Forage Res., **48**(4) : pp. 502-506 (2023) **http://forageresearch.in**

INFLUENCE OF DIFFERENT NITROGEN DOSE AND SEED RATE ON QUALITY AND NUTRIENT UPTAKE OF DUAL PURPOSE BARLEY

AMIT SHARMA[1]*, BHAGAT SINGH[1], KAMAL[1], B. K. DHAKA[2], SUMIT BHARDWAJ[1] AND AMIT KUMAR[3]

[1] Department of Agronomy, [2]Department of Botany and Plant Physiology,
[3] Department of Soil Science, CCS Haryana Agricultural University, Hisar-125 004 (Haryana), India
**(e-mail: amitsharma1197@hau.ac.in)*

(Received : 06 February 2023; Accepted : 30 March 2023)

SUMMARY

A field experiment was carried out during *Rabi* season 2019-20 at wheat and barley section research area of CCS Haryana Agricultural University, Hisar. The experiment was comprised of three nitrogen doses (N_1-60, N_2-75 and N_3- 90 kg N/ha) as main plot treatments and four seed rates (S_1- 87.5, S_2- 100, S_3- 112.5 and S_4-125.0 kg/ha) as sub plot treatments. With four replications, experiment was laid out in split plot design. The goal of this study was to look into how the nitrogen dose and seed rate of dual-purpose barley affect nutrient uptake and nutritional value of grains and straw. Based on the research investigation, it was found that nitrogen dose and seed rate both had significantly influenced the quality and nutrient uptake of dual purpose barley. Among nitrogen doses, 90 kg/ha recorded significantly higher protein content in grain (10.69%) and straw (2.41%) which was 5.7, 16.8 and 9.5, 17.6 per cent higher over 75 and 60 kg/ha and N, P and K uptake in grain and straw with nitrogen dose of 90 kg/ha was found 27.8, 33.0, 37.2 and 33.4, 24.7, 20.3 per cent higher over 60 kg/ha nitrogen doses, respectively. Among seed rates, 87.5 kg/ha closely followed by 100.0 kg/ha recorded significantly higher protein content in grain (10.65%) and straw (2.40%) which was significantly higher with a relative advantage of 12.1, 8.9 and 15.4, 11.6 per cent over seed rate of 125.0 and 112.5 kg/ha while N, P and K uptake in grain and straw failed to show significant variations. Higher N (75.47), P (10.39) and K (17.16) uptake by grain and N (24.79), P (9.42) and K (81.49) uptake in straw was recorded with seed rate 87.5 kg/ha while minimum recorded with 125.0 kg/ha.

Keywords : dual purpose barley, seed rate, nitrogen dose, protein content, nutrient uptake

Barley (*Hordeum vulgare* L.) is the one of the first domesticated cereal of world agriculture. It occupy fourth place among cereal crops after wheat, rice and maize in the world with a share of 7.0 per cent of the global cereal production. Barley is considered as poor man's crop that may thrive well in problematic soils and marginal land. It is not only useful for malting, feed and food purpose but also its β-glucanse is useful in lowering the risk of cardio-vascular diseases (Kharub *et al.,* 2014). It is a valuable crop because it is used for food, processed food and feed for livestock. Its straw is used for making hay and silage.

Because of its low input requirements and tolerance to severe conditions such as drought, salinity, alkalinity, and marginal soils, barley is chosen over other crops for producing feed and fodder for animals (Singh *et al.,* 2016). Barley possesses very high regeneration capacity compared to other cereals after cutting up to attainment of jointing stage. Lodging close to harvest is usually a major problem in cereals under good nutrition and assured water supply conditions, if winds blow after irrigation. Therefore, it is reasonable to assume that one cutting for green forage at active growth stage will reduce the lodging chances in barley. It will also help in mitigating the fodder shortage. Therefore, barley can provide important nutrition to the livestock through its green fodder and grains harvested from regenerated crop.

Proper fertilization is considered to be one of the most important pre-requisite in this respect. Amongst nutrients, nitrogen plays an important role in synthesis of chlorophyll, amino acids and other organic compounds of physiological significance in plant system. Various studies have conclusively shown that the crude protein ratio and protein yield of forages rise as the amount of nitrogen supplied to the plants increases (Ertekin *et al.,* 2021). The plant density is essential to the success of dual-purpose farming since it dictates how plants compete for nutrients, light, and

water (Khalil *et al.,* 2011). Optimizing plant density is essential for the development of dual purpose barley because of the worldwide upward trend in seed prices. Therefore, the aim of this study was to determine the most appropriate nitrogen dose and seed rate for dual-purpose barley for good quality grains and straw production.

MATERIAL AND METHODS

A field experiment was carried out during *Rabi* season 2019-20 at wheat and barley section research area of CCS Haryana Agricultural University, Hisar which is situated in the sub-tropical region at 29° 10' N latitude and 75° 46' E longitude with an elevation of 215.2 m above mean sea level in Haryana State of India. It lies on the outer margins of the south-west (SW) monsoon region. It has tropical monsoonal climate and is characterized as arid type of climate. The major characteristics of climate in Hisar district are its extremes temperature, dryness and scanty rainfall. The average annual rainfall is around 452 mm. The soil exhibits mixed pattern of Aeolian and Alluvial deposits. During crop growing season 133.5 mm rainfall was received. The mean weekly maximum and minimum temperature ranged between 11.9 to 38 ºC and 2.6 to 20 ºC, respectively. The mean weekly values of morning and evening relative humidity ranged between 70 to 100 and 20 to 82 per cent respectively, while sunshine ranged between 1.1 to 8.7 hrs during crop season.The experiment was comprised of three nitrogen doses (N_1-60, N_2-75 and N_3- 90 kg N/ha) as main plot treatments and four seed rates (S_1- 87.5, S_2- 100, S_3- 112.5 and S_4-125.0 kg/ha) as sub plot treatments. Experiment was laid out in split plot design with four replications. All the other standard agronomic practices for the cultivation of barley were followed uniformly in all the treatments. For determination of N, P, K content in straw/grain, 0.2 g ground material of straw/seed samples were digested with 10 ml of diacid mixture of H2SO4 and HClO4 in a ratio of 9:1 on a hot plate to obtain a clear colorless solution (3-4 ml). It was transferred in a 50 ml conical flask and distilled water was added to make volume up to mark. It was passed through Whatman filter paper No. 42 and stored in a plastic bottle for further analysis. i) Colorimetric (Nessler's reagent) method (Lindner, 1944) was used to determine nitrogen in straw taking 0.2 ml of aliquot. ii) Phosphorus in straw samples was measured by the Vanadomolybdophosphoric yellow color method using 5 ml of aliquot (Jackson, 1973). iii) Potassium in straw samples was directly determined in aliquot using a flame photometer (Richards, 1954). NPK uptake was computed using the following formula:

$$\text{NPK uptake (kg/ha)} = \frac{\%\ \text{NPK content} \times \text{Yield of (Grain/Straw)}}{100}$$

The protein content (%) of grain was calculated by multiplying nitrogen percentage in grain by 6.25, a conversion factor for estimating protein content. The experimental data were analyzed by using OPSTAT software available on CCS Haryana Agricultural University home page (Sheoran *et al.,* 1998).

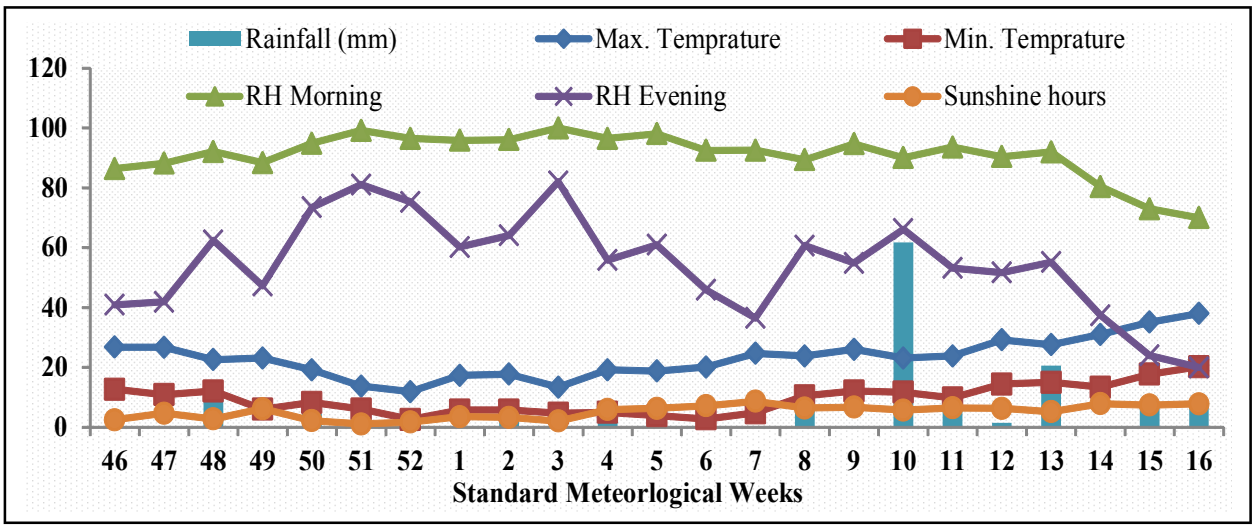

Fig. 1. Mean weekly weather condition during cropping period.

RESULTS AND DISCUSSION

Protein content (%) in grain

A delve to data given in Table 1 presented that protein content (%) was significantly affected by nitrogen dose. Increasing nitrogen dose from 60 to 90 kg/ha progressively increased protein content (%) in grain. Nitrogen dose of 90 kg/ha recorded 5.7 and 16.8 per cent higher over 75 and 60 kg/ha nitrogen dose, respectively. The higher protein yield with higher nitrogen levels is on account of increased yield as well as more nutrient content with increasing N levels. Similar findings were also reported by Shaktawat and Shekhawat (2010).

Protein content progressively decreased with the increase in seed rate from 87.5 kg/ha to 125.0 kg/ha. Protein content obtained with 87.5 kg/ha in grain was found significantly higher over other seed rates. Protein content (10.65%) recorded with seed rate of 87.5 kg/ha was significantly higher with a relative advantage of 12.1 and 8.9 per cent over seed rate of 125.0 and 112.5 kg/ha. Reductions in protein concentration with increasing seed rate of barley have been documented previously (O'Donovan *et al.,* 2011).

Protein content (%) in straw

A delve to data given in table 1 presented that protein content (%) was significantly affected by nitrogen dose. Increasing nitrogen dose from 60 to 90 kg/ha progressively increased protein content (%) in straw. Nitrogen dose of 90 kg/ha recorded 9.5 and 17.6 per cent higher protein content over 75 and 60 kg/ha nitrogen dose, respectively. The significant improvement in nutritional status of grain and straw could be ascribed to their greater availability of nutrients in soil environment along with extraction and translocation towards plant system. This improvement in protein content under the influence of higher fertility level seemed to be on account of increased N content of green fodder, grain and straw. The results are in collaboration with the findings of Duhan (2014).

Protein content progressively decreased with the increase in seed rate from 87.5 kg/ha to 125.0 kg/ha. Protein content obtained with 87.5 kg/ha in grain was found significantly higher over other seed rates. Protein content (2.40%) recorded with seed rate of 87.5 kg/ha was significantly higher with a relative advantage of 15.4 and 11.6 per cent over seed rate of 125.0 and 112.5 kg/ha. Increase in population over and above optimum population might have caused competition for space as well as growth and proliferation of root and therefore, reduced protein percent.

NPK content in grain

A close perusal of data in Table 1 revealed that progressive significant increase in N, P and K content in grain with increase in nitrogen dose from 60 to 90 kg/ha. N, P and K content in grains with nitrogen dose of 90 kg/ha were found significantly higher over other nitrogen doses. Nitrogen dose of 90 kg/ha recorded 5.5, 9.1, 11.1 and 17.1, 20.0, 25.0

TABLE 1
Effect of nitrogen dose and seed rate on protein and NPK content (%) in grain and straw

Treatment	Protein content (%)		N content (%)		P content (%)		K content (%)	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
Nitrogen dose								
N_1–60 kg/ha	9.15	2.05	1.46	0.33	0.20	0.13	0.32	1.14
N_2–75 kg/ha	10.11	2.20	1.62	0.35	0.22	0.14	0.36	1.19
N_3–90 kg/ha	10.69	2.41	1.71	0.38	0.24	0.14	0.40	1.20
S. Em±	0.15	0.04	0.02	0.01	0.003	0.002	0.005	0.02
C. D. (P=0.05)	0.44	0.11	0.07	0.02	0.01	0.01	0.02	NS
Seed rates								
S_1–87.5 kg/ha	10.65	2.40	1.70	0.38	0.23	0.15	0.39	1.26
S_2–100.0 kg/ha	10.00	2.25	1.60	0.36	0.22	0.14	0.36	1.18
S_3–112.5 kg/ha	9.78	2.15	1.56	0.34	0.21	0.13	0.35	1.14
S_4–125.0 kg/ha	9.50	2.08	1.52	0.33	0.21	0.13	0.35	1.12
S. Em±	0.13	0.03	0.02	0.005	0.004	0.002	0.01	0.01
C. D. (P=0.05)	0.45	0.11	0.07	0.02	0.01	0.01	0.02	0.05

percent higher N, P, K content over 75 and 60 kg/ha nitrogen dose, respectively. Thus greater availability of nutrients with additional nitrogen seems to have maintained critical concentration at cellular level, fulfilled their requirements for profuse plant growth and their efficient translocation towards sink component (straw and grain). Similar findings were also reported by Shaktawat and Shekhawat (2010).

Data presented given in Table 1 exhibited that in N, P and K content in grain progressively decreased with the increase in seed rate from 87.5 kg/ha to 125.0 kg/ha. N, P and K content in grain obtained with 87.5 kg/ha was found significantly higher over other seed rates. N (1.70%), P (0.23%), K (0.39%) content recorded with seed rate of 87.5 kg/ha was significantly higher with a relative advantage of 9.0, 9.5, 11.4 and 11.8, 9.5, 11.4 percent over seed rate of 112.5 and 125.0 kg/ha, respectively. Increase in population over and above optimum population might have caused competition for space as well as growth and proliferation of root and therefore, reduced nutrient uptake which in turn failed to improve N, P and K content and uptake of these plant parts significantly.

NPK content in straw

A close perusal of data in Table 1 revealed that progressive significant increase in N and P content in straw with increase in nitrogen dose from 60 to 90 kg/ha while K content in straw failed to produce significant variation among different nitrogen doses. N content with nitrogen dose of 90 kg/ha was found significantly higher over other nitrogen doses while P content with nitrogen dose of 90 kg/ha was found significantly higher over 60 kg/ha nitrogen dose but non-significant differences were recorded between 75-90 kg/ha. Nitrogen dose of 90 kg/ha recorded 8.6 and 15.1 percent higher N content over 75 and 60 kg/ha nitrogen doses, respectively.

Data presented given in Table 1 exhibited that in N, P and K content in straw progressively decreased with the increase in seed rate from 87.5 kg/ha to 125.0 kg/ha. N and P content in straw obtained with 87.5 kg/ha was found significantly higher over other seed rates except seed rate of 100.0 kg/ha while K content with seed rate of 87.5 kg/ha was found significantly higher over other seed rates. N (0.38%), P (0.15%), K (1.26%) content recorded with seed rate of 87.5 kg/ha was significantly higher with a relative advantage of 11.7, 15.4, 10.5 and 15.1, 15.4, 12.5 percent over seed rate of 112.5 and 125.0 kg/ha, respectively.

NPK uptake by grain

An attentive perception of data given in Table 2 indicate that progressive significant increase in N, P and K uptake by grain with increase in nitrogen dose from 60 to 90 kg/ha. N, P and K uptake in grain with nitrogen dose of 90 kg/ha was found significantly higher over other nitrogen doses. Nitrogen dose of 90 kg/ha recorded 8.3, 9.4, 15.2 and 27.8, 33.0, 37.2 per cent higher N, P, K uptake over 75 and 60 kg/ha nitrogen doses, respectively. The positive relation of N application in nutritional status of grain may be ascribed to more supply of nutrient in soil as well as translocation and extraction within plants mechanism.

TABLE 2
Effect of nitrogen dose and seed rate on N, P and K uptake (kg/ha) in grain and straw

Treatment	N uptake		P uptake		K uptake	
	Grain	Straw	Grain	Straw	Grain	Straw
Nitrogen dose						
N_1–60 kg/ha	65.24	21.10	8.70	8.30	14.28	72.70
N_2–75 kg/ha	77.03	24.43	10.57	9.44	17.00	82.73
N_3–90 kg/ha	83.43	28.16	11.57	10.35	19.59	87.43
S. Em±	0.20	0.22	0.07	0.04	0.17	0.21
C. D. (P=0.05)	0.59	0.66	0.21	0.13	0.49	0.62
Seed rates kg/ha						
S_1–87.5 kg/ha	75.47	24.79	10.39	9.42	17.16	81.49
S_2–100.0 kg/ha	75.29	24.65	10.31	9.37	17.00	81.02
S_3–112.5 kg/ha	75.20	24.55	10.23	9.35	16.91	80.79
S_4–125.0 kg/ha	74.99	24.28	10.19	9.31	16.77	80.52
S. Em±	0.26	0.27	0.07	0.31	0.15	0.30
C. D. (P=0.05)	NS	NS	NS	NS	NS	NS

Data mentioned in Table 2 reflects that seed rate failed to produce significant variation in relation to N, P and K uptake by grain. Increasing seed rates from 87.5 to 125.0 kg/ha progressively decreased N, P and K uptake. However, numerical variation was recorded among different seed rates regarding N, P and K uptake. Higher N (75.47), P (10.39) and K (17.16) uptake by grain were recorded with seed rate 87.5 kg/ha while minimum uptake recorded with 125.0 kg/ha (74.99), (10.19) and (16.77) seed rate, respectively.

NPK uptake by straw

An attentive perception of data given in table 2 indicate that progressive significant increase in N, P and K uptake by straw with increase in nitrogen dose from 60 to 90 kg/ha. N, P and K uptake in straw with nitrogen dose of 90 kg/ha was found significantly

higher over other nitrogen doses. Nitrogen dose of 90 kg/ha recorded 15.3, 9.6, 5.7 and 33.4, 24.7, 20.3 per cent higher N, P, K uptake over 75 and 60 kg/ha nitrogen doses, respectively. As the uptake is a product of yield and nutrient content, considerable increase in either of components may increase N and P uptake.

Data mentioned in table 2 reflects that seed rate failed to produce significant variation in relation to N, P and K uptake by straw. Increasing seed rates from 87.5 to 125.0 kg/ha progressively decreased N, P and K uptake. However, numerical variation was recorded among different seed rates regarding N, P and K uptake. Higher N (24.79), P (9.42) and K (81.49) uptake by straw were recorded with seed rate 87.5 kg/ha while minimum uptake recorded with 125.0 kg/ha (24.28), (9.31) and (80.52) seed rate, respectively. It is an established fact that nutrient accumulation depends upon dry matter accumulation and concentration of nutrient at cellular level. The non-significant effect of seed rate on N, P and K uptake failed to record perceptible variation in uptake of these nutrients. The results of the present investigation strongly support findings of Jani (2005).

CONCLUSION

Based on field research, it is concluded that increasing nitrogen dose from 60 to 90 kg/ha progressively increased protein content and nutrient uptake in grain and straw which were significantly higher than nitrogen dose of 60 and 75kg/ha, respectively. Among seed rates, 87.5 kg/ha closely followed by 100.0 kg/ha recorded significantly higher protein content in grain and straw which was significantly higher over higher seed rate. So, to obtain good quality grain and straw of dual purpose barley should be sown using optimum seed rate of 87.5 kg/ha and nitrogen dose of 90 kg/ha.

REFERENCES

Duhan, B. S. 2014 : Effect of nitrogen, phosphorus and FYM on yield and nutrients uptake by barley (*Hordeum vulgare* L.). *Forage Res.,* **39**: 205-207.

Ertekin I., I. Atis, Y.Z. Aygun, S. Yilmaz, M. Kizilsimsek, 2022 : Effects of different nitrogen doses and cultivars on fermentation quality and nutritive value of Italian ryegrass (*Lolium multiflorum* Lam.) silages. *Anim. Biosci.,* **35**(1): 39-46.

Jackson, M. L., 1973 : Soil chemical analysis. Prentice Hall of India Pvt. Ltd., New Delhi. pp. 183-192.

Jani, P. P. 2005 : Performance of durum wheat (*Triticum durum* Des f.) varieties under varying sowing methods and input levels. Ph.D. (Agron.) Thesis, Department of Agronomy, MPUAT, Udaipur.

Khalil, S.K., F. Khan, A. Rehman, F. Muhammad, Amanullah, A.Z. Khan, S. Wahab, S. Akhtar, M. Zubair, I.H. Khalil, M.K. Shah and H. Khan, 2011 : Dual purpose wheat for forage and grain yield in response to cutting, seed rate and nitrogen. *Pak. J. Bot.,* **43**(2): 937-947.

Kharub, A. S., R. P. S. Verma, D. Kumar, V. Kumar, R. S. Kumar, and Indu Sharma, 2013 : Dual purpose barley (*Hordeum vulgare* L.) in India :Performance and potential. *Journal of Wheat Research*, **5** : 55-58.

Lindner, R. C., 1944 : Rapid analytical methods for some of the more common inorganic constituents of plant tissues. *Plant Physiology,* **19** : 76-86.

O'Donovan, J. T., T. K. Turkington, M. J. Edney, G. W. Clayton, R. H. McKenzie, P. E. Juskiw and W. E. May, 2011 : Seeding rate, nitrogen rate, and cultivar effects on malting barley production. *Agron. J.,* **103**(3): 709-716.

Richards, L. A., 1954 : Diagnosis and improvement of saline and alkali soils. USDA Hand Book No. 60, Washington, D. C.

Shaktawat, R. P. S. and P. S. Shekhawat, 2010 : Soil fertility status as affected with and farmyard manure in *Kharif* crops and fertilizer levels in barley (*Hordeum vulgare* L.). *Indian J. Agric. Sci.,* **80**: 791-94.

Sheoran, O. P., D. S. Tonk, L. S. Kaushik, R. C. Hasija, and R. S. Pannu, 1998 : Statistical Software Package for Agricultural Research Workers. Recent Advances in information theory, Statistics & Computer Applications by D. S. Hooda and R. C. Hasija, Department of Mathematics Statistics, CCS HAU, Hisar (139-143).

Singh, B., A. K. Dhaka and M. Kumar, 2016 : Performance of dual purpose barley varieties under different nitrogen application schedules. *Forage Res.,* **41**(4): 246-248.