Effect of Different Irrigation Schedules on The Growth and Yield Performance of Wheat (*Triticum aestivum* L.) Varieties Assessment in District Awaran (Balochistan)

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Abstract

The field experiment was carried out to investigate the effect of different irrigation schedules on growth and yield Performance of wheat varieties assessment in district Awaran Balochistan was conducted at Tehsil Mashkai District Awaran, Balochistan during Rabi 2012-13. The experiment was layout in a three replicated randomized complete block design (Factorial) having net plot size of 6.0 m^2. Three wheat varieties i.e. Sassui, TD-1 and Raskoh-2005 were evaluated for their performance against three irrigation schedules i.e. five irrigations (1st 25 DAS and subsequent irrigations at 15 days interval), four irrigations (1st 30 DAS and subsequent irrigations at 20 days interval) and three irrigations (1st 35 DAS and subsequent irrigations at 25 days interval). The results showed that plant height, differed highly significantly ($P<0.01$) for irrigation schedules, and non-significantly ($P>0.05$) for verities and interaction. Spikelet's spike^{-1} and seed index highly significant ($P<0.01$) for irrigation and verities whereas non-significantly ($P>0.05$) for interaction. Tillers, spike length, grains spike$^{-1,}$ biological yield and grain yield showed highly significant ($P<0.01$) effects for irrigation schedules, varieties and their interaction, whereas harvest index was influenced highly significantly ($P<0.01$) between irrigation schedules and varieties and significantly ($P<0.05$) for their interaction. The wheat crop irrigated five times resulted maximum plant height (86.206 cm), tillers m^{-2} (402.11), spike length (12.040 cm) spikelet's spike^{-1} (18.979), grains spike^{-1} (47.099), seed index (44.580 g), biological yield, (13732 kg ha^{-1}), grain yield (6999.30 kg ha^{-1}) and harvest index (50.95%) as compared to four irrigations and three irrigations. Among varieties Sassui ranked 1st in all traits studied particularly grain yield (5818.80 kg ha^{-1}) followed by TD-1 (5407.4 kg ha^{-1}) and Raskoh-2005 (5014 kg ha^{-1}). However, it is concluded that interaction of five irrigations and wheat variety Sassui proved optimum for obtaining maximum grain yield (7444.70 kg ha^{-1}).

Keywords: Wheat, Varieties, Irrigation Schedules, Growth, Yield

Introduction

Pakistan is although counted as an extensive irrigated country like Indonesia, Russian Federation, Mexico, Egypt and USA, yet in its dry regions water is not sufficient even to provide initial requirements of agricultural crops. This deficiency retards not only the growth of the plants but also results in poor harvests thereby causing a great financial loss to the poor tiller of the soil. Even in the regions where irrigation water is available throughout the year, the cultivators fail to provide the optimum requirements because lack of knowledge about the quantities and timings of irrigation. The irrigation scheduling is the process of determining when to irrigate and how much water to apply per irrigation. Proper irrigation scheduling is essential for the efficient use of water, energy and other production inputs. Three major considerations influencing irrigation schedule include water needs of crop; availability of water for irrigation; and capacity of the root zone to store water. Water needs of crop are of paramount importance in determining the time of irrigation during the crop-growing season in irrigation programs (Passioura, 2007).

Wheat, *Triticum aestivum* L. is one of the most cultivated cool-season crop originated from the Middle East. It has somewhat longer growing period and minimum heat requirement than the other small grain crops; and billions of people in the world use it as food in various forms such as steamed breads, cookies, cakes, pasta, noodles and couscous (Cauvain, 2003; Kingfisher, 2004). Due to mild and acceptable flavour, and unique abilities of protein, starch, fat with certain vitamins and minerals, wheat has the exceptional position in the diet of Pakistani people (Soomro and Oad 2002; Sial *et al.*, 2005). It is the cheapest source and supplies 72 percent of the calories and protein in the average diet (Heyne 1987; Ken, 2004; Rehm and Schmitt, 2010). Wheat was cultivated on an area of 8805 thousand hectares, showing a decrease of 3.6 percent over last year's area of 9132 thousand hectares. However, a bumper wheat crop of 24.2 million tons has been received with 3.9 percent increase over the last year's crop of 23.3 million tons. The prospects for wheat harvest improved with healthy fertilizer off-take and reasonable rainfall during pre-harvesting period (GOP. 2011. Economic Survey of Pakistan. 2009-2010).

Wheat is produced under irrigated conditions in the country; but low rainfall and late heat stress conditions are the constraints to achieve the desired results. According to Deshmukh and Padole (1993), in a field trial on a clay loam soil, wheat was irrigated at cumulative pan evaporation (CPE) of 50, 75, 100 or 125 mm. Grain yield increased from 2.07 t ha^{-1} to with irrigation at 125 mm CPE to 3.23 t ha^{-1} with irrigation at 50 mm CPE. Parsad (1993) in the field trial conducted on silty loam found that combination of manual weed control + irrigation at 150 mm CPE + 150 kg N achieved the greatest wheat grain yields. Abd El-Gawad *et al*. (1994) found that increasing number of irrigations from two to four increased wheat growth and seed index; while Ibrahim *et al*. (2011) and Khatun *et al*. (2007) reported yield increase with the increase of irrigation frequency. Alderfasi *et al*. (1999) observed a significant increase of plant height, fertile tillering, thousand kernel weight and grain and biological yields with increasing amount of irrigation. Dawood and Kheiralla (1994) and Bankar *et al*. (2008) observed that five irrigations at crown root initiation, tillering, jointing, flowering and milking stages, led to the highest yield. Bunyolo (2000) found that water use by wheat increased with shorter irrigation intervals; while Munyindaa and Bunyoloa (2000) applied irrigations at tillering either on a weekly, every two weeks, or every three weeks basis and obtained maximum yields with weekly irrigation. Haj *et al.* (2005) studied effects of irrigation regimes on wheat and reported significant differences were noted regarding these parameters due to irrigation regimes. Significant effects of the water regime were found on all measured traits by Ibrahim *et al.* (2007) and number of grain per spike, thousand grain weight, the gains were highest when the crop was irrigated five times at 25 days interval, rather than four times at 30 days intervals. Khan *et al.* (2007) reported that the highest water use efficiency was obtained when crop was irrigated at one week interval; while Lin *et al.* (2007) found that higher yield and greater water use efficiency in wheat appear to be associated with smaller root systems and higher harvest index irrespective of irrigation. Shao *et al.* (2009) reported that good soil moisture conditions at sowing also played an important role in achieving high yields of wheat under limited water supply. The proper irrigation schedules could save considerable amount of irrigation with low yield losses. The present study will be carried out to effect of different irrigation schedules on growth and yield Performance of wheat varieties assessment in district Awaran Balochistan

Study Area

The study was carried out in Tehsil Mashkai District Awaran in the south of the Balochistan Province of Pakistan

MATERIALS AND METHODS

The field study was carried out to investigate the effect of different irrigation schedules on growth and yield Performance of wheat varieties assessment in District Awaran (Balochistan) i.e. Sassui, TD-1 and Raskoh-2005 at Tehsil Mashkai district Awaran, Balochistan during Rabi 2012-13. The randomized complete block design (RCBD) was used with three replications having net plot size of 5× 1.2m ($6.0m^2$). The sowing was done by means of single row hand drill in 3^{rd} week of November 2012. The Nitrogen was applied in the form of Urea @ 168 kg ha^{-1} and Phosphorus in the form of DAP @ 82 kg ha^{-1}. All P (as mono ammonium phosphate) and $1/3^{rd}$ of N (as urea) were applied at the time of sowing and remaining N was applied in two splits at first irrigation and at 2^{nd} irrigation, respectively.

The irrigations were applied according to the treatment plan and the weeding was performed by using weedicides. The following treatments were applied. T1: Five irrigations were applied (1^{st} 25 DAS and subsequent irrigations at 15 days interval), T2: Four irrigations were applied (1^{st} 30 DAS and subsequent irrigations at 20 days interval) and T3: Three irrigations were applied (1^{st} 35 DAS and subsequent irrigations at 25 days interval). For recording observations on various agronomical traits, five plants in each plot were selected at random and labeled. After completion of observations on growth parameters, and when crop matures, the labeled plants were harvested manually and tied in small bundles, and were shifted to threshing yard. Threshing was performed manually. The grains were collected carefully to count and record. The data of the following parameters: Plant height (cm), Tillers m^{-2}, Spike length (cm), Spikelet's $spike^{-1}$, Grains $spike^{-1}$, Seed index (1000 grain weight, g), Biological yield (kg ha^{-1}), Grain yield (kg ha^{-1}) and Harvest index (%) were observed. .

Statistical Analysis

The data thus collected were subjected to statistical analysis using MSTAT-C. The LSD test was applied to compare treatments superiority, where necessary (Russel and Eisensmith, 1983).

RESULTS

The experiment was conducted during Rabi, 2012-13 at Tehsil Mashkai District Awaran, Balochistan to investigate the effect of different irrigation schedules on growth and yield Performance of wheat varieties assessment in District Awaran (Balochistan). Three wheat varieties (V_1= Sassui V_2=TD-1, V_3= Raskoh-2005) were evaluated for their performance against three irrigation schedules such as: I_1=Five irrigations (1^{st} 25 DAS and subsequent irrigations at 15 days interval) I_2=Four irrigations (1st 30 DAS a subsequent irrigations at 20 days interval) and I_3=Three irrigations (1st 35 DAS and subsequent irrigations at 25 days interval). The observations were recorded on plant height, number of tillers plant^{-1}, spike length (cm), spikelets spike^{-1}, grains spike^{-1}, seed index (g), biological yield (kg ha^{-1}), grain yield (kg ha^{-1}) and harvest index (%). The data on the above characters are presented in Fig.1 to 9; while respective analysis of variance as Appendices I to IX. On the basis of statistical analysis, the results are described in this chapter.

Plant height (cm)

The data regarding the plant height of wheat varieties as influenced by different irrigation schedules are presented in Fig.1 and its analysis of variance as Appendix-I. The results of the analysis of variance suggested highly significant ($P<0.05$) effect of irrigation schedules and varieties on the plant height, while their interaction did not show significant effect ($P>0.05$) on this trait. The crop receiving five irrigations grew tallest (86.222 cm), while the wheat crop given four irrigations ranked second with average plant height of 86.206 cm; while the minimum plant height (85.794 cm) of wheat was recorded in plots given 3 irrigations. In case of varieties, the plant height of wheat was markedly higher (96.667 cm) in variety Sassui, while variety Raskoh-2005 ranked second with average plant height of 94.244 cm, while the lowest plant height of 67.311 cm was recorded in variety TD-1. The interaction 5 irrigations x variety Sassui resulted in maximum plant height (97.200 cm), while the interaction 3 irrigations x variety TD-1 resulted in minimum plant height of 67.017 cm. It was observed that regardless of varieties, would grew maximally under five irrigations and reducing irrigation schedules up to four irrigations adversely affected the plant height. However, three irrigations, the wheat crop showed poor growth when compared with their performance in case of five irrigations. The LSD test suggested that wheat plant height under various irrigation schedules as well as in case of different varieties had was linearly influenced ($P<0.05$).

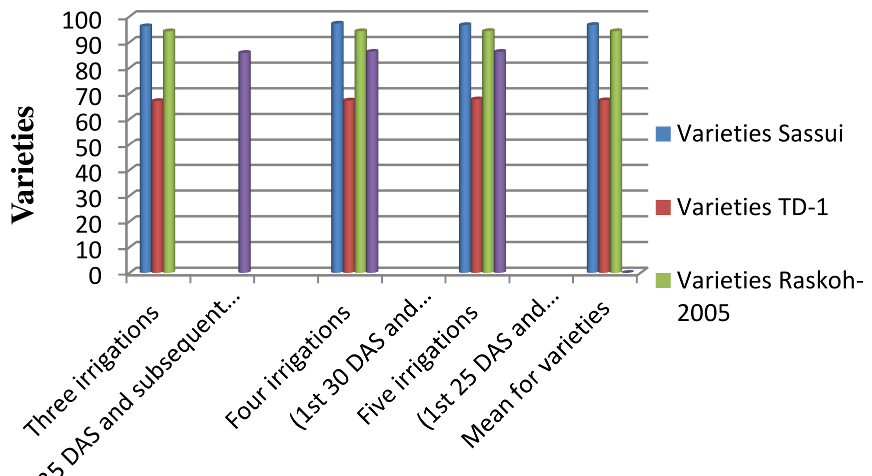

Fig.1 Plant height (cm) of wheat varieties as influenced by irrigation Schedules

Tillers m^{-2}

The results in regards to tillers plant^{-1} of wheat varieties as affected by different irrigation schedules are shown in Fig.2 and its analysis of variance as Appendix-II. The results of the analysis of variance indicated that the differences in the number of tillers plant^{-1} of wheat were significant ($P<0.05$) due to different irrigation schedules and varieties, while their interaction affect the tillers plant^{-1} significantly ($P<0.05$) in wheat. Wheat crop irrigated five times had maximum number of tillers (402.11) plant^{-1}, followed by four irrigations with 364.33 tillers plant^{-1}; while the minimum number of tillers (338.00) plant^{-1} was observed in wheat crop kept on three irrigations. In varieties, Sassui resulted in significantly maximum number of tillers (379.22) plant^{-1}, while the second position was occupied by variety TD-1 with 370.00 tillers plant^{-1}; while the lowest number of tillers (355.22) plant^{-1} was noted in variety Raskoh-2005. The interaction studies indicated that 5 irrigations x variety Sassui resulted in maximum number of tillers (409.33) plant^{-1}, and the minimum tillers (327.33) plant^{-1} was recorded in interaction of 3 irrigations x variety Raskoh-2005. Irrespective of varieties, irrigation application other than five irrigations adversely affected the number of tillers plant^{-1}, this indicates that raising of wheat crop only on 3 irrigations would not fulfill the crop irrigation requirement. The LSD test showed that there was straight effect of irrigation schedules on the number of tillers plant^{-1}, while the varieties also showed varied response to this trait under all circumstances.

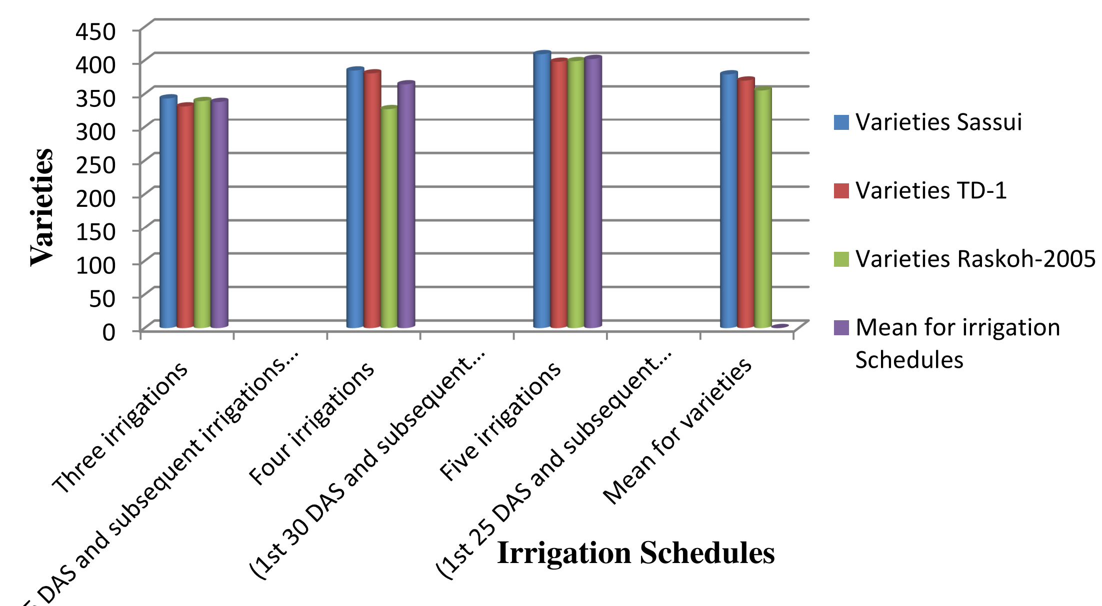

Fig.2 Tillers m^{-2} of wheat varieties as influenced by irrigation Schedules

Spike length (cm)

The results pertaining to spike length of wheat varieties as affected by various irrigation schedules are given in Fig.3 and its analysis of variance as Appendix-III. The analysis of variance indicated significant ($P<0.05$) effect of irrigation schedules on the spike length of wheat, while the effect of varieties and interaction between irrigation schedules and varieties on the spike length was statistically highly significant ($P<0.01$) It is evident from the results that the crop receiving five irrigations resulted in maximum spike length of 12.040 cm, followed by four irrigations with 10.928 cm spike length; while the lowest spike length of 9.638 cm on average was recorded in plots given 3 irrigations. In case of varieties, the maximum spike length of 12.118 cm was noted in variety Sassui, followed by variety Raskoh-2005 with average spike length of 11.209 cm; while the lowest spike length of 9.27 cm was observed in case of variety TD-1. The interaction, “5 irrigations x variety Sassui” resulted in maximum spike length of 13.310 cm, while the interaction 3 irrigations x variety TD-1” resulted in minimum spike length of 8.333 cm. The results further showed that variety Sassui showed its superiority for this trait over Raskoh-2005 and TD-1; while application of five irrigations showed optimistic results for this trait and the application of 4 irrigations or the crop sown under 3 irrigations resulted a marked decrease in the spike length. The LSD test suggested that spike length in crop irrigation five times and four times was statistically highly significant ($P<0.01$) and significant ($P<0.05$) when compared with the spike length under 3 irrigations.

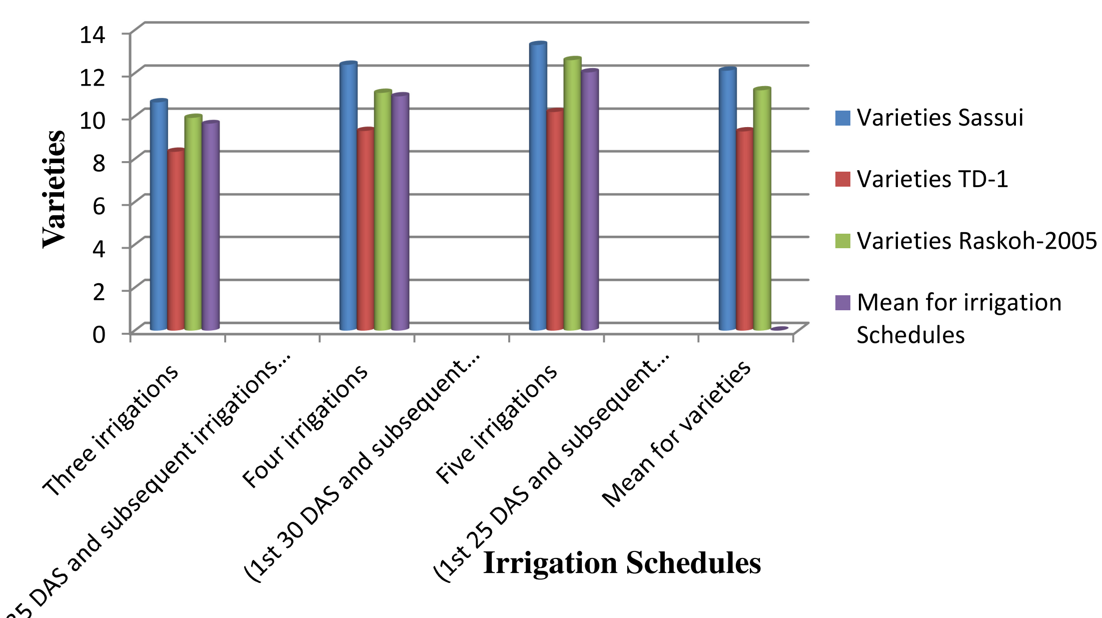

Fig.3 Spike length (cm) of wheat varieties as influenced by irrigation Schedules

Spikelet's spike^{-1}

The data regarding the spikelet's spike^{-1} of wheat varieties as affected by different irrigation schedules are indicated in Fig.4. The analysis of variance (Appendix-IV) illustrated that the differences in the spikelet's spike^{-1} were highly significant (P<0.01) between irrigation schedules and varieties, while non-significant (P>0.05) due to interaction between irrigation schedules and varieties. The crop receiving five irrigations resulted in maximum spikelet's (18.979) spike^{-1}, followed by four irrigations with 17.831 spikelet's spike^{-1}; while the minimum spikelet's (15.756) spike^{-1} was observed in wheat crop 3 irrigations. In case of varieties, Sassui produced significantly highest spikelet's (18.494) spike^{-1}, while variety TD-1 followed with 18.378 spikelet's spike^{-1}; and the minimum spikelet's (15.680) spike^{-1} was achieved in variety Raskoh-2005. Decreasing irrigation number showed severe adverse effects on the spikelet's spike^{-1}. The interaction "5 irrigations x variety Sassui" resulted in maximum number of spikelet's (20.233) spike^{-1}, and the minimum spikelet's (14.000) spike^{-1} was noted in interaction of "3 irrigations x variety Raskoh-2005". Of spikelet's between different irrigation schedules was substantially higher, but the effect was also pronounced for this trait when different varieties were compared. The LSD test indicated that either between varieties or among irrigation schedules, the differences in the spikelet's spike^{-1} were same.

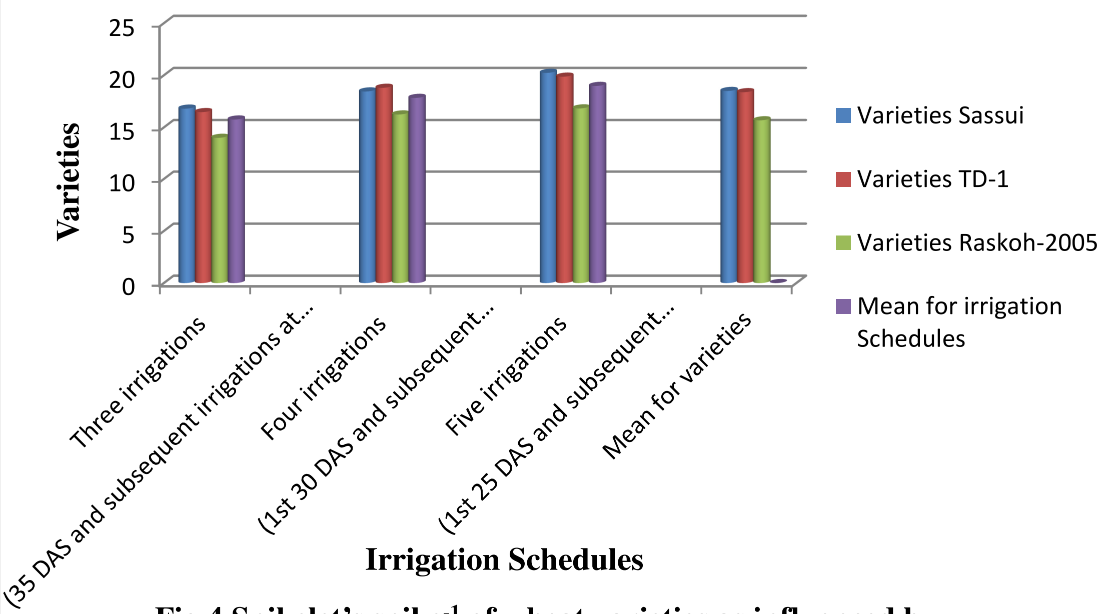

Fig.4 Spikelet's spike^{-1} of wheat varieties as influenced by irrigation Schedules

Grains spike^{-1}

The results in relation to grains spike^{-1} of wheat varieties as influenced by various irrigation schedules are shown in Fig.5. The analysis of variance (Appendix-V) indicated that the differences in the grains spike^{-1} of wheat were highly significant (P<0.05) between irrigation schedules, varieties, and highly significant (P>0.05) due to interaction between irrigation schedules and varieties. Wheat crop irrigated five times, produced significantly highest grains (47.099) spike^{-1}, followed by four irrigations with 43.159 grains spike^{-1}; while the minimum number of grains (37.959) spike^{-1} was recorded in 3 irrigations. In varieties, Sassui resulted in significantly maximum grains (44.229) spike^{-1}, followed by Raskoh-2005 with 42,167 grains spike^{-1}; and the minimum grains (41.821) spike^{-1} was obtained in variety TD-1. Decreasing irrigation number showed severe adverse effects on the grains spike^{-1}. The interaction studies showed that between 5 irrigations and Sassui variety resulted in maximum number of grains (50.013) spike^{-1}, while the lowest grains (36.767) spike^{-1} was observed in interaction between "3 irrigations x variety TD-1". It was observed that grains spike^{-1} were markedly affected in adverse direction due to adoption of irrigation schedules other than five irrigations; while genetically Sassui proved its superiority over Raskoh-2005 and TD-1. The LSD test showed that there were linear differences either when irrigation schedules are compared or comparison was made between varieties for this trait.

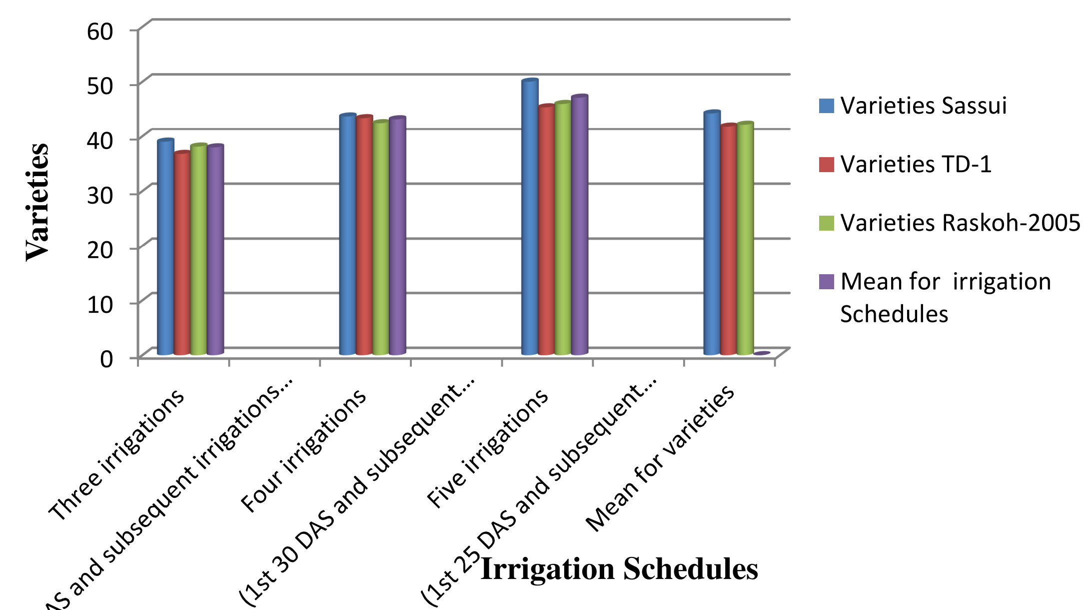

Fig.5 Grains spike^{-1} of wheat varieties as influenced by irrigation Schedules

Seed index (1000 grain weight, g)

The data regarding seed index (1000 seed weight) of wheat varieties as influenced by various irrigation schedules are presented in Fig.6 and its analysis of variance as Appendix-VI. The analysis of variance indicated significant ($P<0.05$) effect of irrigation schedules and varieties on the seed index of wheat, while the effect of interaction between irrigation schedules and varieties on the seed index was statistically non-significant ($P>0.05$). It can be seen from the results that the highest seed index (44.580 g) was recorded in wheat crop while the crop receiving four irrigations receiving five irrigations, ranked second with 42.209 g seed index value; while the lowest seed index value of 40.914 g was recorded in 3 irrigations. In varieties, the maximum seed index (43.658 g) was recorded in variety Sassui followed by variety TD-I with average seed index of 43.184 g; while the lowest seed index value of 40.861 g was noted in variety Raskoh-2005. The interaction between "5 irrigations and Sassui" resulted in maximum seed index value of 45.283 g, while the interaction between "3 irrigations and Raskoh-2005 resulted in minimum seed index value of 39.033 g. Regardless of wheat varieties, irrigation schedules showed significant impact on seed index value and five irrigations, proved to be minimally required irrigation schedules for wheat; because the seed index was under adverse impact when the crop was irrigated four times or three irrigations. The LSD test showed that seed index value in varieties Sassui and TD-1 were significant ($P<0.05$), while significant between all rest of the comparable means.

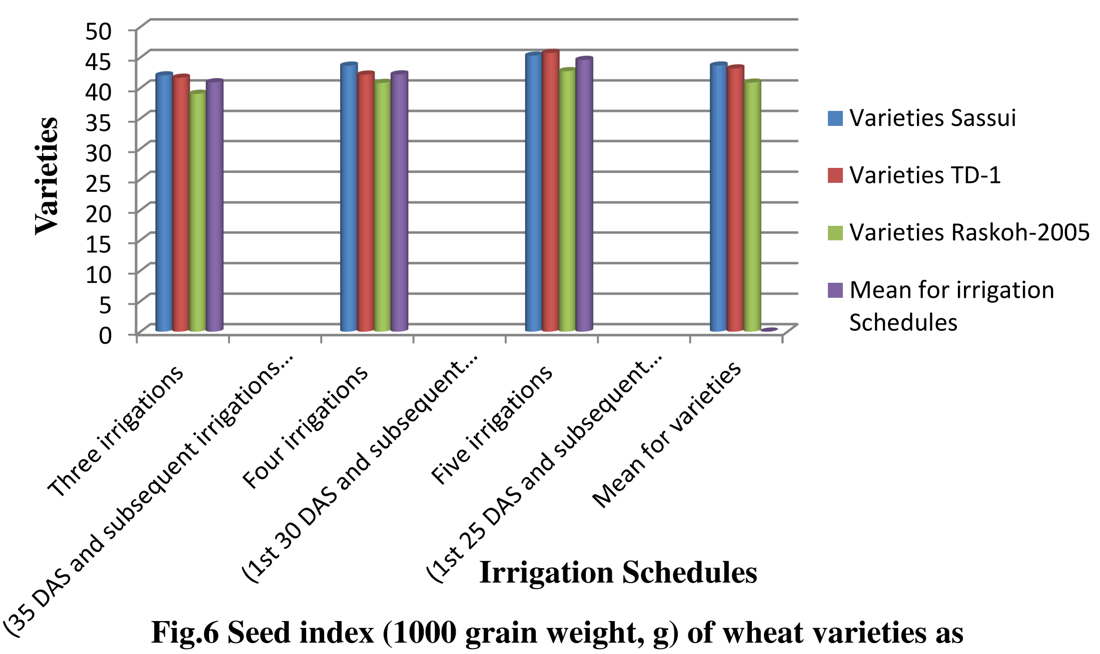

Fig.6 Seed index (1000 grain weight, g) of wheat varieties as influenced by irrigation Schedules

Biological yield (kg ha^{-1})

Biological yield of wheat is the total biomass weight of the crop including straw, grain and the results on this trait as influenced by various irrigation schedules and varieties are presented in Fig.7. The analysis of variance (Appendix-VII) suggested that the biological yield ha^{-1} of wheat was significantly ($P<0.05$) affected due to irrigation schedules, varieties as well as by their interaction. The data indicated that wheat crop irrigated five times, resulted in significantly maximum biological yield (13732 kg) ha^{-1}, followed by four irrigations with 12098 kg biological yield ha^{-1}; while the minimum biological yield (8600 kg) ha^{-1} was recorded in 3 irrigations. In varieties, Sassui resulted in significantly maximum biological yield (12127 kg) ha^{-1}, followed by TD-1 with biological yield of 11456 kg ha^{-1}; and the lowest biological yield of 10847 kg ha^{-1} was achieved from variety Raskoh-2005. It was observed that other than 4 irrigations the biological yield was significantly decreased and the 3 irrigations resulted in least biological yield. The interaction studies showed that interaction of "5 irrigations x Sassui" resulted in highest biological yield of 14486 kg ha^{-1}, while the lowest biological yield (8105 kg) ha^{-1} was noted in interaction between "3 irrigation x variety Raskoh-2005". The LSD test suggested a straight influence on the biological yield either comparison was made between irrigation schedules or when wheat varieties were compared.

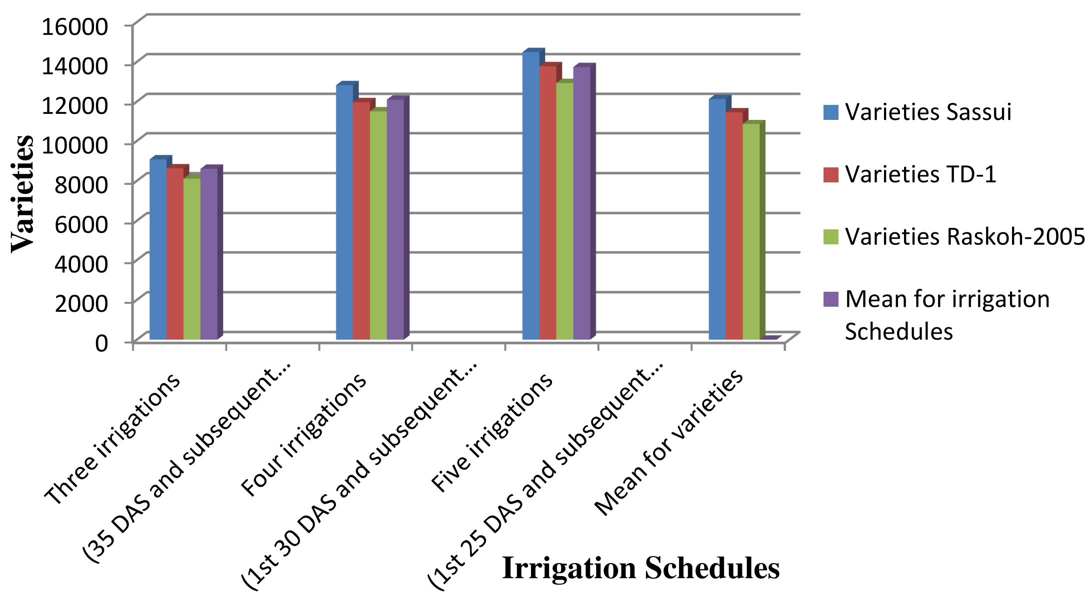

Fig.7 Biological yield (kg ha^{-1}) of wheat varieties as influenced by irrigation Schedules

Grain yield (kg ha^{-1})

The results in regards to grain yield ha^{-1} of wheat varieties as affected by different irrigation schedules are shown in Fig.8 and the analysis of variance as Appendix-VIII. The analysis of variance indicated that the grain yield ha^{-1} of wheat was significantly ($P<0.05$) influenced by irrigation schedules, varieties as well as by interaction between irrigation schedules and varieties. The results showed that the crop irrigated five times, produced significantly maximum grain yield of (6999.30 kg) ha^{-1}, followed by four irrigations with average grain yield of 5761.60 kg grain yield ha^{-1}; while the lowest grain yield (3479.30 kg) ha^{-1} 3 irrigations. In varieties, Sassui produced significantly highest grain yield of 5818.80 kg ha^{-1}, followed by variety TD-1 with grain yield of 5407.40 kg ha^{-1}; and the lowest grain yield of 5014 kg ha^{-1} was obtained from variety Raskoh-2005. The results showed that with decreasing irrigation from five irrigations to four irrigations, the grain yield of wheat was markedly decreased. Moreover, genetically, Sassui proved to be a superior variety over TD-1 and Raskoh-2005. Further more, the interaction of “5 irrigations x Sassui” resulted in maximum grain yield of 7444.70 kg ha^{-1}, while the lowest grain yield of 3133 kg ha^{-1} was obtained in interaction between “3 irrigations x Raskoh-2005”. The LSD test suggested a linear difference in grain yield either between irrigation schedules or when wheat varieties were compared.

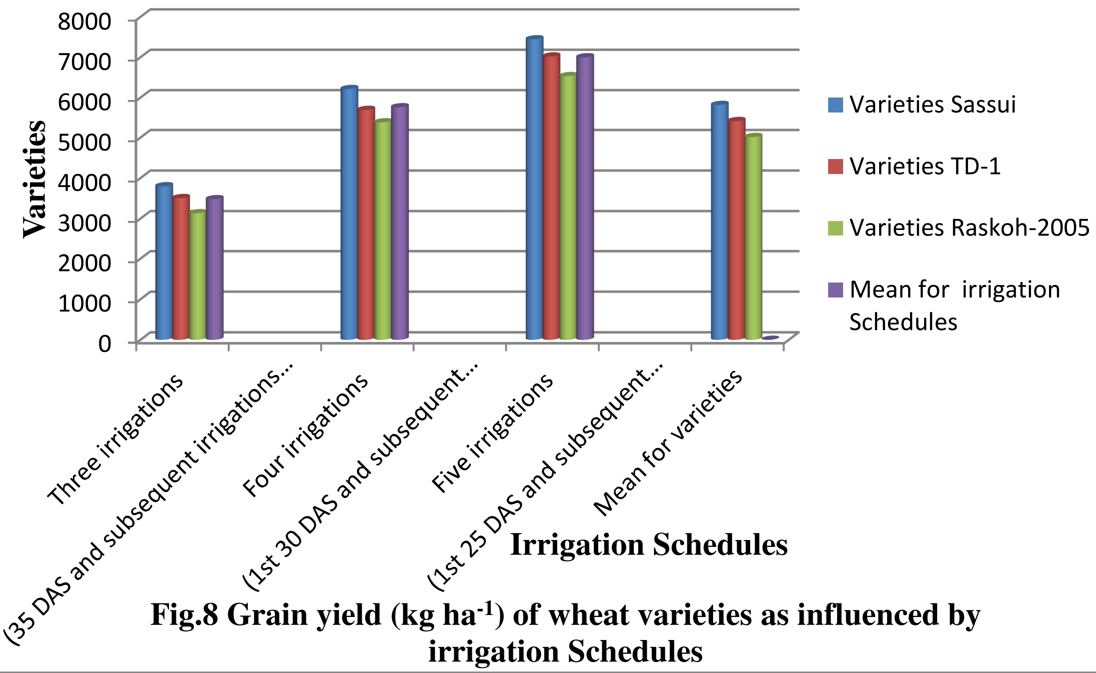

Fig.8 Grain yield (kg ha^{-1}) of wheat varieties as influenced by irrigation Schedules

Harvest index (%)

The harvest index is the percentage of grain from the biological yield obtained from a unit area. The data regarding harvest index of wheat varieties as affected by different irrigation schedules are shown in Fig.9, while its analysis of variance as Appendix-IX. The analysis of variance exhibited significant (P<0.05) effect of irrigation schedules, varieties as well as their interaction on the harvest index. It is evident from the data that harvest index was highest (50.95%) in plots receiving five irrigations, followed by the crop receiving four irrigations with harvest index of 47.59%; while the lowest harvest index of 40.39% was noted in 3 irrigation. In varieties, the highest harvest index (47.23%) was noted in variety Sassui followed by variety TD-1 with harvest index of 46.40%; while the lowest harvest index of 45.30% was observed in variety Raskoh-2005. The interaction between “5 irrigations and Sassui” resulted in maximum harvest index of 51.39%, while the interaction between “3 irrigation and Raskoh-2005” resulted in minimum harvest index of 38.66%. Regardless of wheat varieties, the impact on irrigation schedules on harvest index was significant (P<0.05); and five irrigations, proved to be optimally required irrigation schedules for obtaining higher yields in wheat. In varieties, Sassui surpassed the TD-1 and Raskoh-2005 showing genetic superiority of Sassui over rest of the varieties examined. The LSD test showed that harvest index in varieties Sassui and TD-1 were non-significant (P>0.05), while significant between all rest of the comparable means.

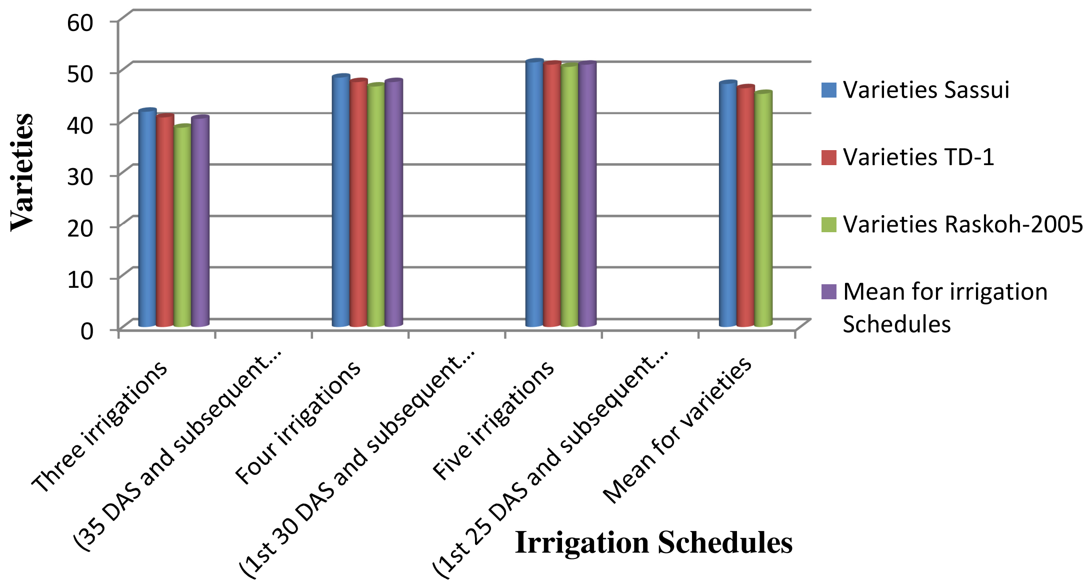

Fig.9 Harvest index (%) of wheat varieties as influenced by irrigation Schedules

DISCUSSION

The results of the present study revealed that crop irrigated five times, resulted 86.206 cm plant height, 402.11 tillers m^{-2}, 12.040 cm spike length, 18.979 spikelets $spike^{-1}$, 47.099 grains $spike^{-1}$, 44.580g seed index, 13732 kg ha^{-1} biological yield, 6999.30 kg ha^{-1} grain yield and 50.95% harvest index; while crop receiving 4 irrigations ranked 2nd and 3 irrigations. Ranked least for all the growth and grain yield traits. Among varieties, Sassui ranked 1st with 96.667 cm plant height, 379.22 tillers m^{-2}, 12.118 cm spike length, 18.494 spikelet's $spike^{-1}$, 44.229 grains $spike^{-1}$, 43.658 g seed index, 12127 kg ha^{-1} biological yield, 5818.80 kg ha^{-1} grain yield and 47.23% harvest index. Variety TD-1 ranked 2nd with grain yield of 5407.4 kg ha^{-1} and Raskoh-2005 ranked 3rd with grain yield of 5014 kg ha^{-1}. It was concluded that crop growth and grain yield were markedly ($P<0.05$) affected in adverse direction due to adoption of irrigation schedules other than five irrigations, while genetically Sassui proved its superiority over TD-1 and Raskoh-2005. These results are in accordance with those of Abd El-Gawad *et al*. (1994) who found that increasing irrigation frequency increased thousand kernel weights; while Khatun *et al*. (2007) reported yield increase with the increased irrigation frequency. Similarly, Alderfasi *et al*. (1999) have reported marked increase in plant height, tillers, seed index, grain yield and biological yields with increased amount of irrigation. In another study on the same aspects, Bunyolo (2000) found that significant improvement in wheat yields with increasing irrigation frequency; while Munyindaa and Bunyoloa (2000) applied irrigations at tillering either on a weekly, every two week, or every three week basis and obtained maximum yields with weekly irrigation. Haj *et al.* (2005) studied effects of irrigation regimes on wheat and reported significant differences were noted regarding these parameters due to irrigation regimes. Significant effects of the water regime were found on all measured traits by Ibrahim *et al.* (2007) and the studies carried out by Khan *et al.* (2007); Lin *et al.* (2007) and Shao *et al.* (2009) indicated that at least four to five irrigations are needed for obtaining desired results in wheat. Considerable research has been carried out by researchers in different parts of the world on the effect of irrigation frequencies on wheat. Gharib *et al.* (2009) evaluated productivity and seed quality of wheat variety (Elnilain) in response to irrigation regimes at 7, 14 and 21 days interval and indicated that seeds produced at irrigation intervals of 7 or 14 days and emphasized the necessity of avoiding the use of seeds that had been under storage for 18 month or more in future wheat cultivation. Similarly, Kabir *et al.* (2009) examined the effect of irrigation level on the performance of wheat cv. Gourab using different levels of irrigations and reported that higher irrigation levels resulted in highest plant height (82.36 cm), total tillers plant-1 (8.99), spike length (8.05 cm), spikelet's spike-1 (15.50), grain yield (2.82 t ha-1), biological yield (6.55 t ha-1) and harvest index (42.43%) were recorded from one irrigation; while better performance was recorded in case wheat cv. Gourab as compared to rest of the varieties. Shao *et al.* (2009) suggested that deficit irrigation applications given to crops in several small amounts were no better than applying them in relatively large quantities, typically as two or even one application. Good soil moisture conditions at sowing also played an important role in achieving high yields of this crop under limited water supply. Zeidan *et al.* (2009) suggested irrigation interval of 15 days during growing seasons; while contradicting the findings of the present study, Ibrahim *et al.* (2011) found that grain production obtained by irrigation was similar under three and four irrigations at 30 days interval but drastically decreased under five and six irrigations at 25 days interval. Was irrigated five times at 25 days interval, rather than four times at 30 days intervals. The study emphasizes the importance, for irrigated wheat, to define irrigation timing and frequency that allow maximal yield and optimal use of irrigation water. These results may be associated with the environmental conditions, soil structure and varieties, when compared with the findings of the present research.

Conclusions

The data concluded that among irrigation schedules five irrigations, produced maximum all the growth and yield traits studied particularly grain yield (6999.30 kg ha^{-1}) as compared to four irrigations and 3 irrigation. Among varieties Sassui gave superior performance particularly grain yield (5818.80 kg ha^{-1}) than TD-1 and Raskoh-2005. Hence Sassui x five irrigation interaction was found most suitable for obtaining maximum grain yield (7444.70 kg ha^{-1}) of wheat.

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