مجلة جامعة تشرين للبحوث والدراسات العلمية _ سلسلة العلوم البيولوجية المجلد (30) العدد (5) 2008
Tishreen University Journal for Research and Scientific Studies - Biological Sciences Series Vol. (30) No. (5) 2008

Forage Potential of Triticale in Mixtures with Forage Legumes in Rainfed Regions (Second and Third Stability Zones) in Syria.

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(Received 12 / 10 / 2008. Accepted 2/12/2008)

□ ABSTRACT □

Two experiments designed in a randomized complete block were conducted to investigate the potential of triticale as the sole forage crop and in mixtures at two sites in north-west of Syria's Mediterranean environment, using triticale (x.*Triticosecale* Wittmack), barley (*Hordum sativum* L.), common vetch (*Vicia sativa* L.) and grasspea (*Lathyrus sativus* L.) monoculture as well as in mixtures in one seeding ratio (1:1), during 2006/2007. Data of fresh and dry matter, legumes contribution in mixtures, relative yield total (RYT) and competitive ratio (CR) showed that the booting stage is the optimum harvesting date for triticale as a sole crop or in mixture. RYT values exceeded unity in cut 2 in the two sites, whereas the contrary was observed at cut1. Legume proportions were better in triticale mixtures in both sites and cutting dates. CR values indicated that triticale is less competitive in mixtures than barley. Cereals were more competitive than legumes.

Key words: forage, monoculture, mixtures, triticale, barley, grasspea, common vetch, relative yield total, competitive ratio, Mediterranean environment.

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مجلة جامعة تشرين للبحوث والدراسات العلمية _ سلسلة العلوم البيولوجية المجلد (30) العدد (5) 2008
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القدرة الكامنة للتريتيكالي (*x.Triticosecal* Wittmack) في نظام الزراعة المختلطة مع البقوليات العلفية في المناطق البعلية (استقرار ثانية وثالثة) من سوريا

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(تاريخ الإيداع 12 / 10 / 2008. قبل للنشر في 2008/12/2)

□ الملخّص □

نُفذ البحث في موقعين شمال غرب سوريا: تل حديا (استقرار ثانية)، وبريدة (استقرار ثالثة)، وفق تصميم القطاعات العشوائية الكاملة باستخدام محصولين نجيليين: تريتيكالي (*x.Triticosecale* Wittmack) وشعير (*Hordum sativum* L.)، ومحصولين بقوليين: بيقية (*Vicia sativa* L.) وجلبان (*Lathyrus sativus* L.) بمعدل بذر 1:1 في الزراعة المختلطة، خلال الموسم الزراعي 2007/2006، لدراسة إنتاجية المادة الخضراء والجافة، والنسبة المئوية للبقوليات في معاملات الخلط مع النجيليات، وإجمالي الغلة النسبية RYT ومعامل التنافس في موعدي الحش، حيث تبين أن الموعد الأمثل لحش التريتيكالي كمحصول منفرد أو مختلط مع البقوليات هو مرحلة الحبل. تجاوزت قيم RYT في موقعي التجربة الواحد الصحيح في موعد الحش الثاني، في حين لوحظ العكس في الموعد الأول، وكانت النسبة المئوية للبقوليات في معاملات خلط التريتيكالي متفوقة معنوياً على معاملات خلط الشعير في كل من موقعي التجربة وموعدي الحش. كان التريتيكالي أقل منافسةً من الشعير لدى خلطه مع البقوليات. وعموماً كانت النجيليات أكثر منافسةً من البقوليات في الزراعة المختلطة.

كلمات مفتاحية: الزراعة المختلطة، تريتيكالي، شعير، بيقية، جلبان، إجمالي الغلة النسبية، معامل التنافس.

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Introduction:

Cereals and legumes are considered as an important forage crops, because of these nutritional value especially protein content in legumes and crude fiber in cereals. Monocultures of legumes or cereals do not provide satisfactory results for forage production (Osman and Nersoyan, 1986). Legume crops are low-yielding, particularly in areas with low rainfall (Hadjichristodoulou, 1978) and hinder harvest because they normally lay on the soil surface (Robinson, 1969). On the other hand, small grain cereals provide high yields in terms of dry weight but they produce forage with low protein (Lawes and Jones, 1971). Forage quality of cereal hay is usually lower than that required to meet satisfactory production levels for many categories of livestock. In recent years, there has been increased interest in agricultural production systems in order to achieve high productivity and promote sustainability over time, such as crop rotation, relay cropping, and intercropping of annual cereals with legumes. Intercropping of cereals with legumes has been a common cropping system in rain-fed areas and especially in the Mediterranean countries (Papastylianou, 1990; Anil et al., 1998; Lithourgidis et al., 2004; Lithourgidis et al., 2006).

In mixtures, companion cereals provide structural support for legumes growth, improve light interception, and facilitate mechanical harvest, whereas legumes improve the quality of forage (Robinson, 1969; Thompson et al., 1992). Other benefits of mixtures include greater uptake of water and nutrients, enhanced weed suppression, provides better lodging resistance, and increased soil conservation (Stern, 1993; Ranells and Wagger, 1997; Vasilakoglou et al., 2005), yield stability (Lithourgidis et al., 2006), hay curing, and forage preservation over pure legumes and may increase crude protein percentage, protein yield, and length of optimum harvest period over grasses (Qamar et al., 1999; Carr et al., 1998). On the other hand, intercropping legumes crops with small-grain cereal crops can be an effective way to improve forage quality and nutritive value of the crop (Ross et al., 2004). Potential benefits of intercropping include increased total DM (Reynolds et al., 1994; Ghaffarzadeh, 1997; Holland and Brummer, 1999; Izaurralde et al., 1993), N contributions from legumes. This culture practice is particularly well suited for silage production. The best relationships between yield and quality were generally obtained when the cereal reached boot stage and the legume reached the flowering stage (Carnide et al., 1998).

In the Mediterranean countries, one of the legumes extensively used in intercropping with cereals is common vetch (*Vicia sativa* L.), an annual legume with a climbing growth habit and high levels of protein (Thomson et al., 1990; Anil et al., 1998). A number of different cereals have been proposed to be appropriate for intercropping with common vetch such as barley, oat, triticale and wheat (Caballero and Goicoechea, 1986; Thompson et al., 1992; Lithourgidis et al., 2006). Moreover, Caballero and Goicoechea (1986) and Thomson et al., (1990) reported that the most suitable cereal for mixtures with common vetch is oat (*Avena sativa* L.), whereas Thompson et al. (1992) and Roberts et al. (1989) reported that barley (*Hordeum vulgare* L.) and wheat (*Triticum aestivum* L.) respectively, are the most suitable cereals for mixtures. However, Anil et al. (1998) reported that triticale (x.*Triticosecale* Wittmack) can be used as an alternative cereal for mixtures with common vetch.

The results of Lauriault and Kirksey (2004) indicated that intercropping with pea (*Pisum sativum* L.) or hairy vetch (*Vicia villosa* L.) reduced yield of wheat and triticale compared with monocultures, but these yields were still greater than those of the other cereal forages, and winter pea improved quality indicators when intercropped with wheat or triticale. Studies by Blade et al. (2002) at four locations found variable yield performance for barley and triticale in mixtures with peas. Yields depended on location and site yield potential. Although results were variable at different locations, including peas in the mixture usually increased the protein content in the harvested silage; this sometimes came at the expense of silage-yield-per-unit-area. Depending on conditions, spring triticale intercropped with peas may yield as well as triticale does by itself. However, the pea content in the silage usually results in a significant increase in the protein content as compared to that found when triticale is grown alone (Blade et al., 2002). Hall and Kephart (1991) found that seedling population in triticale-pea intercrops were well correlated with target ratios, indicating that any lack of emergence was consistent across component forage. And they found that when mixtures of triticale contained 60% or more peas, they had higher dry matter yields and net profit than mixtures containing less pulse, but only when harvested at the boot to milk stages of the triticale.

Jedel and Helm (1993) found that intercropping oat with pulse crops produced greater DM yield than intercropping barley or triticale (x *Triticosecale* rimpaui Wittm.) with pulse crops, but intercrops with barley or triticale gave a better combination of quality and protein content than intercrops with oat. And they concluded that if the choice of a pulse-cereal mixture is for high quality with maintenance of protein content, mixtures with barley or triticale should be selected over those with oats.

In a study of berseem clover intercropped with one cultivar each of oat, barley, or triticale, biomass yields, species composition, and forage quality were affected by cereal species. Berseem clover intercrops with triticale and oat had greater Cut1 silage-stage yields and a greater percentage of berseem clover in Cut 1 than intercrops with barley. Moreover, triticale had advantages to barley and oat of greater silage yield when intercropped with berseem clover (Ross et al., 2004).

Mixtures where triticale was the cereal showed an advantage over mixtures with other cereals (barley and oats) in overall quality due to a higher proportion of legume in the forage crop harvested (Benbelkacem and Zeghide, 1996). This du to the more upright growth habit of triticale compared to oats and barley. Another study was carried out in Syria, Aleppo (Jazraia), to evaluate quality and quantity of triticale and barley when intercrop with vetch. The results of this study showed that the forage of triticale-vetch mixture was higher than barley-vetch mixture (Al-Yousif, 2000).

Several factors can affect growth of the species used in intercropping, including cultivar selection, seeding ratios, and competition between mixture components (Droushiotis, 1989; Roberts et al., 1989; Papastylianou, 1990; Caballero et al., 1995; Carr et al., 2004). Studies of cereal intercrops in Alberta have found that triticale and wheat were less competitive in mixtures than were barley and oat (Berkenkamp and Meeres, 1987).

Objects and justifications:

Triticale may be useful in marginal areas to enhance feed resources in animal production zones, in addition to supply forage in winter when other sources are not available. Moreover, as cereal-legume mixtures can improve forage quality and quantity, it is felt important to study triticale potential as a sole crop and in mixtures. Therefore, two experiments were conducted to investigate the potential of new introduced triticale line monoculture as well as mixtures with legume crops for forage yield at different growth stages at different environmental conditions.

Materials and methods:

Plant material:

One triticale line (line No. 14), one local barley cultivar (Arabic aswad), common vetch (line 2604) and grasspea (line 554) were used in this experiment. All these lines obtained from International Center for Agricultural Researches in Dry Areas (ICARDA).

Locations:

The experiments were conducted during growing season 2006-2007, at two sites belong to ICARDA in north-west of Syria which characterized by Mediterranean conditions: Tel Hadya (TH) (second stability zone) and Breda (BR) (third stability zone). Climatic data during the study period are shown in figure (1).

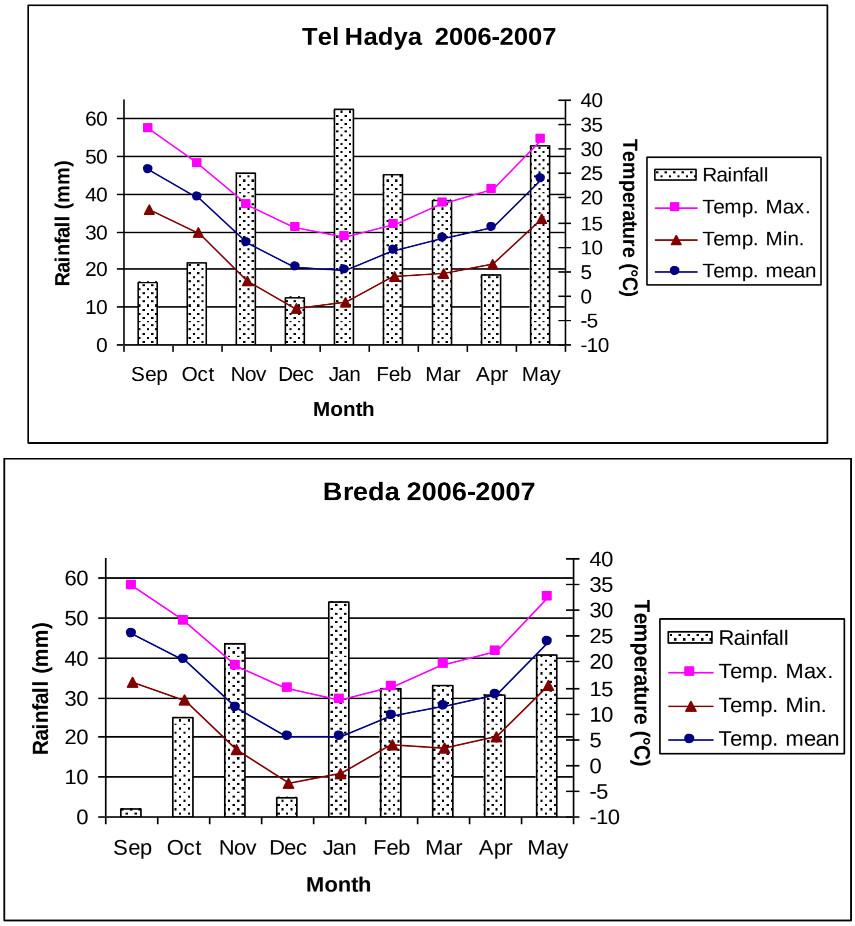

Fig.1 Monthly temperature and rainfall for each experiment at the two sites. Lines join means of maximum (squares), mean (circles), and minimum (triangles) temperature.

Crop management and experimental design:

Seedbed preparation included plowing, disk harrowing and cultivation. The mentioned plant material monocultures as well as mixtures (cereals and legumes) in one seeding ratio (50:50) based on seed weight, were sown within the middle of December in both of the two sites at a seeding rate of 130 kg/ha for cereals, and 160 kg/ha for legumes.

Seeds in mixture treatments were mixed and sown together. The experimental design comprised a randomized complete block (RCBD) with eight treatments (four monocultures and four mixtures). The experimental plots were 1.6 m wide X 2.5 m long (eight rows, 20 cm apart), with three replications for each treatment.

Treatments:

Eight treatments were applied: pure triticale (TCL), pure barley (BAR), pure common vetch (VET), pure grasspea (GRP), triticale + common vetch (TCLBVET), triticale + grasspea (TCLBGRP), barley + common vetch (BARBVET), barley + grasspea (BARBGRP).

Observations:

Pure stands and mixtures were harvested at two growth stages (stem elongation, booting and maturity) according to Zadock`s et al., (1974). At each stage, four rows of each plot were cut to ground level with manual shears, and separated by hand for determination of fresh weight for cereals and legumes percentage in each mixture. The samples were dried in the oven at 70˚C to a constant weight to determine the relative water content.

Relative yields of the four species were calculated as a ratio of yields in mixture to yield in monoculture. The RYT (the sum of both relative yields) was used as the criterion for mixed stand advantage as both legumes and cereal were desired species. The value of unity is the critical value for RYT. When the RYT value is greater than one, it means that the intercropping favored the growth and yield of that species. In contrast, when the RYT value is lower than 1, then intercropping negatively affected the growth and yield of the plants grown in mixtures (Mead and Willey, 1980; Caballero et al., 1995). The RYT was calculated as:

$RYT = RY_{cereal} + RY_{legume}$, where:

$RY_{cereal} = (Y_m X_{cl+le} / Y_{cl})$, $RY_{legume} = (Y_m X_{le+cl} / Y_{le})$.

Where Y_m is the dry matter yield of mixture, Y_{le} and Y_{cl} the dry matter yields of legumes and cereal, respectively, as sole crops, X_{le+cl} is the actual dry matter proportion of legume (as measured at harvest) in mixture with cereal, and X_{cl+le} is the actual proportion of cereal in mixture with legume.

Also, competitive ratio (CR) is another way to assess competition between different species, and gives a better measure of competitive ability of the crops. The CR represents simply the ratio of individual land equivalent ratio (LERs) of the two component crops and takes into account the proportion of the crops in which they are initially sown. The CR is calculated according to the following formula:

$$CR_{cereal} = (\frac{LER_{cereal}}{LER_{legume}})(\frac{Z_{lc}}{Z_{cl}}), \quad CR_{legume} = (\frac{LER_{legume}}{LER_{cereal}})(\frac{Z_{cl}}{Z_{lc}})$$

Where Z_{lc} is the proportion of legumes in mixtures with cereals, Z_{cl} is the proportion of cereals in mixtures, LER_{legume} is land equivalent ratio for legumes, and LER_{cereal} is land equivalent ratio for cereal. The LER_{legume} and LER_{cereal} were calculated as:

$$LER_{legume} = (\frac{Y_{le+cl}}{Y_{le}}), \quad LER_{cereal} = (\frac{Y_{cl+leg}}{Y_{CL}})$$

Statistical analysis:

Standard analysis of variance was used to analyze the data obtained. Data were analyzed across both sites. The *F* estimates were directly obtained by the general linear model procedure of the GenStat10 package, and then differences between means were compared based on the *F*-test. Means were compared by least significant differences (LSD) when *F*-test indicated significant.

Results and discussion:

Results:

1. Fresh and dry weight of green forage:

Table (1) shows the mean values of fresh and dry weight for the defoliated forage at the two cutting stages in the both sites.

Table 1. Fresh and dry matter produced by pure triticale, pure barley, and their mixtures with common vetch and grasspea at two sites in north-west of Syria.

	Cut 1 (Stem elongation)				Cut 2 (Booting)			
	Fresh weight		Dry weight		Fresh weight		Dry weight	
	TH	BR	TH	BR	TH	BR	TH	BR
TCL	18538	10020	3517	1992	40433	13203	11692	5240
BAR	22457	10340	4353	2388	31423	9842	11283	4413
VET	9282	5163	2150	1375	35107	7837	7073	3147
GRP	8175	4303	1690	1120	27875	6728	5790	2678
TCLBVET	18612	7860	3207	1975	43205	9240	10958	4020
TCLBGRP	18267	7087	3255	1720	40415	9910	11395	4460
BARBVET	24512	10418	4087	2408	38318	10748	11645	4858
BARBGRP	24803	10750	4365	2500	36575	10495	11418	5033
Mean	18081	8243	3328	1935	36669	9750	10157	4231
Probability #	S ***; T ***; S x T ***		S ***; T ***; S x T ***		S ***; T ***; S x T **		S ***; T ***; S x T ***	
LSD S #	2913.9		450.4		3532.4		886.7	
LSD T #	1975.6		264.5		3348.5		758.1	
LSD SxT #	3461.3		501.7		5142.9		1203.7	
CV	12.7		8.5		12.2		8.9	

S: Site; T: Treatment; S x T: site-treatment interaction; * significant <0.05; **significant<0.01; ***significant<0.001; ns: non-significant.

1.1 Cutting at stem elongation (Cut 1):

The greatest value of fresh weight was obtained from barley-grasspea mixture (24803 and 10750 Kg ha^{-1}) in Tel Hayda and Breda respectively, and followed by barley-vetch mixture (24512 Kg ha^{-1} in Tel Hadya and 10418 Kg ha^{-1} in Breda). The same trend was observed for the dry weight, where barley-grasspea provided the greatest value in Tel Hadya (4365 Kg ha^{-1}) and Breda (2500 Kg ha^{-1}). In general, pure triticale and barley and their mixtures were better than pure legumes in the both sites. (Table 1).

It was observed that the fresh and dry weight in Tel Hadya were better than Breda. The mean values averaged (18081 and 3328 Kg ha^{-1}) for fresh and dry weight respectively in Tel Hadya, whereas in Breda the mean of fresh weight was (8243 Kg ha $^{-1}$) and the dry weight was (1935 Kg ha $^{-1}$). (Table 1).

1.2 Cutting at booting (Cut 2):

In the contrary of the first cut, pure triticale and its mixtures with common vetch and grasspea in Tel Hadya had the greatest fresh green forage yield which were (40433, 43205, and 40415 Kg ha $^{-1}$) respectively. The differences between both triticale and barley and pure legumes were statistically significant. For the dry weight, the greatest value was obtained from pure triticale which ranged from (11692 Kg ha $^{-1}$) in Tel Hadya to (5240 Kg ha $^{-1}$) in Breda. However, similar to the first cut, the treatments yield in Tel Hadya surpassed the yield values in Breda for both fresh and dry weight.

2 Relative yield total (RYT):

The mean values of relative yield total for the studied treatments in both sites are presented in table (2).

Table 2. Relative yield total of triticale and barley in their mixtures with common vetch and grasspea at two sites in north-west of Syria.

	Cut 1 (Stem elongation)		Cut 2 (Booting)	
	TH	BR	TH	BR
TCLBVET	0.69	0.45	2.4	0.72
TCLBGRP	0.62	0.32	2.50	1.00
BARBVET	0.88	0.45	2.64	1.12
BARBGRP	0.88	0.45	2.44	1.17
Mean	0.77	0.42	2.50	0.98
Probability #	S **; T *; SxT ns		S***; T ns; SxT ns	
LSD S #	0.183		0.211	
LSD T #	0.125		0.42	
LSD SxT #	0.209		0.531	
CV	16.7		19.2	

S: Site; T: Treatment; S x T: site-treatment interaction; * significant <0.05; **significant<0.01; ***significant<0.001; ns: non-significant.

2.1 Cutting at stem elongation (Cut 1):

Table (2) shows that the values of relative yield total for triticale and barley mixtures with common vetch and grasspea in the two sites were less than one. Barley mixtures characterized by its superiority in the mean values for this parameter (0.88) over triticale ones (0.69). The values of relative yield total in Tel Hadya (0.62 to 0.88) were greater than Breda (0.32 to 0.45).

2.2 Cutting at booting (Cut 2):

The relative yield total of the mixtures exhibited an increasing trend in the second cutting (Table 2). However, in this cutting date RYT exceeded unity, and the greatest value (2.64) was obtained in Tel Hadya from barley-common vetch mixture, followed by (2.5) for triticale-grasspea mixture with non-significant differences between them, while the differences were statistically significant between the mean values in Tel Hadya (2.5) and Breda (0.98).

3 Legumes contribution (LEG %):

Proportion of common vetch and grasspea intercropped with triticale and barley were differed significantly among cutting dates and between both sites (Table 3).

Table 3. The effect of common vetch and grasspea intercropping with triticale and barley on legumes contribution at two sites in north-west of Syria.

	Cut 1 (Stem elongation)				Cut 2 (Booting)			
	TH		BR		TH		BR	
	GRP %	VET %	GRP %	VET %	GRP %	VET %	GRP %	VET %
TCLBVET	–	26.76	–	28.51	–	25.39	–	21.45
TCLBGRP	14.62	–	20.72	–	11.98	–	18.26	–
BARBVET	–	14.48	–	15.24	–	14.19	–	12.62
BARBGRP	6.74	–	10.30	–	5.68	–	11.37	–
Probability #	S*; T***; SxT ns				S ns; T***; SxT **			
LSD S #	2.326				1.723			
LSD T #	3.672				2.76			
LSD SxT #	4.747				3.562			
CV	17				14.5			

S: Site; T: Treatment; S x T: site-treatment interaction; * significant <0.05; **significant<0.01; ***significant<0.001; ns: non-significant.

3.1 Cutting at stem elongation (Cut 1):

Table (3) shows that the legumes percentages (common vetch and grasspea) in mixtures treatments with cereals (triticale and barley) which were calculated on dry weight basis, were greater in triticale mixtures than barley ones. The greatest value was obtained from common vetch percentage in its mixture with triticale (28.5 and 26.76 %) in Breda and Tel Hadya respectively, followed by grasspea percentage in triticale-grasspea mixture in Breda (20.72%) and Tel Hadya (14.62 %), whereas the values of this parameter reduced in barley mixtures. In fact, the legumes contribution was greater in Breda than Tel Hadya especially for grasspea mixtures.

3.2 Cutting at booting (Cut 2):

Similar trend was observed in the second date, where the percentage of common vetch in its mixture with triticale recorded the greatest values (25.39 and 21.45 %) in Tel Hadya and Breda respectively, followed by grasspea contribution (18.26 %) in Breda and (11.98 %) in Tel Hadya. However, common vetch and grasspea contributions when mixed with triticale were better significantly in comparison with their mixtures with barley.

4 Competitive Ratio (CR):

The results of the competitive ratio for cereals and legumes crops in mixtures treatments are shown in table (4).

Table 4. Competitive ratio for mixtures of triticale and barley with common vetch and grasspea at two sites in north-west of Syria.

	Cut 1 (Stem elongation)				Cut 2 (Booting)			
	TH		BR		TH		BR	
	cereal	legume	cereal	legume	cereal	legume	cereal	legume
TCLBVET	1.71	0.61	1.79	0.56	1.80	0.56	2.42	0.46
TCLBGRP	2.91	0.36	2.31	0.45	3.74	0.28	2.41	0.42
BARBVET	2.92	0.35	3.22	0.31	3.87	0.26	4.89	0.21
BARBGRP	5.42	0.19	4.17	0.24	8.84	0.12	4.82	0.21
Probability #	S ns; T***; SxT *				S ns; T***; SxT***			
LSD S #	0.228				0.643			
LSD T #	0.458				0.777			
LSD SxT #	0.626				1.127			
CV	22.6				12.9			

S: Site; T: Treatment; S x T: site-treatment interaction; * significant <0.05; **significant<0.01; ***significant<0.001; ns: non-significant.

4.1 Cutting at stem elongation (Cut 1):

The data presented in table (4) revealed that barley was more competitive than triticale when they mixed with common vetch and grasspea. This results can be explained by the mean values of the competitive ratio for barley in its mixture with grasspea (5.42) in Tel Hadya and (4.17) in Breda. On the other hand, the mean values of competition ratio for triticale in its mixture with grasspea recorded (2.91) in Tel Hadya and (2.31) in Breda, whereas this values in triticale-common vetch mixture ranged from (1.71) in Tel Hadya to (1.79) in Breda.

4.2 Cutting at booting (Cut 2):

Mean values of this parameter show that cereals became more competitive than legumes in the second cutting date in comparison with the first one. The same trend was observed in cut 2 in terms of superiority of barley in competitive ratio value which was in barley-grasspea mixture (8.84) in Tel Hadya, while triticale recorded (3.74) when mixed with grasspea in the same site. The differences between the values of this parameter were lower in Breda than Tel Hadya. Although cereals were more competitive than legumes in mixtures, it was observed that common vetch was more competitive than grasspea.

Discussion:

The obtained results revealed that triticale is a crop which can be used as a sole crop or in mixture system with forage legumes, but it is felt important to determine the optimum date for cutting, which has an important role in terms of the effect on fresh and dry matter yield. It was observed that booting stage is the optimum date for forage defoliated in triticale, as a result of producing the greatest forage yield from monoculture and intercropping systems, where the forage yield of triticale as a sole crop was surpassed barley one about 15.8 % in Breda, and this result is in agreement with (Juskiw et al., 2000; Hall and Kephart, 1991; Ross et al., 2004; Baron et al., 1992; Jedel and Salmon, 1995). Moreover, this result was supported by the values of relative yield total which exceeded unity in both sites during booting stage, and this case indicates an advantage from intercropping over monocultures in terms of using the environmental resources for plant growth (Mead and Willey, 1980; Karadag and Buyukburc, 2004). Although the values of RYT in Breda was more one, it is still less than Tel Hadya. However, the superiority of barley over triticale in fresh and dry matter yield during the first cutting date in both of monoculture and mixtures; can be interpreter by the vigor growth of barley in the early stages of its life-cycle in comparison with triticale.

On the other hand, legumes contribution (dry matter basis) in triticale mixtures were better than barley ones in both sites and cutting dates, where it recorded 28.5 % for common vetch in its mixture with triticale, it was 15.2 % in barley-common vetch mixture. In addition, this result promoted by the lower values of the competitive ratio for triticale in the mixture treatments in comparison with the values that recorded by barley. However, the smaller effect of triticale on growth rate of common vetch and grasspea than that of barley, however, could be explained by the lower competitive ability of triticale compared to that of barley (Dhima and Eleftherohorinos, 2001; Dhima et al., 2007) which resulted in greater contribution of legumes in triticale mixtures. Moreover, the CR values of cereals exhibited an increasing trend from the first cutting date through the second one, while the contrary was observed in CR of legumes which decreased, indicating the dominance of cereals under these crop mixtures. This increasing in CR values for cereals caused decreases in the legumes percentage in the mixture, because of the greater growth rate of cereals and using the environmental resources better than legumes (Hadjichristidoulou, 1976).

Pure stands and mixtures of cereals gave higher fresh and dry matter yield compared with common vetch and grasspea pure stand and with mixtures in both sites and during the two cutting dates. On the other hand, growth habit of legumes in mixture treatments was better than monocultures, as a result of cereals support which avoid legumes laying on the soil surface. However, the forge yields that recorded by common vetch and grasspea in mixture treatments is in agreement with (Anil et al., 1998; Thomson et al., 1990) which consider this two crops of the important crops in mixture systems.

Conclusion:

The results of this study clearly indicate that triticale characterize by its superiority over barley in terms of producing grater forage yield at booting stage as a sole crop or in mixture with forage legumes in the both sites. Forage yield was higher in cereals-legumes mixtures than monoculture in Tel Hadya, while the contrary was observed in Breda for triticale mixtures yield which was less than triticale monoculture. The greater forge yield in Tel Hadya for pure stand and mixture of both cereals and legumes can be attributed to the better conditions in Tel Hadya than Breda. The RYT exceeded unity in the second cutting date indicating the advantage of intercropping at this date over monoculture system, as a result of exploiting the environmental resources. The greater contribution of legumes was found when common vetch and grasspea were mixed with triticale than barley. This result promoted by the lower values for the competitive ratio of triticale than barley in mixture treatments.

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