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EFFECT OF DIFFERENT CUTTING MANAGEMENT ON GROWTH, YIELD, QUALITY AND ECONOMICS OF DUAL PURPOSE OAT, BARLEY AND WHEAT

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SUMMARY

An experiment was conducted to study the effect of different cutting management schedules on growth, yield, quality and economics of dual purpose oat, barley and wheat during 2012-13 to 2014-15. The three year pooled data under cutting management revealed significantly higher green forage (54.3 t/ha), dry matter (9.15 t/ha), crude protein (0.93 t/ha), straw yield (10.02 t/ha) and green forage equivalent yield (78.31 t/ha) of oat, respectively. For dual purpose, oat variety RO-19 recorded significantly higher net monetary returns (Rs. 36033/ha) with B:C ratio (2.35) than rest of the crops. Whereas, seed yield (2.48 t/ha) was recorded significantly higher in the wheat crop. As regards to the cutting management, cutting at 70 days after sowing for fodder recorded significantly higher green forage, dry matter and crude protein yield (39.03, 7.12, 0.77 t/ha respectively) than rest of the cutting managements. The seed and straw yield (2.48 and 9.40 t/ha) was recorded significantly higher in the no cutting for fodder and left for seed only on pooled mean basis; while, cutting at 50 DAS and left crop for seed recorded significantly higher green forage equivalent yield (79.45 t/ha), gross monetary returns (Rs. 63561/ha) and net monetary returns (Rs. 36128/ha) with B:C ratio (2.31). The pH, EC and organic carbon after harvest of crop remained unaffected. The differences are non-significant on pooled mean basis. The available N after harvest was recorded significantly higher *i.e.* 183.46 kg/ha in Barley crop. The soil available phosphorus (20.62 kg/ha) was recorded in wheat crop. While, available potash remained non-significant on pooled mean basis. As regards cutting management, no cutting for fodder and left for seed recorded significantly higher soil available N after harvest (173.46 kg/ha). The soil available phosphorus (20.78 kg/ha) was recorded at cutting at 70 DAS after sowing and left the crop for seed. The soil available potash remained unchanged due to cutting management on pooled mean basis.

Key words : Green forage yield, seed yield, dual purpose crops, cutting management, crude protein, economics

India has large number of livestock population as compared to the other countries of the world. In spite of having huge livestock population, milk productivity is very low due to inadequate quality forage. In recent years, it has been observed that, animal husbandry occupies an important role and there is a big gap between demand and supply of forage. The availability of green fodder for livestock is one of the most important problems especially in winter season. Thus, the farmers and other livestock owners feel great problem for feeding livestock so oat, barley and wheat can be used as dual purpose crops to provide good quality forage and grain during the period of reduced availability of forage.

Oat (*Avena sativa* L.) grain has always been an important for livestock feed. Oat is the good source of protein, fibre and minerals. In many parts of the world, oat is grown as a dual purpose crop, used for grain as well as for fodder, straw for bedding, hay, silage & chaff. Oat is an important winter fodder, mostly fed as green but surplus is converted into silage or hay to use during fodder deficit periods (Suttie and Reynolds, 2004). It is preferred feed of all animals and its straw is soft and grain is also valuable feed for horses, dairy cows, poultry and young breeding animals as it is a nutritious cereal grain. In India, oats have a wider adaptability, particularly in western and north western regions of the country because of its excellent growing habitats, quick re-growth and better nutritional value. Only a few varieties of oats are available for cultivation and their grain yields under good management conditions vary from 15 to 25 q/ha (Ahmad and Zaffar, 2014). Barley (*Hordeum vulgare* L.) was one of the most important fodder crops. Today

its major utility as food crop has reduced but it is still used as fodder crop throughout the world. Wheat (*Triticum aestivum* L.) ranks first among the cereals on the basis of production. It is a valuable source of high quality forage rich in protein, energy, nutrient and low in fibre (Hossain *et al.*, 2003). To overcome the food and feed shortage, there is an urgent need to increase the yield of wheat by bringing more area under cultivation or increasing yield per unit area. Wheat has the potential to meet the food and feed requirements of the rapidly growing human and livestock population from the same piece of land under optimum management practices. Similarly, wheat can be used as dual purpose *i.e*. for green fodder and grain. It will serve the purpose for green fodder for animals and food for the human beings. Using new varieties of cereals as dual purpose crops have recently been tested and found to be capable of providing nutritious green fodder. Khalil *et. al.,* (2011) studied wheat as dual purpose crop and found that grain yield decreased with delay in cutting, while no cut produced tallest plants with highest grain yield. Arif *et al.,* (2006) worked on the dual purpose wheat and found that non-cut plots produced significantly more grain yield and biological yield.

Thus, barley, oat and wheat are being used as a grain crop for human consumption and animal feed in India. For dual purpose crops, stage for forage cutting is most important on which both forage and grain yield depends. If cut is given early, forage yield will be reduced and if cut is given late plant regeneration and the grain yield will be affected. The aim of present field experiment was to evaluate dual purpose forage and grain yield of oat, barley and wheat under different cutting management.

MATERIALS AND METHODS

The field experiment on performance of dual purpose crops under different cutting management system was conducted for three consecutive years *i.e*. from 2012-13 to 2014-15 under All India Coordinated Research on Forage Crops and Utilization, Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra). The soil of the experimental field was medium black with low in available nitrogen (139.30 kg/ha), medium in available phosphorus (16.40 kg/ha) and high in available potassium (526.40 kg/ha). It was moderately alkaline in reaction (pH 8.02) with 0.37dS/m electrical conductivity. The organic carbon content was 0.29 per cent.

The experiment comprised of 12 treatment combinations of three dual purpose crops *viz*., D_1 - Oat (RO-19), D_2 - Barley (RD-2552), D_3 - Wheat (VL-829) in main plot and four cutting management treatments in sub plot *viz.*, C_1 - No cutting for fodder and left for seed only, C_2 - Cut at 50 DAS for fodder and left for seed, C_3 - Cut at 60 DAS for fodder and left for seed, C_4 - Cut at 70 DAS for fodder and left for seed. The experiment was laid out in split plot design with three replications. The crop was sown in lines with a row to row spacing of 30 cm. The recommended dose of nitrogen (N), phosphorus (P_2O_5) and potassium (K_2O) was 120:50:40 kg/ha, respectively. Nitrogen was applied in 3 equal splits *i.e*. as basal, 25 DAS and after I^{st} cut and P_2O_5 and K_2O were applied at the time of sowing. The first cut was taken for fodder and second cut for seed and straw. The gross plot size was 4.00 m × 3.00 m and net plot size was 3.40 m × 2.40 m. Harvesting schedule and other package of practices were as per recommendation for individual crops in the region.

The plant sample was oven dried for computation of dry matter yield as per standard procedures. Dry matter and crude protein yields of fodder and seed were calculated by multiplying dry matter content (%) to green fodder yield and protein content (%) to dry matter yield, respectively.

RESULTS AND DISCUSSION

Growth and yield

The plant population per meter row length (158.5) and leaf: stem ratio (2.18) was significantly higher in wheat crop. Similar results have been earlier reported by Khalil *et al.* (2011). However, plant height was significantly higher (87.1 cm) in the oat crop on pooled mean basis. These results are in agreement with the findings of Singh *et al*. (2005) and Karwasra *et. al*. (2011). The plant population was not differed significantly due to cutting management treatments. While, plant height (92.7 cm) was recorded significantly higher with no cutting for fodder and left the crop for seed. The reduction in plant height in other cutting management technique may be due to the fact that cutting caused termination of growth and the new growth of shoot could not reach the same height due to shorter growth time. The cutting at 50 DAS and left crop for seed recorded significantly higher leaf : stem ratio (1.82). Similar findings were reported by Khalil *et al.* (2011), Fazal *et. al*. (2012)

TABLE 1
Growth parameters, yield and crude protein content as influenced by dual purpose forage crops under different cutting management system in pooled data (2012-13 to 2014-15)

Treatments	Growth parameters			Yield (t/ha)						Crude protein content (%)	
	Plant population (m row length)	Plant height (cm)	leaf : stem ratio	Green forage yield	Dry matter yield	Crude protein yield	Seed yield	Straw yield	Green forage equivalent yield	Fodder	Seed
A) Main plot (Dual purpose crops) (3)											
D_1–Oat (RO-19)	122.0	87.1	1.17	54.30	9.15	0.93	0.97	10.02	78.31	10.14	12.81
D_2–Barley (RD-2552)	106.03	77.5	1.03	31.57	6.23	0.78	1.18	3.96	62.16	12.51	14.41
D_3–Wheat (VL-829)	158.5	62.8	2.18	18.08	3.39	0.67	2.48	5.33	77.79	11.02	13.33
C. D. (P=0.05)	8.94	3.93	0.21	3.41	0.75	0.11	0.21	1.16	7.24	0.66	0.53
B) Sub plots (Cutting management-4)											
C_1–No cutting for fodder and left for seed only	131.3	92.7	0.00	0.00	0.00	0.00	2.47	9.40	75.37	0.00	14.55
C_2–Cut at 50 DAS for fodder and left for seed	126.8	58.8	1.82	30.00	5.30	0.59	1.63	6.76	79.45	11.28	13.82
C_3–Cut at 60 DAS for fodder and left for seed	127.9	72.0	1.43	34.93	6.34	0.72	1.22	5.52	71.53	11.50	13.26
C_4–Cut at 70 DAS for fodder and left for seed	129.8	79.8	1.13	39.03	7.12	0.77	0.85	4.07	64.65	10.90	12.43
C. D. (P=0.05)	NS	2.90	0.14	1.54	0.32	0.06	0.12	0.76	3.93	NS	0.36

and Godara *et al.* (2019).

Among the forage crops under study, oat crop recorded significantly higher green forage yield, dry matter yield, crude protein yield and straw yield (54.30, 9.15, 0.93 and 10.02 t/ha, respectively) on pooled mean basis similar results were also reported by Sharma and Bhunia (2001), Rana *et al.* (2002), Ahmed and Zafar (2014), Mushtaq Ahmed *et al.* (2014). Whereas, Bhatti (2002) also reported that oat produced 38 and 44 per cent more dry matter yield than barley and wheat, respectively. However, seed yield (2.48 t/ha) was recorded significantly higher in the wheat crop. While straw yield (10.02 t/ha) recorded significantly the highest in oat crop. Similar trend was also reported by Khalil *et al.* (2011), Hassan *et al.* (2003) and Larson *et al.* (2005). Whereas, green forage equivalent yield (78.31 t/ha) was significantly higher in the oat crop.

The cutting at 70 days after sowing for fodder recorded significantly higher green forage yield (39.03 t/ha), dry matter yield (7.12 t/ha) and crude protein yield (0.77 t/ha) on pooled mean basis, than rest of the cutting managements. Early cut 50 DAS resulted in lower forage dry matter compared with late cut (70 DAS). This was due to increase in biomass in 70 days as compared to 50 days. Similar results were also reported by Khalil *et al.* (2011).

However, seed yield (2.47 t/ha) and straw yield (9.40 t/ha) were recorded significantly higher in the no cutting for fodder and left for seed treatment only on pooled mean basis. While, green forage equivalent yield (79.45 t/ha) was significantly higher at the cutting at 50 DAS for fodder and left for the seed (Table.1). These results are similar to that reported by Sharma and Bhunia (2001), Rana *et al.* (2002), Patel *et al.* (2003), Singh *et al.* (2005) and Karwasra *et al.* (2007).

Quality

Crude protein content in fodder (12.51 %) and in grains (14.41 %) was recorded significantly higher in the barley crop on pooled mean basis. However, in cutting management treatment crude protein content was found non-significant. While, the crude protein content (14.55 %) in the grains was recorded significantly higher at the treatment of no cutting for fodder and left for seed than rest of the treatments of cutting management on pooled mean basis. These results are in close vicinity to those reported by Yau *et al.* (1989), Khalil *et al.* (2011) and Fazal *et al.* (2012) (Table 1).

Economics

Dual purpose oat crop recorded the significantly higher gross monetary returns (Rs. 62645/ ha), net monetary returns (Rs.36033/ha) and B:C ratio (2.35) than rest of the crops. Whereas, the gross

TABLE 2
Economics and soil properties after harvest as influenced by dual purpose forage crops under different cutting management system (Pooled data) (2012-13 to 2014-15)

Treatments	Economics				Soil properties after harvest					
	Gross monetary returns (Rs./ha)	Cost of cultivation (Rs./ha)	Net monetary returns (Rs./ha)	Benefit : cost ratio	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)	pH	EC (dS/m)	OC (%)
A) Main plot (Dual purpose crops) (3)										
D_1–Oat (RO-19)	62645	26612	36033	2.35	160.32	19.24	431.14	8.27	0.27	0.39
D_2–Barley (RD-2552)	49728	26446	23281	1.88	183.46	20.21	431.66	8.25	0.28	0.40
D_3–Wheat (VL-829)	62229	27546	34682	2.25	159.44	20.62	425.39	8.37	0.28	0.41
C. D. (P=0.05)	5793	-	5792	0.21	5.68	0.82	NS	NS	NS	NS
B) Sub plots (Cutting management-4)										
C_1–No cutting for fodder and left for seed only	60298	26906	33391	2.23	173.46	19.70	434.14	8.35	0.28	0.40
C_2–Cut at 50 DAS for fodder and left for seed	63561	27433	36128	2.31	163.20	19.35	422.92	8.35	0.27	0.39
C_3–Cut at 60 DAS for fodder and left for seed	57223	26754	30468	2.14	162.42	20.27	420.47	8.24	0.27	0.41
C_4–Cut at 70 DAS for fodder and left for seed	51721	26380	25340	1.96	171.88	20.78	440.07	8.24	0.28	0.41
C. D. (P=0.05)	3145	-	3145	0.12	5.39	0.96	NS	NS	NS	NS

Selling rate: GFY - Oat, Wheat and Barley -Rs. 800 t/ha, Straw- Oat, Wheat and Barley Rs.350 t/ha, Seed - Oat- Rs.27500 t/ha, Barley - Rs.25000 t/ha and Wheat-Rs. 20000 t/ha.

monetary returns (Rs. 63561/ha) and net monetary returns (Rs.36128/ha) with B:C ratio (2.31) were recorded significantly higher in cut at 50 DAS and left for seed on pooled mean basis than other cutting management treatments under study. These results are in agreement with those reported by Sharma and Bhunia (2001), Rana *et al.* (2002) and Patel *et al.* (2003) (Table 2).

Chemical properties of soil after harvest

The pH, EC and organic carbon after harvest of crop remained unaffected due to treatments under study. The difference are non significant on pooled mean basis. After harvest, significantly higher available nitrogen (183.46 kg/ha) was recorded in barley crop. Whereas, the maximum soil available phosphorus (20.62 kg/ha) was recorded in wheat crop. As regards cutting management no cutting for fodder and left for seed recorded significantly higher soil available nitrogen (173.46 kg/ha) after harvest. The soil available phosphorus (20.78 kg/ha) was recorded highest in cutting at 70 DAS after sowing and left crop for seed. The soil available potash remained unchanged due to different cutting management on pooled mean basis. These results are in agreement with the findings of Khalil *et al.* (2011), Khalil *et al.* (2011) and Fazal *et al.* (2012) (Table 2).

CONCLUSION

Based on the results, it can be concluded that oat (RO-19) crop is beneficial for obtaining higher yield and monetary returns. While, cuttings of the crop at 50 DAS for green forage and left for grain as a dual purpose forage crop during *Rabi* season is recommended for higher monetary returns.

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