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# PERFORMANCE OF DUAL PURPOSE OAT, WHEAT AND BARLEY UNDER DIFFERENT CUTTING MANAGEMENT SYSTEM

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## SUMMARY

A field experiment was conducted at CCS Haryana Agricultural University, Hisar (Haryana) during winter season (*rabi*) 2014-15 to study the performance of dual purpose oat, wheat and barley under different cutting management system. Three crops *i. e.* oat, wheat and barley and four cutting management *i. e.* no cutting, cutting for fodder at 50, 60 and 70 days after sowing (DAS) were replicated thrice under split plot design. The varieties used were HJ 8, WH 1164 and RD 2035 for oat, wheat and barley, respectively. The soil of the experimental field was sandy loam in texture with pH 8.6, organic carbon 0.49%, available phosphorus 14.0 kg/ha and available potassium 254.0 kg/ha. Among crops, oat produced the maximum green fodder, dry matter followed by barley. However, wheat produced the maximum grain yield followed by barley. Among different cutting management practices, maximum green fodder and dry matter yield were recorded when cut was taken 70 DAS and then left for grain. Wheat crop produced the highest grain and second highest straw yield and thereby fetched highest B:C ratio (2.16). Based on the results, it could be concluded that among the crops i. e. oat, barley and wheat, all the three crops suits for dual purpose but crop selection should be based on the priority of end user. If the priority was to get more green fodder from first cut then oat could be first choice followed by barley and wheat. Besides this, the cutting management schedule needs to be standardized. The green fodder yield increased significantly as the number of days to cut increased from 50 to 70 from sowing. But the grain yield decreased significantly as the cutting schedule was advanced from 50 days onward. Based on the economic analysis, wheat was the most remunerative crop followed by oat for dual purpose. If compared with no cut where remunerations were highest, the cut at 50 DAS was most beneficial.

**Key words :** Dual purpose, dry matter, fodder yield, cutting management, oat, barley and wheat

India supports 512 million livestock population and there is tremendous pressure on availability of feed and fodder for the livestock (Anonymous, 2014a). Country faces a net deficit of 36% green fodder, 11% dry fodder and 49% feed (Anonymous, 2016). Dual purpose varieties of wheat, oat and barley can be helpful in ensuring fodder and feed security for the burgeoning livestock and human population. Besides this, the lodging problem of these cereal fodders can be managed by taking one fodder cut and then one cut for grain. The main problem is to identify the location specific variety of cereal crop suitable for dual purpose along with the cutting management schedule and improved agronomic practices to overcome the issue of fodder, feed and food scarcity. Barley, wheat and oat besides providing grain, has enormous potential for fodder and is fast emerging as promising crop for dual purpose. To mitigate the continued shortage of green fodder for animal consumption and grains for human, the conventional cereal crops need to be grown for dual purpose under irrigated farming system (Naveed, 2013; Dove and Kirkegaard, 2014; Jarial, 2014). In the Northern plains (Rajasthan, Madhya Pradesh, Southern Haryana, South West Punjab and Western U.P.), animal husbandry occupies an important role and there is a big gap between demand and supply of forage. In these areas barley can be grown as dual purpose crop (Verma *et al.*, 2007). The grain yield of improved varieties of multicut oat is poor due to lodging and as such grain yield potential of this crop is low in comparison to other cereal crops. Lesser seed production of this crop results in less availability of quality seeds. Therefore, it is necessary to develop strategies for obtaining considerable yield of green fodder as well as grain from the same crop by adopting appropriate cutting management (Singh *et al.*, 2014). Among cereals, wheat also has the potential to produce

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more grain yield along with substantially higher green fodder and also for fetching higher net income, dual purpose wheat requires high level of management and a balance should be there between both the components (fodder and grain). Schedules of cutting as well as sowing time both are important to realize the optimum yield of green fodder and grains from dual purpose wheat (Waheddullah *et. al*., 2018). Keeping these points in view, the present investigation was taken up to find out suitable cereal crop and cutting schedule to realize the maximum green fodder and grain yield under semi-arid conditions.

## MATERIALS AND METHODS

A field experiment was conducted during *Rabi* season of 2014-15 at Forage Section Research Farm of CCS Haryana Agricultural University, Hisar (Haryana), India situated at 29°10' N latitude, 75°46' E longitude, and altitude of 215.2 m above mean sea level. The site has semi-arid and sub-tropical climate with hot dry summer and severe cold winter. Average annual rainfall is about 450 mm, 75 per cent of which is received in three months, from July to September during south-west monsoon. Fig. 1 represents the weekly weather parameters *i.e*. temperature - minimum and maximum (ºC), relative humidity of morning and evening (%) and rainfall (mm). The soil of the experimental site was sandy loam in texture with pH 8.6, organic carbon 0.49%, available phosphorus 14.0 kg/ha and available potassium 254.0 kg/ha. Three crops *viz*. oats, barley and wheat and four cutting management *viz*. no cut, cutting of fodder at 50 DAS, cutting of fodder at 60 DAS, cutting of fodder at 70 DAS, were replicated thrice under split plot design. Second cut was taken for grain in all the treatments except for no cut. The varieties used were HJ 8, WH 1164 and RD 2035 for oat, wheat and barley, respectively. The sowing was done in second fortnight of November 2014 in open furrows at 25 cm apart using the seed rate of 100 kg/ha. All the other standard agronomic practices for the cultivation of oat, wheat and barley were followed uniformly in all the treatments (Anonymous, 2014b). The harvested green fodder from each plot was weighed in situ and then converted into q/ha. A random sample of 500 g was taken from each plot at the time of green fodder harvest, chopped well and put into paper bag. These bags were aerated by making small holes all over. The samples were first dried in the sun for 15 days and then transferred in an electric hot air oven for drying at a temperature of 60±5°C till constant weight was

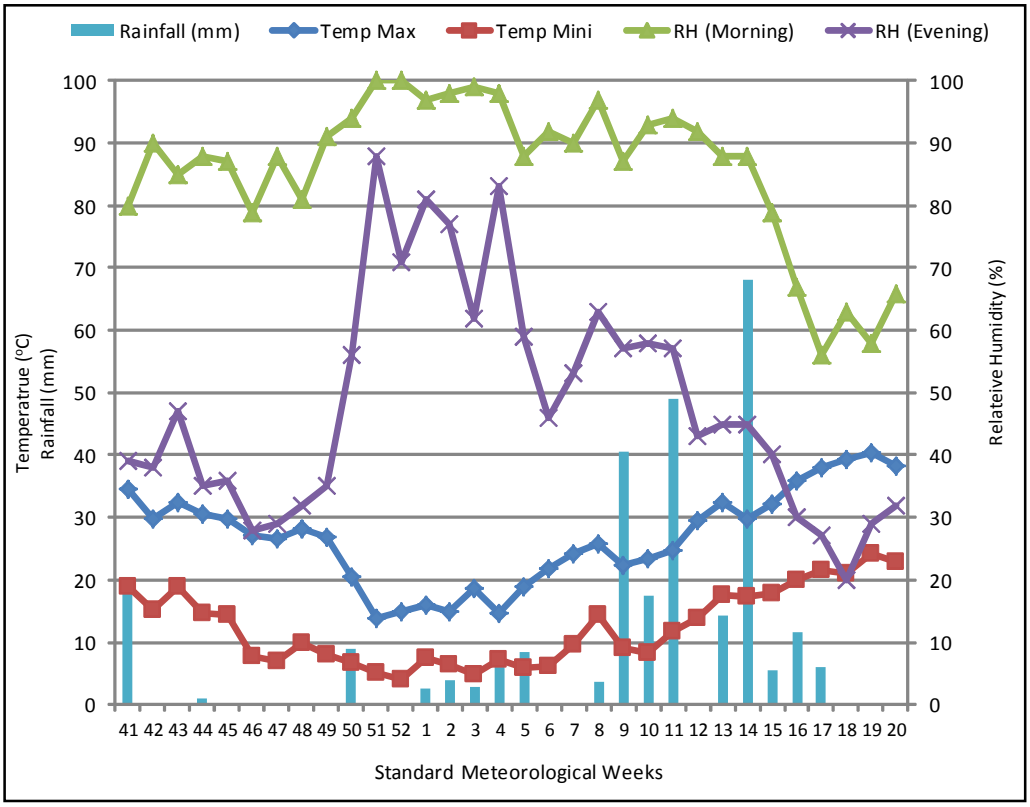


Fig. 1. Weekly weather data during the season.

achieved. On the basis of dry weight of these samples, the green fodder yield was converted into dry matter yield (q/ha). Crude protein content was estimated in dried and grinded samples (2 mm sieve size), collected at first cut. The crude protein content was calculated by multiplying the nitrogen percentage with 5.83 estimated by conventional micro-Kjeldhal method (AOAC, 1995). Crude protein yield was calculated by the multiplication of crude protein content (%) with dry matter yield (q/ha), respectively. Economics was worked out on the basis of prevailing prices of inputs and outputs in the local market. The experimental data were analyzed by using OPSTAT software available on CCS Haryana Agricultural University home page (Sheoran *et al*., 1998).

## RESULTS AND DISCUSSION

### A. Crops :

**Green fodder & dry matter evaluation among crops :** The data presented in Table 2 revealed that among crops, highest green fodder and dry matter yield (154.7 and 24.6 q/ha) were recorded with oats which were significantly superior over barley and wheat. The green fodder yield recorded in oat was 31.09 and 36.40 percent higher over barley and wheat. The dry matter yield of oat was 29.27 and 33.74 percent higher over barley and wheat. Loretta Serafin *et. al.* (2013) also reported that oats and barley produced more dry matter than wheat. Maximum plant height (71.0 cm) was recorded with oat which was significantly higher over barley and wheat. Higher yield of oat is because of maximum height and higher number of tillers per meter row length. Highest number of tillers per m row length (112.4) was recorded with wheat which was on a par with oat but significantly superior over barley. Maximum L:S ratio was recorded in oat followed by wheat and barley. The higher L:S ratio of oat indicates more leafage, leaf area and more green biomass of this crop as compared to wheat and barley. High value of L:S ratio of oat is an indicator that it is a more suitable crop for green fodder.

**Grain and straw yield evaluation among crops :** Highest straw yield was recorded with oat which was significantly superior over barley but at par with wheat. However, highest grain yield (35.1 q/ha) was recorded with wheat which was significantly superior over barley and oat. Wheat tends to produce more tillers and leaves than are necessary for maximum grain yield, so a reduction in tiller number may have no effect on grain yields. The dual-purpose system is likely to have little effect on wheat grain yield when soil fertility is adequate (Lollato *et al*., 2017). Highest plant height (118.6 cm) was recorded with oat which was significantly superior over wheat and barley. No significant difference was observed among number of tillers per meter row length at grain harvest. Higher straw yield of oat was due to its better regeneration

TABLE 1
Performance of dual purpose forage crops under different cutting management system

| Treatments | Plant height at fodder harvest (cm) | Leaf : Stem ratio | Tillers/mrl at fodder harvest | Green fodder yield (q/ha) | Dry matter yield (q/ha) | Grain yield (q/ha) | Straw yield (q/ha) | Plant height at grain harvest (cm) | Tiller/mrl at grain harvest | B : C |
|---|---|---|---|---|---|---|---|---|---|---|
| **A. Crops** | | | | | | | | | | |
| Oat (HJ 8) | 71.0 | 0.48 | 111.8 | 154.7 | 24.6 | 19.7 | 47.9 | 118.6 | 102.8 | 1.76 |
| Wheat (WH 1164) | 55.9 | 0.42 | 112.4 | 98.4 | 16.3 | 35.1 | 46.1 | 94.4 | 100.0 | 2.16 |
| Barley (RD 2035) | 58.1 | 0.38 | 100.7 | 106.6 | 17.4 | 31.7 | 38.5 | 83.9 | 94.8 | 1.71 |
| C. D. (P=0.05) | 3.4 | - | 8.0 | 9.7 | 1.3 | 1.8 | 3.7 | 4.3 | NS | 0.1 |
| **B. Cutting management** | | | | | | | | | | |
| No cut | - | - | - | - | - | 36.5 | 53.9 | 107.8 | 112.3 | 2.15 |
| Cut (50 DAS) | 47.6 | 0.46 | 103.7 | 61.6 | 8.4 | 34.1 | 49.2 | 104.3 | 106.9 | 1.99 |
| Cut (60 DAS) | 58.7 | 0.43 | 110.0 | 105.1 | 16.0 | 26.9 | 42.0 | 96.9 | 96.8 | 1.77 |
| Cut (70 DAS) | 78.8 | 0.39 | 111.2 | 192.9 | 33.9 | 17.8 | 31.6 | 86.9 | 80.9 | 1.58 |
| C. D. (P=0.05) | 3.4 | - | NS | 9.7 | 1.3 | 2.0 | 4.2 | 4.9 | 7.9 | 0.12 |
| **A × B** | | | | | | | | | | |
| C. D. (P=0.05) | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |

DAS-Days after sowing, NS-Non Significant, B : C-Benefit Cost ratio.

capacity, higher re-growth and plant height over the wheat and barley but the higher grain yield of wheat might be due to higher number of grains per earhead, test weight and higher no. of effective tillers per unit area. Serafin *et. al*. (2013) while comparing the performance of oat, barley and wheat also found wheat produced the least amount of dry matter but the second highest grain yield. Oats in comparison had the poorest grain recovery of all species. Barley appeared to give the best balance between dry matter production and grain recovery.

**B. Cutting management**

For green fodder, cuttings were taken at 50, 60 and 70 DAS, besides this one treatment was also kept under no cut. Highest plant height (78.8 cm) was recorded with the cut at 70 DAS which was significantly higher over 60 and 50 DAS. Significantly highest green fodder yield (192.9 q/ha) and dry matter yield (33.9 q/ha) were recorded at 70 DAS which was 83.9, 124.9 and 111.9 and 303.6 per cent higher over 60 and 50 DAS. This might be due to increased leaf area index with the advancement of crop age till 70 days after sowing. Similar results were also reported by Verma *et al*. 2016. However, Maximum L:S ratio (0.46) was observed in the cut at 50 DAS followed by cut at 60 and 70 DAS. The number of tillers per meter row length was not affected significantly among the cut at different intervals. The treatments in which cut were taken at 50, 60 and 70 DAS were later on left for grain production. It was observed that highest grain yield (36.5 q/ha) was recorded in no cut which was significantly superior over the cut at 50, 60 and 70 DAS treatments. The grain yield produced in no cut was 7, 35 and 105 per cent higher over 50, 60 and 70 DAS cut for green fodder treatment. Same trend was also observed for straw yield. This was probably due to lower number of effective tillers in cut treatments as some tillers might have failed to regenerate after cutting (Waheddullah *et. al*., 2018). Maximum Plant height (107.8 cm) was recorded in no cut which was significantly higher over 60 and 70 DAS but at par with the cut at 50 DAS. The reason might be decapitation of wheat causing termination of growth and the new growth of shoot could not attain the same plant height as that of uncut treatment on account of slow growth under different planting time Khalil *et al*. (2011) also found that plant height was significantly affected by different cutting schedules. Highest number of tillers/mrl was recorded in no cut which was at par with cut at 50 DAS but significantly superior over cut at 60 and 70 DAS.

**Interaction of crop and cutting management :** Data presented in table 1 reveal that no interactive effect was observed for all the characters among crops and cutting management schedules.

**Economics :** Data presented in Table 1 reveal that wheat crop produced the highest grain and second highest straw yield and thereby fetched highest B:C ratio (2.16). Waheddullah *et. al*. (2018) also reported that wheat (C 306) harvested at 55 DAS for green fodder was found most suitable having grain yield (37.10 q/ha with a percent reduction of 9.3 over uncut) and additional green fodder yield of 143.13 q/ha over uncut and concluded it as most remunerative option. Serafin *et. al.* (2013) concluded that wheat has a higher return price for the sale of the grain as compared to barley and oat. Among cutting management, highest B:C ratio (2.15) was observed in no cut followed by cut at 50 DAS.

**Soil fertility status :** No significant differences were observed for organic carbon (%), available phosphorus and available potassium analyzed in the soil after crop harvest among various treatments (Table 2).

TABLE 2
Soil fertility status of the soil after crop harvest

| Treatments | Organic carbon (%) | Available Phosphorus (kg/ha) | Available Potassium (kg/ha) |
|---|---|---|---|
| **A. Crops** | | | |
| Oat | 0.48 | 13.0 | 252 |
| Wheat | 0.50 | 14.0 | 252 |
| Barley | 0.50 | 14.0 | 254 |
| C. D. (P=0.05) | NS | NS | NS |
| **B. Cutting management** | | | |
| No cut | 0.48 | 14.0 | 254 |
| Cut (50 DAS) | 0.50 | 13.0 | 252 |
| Cut (60 DAS) | 0.49 | 13.0 | 251 |
| Cut (70DAS) | 0.50 | 14.0 | 252 |
| C. D. (P=0.05) | NS | NS | NS |

DAS-Days after sowing, NS-Non Significant.

## CONCLUSION

Based on the results, it can be concluded that among crops, oat produced the maximum green fodder, dry matter followed by barley at first cut. Among crops, wheat produced the maximum grain yield followed by barley. Among different cutting management

practices, maximum green fodder and dry matter yield were recorded when cut was taken 70 DAS. Based on the economic analysis, wheat was the most remunerative crop followed by oat for dual purpose. If compared with no cut where remunerations were highest, the cut at 50 DAS was most beneficial.

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