Vegetables & Floriculture Department

THE IMPACT OF IRRIGATION REGIME IN DIFFERENT STAGES OF GROWTH AND IRRIGATION WITH MAGNETIZED WATER ON SEED PRODUCTION OF COWPEA.

BY

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5. SUMMARY

Two field experiments were conducted at the Experimental farm, Sakha Agricultural Research Station, Kafr El-Sheikh Governorate, during the two successive summer seasons of 2017 and 2018. The work aimed to study the impact of deficit irrigation during various growth stages (vegetative & reproductive) with magnetized water on parameters of vegetative growth, flowering, seeds yield and its components, and maximizing the utilization of irrigation water and use water efficiency (WUE) on cowpea cv. Kafr El-Sheikh.

The experiment in each season included 16 treatments, representing the combinations of two magnetized of irrigation water, deficit irrigation at two growth stages and four irrigation regime treatments as follows:

I. First factor (Magnetized irrigation water):

1. Non-magnetized water (control).
2. Magnetized water:

II. Second factor (Plant growth stages):

1. Deficit at vegetative growth stage (V).
2. Deficit at reproductive growth stage (R).

III. Third factor (Irrigation regime):

The water requirements of the cowpea crop in open field were calculated using FAO CROPWAT software. The irrigation requirement treatments were supplied to the crop daily through inline drip system as follow:

The regulated water deficit treatments during vegetative growth stage were 100, 75, 50 and 25 % of full crop evapotranspiration (Etc) as follow:**.**

T1 = V100% + R100%

T2 = V 75% + R100%

T3 = V 50% + R100%

T4 = V 25% + R100%

The regulated water deficit treatments during reproductive growth stage were 100, 75, 50 and 25 % of Etc as follow:**.**

T1 = V100% + R100%

T2 = V 100% + R75%

T3 = V 100% + R50%

T4 = V 100% + R25%

The experimental layout was split-split plot system in a complete randomized block design with three replicates. Magnetized water treatments were randomly distributed in the main plots which were sub-divided to two sub-plots, each of them contained one of deficit at growth stage treatments, while irrigation regime treatments were assigned to the sub-sub plots.

The obtained results in this study are summarized as follows:

5.1. Vegetative growth parameters:

The magnetized water treatment gave the best vegetative growth parameters in terms of plant height, plant fresh weight, plant dry weight, number of leaves, number of branches, leaf area per plant and total chlorophyll. To compared with non magnetized water in both seasons.

The treatment of water deficit at vegetative growth stage (V) recorded the lowest vegetative growth parameters in both seasons. The differences were significant in both seasons

Concerning the effect of irrigation regime treatments on vegetative growth characteristics (plant height, plant fresh and dry weight, number of leaves, number of branches, leaf area per plant and total chlorophyll). Data reveal that there were highly significant differences of abovementioned characters among the treatments in both seasons. The highest values were obtained from treatments had more water supplies (100% and 75% of Etc. on the other hand, the lowest values were recorded from plants treated with 50% and 25% in both seasons.

Dealing with the effect of double interactions between magnetized irrigation water and deficit irrigation at growth stages or irrigation regime treatments, on vegetative growth characteristics, data demonstrate that the lowest values of vegetative growth parameters were obtained from irrigated plants by magnetized or non-magnetized water at vegetative growth stage (V). The differences were not significant in both seasons, except plant height and No. of leaves.

As the interaction between magnetized irrigation water combined with 100% ETc gave the highest values, on the other hand the lowest values were obtained from plants irrigated by non-magnetized water and 25% ETc in both seasons.

Regarding the effect of interaction between deficit irrigation at different growth stages and irrigation regime treatments on the most of vegetative growth characteristics, had significant differences in both seasons. In addition, the interaction between deficit irrigation at vegetative growth stage (V) treatment combined with 100% Etc produced the highest records of the most vegetative growth characteristics compared with the interaction between deficit irrigation at vegetative growth stage (V) treatment and 25% ETc treatments which gave the least ones in both seasons.

Regarding the effect of triple interaction among magnetized irrigation water, deficit irrigation during growth stages and irrigation regime treatments on vegetative growth parameters that the differences were not significant in both seasons. The same data indicated that, the plants irrigated by magnetized water at 100% ETc tended to give the highest values of vegetative growth parameters during water stress at vegetative growth stage (V). On the other hand, the combined interaction among magnetized irrigation water or non-magnetized water with 25% ETc during deficit irrigation at vegetative growth stage treatment tended to give the lowest values in both seasons.

5.2. Flowering parameters:

4.2.1. Number of flowers per plant:

The magnetized irrigation water treatments caused an increase in number of flowers per plant compared with the plants non-treated, which gave the lowest values in both seasons.

Concerning the effect of deficit irrigation at growth stages on number of flowers per plant, the deficit irrigation at vegetative growth stage led to increase not significant on number of flowers per plant compared with deficit irrigation at reproductive growth one in both seasons.

For irrigation regime treatments and its effect on number of flowers per plant, the treatments of 50% and 25 % Etc tended to produce the highest values compared with 100% and 75% treatments of Etc. The differences was not significant in both seasons

The interaction between magnetized irrigation water and deficit irrigation during at vegetative growth stage led to give the highest number of flowers per plant values but the differences were not significant in both seasons. Also, as for the interactions between magnetized irrigation water and irrigation regime treatments or irrigation regime and water stress at different growth stages or the triple interaction among magnetized irrigation water, water stress at different growth stages and irrigation regime treatments had no significant effect on number of flowers per plant in both seasons.

5.2.2. Pod set (%)

The magnetized water treatment gave the highest significant value of fruit set (%) as compared with non-magnetized irrigation water treatments which gave the lowest one in both seasons

The highest fruit set (%) was obtained from cowpea plants which were treated at reproductive growth stage (R) comparing with the treatment of water stress imposed during the vegetative growth (V) in both seasons.

With regarding to the effect of irrigation regime treatments, the treatments of irrigation with 100% and 75 % of Etc increased the fruit set %, on cowpea plants while the lowest value resulted from 50% and 25% of Etc in both seasons.

Concerning the interaction between magnetized irrigation water, water stress at both vegetative and reproductive or irrigation regime treatments on fruit set %, the differences were not significant in both seasons.

The other interaction between deficit irrigation during growth stages and irrigation regime treatments on fruit set % were highly significant effect in the first season only. Also, the interaction between the treatment of water stress imposed during the reproductive growth stage (R) combined with 100% of Etc, produced the highest records of fruit set%, on the other hand, the least fruit set% was obtained from water stress applied at vegetative growth stage (V) and 25% of Etc treatments in both seasons.

Regarding, the interaction among magnetized irrigation water, deficit irrigation at different growth stages and irrigation regime treatments, had no significant effect on fruit set % in both seasons.

5.3. Seed yield and its components:

The magnetized irrigation water treatment gave the highest values of seed yield per plant, seed yield/fed, shelling ratio, number of total seed per plant, number of marketable seed per plant, number of non-marketable seed characters per plant and 100-seed weight. On the other hand, the lowest records were obtained from the plants treated with non-magnetized water treatment in both seasons in both seasons.

The treatment of water deficit at reproductive growth stage (R) gave the best results of seed yield and its components. While the treatment of water deficit stress at vegetative growth stage (V) recorded the lowest digits, except on number of non- marketable seeds per plant in both seasons.

Regarding the effect of irrigation regime treatments on seed yield and its components, there were significant differences among treatments and had non- significant effect on shelling ratio in both seasons.

The highest values of seeds yield per plant, seed yield/fed, number of total seed per plant, number of marketable seed per plant and 100- seed weight were obtained from irrigation at 100% and 75% of Etc compared with the 50% and 25 % treatments in both seasons. While, the irrigation at 50% and 25 % recorded the lowest ones, except on number of nonmarketable seed character per plant.

Concerning the interactions between magnetized irrigation water and both deficit irrigation at growth stages or irrigation regime treatments on seed yield and its components, the differences were not significant in both seasons.

The interaction between deficit irrigation during growth stages and irrigation regime treatments on seed yield and its components had significant differences in both seasons and number of total seeds in the first season only and non-significant effect on shelling ratio in both seasons.

The interaction between the treatment of water deficit at. reproductive growth stage (R) combined with 100% of Etc produced the highest records of seed yield per plant, seed yield/fed, total seeds number per plant, number of marketable, non-marketable seeds per plant and 100- seed weight compared with the interaction between the treatment of water deficit at vegetative (V) and 25% of Etc treatments which gave the least ones in both seasons.

Focusing on the interaction among magnetized irrigation water, water stress applied during different growth stages and irrigation regime treatments on seed yield and its components, the differences were not significant in both seasons.

5.4. dry pods yield and quality:

The highest significant values of pod yield characteristics; length, diameter, number of seeds, seeds weight, pod yield per plant, number of pod per plant and average pod weight were obtained from the magnetized irrigation water. On the other hand, the lowest records were obtained from the non-magnetized water treatments in both seasons**.**

With respect to effect of deficit irrigation during growth stages on pod yield characteristics, the treatment of water deficit at reproductive growth stage (R) treatment gave the highest pod length, pod diameter, number of seeds per pod, seeds weight per pod, pod yield per plant, number of pod per plant and average pod weight compared to the treatment of water deficit at vegetative growth stage (V), which recorded the lowest ones in both seasons.

Regarding the effect of irrigation regime treatments on pod yield characteristics, there were highly significant differences among values in both seasons. The highest values of pod yield characterstics were obtained from plants irrigated at 100% and 75 % of Etc. While, the treatments of 50% and 25 % of Etc recorded the lowest ones in both seasons.

Concerning to the interaction between magnetized irrigation water combined with the treatment of water deficit at reproductive growth stage (R) caused an increase in pod length, number of seeds per plant and pod yield per plant compared with that irrigated by non-magnetized water at the vegetative growth stage (V).

In addition, the interaction between magnetized irrigation water combined with 100% of Etc gave the highest values, on the other hand, the lowest ones were obtained from plants irrigated by non-magnetized water and 25% of Etc in both seasons. While, the interaction between magnetized irrigation water and irrigation regime treatments on pod characteristics had not significant effects in both seasons.

Concerning the interaction between deficit irrigation water at different growth stages and irrigation regime treatments on pod yield characteristics,

the interaction between the treatment of water deficit at reproductive growth stage (R) combined with 100% Etc produced the highest values, while the lowest ones were obtained from the treatment of water deficit at vegetative growth stage (V) and 25% treatment of Etc in both seasons. While, the interaction among magnetized irrigation water, deficit irrigation water at different plant growth stages and irrigation regime treatments on pod characteristics, the differences were not significant in both seasons.

5.5. Water use efficiency (WUE):

Data show that, magnetized irrigation water treatments was significant effect on water use efficiency (WUE) in both seasons. The magnetized water treatments caused an increase in water use efficiency compared with the non-magnetized water, which gave the lowest value in both seasons.

Concerning with the effect of deficit irrigation at different plant growth stages on WUE, data state that the highest significant value was obtained from plants treated water stress treatments at reproductive growth stage (R), in contrast applying water deficit during vegetative growth stage (V) had the lowest ones in both seasons.

Data presented clear that; WUE was highly significant affected by applying the irrigation regime treatments during the two seasons. Therefore, the irrigation at 50% ETC treatments produced the greatest water use efficiency. On the other hand, the lowest values of this trait were obtained from plants treated with 100 % ETc in both seasons..

Regarding the effect of combined interaction between magnetized irrigation water and deficit irrigation at different growth stages treatments on WUE, data in Table (7) clear that the differences were not significant in both seasons.

In the same table, the resulted indicated that the treatment of magnetized water irrigation combined 50% ETc produced the highest records of WUE, on the other hand, the least one was obtained from 100%

ETc and non-magnetized water irrigation. The differences were significant in both seasons. In addition, data in the same table showed that the interaction between reproductive growth stage and 50% ETc produced the highest records of WUE in both seasons.

Focusing on the combined interaction among magnetized irrigation water, different growth stages and irrigation regime treatments on WUE, data in Table (8) show that the differences were not significant in both seasons.

5.6. Chemical constituents:

5.6.1. Mineral constituents of leaves:

The cowpea plants irrigated by magnetized irrigation water gave the highest values of mineral leaves constituents (N, P and K) while the lowest ones were obtained from those irrigated by non-magnetized water in both seasons.

Regarding to the effect of deficit irrigation at different growth stages on mineral constituents of leaves, the water deficit at reproductive growth stage (R) produced the highest significant values. On the other hand, the lowest values were obtained from the water stress imposed during the vegetative growth stage (V) treatment in both seasons.

Data clear that the lowest values of chemical constituents were obtained from the treatment of deficit irrigation at vegetative growth stage (V) in both seasons.

The irrigation regime treatments had a positive effect on leaves mineral constituents (N, P and K). The plants irrigated by100 and 75% recorded the highest values compared with 25% treatment of Etc in both seasons.

With regard to the effect of interaction between magnetized irrigation water and water deficit at different growth stages treatments on mineral

constituents, the differences were not significant in both seasons. While, the interaction between magnetized irrigation water and irrigation regime treatments, the differences were highly significant in second season only. The magnetized irrigation water treatment combined with 100% of Etc gave the highest values, on the other hand the lowest ones were obtained from plants irrigated by non-magnetized water and 25% of Etc in both seasons.

The interaction between the water deficit at reproductive growth stage (R) combined with 100% of Etc gave the highest values, on the other hand the lowest ones were obtained from the water deficit at vegetative growth stage (V) treatment and 25% of Etc in both seasons.

As for the interaction among magnetized irrigation water, water deficit at different growth stages and irrigation regime treatments on mineral constituents, the differences were not significant in both seasons.

5.6.2. Crude protein of seeds content:

The highest significant value of protein (%) of seeds was obtained from the magnetized irrigation water treatment. On the other hand, the lowest records were obtained from the non-magnetized water treatment in both seasons.

With respect to the effect of water deficit at.different growth stages on protein (%) of seeds, the water deficit at reproductive growth stage (R) produced the highest significant values. On the other hand, the lowest values were obtained from the water deficit at vegetative growth stage (V) treatment in both seasons.

The irrigation regime treatment at 100% and 75% of Etc had a positive effect on protein (%) of seeds compared with 25% of Etc treatment in both seasons.

As for the all combinations interactions of two magnetized of irrigation water, deficit irrigation at two growth stages and four irrigation regime treatments had no effect on protein (%) of seeds in both seasons.

5.7 Germination:

5.7.1. Seed germination (%):

The magnetized irrigation water treatment plants gave the highest value of seeds germination percentage, while, the lowest ones were obtained from the non- magnetized water treated ones in both seasons.

As for the effect of both water deficit during different growth stages and irrigation regime, treated plants had no effect on seed germination (%), on first, second and third days in both seasons.

All combinations interactions of two magnetized of irrigation water, deficit irrigation at two growth stages and four irrigation regime treatments had no effect on seed germination (%) in both seasons.

5.7.2. Seed germination rate:

The magnetized irrigation water treatment produced the highest value of seed germination rate. On adverse, the lowest records were obtained from plants treated by non - magnetized water in both seasons.

Regarding the effect of water deficit during different growth stages on seed germination rate, the differences were not significant in both seasons.

The irrigation regime treatments at 100 and 75% tended to give the highest germination rate compared with 25% of Etc treatment. The differences were not significant in both seasons

All combinations interactions of two magnetized of irrigation water, deficit irrigation at two growth stages and four irrigation regime treatments had no effect on seed germination rate in both seasons.