COMPARISON OF SIX CULTIVARS OF ALFALFA FOR TOLERANCE TO PHOTOCHEMICAL OXIDANTS

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Introduction

In previous work (1) the effect of air pollution on two varieties of alfalfa (Medicago sativa L) was measured by growing the alfalfa in pots in a carbon-filtered atmosphere (clean) air and non-filtered (ambient) air. Green forage weights, leaf to stem ratios, number of stems, and numbers of surviving plants were determined. Green forage yields in ambient air were 42.2% and 33.3% less than in clean air for the varieties Hayden and Eldorado, respectively. Reduced yields paralleled increases in concentrations of oxidants in the atmosphere at the experimental site for the first four of the seven harvests made. At the conclusion of the experiment, plant counts in the ambient air showed stand losses of 36.4% for Hayden and 38.1% for Eldorado when compared to clean air.

Chemical analyses of dried forage samples showed higher crude fiber, beta-carotene and vitamin C in both varieties grown in clean air. Niacin was significantly decreased A determination of protein efficiency ratio with rats and an in vitro nitrogen digestibility test showed no varietal or treatment effects.

Current Research

In the present studies, six cultivars of alfalfa were selected for comparison of performance in specialized yield trials at U.C. Riverside with the aid of Dr. W. H. Isom, Extension Agronomist. They are listed as follows:

1. Hayden
2. FMA 21
3. Mesa Sirsa
4. Isom Polycross
5. U.C. Salton
6. W. L. 600

Vegetative propagation by making rooted cuttings and the establishment of clones was used to be able to limit the plots to 10 containers with 10 plants each, and also retain a high degree of uniformity between the plots without losing the integrity of the cultivar. Approximately 150 plants of each cultivar were grown from seed in 5-3 gallon pots beginning May 14, 1975. In mid-July the plants were cut to promote stem formation. In early August 100 plants of each cultivar were selected at random for vegetative propagation by cuttings. To produce the clones, 10 cuttings from each plant were made and rooted in a "mist bed." The cutting bed contained Permalite as a rooting medium and a rooting hormone was applied to the cut stems. Heating cables were used to stimulate root formation. Mist nozzles above the bed operated at 20 minute intervals during the daytime. Rooting took place within 14 days and survival was at least 95%. The cuttings were transplanted August 25-26, 1975 into 30 l pots at 10 plants per pot. Six plants of each clone were used and distributed over the six treatment replicates in such a manner that the comparable pots in these replicates contain identical populations of 10 plants.

Three treatments were used to compare the relative susceptibility to photochemical oxidant as follows: (1) Exposure to carbon filtered air in an open topped greenhouse (clean), (2) to ambient air in an open topped greenhouse (ambient), and (3) to outside air (outside). All treatments were replicated twice resulting in 6 plots per cultivar.

The first harvest was made November 4-5, 1975

Results

Table 1 shows the results of 9 cuttings. During each of the indicated intervals 3 cuttings were made and the dry weights combined. The numbers are the total dry weights per treatment in grams. Also, the percent yield reduction (%R) is included in the table

In Table 2 the number of hours that the ozone (O_3) levels equaled or exceeded 0. ppm or 0.2 ppm are listed for the same periods used in Table 1.

The increased yield reductions during June, July and August correlate clearly with the increased exposure to ozone during those months. The cultivars Mesa Sirsa and Hayden proved to be the most susceptible and were easily identified as such by appearance during the summer months. Leaf injury, premature yellowing and leaf drop were the most prominent symptoms. FMA 21 as judged by appearance seemed to be one of the best cultivars; yield results however show a relatively large reduction. Mesa Sirsa, Isom Polycross and FMA 21 show an apparent yield reduction during the winter months while the smog levels were very low. This requires further investigation and a thorough evaluation of our data is in progress.

Other data besides yield weight have been collected. Alfalfa grown in smoggy air has shorter and thinner stems while the number of stems is not very much affected. Leaf drop is a significant factor since it determines the leafiness of alfalfa hay. Therefore, a determination has been made during the summer and data will be available at a future date.

Literature Cited

(1) Thompson, C. R., Gerrit Kats, E. L, Pippin and W. H. Isom, "Effects of Photochemical Air Pollution on Two Varieties of Alfalfa," J. Env. Quality, 1976. In Press.

Table 1

Dry yields of 6 alfalfa cultivars grown in charcoal filtered and ambient air

	12/15 - 4/19	4/19 - 6/29	6/29 - 9/7
		U.C. Salton	
CF	4007	5348	3393
AMB	4058	4592	2645
%R	0	14	22
		Hayden	
CF	3793	4197	3004
AMB	3761	3566	1900
%R	0	15	37
		FMA 21	
CF	4338	5072	3899
AMB	3435	4216	2810
%R	20	17	28
		Isom Polycross	
CF	4382	4968	3338
AMB	3550	4846	2782
%R	19	2	17
		Mesa Sirsa	
CF	4538	4785	3405
AMB	3787	4047	2014
%R	16	15	41
		W.L. 600	
CF	3737	4765	3174
AMB	4130	4321	2294
%R	-10	9	28

Table 2

Number of hours ozone equaled or exceeded 0.1 ppm and 0.2 ppm during indicated periods

	12/15 - 4/19	4/19 - 6/29	6/29 - 9/7
$\geq$ 0.1	58	335	423
$\geq$ 0.2	0	34	52