EFFECTS OF POST-HARVEST RESIDUE MANAGEMENT ON KENTUCKY BLUEGRASS SEED YIELD AND SEED QUALITY IN CENTRAL OREGON

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Abstract

A study was conducted over three years to evaluate alternatives to open-field burning of post-harvest residue on crop growth, development, and seed yield of Kentucky bluegrass (*Poa pratensis* L.). The least intensive residue treatment was baling the straw after combining and leaving a large portion of the stubble remaining. All other treatments were in addition to baling. The most intensive residue removal was standard open-field burning. Averaged over all testing sites, seed yield was the highest with open-field burning. Seed yield was intermediate when residue was removed with a vacuum-sweep plus propane treatment or with a vacuum-sweep treatment alone. Flail-only and bale-only treatments resulted in the lowest seed yields. Averaged seed yields were progressively lower for second, third, and fourth-year stands, with non-aggressive varieties out-yielding aggressive varieties. Fertile tiller numbers were least in plots receiving the bale-only or flail-only treatments, and were greatest with the open-field burn. The vacuum-sweep plus propane treatment, and the vacuum-sweep treatment alone were intermediate with respect to fertile tiller numbers. Thousand seed weight and seed germination percentages were comparable among all treatments.

Introduction

Burning of post-harvest residue in seed production of Kentucky bluegrass (*Poa pratensis* **L.**) in the Pacific Northwest was originally started in the early 1950s to control disease. Until recently, burning of residue was universal in this region for the many species of cool-season grasses grown for seed. In Kentucky bluegrass, seed is harvested from the same stand for several years and the stand is generally not "plowed out" until it becomes unproductive. The residue cannot be incorporated into the soil after each harvest as it can be for annual crops. If the residue is not burned *in situ* after production of each seed crop, the only known feasible alternative is mechanical removal.

In the intermountain areas of the Pacific Northwest research comparing burning with mechanical removal of residue has given variable results. Seed yields of Kentucky bluegrass using mechanical removal methods have ranged from 70 to 120 percent of yields with burning in several experiments involving different cultivars, years, location, and methods of residue removal under both dry land and irrigated conditions (Canode and Law, 1977; Young, et al., 1984). No difference in yield between burning and mechanical removal of residue was reported in two dry land experiments (Pumphrey, 1965), and one irrigated experiment (Evans et al., 1980). In the high rainfall areas of western Oregon, where diseases of grasses are more numerous and more severe, research comparing burning to mechanical removal of residue has resulted in less variable results with open-field burning out-performing any mechanical removal techniques thus far.

With the increased awareness for air quality, reduction or elimination of smoke from open-field burning of grass seed fields has become a concern. Our research was designed to: 1) determine crop growth and development of Kentucky bluegrass with reduced smoke impact management treatments; 2) demonstrate different mechanical residue management practices; and 3) compare the mechanical treatments to open-field burning for seed yield and seed quality.

Methods and Materials

Studies were initiated in central Oregon in the fall of 1989 on 14 existing commercial Kentucky bluegrass fields. Commercial grass seed fields are relatively flat. Many are furrow irrigated, and growth and production is quite uniform. All fields were row planted with spacing range from 7-14 inches. Before our study, post-harvest residue management on older stands was by open-field burning.

Varieties were classed into two groups, aggressive and non-aggressive. The aggressive varieties are highly rhizominous cultivars. When planted in rows, the rows become obscured within a year or two. Non-aggressive varieties are less rhizominous and do not spread to form a turf mat as quickly. Each of these variety types are managed somewhat differently. Three stand ages were utilized during the course of this study, second, third, and fourth-year harvest. The second year (1990-1991 crop year) of the study involved three of the original 14 sites, all non-aggressive varieties, and the third and final year involved one of the original 14 sites for an assessment of the treatments over time.

For the 1991-1992 crop year, new equipment used for the new study included a wheel rake that has stiff tines to scratch the residue, dethatch, and remove debris from around the crowns, and a Grass Vac, both developed by Rear's Manufacturing in Eugene, Oregon. The Grass Vac machine enabled us to clip and vacuum remove the stubble to a 1 inch height. With the wheel rake, the bulk of the residue is moved to a windrowed strip, which is then baled or otherwise disposed of. Other equipment utilized include a propane flamer with conventional nozzle spacing at 40 psi. Propane flaming after vacuum-sweep results in relatively little smoke.

Commercial grass seed fields normally have a large portion of the crop residue removed as baled straw, followed by open-burning of stubble, propane burning or both. Thus, the primary focus of this research was to compare this "field treatment" with several alternative methods of stubble management. Treatments included 1) field treatment; 2) bale-only (no subsequent stubble management); 3) flail chop (flailing all the stubble back on the ground); 4) rake (wheel rake); 5) vacuum-sweep (mechanical removal of stubble after baling with a Grass Vac); and 6) vacuum-sweep plus propane. The treatment plot size was 200 x 18 ft in selected areas of each field. For vacuum-sweep plus propaning, the Grass Vac was used followed by propane flaming of the plot area.

Data were collected for vegetative tiller development, fertile tiller development, seed yield, and seed quality. All other management practices such as fertilizing, irrigating, and pest control were done as the normal grower practices for the individual fields. Four randomly selected 60-square-foot areas were harvested from each plot by hand after the field was swathed. Bundles were placed in a cloth bag to prevent shattering, then air dried for threshing in a Wintersteiger plot combine. Seed was cleaned and weight of pure seed was determined.

Results and Discussion

Significant differences in seed yield resulted from the various management treatments. Seed yields are reported as lb/a of clean seed. Figure 1 shows the mean of 14 sites in the 1989-1990 crop year. Figures 2 and 3 show the mean seed yield over three crop years of one site 1989-1990 thru 1991-1992. The highest yields consistently were produced where the residue was removed completely either by mechanical means or by burning. Averaging the seed yields from all testing sites showed the field treatment had the greatest yield. Vacuum-sweep plus propane, vacuum-sweep, and bale-only treatments yielded 93, 84, and 50 percent of the field treatment, respectively. This average included 18 sites of three stand ages (second, third, and fourth), and different variety types over three crop years (1989-1990 thru 1991-1992). In the later two years a flail chop treatment was added and in the last year, the wheel rake treatment was added. Flail chop treatment was intermediate in seed yield between the vacuum-sweep and the bale-only treatments. The wheel rake was obtained late in the season and used for residue removal after the crop began to, grow. Therefore, the wheel rake results will be skewed because the treatment was not applied at the appropriate time. Analysis of these data of age of stand and variety type is presented below.

Age of Stand: A decrease in seed yield was observed as the stand aged (Figures 5 and 6). Young et al., 1984, and Canode and Law, 1976, found that after the first and second harvest yields decrease as much as 25 percent to 50 percent.

For the 1989-90 crop year, seed yield of second-year stands showed only 3 percent variation among the vacuum-sweep, vacuum-sweep plus propane, and field treatment. The bale-only treatment, however, yielded 63 percent of the field treatment. For third-year stands, the vacuum-sweep plus propane and bale-only treatments differed little in seed yield (77 percent of field treatment), and fell between seed yield with the vacuum-sweep (54 percent of field treatment), and field treatment (Figure 5).

For the 1990-1991 crop year, third-year stand seed yield for vacuum-sweep plus propane, vacuum-sweep, flail, and bale-only treatments were 122, 106, 95, and 84 percent, respectively of the field treatment in the same crop year. Seed yield from fourth-year stands for flail-chop and vacuum-sweep plus propane treatments were both 89 percent of field treatment seed yield. Yield for the vacuum-sweep and the bale-only treatments was 77 percent and 52 percent of field treatment, respectively (Figure 6).

For 1991-1992 crop year, one site (cv. 'Kelly') of the original 14 sites, was harvested to observe residue management treatments over three years. Seed yield in 1992 for vacuum-sweep plus propane, vacuum-sweep, and bale-only were 69, 64, and 57 percent, respectively, of field treatment. Averaged over three years of continuous treatments, vacuum-sweep and vacuum-sweep plus propane were 91 and 90 percent of field treatment. Bale-only averaged over three years is 70 percent of the field treatment (Figure 3).

Variety type: Differences in seed yield by variety type were observed in our study and are a well-known aspect of Kentucky bluegrass seed production (Canode and Law, 1977). The aggressive varieties showed a significant need for a more complete residue removal in the early years of the stand. In the 1990 harvest we measured an average of 52 percent decrease in yield from the more aggressive varieties compared to the non-aggressive types. In 1990, both aggressive and non-aggressive varieties performed similarly with respect to residue management. In descending order of seed yield, open-field burning yielded the best, followed by vacuum-sweep plus propane, vacuum-sweep, and then bale-only (Figure 4).

Tiller development: The general trend of fertile tiller numbers was the same as the trend for seed yield. Fall and spring vegetative tiller development showed co differences among treatments with the exception that plants in the bale-only treatment had fewer tillers.

Seed quality: Seed quality was determined by observing germination percentage and by measuring 1,000 seed weight. Seed quality was not affected by different residue management treatments (data not shown).

Conclusion

Our results support general grower experiences with respect to open-field burning vs. bale-only treatment. Field burning encourages higher fertile tiller numbers and yield. This increase was true for the older stands, but was even more pronounced on younger stands. In general, mechanical removal performed much better in our studies compared to bale-only treatment. However, compared to open-field burning, removal of residue with vacuum-sweep, or vacuum-sweep followed by propane flaming were not quite as reliable. In general, our data requires economical analysis for final evaluation. It is likely that mechanical means of straw removal will elevate the cost of production over the cost of open-field burning, both by requiring additional equipment purchase and usage, and by depressing yield. For non- aggressive varieties, these mechanical means of residue removal may prove adequate. The rake treatment showed good promise in the first year of use as a cheaper more efficient mechanical stubble removal technique.

References

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Figure 1. 1990 Kentucky Bluegrass Seed Yield Summary (avg. of 14 sites), Madras

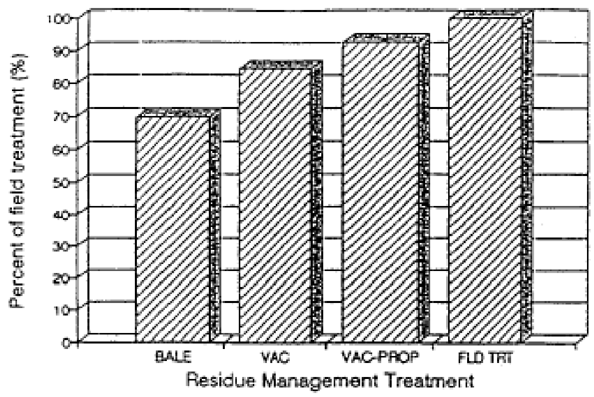


Figure 2. Kelly Kentucky Bluegrass-H&T Farms 3-Year (1990-1992) Average Seed Yields

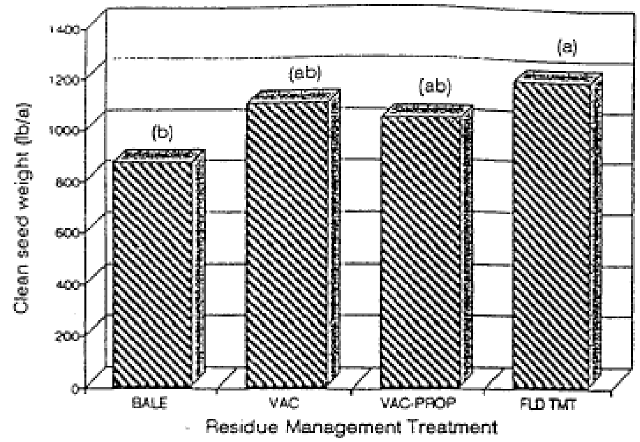
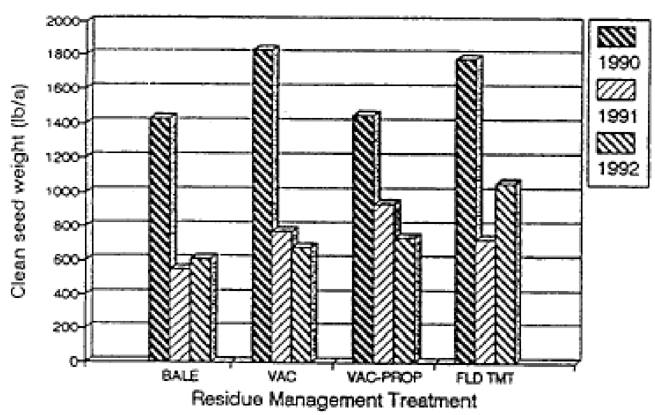


Figure 3. Kelly Kentucky Bluegrass- H&T Farms 1990, 1991 & 1992 Seed Yields



(Field planted fall 1988;first seed crop harvest 1989)

Figure 4. Influence of Variety Type on Kentucky Bluegrass Seed Yields, 1990 Harvest

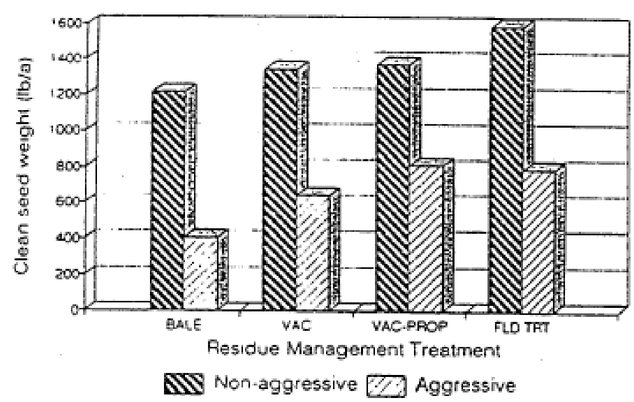


Figure 5. Influence of Stand Age on Kentucky Bluegrass Seed Yields, 1990 Harvest

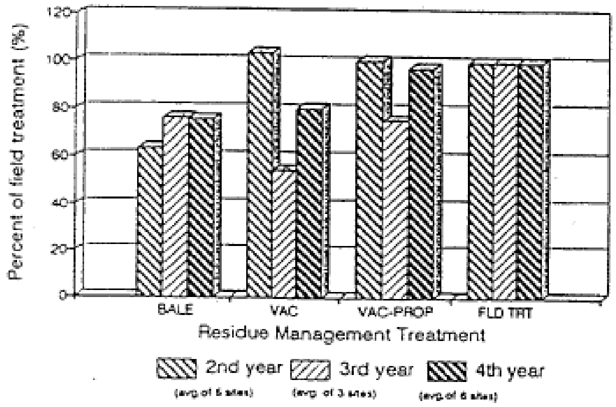


Figure 6. Influence of Stand Age on Kentucky Bluegrass Seed Yields, 1991 Harvest