protein, although the leaves and immature seed pods can also be consumed. In Sudan cowpea is considered as one of the main food for the most of Sudanese people.

The aim of this study is to determine the influence of the magnetic water on the germina-tion growth and some yield components of cowpea (*Vigna* unguiculata (L.) Walp).

2. MATERIALS AND METHODS

The cowpea seeds were local cultivar, obtained from the local market.

Magnetic device:
A magnetic funnel (Magnetic Technologies L.L.C. Model No. MFLo1, Dubai, U.A.E.) was used for water treatment.

Laboratory experiment:
The seeds of cowpea with uniform size without seen defect or insect damage were arranged to five treatments as the following:

- The first treatment (T1), seeds were irrigated with tap water (the control).
- The second treatment (T2), seeds were irrigated with magnetized water (once).
- The third treatment (T3), seeds were irrigated with magnetized water (three times).
- The fourth treatment (T4), seeds were irrigated with magnetized water (four times).
- The fifth treatment (T5), seeds were irrigated with magnetized water (six times).

The germination tests were carried out at laboratory conditions. Seeds of cowpea were germinated in sterilized Petri-dishes 100mm in diameter, on Whitman filter paper moistened with 10ml of double-distilled water. For each treatment five Petri dishes were used, each with 10 seeds either with distilled water (control) or with magnetized water. Petri dishes were kept in

the dark, at 25oC, for aspan of 7 days. During the experiment germinated seeds were counted daily and then the percentage was calculated at the end of the experiment.

Pot experiment:
Soil material: the soil used in all treatments in this experiment was river silt soil, moderately acid (pH 6.75), highly permeable.

Seeds germination:
Plastic pots (26cm in diameter and 18cm in depth) filled with 5Kg of silt soil were arranged in a completely randomized design. There were three replication per each treatment. Seeds were sown in a uniform depth of 20mm and five seeds per pot and later thinned to 2 seedlings per pot. Measured volume (600 ml/pot) of water with or without magnetic treatment was applied in each pot soon after sowing according to the treatments described earlier and then daily during the entire duration of the experiment. The plant height, numbers of leaves, stem diameter, leaf area, were taken during the study. At harvest root length, root fresh and dry weight, shoot fresh and dry weight, chlorophyll content and some chemical elements were analyzed. All data relating to plant height, number of leaves leaf area, chlorophyll content and the chemical element were tabulated and statistically analyzed using analysis of variance (ANOVA) according to [4].

3. RESULTS AND DISCUSSION

1. Laboratory experiment
The germination of cowpea as indicated in table (1) showed a significant difference between treatments as compared to the control. The highest germination percentage 96.6 was attained by treatment three (seeds irrigated with magnetized water three times) and the lowest germination percentage was (66.67%) recorded by the control. Many works have been reported that magnetic field exerts a positive effect on germination of seeds, plant growth and develop-ment, the ripening and yield of crops [5, 6]. The results of this study are supported by the findings of [7] who observed an increase in germination of *Pinus tropicalis* seeds with magnetically treated water. The results of [8] suggested that, magnetic water treatment improved seed imbibitions, vigour and germina-tion rate. Similar results were obtained by [9, 10, 11].

The irrigation with magnetically treated water and seed absorption of magnetized water before sowing may be responsible for activation of enzymes and hormones involved in the germina-tion process and mobilization of nutrients. As a result, there is probably an enhancement in the mobilization and transportation of nutrients to embryonic axis and a resultant increase in speed of emergence and germination rate.

Table (1): Effect of magnetized water on germination of cowpea (*Vigna unguiculata*)

Treatment	Germination percentage
T1	66.67
T2	86.67
T3	96.67
T4	86.65
T5	84.46
LSD	2.49

T1 = Seeds irrigated with tap water
T2 = Seeds irrigated with magnetized water (once)
T3 = Seeds irrigated with magnetized water (three times)
T4 = Seeds irrigated n with magnetized water (four times)
T5 = Seeds irrigated n with magnetized water (six times)

2. Pot experiment:
Table (2) indicated that the plant height of cowpea was significantly increased (15, 30, 45 days after sowing DAS) in both years 2016 and 2017. Similar results were reported by [12], who showed that exposure of Zea mays seeds to magnetic water has favourable effect on the development of shoots in the early stage. In this respect [13] and [14] concluded that magnetic field increased the shoot and root regeneration rate of soybean and Paulownia organ cultures. Moreover, [15] concluded that magnetized water increased growth and considered as an important factor for inducing plant growth. These results were supported by the results of [16] and [17] who reported that the effects of magnetic field were observed on seed germination plant growth, root and shoot growth, seedling growth, seedling vigour, fresh weight, dry weight, activities of some enzymes and seed yield. In connection to this, [18] reported that increases in plant height, seedling weight of maize were noted with magnetized water. They assumed that this increase in seedling height and weight may be due to earlier emergence of maize seedling irrigated with magnetized water in contrast to the control.

Table (2): Effect of magnetized water on plant height of cowpea (*Vigna unguiculata*) at seasons 2016 and 2017.

Treatment	Plant height (cm)					
	2016			2017		
	Days after sowing (DAS)					
	15	30	45	15	30	45
T1	14.86	28.96	36.76	12.17	28.66	34.00
T2	20.43	35.53	43.00	18.16	3577	38.44
T3	21.51	35.40	43.40	19.41	35.99	37.55
T4	20.90	35.20	44.06	19.33	35.66	37.87
T5	20.23	35.39	43.90	20.11	34.79	37.57
LSD	1.76	3.10	3.93	3.64	5.64	3.20

Tables (3, 4 and 5) clear out the number of leaves, stem diameter and leaf area in the years 216 and 2017. A significant increase (P=0.05) was observed in number of leaves at 15, 30 and 45 DAS in 2017 and 45 DAS in year 2016. In connection to this [19] reported that increasing the number of side stem per plant of cucumber plant affected by magnetic field can enhance the number of leaves and leaf area in which directly related to photosynthetic rates.

Table (3): Effect of magnetized water on number of leave per plant of cowpea (*Vigna unguiculata*) at seasons 2016 and 2017.

Treatment	Number of leaves					
	2016			2017		
	Days after sowing (DAS)					
	15	30	45	15	30	45
T1	2.33	3.67	4.06	3.22	5.22	6.33
T2	236	4.00	436	3.78	6.00	7.00
T3	2.46	4.13	4.43	3.55	6.00	7.11
T4	2.40	4.06	4.36	4.66	6.44	7.44
T5	2.36	4.00	4.43	3.66	6.00	6.89
LSD	0.61	0.94	026	0.32	0.23	0.21

Table (4): Effect of magnetized water on stem diameter of cowpea (*Vigna unguiculata*) at seasons 2016 and 2017.

Treatment	Stem diameter (cm)					
	2016			2017		
	Days after sowing (DAS)					
	15	30	45	15	30	45
T1	8.02	18.97	29.57	8.70	20.80	21.97
T2	14.82	25.13	38.00	14.50	26.62	27.66
T3	14.12	25.33	37.76	14.46	27.40	27.88
T4	15.35	25.10	38.86	14.63	27.31	27.75
T5	14.91	26.70	38.70	14.94	26.65	26.94
LSD	4.72	3.42	6.46	3.66	4.82	3.72

Table (5): Effect of magnetized water on leaf area of cowpea (*Vigna unguiculata*) at seasons 2016 and 2017.

Treatment	Leaf area					
	2016			2017		
	Days after sowing (DAS)					
	15	30	45	15	30	45
T1	2.33	3.67	4.06	3.22	5.22	6.33
T2	236	4.00	436	3.78	6.00	7.00
T3	2.46	4.13	4.43	3.55	6.00	7.11
T4	2.40	4.06	4.36	4.66	6.44	7.44
T5	2.36	4.00	4.43	3.66	6.00	6.89
LSD	0.61	0.94	026	0.32	0.23	0.21

Concerning root length, the analysis showed a significant increase in treatments irrigated with magnetized water compared with the control (Table 6). On the other hand the root fresh and dry weight showed a significant increase in both years (2016 and 2017). These results are in agreement with the results of [20], [21], [22] and [23] who reported that the magnetic treatments results in significant increase in fruit yield, number of fruits per plant, average fruit weight, leaf area, plant height as well as fresh and dry masses of growth parameters. Similar results were obtained by [24] who reported that irrigation of sugar beet with magnetized water induced significant increases in root weight, root length and root diameter compared with non-magnetized water. On the other hand the shoot dry weight exhibited a significant increase in treatments irrigated with magnetized water compared with the control. Similar results were reported by [25] who stated that pulsed magnetic field has been found to increase the plant height, fresh and dry weight and protein content in soybean.

Table (6): Effect of magnetized water on root length, root fresh and dry weigh of cowpea (*Vigna unguiculata*) at seasons 2016 and 2017.

	Treatments	Root length (cm)	Root fresh weight (g)	Root dry weight (g)
2016	T1	8.20	0.38	0.10
	T2	10.40	0.59	0.21
	T3	10.46	0.63	0.26
	T4	11.46	0.49	0.29
	T5	11.53	0.50	0.27
	LSD	2.16	0.08	0.03
2017	T1	10.22	0.48	0.13
	T2	19.16	0.90	0.32
	T3	17.11	0.75	0.27
	T4	16.50	0.72	0.28
	T5	16.48	0.74	0.25
	LSD	6.23	0.14	0.03

Table (7): Effect of magnetized water on shoot fresh and dry weight of of cowpea (*Vigna unguiculata*) at seasons 2016 and 2017.

	Treatments	Shoot fresh weight (g)	Shoot dry weight (g)
2016	T1	7.28	1.46
	T2	11.66	1.52
	T3	11.34	2.54
	T4	11.70	1.55
	T5	10.86	1.56
	LSD	3.51	0.032
20177	T1	7.48	1.37
	T2	11.93	1.83
	T3	11.86	1.57
	T4	11.92	1.89
	T5	11.87	1.83
	LSD	4.37	0.14

Table (8) showed an increase in chlorophyll content a and b of cowpea. Similar results were obtained by [13] and [26], where they reported that an increase in chlorophyll and carotenoids content specially appeared after treatment with magnetic water. In connection to this [21] found a slight increase of chlorophyll a for plants exposed to the lowest magnetic field. Common bean (*Phaseolus vulgaris* L.) irrigated with magnetic water exhibited significant increase in photosynthetic pigments (chlorophyll a, chlorophyll b, and carotenoid), photosynthetic activity, and translocation efficiency of the photo assimilates over the control [27].

Analysis of data showed significant difference in content of P and K between the treatments and the control (Table 8). In this respect [28] reported that a marked increase in P content of citrus leaves irrigated by magnetically treated water was observed.

Table (8): Effect of magnetized water on chlorophyll content and some chemical elements of cowpea.

Treatments	Chlorophyll			Elements (K)
	(a)	(b)	Chemical (P)	
T1	4.410	3.510	1645.42	28888.41
T2	9.560	5.324	2670.49	40085.42
T3	6.887	5.940	1953.01	44528.72
T4	10.776	5.390	2296.36	44963.61
T5	5.505	5.655	1983.09	31036.74
LSD	1.80	1.81	5.80	8.37

In connection to this [29] reported that shoot N, P and K contents of faba bean was significantly increased by using different magnetized irrigation water qualities compared with normal or non-magnetized water. Also [30] found that an increase in magnetic field strength increases concentration of, K, Ca of cotton plants.

4. CONCLUSION

It appears that utilization of magnetized water can led to improve quantity (germination and growth characteristics) and quality (chlorophyll content P and K content) of cowpea crop. Generally, using magnetized water could be a promising technique, for plant growth improvements and further research is required on different crops.

5. REFERENCES

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