Iran. J. Ichthyol. (Special Issue 1, 2022): 83-87

P-ISSN: 2383-1561; E-ISSN: 2383-0964
http://www.ijichthyol.org

Research Article

Effect of ratoon cropping of sorghum cultivars on the tillering contributing on the forage and grain yield

Rzan Z.A. Al-BEIRUTY*, Adawiya S. AL-RAWI, Saddam H. CHEYED

Collage of Agricultural Engineering Science, University of Baghdad, Baghdad, Iraq.

Email: albeiruty@coagri.uobaghdad.edu.iq

Abstract

A field experiment was conducted in the fieduring the fall season of 2017 to investigate the effect of ratooning cropping and its contribution to the green forage and grain yield of five sorghum cultivars viz. Inqath, Lilo, Ishtar, Bohooth, and Caffier. The results showed that the cultivars differed in most of the studied traits. The cultivar Bohooth-70 produced the highest average of the field establishment, a number of tillers, and total grain yield. The cultivar Caffier plants were superior in the number of the additional tillers and the contribution percentage to the green forage yield. The results also revealed that the cultivation method affected significantly the studied traits. The plants of ratoon were superior to those of sowing seeds as they produced the highest average of the total and an additional number of tillers, as well as the green forage yield. The regular cultivation method showed advantage in grain yield producing the lowest percentage of the empty heads. The interaction showed a greater response of the green forage using the ratoon cropping.

Keywords: *Sorghum*, Field establishment, Apical dominance, Tillers.

Citation: Al-Beiruty, R.Z.A.; Al-Rawi, A.S. & Cheyed, S.H. 2022. Effect of ratoon cropping of sorghum cultivars on the tillering contributing on the forage and grain yield. Iranian Journal of Ichthyology 9(ICAB Special issue 2022): 83-87.

Introduction

Sorghum *Sorghum bicolor* L. is one of the important cereal forage crops as a multiuse. It is considered a multi-use crop as it is used as cereal feed, green forage, silage, or hay for feeding livestock and poultry. Sorghum is among the crops capable to grow and initiate tillers after harvesting with preserving the high quality compared to the corn and thus providing more harvests during the summer season with low fiber content. It is described as an annual crop of highly good quality forage products (Banks 2005).

Tillering is an essential morphological component enhancing the sorghum yield as it affects light interception, water use, grain yield, and plant competition as well as the other physical and physiological processes (Srirama et al. 2006). Tillering is a desirable trait for compensating the losing plants caused by different reasons. Increasing tillers of the field have a role in compensating for the yield deficiency and improving yield in the area unit that could be happened for some forage crops such as sorghum and cereal crops such as wheat, rice, and barley. It also contributes directly to increasing the grain yield (Khush 1999). Although the tillering in sorghum is low compared to the other cereal crops, it affects the leaf area development significantly (Lafarge et al. 2002). Generally, there are 0-4 fertilized tillers in the sorghum cultivars (Hammer et al. 1993); however, the tiller number can be increased as a result of cutting the main stem that stops the apical dominance depending on the cutting date, cut height, and the sorghum genotype (AL-Dulaimi 2012).

Recent researches indicate the importance of the ratoon cropping of sorghum in terms of production and economy, as following this approach produces

twice the amount of the grain yield (Jassam et al. 2016) which in turn is affected by the cultivar and the growing season (El-Fahdawi et al. 2019). Since it succeeds in the spring-fall season in contrary to the fall-spring season where the ratooning is useless (Cheyed et al. 2014). The formed tillers may not be active to give yield, or they produce poor heads that do not contribute to the yield significantly instead, their influence plant negatively as a result of depleting the nutrient elements and competing with the active tillers for the light and other growth requirements. According to the above-mentioned background, this study aimed to investigate the tillering effects of five sorghum cultivars cultivated by the regular and ratoon method.

Materials and methods

A field experiment was conducted in the experimental fields of the department of Crop fields-College of Agriculture in the fall season of 2017 to investigate the response of sorghum cultivars (Inqath, Lilo, Ishtar, Bohooth-70, and Caffier) to the ratoon cropping. The treatments were distributed according to the Randomized Complete Block Design (RCBD) comprised three replicates within the order of split plots. The main plots involved the ratoon cropping (spring-fall ratoons) for the sorghum cultivars while the sub-plots involved the sorghum cultivars. Having the land prepared, it was divided into experimental units sized 3x2. Seeds of the sorghum cultivars were planted, during both spring and fall seasons at the plant density of 133300 plants ha^{-1}, in rows distanced from each other by 50cm leaving a 15cm distance between the pits. Fertilizers were applied according to the recommendations of the Iraqi Ministry of Agriculture. The experimental units were planted on 2/4/2017 for the spring season. At the harvest maturity, the plants were cut at 7-10cm height to protect the new buds and left to the following season for ratooning the sorghum. After the ratoon plants had been cut, the seeds were sown and irrigated on 22/7/2017.

The field establishment was calculated by dividing the actual number of plants by the standard plant density multiplying by 100. Each of the total tiller numbers, additional tillers (tillers.m^{-2}), total forage yield (t.ha^{-1}), contribution percentage of the additional tillers (%), and empty head percentage (%) were calculated. The obtained data were analyzed statistically using the GenStat software relying upon the least significant difference (L.S.D) at probability level 0.05.

Results and discussion

There was a difference between the two cultivation methods e.g. ratoon cropping and regular sowing during the fall season in the field establishment percentage. The regular planting method showed an average field establishment of 83.80%, higher than the ratooning method (79.53%). This difference may be due to the failure of some plants during the spring to produce sorghum ratoons and construct tillers leading to reducing the number of plants per unit of area compared to the direct planting (Table 1). The results also showed that the difference between the genotypes, cultivation method, and the interaction between them was not significant.

Total tillers number: The cultivar Bohooth-70 showed the highest average of the total tillers as 19.00 tillers.m^{-2} and the two cultivars Inqath and Lilo showed the lowest number of the total tillers. The difference between cultivars is due to the genetic differences that control this trait. Moreover, Bohooth-70 is among the forage cultivars capable of producing more sprouts. This result is in agreement with that of Alwan (2014) showing significant differences between sorghum cultivars in producing tillers.

A significant increase in the number of tillers was found in the ratoon cropping that gave 21.40 tillers.m^{-2} compared to the regular cropping that was 12.47 tillers.m^{-2}. This increase is due to get riding from the apical dominance as a result of cutting the main stem. Mohammedi (2015) also showed the superiority of ratoon cropping in giving numbers of tillers higher than plants sowed directly. The

Table 1. Field establishment and number of tillers affected by the cultivation methods in the sorghum cultivars**.**

Cultivars (CV.)	Field establishment (%)			Total tillers number (tillers.m^{-2})		
	Cultivation method (C)		Means	Cultivation method (C)		Means
	Ratoon	Sowing		Ratoon	Sowing	
Inqath	76.67	80.00	79.00	18.00	12.00	15.00
Lilo	80.67	82.67	82.17	19.33	11.67	15.50
Ishtar	83.33	87.67	86.33	22.33	13.00	17.67
Bohooth70	88.33	92.67	88.17	25.00	13.00	19.00
Caffier	68.67	76.00	79.06	22.33	12.67	17.50
Mean	79.53	83.80		21.40	12.47	
LSD 0.05	CV.	C	CV.×C	CV.	C	CV.×C
	N.S	3.76	N.S	1.25	0.28	1.59

Table 2. Number of plant tillers and additional tillers per meter affected by cultivation method of the sorghum cultivars.

Cultivars (CV.)	Additional tillers number (tillers.m^{-2})			Total green forage yield (t.ha^{-1})		
	Cultivation method (C)		Means	Cultivation method (C)		Means
	Ratoon	Sowing		Ratoon	Sowing	
Inqath	7.25	1.34	4.29	2.68	0.46	1.60
Lilo	8.18	0.65	4.41	2.67	0.23	1.45
Ishtar	10.56	1.31	5.94	3.26	0.49	1.87
Bohooth70	12.69	0.65	6.67	7.61	0.51	4.06
Caffier	12.11	2.54	7.32	4.77	1.41	3.09
Mean	10.16	1.30		4.20	0.62	
LSD 0.05	CV.	C	CV.×C	CV.	C	CV.×C
	1.47	0.32	1.86	0.51	0.30	0.66

interaction between the cultivation method and cultivars showed that the interaction between Bohooth-70 and ratoon cropping produced the highest number of tillers (25.00 tillers.m^{-2}) while all cultivars that were planted regularly (sowing seeds) produced the lowest number of tillers.

Number of the additional tillers: The results showed a significant difference between the sorghum cultivars in the number of the additional tillers (Table 2). Both Caffier and Bohooth-70 produced the highest number of additional tillers, 7.32 and 6.67 tillers.m^{-2}, respectively. The difference between the cultivars in this trait is due to the genetic factors controlling the trait; furthermore, the Caffier and Bohooth-70 are characterized by the high capability of producing vegetative growth than others. The results also showed a significant increase in the number of the additional tillers as a result of using the ratoon cropping method producing 21.40 tillers.m^{-2} on average while the regular method gave about half of this number (12.47 tillerd.m^{-2}). The increase in the number of tillers in the ratooning is due to the elimination of apical dominance as a result of cutting the main stem. Concerning the interaction between the cultivation method and the cultivars, the highest value was obtained from the interaction of Bohooth-70 and Caffier planted in the ratoon cropping method producing 12.69 and 12.11 tillers.m^{-2}, respectively while all other cultivars, except Caffier, planted by the regular method (sowing seeds) gave lower value.

Total green forage yield: The highest yield of the green forage was 4.06t.ha-1 in Bohooth-70 followed by Caffier (3.09t.ha^{-1}). This is because of the ability of the forage cultivars to produce more tillers (Table 1) reflecting positively on increasing the green forage (Table 2). Also, the ratoon cropping gave a green forage yield of 4.20t.ha^{-1}, which is higher than the regular planting by 577.42% on average. This difference is due to the high increase in the number of tillers produced by the ratoon cropping compared to the regular cultivation (Table 1) (Al-Mohammedi 2015). The interaction between Bohooth-17 and ratoon cropping showed the highest yield of the green forage as 7.61t.ha^{-1}.

Table 3. Contribution percentage of the tillers to the green forage and empty heads affected by the cultivation methods of the sorghum cultivars

Cultivars (CV.)	Tillers contribution percentage to the green forage yield (%)			Empty heads (%)		
	Cultivation method (C)		Means	Cultivation method (C)		Means
	Ratoon	Sowing		Ratoon	Sowing	
Inqath	39.9	10.1	24.5	17.0	5.0	11.0
Lilo	38.2	5.4	21.8	20.0	7.7	13.8
Ishtar	42.5	9.2	25.9	23.0	5.3	14.2
Bohooth70	44.6	4.4	24.5	37.4	2.7	20.0
Caffier	48.3	18.6	33.4	42.5	3.7	23.1
Mean	42.5	9.5		28.0	4.9	
LSD 0.05	CV.	C	CV.×C	CV.	C	CV.×C
	7.0	1.8	N.S	1.2	1.6	16.1

Table 4. Grain yield and the contribution percentage of the tillers to it affected by the cultivation methods of the sorghum cultivars.

Cultivars (CV.)	Grain yield (kg.m^{-2})			Tillers contribution to the yield (%)		
	Cultivation method (C)		Means	Cultivation method (C)		Means
	Ratoon	Sowing		Ratoon	Sowing	
Inqath	0.728	0.618	0.673	33.3	10.1	21.7
Lilo	0.646	0.565	0.606	33.7	5.1	19.4
Ishtar	0.551	0.620	0.586	36.4	9.2	22.8
Bohooth70	0.385	0.842	0.613	31.8	4.6	18.2
Caffier	0.335	0.552	0.444	31.2	19.1	25.2
Mean	0.529	0.640		33.3	9.6	
LSD 0.05	CV.	C	CV.×C	CV.	C	CV.×C
	0.033	0.039	0.046	N.S	N.S	8.78

Contribution percentage of the tillers to the green forage: The Caffier had the highest contribution of the tillers to the green forage (33.4%) and Lilo recorded the lowest of tiller contribution to the green forage yield (21.8%) (Table 3). The results also showed that the tillers from the ratoon cropping contributed forage yield of 42.5% compared to the regular cultivation method where the tiller contributed to the green forage was 9.5%. The advantage of Caffier and ratoon cropping in the contribution of the tillers to the green forage is due to the high number of the produced tillers (Table 1).

Empty heads: This trait is associated directly with the grain yield as not all head-bearing tillers contribute to the grain yield, but only the tillers that bear active heads filled with seeds. The cultivar Inqath produced the least empty heads not exceeding 11.0% while the Caffier produced the highest empty head (23.1%) followed by Bohooth-70 (Table 3). The regular cultivation gave the lower empty heads 4.9% compared to the ratoon cropping (28.0%). This is due to the advantage of the cultivar Caffier and the ratoon cropping in the number of tillers that increased the competition for the growth inputs that made these tillers not able to produce fertilized flowers unlike the Lilo and Inqath (El-Fahdawi et al. 2019).

Grain yield: The cultivar Inqath showed the highest grain yield averaged as 0.673kg.m^{-2} compared to the other cultivars where grain yield was 0.444kg.m^{-2} in the Caffier. The regular cultivation method also showed the highest average grain yield as 0.640kg.m^{-2}. The interaction of planting the Bohooth-70 regularly produced the highest grain yield as 0.842kg.m^{-2} followed by 0.728 kg.m^{-2} in the Inqath and the ratoon cropping method. The lowest interaction was 0.335kgm^{-2} in the cultivar Caffier grown by ratoon cropping method followed by the cultivar-70 with the same cropping method. The Inqath is one of the cultivars that respond greatly to ratoon cropping in comparison to the forage cultivars

such as Bohooth-70. El-Fahdawi et al. 2019) also pointed out that the regular cultivation led to the advantage of the Inqath in the grain yield.

Conclusion

Sorghum cultivars differ in their capability of tillering and producing green forage or grain yield. The cultivars of the Inqath, Lilo, and Ishtar tend to produce a lower number of vegetative tillers or grain yields than the Bohooth-70 and Caffier. Moreover, when the target is the green forage, ratoon cropping is distinguished from the regular method of cultivation but, the regular cultivation method is preferred when the grain yield is the target. However, the contribution of the additional tillers to the green forage is a great deal distinguished in the ratoon cropping. Nonetheless, it is observed from the interaction between the sorghum cultivars and the cultivation method that the seed cultivars are more responsive than the forage cultivars to the ratoon cropping method.

References

AL-Dulaimi, N.M.A. 2012. The Effect of Seed Soaking with pyridoxine, height and stages cutting in Yield, forage quality and HCN Content of *Sorghum bicolor* L. Moench. Ph.D. Thesis College of Agriculture, University of Anbar.

Al-Mohammedi, A.M.S. 2015. Effect of Production Style and Nitrogen Fertilization on Growth and Yield of Sorghum. M.Sc. Thesis. Faculty of Agriculture, Baghdad University. 78 p.

Alwan, A.L. 2014. Hormonal Regulation of Tillering in Sorghum (*Sorghum bicolor* (L.) Moench). MSc. Thesis College of Agriculture, University of Baghdad.

Banks, S. 2005. Annual forage for grazing or stored feed. Food and rural affairs, OMAFRA, forage web site, Ontario.

Cheyed, S.H.; Al-kubaisy, M.I. & Motlag, N.A. 2014. Effect of nitrogen and potassium fertilizers on seed yield and its components of sorghum ratoon. Iraqi Journal of Agricultural Ministry of Agriculture 19(6): 111-120.

El-Fahdawi, W.A.T.; El-Jubouri, M.D.; Cheyed, S.H. &Al-Rawi, A.M. 2019. The influence of irrigation deficit and ratoon cultivation pattern sorghum cultivars on 1-grain yield of sorghum. International Journal of Agricultural and Statistical Sciences 15(2): 575-583.

Hammer, G.L.; Carberry, P.S. & Muchow, R.C. 1993. Modeling genotypic and environmental control of leaf area dynamics in grain sorghum. I. Whole plant level. Field Crops Research 33: 293-310.

Jassam, K.T.; Ali, I.H.; Cheyed S.H. & Naif S.H. 2016. Financial analysis of sorghum crop planted by ratoon method. Association of Genetic and Environmental Resources. The 4th International Scientific Congress. Cairo, Egypt, 4(2): 11-18.

Khush, G.S. 1999. Green revolution: preparing for the 21st century. *Genome* 42: 646-655.

Lafarge, T.A. & Hammer, G.L. 2002. Tillering in grain sorghum over a wide range of population densities: modelling dynamics of tiller fertility. Annals of Botany 90: 99-110.

Srirama, R.; Krishnareddy, B.A.; Stewart, W.A.; Payne Robinson, C.A. & Thomason, R.C. 2006. Tillering in dry land grain sorghum clumps as influenced by light, planting density and geometry. Journal of Crop Improvement 26-28.