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GREEN FORAGE YIELD, DRY MATTER YIELD AND CHEMICAL COMPOSITION OF OAT WITH ADVANCES IN MATURITY

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Green forage yield, dry matter yield and forage quality of oat variety S-81 as affected by different cutting treatments were determined during 1987-1989 at the National Agricultural Research Centre, Islamabad. Green forage yield, dry matter yield and crude fibre increased, while seed yield and crude protein declined with maturity. Maximum green forage and dry matter yields with considerably inferior forage quality as determined by lower crude protein and higher crude fibre values were recorded at the 50% flowering stage. Minimum green forage and dry matter yields with superior quality forage were recorded in the crop harvested at 70 and 85 days after planting. The results of this research indicate that it is possible to have a satisfactory forage and grain crop from oat which were harvested once for forage at 115 days after planting.

Key words: Oat (*Avena sativa* L.), Cutting stages, Forage yield and Quality.

Introduction

The utilization of oat *Avena sativa* as a multicut crop is a common practice in Pakistan. Relatively little research data are available to aid the farmer in the selection of the best forage harvest schedule of the dual utilization of oat and allow him to obtain high forage and grain yields and good forage quality. The primary objective of this investigation was to study the response of oat variety S-81 to different cutting treatments.

Gupta and Pradhan [1] reported that chemical constituents of oat forage were greatly influenced by the stage of plant growth. Crude protein and in vitro dry matter digestibility decreased with increases in plant age. Singh *et al.* [2] reported that dry matter, NDF, ADF, lignin and silica of oat forage increased over a growth period of 90 days. On the other hand, CP decreased from 4.8 to 2.8%. They also concluded that in oat, stage of maturity of the plant had a great effect on the chemical composition.

A reduction of 20% in grain yield of winter cereal crops has been reported when they were harvested once before stem elongation (CSIRO [3]). In contrast, Sharrow and Motazedian [4] and Winter and Thompson [5] noted that early, light or moderate grazing/clipping of oat and other small grain cereals either increased grain yield or had no significant effect on it. Elder [6] reported increased yields of oat forage as the time between successive harvests was extended from 15-60 days. Dunphy *et al.* [7] conducted experiments on wheat to see the effect of forage removal at three stages of plant development on grain yield and found that delaying the final forage harvest till late joint stage resulted in a significant, progressive reduction in grain yield. They further concluded that forage utilization should be terminated by the early joint stage or earlier to obtain maximum grain yield.

Bhatti *et al.* [8] evaluated 13 cultivars of oat for fodder yield under a two cut system at NARC, Islamabad. The cultivars PD2-LV65 and S-81 produced maximum green fodder yields of 29.32 t/ha each and dry matter yields of 5.81 and 5.89 t/ha respectively in the first cutting, taken 70 days after planting. In the second cutting at 50% flowering, these cultivars produced 58 and 56 t/ha of green fodder yields and 20 and 21 t/ha of dry matter yields, respectively.

Materials and Methods

Six cutting treatments, *viz*: cutting for fodder 70 days after planting and then harvesting for seed at maturity (CT 1); cutting for fodder 85 days after planting and then harvesting for seed at maturity (CT 2); cutting for fodder 100 days after planting and then harvesting for seed at maturity (CT 3); cutting for fodder 115 days after planting and then harvesting for seed at maturity (CT 4); cutting at the 50% flowering stage, only for fodder (CT 5); and harvesting only for seed at plant maturity (CT 6) were tested on oat cultivar S-81 (late maturing, winter type and broad leaved oat cultivar with erect growth habit). The crop was harvested for forage production approximately 6-8 cm above ground level in all treatments. The experiment was planted during the second week of October at the National Agricultural Research Centre (NARC), Islamabad for each of three years (1987-1989). A randomized block design with three replications was used in each year. The plot size for each treatment in each experiment was 3 x 6 m, while the harvested plot area was 1.8 x 6 m for estimation of fodder and seed yields. Rows were spaced 30 cm apart. The recommended fertilizer rate of 75-50 N-P kg/ha was made by applying 50-50 N-P kg/ha in the form of nitrophos at the time of sowing and adding 25 kg nitrogen in the form of urea per

hectare after cutting for fodder. In treatments CS 5 and CS 6, the remaining nitrogen dose was applied with irrigation one-month after planting. Prior to forage harvest, 5 plants were selected at random in each plot to record morphological data such as plant height, number of tillers per plant and leaves per tiller. The following morphological, fodder yield and forage quality parameters were studied: (i) Plant height in cms (PH). (ii) Tillers per plant (TL). (iii) Leaves per tiller (LV). (iv)Green fodder yield in t/ha (GY). (v) Dry matter yield in t/ha (DY). (vi) Seed yield in t/ha (SY). (vii) Crude protein content in percentage (CP). (viii) Crude fibre content in percentage (CF).

Analysis of variance was performed on the data meaned over three years. Representative green samples (500 g) from each replication of each treatment were collected at random and dried in an oven at 60°. After drying, these samples were weighed to estimate dry matter yield. Dried samples subsequently were ground using a Wiley mill having a screen of 1mm. Crude fibre was determined by the Van Soest method [9]. Crude protein (N% x 6.25) was estimated by the Reardon *et al.* method [10].

Results and Discussion

Combined analysis of variance for plant height, number of tillers/plant, number of leaves/tiller, green fodder yield, dry matter yield, seed yield, crude protein content and crude fibre content are given in Table 1. Significant differences (P=0.01) were observed among various cutting treatments for all the morphological, fodder yield, seed yield and forage quality characteristics. Significant differences (P=0.01) also were noted for all traits except plant height and number of tillers per plant for different years.

The stages of growth at the time of harvesting oat variety S-81 and the plant height, number of tillers per plant, leaves per tiller, green forage yield, dry matter yield, seed yield, crude protein and crude fibre content from each cutting treatment are presented in Table 2. Plant height, number of tillers per plant, leaves per tiller, green fodder and dry matter yields generally increased with advances in maturity, as would be expected.

Maximum plant height was observed at the 50% flowering stage (135-145 days after planting) followed by cutting treatments 115 and 100 days after planting. There was no significant difference in plant height between cutting treatments made 115 and 100 days after planting or 100 days and 85 days after planting. As would be expected, the minimum plant height was recorded in the cutting treatment made 70 days after planting, as these plants were in the early vegetative growth stage.

Significant differences were observed in the number of tillers per plant among various cutting treatments. The maximum number of tillers per plant was recorded in the cutting treatment made 115 days after planting. However, there were no significant differences among cutting treatments made 115, 100 and 85 days after planting. Similarly, there were no significant differences among cutting treatments made 100 and 85 days after planting and at the 50% flowering stage. The lowest number of tillers per plant was recorded in the cutting treatment made 70 days after planting. This minimum number of tillers per plant might also be due to the fact that plants were in an early vegetative stage. With advances in growing stage, the plants increased in plant height and number of tillers per plant.

Leaves per tiller followed a similar pattern of growth as plant height and number of tillers per plant. The maximum number of leaves per tiller was observed at 115 days after planting and at the 50% flowering, although the number of leaves 85 days after planting was not significantly smaller. The lowest number of leaves per tiller was recorded at 70 days after planting, as would be expected at this earlier growth stage. Bhatti *et al.* [8] reported similar results for plant height, number of tillers per plant and leaves per tiller in different oat cultivars under a two-cut forage harvest system.

Data in Table 2 indicate that both green fodder yield and dry matter yield increased with advances in plant maturity. The significantly highest green fodder and dry matter yields

TABLE 1. SOURCE OF VARIATION, DEGREE OF FREEDOM AND MEAN SQUARES OF DIFFERENT TRAITS OF OAT VARIETY S-81.

		Mean squares							
SV	DF	PH	TL	LV	GY	DY	SY	CP	CF
Replicate	2	12.06	1.14	0.07	81.72*	4.45**	0.07	0.36	0.03
YR	2	542.70	2.17	1.78**	447.19**	32.49**	2.10**	4.42**	17.77**
$Error_1$	4	284.22	0.39	0.07	7.54	0.20	0.03	0.08	0.08
CT	5	6087.07**	1.13**	4.43**	2491.30**	175.86**	1.04**	41.88**	20.45**
YR x CT	10	450.99**	0.24	1.19**	291.60**	15.55**	0.05	4.18**	1.63**
$Error_2$	30	65.80	0.31	0.23	12.89	1.04	0.03	0.07	0.08

* and ** Significant at 5 and 1 percent levels respectively. YR, CT, PH, TL, LV, GY, DY, SY, CP and CF indicate years, cutting treatments, plant height, tillers per plant, leaves per tiller, green fodder yield, dry matter yield, seed yield, crude protein and crude fibre, respectively.

TABLE 2. AVERAGE PLANT HIGHT (PH), TILERS/PLANT (TL), LEAVES/TILLER (LV), GREEN FODDER YIELD (GY), DRY MATTER YIELD (DY), SEED YIELD (SY), CRUDE PROTEIN CONTENTS (CP), AND CRUDE FIBRE CONTENTS OF OAT VARIETY S-81.

Cutting treatments	PH	TL	LV	GY	DY	SY	CP	CF
CT 1	63.63 d	6.18 c	4.89 c	13.59 d	2.07 d	0.85 b	12.29 a	22.32 d
CT 2	83.70 c	6.80 ab	5.89 b	16.92 d	2.57 d	0.54 c	12.25 a	22.94 c
CT 3	90.06 bc	6.89 ab	6.26 ab	23.46 c	4.08 c	0.48 c	8.68 b	24.50 b
CT 4	94.74 b	7.07 a	6.59 a	33.33 b	6.60 b	0.46 c	8.46 b	25.58 a
CT 5	134.78 a	6.46 bc	6.56 a	54.99 a	12.90 a	–	7.94 c	25.60 a
CT 6	–	–	–	–	–	1.34 a	–	–
LSD (0.01)	10.70	0.54	0.63	4.73	1.34	0.24	0.34	0.36

Means followed by the same letter do not differ significantly at 0.01 level. CT 1 : Cutting for fodder after 70 days of planting, CT 2: Cutting for fodder after 85 days of planting, CT 3: Cutting for fodder after 100 days of planting, CT 4: Cutting for fodder after 115 days of planting, CT 5: Cutting at 50% flowering for fodder only, CT 6: No cutting for fodder but for seed only.

(54.99 and 12.90 t/ha, respectively) were recorded at the 50% heading stage, followed by cutting at 115 days after planting with the green fodder and dry matter yields of 33.33 and 6.60 t/ha, respectively. The minimum green fodder yields (13.59 and 16.92 t/ha) and dry matter yields (2.07 and 2.57 t/ha) were observed for cutting made 70 and 85 days after planting, respectively (Table 2). These results are in agreement with Bhatti *et al.* [8] and Gupta and Pradhan [1] who reported that clipping oat before 50% flowering stage resulted in a loss of both green forage and dry matter yields.

A maximum seed yield of 1.34 t/ha was recorded in the treatment not harvested for fodder but for seed only (Table 2), followed by the treatment in which forage was cut once 70 days after planting (0.85 t/ha). Even lower seed yields were observed for treatments in which forage was cut at 115, 100 and 85 days post planting (0.46, 0.48 and 0.54 t/ha respectively).

In modern dairy farming technology forage and dry matter yields are not meaningful unless reasonable forage quality (as determined by high crude protein and low crude fibre) is maintained. Maximum crude protein values (12.29 and 12.25%) were recorded in samples taken at 70 and 85 days after planting, followed by samples taken at 100 and 115 days post planting (8.68 and 8.46%). The minimum crude protein content (7.94%) was observed in samples taken at the 50% flowering stage.

With regard to crude fibre content, data in Table 2 indicate that maximum crude fibre values were recorded in samples taken at the 5% heading stage and at 115 days post planting (25.00 and 25.58%). The lowest crude fibre content (22.32%) was noted in cutting made 70 days after planting.

Our results indicated that a satisfactory forage and grain crop could be harvested from oat cut for forage 115 days after planting. A reasonable quantity of green fodder, dry matter and seed yield with moderate forage crude protein content was produced under this cutting treatment. If seed is not required and the farmer is only interested in maximum green forage and dry matter yields, then harvesting the oat crop at the 50% flowering stage would be the best alternate but the forage quality will be somewhat inferior.

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