J. Agric. Sci. Mansoura Univ., 27 (1): 61 - 69, 2002

TRITICALE AS A MULTICUT CROP FOR FORAGE AND GRAIN

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ABSTRACT

Triticale (*X. Triticosecale Wittmack*) is the first man-made cereal crop that can be simultaneously used for forage and for grain. Three successive cuttings with no grain yield, one and two cuttings plus grain yield were obtained. The removal of triticale was affected by the number of tillers and leaf area values, whereas, high forage yield was influenced by the number of tillers and leaf area value. Forage removal reduced number of tillers / m², spikes / m², number of kernels / spike and grain yield.

Crude protein, ether extract, ash and digestable crude protein were decreased by the cutting frequency, in contrast with crude fiber, nitrogen free extract and organic matter which increased in values by the cutting frequency.

Insito dry matter and *insito* organic matter disappearance in the second cut were lower in values than in the first for all tested cultivars with no significant differences between all cultivars, indicating more nutritive value for the first cutting forage yield.

INTRODUCTION

Triticale (*X. Triticosecale Wittmack*) is a relatively new cereal crop could be used simultaneously for forage and grain production. It was produced by doubling the chromosomes number of the sterile hybrids that resulted from crossing tetraploid wheat (*Triticum sp.*) and diploid rye (*Secale sp.*). A major thrust was provided when Zillinsky (1985) hybridization, embryo culture and colchicine treatment to produce a primary hexaploid triticale from the cross 'Stewart' durum (*Triticum turgidum L.*) x 'prolific' rye (*Secale cereal L.*).

In Egypt, some triticale cultivars were competitive and higher production in grain yield than some wheat and barley under different conditions, especially in the newly reclaimed areas. In addition, some cultivars showed good rheological properties and acceptable dough mixing performance, indicating that, good bread could be obtained from pure triticale flour, (Abdel-Galil, 1995). The name triticale is a combination of the names of the two genera involved, triticum and secale. The plant breeders have attempted to produce fertile off spring from wheat and rye sence 1815 when Wilson reported to the Botanical Society of Edinburgh that he had grown a sterile plant from a wheat x rye cross, (Varughese *et al.,* 1987).

The objective of such cross was to combine the quality and productivity of wheat with the disease resistance, vigor and hardiness of secale, (Briggle 1969). Triticale can be used simultaneously for forage and grain production, it could be grazed one or two times during the early stages of growth (prior to jointing) and later to allow to produce grain yield (Garcia Del Moral, 1992).

Even though, triticale was developed as a food grain, it has more potential as a feed for ruminants and nonruminants (Briggle 1969, Knipfel 1969, Longnecker 1973 and Poysa 1985).

When triticale used as a forage crop, it has been found to have higher forage potential and protein content than Oats and higher forage and silage yields than wheat, rye and barley (Varughese *et al.,* 1987). This investigation was carried out to evaluate the ability of the triticale cultivars to be used either as a multicut forage crop or a double perpous crop for forage and grain.

MATERIALS AND METHODS

During 1998 – 1999 and 1999 – 2000 seasons, five cultivars of hexaploid triticale (Bahtem-1, Bahtem-2, Jhuan, imported Strain-2 and imported Strain-7) were evaluated either for forage production only or forage production plus grain yield at Giza Exp. Res. Station and Ismailia Res. Station where the chemical analysis and nutritive value of triticale were carried out. The cultivars were planted on November 1st each year of testing in fertile soil. Each cultivar was sown in adjusted density of 40 kg/fed., in six rows, 4 m long with 0.20 cm interrow spacing. All plots were fertilized uniformly with 30 unit of nitrogen per fed. Prior to the first irrigation after planting, and 30 unit after each cut, and 15 kg/fed. P_2O_5 and K_2O prior to planting.

Three systems of cutting were compared (S_1), one cutting plus grain yield (S_2), two cuttings and grain yield and (S_3), three cuttings and no grain yield.

The experimental design was a split plot, replicated three times with cultivars as main plots and cutting treatments as subplots, least significant differences (LSD) was used. The first cut was attained on Jan. 7th, the second cut on Feb. 22nd prior to the tillering stage and the third cut on March, 30th.

The grain yield of the first and second treatments were harvested on April, 20th. Ten plants were randomly selected to estimate leaf area per plant. Accordingly, at the harvest time, kernels per spike (as a mean of the ten randomly plants) and number of spikes per square meter were recorded. The green forage yield and the grain yield were recorded as a yield of 4.8 m^2, then estimate as a yield of feddan. Dry matter yield was estimated of approximately 0.5 kg green samples prior the cutting time. Chemical composition of crude protein (CP), crude fiber (CF), ether extract (EE), ash, nitrogen free extract (NFE)), organic matter (OM) and digestability were determined.

Representative samples were obtained from all cultivars for *insitu* dry matter disappearance (ISDMD) and *in situ* organic matter disappearance (ISOMD) determinations, according to Mehrez and Orskov (1977) as 2 g of air dry forage milled through 2.0 mm screen placed in each of nylon bags (6 $\times$ 12 cm) prepared from polyester cloth (41 mm. pore size). The nylon bags were incubated for 48 h in the rumen of two buffalo bulls fitted with permanent rumen canula. Four bags of each cultivar were used (two bags incubated in each bull).The analysis of variance were made, using MSTAT-C computer program.

RESULTS AND DISCUSSION

I. Performance of cultivars:

Means of fresh yield, dry yield (t/fed) number of tillers (m^2), leaf area/plant (cm^2) and grain yield over two years are presented in Table (1).

The analysis of variance showed significant differences between the five cultivars of triticale in all studied traits. The data obtained indicated that, the three cultivars Bahtem-1, Bahtem-2 and Jhuan had no significant differences among each other ($P > 0.05$) and they were significantly higher than the two imported cultivars (Strain-2 and Strain-7). Bahtem-1 recorded the highest fresh and dry yield in each cut. The first clipping had the highest yield, either fresh or dry for all cultivars and the yields were decreased by the frequency of clipping.

Number of tillers / m^2 were significantly declined in relation to the number of cuttings indicating lower production of green forage and lower number of tillers-bearing spikes after each cut. Leaf area / plant significantly decreased after cuttings. It is probably due to the expected reduction of number of tillers and the green leaf area surface per leaf. Similar results have been reported by Dunphy *et al.* (1982) and Sharow (1990).

The result indicated that the green forage yield were affected by the number of clippings, where, the yield of each cut was reduced as a result of the reduction of the traits controlled the forage yield (No. of tillers and leaf area). These results were in agreement with the findings of Garcia Del Moral (1992), who indicated that, forage removal in proportion to the number of cuttings, mainly reduced the number of tillers with spikes at harvest. Also the leaf area / plant showed significant loss due to cuttings due to the decrease in the number of leaves per plant and the green area per leaf, this caused similar decreases in the leaf area.

Table (2) presents the total dry yield for different systems of cutting in the two growing seasons (1998 – 1999 and 1999 – 2000) and its combined. The data obtained indicated significant differences between the three systems of clipping in both years and their combined.

The removal of the areal part of triticale sequentially three times (S_3), exhibited significant higher production than the other two systems in both years and their combined.

The combined analysis showed slightly significant differences among the five cultivars, where, Bahtem-1 produced the highest dry yield (2.39 ton/fed) and the imported strain-7 was the lowest (1.93 t/fed).

Grain yield, was significant diminished by the frequency of forage removal for all cultivars in different systems. Bahtem-1 was the highest productive cultivar (2.57 and 1.13 t/fed), Table (3).

1Table (2). Total dry yield for different systems of cutting and its combined

No	FY/fed.				DY/fed.				No. of Till / m²			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
Bahtem-1	1.57	2.30	2.70	2.19a	1.88	2.73	3.15	2.59a	1.72	2.52	2.92	2.39a
Bahtem-2	1.50	2.37	2.73	2.20a	1.78	2.81	3.06	2.55a	1.64	2.59	2.90	2.38a
Jhuan	1.53	2.13	2.47	2.04a	1.65	2.45	3.07	2.39a	1.59	2.29	2.77	2.22ab
Strain-2	1.20	1.80	2.43	1.81b	1.63	2.52	2.88	2.35ab	1.42	2.16	2.66	2.08bc
Strain-7	1.37	1.90	2.17	1.81b	1.58	1.70	2.87	2.05b	1.48	1.80	2.52	1.93c
Mean	1.43c	2.10b	2.50a	2.01	1.71c	2.44b	3.01a	2.39	1.57c	2.27b	2.75a	2.20
L.S.D.$_{0.005}$	V.	0.217			0.324				0.1788			
	Treat.	0.096			0.125				0.0774			
	V × T	0.215			0.279				0.1731			

Table (3). Grain yield and some studied traits of yield components in relation to the number of cuttings over two years.

Cult.	Treat	Grain yield t/fed	No. Spikes/m²	No. Kernels/spike
Bahtem-1	S_1	2.73a	306.17a	72.50a
	S_2	1.13d	224.17d	61.93d
	S_3	-----	-----	----
Bahtem-2	S_1	2.10b	298.50abc	69.33b
	S_2	0.94e	224.83d	55.58e
	S_3	----	-----	-----
Jhuan	S_1	2.07b	301.50ab	70.27b
	S_2	1.00de	205.17e	55.25ef
	S_3	----	-----	-----
St. 2	S_1	1.49c	283.33c	65.28c
	S_2	0.74f	194.00e	53.78ef
	S_3	----	----	----
St. 7	S_1	1.44c	287.17bc	63.42c
	S_2	0.68f	206.17e	53.05ef
	S_3	-----	-----	----

*** Values with the same letters are not significant.**

Similar reduction appeared for number of spikes / m² and kernels / spike, where these traits were significantly declined in relation to the number of cuttings, Table (3). This results were similar with those recorded by Abdel Gawad and Iskander (1998) who recorded that, grazing wheat tended to reduce grain and straw yields and yield components. Two cuts of green triticale as forage plus grain yield could be obtained, the grain yield was significantly decreased by the frequency of cutting, (Mosa 1991).

Decreases in grain yield were mainly attributed to a reduced number of spikes / m² at harvest. The timing and the number of cuttings could affect forage production and grain yield in triticale as mentioned by Brignall *et al.* (1988), Poysa (1985), Dunphy *et al.* (1982) and Milthorpe and Davidson (1966).

II. Chemical Composition and Nutritive Value

Significant different values (P < 0.05) were found between the tested cultivars in different cuttings for the measured components. Crude protein, ether extract, ash and digestible protein were high in the first cutting and decreased by each successive clipping (Table 4). Bahteam-2 recorded the highest values for the previous components in each clipping.

Table (4): Means of chemical analysis for the three cuts over the two seasons.

Variety	Cuts	Chemical Components						
		CP%	CF%	EE%	ASH%	NFE%	OM%	DCP%
Bahtem-1	I	23.7e	27.7b	2.6b	15.9b	30.1a	84.2a	18.0e
Bahtem-2		27.3a	25.6c	2.9a	16.5s	27.1bc	83.5b	21.9a
Jhuan		25.9b	27.2b	2.7b	16.6s	27.6b	83.4b	19.9b
St_2		24.8d	27.4b	2.5c	15.6b	29.8a	84.4a	18.9d
St_7		25.3c	28.4a	2.8a	16.8a	27.0c	83.3b	19.4c
Bahtem-1	II	18.4b	28.2b	1.9ab	10.9bc	39.bc	89.1a	13.1bc
Bahtem-2		21.0a	28.3b	1.9a	11.0b	38.4d	89.0ab	15.4a
Jhuan		17.2c	29.8a	1.8ab	11.8a	39.4c	88.2c	12.0d
St_2		18.2b	28.3b	1.8ab	10.8bc	40.4b	88.7abc	12.9c
St_7		18.9b	28.2b	1.7b	10.4c	42.1a	88.4bc	13.6b
Bahtem-1	III	9.1d	33.16b	1.4d	8.5d	47.9a	91.6b	4.7d
Bahtem-2		10.7a	32.3	1.4cd	7.6e	48.0a	92.4a	6.1
Jhuan		8.9e	35.0a	2.6a	8.7c	44.8c	91.4c	4.5e
St_2		10.2b	33.4b	1.6b	9.7a	45.1b	90.3e	5.6b
St_7		9.5c	32.1b	1.5c	9.0b	47.9a	91.0d	5.0c

*** Values with the same letter are not significant**

Crude fiber, nitrogen free extract and organic matter were increased by the clipping frequency. The data obtained were in agreement with the findings of Brown and Almodares (1976). Insito dry matter disappearance (ISDMD) and insito organic matter disappearance (ISOMD) for the first and second cuttings are presented in Table (5). The date show insignificant differences between the tested cultivars (P > 0.05) in two cuttings. The values were high in the first cutting and decreased in the second cutting for both ISDMD and

ISOMD. However, the average values for the two cuttings indicated slightly higher nutritive value of Bahtem-2 than the other cultivars, due to its high crude protein, low crude fiber, high ether extract and digestible crude protein.

Table (5). ISDMD and ISOMD of the five cultivers of triticale

Varieties	ISDMD			ISOMD		
	1st cut	2nd cut	Average	1st cut	2nd cut	Average
Bahtem-1	71.06	70.16	70.61	71.91	72.09	72.00
Bahtem-2	71.32	70.88	71.10	72.27	72.59	72.43
Jhuan	70.88	69.30	70.09	71.21	71.20	71.21
St. 2	68.12	67.13	67.63	69.88	68.29	69.09
St. 7	68.40	68.39	68.36	69.92	69.98	69.95

The data obtained show increased concentration of lignified fiber accumulation in the structural framework of the tested cultivars. Hence, high digestable energy and protein values is expected for the first cutting forage yield than the second cutting yield, whereas, the first cutting yields were low in crude fiber for all cultivars. High lignin content is associated with low digestability of feed nutrients (Sulivian 1955).

In conclusion, the data presented here suggest that although, triticale as the first man-made cereal was produced mainly as a cereal crop, it could be used as a double purpose crop, giving the grower the alternatives to have either green forage only or green forage plus grain yield. The results indicated that forage removal in triticale affects the final grain yield, mainly due to the reduction of the number of tillers with spikes at harvest. Grain yield after forage removal in large part, influenced by the ability of the cultivar to recover and develop new tillers of high leaf area value.

The main features in the new triticales developed for dual purposes of forage and grain production, should be a higher capacity for tillers and for leaf area development in the period after forage removal.

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الترتيكال كمحصول متعدد الحشات للعلف والحبوب

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الترتيكال محصول حبوب يمكن إستخدامه كمحصول متعدد الحشات لانتاج العلف الاخضر أو لانتاج العلف الاخضر بالإضافة للحبوب• نتائج هذا البحث تشير إلى إمكانيه الحصول على ثلاث حشات علف أخضر دون حبوب، كما يمكن الحصول على حشه واحده أو حشتين بالإضافه إلى محصول الحبوب•

محصول العلف الاخضر تأثر معنوياً بعدد الاشطاء فى المتر المربع ومساحه سطح الورقه ، كما أدى الحش المتكرر لنقص عدد الاشطاء فى المتر المربع، عدد السنابل فى المتر المربع، عدد الحبوب فى السنبله بالإضافه إلى إنخفاض محصول الحبوب وكانت الفروق للصفات السابقه معنويه بين الاصناف والسلالات المختبره فى نظم الحش المختلفه•

وقد أظهرت النتائج تفوق ألأصناف بهتيم -١، بهتيم ٢، خوان معنوياً على السلالات المستورده رقم ٢، رقم ٧ ولم تكن الفروق معنويه بين بهتيم ١ ،وبهتيم ٢، حوان وذلك لصفتى المحصول الاخضر والجاف•

كما أظهرت النتائج فروقاً معنويه بين الاصناف والسلالات لصفات عدد الاشطاء، مساحه سطح الورقه، عدد السنابل، عدد الحبوب فى السنبله ومحصول الحبوب خلال نظم الحش المختلفه•

نسبه البروتين الخام، الزيت، الرماد والبروتين المهضوم إنخفضت معنوياً بتكرار الحش بينما زادت معنوياً نسبه الالياف والنتروجين الحر والماده العضويه بتكرار الحش • وأظهرت تجارب التغذيه على الجاموس عدم وجود فروق معنويه بين الاصناف للمأكول فى الحشه الاولى والثانيه وأنخفضت معدلات الهضم للماده الجافه والماده العضويه بتكرار الحش ، وقد حقق الصنف بهتيم ٢ أعلى معدل هضم للماده الجافه أو العضويه•

J. Agric. Sci. Mansoura Univ., 27 (1): 61 - 69, 2002

Table (1): Means of fresh yield (FY t/fed), dry yield (DY t/fed) and some studied traits in relation to three cuts over two years.

No	FY/fed.				DY/fed.				No of Till / m²				Leaf area / Plant (LA cm^2/plant)			
	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean
Bahtem-1	10.62	7.98	6.12	8.24a	1.72	1.25	0.98	1.32a	374.3	309.1	256.8	313.4a	201.5	177.9	166.6	182.0b
Bahtem-2	10.40	7.88	6.07	8.12a	1.64	1.29	0.96	1.30a	314.5	281.1	241.1	278.9b	206.7	188.2	166.2	187.0b
Jhuan	10.40	7.38	5.80	7.86a	1.60	1.15	0.93	1.22a	334.7	280.2	242.3	285.9b	215.7	192.0	166.2	191.3a
Strain-2	8.98	6.75	5.8	7.18b	1.42	1.08	0.90	1.13b	303.3	258.8	237.7	266.6c	214.0	192.4	172.7	193.0a
Strain-7	9.73	6.20	5.57	7.17b	1.48	0.90	0.84	1.07b	302.8	241.0	226.1	256.6d	188.4	164.3	154.6	169.1c
Mean	10.03a	7.24b	5.87c	7.71	1.57a	13b	0.92c	1.21	325.9	274.0	240.8	280.2	205.3a	182.9b	165.3c	184.49
L.S.D. 0.005 V.	0.49				0.09				8.1				7.8			
Treat.	0.22				0.05				4.07				2.7			
V × T	0.51				0.10				9.11				5.9			