

AGRONOMIC CROP SCIENCE REPORT

Research

Extension

TECHNIQUES AND TIMING OF POST-HARVEST GRASS SEED FIELD BURNING 1/

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Introduction.

Techniques and timing of post-harvest burning of grass seed fields, to reduce smoke emissions and accumulation of smoke in urban areas, were investigated during the early stages of the cooperative research program 3/ on field burning abatement. Little work had been done previously on methods and timing of firing fields and the concomitant effect on smoke emission and crop yield. Most open field burning uses a backfire at the field boundaries to protect against fire spread from the field and then firing the periphery of the field resulting in a rapid burn of the residue with a central heat column that carries smoke and entrained material to a considerable height.

The possibilities of backfiring the entire field, firing fields along a single flame front, or burning stubble after straw removal had not been assessed for potential reduction in smoke emission or for effects on the subsequent regrowth and seed production of various grass seed crops. Work at Riverside, California, has suggested that peripheral burning of grass seed fields is the least advantageous in terms of pollution emission because of the restriction of oxygen supply for complete combustion in the center of the field.

The amount of green regrowth, straw stubble moisture content and atmospheric conditions at time of burning would influence the efficiency of the fuel combustion, and might also have an effect on the seed crop. The transport and dispersion of the smoke columns from open field burning had been noted to vary with time of burn and also season of the year. Reduction in emissions and better dispersion to the upper regions of the atmosphere would be important in terms of subsequent pollution problems in urban areas. For these reasons, research was undertaken to evaluate different burning times and procedures in terms of smoke emission and impact on seed crop yield.

Results.

Seasonal Aspects of Burning. Burning field plots early, mid-season, and late (August, September, October) showed that burning early in the early season when green tissue is minimal, before growth is initiated and the straw is dry,

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is preferable from the standpoint of both smoke emission and dispersion ^{4/}, as well as subsequent seed yield (see Table 1). Of course, soil moisture, the amount of green leaf tissue and the straw moisture content are dependent on the particular seasonal and daily weather patterns. Therefore, proper timing of a burn must take into consideration the particular conditions for that year. Late season burning, after regrowth has begun, was less advantageous because of greater stand injury and reduced seed yield. Late season burns encounter the problems of plant regrowth and high straw moisture content which create greater smoke emissions. ^{5/} Often atmospheric conditions are unfavorable for smoke dispersion in September and October.

Table 1. Mean seed yield of four grass species where post-harvest residue was burned early (August) versus late (October).

Species	Seed Yield (lbs/A)	
	Burned early	Burned late
Chewings fescue	920	648
Highland bentgrass	459	299
Orchardgrass	1113	946
Bluegrass	1182	1044
Mean	918	734

Techniques of Open Field Burning. Backfiring field plots reduced emissions and worked effectively when environmental and straw-stubble conditions were favorable (dry, with low humidity) for burning (Table 2). Straw load was an important factor. Greater amounts of residue improve the uniformity of the burn and carry the fire throughout the field. Backfiring was quite slow and wind shift could change it to a forward fire very quickly. Differences in total emissions are difficult to ascertain since burning takes place over a much longer period of time. In addition, the smoke does not rise as high in the atmosphere, resulting in retention of the smoke at a low level. The fate of this low level smoke is subject to question.

^{4/} Proceedings, 59th Annual Meeting of the Air Pollution Control Association, June 20-24, 1966, San Francisco, CA.

^{5/} Work at Davis, California, indicates that reducing rice straw moisture from 20% to 10% cuts smoke by a factor of 2 or 3.

Table 2. Comparison of residue burning techniques in 5 grass species, 1968-69.

Treatment	<u>Seed Yield (lbs/A)</u>				
	Bluegrass	Bentgrass	Chewings Fescue	Creeping Fescue	Orchardgrass
Burn early	1027	633	599	1073	536
Backfire early	1000	579	681	860	836
Backfire stubble only	--	536	607	---	---

Burning of stubble only was also an effective procedure under dry, low-humidity conditions (Table 2). Burning the stubble has the added advantage of substantially reducing the total amount of residue burned, thereby contributing to reduced emissions by virtue of changes in fuel load.

With backfiring and stubble burning, one must recognize that the burning season is more restricted and dependent on climatic and residue conditions. Burning is limited to dry conditions with favorable winds to carry the fire through the limited amount of residue.

Burning with a single flame front is theoretically better than encirclement of the field in terms of fuel-oxygen relationships. Under the conditions of these tests, the smoke did seem to be blacker in appearance, perhaps indicating more complete combustion with this technique. However, there was little visual difference in total smoke emission. The plot areas burned were small (5 acres) in comparison to seed fields and extrapolation to large areas is difficult. Fire control is a problem with this technique since the fire increases wind velocity and the flame front has greater intensity compared to the encirclement procedure (peripheral fire).

No adverse agronomic effects of the various burning methods was noted in these tests. Some growers have experienced burn-out where backfiring has been used; however, these experiments were conducted early in the season, which may have contributed to lack of injury. Results have shown that the severity of stand thinning increases with late burning.

Some new innovations in burning procedure have been suggested by growers and by other researchers 6/. These are essentially innovations of the backfiring technique where burns are conducted against the wind in a series of parallel strips which are then allowed to burn toward each other. As with backfiring, this technique provides a slower, high-combustion burn.

6/ University of California, Davis campus.

The possibilities of accumulating the straw from the field in stacks and firing these stacks to dispose of the straw was studied from the standpoint of emissions. Studies indicated that firing the stacks from the top can be accomplished with minimum visible smoke emission. Of course, the cost of removal and disposal certainly casts this in a poor light from an economic standpoint.

It should be noted that differences in smoke emission from burning the various different grass species in the valley can be expected because of the different amounts of green regrowth characteristic of a particular species. Annual ryegrass burning has been observed to be accomplished with less smoke than some of the perennial grass species, probably because of the lack of green regrowth and the drier condition of the residue remaining after harvest. However, the straw load on annual ryegrass is usually greater, thus offsetting some of the benefits of a reduced fuel moisture content.

Conclusions.

Research suggests that burning early in the season is advantageous in terms of reduced smoke emission and increased seed yield, as well as helping reduce the potential for smoke accumulation in urban locations because of atmospheric conditions. The earliness of the burn must be consistent, of course, with dry straw conditions and minimum regrowth, which is influenced by the type of climatic conditions preceding and during the harvest season. Selecting the proper temperature, wind, and humidity conditions and a time when there is a minimum amount of regrowth in grass seed fields should make it possible to optimize the benefits of burning in terms of subsequent seed yield and minimize the air pollution problems associated with open burning.

Burning technique studies have suggested that backfiring can be beneficial in reducing emissions and when accomplished early in the season has not resulted in injury to grass seed yield the subsequent year. Firing along a single flame front may be beneficial but difficulties in fire control and questions regarding smoke emissions cast some doubt on the net effect of this firing technique. Innovations of backfiring, including spot firing in a field or firing in parallel strips into the wind offer promise as methods to minimize emission of pollutants in open burning.