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Growth, NPK uptake and forage quality of napier bajra hybrid as influenced by mulch and irrigation schedules

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Abstract
A field experiment was conducted at Punjab Agricultural University, Ludhiana, India during 2014 and 2015 to study the effect of mulch and irrigation schedules on growth, NPK uptake and quality of napier bajra hybrid (*Pennisetum purpureum Pennisetum glaucum*). The experiment was laid out in split plot design with three replications, keeping four mulch levels (no mulch, mulch @ 5 t/ha, 7.5 t/ha and 10 t/ha) in main plot and three irrigation schedules (IW/CPE ratio of 0.8, 1.0 and 1.2) in sub plot. The mulch levels of 10 t/ha and 7.5 t/ha were at par with each other during both years to significantly increase the growth attributes (plant height, tiller count, leaf-stem ratio, leaf area index and PAR), dry fodder yield, NPK uptake and quality parameters *viz.*, moisture content, crude protein, crude fibre, mineral matter, IVDMD of crop over 5 t/ha and no mulch application. The growth, NPK uptake and quality of napier bajra hybrid was significantly improved with scheduling irrigation up to IW/CPE ratio of 1.0 that was at par with higher IW/CPE ratio of 1.2.

Keywords: Dry fodder yield, Irrigation, Mulch, Napier bajra hybrid, NPK uptake, Quality

Abbreviations: **CPE**: Cumulative pan evaporation, **IVDMD**: In vitro dry matter digestibility, **IW**: Irrigation water, **K**: Potassium, **N**: Nitrogen, **NBH**: Napier bajra hybrid, **P**: Phosphorous, **PAR**: Photosynthetically active radiation

Introduction

In India, the green fodder and dry fodder availability is deficit by 61 and 22% respectively. To feed the livestock population, 1025 million tonnes of green fodder and 569 million tonnes of dry roughages are required annually (Das *et al.,* 2009). By 2025, the demand for green fodder, dry forage and concentrate feed is expected to reach 1170, 650 and 152 million tonnes, respectively. Green forage supply will have to grow at a growth rate of 3.2% to meet the projected demand. Therefore, in the present scenario, fodder production per unit area should be increased by growing high yielding multicut forages such as napier bajra hybrid (NBH). NBH, an interspecific cross is perennial; erect growing, palatable and nutritious fodder plant. The crop is hardy, resistant to diseases and insect-pests. Water has a significant effect to increase the yield, nutrient content and improve the quality of crop. Moisture content of plant increases tenderness and reduce the lignin content which is a desirable quality to improve the intake by livestock. In water deficit conditions, nutrient availability to plants is also reduced because in presence of moisture in root zone of crop, nutrients become available due to solubilisation. Rostamza *et al.* (2011) reported that pearl millet absorbed more N when sufficient amount of water was available. The dry matter, crude protein, crude fat and other quality factors of fodder are largely affected by irrigation schedules. As the water scarcity becomes increasingly serious, there is a need for adopting optimum irrigation scheduling. Mulching of soil helps to reduce the irrigation frequency and thus improve water use efficiency. Mulching is also beneficial to conserve the soil moisture that is required to improve the succulency and palatability of crop. Thus, efficient use of available irrigation water through proper scheduling of irrigation and application of straw mulch to increase biomass production of NBH is becoming primary researchable issue. Keeping in view the above fact, the present study was undertaken.

Materials and Methods

Experimental site and designing: A field experiment was conducted at research farm, Department of Agronomy, Punjab Agricultural University, Ludhiana during 2014 and 2015. The soil of the experimental site was loamy sand, low in organic carbon (0.35%), available nitrogen (218.7 kg/ha), medium in available phosphorus (19.4 kg/ha) and high in potassium (330 kg/ha). The soil pH (7.8) and electrical conductivity (0.21 dS/m) values were within the normal range. The experiment was conducted in split plot design keeping four levels of mulch (no mulch, mulch

@ 5 t/ha, 7.5 t/ha and 10 t/ha) in main plot and three irrigation schedules (0.8, 1.0 and 1.2 IW/CPE ratio) in sub-plot with three replications. Paddy straw was used as mulching material. The field was prepared by giving three ploughings and planking done after each ploughing. NBH (var.PBN 233) was raised in April, 2014 and 2015 through root slips (30 cm long) having two to three nodes. Approximately 27,500 root slips per hectare were required for planting at spacing of 60 x 60 cm apart in lines. The mulch was applied immediately after planting the crop and irrigations were scheduled based on IW/CPE ratio.

Sampling and laboratory analysis: The first cutting of crop was taken at 60 DAP and samples of napier bajra hybrid were taken for dry matter at the time of harvesting and sun dried. Then, the samples were dried in the oven at 60^0C for constant results. The plant samples were analyzed for N by using Modified-Kjeldahl's method (Piper, 1966), P by using Vanado-molybdate phosphoric yellow colour method in nitric acid system, K concentration by using Lange's Flame photometer described by Jackson (1967). Total uptake of nitrogen, phosphorus and potassium by crop was calculated by multiplying the per cent plant nutrient with respective dry matter yield. For determining the qualitative parameters of NBH, dried plant samples were grinded and analyzed for crude protein by using Modified-Kjeldahl's method given by Jackson (1967), crude fibre and mineral matter contents by using the method of AOAC (1990) and crude fat by the method of Knowless and Watkins (1960). The oxalate content in NBH was analyzed by titration method (Abeza *et al.*, 1968**)**. The data obtained on various characters under study were also tabulated and analyzed statistically.

Results and Discussion

Growth attributes

Plant height: The plant height is one of the major morphological characters, which influences the forage yield. The data on plant height was recorded at first cutting (60 days after planting; Table 1). The plant height was significantly increased with increase in mulch level up to 7.5 t/ha (88.8 and 94.3 cm) over 5 t/ha (79.7 and 81.0 cm) and no mulch (68.1 and 72.1 cm) in 2014 and 2015, respectively. Further increase in mulch rate up to 10 t/ha increased the plant height but could not attain the level of significance during both years. The increase in plant height with mulch might be due to better hydrothermal conditions provided by mulch. These findings confirmed the results of Patel *et al.* (2013) who reported significant increase in plant height under mulched plots in pearl millet. The irrigation schedules significantly increased the plant height during both years. Significantly higher plant height was observed under irrigation schedule of IW/CPE ratio of 1.0 (85.4 and 87.5 cm) than 0.8 (77.7 and 82.3 cm) but was statistically at par with IW/CPE ratio of 1.2 (86.7 and 90.6 cm) in 2014 and 2015, respectively. Tahir *et al.* (2014) also reported the significant effect of different irrigation schedules on plant height.

Tillers count per plant: The number of tillers is recognized as crucial determinant that markedly affect the crop yield. The data on number of tillers per plant showed that 7.5 t/ha mulch level recorded significantly more number of tillers per plant (20.6) than 5 t/ha (17.5) and no mulch application (14.4) but it was at par with 10 t/ha mulch (21.0) in 2014. The differences between 7.5 and 10 t/ha mulch level was non-significant. It was reported that the tiller count significantly increased from no mulch to mulch @ 7.5 t / ha. Similar trend was noticed during year 2015.

Table 1. Effect of mulch and irrigation schedules on growth attributes at first cutting of NBH during 2014 and 2015

Treatments	Plant height (cm)		Tillers count /plant		Leaf-stem ratio		LAI		PAR (%)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Mulch levels (t/ha)										
No mulch	68.1	72.1	14.4	15.3	0.84	0.84	4.02	4.30	68.8	72.4
5	79.7	81.0	17.5	18.1	0.90	0.91	4.78	5.00	74.6	76.4
7.5	88.8	94.3	20.6	21.5	0.97	1.00	5.62	6.00	82.4	84.1
10	96.6	100	21.0	22.5	1.03	1.03	5.91	6.14	85.8	86.9
CD (P=0.05)	8.45	8.37	1.84	1.50	0.07	0.09	0.54	0.46	4.93	4.25
Irrigation schedules (IW:CPE)										
0.8	77.7	82.3	17.8	18.4	0.90	0.90	4.73	5.13	75.2	77.1
1.0	85.4	87.5	18.5	19.3	0.94	0.96	5.24	5.37	78.3	80.6
1.2	86.7	90.6	18.9	20.4	0.96	0.97	5.28	5.59	80.2	82.1
CD (P=0.05)	2.93	4.83	0.70	1.49	0.04	0.06	0.26	0.31	3.89	4.00

Higher tiller production under mulch might be due to better hydrothermal conditions. The perusal of data revealed that tillers production was significantly affected by irrigation schedules. The tillers per plant increased significantly at 1.0 IW/CPE ratio (18.5 and 19.3) over 0.8 (17.8 and 18.4) but it was at par with 1.2 IW/CPE ratio (18.9 and 20.4) in 2014 and 2015, respectively.

***Leaf-stem ratio*:** Leafy growth in fodder crops is a criterion of fodder quality. Fodder possessing wider leaf-stem ratio is more succulent, palatable and nutritious. The data (Table 1) revealed that leaf-stem ratio was significantly influenced by mulch levels. Leaf-stem ratio increased with increasing the mulch levels up to 10 t/ha (1.03), however, significant response was observed up to 7.5 t/ha (0.97 and 1.00 in 2014 and 2015, respectively). The leaf-stem ratio was significantly higher when mulch was applied @ 7.5 t/ha over 5 t/ha and no mulch treatments. This increase in leaf-stem ratio at higher mulch levels may be due to more availability of conserved moisture in soil which is required for increasing the leaf biomass of plant. Scheduling of irrigation at IW/CPE ratio of 1.0 significantly increased the leaf-stem ratio (0.94 and 0.96) over IW/CPE ratio of 0.8 (0.90) but it was statistically at par with IW/CPE ratio of 1.2 (0.96 and 0.97) in 2014 and 2015, respectively. This increase in leaf-stem ratio with frequent irrigation scheduling at higher levels increased the uptake of nutrients, thus increasing the leaf area and hence, leaf-stem ratio. These results were in conformity with the results obtained by Vannavong and Detpiratmongkol (2008) who reported the increase in weight by relieving water stress.

Leaf area index (LAI): Leaf area index (LAI) is an important parameter which influences the growth and yields of a crop and determines the capacity of plants in trapping solar energy for photosynthesis. The data relating to LAI of napier bajra hybrid at first cutting during both years were recorded (Table 1). Leaf area index was significantly affected by different mulch levels. Application of paddy straw mulch @ 7.5 t/ha (5.62 and 6.00) and 10 t/ha (5.91 and 6.14) were at par with each other to significantly increase the LAI compared to 5 t/ha and no mulch during 2014 and 2015. This increase in LAI with increased levels of mulch might be due to higher number of tillers with increase in mulch level. Similar findings were reported by Iqbal *et al.* (2006) that mulch application significantly increased the LAI. There was significant increase in LAI at IW/CPE ratio of 1.0 (5.24 and 5.37) over 0.8 (4.73 and 5.13) but it was at par with IW/CPE ratio of 1.2 (5.28 and 5.59) in 2014 and 2015, respectively. LAI decreased at IW/CPE ratio of 0.8 as water stress increased. More nutrient mobility coupled with higher water uptake under higher irrigation regime might have increased the leaf area index. Pandey *et al.* (2000) also reported that the reduction in LAI as an adaptation mechanism by plant to decrease the transpiration under stressed conditions in maize.

***Photosynthetically active radiation (PAR)*:** PAR interception directly varied with LAI. The maximum PAR was observed obviously due to highest value of LAI (Table 1) at this stage. The PAR at higher level of mulch @ 10 t/ha (85.8 and 86.9 %) was statistically at par with 7.5 t/ha (82.4 and 84.1 %) but significantly higher than 5 t/ha (74.6 and 76.4 %) and no mulch (68.8 and 72.4 %) owing to higher LAI in 2014 and 2015, respectively. The PAR interception was significantly increased up to mulch level of 7.5 t/ha. Dadhwal (2011) also reported more PAR interception where mulch was applied as compared to no mulch. Irrigation schedules also influenced the PAR interception at first cutting of crop. The crop irrigated at IW/CPE ratio of 1.2 and 1.0 intercepted significantly higher PAR over IW/CPE ratio of 0.8 during both years. The irrigation schedule at IW/CPE ratio of 1.0 and 1.2 were statistically at par with each other with respect to PAR interception. The higher LAI and fully expanded leaves due to fully turgid cells in case of higher irrigation schedules led to higher surface area for intercepting higher proportion of incoming radiations as compared to lower irrigation schedules where leaves might not be fully expanded in an attempt to reduce transpiration under water deficit conditions. Kar and Kumar (2007) also reported higher value of PAR in crop applied with frequent irrigations.

Dry fodder yield: The mulch application and irrigation schedules influenced the dry fodder yield of NBH (Table 2). Mulch application at the rate of 10 t/ha (92.9 and 94.6 q/ha) significantly increased dry fodder yield over 5 t/ha (62.5 and 68.9 q/ha) and with no mulch (45.5 and 50.1 q/ha) application but it was at par with 7.5 t/ha (87.2 and 90.9 q/ha) in 2014 and 2015, respectively. There was significant increase in dry fodder yield up to mulch level of 7.5 t/ha. Higher dry fodder yield under mulch application might be due to higher number of tillers per plant and dry matter accumulation. These results were in agreement with the findings of Kaur and Singh (2006) who reported that mulch application in pearl millet significantly increased the yields as compared to no mulch.

Table 2. Effect of mulch and irrigation schedules on dry fodder yield (q/ha), NPK uptake (kg/ha) and NPK content (%) at first cutting of NBH during 2014 and 2015

Treatments	Dry fodder yield		N uptake		P uptake		K uptake		N content		P content		K content	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Mulch levels (t/ha)														
No mulch	45.5	50.1	60.3	69.9	9.53	11.3	88.1	97.6	1.32	1.39	0.21	0.22	1.93	1.95
5	62.5	68.9	90.8	110	14.1	16.1	122	136	1.45	1.59	0.22	0.23	1.96	1.97
7.5	87.2	90.9	147	167	20.0	21.7	172	181	1.68	1.84	0.23	0.23	1.97	1.98
10	92.9	94.6	169	176	21.4	22.9	185	189	1.81	1.86	0.23	0.24	1.98	1.99
CD (P=0.05)	14.5	8.18	32.3	15.6	4.18	1.91	31.2	16.5	0.16	0.13	NS	NS	NS	NS
Irrigation schedules (IW:CPE)														
0.8	67.1	71.0	103	117	14.5	16.4	131	140	1.48	1.59	0.21	0.23	1.95	1.96
1.0	73.4	76.4	121	137	16.9	18.1	144	153	1.59	1.69	0.22	0.23	1.96	1.97
1.2	75.7	80.9	127	143	17.4	19.6	150	161	1.63	1.73	0.23	0.24	1.97	1.99
CD (P=0.05)	6.49	4.61	13.0	9.45	1.66	1.87	14.8	10.3	0.10	0.11	NS	NS	NS	NS

Irrigation schedule at IW/CPE ratio of 1.2 (75.7 and 80.9 q/ha) produced significantly more dry fodder yield than IW/CPE ratio of 0.8 (67.1 and 71.0 q/ha) and it was statistically at par with IW/CPE ratio of 1.0 (73.4 and 76.4 q/ha) in 2014 and 2015, respectively. More dry matter yield with more number of irrigations was also reported in forage pearl millet (Rostamza *et al.,* 2011) and baby corn (Sarkar *et al*., 2011).

NPK uptake: Nutrient uptake by a crop refers to the product of crop yield and per cent content of that very nutrient in crop. It is another way to express the growth and yield of crop and can prove helpful in determining the nutrient requirement for the maximization of yields. The data on the N, P and K content and uptake influenced by mulch levels and irrigation schedules in plant samples of NBH were analyzed (Table 2). A perusal of data revealed that different mulch levels and irrigation schedules affected NPK uptake significantly during both years. Maximum NPK uptake by crop was observed under mulch level of 10 t/ha but significant response was observed up to 7.5 t/ha in 2014 and 2015, respectively. The application of 7.5 t/ha mulch recorded significantly higher N, P and K uptake over 5 t/ha and no mulch treatments during both years. The more uptake with higher mulch levels was might be due to high nutrient content (N,P,K) and more fodder production with mulch levels of 7.5 and 10 t/ha. Pervaiz *et al.* (2009) reported the increase in nutrient uptake by crop under mulched plots. This might be due to water conserved within the soil under mulches that leads to more water availability; there were more uptakes of nutrients by crop.

Among irrigation schedules, higher N, P and K uptake was observed under IW/CPE ratio of 1.2 that was at par with IW/CPE ratio of 1.0 and significantly better as compared to 0.8 during both the years. This was due to presence of more moisture in higher irrigation depth which created favourable conditions for plant roots to uptake nutrients from soil. Rostamza *et al.* (2011) and Yaseen *et al.* (2014) also observed increase in nitrogen uptake with increase in irrigation frequency. They reported that the reason for more uptake was absorption of nutrients by roots due to presence of water in the soil, as it is the agent that transports solutes to the soil-root interface. Iqbal *et al.* (2006) also reported similar results of increase in phosphorous uptake with more supply of irrigation water in maize.

Qualitative attributes

Moisture content: The moisture content in NBH increased with increase in mulch level up to 10 t/ha. The application of 10 t/ha mulch recorded significantly higher moisture content than 5 t/ha and no mulch and it was at par with 7.5 t/ha during both years (Table 3). The irrigation schedules also affected moisture percentage in plants. The moisture content was the highest (78.4 and 78.8% in 2014 and 2015, respectively) when crop was irrigated at IW/CPE ratio of 1.2. The corresponding values were 77.5 and 78.0% in both years at IW/CPE ratio of 1.0 that was at par with 1.2. The reduction in moisture content with water stress at lower irrigation regime might be due to more fibre content which probably decreased the succulence of plants. Similar results were also reported by Saini (2012).

Crude protein: The nutritive value of any forage depends on its protein content, essential for growth, development and production of ruminant animals (Ismail *et al.,* 2014). The data of crude protein contents revealed that the protein content increased with mulch application (Table 3). The mulch rate of 10 t/ha (11.3 and 11.6%) and 7.5 t/ha (10.5 and 11.5%) were at par with each other to increase the protein content of NBH in 2014 and 2015, respectively and it was significantly better than 5 t/ha and no mulch application. This might be due to more moisture conservation by higher mulch levels. Significantly higher protein content (10.6%) was observed when mulch was applied in pearl millet as compared to no mulch (10.2%) due to storage of soil moisture by reducing the evaporation which helped to mobilize the nutrients present in soil profile (Patel *et al*., 2013).

The irrigation schedules affected the protein content significantly. The protein content increased significantly with IW/CPE ratio of 1.0 (9.93%) over IW/CPE ratio of 0.8 (9.28%) but it was statistically at par with irrigation schedule of IW/CPE ratio of 1.2 (10.2%) during 2014. The similar trend was observed during 2015. Significantly higher crude protein content at IW/CPE ratio of 1.2 might be due to favourable soil moisture for uptake of native and applied nitrogen through increased root density. Gangaiah (2005) and Tahir *et al*. (2014) also reported highest protein percentage where more number of irrigations was applied.

Crude fibre: The fodder having less crude fibre percentage was considered a good quality because higher crude fibre content decreased digestibility. Mulch levels influenced the crude fibre content significantly (Table 3). Crude fibre content was decreased significantly during both the years with increase in mulch application up to 7.5 t/ha. There was slight reduction in crude fibre with further increase in mulch level up to 10 t/ha. The maximum value of crude fibre was obtained where no mulch was applied followed by mulch level of 5 t/ha. This increase in crude fibre content at lower mulch level might be due reduction in moisture content that leads to more synthesis of structural carbohydrates and deposition of fibrous materials in plant.

Scheduling of irrigation at IW/CPE ratio of 1.2 produced significantly less crude fibre over IW/CPE ratio of 0.8 and 1.0, respectively in 2014. However, crude fibre content was at par with each other at IW/CPE ratio of 1.2 (30.2%) and 1.0 (30.8%) in 2014 and 2015, respectively. Jahanzad *et al.* (2013) also reported that crude fibre was significantly lower in plants where irrigations were applied frequently as compared to stressed plants.

Crude fat: Crude fat is very important for animals because it is the part of structural tissues of body and also acts as a source of reserve energy. The data showed that crude fat content of the crop was at par with each other @ mulch level of 7.5 and 10 t/ha and significantly higher than in the crop where 5 t/ha and no mulch was applied (Table 3). This decrease in crude fat with reduced level of mulching might be due to decrease in succulence i.e. moisture percent which was higher at higher level of mulch application. Deposition of structural carbohydrates in plants prone to water stress may also be one of the other reasons.

Table 3. Effect of mulch and irrigation schedules on quality parameters at first cutting of NBH during 2014 and 2015

Treatments	Moisture content (%)		Crude protein (%)		Crude fibre (%)		Crude fat (%)		Mineral matter (%)		IVDMD (%)		Oxalate content (%)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Mulch levels (t/ha)														
No mulch	72.2	72.9	8.24	8.68	33.2	33.8	2.07	2.58	11.3	11.7	53.0	53.6	3.54	3.53
5	75.4	75.6	9.05	9.92	31.9	32.9	2.48	2.92	12.3	12.5	55.4	56.2	3.54	3.55
7.5	80.9	80.9	10.5	11.5	30.3	30.6	2.77	3.36	13.1	13.4	58.0	58.7	3.62	3.61
10	81.9	82.0	11.3	11.6	28.7	30.2	2.94	3.38	13.6	13.6	58.5	58.9	3.66	3.65
CD (P=0.05)	1.28	1.87	0.99	0.84	1.98	2.33	0.33	0.30	0.64	0.46	1.97	2.11	NS	NS
Irrigation schedules (IW:CPE)														
0.8	76.9	76.8	9.28	9.93	32.1	32.8	2.32	2.94	12.1	12.4	54.8	55.6	3.57	3.56
1.0	77.5	78.0	9.93	10.5	30.8	31.7	2.57	3.08	12.7	12.9	56.6	57.0	3.60	3.59
1.2	78.4	78.8	10.2	10.9	30.2	31.1	2.79	3.16	13.0	13.2	57.3	57.8	3.60	3.61
CD (P=0.05)	1.10	1.53	0.61	0.72	1.47	1.14	0.26	0.16	0.63	0.65	1.70	1.55	NS	NS

Increasing levels of irrigation schedules improved the crude fat content over its lower levels. The highest crude fat content (2.79 and 3.16% in 2014 and 2015, respectively) was observed when irrigation was scheduled at IW/CPE ratio of 1.2 and it was at par with IW/CPE ratio of 1.0. This increase in crude fat content might be due to higher concentration of pigments including chlorophyll which is house of photosynthetic activity for formation of different food ingredients. As a result, with role of pigments and enzymatic activity more quantity of carbohydrates seems to have been converted into fat under better soil moisture conditions favourable for their activity. Similar results were also obtained by Saini (2012).

Mineral matter: Mineral matter content is an index of minerals like Ca, Mg, Zn, Fe etc. which play an important role in the functioning of various systems in the plants as well as in the animals. The higher level of mulch increased the mineral matter content significantly (Table 3). Mineral matter content with mulch application @ 10 t/ha was highest *i.e*., 13.6% which was 3.8, 10.6 and 20.4% higher than 7.5, 5 and no mulch treatments, respectively. The mulch level of 7.5 t/ha was at par with 10 t/ha. Similar trend was noticed in second year.

Among different irrigation schedules, 13.0 and 13.2% mineral matter in 2014 and 2015, respectively were observed at IW/CPE ratio of 1.2 which decreased upto 12.1 and 12.4% at lower IW/CPW ratio of 0.8 in both the years. The IW/CPE ratio of 1.2 was at par with ratio of 1.0 to increase the mineral matter of crop. This increase in mineral matter content at higher level of irrigation might be due to optimum moisture in the soil that increased the rate of uptake of minerals by plants. Similar results were reported by Saini (2012) and Moosavi *et al.* (2012).

In vitro dry matter digestibility (IVDMD): IVDMD improved significantly as the mulch level increased (Table 3). The plant had significantly higher IVDMD when mulch was applied at 10 t/ha as compared to where 5 t/ha and no mulch were applied in both years. The mulch level of 10 t/ha was at par with 7.5 t/ha. Significantly higher IVDMD of plant samples ware reported when irrigation was applied at IW/CPE ratio of 1.2. IVDMD varied from 53.0 to 58.0% in 2014 and 53.6 to 58.9% in 2015. The reason for decreasing IVDMD at lower IW/CPE ratio may be water deficiency that increased the amount of structural carbohydrates and fibers which in turn lowered forage digestibility. Similar results of decreasing the IVDMD at lower irrigation regimes were also obtained by Simsek e*t al.* (2011) and Jahansouz *et al.* (2014).

Oxalate content: Oxalate content in plant is considered as anti nutritional component that become toxic beyond critical level. The effect of mulching levels and irrigation schedules on oxalate content in plant samples of NBH was non-significant (Table 3). The numerical value ranged from 3.54 to 3.66% in 2014 and 3.53 to 3.65% in 2015 under different mulch levels. The range varied from 3.57 to 3.60 and 3.56 to 3.61% in 2014 and 2015, respectively under different irrigation schedules. However, it was observed that moisture stress reduced oxalate content. It might be due to less mobilization of oxalate in plant system under moisture stressed conditions. Ellern *et al.* (1974) also observed the reduction in oxalate content in leaves of the Saltbush *Atriplex halimus* under moisture stress.

Conclusion

It was concluded from the study that mulch level of 7.5 t/ha and irrigation schedule at IW/CPE ratio of 1.0 significantly increased the dry fodder yield, nutrient uptake and improved quality parameters of napier bajra hybrid grass.

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