The Pharma Innovation Journal 2022; 11(9): 645-649

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(9): 645-649
www.thepharmajournal.com
Received: 07-06-2022
Accepted: 22-08-2022

Rakesh Kumar Dhakar
M.Sc. Scholar, Department of Agronomy, School of Agricultural Science, Career Point University, Alaniya, Kota, Rajasthan, India

Ravi Mahour
Assistant professor, Department of Agronomy, School of Agricultural Science, Career Point University, Alaniya, Kota, Rajasthan, India

Raju Lal Dhakar
M.Sc. Scholar, Department of Agronomy, C.P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University Sardarkrushinagar Gujarat, India

Bhanwar lal Nagar
M.Sc. Scholar, Department of Agronomy, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur Rajasthan, India

Corresponding Author:
Rakesh Kumar Dhakar
M.Sc. Scholar, Department of Agronomy, School of Agricultural Science, Career Point University, Alaniya, Kota, Rajasthan, India

Response of fodder barley (*Hordeum vulgare* L.) to date of sowing and nitrogen levels

Rakesh Kumar Dhakar, Ravi Mahour, Raju Lal Dhakar and Bhanwar lal Nagar

Abstract
A field experiment was conducted at Agronomy Farm, School of Agricultural Sciences, Career Point University, Alaniya Kota during *Rabi* season of 2021-22 to study the response of fodder barley (*Hordeum vulgare* L.) to date of sowing and nitrogen levels. The experiment consisting twelve treatment combinations comprising four sowing dates (20th October, 1st November, 10th November, 20th November) and three levels of nitrogen (80 kg N/ha, 100 kg N/ha and 120 kg N/ha) were evaluated in split plot design with four replications. Results found that sowing of the fodder barley on 10th November were produced significantly higher plant height, leaf length, green forage and dry fodder yield at first cut, second cut and total of both cuts.
Among the nitrogen levels, significantly higher plant height, leaf length, green forage and dry fodder yield was recorded at application of 120 kg N/ha as compared to rest of the treatments.

Keywords: fodder barley, date of sowing, nitrogen levels

Introduction
Agriculture and animal husbandry in Rajasthan as well as in India are interwoven with the intricate fabric of the society in cultural, religious and economical ways as mixed farming and livestock rearing forms an integral part of rural living. The farmer possessing the livestock breeds with higher milk yield potential and suffering from deficit in fodder availability in the country.
Livestock population is the largest in the India, comprising 190.90 million cattle, 108.70 million buffaloes, 135.17 million goats, 65.069 million sheeps, 10.29 million pigs and 3.04 million other animals (19th livestock census, 2012). India is having the largest livestock population, 11.6 per cent of the world's livestock population (Islam *et al*., 2016) [13]. Livestock contributing 4.11 per cent to national GDP and source of employment. Among these, cattle and buffalo accounts more than two third of Indian livestock which play an important role in milk production. In India, the *per capita* availability of animal protein is too much lower than standard recommended by the national nutrition committee. The integrated efforts even could not improve the declining trend in *per capita* availability of milk from 299 g during 2012 because most of our animals are either low producer or under malnutrition and about 55.05 and 41.95 per cent of the total cows and buffaloes, respectively remain dry and infertile.
The productivity of animals in India, especially milch animals is very low as compared to developed countries primary due to less availability of nutritive feed and fodder to animals (Patel *et al*., 2011) [21]. In India, the livestock needs 1650 mt. fodder annually, but in contrast of these requirements, 48 mt. of concentrates, 395 mt. of green forage and 451 mt. of dry fodder are available, which contribute about 62.8 and 23.5 per cent deficit of green and dry forage production, respectively. Thus, green forage supply has to grow at 3.2 per cent to meet the deficit of forage. (Kumar and Faruqui, 2010) [18].
Total forage production in India is 866.6 mt. In which 400 mt. green fodder production and 446 mt. dry fodder production. Whereas, the annual forage requirement is 1706 mt. (1097 mt. green fodder and 609 mt. dry fodder). Deficit in green fodder production is 696 mt. (63.50%) and 143 mt. (23.56%) deficit in dry fodder (Bhagmal *et al.*, 2014) [7].
Barley (*Hordeum vulgare* L.) is a valuable crop because it is grown for multiple purposes such as food and processed food products for human being and feed for cattle and poultry-birds and malt manufacture. It is not only useful for malting, feed and food purposes, but also its β-Glucanase is helpful in lowering the risk of cardio-vascular disease (Kharub *et al.*, 2014) [16].

Besides these conventional uses, it is an important industrial crop because it is used as raw material for beer, whisky and brewing industries. Barley is used as green fodder, straw and hay. The barley product like "sattu" (in summer because of its cooling effects on human body) and Missi Roti have been traditionally used in India (Verma *et al*., 2011) [31].

Materials and Methods

Agronomy Farm, School of Agricultural Sciences, Career Point University, Alaniya Kota during *Rabi* season of 2021-22. The soil of experimental field was loamy sand in texture with low in organic carbon (0.25%) and low in available nitrogen (163 kg/ha), medium in available phosphorus (38.2 kg/ha) and potash (288 kg/ha) having pH value of 7.40. The experiment consisting of twelve treatment combinations comprising four sowing dates *i.e.*, 20th October (D1), 1st November (D2), 10th November (D3) and 20th November (D4) and three levels of nitrogen *i.e.*, 80 kg N/ha (N1), 100 kg N/ha (N2) and 120 kg N/ha (N3) were evaluated in Split Plot Design with four replications.

Plant height (cm)

Plant height was measured in centimeter from ground level to top of the main shoot of randomly selected five tagged plants from each net plot at first cut and second cut. The average value was calculated and recorded separately.

Leaf length (cm)

The leaf length of five leaves was measured from the 5th leaves of the stem to tip of the leaf. The average of five plants was considered as average leaf length.

Green forage yield (q/ha)

First the ring area of each plot was harvested and collected outside of the experimental site. Then, the plants from the net plot were harvested keeping 2-3 cm height from ground level and fresh weight of harvested produce was recorded for each treatment separately and converted into hectare basis by multiplying with multiple factor.

Dry forage yield (q/ha)

Thousand gram of green plant sample was weighed randomly from each net plot and kept in a brown paper bag. Then after, samples were sun dried and then oven dried at 60 °C till a constant weight was recorded. After, oven drying, the dry weight of sample were recorded and converted in to hectare basis by multiplying with multiple factor.

Results and Discussion

Plant height

An examination of data presented in above table-1 reveals that the plant height of fodder barley was found significant at first and second cut. Sowing of the barley crop on 10th November recorded significantly the highest plant height during first cut, but it was remained at par with sowing of crop on 1st November. In case of second cut, sowing of the barley crop on 10th November recorded significantly the highest plant height, but it was remained at par with sowing the crop on 1st November. Sowing the barley crop on 20th October recorded the smallest plant height at first and second cut, respectively. The taller plants in the 10th November sowing might be due to favourable temperature effect on the growth of plants. The results are in line with those reported by Razzaque and Rafiquzzaman (2006) [25], Alam *et al.* (2007) [4], Rashid *et al.* (2010) [23], and Sharma *et al.* (2017) [28]. The result of Rashid *et al.* (2007) [23] showed that the early sowing produced significantly highest plants height in barley than late sowing.

Significantly higher plant height was recorded by the application of 120 kg N/ha at first and second cut and it was to the tune of 23.73 and 10.43 per cent higher than that of 80 kg N/ha, respectively. Whereas, the application of 100 kg N/ha increased plant height to the tune of 16.54 and 7.39 per cent than that of 80 kg N/ha at first and second cut, respectively (Table 1). The higher plant height by the application of 120 kg N/ha was due to accelerated meristematic activity on account of availability of nitrogen in sufficient quantity and right time during the entire growth period of the crop. The present findings are in accordance with the findings of Alam *et al.* (2007) [4], Luikham *et al.* (2012) [20], Dubey *et al.* (2013) [11] and Aleminew and Legas (2015) [6]. The result of Fazal *et al.* (2012a) [11] showed that the highest plant height of barley crop was recorded with the application of 120 kg N/ha as compared to 80 kg N/ha.

Leaf length (cm)

Data presented in Table 1. Indicated that the significantly higher leaf length was recorded by the 10th November sowing during the first cut. However, it was remained at par with 1st November and 20th November sowing. In case of second cut, significantly higher leaf length was recorded by the 10th November sowing. However, it was remained at par with 1st November sowing. Significantly the lowest leaf length of fodder barley was recorded by the 20th October sowing.

Sowing the fodder barley on 10th November produced significantly higher leaf length at first and second cut might be due to taller plant of barley crop and favourable temperature effect on growth of crop. The results are closely related with the findings of Dar *et al.* (2014) [10]. The results of Dar *et al.* (2014) [10] showed that early sowing on 5th October recorded significantly higher values of growth attributes like leaf length of oat crop as compared to delayed sowing of 5th November.

At first and second cut, significantly the highest leaf length was recorded by the application of 20 kg N/ha. The application of 120 kg N/ha at first cut and second cut increased the leaf length to the magnitude of 8.10 and 6.22 per cent higher than that of 80 kg N/ha, respectively. Moreover, an application of 100 kg N/ha at all the periodical growth stages recorded 4.43 and 4.97 per cent higher leaf length than that of 80 kg N/ha, respectively. The increase in leaf length was due to continuous supply and availability of nitrogen to the crop which ultimately leads to the higher leaf length of fodder barley crop. The results are closely related with the findings of Sharma *et al.* (2001) [27] and Khan *et al.* (2014) [15]. The result of Khan *et al.* (2014) [15] showed that the application of 180 kg N/ha recorded significantly higher plant height of forage maize crop.

Green forage yield (q/ha)

Significantly the highest green forage yield was recorded by taking first cut on 10th November sowing, but it was remained at par with 1st November and 20th November of sowing, respectively. In case of second cut, maximum green forage yield was recorded by sowing the fodder barley on 10th November sowing, but it was equally effective to the sowing of fodder barley on 1st November and 20th November, respectively. In total values of green forage yield, the highest

green forage yield was observed by sowing the fodder barley on 10th November sowing. The minimum green forage yield was observed with sowing on 20th October of fodder barley at first cut, second cut and total green forage yield, respectively.

The results signified that 10th November sowing recorded more green forage yield than rest of the sowing dates. The remarkable increase in yields with normal sowing might be attributed due to favourable effect on yield attributes *viz.*, plant height, leaf length per plant. This might have ultimately resulted in higher photosynthetic activities and also in production of more photosynthates. The increase in green forage yield was also observed by Abdullah *et al.* (2000) [1], Singh *et al.* (2004) [30] and Sharma *et al.* (2017) [9]. Singh *et al.* (2004) [30] showed that the maximum green forage yield of forage barley was recorded when crop was sown on 30th October.

Significantly higher green forage yield was recorded by the application of 120 kg N/ha at first cut, second cut and total green forage yield, respectively. The lowest green forage yield was recorded by the application of 80 kg N/ha during first cut, second cut and total green forage yield, respectively. The remarkable increase in yields with higher levels of nitrogen might be attributed due to favourable effect on yield attributes *viz.*, plant height (Table 1), leaf length (Table 1). The increase in leafy part due to nitrogen application might have ultimately resulted in higher photosynthetic activities and also in production of more photosynthates. This readily supplied food growing parts might have helped in improvement of growth and yield attributes like plant height, number of tillers per meter row length, number of leaves per plant. As a result of which, nitrogen yielded better response on forage yield of oat crop. More or less similar response to nitrogen has been reported by Kumar *et al.* (2001) [17], Kalol *et al.* (2003) [14], Dubey *et al.* (2013) [11], Choudhary *et al.* (2014) [8] and Dahipahle *et al.* (2017) [9]. The result of Kumar *et al.* (2001) [17] showed that the green forage yield of forage oat crop was significantly affected by the application of 120 kg nitrogen per hectare.

Dry forage yield (q/ha)

Sowing on 10th November recorded significantly the highest dry fodder yield at first cut, but it was remained at pat with 1st November and 20th November sowing. In case of second cut, highest dry fodder yield was recorded by 10th November of sowing, but it was remained at par with 1st November and 20th November of sowing. While in case of total dry fodder yield, the highest dry fodder yield was recorded by sowing of fodder barley crop on 10th November and it was at par with 1st November and 20th November of sowing. The lowest dry fodder yield was recorded by 20th October of sowing at first cut, second cut and total dry fodder yield. The results signified that sowing at 10th November recorded higher dry fodder yield than rest of the sowing dates. This might be due to more green forage yield in the 10th November of sowing treatment, so the dry fodder yield was more in the 10th November of sowing. The increased in dry fodder yield was also observed by Shaikh *et al.* (2004) [26], Alam *et al.* (2005) [3], Razzaque and Rafiquzzaman (2006) [25] and Dar *et al.* (2014) [10]. Alam *et al.* (2005) [3] showed that barley sown on 5th November produced significantly higher dry matter yield than other sowing dates.

Results presented in Table 2. Showed that the effect of nitrogen levels on dry fodder yield of fodder barley was found significant at first cut, second cut and total dry fodder yield. At first cut, significantly highest dry fodder yield was recorded by the application of 120 kg N/ha. An application of 120 kg N/ha was at par with 100 kg N/ha (N2). In case of second cut, maximum dry fodder yield was registered by the application of 120 kg N/ha and it was found at par with 100 kg N/ha. The highest total dry fodder yield was recorded by the application of 120 kg N/ha. The lowest dry fodder yield of fodder barley crop was recorded with the application of 80 kg N/ha at first cut, second cut and total dry fodder yield, respectively. Due to nitrogen is used largely in synthesis of protein, but structurally it is a constituent of chlorophyll molecule combined with carbohydrates and fatty acids. It helps in formation of protoplasm, which is the physical base of a life of the plant. Thus, more production of dry matter can be explained at higher nitrogen rates. The higher dry matter yield with higher nitrogen rates also reported by Kumar *et al.* (2001) [17], Kalol *et al.* (2003) [14], Alam and Haider (2006) [2], Meena *et al.* (2012) [21], Dubey *et al.* (2013) [11]| and Dahipahle *et al.* (2017) [9]. The result of Dahipahle *et al.* (2017) [9] revealed that the application of 100 to 120 kg N/ha recorded significantly higher growth as well as yield attributes resulting in higher dry fodder yield (q/ha) as compared to 80, 60 and 40 kg N/ha.

Table 1: Plant height (cm) and leaf length of fodder barley as influenced by date of sowing and nitrogen levels

Treatments	Plant height (cm)		Leaf length (cm)	
	1st cut	2nd Cut	1st cut	2nd Cut
Date of sowing (D)				
D_1: 20th October	66.00	61.16	17.12	14.26
D_2: 1st November	78.18	71.82	19.62	15.02
D_3: 10th November	81.55	73.51	19.80	16.07
D_4: 20th November	73.00	65.62	19.50	14.66
S.Em. ±	2.495	2.037	0.546	0.377
CD at 5%	7.98	6.52	1.75	1.21
CV %	11.57	10.37	9.94	8.72
Nitrogen levels (N) kg/ha				
S_1: 80 kg/ha	65.84	64.21	18.25	14.46
S_2: 100 kg/ha	76.73	68.96	19.06	15.18
S_3: 120 kg/ha	81.47	70.91	19.73	15.36
S.Em. ±	1.92	1.41	0.38	0.22
CD at 5%	5.61	4.11	1.11	0.64
Interaction (D x N)				
S.Em. ±	3.84	2.82	0.76	0.44
CD at 5%	NS	NS	NS	NS
CV %	10.29	8.28	7.98	5.83

Table 2: Green and dry fodder yield (q/ha) of fodder barley as influenced by date of sowing and nitrogen levels

Treatments	Green forage yield (q/ha)			Dry fodder yield (q/ha)		
	1st cut	2nd Cut	Total	1st cut	2nd Cut	Total
Date of sowing (D)						
D_1: 20th October	179.1	132.1	311.3	46.3	34.2	80.6
D_2: 1st November	196.6	146.8	343.4	50.8	38.0	88.9
D_3: 10th November	207.4	154.6	362.1	53.7	39.9	93.7
D_4: 20th November	193.5	143.2	336.7	50.1	37.0	87.2
S.Em. ±	5.91	4.31	10.16	1.52	1.17	2.67
CD at 5%	18.9	13.8	32.5	4.89	3.75	8.55
CV %	10.55	10.37	10.41	10.52	10.87	10.57
Nitrogen levels (N)						
S_1: 80 kg/ha	178.9	133.8	312.8	48.0	34.4	82.4
S_2: 100 kg/ha	192.4	143.6	336.1	50.4	37.5	87.9
S_3: 120 kg/ha	211.2	155.0	366.3	52.2	40.1	92.3
S.Em. ±	4.25	3.39	6.29	1.06	0.86	1.46
CD at 5%	12.4	9.9	18.3	3.09	2.51	4.26
Interaction (D x N)						
S.Em. ±	8.50	6.79	12.59	2.12	1.72	2.92
CD at 5%	NS	NS	NS	NS	NS	NS
CV %	8.76	9.41	7.44	8.42	9.21	6.66

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