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

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Research Article

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ABSTRAC

In the winter of 2017–2018, a field study was carried out at the College of Agricultural Studies' Demonstration Farm at Sudan University of Science and Technology in Shambat, Khartoum State, Sudan. This experiment aimed to evaluate the impact of water intervals on the growth and yield of three cultivars of chickpeas: Atmore, Wad-Hamid, and Shendi. Three replications of the split-plot design were used. Three chickpea cultivars were positioned in a subplot, and the three water interval treatments—10, 20, and 30 days—were organized in the main plots. 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) were all measured. The quantity of leaves, branches, seeds per pod, and weight of 100 seeds varied significantly across the treatments, according to the data. Plant height, the number of pods per plant, the weight of the pods per plant, and the weight of the seeds per plant, however, varied significantly. Regardless of cultivars, irrigation every 10 days produced the greatest outcomes in the majority of the parameters examined. The findings showed that, with the exception of the number of seeds per pod and the weight of 100 seeds, there are no significant variations across chickpea cultivars in any of the parameters examined.

Key words: water, growth, yield, interval, and chickpea.

INTRODUCTION

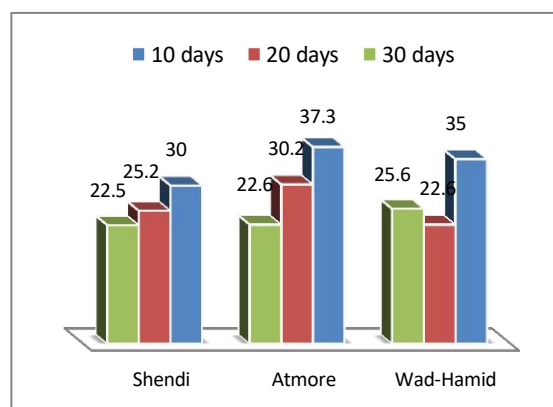
One of the most significant grain legume crops in the world, the chickpea (*Cicer arietinum* L.) is a member of the Fabaceae family and subfamily Faboideae (Knights et al., 2007). *Arietinum* is the sole cultivated annual species in the genus *Cicer*, which has nine annual and thirty-one perennial species (Muchlabuer, 1993). As the third most significant pulse crop, chickpeas account for 15% of global pulse output (FAO, 2010). More than 50 nations cultivate it, with 89.7% of the land in Asia, 4.3% in Africa, 2.6% in Oceania, 2.9% in the Americas, and 0.4% in Europe (Guar et al., 2010). In an effort to comprehend and evaluate the processes by which the plant overcomes drought stress, scientists are now using a number of techniques (Farshadfar, et al., 2013). Chickpeas are mostly cultivated in Sudan's north, where the climate is more conducive to their cultivation than in other regions of the nation. The high temperatures at the start and conclusion of winter limit their growth season to a little amount of time (Mohamed, 1998). With an average seed yield of 17349 kg/ha, the projected total planted area was 6851 ha (FAO, 2017). As the crop extends to new regions and is cultivated in various sections of the nation under residual moisture and irrigation systems, the area output and yield of chickpeas have all exhibited a rising tendency (Abdellatif and Abdalwahab, 2017). While increasing plant density had a negative impact on seed output per plant, it had a positive impact on other growth parameters and led to a significant increase in seed yield per unit area (Naim, 2001). The production of chickpeas is dependent on the water availability from blooming to the pod filling stage, and they are especially vulnerable to water stress during the reproductive stage (Naim, 2001). The creation of early maturing cultivars will effectively use the available soil moisture and provide comparatively larger yields in order to combat this drought stress. A critical evaluation by Upadhyaya et al. (2012) demonstrates effective techniques for phenotyping in relation to drought in pigeon pea and chickpea. Thus, the purpose of this experiment was to investigate how irrigation intervals affected the development and productivity of three different cultivars of chickpeas.

MATERIALS AND METHODS

The experiment was conducted in the winter of 2017–2018 at the College of Agricultural Studies' Demonstration Farm at Sudan University of Science and Technology in Shambat, Khartoum North. The region was semi-arid and tropical. It is situated at an elevation of 386 meters above sea level, between latitudes 15 to 40 degrees North and 32 to 32 degrees East, where three months of rainfall occur (July to September). The research area's clay soil, known as montmorillonite, has a pH range of 7.8 to 8.5 (Abdelhafiz, 2001). Three replications of the split-plot design were used to organize the treatments for the variables under study. Chickpea cultivars and water intervals are the two research elements employed in this experiment. Three chickpea cultivars—Atmore, Shendi, and Wad-Hamid—that were obtained from the Hudeiba Research Station, Agricultural Research Corporation (ARC), Sudan, were planted in subplots and three water interval treatments—10, 20, and 30 days—were used in the study. The ridge was created after the area was leveled, harrowed, and plowed. A plot of 7 m² (3.5 × 2) was created from the experiment's region. Each plot has four ridges that are 1.5 meters long and spaced 70 centimeters apart. In late December 2017, three seeds of each cultivar were manually planted in each hole in the center of the ridge. The holes were spaced 15 cm apart. Chickpea seedlings were reduced to two plants per hole after the soil was immediately watered and then irrigated every two weeks for 30 days. After that, treatments were administered at intervals of 10, 20, and 30 days. Two times, thirty and fifty days following seeding, hand weeding was done. To assess plant height (cm), number of leaves per plant, and number of branches per plant at 60 and 90 days following planting, five randomly chosen plants were tagged from the middle rows of each plot. Following crop harvest, measurements were made of the number of pods per plant, weight of pods per plant (g), number of seeds per pod, weight of seeds (g), and weight of 100 seeds (g). The study's data were statistically analyzed using analysis of variance (ANOVA), and the statistical software Statistic 8 was used to separate means for significance using the Least Significant Differences Test (LSD) at the 5% level.

RESULTS AND DISCUSSION

The findings showed that although there was a very significant difference in water intervals, there were no significant changes in plant height amongst chickpea cultivars. The chickpea cultivar with the maximum plant height (34.1 cm) was watered every 10 days; however, irrigation after 20 and 30 days dramatically reduced plant height to 26.0 cm and 23.6 cm, respectively (fig. 1). Water intervals had a considerable impact on plant height; Ahmed (2006) observed a similar finding. Atmore had the tallest plants at intervals of 10 days, while Shendi had the shortest plants at intervals of 30 days. Our results were consistent with those of Mohamed et al. (2015), suggesting that cultivar Atmore may be more resilient to stress conditions. Chickpea cultivars that get irrigation after ten days often have the most leaves. But after 30 days, irrigation maintained the lowest number. The Atmore cultivar has the tallest leaves, followed by Wad-Hamid and Shendi in declining order. (Figure 2). There were no discernible differences in the number of leaves between the chickpea cultivars; the Atmore cultivar had the most leaves after 10 days of irrigation, while the Shendi cultivar had the fewest leaves after 30 days. This could suggest that the Atmore cultivar is more resilient to stress than the Shendi and Wad Hamid cultivars. The number of leaves was considerably impacted by water intervals. The Atmore cultivar that



was watered after ten days showed the most leaves of all the water intervals, followed by Wad Hamid and Shendi. And this could have been a reference to how water stress affects older leaves, causing them to shed and ultimately lower the overall number of leaves. (AllaJabow, et al., 2015) discovered that several development stages, including germination, seedling, and branch length, are correlated with the impact of water stress.

10 days 20 days 30 days
353

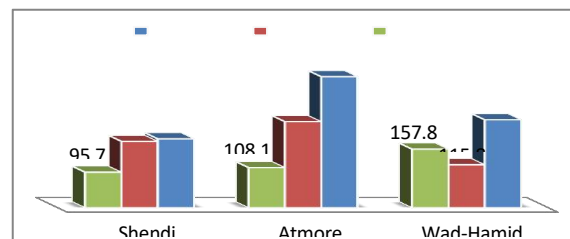


Fig.1. Effect of water interval on plant height (cm) of chickpea cultivars

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

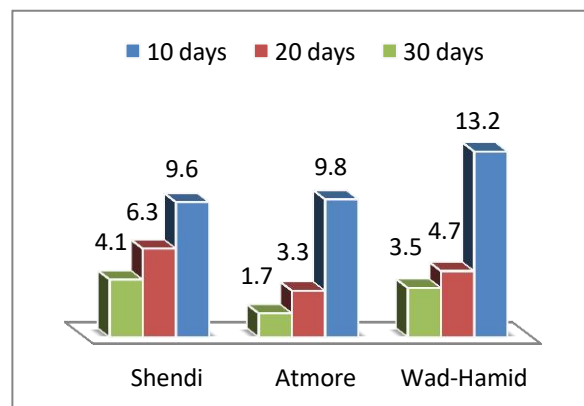
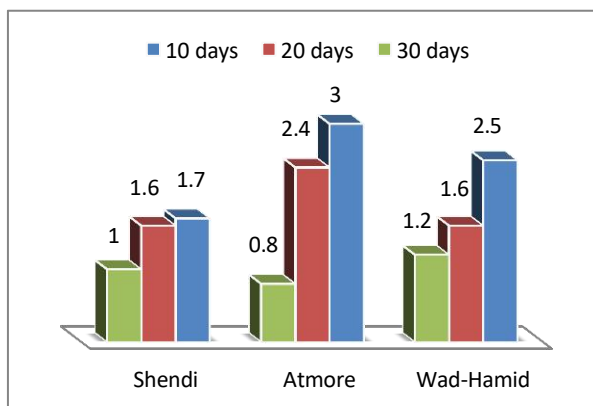


Fig.3. Effect of water interval on number of branches/ plant of chickpea cultivars

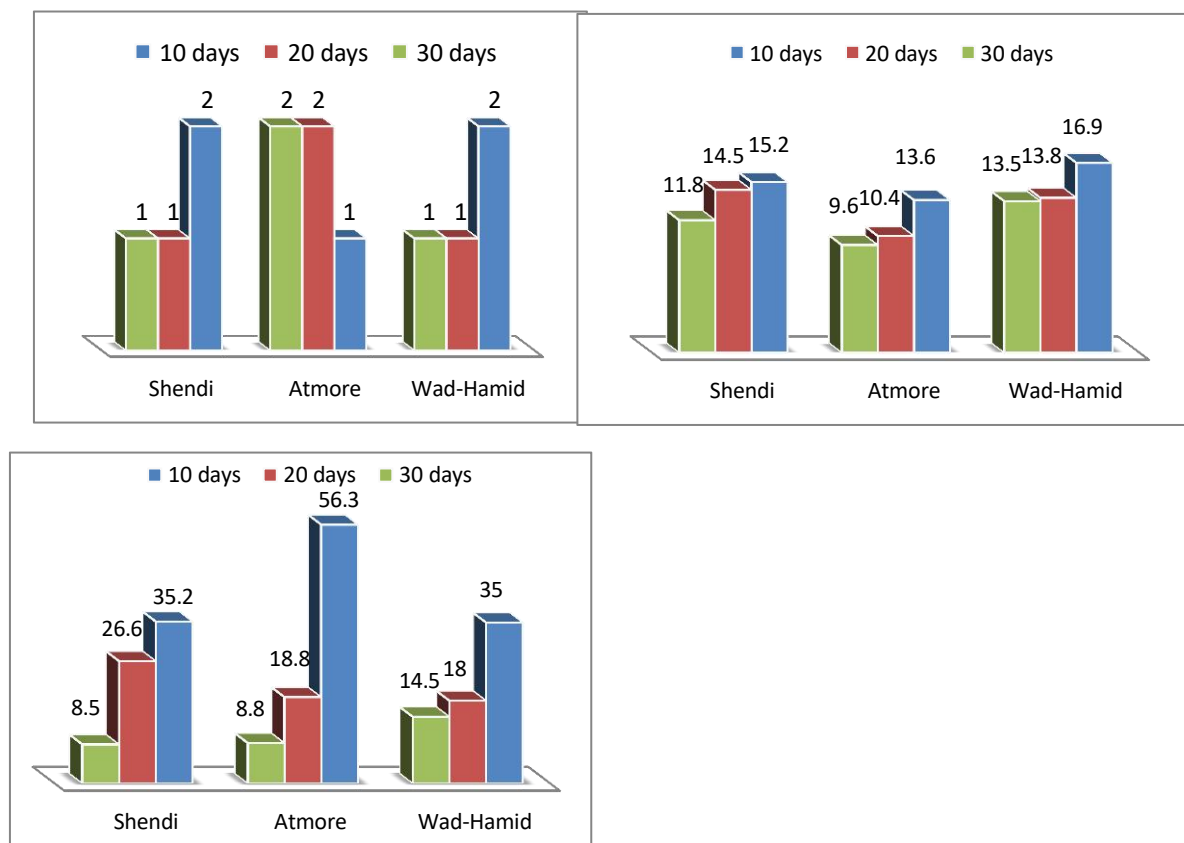


Fig.4. Effect of water interval on number of pods/ plant of chickpea cultivars

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

Each cultivar had a similar number of branches. Nonetheless, there were notable variations in the water intervals. Compared to cultivars that were watered every 20 and 30 days, chickpea cultivars that were irrigated after 10 days had a considerably higher number of branches per plant (Fig. 3). The number of branches was shown to be strongly impacted by watering intervals. At 10 and 30 days of irrigation, the Atmore cultivar had the greatest and lowest number of branches, respectively. Nevertheless, (Ahmed, Fig. 6. Impact of water interval on pod/plant weight of chickpea cultivars

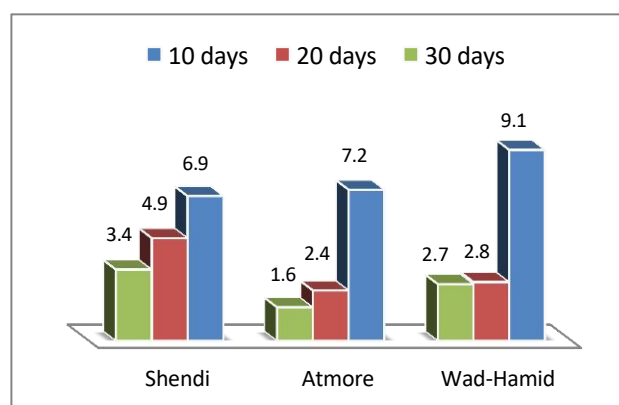


Fig.7. Effect of water interval on weight of seeds/ plant of chickpea cultivars

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

2006) found that there were no significant variations in the number of branches across chickpea cultivars; this might be because to genetic traits. The greatest number of pods is sustained by various cultivars that are watered after 10 days, followed by 20 and 30 days. The quantity of pods per plant did not significantly vary

amongst chickpea cultivars, according to the results (Fig. 4). The quantity of pods per plant dramatically dropped as water intervals increased, according to the results. Atmore (late blooming) had more pods per plant at 10-day intervals than Wad Hamid and Shendi (early flowering). AllaJabow et al. (2015) observed similar findings. The amount of seeds per pod is greatly impacted by water intervals. Generally speaking, chickpea cultivars that were irrigated every ten days showed more seeds per pod, followed by intervals of twenty days. The quantity of seeds per pod was considerably decreased by increasing the water interval to 30 days (Fig. 5). At a 10-day water interval, the weight of the pods showed an average of 13.2 g, 9.8 g, and 9.6 g/plant attributable to Wad-Hamid, Atmore, and Shandi, respectively. When compared to a 10-day interval, increasing the water interval to 20 days resulted in a little reduction in the weight of pods per plant. When the water interval was increased to 30 days instead of 10, the weight of the pods was considerably reduced (Fig. 6). Irrigation intervals and cultivars had a substantial impact on yield and yield component outcomes, including the number of seeds per pod and the weight of a hundred seeds. Additionally, the number of pods per plant, the weight of pods per plant, and the weight of seeds per plant were all greatly impacted by the watering interval. The highest record in these characters was obtained with irrigation every ten days. With the exception of the quantity of seeds or pods, which may be related to genetic traits, there was no significant interaction between irrigation intervals and cultivars. The cultivars Wad-Hamid and Atmore produced the greatest weight of seeds per plant at a water interval of 10 days, but the weight of seeds was considerably reduced during intervals of 20 and 30 days. At the lowest water interval (10 days), the Shendi cultivar showed 5.0 g of seeds per plant. When compared to a 10-day interval, increasing water intervals to 20 and 30 days decreased seed weight per plant, although not considerably (Fig. 7). Atmore had the lowest hundred seed weight among the cultivars, whereas Wad-Hamid and Shendi had the highest and similar weight. The maximum 100 seed weight (15.3 g) was obtained with an irrigation interval of 10 days. 100 seed weight per plant dropped dramatically to 12.9 g and 11.7 g, respectively, when water intervals were increased to 20 and 30 days (Fig. 8). The quantity of seeds per pod and the weight of 100 seeds varied significantly; Wad Hamid had the greatest weight of 100 seeds throughout a 10-day period. The Shendi cultivar produced the most seeds per pod in 10-day intervals, whereas the Wad Hamid cultivar produced the fewest seeds per pod in 30-day intervals. When the water interval increased, there was a noticeable decrease in the weight of the pods and seeds per plant. The quantity of pods per plant was comparable to this trend. The maximum values of these characteristics were recorded at intervals of 10 days, while the lowest values were recorded at intervals of 30 days under severe water conditions. Water availability will ensure that the seeds continue to fill with assimilate. The results of this study indicate that, regardless of cultivars, chickpea crops irrigated every ten days produced the best results in terms of plant height, number of leaves, number of tillers, number of pods per plant, weight of pods per plant, number of seeds per pod, weight of seeds per plant, and weight of 100 seed. The Atmore cultivar outperformed all other cultivars in terms of sustainability. The effects of various organic and inorganic fertilizers on chickpea production and yield components under water intervals need further research.

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