Response of Two Fenugreek \textit{Trigonella foenum-graecum} Varieties to Different Cutting Dates and Nitrogen Fertilizer for Growth and Forage Yield Traits under Rainfed Condition

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Keywords: Fenugreek, nitrogen fertilizer; cutting dates; varieties; fresh yield; dry yield; dry matter.

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ABSTRACT
In order to study the response of two fenugreek (\textit{Trigonella foenum-graecum} \ L.) varieties to different cutting dates and nitrogen fertilizer for growth and forage yield traits, a field experiment was conducted at Faculty of Agricultural Sciences University of Sulaimani, during 2014 - 2015 using split split plots based on randomized complete block design with 3 replications. Two varieties of Fenugreek (Mithe and EP 101) as the main factor and two levels of nitrogen (0 and 40 kg/ha) as sub plots and two cutting dates as sub sub-plots were investigated. Means comparison were carried out using least significant difference test (LSD) at 0.05 significant levels. The results indicated that there was not significant effect of nitrogen fertilizer on all growth and forage yield characters, but regarding the varieties the effect was not significant for most traits with the exception of the characters no. of tillers/plant, fresh forage yield (t/ha), dry forage yield (t/ha), and %dry matter which was found to be significant, EP 101 variety recorded maximum values with 2.915, 12.85 t/ha, 1.654 t/ha for the traits no. of tillers/plant, fresh forage yield, and dry forage yield respectively, while Mithe variety gave maximum percent of dry matter with %13.980. Concerning cutting treatments on studied traits was significant on all growth and forage yield characters with the exception of the characters no. of tillers/plant, no. of leaves/plant and dry matter% which was found to be not significant. The second cutting date out yielded the first cutting date significantly and gave maximum values of (plant height, %fresh stem, %dry stem, fresh weight/plant, fresh forage yield and dry forage yield) with (61.465cm, %57.681, %6.803, 10.037gm, 15.029 and 1.978 t/ha)) respectively, while the first cutting date out yielded the second cutting date in the characters (%fresh leaf, %dry leaf, leaf/stem ratio and dry weight/plant) with the values (%67.254, %10.711, 2.188 and 1.706gm) respectively.

استجابة صنفين من الحمبة لمواعيد حش مختلفة و السماد النايتروجيني على صفات النمو و حاصل العلف تحت الظروف الديمية

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الخلاصة
أجريت هذه التجربة في حقول كلية العلوم الزراعية/جامعة السليمانية خلال موسم 2014- 2015 بهدف دراسة أستجابة صنفين من الحمبة (\textit{Trigonella foenum-graecum} \ L.) لمواعيد مختلفة من الحش والتمدد التايتروجيني على صفات النمو و حاصل العلف و باستخدام نظام القطع القطع المنشقة (RCBD) و بثلاث مكررات. حيث وضعت صنفين من الحمبة (Mithe و EP 101) في القطع الرئيسية و مستوى السماد التايتروجيني (0 و 40 كغم/هاكتار) في القطع منشقة و موعدين للحش في قطع منشقة مرتين. و تم مقارنة الم entsprechات باختبار أقل فرق معنوي (LSD) بمستوى معنوية (0.05). أظهرت النتائج بأنه لم يكن هناك تأثير معنوي للسماد التايتروجيني على صفات النمو و حاصل العلف ، كذلك لم يكن هناك تأثير معنوي لحش مختمع وقطع مختلفة وسماد التايتروجيني على صفات النمو و حاصل العلف. 

كلمات مفتاحية:
الحمبة, السماد النايتروجيني, مواعيد الحش, الأصناف, حاصل العلف, النسب, المادة الحيوية, للمراسلة:
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تأثير معنوي للأصناف عمى معظم الصفات ما عدا صفات: عدد التفرعات/نبات, حاصل العلف الأخفض و حاصل العلف الجاف على النبات. أذ سجل صنف EP101 أعطى قيمة (2.915, 12.85 طن/ىكتار و 1.654 طن/ىكتار) للصفات عدد التفرعات/نبات , حاصل العلف الأخفض و حاصل العلف الجاف على النبات. أما بالنسبة لمعاملة الحش للنباتات المدروسة كانت معنوية لكل من صفات النمو و حاصل العلف ماعدا صفة عدد الفروعات/نبات و نسبة الأوراق/السيقان و نسبة المادة الجافة التي كانت غير معنوية. و قد تفوق موعد الحشة الثانية على الحشة الأولى معنويًا حيث أعطى أعمى قيمة في صفات (ارتفاع النبات , نسبة السيقان الخضرة , الوزن الخضري/نبات , حاصل العلف الأخفض و حاصل العلف الجاف) بقيمة (61.465 سم , 57.681% , 6.803%, 10.037 غم , 15.029 طن/ىكتار و 1.978 طن/ىكتار) على التوالي. بينما تفوق موعد الحشة الأولى على موعد الحشة الثانية في صفات (نسبة الأوراق الخضراء , نسبة الأوراق/السيقان و الوزن للنباتات) بقيمة (67.254% , 10.711% , 2.188 و 1.706 غم) على التوالي.

Introduction:

Fenugreek (Trigonella foenum-graecum L.) is an annual herb of the family Fabaceae, which is commonly encountered in Southwest Asia and the Mediterranean region. Fenugreek is cultivated across Western Europe and China for its aromatic seeds, and it is grown for fodder in selected parts of Europe and Northern Africa (Kinji, Rhadi 2012, Kołodziej, Zejdan 2000). This herbaceous plant is widely used for medicinal purposes, and its seeds are rich in protein, macronutrients, micronutrients, steroids, saponins, mineral salts and vitamins (Madar, Stark 2002).

Fenugreek is a fodder of very ancient cultivation in Mediterranean countries. Turkey is considered to be the primary center of origin. It is cultivated both under irrigation and as a rainfed crop. Fenugreek is grown as a cool season crop in India and the Mediterranean region both irrigated and as a rainfed crop. It has long been used as hay or green feed and is reputed to be highly nutritious. It is not suited to grazing. Fenugreek is highly palatable to livestock. A highly aromatic plant which is used as a pot-herb, spice and fodder. It is widely grown in India and neighboring countries as a flavoring and fodder, and in north Africa and western Asia as a fodder and spice (Golden Jubilee Publication).

Fenugreek is an annual, self-pollinated plant with small seeds and since ancient times has always been known as a medicinal herb (Slinkard, 2006). The crop is currently grown in India and parts of west Asia, north Africa, Mediterranean Europe, Australia, Argentina, United States of America and Canada (Acharya et al. 2006 a). Some genotypes of this species are adapted for growth under the rain-fed conditions found in western Canada (Acharya et al. 2007 b, 2008). Fenugreek leaves broadly are consumed as leafy green vegetables in India and are rich in calcium, iron, carotene B and other vitamins (Sharma, 1986). Duke (1986) reported that this plant increased the milk flow in cows, but impacts its aroma. An extract from fenugreek seed is usually added to fodder in order to improve animal’s palatability (Smith, 1982). Generally, nitrogen fertilizers have a major effect on stem formation, foliation and germination of plants and as a whole; it accelerates their vegetative growth (Omid-beigi, 2007). Using nitrogen in fenugreek leads to growth increase, delayed maturation, producing desired leaves, developed stem and luxuriant foliage with the desired dark-green color which indicates a desired growth, efforts are being made to improve the yield and qualitative composition of fenugreek to make it amenable to large-scale production (Petropoulos, 2002, Jadwiga and Krystyna, 2014). Recent studies indicate that fenugreek developed in western Canada can also be used as a forage crop since the plant maintains high nutritional quality irrespective of its maturity and the forage does not cause bloat in ruminants (Mir et al. 1997 a,b). A decreased need for application of fertilizers to the soil has potential to decrease contamination of
surface waters by runoff from agricultural fields. This has potential to reduce eutrophication of surface waters and limit contamination of ground water sources (Acharya et al., 2004a). These properties also make fenugreek a useful legume crop for incorporation into short term rotations where perennial forage legumes do not fit. Despite the fact that fenugreek has been identified as a forage crop, few adapted cultivars/ lines are available for successful forage production on the Canadian prairies (Moyer et al. 2003; Acharya et al. 2006 b, 2008). In addition, it can produce high quantity (Mir et al., 1993) and high quality forage, can be grown for hay or silage (Mir et al., 1998), does not cause bloat in cattle, and contains animal growth promoting substances such as diosgenin not present in other forage legumes (Mir et al., 1997a).

If we are harvesting the plants for leaves, cut the stem a few cm above the base when the plants are up to 25 cm tall. The larger white flowered variety will not regrow after flowering so needs successional sowing whereas the yellow variety can be cut a number of times and should be cut regularly to prevent it seeding and keep it productive. They will generally be ready by 6 weeks after sowing depending on the weather. The quality of leaves will decline once flower buds start to appear so try and harvest before then (Anton R. and S. Cunningham, 2010). Residual plant heights of around 5–10 cm for prostrate types and 10–20 cm for upright types (G. Hennessy and B. Clements, 2009). Cutting height is usually conducted at 7–10 cm above ground level. Cutting higher will result in a slight increase in nutritive value but will also reduce yields accordingly. A higher cutting height will also reduce the risk of soil contamination from other equipment operations such as raking. Cutting at greater heights will leave behind increased levels of stubble which creates a problem of removal in the future and preparation for the next forage (F. Mickan and T. Farran, 2009). For forage crops, it is important to produce greater forage yields per hectare, higher nutritional quality (percentage composition of selected nutrients) or combined nutrient yields. High forage yield is very important for producers but for livestock Enterprises, it is also important to produce high quality forages (Lithourgidis, et al. 2006).

The aim of this study was to determine the effects of different cutting dates and nitrogen fertilizer levels on growth and forage yield of two fenugreek varieties under rainfed condition.

Materials and Methods:

A field experiment was conducted at two different locations, the first was at Faculty of Agricultural Sciences-University of Sulaimani located (Latitude: 35° 33 '; N, Longitude 45° 27 '; E, at altitude of approximately 830 m) during the winter season of 2014-2015, to study the response of two fenugreek varieties (Trigonella foenum-graecum L.) to different cutting dates and nitrogen fertilizer for growth and forage yield traits. Sowing was conducted during Dec.18 of 2014 according to the recommended seed rates 25Kg/ha for two used varieties and the recommended dose of fertilizer was used 40 kg N/ha by two doses, first dose at sowing seeds and the second dose after 30 days of sowing. All plots were fertilized with 20Kg P2O5/ha as triple super phosphate, which was broad casted before sowing. The experiment was conducted in split-split plot design. Two levels of nitrogen (0 and 40 kg/ha) were implemented in the main plots and arranged according to CRBD and replicated three times, two varieties of Fenugreek (Mithe and EP 101) allotted in sub plots, and two cutting dates as sub sub-plots were investigated which consisted of { cut 80 days after sowing (cut1), cut 90 days after sowing (cut2) }, dated March 17 and April 7 respectively. Each sub-sub plots consist of 4 rows, 2m long with 0.30m apart between rows. All required agricultural practices were used as needed. Forage clipping were conducted at the height (6-8cm) from the soil surface to determine:

Yield characters (Component):

Fresh and dry weight/plant (gm), fresh forage and dry forage yield (t/ha) and dry matter percent. at harvest, fresh (green) forage weight was determined. The sub samples were taken (and weighted) to put it in the oven at 65 C° for 72 hours to determine dry matter percent. Forage dry matter yield
was recorded and converted in to dry matter production by using following formula [Khalil et al, 2011].

\[ \text{Dry yield (Kg/ha)} = \frac{\text{Dry yield in cut plot}}{\text{Plot area}} \times 10000 \]

**Growth characters:**

Plant height (cm), number of tillers/plant, number of leaves/plant, fresh and dry leaf percent, fresh and dry stem percent and leaves/stem ratio.

For recording plant height 5 plants were randomly selected in each plots, and the height was measured from the ground level to the apex of main stem. The number of tillers/plant was determined on the same five plants. Another sub-sample was taken to separate leaf and stem [Hsu et al, 2005] to determine fresh and dry leaf and stem percent; leaves/stem ratio was recorded by:

Weight of leaves/ weight of stems

The data were statistically analyzed according to the methods of analysis of variance as a general test and combined analysis conducted [AL Mohamad and .AL younis, 2000]. Comparison among the means was carried out using least significant test (L.S.D) at significant level of 5% [AL Mohamad and .AL younis, 2000].

**Results and Discussion:**

Effect of varieties on growth characters of fenugreek.

Data in table 1 showed the effect of varieties on growth characters which was not significant for all characters with the exception of the character number of tillers per plant which was found to be significant, EP 101 gave maximum number of tillers per plant (2.915), while Mithe variety recorded minimum numbers of tillers per plant with (1.917). The differences between two varieties in growth traits may be due to their differences in relative performance of each genotype regarding to the character no. of tillers/plant. This result was agreed with the results of (Royo C. and Tribó F., 1997).

**Table 1:** Effect of varieties on growth characters of fenugreek.

<table>
<thead>
<tr>
<th>Varieties</th>
<th>Plant height (cm)</th>
<th>No. of Tillers/plant</th>
<th>No. of Leaves/plant</th>
<th>% Fresh leaf</th>
<th>% Fresh stem</th>
<th>% Dry leaf</th>
<th>% Dry stem</th>
<th>Leaves/Stem ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mithe</td>
<td>41.135</td>
<td>1.917</td>
<td>20.11</td>
<td>55.263</td>
<td>44.737</td>
<td>8.914</td>
<td>5.066</td>
<td>1.435</td>
</tr>
<tr>
<td>EP 101</td>
<td>42.033</td>
<td>2.915</td>
<td>25.36</td>
<td>54.310</td>
<td>45.690</td>
<td>8.219</td>
<td>4.605</td>
<td>1.493</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>N.S</td>
<td>0.7172</td>
<td>N.S</td>
<td>N.S</td>
<td>N.S</td>
<td>N.S</td>
<td>N.S</td>
<td>N.S</td>
</tr>
</tbody>
</table>

N.S: not significant

Effect of nitrogen fertilizer on growth characters of fenugreek.

Data represented in table 2 showed the effect of nitrogen fertilizer on growth characters of fenugreek which was found to be not significant for all traits (Plant height, no. of tillers/plant, No. of Leaves/plant, % Fresh leaf, % Fresh stem, % Dry leaf, % Dry stem and Leaves/Stem ratio, however nitrogen fertilizer (N40) gave maximum value with (42.611, 2.443, 24.028, 46.352 and 4.928) for the characters plant height, no .of tillers/plant, no. of leaves/plant, %fresh stem, and %dry stem respectively, in compare to no fertilization (N0) but the effect was not significant. Similar results were obtained previously by (Daramola et al. 2013) which was found that the increase of stem dry matter of other legumes crop (cowpea) accumulation was observed as N rates increased. This increase of plant height and number of tillers/plant may be due to that the nitrogen is a building
block of amino acids and protein in plants, chlorophyll is the most abundant protein in plant, it is involved in photosynthesis and increasing vegetative growth [Baker, et al. 1991, Blumental, J.M and Batensperger D.D, 2002].

Table 2: Effect of nitrogen fertilizer on growth characters of fenugreek.

<table>
<thead>
<tr>
<th>Nitrogen Fertilizer level (kg/ha)</th>
<th>Plant height (cm)</th>
<th>No. of Tillers/plant</th>
<th>No. of Leaves/plant</th>
<th>% Fresh leaf</th>
<th>% Fresh stem</th>
<th>% Dry leaf</th>
<th>% Dry stem</th>
<th>Leaves/Stem ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>N0 (0)</td>
<td>40.557</td>
<td>2.388</td>
<td>21.445</td>
<td>55.925</td>
<td>44.075</td>
<td>8.684</td>
<td>4.743</td>
<td>1.599</td>
</tr>
<tr>
<td>N1 (40)</td>
<td>42.611</td>
<td>2.443</td>
<td>24.028</td>
<td>53.648</td>
<td>46.352</td>
<td>8.449</td>
<td>4.928</td>
<td>1.328</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>N.S</td>
<td>N.S</td>
<td>N.S</td>
<td>N.S</td>
<td>N.S</td>
<td>N.S</td>
<td>N.S</td>
<td>N.S</td>
</tr>
</tbody>
</table>

N.S: not significant

- Effect of cutting dates on growth characters of fenugreek.

The results of table 3 confirmed that the effect of cutting dates on all growth characters was significant with the exception of the characters no. of tillers/plant and no. of leaves/plant which was found to be not significant. First cutting date exhibited maximum percent of fresh leaf%, dry leaf% and leaf/stem ratio were 67.254%, 10.711% and 2.188 respectively, while the second cutting date recorded minimum value for these three traits with 42.319, 6.423 and 0.740 respectively.

Regarding the other characters (plant height, %fresh stem and %dry stem), the second cutting date exceeded the first cutting treatment significantly and gave maximum value (61.465, %57.681 and %6.803) respectively, in which first cutting date recorded minimum value with (21.703, 32.746 and 2.868) for the traits (plant height, %fresh stem and %dry stem) respectively. These maximum values for most characters due to the delay of cutting date, these results were in agreement with the results of [Hsu et al. 2005].

Table 3: Effect of cutting dates on growth characters of fenugreek.

<table>
<thead>
<tr>
<th>Cutting dates</th>
<th>Plant height (cm)</th>
<th>No. of Tillers/plant</th>
<th>No. of Leaves/plant</th>
<th>% Fresh leaf</th>
<th>% Fresh stem</th>
<th>% Dry leaf</th>
<th>% Dry stem</th>
<th>Leaves/Stem ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second Cut 7/4/2015</td>
<td>61.465</td>
<td>2.193</td>
<td>26.33</td>
<td>42.319</td>
<td>57.681</td>
<td>6.423</td>
<td>6.803</td>
<td>0.740</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>4.489</td>
<td>N.S</td>
<td>N.S</td>
<td>4.863</td>
<td>4.863</td>
<td>1.226</td>
<td>0.475</td>
<td>0.450</td>
</tr>
</tbody>
</table>

N.S: not significant

Effect of varieties on forage and dry yield characters of fenugreek.

Data represented in table 4 explain the effect of varieties on forage and dry yield characters which was significantly affected all characters with the exception of the character Fresh weight/plant and Dry weight/plant were found to be not significant. EP 101 variety recorded maximum values of Fresh forage yield and Dry forage yield were 12.854 and 1.654 t/ha respectively, while Mithe variety gave minimum value with 7.576 and 1.033 t/ha for the traits Fresh forage yield and Dry forage yield respectively. but concerning the character dry matter percent , Mithe variety exhibited the highest value with % 13.980, in which the lowest value of dry matter percent (%12.824) recorded by EP 101 variety. The differences between two varieties in forage yield may be positively and strongly related to the time between sowing and
cutting. These results were in agreement with the results reported by (Royo C. and Tribó F., 1997).

Table 4: Effect of varieties on forage and dry yield characters of fenugreek.

<table>
<thead>
<tr>
<th>Varieties</th>
<th>Fresh weight/plant (gm)</th>
<th>Dry weight/plant (gm)</th>
<th>Fresh forage yield (t/ha)</th>
<th>Dry forage yield (t/ha)</th>
<th>% Dry matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mithe</td>
<td>7.065</td>
<td>1.536</td>
<td>7.576</td>
<td>1.033</td>
<td>13.980</td>
</tr>
<tr>
<td>LSD</td>
<td>N.S</td>
<td>N.S</td>
<td>4.0519</td>
<td>0.5843</td>
<td>0.6514</td>
</tr>
</tbody>
</table>

N.S: not significant

Effect of nitrogen fertilization on forage and dry yield characters of fenugreek.
Results of table 5 showed that the effect of nitrogen fertilization on forage and dry yield characters was not significant for all characters (Fresh weight/plant, Dry weight/plant, Fresh forage yield, Dry Forage yield and % Dry matter). This results opposite with the findings of Chaudhary (1999), Bothe et al. (2001), Jat and Shaktawat (2001), Jat (2004), Thapa and Maity (2004) and Nehara et al. (2006) which was found that all the yield parameters were positively affected by fertilization.

Table 5: Effect of nitrogen fertilization on forage and dry yield characters of fenugreek.

<table>
<thead>
<tr>
<th>Nitrogen Fertilizer level (kg/ha)</th>
<th>Fresh weight/plant (gm)</th>
<th>Dry weight/plant (gm)</th>
<th>Fresh forage yield (t/ha)</th>
<th>Dry Forage yield (t/ha)</th>
<th>% Dry matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>N0 (0)</td>
<td>7.593</td>
<td>1.545</td>
<td>11.286</td>
<td>1.493</td>
<td>13.428</td>
</tr>
<tr>
<td>N1 (40)</td>
<td>7.083</td>
<td>1.480</td>
<td>9.144</td>
<td>1.194</td>
<td>13.377</td>
</tr>
<tr>
<td>LSD</td>
<td>N.S</td>
<td>N.S</td>
<td>N.S</td>
<td>N.S</td>
<td>N.S</td>
</tr>
</tbody>
</table>

N.S: not significant

Effect of cutting dates on forage and dry yield characters of fenugreek.
Data in table 6 confirm the out-yielding the second cut for all characters due to forage and dry yield characters with the exception of the character dry matter percent which was found to be not significant. The second cut predominated first cut in the character (fresh weight/plant, fresh forage yield and dry forage yield) with (10.037gm, 15.029 and 1.978 t/ha) respectively, while the first cut treatment gave minimum values for these traits with 4.639gm, 5.401 and 0.708 t/ha) respectively. But regarding the character dry weight/plant, first cut recorded the highest value of 1.706gm in compare to the second cutting date which gave the lowest value of dry weight/plant with 1.319gm. Forage yield increased as cutting dates delayed across growing season as the crop mature. These results agreed with the previous result who found that highly significant differences were observed in forage yield due to date of harvest and genotype (Khorasani G. R. etal, 1997).

Table 6: Effect of cutting dates on forage and dry yield characters of fenugreek.

<table>
<thead>
<tr>
<th>Cutting Dates</th>
<th>Fresh weight/plant (gm)</th>
<th>Dry weight/plant (gm)</th>
<th>Fresh forage yield (t/ha)</th>
<th>Dry Forage yield (t/ha)</th>
<th>% Dry matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Cut 17/3/2015</td>
<td>4.639</td>
<td>1.706</td>
<td>5.401</td>
<td>0.708</td>
<td>13.579</td>
</tr>
<tr>
<td>Second Cut 7/4/2015</td>
<td>10.037</td>
<td>1.319</td>
<td>15.029</td>
<td>1.978</td>
<td>13.225</td>
</tr>
<tr>
<td>LSD</td>
<td>2.487</td>
<td>0.320</td>
<td>3.238</td>
<td>0.404</td>
<td>N.S</td>
</tr>
</tbody>
</table>

N.S: not significant
Conclusion:

From the results of this study, we concluded that forage yield and fenugreek growth were not affected by nitrogen fertilizer, but significantly affected by varieties and cutting treatment. EP 101 variety recorded maximum values for the traits no. of tillers/plant, fresh forage yield, and dry forage yield, while Mithe variety gave maximum percent of dry matter. The second cutting date out yielded the first cutting date significantly and gave maximum values of plant height, %fresh stem, %dry stem, fresh weight/plant, fresh forage yield and dry forage yield, in which the first cutting date out yielded the second cutting date in the characters (%fresh leaf, %dry leaf, leaf/stem ratio and dry weight/plant).

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References:


Anton R. and S. Cunningham, 2010. Growing Fenugreek (Trigonella foenum-graecum), Garden organic, For further information email sowingnewseeds@gardenorganic.org.uk or visit www.sowingnewseeds.org.uk. (Arabic).


Khalil, SH.K.Khan; A.Rehman; F.Muhammad; Amanullah; A.Z.Khan; S.Wahab; S.Aktar; M.Zubair; I.H.Khalil; M.K.Shah; H.Khan; Dual purpose wheat for forage and grain yield in response to cutting, Seed rate and nitrogen, Khybar oakhtunkhwa Agricultural University, Peshawar Pakistan Correspondence author E-mail: drshadkh2010@yahoo.com. Pak.j.Bot., 43(2):937-947, (2011).


Royo C. and Tribó F., 1997. “Triticale and barley for grain and for dual- purpose (forage+grain) in a Mediterranean-type environment”, II. Yield, yield components, and quauukulity, Australian

