Light Disking to Enhance Early Successional Wildlife Habitat in Grasslands and Old fields: Wildlife Benefits and Erosion Potential

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In the Midwest and Southeast, annual plant communities provide essential resources for bobwhite and other early successional species. Annual plant communities are characterized by grasses, forbs, and legumes that occur following some form of soil disturbance such as agriculture, timber harvest, or discing and live a single growing season. Plant species characteristic of annual communities include ragplant, partridge pea, lespedezas, beggar plant, Illinois bundle flower, wooly croton, foxtail, and panic grasses.

Annual plants reproduce by prolific seed production, providing granivorous (seed-eating) birds and mammals with abundant food resources. Additionally, this plant community supports an abundant and diverse insect community. The insects associated with annual plant communities provide critical nutrients, including protein, energy, and essential amino acids for growing nestlings and chicks. Annual plant communities are

typically open at ground level, with abundant bare ground and little litter accumulation. This combination of invertebrates, seeds, bare ground, and herbaceous canopy creates optimal bobwhite brood-rearing habitat, simultaneously providing food and cover.

Annual plant communities are short-lived, lasting only 1-2 growing seasons. In the absence of further disturbance the plant community composition changes over several years through normal successional process. The annual plants are replaced by perennial forbs, grasses, and eventually, woody plants. Changes in vegetation composition are accompanied by changes in vegetation structure. As a plant community ages, bare ground declines, litter accumulates, and vegetation density increases. The rate of successional change is a function of site fertility, rainfall, local hydrology, temperature, and length of the growing season. Planned disturbance is required to maintain this ephemeral community in a managed landscape.

Land managers targeting early successional wildlife species implement disturbance regimes to create and maintain these essential early successional habitats. Disturbance not only influences the plant communities' composition and invertebrate resources, but also the structural characteristics which may influence the accessibility of food resources to ground foraging birds.

Rotational (strip) discing is an efficient and cost-effective vegetation management practice commonly used to create early successional plant communities for bobwhite and other early successional wildlife species. Discing enhances habitat quality for bobwhite chicks because it inhibits woody growth, promotes favored seed producing plants, reduces plant residue, increases bare ground, and increases insect abundance.

When to Disc

Discing can enhance habitat quality in dense, monotypic stands of broomsedge, abandoned pastures, Conservation Reserve Program fields, old fields succeeding to brush, and dense cool or warm season grass plantings. Implementation of this management technique is appropriate within areas established to grass for at least 3 years. Sites that have not been disturbed for 2-3 years are good candidates for discing. Discing is very effective in broomsedge communities and can enhance habitat quality for several years.

Benefits of discing will be more modest and short-lived (1-year) in established stands of fescue. Discing should not be used on Bermuda grass sod because the discing stimulates growth and spread of the Bermuda grass. Discing will be most beneficial on sites dominated by fescue and Bermuda grass, *after* the exotic forage grasses are eradicated with herbicidal treatments. ***Discing should not be used on sites where sensitive, remnant native ground cover exists (wiregrass, native tallgrass prairie).*** However, light discing may be appropriate in dense, native warm season grass plantings.

How to Disc

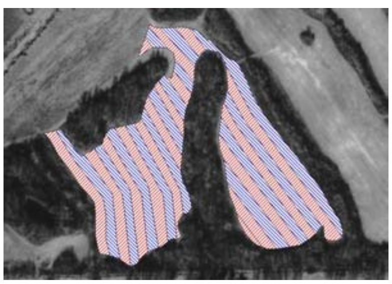
Frequency

To maintain annual plant communities, fields should be disced on a 1-3 year rotation, depending on rate of succession, specific plant community, and management objectives. In pine/grassland systems where small fields provide the only annual plant communities and primary brood habitat, annual discing may be desirable. More often, discing will be conducted on a 2-3

year rotation, with ½ - 1/3 of each field being disced each year in a strip pattern. Strip discing creates a mosaic of 1, 2, and 3-year old plant communities. Strip discing will maintain nesting cover and produce adjacent brood habitat within each field.

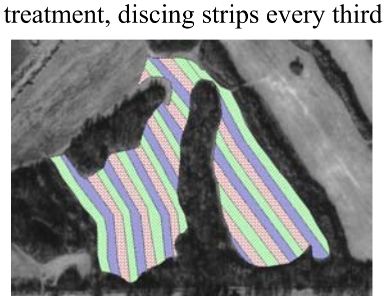
Two Year Rotation Example:

Divide each field into adjacent plots, with each plot containing 2 strips of land 30 to 50 feet in width, resulting in each plot being 60 to 100 feet wide. In fall or spring of the first year, within each plot, disc the first strip of land and leave the second strip "undisced." In fall or spring of the second year, within each plot, disc the second strip and protect the first strip disced the previous year. In fall or spring of the third year, within each plot, disc the first strip disced during year 1, protecting the strip disced in year 2. Continue this rotation treatment, discing strips every other year.



Three Year Rotation Example:

Divide each field into adjacent plots, with each plot containing 3 strips of land 30 to 50 feet in width, resulting in each plot being 90 to 150 feet wide. In fall or spring of the first year, within each plot, disc the first strip of land and leave the second and third strip "undisced." In fall or spring of the second year, within each plot, disc the second strip and protect the first (disced during previous year) and third strip. In fall or spring of the third year, within each plot, disc the third strip and protect the first (disced during year 1) and second (disced during year 2) strips. In the fall or spring of the fourth year, within each plot, disc the first strip (disced in year 1) and protect the second (disced during year 2) and third (disced during year 3) strips. Continue this rotation treatment, discing strips every third year.



Seasonal Timing of Discing

Discing can be done from late fall through early spring. Fall discing should not be initiated until after the end of the nesting season for resident birds (October). Spring discing should be completed prior to the beginning of the reproduction season of most wildlife species (late March). The seasonal timing of discing influences the vegetation structure and composition. Fall discing tends to promote hard seeded forbs and legumes (ragplant, partridge pea, lespedeza, etc.), whereas spring discing promotes annual grasses (foxtail, millets, etc). Fall discing may be more effective in stimulating important food plants for bobwhite. On sites with an agricultural history, spring discing may promote agricultural pest species such as sickle-pod, johnson grass, and rattlebox. For the best diversity of plants, timing of discing can be varied with some discing being conducted during each season.

Discing Intensity

Discing intensity can be altered by adjusting the depth of the disc and/or the number of passes. Creation of an annual plant community does not require a seedbed quality site preparation. Light discing (1-2 passes 3-5" deep) can effectively stimulate germination of an annual plant community. In general, the more intensively the site is disced, the less residual perennial grass and greater annual plant component. Sites with dense stands of perennial grass or sod-forming grasses like fescue will require greater discing intensity. Sites dominated by exotic forage grasses (fescue, Bermuda grass, Bahaia grass) may require herbicidal renovation prior to implementation of a disking regime.

Highly Erodible Land

Strip discing on highly erodible lands requires special precautions. Research in Mississippi and Missouri has demonstrated, that strip discing, when implemented along the contour, created minimal erosion (0.01 – 0.17 ton/acre) at the field level, with observed erosion rates well below soil specific T-levels. Specific guidelines for strip-disking on HEL or CRP must be formulated by NRCS at the state level. In Mississippi the NRCS developed the following specific guidelines for strip discing on HEL.

1. Strips shall be disced light enough to provide for a minimum of 30 percent residue on the soil surface after discing operations are complete.

2. Discing should be done on the least erosive parts of fields and not in places where gully formation is a problem. In addition, a disced strip must be no wider than 30 feet.

3. Strips shall be disced along field contours as near as practical.

4. Strips may be disced from late October through late March. Strips disced in late fall may be seeded to a winter cover crop suited for wildlife.

5. Light discing should be performed on a 2-3 year cycle. Rotate and/or alternate the location of the lightly disced strips each year. Continue this rotation, discing strips every 2nd-3rd year. When disced area is rotated, the old area should have sufficient permanent cover to provide wildlife habitat and soil loss protection.

6. Discing must follow technical specifications in Table 1.

Table 1. Requirements for Light Strip Discing on Highly Erodible Fields, MS

EI Range	Amount of Field to be Disced	Maximum Width of Disced Strips	Minimum Width Between Disced Strips
8-20	33.3%	30 feet	60 feet
20-25	25.0%	30 feet	90 feet
25-28	20.0%	30 feet	120 feet
28-30	17.0%	30 feet	150 feet
30 +	14.0%	30 feet	180 feet

Combinations

Strip discing can be used in combination with prescribed fire to create an even greater diversity of desirable plants. Disced strips can be used as fire breaks. Within a given year, ½ of the undisced areas between strips can be burned to create a mosaic of annual and perennial, burned and unburned plant communities. Fertilizer (0-20-20) may be applied to disced areas to improve production of legumes. Legumes or other wildlife food plants can be seeded on disced areas to provide early ground cover and additional food resources.

TECHNICAL ASPECTS

Effects of Discing on Soil Erosion

Since 1985, an annual average of more than 14 million ha of highly erodible cropland has been taken out of

production and enrolled in the Conservation Reserve Program (CRP), much of which was established in perennial grass practices. Plant communities on CRP grasslands are not static, but progress through predictable successional stages over the life of the contract. As plantings age, vegetation composition changes from a diverse annual community with an abundance of bare ground, to a perennial grass and forb community with dense litter accumulation and little bare ground. The rate of succession is a function of fertility, moisture, and length of growing season. The composition and structure of plant communities, including those on CRP fields, can be modified (intentionally or accidentally) by

disturbance/management regimes. Throughout the Midwest and Southeast, habitat quality for early successional and grassland species may decline as CRP grasslands age, but premeditated disturbance regimes may enhance and maintain habitat quality for these species. However, concerns regarding perceived conflicts between wildlife habitat and soil erosion objectives persist among USDA-FSA and NRCS personnel. Disturbance regimes will only be accepted if they can enhance wildlife habitat quality without compromising the erosion-controlling benefits of the established ground cover.

To evaluate effects of rotational light discing, implemented in a strip fashion as prescribed under NRCS guidelines, controlled studies were established in Mississippi and Missouri as part of a cooperative study between Mississippi State University, Missouri Department of Conservation, Mississippi Department of Wildlife, Fisheries, and Parks, and the Missouri and Mississippi state offices of USDA-NRCS. This study examined differences in predicted soil loss across treatments using Revised Universal Soil Loss Equation (RUSLE). The value of this work is to help NRCS develop new technologies and evaluate existing conservation standards utilized in Farm Bill programs and conservation planning.

The Missouri experiment evaluated effects of 3 treatments [i.e., fall disc (1 pass), fall disc (2 passes), and control] on vegetation structure, floristics, and soil erosion in 5 plots/treatment in each of 4 fescue and 4 orchard grass CRP fields (20 plots/treatment/planting). Study sites were established in a split-plot arrangement of treatments in a randomized complete block design. Each study site (i.e., blocking factor, n = 4) contained 5 hillslope positions (i.e., whole plot effect) with 3, 10 × 20 m split-plots per hillslope position. Treatments were randomly assigned to to split-plots within each hillslope position with each treatment in 5 split-plots in each of 4 study sites for a total of 20 split-plots/treatment/planting. The Mississippi study evaluated effects of 7 treatments (i.e., fall disc [1 pass], fall disc [2 passes], winter burn, spring disc [1 pass], spring disc [2 passes], spring burn, and control [no manipulation]) on vegetation structure, floristics, and soil erosion in 5 plots/treatment on each of 4 fescue CRP fields (20 plots/treatment). Again, study sites were estbalished in a split-plot arrangement of treatments in a randomized complete block design. Each study site (i.e., blocking factor) contained 5 hillslope positions (i.e., whole plot effect) with 7, 10 × 20 m split-plots per hillslope position. Treatments were randomly assigned to split-plots within each hillslope position with each treatment in 5 split-plots in each of 4 study sites, for a total of 20 split-plots/treatment.

Evaluation of Soil Loss Response Variables

Soil loss is strongly influenced by canopy and ground cover intercepting rain fall. Ground and canopy cover was estimated for soil loss equations using a point intercept method along a 15.4 m line (string) with 50 points located at 0.3 m intervals. On each plot, the string was placed along 2 diagonals for a total evaluation of 100 points/plot. At each point, 3 forms of canopy, canopy height, plant basal area, and 3 types of ground cover (residue, live, other) were measured. Measurements were conducted monthly from treatment implementation through 1 year post-treatment.

RUSLE$^{@}$ (copyright 1992, Soil and Water Conservation Society), a computer based application used to predict soil loss from a variety of agricultural practices was used to evaluate and predict soil loss associated with discing practices. RUSLE uses crop and region specific databases to formulate soil loss predictions (SWCS 1993). The RUSLE is A = RKLSCP, where A = the annual soil loss, R = a rainfall factor based on geographical locale, K = soil type, L = slope length, S = slope degree, C = canopy and ground cover management, and P = conservation practices. Rainfall factors (R) are based upon geographical location derived from a city climatic database available within the RUSLE program. K-factors are based on soil series and geographical locale, and are a measure of a particular soil series' potential to erode, given rainfall patterns characteristic of the location. The LS-factor is based on length and steepness of slopes, and is a measure of the effect of slope length and steepness on soil loss. The P-factor is affected by conservation practices such as contour plowing, terracing, drainage systems, strip-cropping, etc. To account for this variability, a C-factor is an average soil loss ratio weighted according to the distribution of R during the year (SWCS 1993). Factors R, K, L, and S did not vary among treatments in our experiments. The P-factor varied between control and other treatments, but was similar for all manipulations within each experiment. The C-factor was the only factor that varied among treatments within each experiment. A C-factor database was formulated for each management technique based on canopy and ground cover data (Table 1). From these databases, we derived a C-factor for each management practice. The C-factor represents effects of plants, soil cover, soil biomass, and soil disturbing activities on soil erosion. Calculated values of C are weighted averages of soil loss ratios (SLR's) that represent soil loss under the given conditions recorded from unit plots under clean-tilled continuous fallow management.

In addition to data collected, RUSLE requires estimated residue at harvest, row spacing of crop, plant population, a surface residue decomposition coefficient, subsurface residue decomposition coefficient, root mass in top 4", and residue at 30%, 60%, and 90% canopy cover for input into crop databases used in formulation of C-factors. These parameters were estimated from fescue, brome, and plant databases currently available in RUSLE. Residue at harvest was estimated as 3000 lbs/ac from brome and plants databases. Plant population was estimated from the brome database as 600,000 plants/ac. Residue decomposition rates were estiamted from the plants databases because of the high plant component on these study sites. Residue at 30%, 60%, and 90% canopy cover was estimated from plants and brome databases as 640, 1650, and 4100 lbs/ac, respectively. Root mass in the top 4" was estimated as 7000 lbs/ac from the fescue pasture database and was assumed constant throughout the time period. Root mass was not measured, so it was not possible to estimate change after manipulations. RUSLE crop databases stipulate canopy cover at given intervals post-treatment; however, the program is mainly geared toward a row crop situation where ground cover is low. To address concerns that if canopy cover was included without the ground cover, full effect of ground cover in impediment of soil loss on the study sites would not be adequately addressed. Therefore, both ground cover and canopy fall height were used for each measurement period. RULSE requires that information be entered on 15-day intervals. Because cover was measured at monthly intervals, researchers interpolated between measured values to provide the required data. During each measurement period canopy height of plants was measured and converted to effective fall height (feet) by assuming effective height was 50% of the average canopy height (SWCS 1993). Using these methods, C-factor crop databases were formulated for each practice and planting [Missouri: Orchard grass fall disc (1 pass), fall disc (2 passes), and control; Fescue fall disc (1 pass), fall disc (2 passes), and control, Mississippi: Fescue fall disc (1 pass), fall disc (2 passes), spring disc (1 pass), spring disc disc (2 passes), winter fire, spring fire, and control].

After formulation of crop databases, C-factors were derived for each practice by incorporating a schedule of management in an operations database in conjunction with the crop database. For discing treatments, the equipment type selected was a light tandem disc. The addition of residue (i.e., ground cover), as a result of the pre-treatment mowing of study sites, was accounted for by stipulating a harvest in the schedule of operations. Addition of residue (i.e., ground cover), as a result of plant senescence, was adjusted to detect its influence on soil loss. Following these methods, C-factors were derived for each treatment in each planting type. After formulation of C-factors for each treatment, RUSLE was solved for each treatment and soil loss was predicted. Soil loss is reported at 2 scales, within strip (i.e., strip management scenario) and at the field level (i.e., scale of most concern to NRCS).

In the Missouri study, C-factors for orchard grass fields ranged from 0.0002 for the control to 0.004 for the fall disc (2 passes). In fescue fields, C-factors ranged from 0.0001 for the control to 0.003 for the fall disc (2 passes). A complete listing of database values for each treatment can be found in Greenfield (1997). Predicted soil loss for all treatments on both cover types were well below 1 ton/ac/year for both the treated strip and field scales (Table 1). Soil-series-specific tolerable soil loss levels (T) for Leonard silty clay loam in Missouri was 3 tons/ac/year. Overall, soil loss at both the strip and field scale were well less than predictions for all cropping systems. In the Mississippi study, calculated C-factors ranged from 0.0001 for the control to 0.012 for the fall disc, 2- passes (Table 1). A complete listing of database values for each treatment can be found in Greenfield (1997). Predicted soil loss for all treatments, were well below 1 ton/ac/year for both the treated strip and field scales (Table 3). Soil-series specific tolerable soil loss levels (T) for Vaiden silty clay loam was 3-4 tons/ac/year. Overall, soil loss at both the strip and field scale were well less than predictions for all cropping systems.

These studies demonstrate that enhancements in bobwhite brood-rearing habitat generally increased with increasing discing intensity (2-pass vs. 1-pass). RUSLE predictions demonstrates that disking at these intensities has negligible effects on soil erosion. To enhance wildlife habitat value discing and burning intensity could likely be increased 2-3 times without accruing a soil loss greater than soil type specific T and without compromising soil erosion provisions, particularly when applied in a strip-fashion.

Table 1. C-factors and soil loss (ton/ac/yr) predictions based on Revised Universal Soil Loss Equation (RUSLE) for tall fescue and orchard grass CRP fields in Missouri and tall fescue fields in Mississippi Managed for northern bobwhite. Predictions were made under assumption that treatments were applied in a strip-fashion on a 3-year rotation. Predicted soil loss reported for treated strip and entire field/

State	Planting	Treatment	C-factor	Soil loss (stripo)	Soil loss (field)
MS	Fescue	Control	0.0001	0.0	0.00
		Fall disc-1	0.0100	0.42	0.1400
		Fall disc-2	0.0120	0.52	0.1733
		Sprg disc-1	0.0010	0.06	0.0200
		Sprg disc-2	0.0010	0.06	0.0200
		Wint burn	0.0003	0.01	0.0030
		Sprg burn	0.0002	0.01	0.0030
MO	Fescue	Control	0.0001	0.00	0.0000
		Fall disc-1	0.0020	0.03	0.0100
		Fall disc-2	0.0030	0.03	0.0100
	Orchard	Control	0.0002	0.00	0.0000
		Fall disc-1	0.0030	0.04	0.0133
		Fall disc 2	0.0040	0.06	0.0200

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