Forage Res., **47** (1) : pp. 79-83 (2021) **http://forageresearch.in**

PERFORMANCE OF DUAL-PURPOSE WHEAT AS INFLUENCED BY CUTTING AND NITROGEN SCHEDULES

ABDUL RAUF[1], BHAGAT SINGH[2,*] AND A. K. DHAKA[2]

[1]Department of Cooperative,
Directorate of Agriculture, Irrigation & Livestock, Province Nangarhar, Afghanistan
[2]Department of Agronomy,
CCS Haryana Agricultural University, Hisar-125004 (Haryana), India
(e-mail: bsdahiya@gmail.com)

(Received : 14 June 2021; Accepted : 28 June 2021)

SUMMARY

Present investigation was carried out during *Rabi* season of 2018-19 at Wheat Section Research Area of CCS Haryana Agricultural University, Hisar. The experiment was laid out in split plot design with four replications. In main plot, three cutting schedules *i.e.* 45 DAS, 55 DAS and 65 DAS were taken and six nitrogen schedules *i.e.* N_1- 1/3 basal +1/3 at first irrigation and 1/3 after cut, N_2- ½ basal + ½ at first irrigation, N_3-½ basal and ½ after cut, N_4- ¼ basal +½ at first irrigation and ¼ after cut, N_5 - ½ basal +¼ at first irrigation and ¼ after cut, N_6 - ¼ basal +¼ at first irrigation and ½ after cut as sub plot treatments. Based on the research findings, it was observed that different cutting and nitrogen schedules significantly influenced the growth, yield attributes and yield of dual-purpose wheat. Crop cut at 45 DAS for green fodder resulted in significantly higher plant height, dry matter accumulation (415.0 g), number of tillers (112.2 /mrl), number of effective tillers/mrl (102.87), grains per spike (47.61) and 1000 grain weight (42.57g) as compared to crop cut at 55 DAS and 65 DAS. Crop cut at 45 DAS for green fodder also produced maximum grain yield (61.36 q/ha) and straw yield (98.12 q/ha), which were significantly higher than cut at 55 and 65 DAS. Whereas, minimum grain yield (47.42 kg/ha) was recorded when crop cut was taken at 65 DAS for green fodder. Among different nitrogen schedule, N_3 resulted in maximum plant height (106.9 cm), dry matter accumulation, number of tillers (109.0), number of effective tillers (100.50), grain per ear head and 1000-grain weight. Similarly, maximum grain yield (56.88 q/ha) was recorded when half nitrogen dose was applied as basal and half dose of nitrogen was applied just after cut (N_3) which was significantly higher than N_2 and N_5 but it was at par with N_1, N_4 and N_6. Whereas, minimum grain yield (54.09 q/ha) was recorded with N_2 treatment. However, maximum straw yield (98.12 qha^{-1}) was recorded with N_1 being at par with N_3 and N_6 but significantly higher as compared with rest of the nitrogen schedule.

Key words : Wheat, dual purpose, nitrogen, cutting, grain yield

Wheat (*Triticum aestivum*) is the second important food and strategic cereal crop for the majority of the world population (about 2 billion people which is around 36 per cent of the world population). The area, production and productivity of wheat in India is 30.7 m ha, 97.4 m t and 3172 kg/ha, respectively. The area, production and productivity of wheat in Haryana state is 2.54 m ha, 11.4 m t and 4407 kg/ha, respectively (ICAR-IIWBR, 2019). In addition to this, we also get straw as by-product, which is generally utilized as dry fodder for animals (Preeti *et al.,* 2016). But for milch animals, green fodder is required. Increasing milk productivity in view of fodder deficiency, particularly in arid and semiarid regions, has also been a major challenge for the farmers in the country. There is greater need to find an alternative production system as compared to wheat grain monoculture. Cutting of wheat for forage purpose during its vegetative growth stages would provide a reasonable, high-quality forage source for livestock. However, cutting may reduce grain yield in wheat, due to leaf area limitations and tiller senescence during reproduction phase if crop is not managed properly. On the other hand, normal vegetative growth is required after cutting to produce reasonable yield. This is possible if good regeneration of the crop is achieved and adequate nutrition is provided to the crop well in time after cutting. To achieve better regeneration of the crop, cutting time is very important, but the information on this aspect is not available in respect to wheat. Similarly, time of nitrogen fertilizer application is the most limiting factor in the production of grain and forage production of dual-purpose wheat. In order to mitigate the losses caused by crop cutting for fodder, split application of nitrogen may play a significant role through rapid growth of plant by providing the proper plant stand. The studies on these aspects are very scanty. Therefore, the experiment was plan to study to effects of cutting and nitrogen schedules on the performance of dual -purpose wheat.

MATERIALS AND METHODS

The field experiment was conducted at Wheat and Barley Section Research Area, CCSHAU, Hisar during *Rabi* season of 2018-19. The experiment was laid out in split plot design with four replications. The main plot treatments were three cutting schedules at 45, 55 and 65 days after sowing (DAS) and six nitrogen schedules *i.e.* N_1- 1/3 basal + 1/3 at first irrigation and 1/3 after cut, N_2 - ½ basal + ½ at first irrigation, N_3 - ½ basal and ½ after cut, N_4 - ¼ basal + ½ at first irrigation and ¼ after cut, N_5 - ½ basal + ¼ at first irrigation and ¼ after cut and N_6 - ¼ basal + ¼ at first irrigation and ½ after cut were taken as sub plot treatments. The soil of the experimental field was sandy loam. The soil of field was almost neutral (pH 7.6) with organic matter content of 0.25%. The available N, P and K content of soil were 128, 16.5 and 243 kg ha^{-1}, respectively. Wheat variety HD 3086 was used for dual purpose. Seeds were sown by hand plough with 20 cm row spacing. Full dose of phosphorus and potassium was applied as basal and nitrogen was applied according to treatments. Weeding and hoeing was done mechanically at 30 DAS and after cutting. Data on growth, yield attributes and yields were recorded at maturity with standard procedure.

RESULTS AND DISCUSSION

Growth Studies

Plant height (cm)

In present study, it was observed that among different cutting schedules cut at 45 DAS resulted in significantly taller plants in comparison to rest of the cutting schedules (Table 1). Plant height reduced by 5.59 and 15.97 per cent by delayed cut at 55 and 65 DAS as compared to cut 45 DAS, respectively. Forage harvest might have slowed down the rate of internode elongation and caused reduction in the supply of assimilates from the leaves to roots. This might be the reason for shorter plants with delay harvesting (Gill *et al.*, 2017). Among different nitrogen schedule, N_3 resulted in significantly taller plants (106.9 cm) as compared N_2, but it was statistically at par with rest of the treatments. The higher crop growth rate in the treatments receiving more nitrogen in after cut was attributed to availability of sufficient nitrogen which subsequently enhances photosynthetic activity (Naveed *et al.*, 2013). Iqbal *et al.* (2012) also informed that an increase in plant height due to nitrogen fertilization in split. This tendency can be attributed to higher dose of N, which greatly helps the plant to expose its potential to grow vigorously.

Dry matter accumulation

Among different cuttings schedule, crop cut at 45 DAS resulted in significantly higher dry matter accumulation (415.0 g) as compared to crop cut at 55 DAS and 65 DAS (Table 1). Crop cut at 45 DAS recorded 15.9 and 30.84 per cent higher dry matter accumulation as compared to crop cut at 55 DAS and 65 DAS, respectively. Among various nitrogen schedules, maximum dry matter was accumulated when nitrogen was applied in two splits *i.e.* half dose of nitrogen as basal and half nitrogen after cut (N_3), which was significantly higher than N_2 treatment *i.e.* half does of nitrogen was applied as basal and half nitrogen at first irrigation but it was statistically at par with the treatments when nitrogen was applied in three splits. N_3 resulted in 0.35, 2.77, 4.25, 6.12 and 9.94 per cent higher dry matter as compared to N_1, N_4, N_6, N_5 and N_2, respectively. Application of 150 kg N ha^{-1} in 3 splits resulted in significantly taller plants, higher leaf area index, more dry matter accumulation (Kumar *et al.,* 2010).

Number of tillers

Number of tillers per meter row length is a useful and important index of the growth of the plant to give an idea about the dry matter production leading to the yield. Cutting and nitrogen schedules showed significant effect on the number of tillers (Table 1). Among different cutting schedules, maximum number of tillers (112.2 /mrl) were recorded when cut was taken at 45 DAS, which was significantly higher than cut at 55 and 65 DAS. Crop cut at 45 DAS resulted in 4.81 and 13.63 per cent higher number of tillers as compared to cut at 55 DAS and 65 DAS, respectively. Among different nitrogen schedules, N_3 resulted in significantly higher number of tillers (109.0) as

TABLE 1
Effect of different cutting and nitrogen schedule on growth of dual-purpose wheat at maturity

Treatment	Plant height (cm)	Dry matter accumulation (g/mrl)	Number of tillers/mrl
Cutting schedule			
C_1-45 DAS	112.7	415.0	112.2
C_2-55 DAS	106.4	349.0	106.8
C_3- 65 DAS	94.7	287.0	96.9
SEm ±	1.4	5.32	0.7
CD at 5%	5.0	18.77	2.5
Nitrogen schedule			
N_1- 1/3 basal + 1/3 at first irrigation and 1/3 after cut	105.2	363.0	107.0
N_2- ½ basal + ½ at first irrigation	100.6	328.1	100.2
N_3- ½ basal and ½ after cut	106.8	364.3	109.0
N_4- ¼ basal + ½ at first irrigation and ¼ after cut	104.7	354.2	106.4
N_5- ½ basal + ¼ at first irrigation and ¼ after cut	104.2	342.0	104.2
N_6 - ¼ basal + ¼ at first irrigation and ½ after cut	106.1	348.8	105.0
SEm ±	1.05	8.20	1.8
CD at 5%	2.99	23.47	5.1

compared to N_2, but it was statistically at par with rest of the nitrogen schedules. N_3 recorded 1.83, 2.39, 4.40, 3.67, and 8.07 per cent higher tillers as compared to N_1, N_4, N_6, N_5 and N_2, respectively. Split application of fertilizers especially nitrogen was reported to be associated with the better use efficiency of nitrogen leading to better growth and development of plant (Kumar *et al.*, 1997). It may be due to the optimum amount of nitrogen available for regeneration of tissues through increased cells expansion and elongation (Naveed *et al.*, 2013).

Yield Attributes and Yield

Yield attributes

Number of effective tillers/mrl, number of grains per spike and 1000 grain weight were significantly influenced by cutting and nitrogen schedules (Table 2). Among different cutting schedules, maximum number of effective tillers/mrl (102.87), grains per spike (47.61) and 1000 grain weight (42.57g) were recorded when crop was cut at 45 DAS for green fodder, which were significantly higher than cut at 55 DAS and 65 DAS. Cut at 45 DAS produced 4.13 and 14.17 per cent higher effective tillers, 5.9 and 13.13 per cent higher number of grains per spike and 1.95 and 6.13 per cent higher 1000 grains weight as compared to cut at 55 DAS and 65 DAS, respectively. Cutting of wheat crop for green fodder at 65 DAS had reduced number of effective tillers/mrl significantly as compared to 45 DAS and 55 DAS. Gill *et al.* (2017) also reported that the number of effective tillers (546.4) were produced significantly higher where one cutting for forage was taken at 45 DAS and further delay in forage harvest to 60 DAS significantly reduced the number of effective tillers per unit area. Reduction in effective tillers might be due to forage removal as forage harvest imposed the stress on roots due to lesser photosynthetic assimilation and resulted in decreased dry matter accumulation and further turn out of tillers to effective tillers. Cutting of wheat crop at 65 DAS for green fodder purpose had reduced weight of grain significantly as compared to cut at 45 and 55 DAS. The reason of low grain weight might be due to removal of photosynthetic organs by clipping which negatively affected source sink relationship. Shuja *et al.* (2010) also reported maximum number of grains per spike obtained on early cutting of wheat crop and minimum was obtained with cut at 65 DAS of wheat crop. The reason of maximum number of grains spike^{-1} obtained in earlier cutting crop was possibly due to longer growing season and more transfer of photosynthesis from source (leaf) to sink (grain) which resulted in better development of grain accompanied by grain filling. Reduction in 1000 grain weight with forage cut might be due to more percentage of shriveled grains with forage cutting due to shortening of grain filling period and the percentage of shriveled grains further increased with delay in forage harvest (Gill *et al.,* 2017).

In present experiment, number of effective tillers (mrl), number of grains per spike and 1000 grain weight were significantly influenced by nitrogen schedules (Table 2). Among various nitrogen schedules, maximum number of effective tillers (100.50) were recorded when half nitrogen applied as basal and half nitrogen was applied after cut, which was significantly higher than the treatment when half nitrogen was applied at basal and half nitrogen at first irrigation. However, it was statistically at par with rest of the treatments. In terms of number of effective tillers, N_3 resulted in 0.92, 2.82, 4.40, 4.98 and 10.20 per cent higher effective tillers as compared to N_1, N_4, N_6, N_5 and N_2, respectively. Similar trend was also recorded for grain per ear head and 1000-grain weight. In relation to number of grains per spike N_3 was recorded with 0.13, 0.75, 0.42, 2.54 and 4.80 per cent higher grains per spike than N_1, N_6, N_4, N_5 and N_2, respectively. Similarly, N_3 was recorded with 0.29, 1.61, 1.73, 1.92 and 4.96 per cent higher 1000 grains weight than N_1, N_4, N_6, N_5 and N_2, respectively. Bulk nitrogen application at sowing may have resulted in leaching or volatilization of the nutrient that subsequently resulted in significantly lower number of productive tillers. The reason of increased number of grains produced in plots receiving major portion of the nutrient after cut may be attributed to the positive role of nitrogen in cells expansion, enlargement and over and above the grain filling (Naveed *et al*., 2013).

Grain yield (q/ha)

Grain yield was significantly affected by cutting and nitrogen schedules (Table 2 and Fig. 1). Among various cutting schedule, crop cut at 45 DAS for green fodder produced maximum grain yield (61.36 q/ha), which was significantly higher than cut at 55 DAS and 65 DAS. Whereas, minimum (47.42 q/ha) grain yield was recorded with cut at 65 DAS. The grain yield was decreased by 8.02 and 22.72 per cent by delay in cutting from 45 DAS to cut at 55 DAS and 65 DAS, respectively. The reason for significant reduction of grain yield in late cut at 65 DAS was possibly due to removal of photosynthetic tissues that resulted in lower crop growth rate, grain weight and number of productive tillers which resulted in low grain yield (Waheddullah *et al*., 2018).

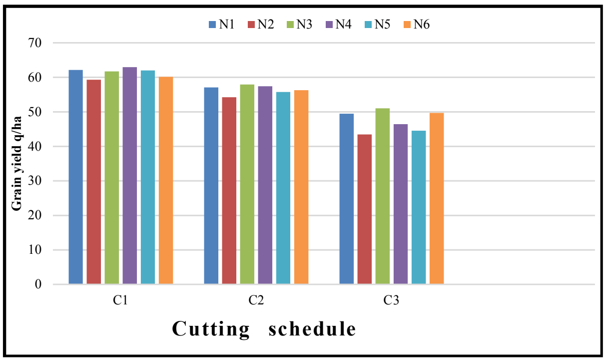

Fig. 1. Effect of different cutting and nitrogen schedules on grain yield (q/ha) of dual purpose wheat.

Among different nitrogen schedules, maximum grain yield (56.88 q/ha) was recorded when half nitrogen dose was applied as basal and rest was

TABLE 2

Effect of different cutting and nitrogen schedule on yield attributes of dual - purpose wheat

Treatment	Yield attributes			Yields (q/ha)	
	No. of effective tiller/mrl	No. of grain/ spike	Test weight (g)	Grain yield	Straw yield
Cutting schedule					
C_1-45 DAS	102.87	47.61	42.57	61.36	98.12
C_2-55 DAS	98.62	44.80	41.74	56.44	83.22
C_3- 65 DAS	88.29	41.36	39.96	47.42	66.62
SEm ±	1.09	0.39	0.33	0.54	0.88
CD at 5%	3.86	1.40	1.17	1.93	3.11
Nitrogen schedule					
N_1- 1/3 basal +1/3 at first irrigation and 1/3 after cut	99.58	45.18	42.04	56.20	85.32
N_2- ½ basal +1/2 at first irrigation	90.25	43.07	40.07	52.33	77.55
N_3- ½ basal and ½ after cut	100.50	45.24	42.16	56.88	84.49
N_4- 1/4 basal + ½ at first irrigation and 1/4 after cut	97.67	44.90	41.48	55.58	82.57
N_5-1/2 basal + 1/4 at first irrigation and ¼ after cut	95.50	44.09	41.35	54.09	80.97
N_6 - 1/4 basal +1/4 at first irrigation and 1/2 after cut	96.08	45.05	41.43	55.37	85.06
SEm ±	1.40	0.49	0.37	0.52	0.82
CD at 5%	4.01	1.42	1.07	1.47	2.34

applied after cut (N_3), which was significantly higher than treatment in N_2 and N_5 but it was at par with in N_1, N_4 and N_6. Whereas, minimum grain yield (52.33 q/ha) was recorded with N_2. N_3 resulted in 1.20, 2.29, 2.65, 4.91 and 8.00 per cent higher grain yield as compared to N_1, N_4, N_6, N_5 and N_2, respectively.

The maximum grain yield (62.92 q/ha) was recorded when crop was cut for green fodder at 45 DAS and nitrogen was applied as ¼ basal + ½ at first irrigation and ¼ after cut in interaction effect (Fig. 1).

Singh *et al.* (2012) also revealed that the application of nitrogen in three splits (1/3 at basal+1/3 immediate after cut+1/3 at 100 DAS) recorded significantly highest grain yield compared to other schedules. The higher yield in three splits may be attributed to better availability of nitrogen to the crop during entire season. Kharub *et al.* (2013) also revealed that highest grain yield was obtained when nitrogen applied in three splits (1/3 at basal+1/3 immediate after cut+1/3 tillering stage after cut) closely followed by two splits (1/2 at basal+1/2 immediate after cut).

Straw yield (q/ha)

Straw yield was also significantly influenced by cutting and nitrogen schedules (Table 2). Among various cutting schedules, cut at 45 DAS resulted in significantly higher straw yield (98.12 q/ha) as compared to cut at 55 DAS and 65 DAS. Early cutting at 45 DAS recorded with 15.19 and 32.10 per cent higher straw yield over cut at 55 and 65 DAS, respectively. Among different nitrogen schedules, maximum straw yield was recorded with N_1 being at par with N_3 and N_6, but it was significantly higher than rest of the nitrogen doses. N_1 resulted in 0.30, 0.97, 3.22, 5.10 and 10.10 per cent higher straw yield as compared to N_6, N_3, N_4, N_5 and N_2, respectively. With delay in cut for green fodder, straw yields reduction might be due to shortening of vegetative and reproductive period (Waheddullah *et al*., 2018).

CONCLUSION

It is concluded that to obtain maximum grain yield of dual- purpose wheat, take cut at 45 DAS for green fodder along with nitrogen (150 kg/ha) applied in two splits *i.e.* half nitrogen dose was applied as basal and half dose of nitrogen was applied after cut or 1/3 basal + 1/3 at first irrigation and 1/3 after cut may be followed.

ACKNOWLEDGEMENT

First Author, Mr. Abdul Rauf is thankful to Head of the Department, Department of Agronomy, CCS HAU, Hisar for providing the necessary facilities to conduct his M. Sc. (Agriculture) Agronomy research work.

REFERENCES

Gill, G.K., C.S. Aulakh and P.K. Sharma, 2017 : Effect of Agronomic practices on green fodder, grain quality, grain yield and economics of dual-purpose barley (*Hordeum vulgare* L.). *Int. J. Curr. Microbiol.* App. Sci. **6** (7): 1492-1497.

ICAR-IIWBR, 2019 : Director's report of AICRP on Wheat and Barley, 2018-19, Ed: G.P. Singh. ICAR-Institution of Wheat and Barley Research, Karnal, Haryana India. p.72

Iqbal, J., K. Hayat, S. Hussain, A. Ali and M.A.A.H.A. Bakhsh, 2012 : Effect of seeding rates and nitrogen levels on yield and yield components of wheat (*Triticum aestivum* L.). *Pak. J. Nu.,* **11**: 531-536.

Kharub, A.S., R.P.S. Verma, D. Kumar, V. Kumar, R. Selvakumar and I. Sharma, 2013 : Dual purpose barley (*Hordeum vulgare* L.) in India: Performance and potential. *J. Wheat Res.*, **5** (1): 55-58.

Kumar, A., K. D. Sharma and A. Yadav, 2010 : Enhancing yield and water productivity of wheat (*Triticum aestivum*) through furrow irrigated raised bed system in the Indo-Gangetic Plains of India. *Indian. J. Agric. Sci*., **80**: 198-202.

Kumar, Y., B.L. Sharma, G.H. Yadav and P.K. Sharma, 1997 : Nitrogen management in fodder crop of double-cut oat (*Avena sativa*). *Indian. J. Agron.* **42**: 313-15.

Naveed, K., M.A. Khan, M.S. Baloch, N. Khan and M. A. Nadim, 2013 : Effect of time of nitrogen application on morphological and physiological attributes of dual-purpose wheat. *Pak. J. Bot*., **45**(4): 1299-1305.

Preeti, I. S. Panwar and R. K. Arya, 2016 : Effect of changing environment on wheat dry matter yield. *Forage Res.,* **42** : 56-61.

Shuja, M. N., D. Nayab, M. Ali, A. Iqbal and I.H. Khalil, 2010: Evaluating the response of wheat genotypes to forage clipping. *Intern. J. Agri. Bio*., **12**: 111-114.

Singh, G., D. R. Thakur, D.K. Parmar and S. Manuja. 2012 : Effect of different nitrogen levels and its scheduling on dual purpose barley under rainfed conditions in north-western Himalayas. *Extended Summaries Vol. 2. 3rd International Agronomy Congress on "Agriculture Diversification, Climate Change, Management and Livelihoods held at New Delhi from November* 26-30, 2012. pp. 67-68.