Indicators to determine the usefulness of mixed and pure culture systems of triticale (*X Triticosecale.* Wittmack) and green pea (*Lathyrus sativus* L.) in rainfed conditions of Iran

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Abstract: To evaluate the yield quality and quantity of forage cultivation and green pea mixture Triticale Experimental Agricultural Research Station, University of Lorestan in agricultural 2007-2008 (November 23) as a randomized complete block design (RCBD) in dry conditions with four replications and five levels (seed ratio) pure stand and mixture of triticale: green pea (100:0), (0:100), (80:20) (60:40) and (40:60) was executed. Initial results of analysis of variance showed superior component mixture 60:40 (Triticale:green pea) on forage production and utilization of environmental resources (LER) was such that this treatment (combination of seed) in the Partial Land Equivalent Ratio and Total Land Equivalent Ratio dominant the other treatments were. In Relative Crowding Coefficient (RCC) top treatments, seed ratio was 80:20, as well as seed mix 60:40 (Triticale: green pea) in terms of system productivity index (SPI) superior to other combinations was the seed.

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Introduction

Multiculture techniques rooted in the history of human civilization, and are considered the traditional methods, using such methods in optimal production factors have a fundamental role, and today many researchers have been considered, this definition is as follows Planting more than one plant in one year and a piece of farm land. Advantages of mixed cultures can increase productivity and efficiency yield compared with pure stand cited. In addition, mixed cultures led to a balance of food soil, risk of cultivation, due to the loss of a product by improved use of limited resources and reduce soil erosion and increase yield is stability (Anil *etal*,. 1998 and Dapaah., *etal*. 2003). Cultivated cereal and scrambled Legume often high efficiency compared to pure stand it is (Ofori and Stern, 1987), because each of the plants in mixed culture with many different types of food needs are (Willey, 1979). The mixed culture legume with non Legume, due to the use of different sources of nitrogen is very valuable (Cho and colleagues, 2004) because the grains may get more minerals from the soil, but must compete Legumes If there are bacteria capable of stabilizing Rhizobium are nitrogen. Assefa and Ledin (2001) showed that mixed cultures with vetch and oat and Triticale in seed different ratios, growth rates and forage quantity and quality will affect, so that in normal mixed cultures vetch:oat, in comparison 35:65 Rate exploited seed environmental conditions and increased forage yield little more than seed ratio 35:65 vetch:triticale, but the yield of crude protein (CP) in all seed ratios in mixtures vetch-oat and triticale increased. Jones and Arous (1999) showed that monoculture system may cause soil nutrient depletion, increased pest and weed populations will be. Thus, monoculture system, leading to reduced yield and farmer's income is. Therefore, a stable and profitable option should be replaced by a single system, which through the cultivation of Legume with the grain in many semi-arid regions of the world benefit has been introduced (Vasilakoglou *etal*. 2005). Hossein *etal* (2003) to evaluate the different planting patern of cultures on bean and pearl millet yield in mixed cultures in concluded that pearl millet yield to treatment increased 20% belong to mixed results and in front of the beans plant has been defeated in the mixture, the land Equivalent Ratio (LER) of equal in mixed cultures showed that 20% increase in yield 32% more than a pure stand. Majnoun Hosseini *etal* (2003) showed that different ratios mixed cultures of sorghum with Legumes significantly increased forage dry and fresh weight, especially in two rows of sorghum- one row Legume, but Legume type had no significant effect on forage yield but not on all the properties have significant effects on forage quality. Since nowadays need for forage (animal food) and indirect role in human nutrition more than ever before in our country (Iran) are

feeling, with the aim of this study using various combinations to achieve maximum forage cutting and a very valuable role in the mixed system in soil conservation and creating sustainable agriculture systems in product manufacturing climate Khorramabad was executed.

Materials and methods

Field experiment in cropping year 2007-2008 (November 23) in Agricultural Research Station, University of Lorestan, a randomized complete block design (RCBD) in four replications and five levels (ratio of seed) including single culture and mixed of triticale:green pea (100:0), (0:100), (80:20) (60:40) and (40:60) as mixed cultures with maximum density of triticale and green pea equal to 400 and 150 plant per m^2 implement in rainfed conditions. After land preparation operations using machinery tillage, planting operations at once, as dry sown took place during this experiment, length of each plot 4.50 meters, 2 meters wide (6 lines each plot with planting distance 25 cm from each other) and distance of plots from each 1m and 3m between blocks were considered, for sampling interval was 14 days. This test to determine the usefulness of mixed cultures compared to pure cultures of the following indicators, using existing relationships were used. One of the most common ways to evaluate the usefulness of yield in mixed cultures were used, LER or the Land Equivalent Ratio was equal to the total land surface required under pure crop system (Single Cropping) compared with the mixed farm system for obtaining maximum yield is defined.

$$LER = \frac{y_{ij}}{y_{ii}} + \frac{y_{ji}}{y_{jj}}$$

Y_{ii} and in this regard specific yield of any product y_{jj} in pure stand system, y_{ij} and y_{ji} yield per unit area, respectively, in mixed cultures is the first and second product. If

LER>1 mixed cultures is beneficial to represent pure culture. Or other words indicating optimum growth and yield components using mixing periods for plant growth is environmental factors. If LER=1 is the index indicating critical state, and if LER<1 is negative effects on growth and yield of plants grown in mixed cultures can express words and resource use efficiency by more than pure cultures mixed cultures is the same plant (Hauggaard *etal*., 2005). Two other indicators that express the relationship of two competitive product mix are calculated (Willey, 1979) including: Relative Crowding Coefficient and dominance or superiority index (Aggressivity), indicating that these indices measure of dominance of a component to other components of the mixture is or in other words indicates that the amount of competition between plants using a replacement culture have been mixed (Ghosh, 2004). Relative Crowding Coefficient for mixed crop and green pea Triticale was calculated as follows.

For green pea:

$$RCC(k_{ab}) = \frac{Y_{ab} \times Z_{ba}}{(Y_{aa} - Y_{ab}) \times Z_{ab}}$$

For Triticale:

$$RCC(k_{ba}) = \frac{Y_{ba} \times Z_{ab}}{(Y_{bb} - Y_{ba}) \times Z_{ba}}$$

If K>1 there is utility function, if K=1 in the mixed farming any increase or decrease in farm products than Pure stand not see the end if K<1 is inadvisable to be mixed cultures can express and the amount of product obtained from farm product mix than a pure stand.

Green pea:

$$Aggressivity\ (A_{ab}) = \frac{Y_{ab}}{Y_{aa} \times Z_{ab}} - \frac{Y_{ba}}{Y_{bb} \times Z_{ba}}$$

Triticale:

$$Aggressivity\ (A_{ba}) = \frac{Y_{ba}}{Y_{aa} \times Z_{ba}} - \frac{Y_{ab}}{Y_{bb} \times Z_{ab}}$$

Y_{aa} and that Y_{bb} average net yield on the Pure stand green pea and triticale for replications, Y_{ab} and green pea mixture Y_{ba} cultivation and average yield for replications are triticale and green pea, Z_{ab} and Z_{ba} respectively represent the yield yield ratio of green pea and triticale is mixture cultivation. System productivity index through the formula provided by the odo (1991) was calculated as follows.

$$\mathrm{SPI} = \frac{S_a}{S_b} Y_b + Y_a$$

S_a and S_b, respectively, for green pea and triticale yield average in pure culture and Y_a and Y_b are represent the yield average in mixed culture of green pea and triticale.

Results and discussion

Normality test data after confirming normal and data obtained from test results showed that different treatments, including the mixed culture and pure stand significant difference between dry forage crop (triticale:green pea) respectively at the time that spike formation and flowering were harvested, there are (Table 1). In green pea plant treatments were significantly different between mixed and pure stand was treated as 40:60 (Triticale:green pea) in the first yield was out, but a significant difference with single cultures and showed no evidence of this self-cultivation mixture was superior high yield culture than are single. In other words, this result showed that treatment 40:60 (Triticale: green pea) the amount of yield obtained from this treatment in addition to the yield of a single green pea cultivation was achieved, the amount of forage obtained from cultivation triticale that this surplus

function treatment, respectively. The results of analysis of variance for dry matter yield data from a pure stand and mixed triticale showed a significant difference between treatments exists, so this adjective 60:40 treatment (triticale: green pea) best treatment, even to a single culture triticale for was to get maximum yield. Initial results of analysis of variance showed superior treatment combines 60:40 (Triticale: green pea) for both plants in the seed yield of forage was dry. triticale treatment plant in 60:40 (triticale:green pea), traits such as leaf fresh weight, forage yield in flowering time, stem number, stem height, stem freash and dry weight most values allocated to these traits were (Table 2). As shown in bottom diameter of Table 3 is highly correlated with these traits are that the dry matter yield traits as superior traits to select superior treatment were selected. So the first point of view and best treatments for common variance to get the maximum yield treatments Triticale 60:40 (triticale:green pea) was proposed. Green pea treatments for 40:60 (triticale:green pea) for most traits was best known treatment. Table 3 also top diameter correlation between the of different traits with each other has been shown that these traits showed a high correlation with each other and this suggests that these traits, it was a determining role in increasing the yield. In table 1 LER index values for each mixture treatments has shown that if the index values of more than one treatment superior to pure stand would have made that much in green pea plant in the treatment 60:40 (triticale:green pea) More than one and mix in other treatments was less than 1. In the triticale 60:40 (Triticale : green pea) Best treatment of LER, was recognized. Total Land Equivalent Ratio for the two plants showed that treatment 60:40 (triticale:green pea) best treatment for maximum yield. Other indices calculated results for mixed cultures, is given in Table 4. Using index K, the maximum k for green pea treated 60 : 40 (triticale : green pea) and lowest for the index treatment 40 : 60 (Triticale:green pea) were obtained, which showed best treatment in terms of competition for most treatment yield 60:40 (triticale:green pea, respectively). Also, top level competition treatment Triticale 20:80 (triticale:green pea) than other treatments that yield had relatively highest. In general, using this index best treatments for both plants, treated 20:80 (triticale:green pea) were recognized. A index for the two plants in mixed cultures showed that the tendency green pea to regain Triticale is more mixed cultivation and between the mixture treatments best treatment, treatment 60:40 (triticale:green pea) were recognized. SPI index that shows the aspect of maximum productivity, 60:40 treatment (triticale:green pea) as a superior treatment introduced. Since most of the traits highly correlated with dry matter yield was, therefore use any of the indices for the interpretation of mixed cultures regardless of other attributes was because the treatment was superior to that by dry matter yield trait has been introduced (Table 4). Analysis using various indicators, mixed culture than single culture was accompanied by greater usefulness. Reasons for this can be optimized using two plant nutrients at different levels of soil, competition with weeds and lack of adequate opportunities for the growth of weeds, allelopatic discharge of two plants (cereal and Legume) to relation, possibly resulting in increased yield is and characteristics of nitrogen fixation by Legumes, cited. In fact, a mixture of plants with different root systems cause water and nutrient absorption maximum is (yazdi samadi and poustini, 1994). Oswald *etal* (2002) experiment conducted in Kenya to evaluate corn and soybean mixed cultures simultaneously and delayed and 40% yield increase in corn cultivation announced the delay, they increased to the optimal use of resources in the mixed cultures were also compared sanderson *etal* (2005) showed that mixed cultures Legume plants with grain silage for forage production is caused pasture management system stability and sustainable agriculture. Therefore, the results showed that mixed cultures of legume with grass, can a good forage during dry years to produce, and also in addition to strengthening the soil causes being less invasive weeds will be for several years. Kandel *etal* (2000) showed that mixed cultures Legume (hairy vetch, yellow sweet clover and alfalfa) with sunflower increased soil cover, reduce erosion and increase soil carbon and nitrogen are also secondary effects of this type agriculture led to increased yield and protein content of hard red spring wheat (HRSW) has been. In general, using from the results different indicators and mean comparisons were best treatment in order to increase the hay yield, treatments 60:40 (triticale : green pea) and 40:60 (triticale : green pea). Although it is better that this test will be tested in different areas, but the obvious superiority of treatments introduced, these results can be generalized to other regions is the country (Iran) that are similar climate.

Table 1. Mean comparisons of final dry matter yield for the two plants green pea, triticale and index LER values

LER			Hay yield		**Treatment**
Total	Triticale	Green pea	Triticale	Green pea	
1	0	1	0	1327.45 [a]	Green pea 100%
1	1	0	2100.97 [a]	0	Triticale 100%
1.57	0.67	0.89	1412.66 [b]	1185.27 [b]	Triticale:green pea(20:80)
1.6	0.58	1.03	1208.23 [c]	1363.25 [a]	Triticale:green pea(40:60)
1.73	1.04	0.69	2188.54 [a]	925.66 [c]	Triticale:green pea(60:40)
1.38	0.82	0.9	1727.6	1197.16	Mean
			110.65	46.72	S.E

Table 2. The mean comparisons for all traits measured in different treatments

Fresh forage yield (flowering and spike formation stage)		Leaf dry weight		Leaf fresh weight		**Trait**
Triticale	Green pea	Triticale	Green pea	Triticale	Green pea	treatments
5545.2 [b]	5022.22 [a]	349.76 [a]	612.35 [a]	761.83 [b]	2405.27 [a]	Pure stand
4010.66 [c]	3933.1 [c]	306.21 [b]	500.16 [b]	701.03 [c]	1654.76 [c]	Triticale:green pea(20:80)
3636.91 [d]	4657.95 [b]	166.7 [c]	599.73 [b]	553.03 [d]	2128 [b]	Triticale:green pea(40:60)
6856.11 [a]	3715.17 [d]	312.32 [b]	402.08 [c]	988.99 [a]	1726.24 [c]	Triticale:green pea(60:40)
334.39	139.26	18.35	23.66	40.59	80.86	S.E

Table 2 continued. The mean comparisons for all traits measured in different treatments

Dry stem weight		Fresh stem weight		Stem height		Stem number		**Trait**
Triticale	Green pea	Triticale	Green pea	Triticale	Green pea	Triticale	Green pea	**Plant** / **Treatrment**
1751.21 [b]	715.11 [b]	4783.37 [b]	2616.95 [a]	57.18 [c]	37.71 [a]	5.14 [a]	4.3 [a]	Pure stand
1106.45 [c]	685.12 [b]	3309.64 [c]	2278.34 [b]	61.60 [b]	34.47 [b]	4.36 [b]	4.06 [b]	Triticale:green pea(20:80)
1041.53 [c]	763.52 [a]	8960.83 [c]	2530 [a]	60.20 [b]	37.37 [a]	3 [c]	4.76 [a]	Triticale:green pea(40:60)
1876.23 [a]	510.59 [c]	5867.13 [a]	1988.93 [c]	67.18 [a]	37.74 [a]	4.94 [ab]	3.5 [c]	Triticale:green pea(60:40)
97.30	25.39	296.4	65.07	0.97	0.4	0.24	0.14	S.E

Table 3. Correlation between different traits measured for each of the plants in mixed cultures. Top diameter table for traits related to triticale and bottom diameter to is the correlation of traits in green pea.

	Hay yield	Fresh forage yield	Leaf dry weight	Leaf fresh weight	Stem dry weight	Stem fresh weight	Stem height	Stem number
Hay yield		**0.92	**0.77	**0.86	**0.99	**0.92	^{ns} 0.25	**0.78
Fresh forage yield	**0.84		*0.60	**0.94	**0.94	**0.99	^{ns} 0.49	**0.70
Leaf dry weight	**0.94	**0.87		**0.65	**0.68	*0.59	^{ns} 0.03	**0.80
Leaf fresh weight	**0.70	**0.96	**0.77		**0.85	**0.92	*0.66	**0.72
Stem dry weight	**0.95	**0.74	**0.81	*0.57		**0.94	^{ns} 0.30	**0.73
Stem fresh weight	**0.94	**0.94	**0.92	**0.82	**0.86		^{ns} 0.46	**0.72
Stem height	^{ns} 0.00	^{ns} 0.37	^{ns} 0.13	*0.56	^{ns} 0.12-	^{ns} 0.08		0.10 ^{ns}
Stem number	**0.82	**0.67	**0.78	*0.53	**0.79	*0.77	^{ns} 0.02	

^{ns}, * and ** respectively significant and not significant at 0.05 and 0.01 can be.

Table 4. Index values of A, K, and SPI for different treatments in mixed cultivation of green pea and triticale

SPI	A value		K	K value		Index
	Green pea	Triticale		Triticale	Green pea	**Plant / Treatrment**
2077.83	0.72	-0.72	17.11	8.21	2.08	Triticale:green pea(20:80)
2126.64	0.71	-0.71	-51.54	2.03	-25.42	Triticale:green pea(40:60)
2295.44	0.86	-0.86	-54.99	-16.66	3.3	Triticale:green pea(60:40)
2166.64	0.76	-0.76	14.29	-2.14	-6.68	Mean

A reflect or Aggressivity index comparative advantage, K represent the Relative Crowding Coefficient and SPI represent the productivity index

Refrences

1- **Hosseini, S, M, B., Mazaheri, D. and Jahansouz, M, R. 2003**. Effect of planting pattern on yield of bean and pearl millet in mixed cultures. Abstracts the first National Conference of forage plants. Publishing Technology Services-Educational-gricultural education publishing. **P. 239**.

2- **Majnoun Hosseini, N., Mazaheri, D., Jahansouz, M, R. and Homayouni, H .2003**. Row intercropping of forage sorghum with beans, cowpea and soybean. Abstracts the first National Conference of forage plants. Publishing technology services-Educational agricultural education publishing**. P. 323**.

3- **Anil, L., Park, J., Phipps, R. H. and Miller, F. A. 1998**. Temperate intercropping of cereals for forage: a review of the potential for growth and utilization with particular reference to the UK. *Grass and Forage Science* **53:301–317**.

4- **Assefa, G. and Ledin, I. 2001**. Effect of variety, soil type and fertilizer on the establishment, growth, quality and voluntary intake by cattle of oats and vetch cultivated in pure stands and mixtures. *Animal Feed Science Technology*. **92: 95- 111.**

5- **Chu, G. X., Shen, Q. R. and Cao, J. L. 2004**. Nitrogen fixation and N transfer from peanut to rice cultivated in aerobic soil in intercropping system and its effect on soil N-fertility. *Plant and Soil.* **263:17–27.**

6- **Dapaah, H. K., Asafu-Agyei, J. N., Ennin, S. A. and Yamoah, C. Y. 2003**. Yield stability of cassava, maize, soybean and cowpea

intercrops. *Journal of Agricultural Science Cambridge*. **140:73–82.**

7- **Ghosh, P.K. 2004**. Growth, yield, competition and economics of groundnut / cereal fodder intercropping systems in the semi-arid tropics of India. *Field Crop Research*. **88: 227-237.**

8- **Hauggaard-Nielsen, H., Andferson, M.K., Jqrnsgaard, B. and Jensen, E.S. 2005**. Density and relative frequency effects on competitive interactions and resource use in pea-barley intercrops. *Field Crop Research.* **95: 256-267.**

9- **Jouns,M.J. and Arous, Z. 1999**. Effect of time harvest of vetch on yields of subsequent barley in a dry mediteranian environment. Published in Journal Agron. *Crop science*. **182: 291 – 294**.

10- **Kandel, H.J., Johnson, B.L. and Scheiter, A.A. 2000**. Hard red spring wheat response fallowing the intercropping of legumes into sunflower. *Crop Science*. **40: 731 – 736.**

11- **Odo, P. E. 1991**. Evaluation of short and tall sorghum varieties in mixtures with cowpea in the Sudan savanna of Nigeria: Land equivalent ratio, grain yield and system productivity index. *Experimental Agriculture*. **27:435–441**.

12- **Ofori, F. and Stern, W. R. 1987**. Cereal-legume intercropping systems. *Advances in Agronomy*. **41:41–90**.

13- **Oswald. A., J. K. Ransom, J. Kroschel and J. Sauerborn. 2002**. Intercropping controls S*triga* in maize based farming systems. *Crop Protection*. **21: 367-374**.

14- **Sanderson, M.A., Soder, K.J., Muller, L.D., Klement, K.D., Skinner, R.H. and Goslee, S.C. 2005**. Forage mixture productivity and botanical composition in pastures Grazed by Dairy cattle. *Agronomy journals*. **97: 1465-1471**.

15- **Vasilakoglou, I.B., Lithourgididis,A.S. and Dhima, K.V. 2005**. Assessing common vetch:cereal intercrops for suppression of wild oat. In proceeding of the 13th international symposium, session S5, European weed Research society, Bari, Italy. **371 – 379**.

16- **Willey, R. S. 1979**. Intercropping – its importance and research needs. Part 1. Competition and yield advantages. *Field Crop Abstracts*. **32:1–10**.

17- **Yazdi Samadi, B and k. poustini. 1994**. The principles of arable crop production. Markaz Nashr Daneshgahi. **300 pp**.

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