



# EFFECT OF LEAVES REMOVAL IN YIELD AND ITS COMPONENTS OF TWO VARIETIES OF SORGHUM (*SORGHUM BICOLOR* L. MOENCH)

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## Abstract

A field experiment was conducted during Autumn season 2017 in AL-Muthanna University, Agriculture College, Agricultural Experiment and research station which located in Albandar dist (3 km Southwest from AL-Muthanna city) to knowing the effect of the flag leaf removal and the other leaves at flowering as well as control treatment in growth, yield and its components characters of two varieties of Sorghum (*Sorghum bicolor* L. Moench) (Inqath and Rabih). The experiment including study the effect of several treatments L1 (Control), L2 (Flag leaf removal), L3 (removal the flag leaf and the leaf under the flag), L4 (removal the leaf under the flag), L5 (removal the lower leaves), L6 (removal the flag leaf and the lower leaves), L7 (removal the leaf under the flag and the lower leaves). All these treatments were conducted at spike formation stage %50 and the experiment was applied by Spilt-Plot design by using Randomized Complete Block Design (R.C.B.D), Varieties were put in main plots and the treatments in subplots with three replicates and by (42) experimental units, the results summarized as following: Inqath variety significantly exceeded in each of duration from 50% to physiological maturation, plant height 48.81 day, 144.32 cm and it's also gave the best response in the number of grains in head (grain head -1), dry weight (Ton H -1) attained 3866.3 grain head-1, 6.542 Ton H-1, while Rabih variety gave the highest mean to the days' number from planting to 50% flowering and weight of 1000 grain attained 75.57 day and 26.286 gm respectively.

**Key words :** Plant leave removal, sorghum, varieties.

## Introduction

Sorghum crop (*Sorghum bicolor* L. Moench) belong to Poaceae. It was ranked fifth between field crops in Iraq and the world because of its importance, cultured area and production after wheat, barley, rice and corn (Agricultural Statistics Directorate, 2016). The dominant environment condition in the southern regions as high temperature, soil salinity and water scarcity were the limiting factors to culturing some field crops and that leads to culturing highly adopted crops to conquer conditions as sorghum (AL-Tahir, 2012). The most varieties that are currently grown in Iraq are two varieties approved since 2001 these are Inqath and Rabih as long as kafyir, Sorgham cultured in most poor and newly reclaiming soils which are not suitable for culturing other crops (AL-Sadon and AL-Dahry, 2011). The high production of grain crops depending on many factors as the activity of photosynthesis of flag leaf because of its

importance in dry matter production during grain growing and maturation (Jaber, 2003; Kathem, 2015) and when we talking about crop production as we talking about dry matter production and distrusted within the relationship of source and sink, the responsible for this matter production is different parts of plant especially the leaf which it the main factory by the photosynthesis process which occurring mainly on it and on a very limited scale from the steam, since the flag leaf characterized by being the last leaf in the plant from the evolution and aging and its area positively corresponding with dry matter yield so it's being from the limiting factors to determining the growth and productivity of the plant (Khalig *et al.*, 2004; Ali *et al.*, 2010). As well as its importance came from its closely site from the storage places (grain) and its evolution is late and the photosynthesis process still continues unlike almost plant leaves as long as it's the most part exposure to receiving photo because its located in the top of the plant, all these things gave it the great

ability and effect in dry matter manufacture and moving to grain, so this study aimed to determine the contribution percentage of plant leaves removal on dry matter manufacture, yields production and the difference of new varieties from its previous on growth characters under agricultural irrigation conditions in southern Iraq (AL-Muthanna University).

### Materials and Methods

A field experiment was conducted in AL-Muthanna University, Agriculture College, Agricultural Experiment and Research Station, which located in Albandar dist. A randomly samples from soil were taken at depth (0-30 cm) and from different locations, the samples were mixed together to be homogenized, air-dried, softened and passed from sieve with holes 2 mm diameter then a combination samples were taken to make some physical and chemical analysis then some of the physical and chemical characters were analyzed before experiment conducted in water and Doil Department Laboratory in Agriculture college, AL-Muthanna University as shown in table 1 to study the effect of flag leaves and other leaves removal at the flowering on growth and yield of two varieties from sorghum (Inqath and Rabih).

#### The standard characters of the studying

##### Number of days until 50 % flowering

The date of flowering was recorded independent on 50% appearance from anthers in head to 50% from the two middle furrow plants to each experimental unit and for all replicates, the number of days rate was calculated from culturing until 50% flowering (House, 1985).

**Table 1 :** Showed some physicals and chemicals characters to soil of experiment field\*.

Character	Value	Unit
Electrical conductivity Ec	2.2	ds/m <sup>-1</sup>
Available nitrogen	9.8	Mg Kg <sup>-1</sup>
Available phosphor	35	Mg Kg <sup>-1</sup>
Available potassium	250	Mg Kg <sup>-1</sup>
Organic matter	1.1	%
Total amount of salt	3.5	Gm.L <sup>-1</sup>
pH	7.2	—
<b>Soil separators</b>		
Clay	52	%
Sand	49	%
Silt	43	%
Soil texture	Silty clay	

\*These parameters were analyzed at water and soil department laboratory in Agriculture college \ AL-Muthanna university.

##### Number of days from 50% flowering until physiological maturation

This character was calculated by observed the physiological maturation for 10 plants from the two middle lines to each experimental unit by observed black scar under the grain and by the press on grain by the thumb finger and recorded date of this (Saeed and Francis, 1983).

##### The plant height (cm)

The plant height was measured for 10 plants randomly taken from the two middle furrows to each treatment before harvesting starting from the soil surface to head node (House, 1985).

##### Numbers of grains in the head (grain head<sup>-1</sup>)

10 plant randomly taken (that was marked) according to the rate of numbers of grains to heads in these plants after heads break up and cleaning manually.

##### The weight of 1000 grains (gm)

1000 grains were taken randomly from the plant, which was calculated the number of grains to heads on it then its weighted by a very sensitive electronic scale after its manually calculated (House, 1985).

##### The grain yield (Tan H<sup>-1</sup>)

It was evaluated by harvested 10 plants to each experimental unit and the mean of its yield was calculated and multiply in plant density (66.660 plant H<sup>-1</sup>) and then the data converted to Tan H<sup>-1</sup> (Abdullah *et al.*, 2012).

## Results and Discussion

### Number of days from 50% flowering

The result in table 2 shows a significant differences existing of varieties in the number of days from culturing until 50% flowering, Rabih plants significantly exceeded by given the highest mean to this character attained 75.57 day as comparing with the plants of Inqath variety which gave the least men attained 73.81 day, the reason of this differences may be due to genetically variation of the two varieties and to the environment conditions which reflected their differences in this character, which mean there was interaction between genotype and the length of photoperiod and temperature in night and day on determined the date of starting the flower clusters formation and the length of the flowering phase (Ibrahim, 2002) and this agreed with AL-Rawi (2005), AL- Hassani (2007), Mohammed (2017), whose found a significant differences between sorghum varieties in number of days from culturing until 50% flowering.

### Number of days from 50% flowering until physiological maturation

Table 3 shows that there was a significant effect

**Table 2 :** Effect of leaves removal, varieties and interaction between them treatments on number of days from culturing until 50% flowering.

Treatments	Vaireties		
	Rabih	Inqath	Mean
Control treatment	75.67	73.67	74.67
Flag leaf removal	76.00	73.67	74.83
Removal the leaf under the flag	76.00	73.67	74.83
Removal the flag leaf and the leaf under the flag	75.67	74.33	75.00
The lower leaves removal	74.67	73.67	74.17
Removal the flag leaf and the lower leaves	75.67	74.00	74.83
Removal the leaf under the flag and the lower leaves	75.33	73.67	74.50
Mean	75.57	73.81	
L.S.D (005) Value	Treatments	Vaireties	Interaction
	N.S	0.542	N.S

**Table 3 :** Effect of leaves removal, varieties and interaction between them in number of days from 50% flowering until physiology maturation.

Treatments	Vaireties		
	Rabih	Inqath	Mean
Control treatment	50.00	51.33	50.67
Flag leaf removal	49.00	50.67	49.83
Removal the leaf under the flag	49.67	50.67	50.17
Removal the flag leaf and the leaf under the flag	47.67	48.67	48.17
The lower leaves removal	46.33	48.33	47.33
Removal the flag leaf and the lower leaves	45.67	46.33	46.00
Removal the leaf under the flag and the lower leaves	44.33	45.67	45.00
Mean	47.52	48.81	
L.S.D (005) Value	Treatments	Vaireties	Interaction
	0.875	1.229	N.S

among the two varieties (Inqath and Rabih), Inqath variety gave the highest mean attained 48.81 day as compared with Rabih variety which gave mean attained 47.52 day, the reason may be due to the genetic nature of variety and the environment factors and this result agreed with AL-Doogie (2011), Nahaba (2004), AL-Hassani (2007), Mohammed (2017), whose pointed to different of genotypes of sorghum crop to this character, the number of days was corresponding in genotype from the earliness or delay in puberty. The result showed also control treatment exceeded in this character which It took a long time to arrive to this phase which attained about 50.67 day and it never significantly differ from Flag leaf removal treatment, which gave a mean attained 49.38 day whilst the treatment of removal the leaf under the flag and the

lower leaves the least mean and did not significantly differ from the treatment of removal the flag leaf and the lower leaves, which recorded two means attained 45.00 and 64.00 day sequentially the reason of control treatment exceeded during this duration may be due to the presence of whole plant leaves and this leads to continuing the photosynthesis process to a long time from other treatments and that caused to an elongate period of dry matter accumulation in the same time as long as whole parts of plant is presence and this leading to taking a long time to accumulated the dry matter ,the increasing of leaf area and the light exposed area (increasing the area of light exposed surface) resulted to increasing the production of photosynthesis outputs and transferred to the grains that resulted to delayed grains full and its

maturity. In other words, the extension of photosynthesis positively reflected in increasing of dry matter and this result agreed with result of Ahmed (2007).

### **The plant height (cm)**

The result in table 4 shows a significant differences between the two varieties (Inqath and Rabih), Inqath gave the highest mean to this character attained 144.32 cm as comparing with Rabih variety, which gave the least mean attained 132.97 cm, the reason may be due to the interaction between environment factors and the genotypes, which determined the length of stem internodes, this result agreed with Faqira (2001), Al-Rifai (2005), Al-Rawi (2005), Mohammed (2017) whose mentioned to different varieties of Sorghum that used in their experiment on most growth characters and they due to the reason to the difference in genotype and its interaction with environmental influences. The result showed there was no significant effect between leaves removal treatment furthermore the interaction between these treatments and Sorghum varieties there was no significant effecting to the leaves removal treatments in plant height character because these treatments were conducted at lately time that means the plant height relatively complete and this result agreed with Kadhium (2015), who found in his study about the effect of regulation of source-sink relationship of different bread wheat cultivates and Wahib *et al.* (2006) in their studies about the effect of leaves removal at flowering on growth and yield to sorghum crop whose found the plant height character was not affected by the leaves removal.

### **The yield and its ingredients**

#### **The number of grains in the head (Grain Head<sup>-1</sup>)**

The result in table 5 shows a significant effect between the two varieties (Inqath and Rabih), Inqath gave the highest mean to this character attained 3866.3 grain head<sup>-1</sup> as comparing with Rabih variety, which gave the least mean attained 2851 grain head<sup>-1</sup> the difference in the number of grains between varieties may be belonged to the number of flowers, which formed in head which formed grains later and this is maybe due to the genetic nature of the variety because of the number of grains character from the genetically specific characters (Al-Bahadli, 2006) and it differ from genotype to other, this result agreed with Al-Hassani (2007), Al-Tahir *et al.* (2012), Mohammed (2017), whose pointed to the different of genotypes that used in their experiments on the number of head grains and explained that to exceeded some genotype with a large number of flowers in head and the readiness of female members to a long time to receive pollen, also the reason may be due the differences

between the varieties in this character to its variation originally in the length of the head especially the variety that exceeds in the number of grains of the cluster it exceeds also in the length of the head, however, the number of grains in the head from the quantity characters that positively correlated with the genetic factors. The results indicated that the removal of leaves did not have a significant effect on this character although some treatment had increases in the number of grains from control treatment but this increase was not significant that's mean the treatment of leaves removal was not affected on this character, the reason may be due to the number of grains was determined by the second stage of plant growth, which it the vegetation stage (Al-Sahuki, 2002) and the leaf area decreased which affected on supporting of manufacture food compounds to the flowers primordial and this agreed with Vannozzi *et al.* (1999), who finding that the removal of leaves after flowering and almost leaves were arrived to aging stage so it had no any contributed in carbonic synthesis but It may be parasitic and certified in its feeding on other green leaves at the lowest age at the top of the plant and this result agreed with Wahib *et al.* (2006), who found in their study about sorghum crop and Kadhium (2015) in his study about the effect of regulation of source-sink relationship of different bread wheat cultivates and Al-Jobouri and Dirach (2009) in his study about effect of leaves defoliation on growth and yield of sunflower crop (*Helianthus annuus* L.).

#### **The weight of 1000 grain (gm)**

The result of table 6 shows to significant effect between the two varieties Inqath and Rabih, Rabih gave the highest mean to this character attained 26.28 gm, while Inqath gave the least mean attained 24.52 gm, the lately flowering to Rabih variety table (2) gave more time to fill the grain with food prepared in photosynthesis which had positive effect in increasing their weight as long as decrease the number of grain in head to Rabih variety that decrease the competition between grains thus increasing the share of each grain from synthesis substances also may be due to differences between genotypes, this result agreed with similar result to Al-Tahir *et al.* (2012), Mohammed (2017), whose pointed the differences of genotypes of sorghum crops in weight of 1000 grain. The result showed there was a significant difference between treatments in this character, control treatment significantly exceeded on other treatments which gave the highest mean attained 31.33 gm, which not differ significantly from the flag leaf removal treatment which it differs significantly from other treatment, whereas the removal of the flag treatment, removal flag

**Table 4** :Effect of leaves removal , varieties and interaction between them in plant height character (cm) to Sorghum.

Treatments	Vaireties		
	Rabih	Inqath	Mean
Control reatment	133.75	144.38	139.07
Flag leaf removal	133.94	144.24	139.09
Removal the leaf under the flag	132.90	145.54	139.22
Removal the flag leaf and the leaf under the flag	131.34	144.66	138.00
The lower leaves removal	134.03	144.23	139.13
Removal the flag leaf and the lower leaves	132.32	144.23	138.27
Removal the leaf under the flag and the lower leaves	132.52	142.95	137.73
Mean	132.97	144.32	
L.S.D (005) Value	Treatments	Vaireties	Interaction
	N.S	3.200	N.S

**Table 5** :Effect of treatments, varieties and interaction between them in the number of grains in head (Grain Head<sup>-1</sup>).

Treatments	Vaireties		
	Rabih	Inqath	Mean
Control reatment	2841.4	3872.1	3356.7
Flag leaf removal	2857.3	3871.4	3364.3
Removal the leaf under the flag	2853.9	3844.9	3349.4
Removal the flag leaf and the leaf under the flag	2871.8	3925.7	3398.8
The lower leaves removal	2845.3	3874.8	3360.0
Removal the flag leaf and the lower leaves	2844.0	3833.3	3338.7
Removal the leaf under the flag and the lower leaves	2847.2	3842.0	3344.6
Mean	2851.6	3866.3	
L.S.D (005) Value	Treatments	Vaireties	Interaction
	N.S	71.15	N.S

leaf, and the leaf under the flag and removal the middle lower leaves gave a means amount to 24.6, 28.66, 30.667, 28.66 gm, sequentially. While the removal of flag leaf and the lower leaves, removal of the leaf under flag leaf and the lower leaves gave the least means attained (17.66, 16.16 gm) sequentially to this character and this result agreed with Natt and Hofner (1987), whose found that the flag leaf removal caused to decrease the weight of grain by 10-29%, the removal of leaves caused decreasing the weight of grains and this result agreed with Alizadeh *et al.* (2013), whose pointed to that the removal of flag leaf caused noticed decreasing in weight of 1000 grain, that mean the existing of all plant parts in photosynthesis was the main reason to the exceeding of control treatment (without removal of any part) on the other treatments

which including removal part or more from active parts which left its affecting in reducing the weight of 1000 grain to sorghum by different ratio and every part according to its effect and its role in production of dry matter and transfer it to grain as long as its closeness and distance from grain and the existing of this parts in the integrated form means received a large quantity from available photo and used at increasing the activity of photosynthesis and transferred its products (Carbohydrates substances) to the grains that are reflected in the weight of grain (Cruz-Aguado *et al.*, 1999). This result agreed with study of Al- Hamdawi (2017) on wheat crop, or maybe due to the reason of control treatment exceeding to the length of the fill period that given a long chance to accumulating a highly rate of

**Table 6** : Effect of treatments, varieties and interaction between them in the weight of 1000 grain to sorghum crop.

Treatments	Varieties		
	Rabih	Inqath	Mean
Control reatment	32.33	30.33	31.33
Flag leaf removal	29.66	27.66	28.66
Removal the leaf under the flag	31.66	29.66	30.66
Removal the flag leaf and the leaf under the flag	26.00	23.33	24.66
The lower leaves removal	28.66	28.66	28.66
Removal the flag leaf and the lower leaves	17.00	15.33	16.16
Removal the leaf under the flag and the lower leaves	18.66	16.66	17.66
Mean	26.28	24.52	
L.S.D (005) Value	Treatments	Varieties	Interaction
	0.7655	0.5421	1.0314

**Table 7** : Effect of treatments, varieties and interaction between them in the grains yield character to sorghum crop (Tan H<sup>-1</sup>).

Treatments	Varieties		
	Rabih	Inqath	Mean
Control reatment	7.48	8.15	7.81
Flag leaf removal	6.52	7.88	7.20
Removal the leaf under the flag	6.94	8.06	7.50
Removal the flag leaf and the leaf under the flag	6.06	7.43	6.74
The lower leaves removal	4.17	5.55	4.86
Removal the flag leaf and the lower leaves	3.01	4.17	3.59
Removal the leaf under the flag and the lower leaves	3.75	4.55	4.15
Mean	5.42	6.54	
L.S.D (005) Value	Treatments	Varieties	Interaction
	0.1992	0.1362	0.2679

dry matter in grains which positively reflected on weight increasing of grain (tables 2 and 3). The results showed a significant differences in grain weight of the studied varieties under the effect of one treatment and between treatments, but the biggest effect of increasing grain weight that belongs to control treatments and the flag leaf removal was with Rabih variety, whilst the biggest effect that produced by removal of other leaves treatment was with Inqath variety, this clearly indicates the actual interaction between genetic factor (variety) and environment factor (treatments) as the combination (Rabih variety  $\times$  Control treatment) gave the highest mean to this character attained 32.33 gm without any significant differences with combination (Inqath variety  $\times$  the flag leaf removal) while the combination (Inqath variety  $\times$

removal the flag leaf and the lower leaves) gave the least mean to this character attained 15.33 gm and we perhaps reverted the interaction to individual factors and we can revert the reason of mentioned combination exceeded to what is mentioned in the discussion of factors, which are individual.

#### The Grain yield (Tan H<sup>-1</sup>)

The result in table 7 shows a significant effect between the two varieties (Inqath and Rabih), Inqath gave the highest mean to this character attained 6.54 Tan H<sup>-1</sup> as comparing with Rabih variety, which gave the least mean attained 5.421 Tan H<sup>-1</sup>, the reason to exceeding the variety in this character may be due to it originally exceeded in dry weight of plant, also may be due to a

significant increasing, which obtained in numbers of grains in head which exceed the decreasing in weight of 1000 grain (6) with the stability of the third yield of component (number of plants in area unit) and this result agreed with Al-Asadi (2004), Nahaba (2004), Al-Bahadli (2006), Al-Tahir *et al.* (2012), whose pointed to the different of genotype that used in their experiment in grain yield character. The result pointed to exceeding of control treatment on all other treatments in grain yield which gave the mean attained 7.81 Tan H<sup>-1</sup> and its not differ significantly from removal the leaf under the flag and flag leaf removal treatments, which they recorded means attained 7.50 Tan H<sup>-1</sup> and 7.20 Tan H<sup>-1</sup>. Sequentially, whilst flag leaf removal and the under leaves treatment which not differs from the under flag leaf removal and the lower leaves least means the least means attained 3.59 Tan H<sup>-1</sup> and 4.15 Tan H<sup>-1</sup>. Sequentially the reason maybe due to grains yield of plant to its exceeded in the grain weight character which is the one of the main components of yield and this result agreed with Birsin (2005) and Alam (2008), whose pointed in their study on wheat crop that the removal of flag leaf caused a significant decreasing in grains yield because of the decreasing in weight of grain per head, this result agreed with Khaliq *et al.* (2004) and Ahmadi *et al.* (2009) and Al-Hamdawi (2017) whose explained the removal of flag leaf caused decreasing the yield because of decreasing of metabolizable substances which reflected to gave the least means of yield, also it agreed with Balkan *et al.* (2011) and Alizadeh (2013) whose mentioned to the removal of flag leaf caused a significant decreasing in grains yield Tan H<sup>-1</sup>. The result showed there was a significant effect of the interaction between the treatments and varieties of sorghum crop in weight of 1000 grain, all combination exceeded by gave the higher means but the highest mean recorded in the combination (Control treatment × Inqath variety), (removal the leaf under the flag leaf × Inqath variety), (flag leaf removal × Inqath variety), which recorded the higher means attained 8.15 Tan H<sup>-1</sup>, 8.06 Tan H<sup>-1</sup> and 7.88 Tan H<sup>-1</sup>, while the combination (removal of flag leaf and the lower leaves treatment × Rabih variety), which was not differ significantly from combination (removal the leaf under the flag and the lower leaves treatment × Rabih variety) recorded the least means attained 3.01 Tan H<sup>-1</sup> and 3.75 Tan H<sup>-1</sup>, the reason for grains yield exceeded with mentioned combination may be due to the same reasons that discussing the individual factors.

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