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Research Article

Effects of Water Intervals on Growth and Yield of Three Chickpea Cultivars (*Cicer arietinum* L.)

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ABSTRACT
A field experiment was conducted during the winter season, 2017-2018, at Demonstration Farm of the College of Agricultural Studies, Sudan University of Science and Technology, Shambat, Khartoum State, Sudan. The objective of this experiment was to assess the effect of water intervals on growth and yield of three Chickpea cultivars, namely Atmore, Wad-Hamid and Shendi. Split-plot design was adopted with three replications. The three water intervals treatments were (10, 20 and 30) days which arranged in the main plots and three chickpea cultivars placed in subplot. Plant parameters measured were plant height (cm), number of leaves per plant, number of branches per plant, number of pods per plant, weight of pods per plant (g), number of seeds per pod, weight of seeds per plant (g) and hundred seed weight (g). The results showed that there were significant differences among the treatments in number of leaves, number of branches, number of seeds per pod and hundred seeds weight. However, there were highly significant differences in plant height, number of pods per plant, weight of pods per plant and weight of seeds per plant. Irrigation every ten days gave best results in most of the studied parameters, irrespective to cultivars. The result revealed that no significant differences occur between chickpea cultivars in all parameters measured except in the number of seeds per pod and hundred seeds weight.
Key words: *water, interval, Chickpea, growth and yield.*

INTRODUCTION

Chickpea *(Cicer arietinum* L.) is one of the most important grain legumes crops in the world, belongs to the family Fabaceae and sub family Faboideae (Knights *et. al.*, 2007). The genus *Cicer* consists of 9 annual and 31 perennial species, *arietinum* is the only cultivated annual species (Muchlabuer, 1993). Chickpea is the third important pulse crop, and 15% of the world total pulse productions belong to this crop (FAO, 2010). It is grown in more than 50 countries, 89.7% area in Asia, 4.3% in Africa, 2.6% in Oceania, 2.9% Americas and 0.4% in Europe (Guar, *et al.*, 2010).Today, scientists are using several approaches trying to understand and assess the mechanisms through which the plant overcomes drought stress (Farshadfar, *et. al*., 2013). In Sudan, chickpea is grown mainly in the north part of the country where environmental conditions suit their production better than in other parts of the country. Their growing season is restricted to a short period of time by the high temperatures prevailing at the beginning and end of winter (Mohamed, 1998). The total cultivated area was estimated at about 6851 ha with average seed yield of 17349 kg/ha (FAO, 2017). The area production and yield of chickpea have all shown an increasing trend as the crop spreads to new areas and is grown in different parts of the country under residual moisture and irrigation systems (Abdellatif and Abdalwahab, 2017). Increasing plant density affected most of growth attributes and resulted in substantial increase in seeds yield per unit area, while seeds yield per plant was negatively affected by increasing plant density, (Naim, 2001). Chickpea is sensitive to water stress, particularly during the reproductive stage and its yield depends upon the water supply from flowering to pod filling stage (Naim, 2001). In order to counter this drought stress, development of early maturing cultivars will make judicious use of the available soil moisture efficiently and produce relatively higher yields. Critical review made by (Upadhyaya, *et. al*., (2012) illustrates efficient methods for phenotyping with respect to drought in chickpea and pigeon pea. Therefore the objective of this experiment was designed to study the effect of irrigation intervals on growth and yield of three chickpea cultivars.

MATERIALS AND METHODS

The Experiment was carried out in the Demonstration Farm of the College of Agricultural Studies, Sudan University of Science and Technology at Shambat, Khartoum North, during the winter season of 2017 – 2018. The area lay in a tropical, semi-arid region. It is located within the grids latitudes 15o - 40o N, 32 o

32" E and altitude 386 m above sea level, where the rainfall lasts for three months (July to September). The soil of the study area is clay described as montmorillonite with pH ranges between 7.8 - 8.5 (Abdelhafiz, 2001).

The studied factors treatments were arranged in split-plot design in three replications. The two study factors used in this experiment includes water intervals and chickpea cultivars. The three water intervals treatments used in the study were (10, 20 and 30) days irrigation interval which arranged in the main plots and three chickpea cultivars placed in subplot namely Atmore, Shendi, and Wad-Hamid which obtained from Hudeiba Research Station, Agricultural Research Corporation (ARC), Sudan.

The land was ploughed, harrowed, leveled and the ridge was formed. The area of the experiment was divided into plot; the plot size was 7 m^2 (3.5 × 2). Each plot consists of four ridges 70 cm apart and 1.5 m long. Three seeds per hole from each cultivar were sown manually in the middle of the ridge in late December 2017. The spacing between holes was 15 cm. After sowing land was immediately irrigated and subsequent irrigation was made every two week till 30 days, thereafter, the irrigation intervals treatments were applied as following 10, 20 and 30 days irrigation interval, chickpea seedlings were thinned to two plants per hole. Hand weeding was practiced two times at 30 and 50 days after sowing.

Five plants were randomly selected and tagged from the middle rows of each plot, to measure plant height (cm), number of leaves /plant and number of branches / plant at 60 and 90 days after sowing. Number of pods /plant, weight of pods /plant (g), number of seeds/ pod, weight of seeds (g), and weight of 100 seeds (g) was done after the crop was harvested.

Data collected in this study were statistically analysis according to analysis of variance (ANOVA), and means were separated for significant by Least Significant Differences Test (LSD) at 5 % level using statistic 8 computer program.

RESULTS AND DISCUSSION

The results revealed that there were no significant differences in plant height between chickpea cultivars, while there was a highly significant difference in water intervals. Chickpea cultivar irrigated every 10 days, displayed the highest plant height (34.1 cm), while, irrigation after 20 and 30 days decreased plant height significantly to 26.0 cm and 23.6 cm, respectively (fig.1). Plant height was significantly affected by water intervals; similar result was found by (Ahmed, 2006). The highest plant height was found in Atmore at 10 days interval, while the lowest was found in Shendi cultivar at 30 days intervals. It possible that cultivar Atmore is more tolerance to the stress condition which may have lead to its superiority our result was agreed with Mohamed *et. al*. (2015).

In general, chickpea cultivars irrigated after 10 days display highest number of leaves. However, irrigation after 30 days sustained the lowest number. Atmore cultivar displayed the highest leaves, followed by descending order by Wad-Hamid and Shendi. (Fig. 2). No significant differences in number of leaves between chickpea cultivars, the highest number of leaves were found in Atmore cultivar at 10 days irrigation while the lowest number of leaves was found in Shendi cultivar at 30 days irrigation, this may indicated that Atmore cultivar has more stress tolerance characteristic than Shendi and Wad Hamid. Water intervals had significantly effect on leaves number. Among all water intervals, Atmore cultivar irrigated after 10 days displayed the highest number of leaves followed by Wad Hamid and Shendi. And this perhaps referred to the role of water stress in old leaves, which will lead to shedding and resulting to reduce the total number of leaves. (AllaJabow, *et. al*., 2015) they found that the effect of water stress coincides with various growth stage such as germination; seedling and shoot length.

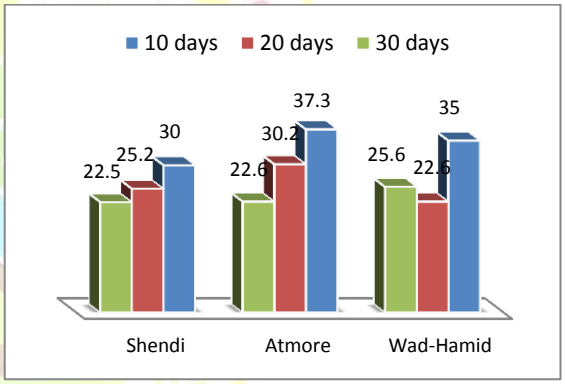

Fig.1. Effect of water interval on plant height (cm) of chickpea cultivars

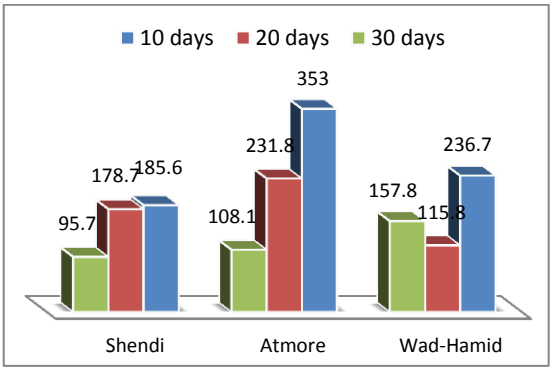

Fig.2. Effect of water interval on number of leaves/ plant of chickpea cultivars

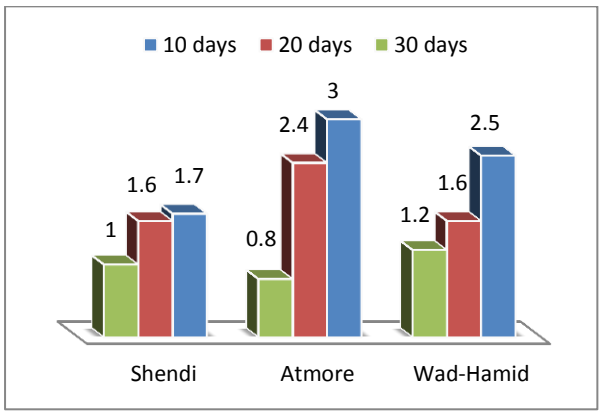

Fig.3. Effect of water interval on number of branches/ plant of chickpea cultivars

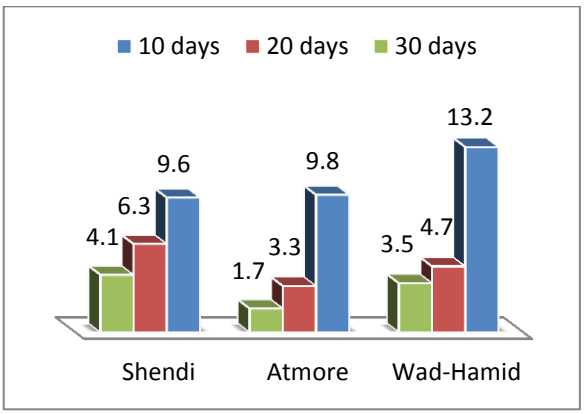

Fig.6. Effect of water interval on weight of pods/ plant of chickpea cultivars

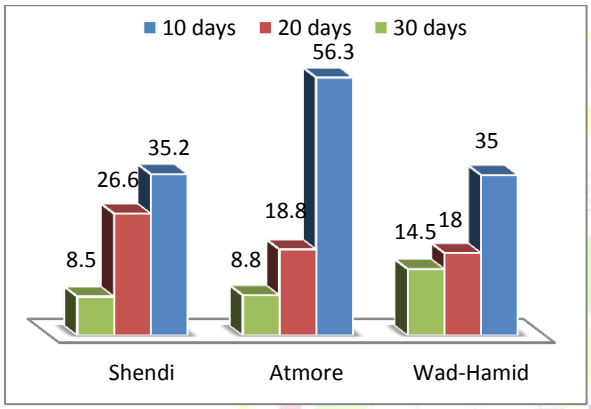

Fig.4. Effect of water interval on number of pods/ plant of chickpea cultivars

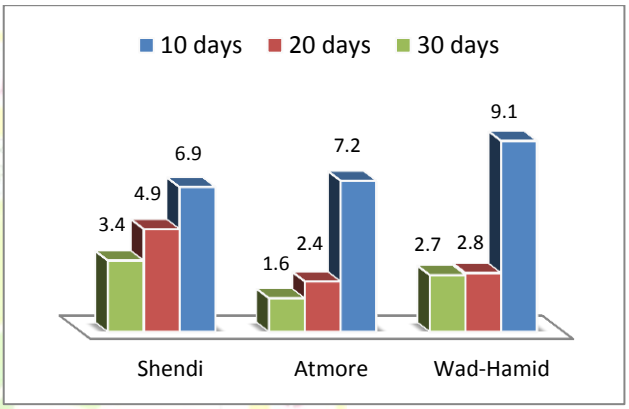

Fig.7. Effect of water interval on weight of seeds/ plant of chickpea cultivars

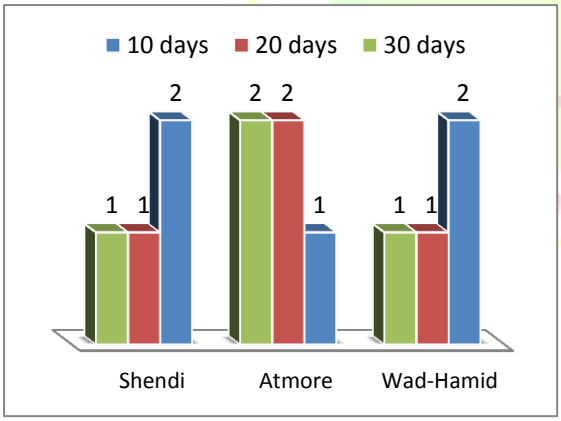

Fig.5. Effect of water interval on number of seeds per pod of chickpea cultivars

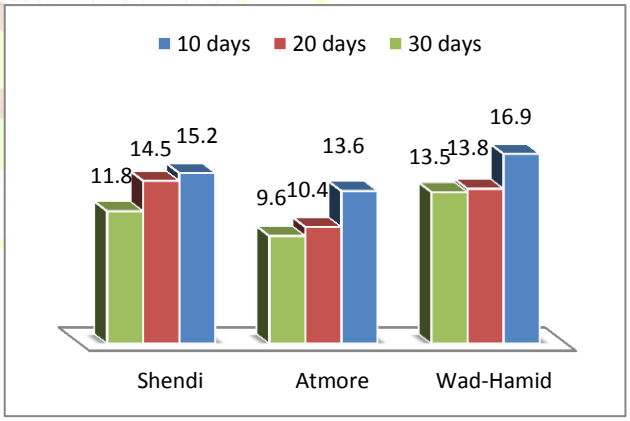

Fig.8. Effect of water interval on hundred seed weight of chickpea cultivars

All cultivars displayed comparable number of branches. However, the differences between water intervals were significant. Chickpea cultivars irrigated after 10 days increased number of branches per plant significantly, as compared to irrigation every 20 and 30 days (Fig. 3). Result showed that branches number was significantly affected by irrigation intervals. The highest and lowest number of branches was record in Atmore cultivar at 10 and 30 days irrigation respectively. However, (Ahmed, 2006) reported that no significant differences between chickpea cultivars in branches number, and this may be due to genetic character.

Different cultivars irrigated after 10 days sustain the highest pods number, followed by 20 and 30 days. Results showed that no significant difference was observed in number of pods per plant between chickpea cultivars (Fig. 4). Result displayed that

number of pods per plant decreased significantly with the increase in water intervals. The highest number of pods per plant was observed in 10 days intervals in Atmore (late flowering) than Wad Hamid and Shendi (early flowering). Similar results were reported by (AllaJabow, *et. al*., 2015).

Water intervals affect significantly number of seeds/ pod. As general, irrigation chickpea cultivars every 10 days displayed greater number of seeds/pod, followed by 20 days interval. Increasing water interval to 30 days reduced the number of seeds /pod significantly (Fig. 5). The weight of pods displayed an average of 13.2 g, 9.8 g and 9.6 g / plant due to Wad-Hamid, Atmore and Shandi respectively at 10 days water interval. Increasing water interval to 20 days decreased weight of pods /plant, but not significantly, as comparison to 10 days interval. A further increase in water interval to 30 days decreased weight of pods significantly, as compared to 10 days interval (Fig. 6). With respect to yield and yield component results showed that number of seeds per pod and hundred seed weight were significantly affected by irrigation intervals and cultivars. Moreover, irrigation interval was highly significantly affected on number of pods / plant, weight of pods / plant and weight of seeds / plant. Irrigation every 10 days gave the highest record in these characters. Interaction between irrigation intervals and cultivars were not significant in all characters except in number of seeds / pods, and this may referred to genetic characters.

Cultivars Wad-Hamid and Atmore at 10 days water interval gave highest weight of seeds / plant, while increasing water intervals to 20 and 30 days decreased seeds weight significantly. Shendi cultivar at the lowest water interval (10 days) displayed 5.0 g seeds weight /plant. Increasing water intervals to 20 and 30 days reduced seeds weight / plant, but not significantly, as comparison to 10 days interval (Fig. 7). Among the cultivars Wad-Hamid and Shendi had the highest and comparable hundred seed weight, while Atmore had the lowest. Irrigation interval at 10 days gave the highest 100 seed weight (15.3 g). Increasing water intervals to 20 and 30 days decreased 100 seed weight / plant significantly to 12.9 g and 11.7, respectively (Fig. 8). There were significant difference in number of seeds / pod and 100 seed weight; the highest weight of 100 seed was obtained from Wad Hamid in 10 days interval. The highest number of seeds / pod was recorded from Shendi cultivar in 10 days intervals, and the lowest number of seed / pod was obtained from Wad Hamid cultivar in 30 days intervals. There were significant reduction in weight of pods / plant and weight of seeds / plant when water interval increased. This trend was similar to the number of pods / plant. The highest values of these traits obtained with 10 days intervals; whereas the lowest values recorded under severe water condition (30 days interval). Availability of water will maintain continuous filling of assimilate in the seeds.

According to the results findings obtained from this study it can be concluded that chickpea crop irrigated every 10 days gave the best in plant height, number of leaves, number of tillers, number of pods /plant, weight of pods /plant, number of seeds /pod, weight of seeds /plant, and weight of 100 seed irrespective to the cultivars. Among all cultivars, Atmore cultivar sustained the best cultivar as compared to other cultivars. Further studies are needed to study the effects of different organic and inorganic fertilizers on chickpea yield and yield components under water intervals.

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