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WINTER FOOD AND COVER PLOTS FOR FARM WILDLIFE

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ABSTRACT

In the experimental management project on the Waterloo Wildlife Area, food patches were established to provide a reliable supply of food and cover during the critical winter period. Food patches were planted near traditional wintering areas for pheasants to assure use and reduce potential exposure to predation. A wintering flock nearby also increases the probability of attracting hens secure nesting cover.

Millets, soybeans, sunflowers, winter wheat and rye, flax, and buckwheat were planted experimentally, but corn and sorghums proved to be the most reliable food sources in severe winters when the other plants lodged and were covered by snow. Food patches were established in late May or early June when the sites became accessible for traditional farm implements. Many plots were planted along wetland edges, occasionally on areas not previously tilled. Approval to establish food patches on private lands enrolled in federal land retirement programs was granted by Dodge and Jefferson County ASCS administrators. Interested cooperators were given seed and fertilizer after a mutually agreeable site was selected. Most seed beds were prepared with a heavy duty Howard rotovator powered by an International Harvester #706 tractor. Corn and soybeans were seeded with a McCormick 2-row cornplanter. Grain and forage sorghums were seeded in 14 -or 21-inch rows with a small grain drill. Only two types of fertilizer were used: 6-24-24 (N-P-K) on organic soils and 20-10-10 on all upland soils. Application rates ranged from 200 to 350 lb/acre based on soil test results. Weed control for corn and sorghum food patches consisted of a pre-emergent broadcast application of 2.5 lb of Atrazine in 20 gal water/acre.

Criteria for selecting corn and sorghum varieties most suitable for wildlife food and cover plus establishment techniques for various site characteristics are reported.

Forage sorghums or selections of black amber cane produced the best winter cover at Waterloo. After frost, these tall sorghums bent, twisted, and kinked into a matrix of intertwined leaves, stems and seed heads.

The best combination for food and cover consisted of side-by-side patches of corn and forage sorghums. Corn contributed a dependable food source and the sorghums supplied attractive cover and additional food. The costs for seeding 1-acre food plots including seedbed preparation, fertilizer, seed, and herbicide were: corn-$80, forage sorghum-$62, grain sorghum-$56, and other grains-$30-$55.

The results of the Waterloo experiments have been combined in this report with previous experience and information from other sources to provide guidelines on the "state of the art" of food and cover plot development in Wisconsin.

Department of Natural Resources • Madison, Wisconsin

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INTRODUCTION

Objectives

With the initiation of an experimental habitat management study on the Waterloo Wildlife Area, food patches were established to provide a reliable supply of food and cover over the critical winter period. These were planted near traditional wintering areas to reduce potential exposure to predation. New winter traditions were encouraged to increase the probability of attracting pheasant hens to nest in nearby secure cover. The food patch program offered an opportunity to plant many grains capable of growing under Wisconsin conditions, and to evaluate the growth, standability, availability, and winter wildife use of several different varieties.

The purpose of this report is to present the information gained from these studies and from pertinent information drawn from experience and other sources as an information manual to aid land managers in their attempts to establish and maintain farm wildlife food and cover developments.

Background

Planting of grain mixtures for wildlife food patches received considerable attention in the mid-1930's throughout the upper midwest, where long, severe winters occur at frequent intervals. Prominent leaders in these investigations, Grange (1937) and Leopold et al. (1939), recognized food availability as critical to wintering populations. They planted, evaluated and recommended agricultural grains for attracting wildlife to reduce the stress of locating ample quantities of palatable and nutritious foods. Complementing the establishment of wildlife food patches, interest was directed to alternative measures of winter feeding with the provision of shelters constructed from poles, brush, cornstalks, and unsold Christmas trees. Such practices were widely accepted and adopted for the next decade by farmers, sportmen's clubs, such youth groups as the Junior Izaak Walton Leagues, and emerging state conservation departments.

Appreciation for and participation in this activity waned as ecological studies involving wildlife populations and habitat relationships began to show that any given winter habitat could only support a limited number of animals. Carrying capacity became an accepted concept in managing wildlife. Protection for many game birds and animals gave way to more liberal hunting seasons, regulated harvest of females in the case of the white-tailed deer, and emphasis on native vegetation to nourish stressed populations whenever they developed. Several decades later investigations rekindled interest in wildlife food patches with the appearance of herbicides for controlling weeds in common agricultural crops (Zorb 1956 and Buchholtz and Bayer 1960). Vohs (1959) undertook a 3-year study in Illinois whereby corn was established in wide rows in alfalfa or grass sods. This author concluded that local wintering species such as cottontails, bobwhites, mourning doves, and Canada geese used wide-row corn at significantly higher frequencies than the adjacent conventionally planted corn.

Federal land retirement policies of the late 1950's through the 1960's temporarily offset massive habitat destruction created by wetland drainage, removal of hedgerows and fencelines, and grazing of wetlands and woodlots. Increased efficiency of larger farm machinery, declining numbers of small farms, and expanding foreign markets for grains, however, quickly reversed the habitat picture for farm wildlife in the 1970's. Continued degradation of preferred habitats often precipitated problems associated with reproduction or survival of the species. Annual abundance of natural food reserves is difficult to forecast. Agricultural grain residues often supplement the diets of most farm wildlife species, notably the ring-necked pheasant, Hungarian partridge, bobwhite quail, cottontail rabbit, and gray and fox squirrels. Songbirds, small mammals, furbearers, migratory waterfowl, and deer consume quantities of weed seeds, small grains and domestic forages. Intensive farming practices combined with increased efficiency have gradually reduced the fringe benefits of waste grains, weedy fields, corn shocks, brushy fence lines, filled corn cribs, and manure piles, often a source of sustenance in recent decades. The wildlife food patch may once again be an important habitat component for farmland wildlife.

PROCEDURES

Food patches on the Waterloo Area, consisting of most small grain crops, corn, sorghum, and soybeans were established in late May or early June or as soon as sites became accessible for traditional farm implements. Winter rye and wheat were seeded in mid- to late September. Numerous food patches were planted along wetland edges, occasionally on areas not previously tilled. Approval to establish food patches on private lands enrolled in federal land retirement programs was granted by Dodge and Jefferson County ASCS administrators. Interested cooperators were given seed and fertilizer after a mutually agreeable site was selected. When private landowners could not prepare a seed bed and plant the crop, the field research team did the work. At the peak of annual food patch planting, between 38 and 44 plots were seeded each year to either corn or sorghum or both. An additional 8-12 plots were planted to soybeans or small grains. Size of food patches varied according to tillable area and the number of wildlife species expected to winter in the immediate vicinity.

Most seed beds were prepared with a heavy duty Howard rotovator powered by an International Harvestor #706 tractor mounted with dual rear wheels. This equipment had several distinct advantages over conventional plow, disk method of seed bed preparation. The rotovator was capable of tearing up sod, corn stalks, or weedy growth on idled cropland. On heaviest sods, plots were rotovated twice which resulted in a satisfactory seed bed for a two-row corn planter or an 8-ft grain drill. Dual tractor wheels improved flotation and advanced the date that wetlands could be safely tilled. Corn or soybeans were seeded with a McCormick 2-row cornplanter. Plates recommended for different seed sizes were used to secure proper seeding rate. Fertilizer was applied with the corn planter, and with the grain drill when planting sorghum. Only two types of fertilizer were used: 6-24-24 (N-P-K) on organic soils and 20-10-10 on all upland soils. Application rates ranged from 200 to 350 lbs/acre based on soil test results. Generally, higher rates were used if soil test data were not available or if previous plant growth suggested low fertility.

Weed control consisted of a pre- or postemergent broadcast application of 2.5 lb of Atrazine in 20 gal water/acre. A single cultivation was made if the herbicide activity was limited because of moisture deficiency after seeding or if the herbicide was omitted. Minor food crops, millets, flax, sunflower, and buckwheat were seeded on several occasions on upland sites to assess potential for supplementary or specialized use.

Test plots with hybrid forage sorghums, short grain sorghums, and early maturing corn varieties were planted to evaluate varietal differences or performance on upland or lowland sites. The only cultural difference between food patches and test plots was the hand planting of the test plots. Corn varieties selected were early maturing types rated at 70-90 days relative maturity. Food patches were checked during the growing season for evidence of weed problems, nutrient deficiency, or insect and disease infestations. Varietal evaluations were based on vigor, disease resistance, maturity and winter standability. In the case of sorghums the winter cover value was assessed on the tendency of the stalks to kink, bend, or twist into a matrix at 2-3.5 ft in height in which fruiting heads penetrated to within reach of ground-dwelling wildlife. Intertwining stems formed a canopy that offered a high level of protection from the elements and predators, but also rigid enough to support 6-8 inches of snow.

Wildlife use of food patches and test plots was determined from visits made 2-4 times each winter, generally 2 or 3 days after a fresh snowfall. Species use was determined by flushes, track frequency or night roosts. Evidence of disturbance or predation was noted by tracks or carcass remains. Simultaneously, the patches were rated for relative cover and availablity of the seed.

SITE SELECTION

Sites should be selected on the basis of habitat considerations (e.g., quality of nearby permanent protective cover and prevalence of undisturbed nesting cover), soils, and accessibility.

Habitat Considerations

Management at Waterloo was focussed on the pheasant, and decisions on possible location of food and cover patches were related to pheasant wintering habits. In southeastern Wisconsin, where highest pheasant populations have always occurred, the majority of birds move locally to wetlands, which provide optimum protective cover from the elements. The strategy was that a dependable source of food to sustain the wintering population would reduce predation losses and maintain better physiological condition for the spring reproductive period. Traditional wintering areas commonly include shrub-carr (shrub swamps) and cattail marshes. Of less importance are tamarack swamps and formerly cultivated wetlands that revert to canary grass, nettles, ragweeds, or aster-goldenrod complex, none of which provide much in natural foods.

Past history of pheasant use in winter is an important consideration in locating a food patch in or near any of these locations, and in determining the number of food patches required. Where extensive wetland tracts exist, more than one food patch is preferred. On one large wetland tract exceeding 600 acres at Waterloo, we planted 4 food patches annually at various locations along the edges and 1 approximately in the center. After evaluation, however, 3 patches (0.5-1 acre) would have been adequate to support existing wintering populations of pheasants, cottontails, squirrels, and deer. Food patches also proved to be a popular location for hunters to encounter pheasants.

Brushy fencelines or field borders adjoining wetlands provide alternative sites for a food plot. Where good hedgerow cover exists, select a southern or eastern exposure to evade the prevailing winds. Northern exposures should be avoided if possible because shade from woody species prevents normal seed development in the shaded areas. Competition for moisture and nutrients often limits yields on the first 2 or 3 rows on east or south exposures.

Other sites that merit consideration are small undisturbed upland woodlots. These woodlots generally support a dense understory of shrubs and vines especially attractive to squirrels and cottontails. Conifer groves or farm windbreaks sometimes function as winter cover for pheasants and cottontails. Where these sites are used frequently, a food patch is highly beneficial. Pheasants commonly roost in the evergreen boughs during the winter, gaining maximum protection from predators. As groves mature and form a closed canopy, much of the snow cover remains on the branches, permitting easy access at ground level. Edges and slightly elevated locations such as levelled banks of drainage ditches can often be worked into small food patches.

Soils and Soil Testing

To assure good growth and yield, soil should be tested. Soils can be sampled anytime the moisture conditions are suitable, although the preferred time is the fall prior to planting. A soil test probe is the most convenient means of taking soil samples, but samples can also be collected with a shovel or knife to a depth of 8 inches. Some difficulty may be experienced with these methods in securing a uniform core. Since food patches are usually planted on small areas, only 1 sample consisting of 5 random cores is necessary. Larger fields planted under a share crop agreement are sampled according to variations in slope or texture. Subsamples of uniform sections of a large field are identified as 1a, 1b, etc. Aerial photos or field maps are useful in designating field divisions. The cores (mixed together) or subsamples are submitted along with a recent crop history to the state soils laboratory or any recognized private soil analysis laboratory for testing. A list of soil test firms are available through county agents or soil testing laboratories.

General soil test reports give the organic content in percent and tons/acre, pH, and lb/acre of available phosphorus and potassium. Recommendations are given for corrective fertilization if necessary and specific nutrient applications for the crop to be planted. For small orders, most local farm cooperatives carry a selection of the commonly used fertilizer mixtures. Larger quantities can be purchased through the bid-contract procedure.

Organic soils are frequently deficient in potassium, while upland soils are usually short of nitrogen. Acid soils (pH of 6.2 or less) benefit from lime applications. If lime is indicated, it should be applied in advance of planting and worked into the soil before seeding. Corrective lime applications are good for about 4 years under continuous cropping. Good cultural techniques on previously cultivated agricultural land will be reflected in comparatively good soil test results.

Judgment and discretion on the part of the property manager and/or sharecropper is required on the sampling procedure for each field. Soil samples are not required annually. A test made about 1 in 4 years should be adequate. Fertilizer application recommendations will vary according to the crop to be grown. Proper use of the soil test results will insure optimum yields.

Lacking soil tests, the existing vegetation will provide a clue to the probable nutrient level. Heavy growth of rich green plants suggests a good nutrient balance. Stunted, off color plants indicate nutrient deficiencies.

Accessibility

Ideal locations for wildlife food patches may present some hazards in transporting equipment to the sites. Some precautions may save time and expense by preventing unnecessary damage or equipment from becoming mired in soft soils. Before moving equipment through uncertain territory like wetlands, a reconnaissance on foot may help to decide if access is feasible. Consider viewing the area in early spring before new growth begins. Topographic variations are easily identifiable and sink holes, soft spots, or areas of thin sod should be noted or marked. Wetlands are normally the driest in August or September, allowing reasonably safe movement of equipment. Canary grass forms a dense sod capable of holding up small to midsize tractors. Bluejoint grass also develops an extremely fibrous root system which helps keep machinery from getting bogged down. Thin sods or areas dominated by such forbs as aster-goldenrod complex, sunflowers, nettles, cattails or shrubs generally should be avoided because of greater probability of getting machinery stuck. If a satisfactory route can be established to a potential food patch site, flagging tape should be used to mark the trail, although many colors fade after 3-4 months. Fluorescent orange has proved the best color to use year round. Stream beds should be checked at crossing points to ensure adequate footing. Ballast should be added if needed. Bank erosion can be affected by high water flow and/or muskrat denning.

Other considerations related to the accessibility of the food patch site are freedom from human or animal disturbance and protection from the danger of flooding.

SEED BED PREPARATIONS

Traditional Tillage Methods

All potential food patch sites need to be judged in terms of the kind and amount of surface vegetation and the equipment available to do the job. The traditional tillage of the soil by plowing with a moldboard plow followed by a disking with a tandem disk, and completing the job with a spiketooth harrow is still the most popular and effective means of preparing a firm, level seedbed for corn and small grain seeding.

For wildlife food patches some preplow operations are necessary, such as burning residual cover or rotary mowing, to reduce or remove the surface accumulation of existing grasses and forbs. This insures that all of the material can be completely turned under when plowed.

The best alternative to the plow-disk-drag operation is to use a heavy duty rotovator on relatively small areas, up to several acres. Rotovators work best in fields or sod without much surface debris. Corn stubble (harvested for silage), plowed fields or recently harvested hay fields are preferred sites for rotovator use. It also can be used in fields containing corn stalks, annual weedy growth, or wetlands, but these sites often require 2 and occasionally 3 rotovations for a good seed bed. Tall vegetation has a tendency to wind tightly around the shaft and eventually requires hand removal to maintain performance. Advantages of rotovating are that field work can be done with one piece of equipment and it is easier to operate on organic soils. Disadvantages include slow field speed, requirement for a tractor of at least 70 hp, and repeat rotovations on trashy sites. Wetland soils are often difficult to work compared to upland mineral soils. Old sods often contain extensive fibrous root systems creating problems in turning them over completely. On recently worked organic soils the surface is frequently very soft and powdery. Dual-wheeled tractors or tracked vehicles may be necessary if the acreages of these soils are extensive. Incomplete drainage or wet spots are common on wetland soils. Wetlands previously disturbed or cropped are a better choice than attempts to break new ground. Look for old ditches, predominantly canary grass fields, stinging nettle, or giant ragweed. These species often persist on old wetland crop areas.

Generally, highest yields are obtained under the standard tillage system. Fall plowing is preferred to spring plowing, but only if potential soil erosion is not a factor. The rough surface of a fall-plowed field traps moisture and reduces soil erosion, but only on nearly level or slightly rolling locations. Fall-plowed fields dry out faster in the spring and warm up earlier. Frost action also improves soil structure and makes disking easier than on spring-plowed lands. Decomposition of plant residues fall-plowed begins earlier and released nutrients become available to the recently seeded crop. Fall plowing may help redistribute the normally heavy spring workload. Disadvantages of fall plowing include potential for soil erosion and loss of some food and cover. Equipment transport becomes another consideration.

A firm, well-prepared seed bed ensures proper seeding depth, seed distribution and more effective weed control through cultivation or herbicide treatment. Fields may have to be reworked if seeding is not done soon after the seed bed is prepared, since weed control will be largely dependent on a pre-emergent herbicide application. Most weed seeds germinating prior to a pre-emergent herbicide application will not be affected by the activity of the chemical. Therefore use postemergent application with a surfactant, especially an organic soils.

Limited Tillage or No-till

Limited tillage incorporates most surface residue into the soil through chisel plowing and tandem disking or offset disking followed by tandem disking. Either procedure leaves some reduced trash on the surface, and a soft seed bed. Moldboard plowing and harrowing are eliminated. Because limited tillage operations require large equipment intended for big fields, they are not suitable for food patch planting unless planting equipment can be rented or purchased or the land is prepared by a sharecropper who has the machinery.

No-till is primarily adapted to sodded fields in which the top growth has recently been cut for hay or to sites where residual cover can be burned off. No-till, as the name implies, means the seeding is done without any soil disturbance. A no-till seeder is required for planting. Weed control is accomplished with various herbicide combinations, which may include 2 or 3 chemicals consisting of one contact weed killer to eliminate all top growth and residual herbicides to control annual weeds. Compatible herbicides can be mixed together and applied in one application. Rainfall after chemical treatment is critical to activate the herbicides. As a consequence crop yields are apt to be more variable. Limited tillage or no-till methods generally apply to corn planting only. Buchholtz and Bayer (1960) developed the first techniques for establishing food patches without tillage. Further details on the application of herbicides are presented in a later section entitled "weed control".

TABLE 1. Recommended early maturing corn varieties for wildlife food patches.*

Variety	Relative Maturity (R.M.)
Warwick SL-207	75
Warwick W-777	75
Seneca 140	75
Pickseed 2277	75
Jacques JX-20	80
Carhart CX8A	80
Midland M180	80
Northrup-King PX11	80
Supercrost 1210	80
Payco 3X227	80
FS 010	80
PAG SX111	80
Northrup King PX7	85
Midland M385	85
Carhart C385	85
Cenex 3015	85
Jacques JX32	85
Cenex 3018	85
Lemke SL10	85
Seneca S3193	85

*Above varieties selected from Northern Hybrid Corn Trials, 1979 and 1980; Elwood Brickbauer U.W. Extension; or from experimental planting on DNR Hargrave property, Madison.

MAJOR GRAIN CROPS

Variety Selection

Corn. Confronted with hundreds of commercial corn varieties from approximately 40 or more seed producers in and near Wisconsin, the wildlife manager faces a perplexing situation in selecting one or two varieties that possess superior qualities for wildlife food patches. Preferred characteristics for wildlife purposes include good winter standability, ear retention, disease resistance, and tolerance to cool soil temperatures. Capacity to remain erect after maturity combines good stalk strength, a vigorous root system and resistance to stalk and/or root rots. In general, these characteristics are always a component of commercial corn breeding programs and differences between varieties is often not significant. To assure ripe or mature corn by the end of the growing season, selections are necessarily limited to very early maturing varieties within 75- to 95-day relative maturity groups. This limitation reduces the number of varieties to consider (Table 1).

Only very early varieties should be planted in wetlands or low sites subject to late spring or early fall frosts. Ability to germinate and grow at relatively cool soil temperatures is essential for semihazardous locations. Unfortunately, not all variety descriptions refer to all desired characteristics. Commercial seed growers list their varieties and prominent qualities in a yearly brochure. Comparison between varieties from different growers is difficult due to production at different locations and to the extent that desired plant characteristics are noted in their descriptions. Since the grower's evaluation is concluded at the end of the harvest period in late October to mid-November, the performance under adverse winter conditions is unknown except to the extent that standability is recorded at harvest.

According to Brickbauer (1980) over 1,000 varieties or selections of corn are offered annually to Wisconsin farmers. Through continuous selective corn breeding programs, any single corn variety has an average longevity of only 6 years in commercial channels before it is replaced by newer selections. About 350 corn varieties are evaluated at one or more agricultural experiment stations throughout Wisconsin each year. Varieties are ranked for production and moisture content at harvest, and rated for stalk breakage if this occurs before harvest. These trials are helpful since high moisture percentage infers probability of mold development in the fall prior to freezeup. In years that stalk breakage occurs, varieties prone to breakdown can be eliminated from consideration for wildlife food patches. When independent objective criteria are not available, all varieties rated 95 days relative maturity (R.M.) or over should be not be planted. Consult the results of recent University tests run at the nearest experiment station, which will list in ascending order varieties according to percentage of kernel moisture at harvest. Select about 10 varieties with the lowest moisture level. If broken stalk percentage is given, eliminate all varieties that had a percentage of broken stalks above the mean. Note varieties that have a very low percentage of broken stalks. A third reference is the annual seed producers or growers manual Brief descriptions of all varieties available that year are given. Select varieties that are recognized for excellent standability or stalk strength. By evaluating information from these sources, many corn varieties can be disregarded and those remaining should be the best prospects for wildlife food plots. At this point final

TABLE 2. Preferred selections of grain and forage sorghums.

Type	Variety	Days to Bloom	Plant Height (inches)	Grain Yield (bu/acre)	Lodging (%)	Source
Grain	DeKalb-46A	74	41	75	2	Univ. Neb (1978)
	DeKalb-E-57-A	75	42	78	9	
	Asgrow Bug-off E	75	39	83	11	
	NK 2779	75	38	74	12	
	Tekseed Tek 16R	75	41	74	11	
	Growers GSA-1310	76	38	71	7	
	Warner W-839T	76	39	77	7	
	Golden Acres T-e Y-101-R	77	38	76	7	
Forage	Northrup King NK-145	Early	100	-	-	Field tests, DNR
	Northrup King Trudan 8	Mid-season	100	-	-	
	Bug-off	Mid-season	80	-	-	
	Titon E	Mid-season	110	-	-	

selection of 1, 2, or 3 varieties is arbitrary, although cost factors might be considered. Preference should be given to hybrids produced in Wisconsin.

Sorghum. In contrast to corn, there are only an estimated 50-60 varieties of grain and forage sorghums offered in Wisconsin each year. Variety preference for wildlife food patches is also hampered because producer or University evaluations are generally concluded at the end of the growing season or at harvest and a majority of the trials are conducted in the plains states or southern states. A primary difference in cultural requirements between corn and sorghum is that sorghums grow better on dryer soils. They can be grown on organic soils if well drained, but will do poorly on any soil that remains wet, cold, or waterlogged.

Most grain sorghums are 40-60 inches at maturity. The mini milos are very short (36 inches), early maturing (R.M.=90 days), and have relatively thin stalks. Winter standability of mini milos is fair. Short varieties with thick stalks generally have had much better winter standability. They also are leafier and offer better cover, but tend to be later maturing. If available, seed of both types can be mixed together to get the benefit of each.

Forage sorghums are grown for summer livestock feed when traditional forages are in short supply. Mature height may vary from 6 to 10 ft. Some varieties offered in Wisconsin will not produce ripe seed so their primary function is winter cover. After killing frost, the tops begin to kink, forming a canopy of canes at 2-4 ft. The tangle of stems usually supports the average winter snowfall, resulting in good protective cover. Winter songbirds and cottontails preferred this cover when planted adjacent to corn at Waterloo. Other varieties do produce seed, which is eaten if ripe. In general, winter seed retention is good for most sorghum varieties that mature seed in Wisconsin. A group of sorghums known collectively as black amber canes are early maturing, produce a good crop of large black seeds, but do not have good standability. Mixing a variety that forms a canopy with the early maturing black amber cane is the safest route to go.

Selecting sorghum varieties for food patches repeats the problem in selecting a corn variety. Varieties to look for are the early maturing grain selections and the stiff-stalked forage types. A tentative list of varieties is given in Table 2. If the short grain sorghums are mixed with the tall forage varieties, a ratio of 2-3 grain sorghum seeds to 1 forage sorghum seed is suggested. The quantity of each variety is determined by the average number of live seed/pound since grain sorghum seeds are larger than forage sorghums. Sorghums can also be planted with corn in alternate rows although separate plates are necessary to accommodate the difference in seed size and shapes. Perhaps the best alternative is to seed corn and sorghum patches adjacent to each other, with corn on the north or west side of the sorghum to act as a snowfence.

Equipment

Machinery needed to perform satisfactorily depends primarily on matching up the tractor's horsepower rating with the tillage equipment available to do the job. Successful operation cannot be expected if the tractor is underpowered for plowing and rototilling. If necessary, use a larger tractor than required if the equipment cannot be procured for the most economical operation. Generally smaller units are more suitable for the average-sized food patch. Rototillers (or rotovators) should be operated by tractors on the basis of 1 HP/inch of rotovator. A 70-inch width heavy-duty rotovator requires a tractor with minimum 70 HP rating.

A 2- or 4-row corn planter with a 3-point hitch is the easiest to maneuver on small acres. Each bag of seed corn identifies the recommended planter plates to be used for different models from each manufacturer. For proper seeding rates, the suggested plate size should be used to accommodate the type of seed. Corn, sorghums, and sunflowers can all be seeded with a corn planter.

Sorghums can also be seeded with a small grain drill, provided alternate seed spouts are taped, to seed in 14- or 21-inch rows. Millets, flax, and buckwheat are also seeded with a grain drill. Proper settings must be used to obtain recommended seeding rates. Manuals or charts inside the seed box cover will usually give appropriate settings for each type of seed. If drills do not have recommended settings for species to be seeded, local implement dealers should be consulted or the machine can be calibrated prior to use.

Tandem disks should also be matched to the type of power available. Small herbicide sprayers with 200- to 300-gal tanks and 20-ft booms are adequate for small patches. Sprayers may be self-powered by a small gasoline engine or may have a power take off attachment for a tractor. Self-powered units have the option of being mounted on or pulled by a pick-up truck.

Proper maintenance of all equipment cannot be overemphasized. Worn parts need prompt replacement. Attention to oil levels, hydraulic systems, grease fittings, and coolant levels will help prevent unnecessary breakdowns. All equipment should be checked by a competent mechanic before moving to the field. Each operator needs to be fully informed on proper operation and daily maintenance of each piece of equipment, and must know both hazardous features and safety precautions.

Planting Dates

Except for fall-seeded small grains, the earliest suggested planting dates will generally give the best results. Corn is especially responsive to early planting. Yields drop steadily after the optimum planting period of May 5-15 in southern Wisconsin. Field schedules need to be flexible during the planting season to take advantage of all suitable days. Preferred planting dates for seeding various grains are given in Table 3. If unavoidable delays prohibit corn planting on schedule, earlier maturing varieties should be selected. Early maturing sorghums and soybeans are available through many local dealers and should also be considered if midseason or late planting is anticipated.

Optimum spring planting dates decline about 5 days for each 100 miles north of the southern tier of counties. Likewise fall-seeded grains should be planted 5 days earlier in the fall for each 100 miles north of the southern counties. Seeding after the optimum period reduces yields. However, crops can be anticipated in average or better growing seasons. Complete failures infrequently occur in short growing seasons or on low-lying fields where crop growth is curtailed by earlier-than-average killing fall frosts. Prime seeding periods for most species are fairly short. Advancing sorghum seeding to before recommended planting dates may also have adverse results abnormally cool soil temperatures will delay germination and increase susceptibility to seed rots.

Fertilization

Fertilizer (commercial or inorganic) use and application should be based on soil testing. Low fertility soils, usually sands, sandy loams, or organic soils, often require a corrective broadcast application to reach overall minimum acceptable levels of phosphorus and potassium. Soil tests will indicate that. If corrective fertilization is not required, a complete (N-P-K) fertilizer application is recommended for row crops at planting time according to soil test recommendations. High yield corn recommendations will also suggest a supplemental nitrogen treatment for most soils. It is at this point that managers often deviate from recommendations, that is, the manager is usually not concerned with maximizing yields. Sharecroppers use their own discretion unless fertilization recommendations are specified in the contract.

If soil test data are not available, supplementary fertilization becomes a routine practice based on subjective judgment. Though not optimum management, reasonably good corn food patches can be established with a single fertilizer application at planting, provided early planting and good weed control are accomplished. At Waterloo, upland sites received 350 lb/acre of 20-10-10 and organic soil sites 200 lb/acre of 6-24-24. Depending on the site, most crops will show a response to fertilizer. Small grains, especially rye, grow very well on poor soils. Fertilizer requirements for food patch grains other than corn are lower when seeded on comparable sites. Livestock manures are a satisfactory substitute if spread in sufficient quantity and worked into the soil. Prospects for using organic materials are unlikely unless preferred or agreed upon through sharecrop arrangements.

Seeding Rates

Corn. Recommended seeding rates are based on expected 90-95% germination in corn and 80-85% germination of sorghums. If labels indicate a lower germination, the seeding rate should be adjusted accordingly. Carry-over seed from the previous year will usually give satisfactory

TABLE 3. Planting dates for wildlife food patches in southern Wisconsin.

Species	Preferred	Marginal
Corn	May 5 - May 15	May 30 - Jun 10
Grain sorghum	May 20 - Jun 4	Jun 4 - Jun 15
Soybeans	May 30 - Jun 10	Jun 10 - Jun 20
Sunflower	May 10 - May 25	May 30 - Jun 10
Millets	May 20 - Jun 1	Jun 15 - Jun 25
Buckwheat	Jun 15 - Jun 25	Jul 1 - Jul 10
Flax	Apr 20 - May 15	May 20 - Jun 1
Sorghum-forage	May 15 - May 30	Jun 5 - Jun 15
Winter wheat and rye	Sep 15 - Sep 30	Sep 30 - Oct 8

TABLE 4. Recommended corn plant population and seeding rates.

Relative Soil Fertility & Water-holding Capacity	Mature Plants /Acre	Spacing Between Seeds*	
		30-inch rows	40-inch rows
Low	10,000 - 14,000	19.0 - 13.2	14.3 - 10.2
Medium	14,000 - 18,000	13.2 - 10.5	10.2 - 7.8
High**	18,000 - 20,000	10.5 - 9.4	7.8 - 7.1

*Seeding rate = 10% over mature plant population expected. Adapted from Berge et al. (1979).
**Higher densities than noted here may result in lower winter standability.

TABLE 5. Sorghum seeding rates.

Relative Soil Fertility & Water-holding Capacity	Spacing Between Seeds		Approximate lb/Acre
	14-inch rows	21-inch rows	
Low to Medium	7	5	4
Medium to High	6	4	5

results if the seed was stored in moisture-proof bags at temperatures less than 80 F. Corn will lose viabilty faster than sorghums. All old seed lots should be rechecked for germination. Wrapping several hundred seeds in moist paper towels and maintaining them at room temperatures of at least 65 F will produce results in 10 days. Germinated corn should be checked carefully for vigorous growth. Some corn varieties lose vitality rapidly and this is often evident in comparing the root and shoot development at the completion of the test. Low vitality corn may have high germination, but weak growth. If this condition exists, the seed should be discarded. Seeding rates should also be adjusted according to soil capability. Table 4 gives recommended seeding rates based on anticipated plant populations on low to high fertility soils.

Lower rates are always used on sandy soils and on some organic soils. Medium and high rates are recommended on moderate or highly fertile soils. Overseeding on low capacity soils does not compensate in production, but often reduces yield. Seeding rates may vary slightly between different hybrids. Recommendations, if given on the bag, should be followed.

Sorghum. The grain sorghums can be planted with the use of a small grain drill or a corn planter with plates for sorghums. To plant with a grain drill, heavy duty tape is temporarily placed over alternate seed tubes for 14-inch rows or 2 for each 3 seed outlets for 21-inch rows. Use of a grain drill is the easiest means of seeding sorghums. Care must be exercised to calibrate the drill for recommended seeding rates. Since seed size differs between varieties, the drill should be adjusted according to variety used. Some drills may list recommended settings on their seeding rate chart. However, the listing only refers to seeding in normal 7-inch rows. The preferred method of checking seeding rate is to operate the drill over a hard surface for 1/100 acre and weigh the seeds discharged. The procedure is replicated three times and seed output averaged. Average seed spacing should range from 5 to 7 inches. When rates exceed this mean the drill should be readjusted accordingly. High seeding rates result in interspecific competition and lowered cover quality and grain production. Table 5 suggests seeding rates based on variation in row width and soil fertility.

Weed Control

Corn

Chemical. Basic to corn production is adequate weed control. Uncontrolled moderate to heavy weed growth in corn will often reduce the yield 75 to 90%. Seeding a corn food patch without incorporating an effective weed control plan is not recommended. Without any means of weed suppression, the planting and land preparation will be an exercise in futility. Chemical weed control has been the most common and usually reliable means of reducing weed competition in the past two decades, and applied correctly it is often the most expedient and economical. Numerous herbicides are labeled to control all common agricultural weeds likely to be encountered. Three methods of herbicide application most commonly employed on conventionally prepared seed beds are preplant incorporated, pre-emergent, and post emergent. Preplant incorporated is generally the most effective and dependable. Pre-emergent application however, is the most common method employed, and post emergent treatments are regarded as a backup if neither of the other two was used. Because the scope of corn weed control is broad, only the pre-emergent treatment is covered for establishing wildlife food patches.

County agricultural agents can provide the latest herbicide treatment recommendations by Extension weed specialists and are the best source of information for special circumstances or local problems. Some recommendations are changed yearly and new products appear regularly. Herbicide selection should be determined by weeds present. Preplant incorporated treatment usually consists of one or two compatible herbicides applied on a rough seedbed and promptly worked into the soil with a disk or a mulch-spreader. Two passes are usually necessary to thoroughly incorporate the herbicide into the top 2 or 3 inches of soil. This technique is the most efficient and will give better weed control in dry seasons when most pre-emergent applications are not very effective. A pre-emergent application normally consists of a combination of 2 herbicides for optimum control of broad-leaved and grassy weeds. Treatment can be made within up to 4 days of planting time, which permits some flexibility in scheduling field work. Precipitation is necessary after the application of pre-emergent herbicides to activate the chemicals for maximum effectiveness. Rainfall deficiency after planting causes postponement in weed control. When this condition occurs, some type of cultivation is required to curb the competiton. Subsequent precipitation will make the herbicide effective. A postemergent treatment is used as a backup method if other treatments were not used. Herbicides are applied when weed seedlings are 3-4 inches tall. Crop oil is also added to the herbicide mixture to improve effectiveness. Posttreatment is recommended on organic soils.

Annual weeds are extremely persistent and the seeds of many species remain viable indefinitely, often for decades. Some species are incompletely controlled because of environmental conditions, others germinate late in the season after herbicides begin to break down, while still others can tolerate the recommended application rates. Where excellent chemical control exists in current fields, look along field borders or walk across the field looking for skips to identify weeds surviving past herbicide applications. Perennial grasses and forbs tend to tolerate commonly used corn herbicides. Except for quackgrass, plowing will greatly reduce their abundance. In former croplands supporting a perennial grass and/or grass-legume mixture, the annual weeds expected when the fields are tilled cannot always be anticipated. Lacking any recent crop history, check neighboring fields for the presence of weeds. Former fields or wetlands that have not had a recent cropping history might be planted without a herbicide if the plots can be cultivated at a later date. On two sites at Waterloo, one field dominated by canarygrass and the second by Kentucky bluegrass were tilled for food patches. The canary grass was burned and the regrowth treated with Roundup at 2 qt/acre. The bluegrass field was not chemically treated. Neither field had any significant weed problems the first year. Both fields had been idle for at least 10 years. Cropfields retired for more than 10 years have a reduced probability of annual weed problems and planting without a herbicide should be considered.

Annual weeds likely to be encountered through the southern and western part of Wisconsin include witchgrass and wild proso (Panicum), the foxtails (Setaria), lambsquarters (Chenopodium), pigweeds (Amaranthus), smartweeds (Polygonum), and velvet leaf (Abutilon). The grassy annuals are extremely competitive on fertile soils. To some degree, the broad-leaved annual weeds have been greatly reduced on croplands with a history of consistent use of Atrazine. Herbicide recommendations in Table 6 apply only to fields under conventional tillage using the pre-emergent treatment. Herbicide combinations or "tank mixes" are chemically compatible and do a better job of controlling a broad range of weeds than a single herbicide. Table 7 compares the effectiveness of commonly used pre-emergent herbicides.

Critical for proper application rates of recommended herbicides are maintenance and calibration of equipment. Hoses, fittings, and especially nozzles and screens should be watched carefully for leaks, wearing, and accumulation of debris. Wettable powders are quite abrasive, causing wear on nozzle spray tips which alters the angle of the spray band and distribution of the herbicide mixture within the band. Small particles of undissolved herbicide or inert matter collect around the nozzle screen or may filter through the screen and partially plug the orifice. The operator should always be alert to these common problems and keep the necessary tools and spare parts on hand at all times to correct common malfunctions occurring in the field. Plugged nozzles should be promptly cleaned as soon as detected to minimize the amount of untreated area.

Calibration of sprayers is essential in order to know what the delivery is in gallons of liquid applied/acre. Output is a function of machine speed, pressure, and nozzle type. A common application rate is 20 gal herbicide mixture/acre. Water use can be reduced to 10 gal/acre in circumstances where transport and/or accessiblity is a problem. Sprayer calibration should be checked each spring before field work gets underway at the same time that all parts are checked for proper functioning. Sprayers should be calibrated at different tractor speeds and tank pressures to accommodate varying field conditions such as size, surface condition, or shape. Each operator can adjust his equipment as needs dictate without unnecessary delays.

While only a few herbicides have a restricted use label, the operator and/or handler needs to be cognizant that all chemicals have some level of toxicity and should be handled accordingly. Goggles, gloves, long-sleeved coveralls, and rubber boots must be standard apparel when mixing or spraying herbicides. Several gallons of fresh clean water must always be on hand to wash off accidental spills or diluted sprays that come directly in contact with the skin. Of paramount importance is the need to carefully read the labels of all chemicals prior to their use.

After seasonal sprayer use, the equipment should be completely cleaned with a detergent and

TABLE 6. Pre-emergent herbicide rates for annual weed control in corn.*

Herbicides	Rate/Acre	Precautions	Primary Control
Atrazine 4-L	2-3 qt	Use maximum rate for foxtails and on organic soils; carryover risk high.	Broad-leaved
Bladex 4-L	1.6-3.2 qt	Do not use on sands or mucks. Apply within 4 days of planting.	Crabgrass, foxtails, fall panicum
Bladex/Atrazine	1.07-2.13 qt Bladex + 0.54-1.07 qt Atrazine	Do not use on sands or mucks. Apply within 4 days of planting. Use 2:1 ratio of Bladex/Atrazine where annual grasses are a problem.	Grassy and broadleaved
Lasso	2-3 qt	Apply within 5 days after planting.	Foxtails, crabgrass, fall panicum
Lasso/Atrazine	1.5-2.5 qt Lasso + 1-1.6 qt Atrazine 4L	Vary Lasso rate according to severity of annual grass problems. Ineffective on mucks. Use maximum rate of Atrazine on soils.	Foxtail, crabgrass, fall panicum, all broad-leaved except velvet leaf
Prowl	1.5-2 qt	Use on soils with 1.5% organic matter. Do not apply before planting; apply after planting but before germination.	Annual broad-leaved
	.75-1.5 qt	Use on soils with less than 1.5% organic matter.	
Prowl/Atrazine	1-1.5 qt Prowl + 1-1.6 qt Atrazine 4L	Adjust rates according to soil textures and organic matter. Do not apply before planting. Ineffective on mucks.	Foxtails, crabgrass, fall panicum, and most broad-leaved annuals

*Always completely read herbicide label before using. Have sprayer calibrated accurately. All herbicides should be mixed with about 20 gal water/acre. Consult county agricultural agent or University of Wisconsin herbicide extension specialists for latest recommendations.

TABLE 7. Relative control and characteristics of herbicide treatments for control of weeds in corn.*

	Velvet Leaf	Broad-Leaved Annuals	Foxtails	Crabgrass and Fall Panicum	Quackgrass**	Risks of Corn Damage	Risks of Carryover
Atrazine	G+	E	F	P	F+	None	High
Bladex	F	G	G+	G+	None	Slight	None
Bladex/Atrazine	G	E	G	G	P	Very slight	Moderate
Lasso	None	F	E	E	None	Very slight	None
Lasso/Atrazine	F	E	E	E	P	Very slight	Moderate
Prowl	F	F	E	E	None	Very slight	None
Prowl/Atrazine	G	E	E	E	P	Very slight	Moderate

E = Excellent; G = Good; F = Fair; P = Poor.
*Adapted from Doersch et al. (1979).
**Quackgrass is not eliminated; the growth is merely suppressed by the herbicide treatment.

rinsed several times with clean water. All parts should be thoroughly air dried and steel or iron units subject to rusting should be wiped with a heavy oil or grease before storing in a dry building. Each nozzle should be removed, washed in warm detergent water, rinsed with clean water, dried and stored in a clean dry container until reassembly. Replacement parts needed can be identified and ordered to insure delivery before the next growing season. Motors on self-contained units should be drained of fuel and tuned up if needed. Be sure the pump is cleaned and a small quantity of oil added to keep the rollers free during storage. If proper maintenance and storage procedures are unknown, consult the service manual. When manuals cannot be located, contact the manufacturer, dealer, or local county agent for recommendations. Prompt and proper equipment maintenance will insure longevity and trouble-free operation, besides reducing potential breakdown or repair delays during the busy planting season.

Cultivation. An alternative to chemical weed control is cultivation. Two types of cultivation can be employed. If the corn is less than 3 inches tall, the field can be weeded with a rotary hoe. After corn growth exceeds 3-4 inches, row cultivators are required to disturb the soil surface and expose the weed root systems. Fields or patches should be cultivated on clear warm days to allow the weeds to dry out completely. Precipitation within 24 hours often is sufficient to allow many weed species to recover. Weed growth is usually rapid, and effectiveness of cultivation is closely related to the size of the weed seedlings. Cultivation before weed growth exceeds 3 inches in height will give the best results. Corn can be cultivated to a height of 20 inches if necessary, provided the weed growth is shorter. However, it becomes increasingly difficult to kill weeds after they exceed 4 inches.

Cultivation results in additional weed seeds being brought up to the germination zone within 1/2 inch of the soil surface. If the germination of weed seeds comes on quickly, a second cultivation may be warranted.

Sorghum

In contrast to corn, which seldom produces a harvestable crop without weed control, the sorghums are capable of producing some grain and considerable forage or cover if planted immediately on a freshly prepared seed bed after soil temperatures are 70 F or higher. Narrow rows of 14 or 21 inches enhance their competitive advantage. The tall forage types compete surprisingly well if planted on moderately fertile soils and the early maturing black amber canes will produce ripe grain under average growing conditions. Short grain sorghums are obviously less competitive without weed control. Grain yields are significantly reduced although absolute yield differences were not precisely determined at Waterloo. Based on field judgement, the grain production was about 50% less if no weed control was practiced.

Chemical. Pre-emergent herbicide treatment is the best means of weed control in sorghum plantings. Because sorghums are often seeded later than corn and at a shallower depth, emergence can occur within 3 days under ideal soil temperatures and moisture. The chemical treatment period is reduced accordingly. Herbicides recommended for weed control in grain and forage sorghums include Atrazine, Propachlor, or Propachlor and Atrazine. These chemicals can be applied individually or as a tank mix. Table 8 shows the recommended rates.

Cultivation. Cultivation is another method of weed control if the grain or forage sorghums are planted in row widths compatible with cultivation equipment. Optimum results can be expected if cultivation is done before weed seedlings reach 2 inches in height.

Diseases and Insects

Commercial production of any major agricultural crop is invariably accompanied by plant disease and insect problems that cause substantial losses to the producer in some years if preventive or corrective measures are not taken. It is not the intent to cover this lengthy subject or to necessarily suggest that some form of treatments be applied to wildlife food patches. Rather, the purpose is to identify a few of the common problems and the areas in which they are likely to occur, and to suggest cropping procedures or rotational patterns that should result in biological control or at least minimize possible damage or loss.

Potential for insect control from resident or migratory birds, mammals, or predatory insects is greater on wildlife areas than on intensively cropped areas. But the magnitude of control has not been demonstrated. The planting site may be more closely associated with potential insect damage than with plant diseases. Hayfields, idled croplands, and wetlands which support a heavy sod of grasses, legumes, weeds, or native forbs often contain larvae (white grubs) of June beetles, wireworms, cutworms, and grasshoppers, all of which attack corn at various stages of growth. Early fall plowing prior to October is recommended on these sites (Fisher 1978). Recommended fertilization practices and weed control also lessen the probability of insect damage.

Common above ground insects that cause corn damage are the larvae of the European corn borer, armyworm, and adult corn root worm beetles. Infestation can occur from neighboring fields of corn or idled acreage adjacent to regularly tilled fields. If severe infestation and damage occur in any field the site can be abandoned or if the field is part of a sharecropped agreement, the sharecropper may elect to go with recommended insecticide control. Damage from corn root worm larvae will not occur the first year corn is planted on a new site, but fields planted to corn 2 or more consecutive years may sustain some damage. The presence of curved or goose-necked stalks in the field is a clue to damage from this insect. Preventive insecticide treatment is available at planting if it is necessary to grow corn on infested fields. At Waterloo, the downy woodpecker (*Dendrocopus pubescens*) was frequently observed foraging for corn borer larvae on stalks in food patches.

Foliar diseases, stalk rots, and ear rots are primarily of fungal origin. Spores may be present in the soil or wind-borne from some distance. Infestation is often weather associated and severity is highly variable between years. The best method to cope with these problems, especially stalk rots, is to select either hybrids recommended as resistant or those cited as having exceptional stalk strength.

Rarely do plant diseases completely destroy individual plantings, but they are important factors in economic losses in some years. Sharecroppers should be aware of these potential problems so they can either be avoided, limited or controlled through approved pesticide use.

Bird and Mammal Damage

Blackbird (*Agelaius phoeniceus*) or raccoon (*Procyon lotor*) damage is common in food patches. Raccoons prefer sweet corn, but will eat field corn on occasion, only during the milk stage. Stalks are usually broken and individual ears only partially eaten. Blackbirds invade fields in flocks somewhat later while ears are upright and in the dough stage. Kernels on the upper third or quarter of the ear are eaten or damaged. Deer damage usually occurs after the corn crop is mature or growth is stopped by frost. Ears are partly nibbled and some grain

TABLE 8. Herbicide recommendations for grain and forage sorghums.*

	Treatment	Herbicides	Rates/Acre
Forage sorghum	Pre-emergent	Atrazine 9.0	1.7 - 2.6 lb
		or Atrazine 4-L	1.6 - 2.4 lb
		or Atrazine 80-W	2 - 3 lb
	Postemergent	Atrazine 4-L + 2.4-D	2 - 3 lb + 1/2 pt
Grain sorghum	Pre-emergent	Atrazine 4-L + Ramrod 65 WP	1.6 + 6.0

*Atrazine formulations, i.e. wettable powders (WP), liquid (L) or pelleted (9.0) are available. Either type is satisfactory. Labels should be carefully read to assure proper treatment rate.

falls to the ground. Deer use may be regular at some sites to the point that little grain remains available for other species. Where deer use is consistent and the primary species receives only minimal benefit, sorghum may be substituted for corn. Small mammal damage occurs infrequently and is usually seen on sites surrounded by permanent cover and in years of population highs. Ground squirrels (Citellus tridecemlineatus) occasionally dig out germinating corn seedlings causing high losses in the first 5 or 6 rows adjacent to grassy field borders.

MINOR GRAIN CROPS

A majority of wildlife food and cover patches will normally be seeded to corn or sorghums or a combination of each. Minor crops can be utilized effectively under a variety of conditions that limit establishment of corn or sorghums, or as an alternative or supplement to these grains. Minor crops can also function as an important late summer and fall food source before corn and sorghums are mature and available. They can also be used to attract species other than game birds and mammals, the principal benefactors of food patches.

All of the following grain crops were planted on a limited scale at Waterloo during the period of evaluating food patches. Each species can be seeded with a corn planter or a small grain drill with proper adjustments or planter plates to secure recommended seeding rates. In addition, some minor crops such as wheat, rye, or buckwheat can be planted on moderately fertile sites without fertilizer or chemical weed control and still produce satisfactory yields. These crops should be tried more frequently in circumstances where the potential benefit can be realized.

Because millets, flax, buckwheat, and rye are not important economic crops in Wisconsin, only a limited varietal evaluation was possible. Some of the varietal recommendations are made on the basis of published reports from Minnesota (Robinson 1979) and Nebraska (Nelson 1979). From these recent evaluations, only varieties reported to have superior lodging resistance are suggested, on the assumption that performance would be similar when grown in Wisconsin. Seed sources of recommended varieties may be difficult to locate in Wisconsin. Local seed dealers may be able to acquire them if ordered 3 or 4 months in advance of the planting season. Otherwise, seed producers should be contacted directly for nearest sources of supply.

Varieties

Buckwheat. Buckwheat is probably the most frequently planted species of the minor crops for wildlife purposes. It is a viney indeterminate plant that has mature seeds and flowers simultaneously. Blooming continues until killing fall frosts. Upright growth may reach 24-30 inches before the plant bends over. Lower seeding rates tend to improve stem strength. Advantages are that it can be seeded later than most crops and still produce mature seed. It is also adapted to low fertility and cool acidic soils. The primary disadvantage of buckwheat is that of poor standability. After heavy frosts, it flattens badly and is generally unavailable after accumulation of several inches of snow.

Palatability of the seed to some wildlife species is uncertain, but the seed size and availability render it usable to all species from earliest ripening until late fall.

Winter Wheat and Rye. Fall-seeded grains (winter wheat and rye) are useful in areas of high waterfowl or deer population. Growth produced after seeding is very nutritious and palatable until late fall. These grains can be seeded as early as mid-September to early November at the latest. Rapid fall growth stimulates a good root system which prevents soil erosion from fall or spring rains or runoff from snow melt. Generally, fall weather conditions provide for greater flexibility in seeding winter wheat and rye without sacrificing yields. The rule of thumb in southern Wisconsin for planting small grains is to seed prior to 20 April. For each day that seeding is delayed, yields are reduced by 1 bu/acre. In late growing seasons, spring planting may not begin before 20 April except on droughty or sandy soils. Thus, fall planting has some distinct advantages over spring seeding. Winter wheat or rye may also be used for nesting as growth resumes very early in the spring. Rye straw lodges more rapidly than wheat after grain has ripened. Seeds of both species do not shatter, and remain available from late July to at least early December. Additional weed growth emerges after ripening of the grain in mid- to late

July. Although fall cover may only average about 2 ft in height, the persistence of grain attracts pheasants, songbirds, and small mammals.

Of all small grains, rye is the most adaptable. It is commonly planted on sandy soils or soils of comparatively low fertility. On such soils these grains will respond to fertilization. Rye seeded on organic soils at Waterloo consistently proved winter hardy and tolerant of temporary flooding. By comparison, winter wheat often winterkilled when seeded on muck soils. Even under good management, rye yields will be less than winter wheat.

Birds and cottontails used rye and wheat patches throughout the winter in years of light snow cover. Natural reseeding occurred infrequently. Advantages of either crop is that it functions as a food crop, provides some nesting cover and is good brood cover during the reproductive season, and can be grown without supplementary weed control or fertilization on average locations. Few species of grains serve a dual purpose better than winter rye or wheat. They should be grown more frequently.

Sunflowers. Commercial production of sunflowers for seed has increased notably in the north central region over the past decade. Yields of high quality oils and a high protein meal product have made sunflowers an economic row crop. Wild bird seed mixtures often include sunflower seed because of its universal high palatability. Two general types of sunflowers commonly grown are the small black-seeded types or oil types, and the large gray or striped kind known as the non-oil type. Oil type seeds average 45% oil and non-oil types (actually a misnomer) contain 35-40% oil. Either type is extremely palatable and can be used for food patch planting.

In southern Wisconsin sunflowers are seeded in late May on a good smooth seed bed in 30-inch rows. Moderately fertile soil, supplementary fertilizer per soil test results, early planting, and good weed control are required for maximum yields. During the two years sunflowers were grown experimentally at Waterloo for wildlife purposes, the entire seed crop was eaten or was shattered before snow cover, and no further evaluation on use could be made. Leaves drop off after frost leaving the drooping head and bare stem which offer no substantive cover. Since no volunteer plants were found in the old plots the following season at Waterloo, we assumed all the seed had been consumed soon after ripening. A primary purpose for seeding sunflowers in a wildlife food patch is for late summer or fall food supplies. The bright yellow blooms all facing one direction also offer an attractive diversity to the landscape.

Bobwhite Soybeans. An interagency cooperative effort between the U.S. Soil Conservation Service, Missouri Department of Conservation, and University of Missouri Agricultural Experiment Station produced a soybean expressly for wildlife purposes. Bobwhite quail, wild turkey, ring-necked pheasant, and prairie grouse were the target species expected to benefit from this development. Characteristics sought were a vine-type growth, adaptation to Missouri growing season, ability to compete with weeds, capability to reseed itself, and palatability. Crosses were made between a Chinese selection from the Yangtze river and domestic varieties from Missouri. Seeds of 50 crosses were also irradiated to artifically induce genetic changes. A total of 174 crosses were made in the development (Terrill 1976). After three years of testing under stressed conditions, survivors were selected for further propagation and introduction. In 1976, the beans appropriately called "bobwhite soybeans" were made available through commercial channels.

This variety is an annual which is capable of climbing and adhering to existing perennial vegetation. Reseeding occurs in Missouri. A single planting of this variety was seeded in Richland County in 1976. Beans germinated moderately well, but the widespread drought through the growing season prevented normal development and maturation. Some seed matured, but no regrowth was noted the following growing season. This species has not been adequately tested in Wisconsin and should be planted with grain sorghums or corn to permit the viney growth a chance to ramble. The bobwhite soybean is a plant whose development was programmed exclusively for wildlife purposes, a recognition not yet attributed to other types of plant materials.

Flax. Flax is a short moderately stiff-stalked annual grown in the north central region for seed and straw. Flax seed is processed into linseed oil which is used in the manufacture of paint, oil cloth, and other commercial products. Meal left after oil extraction is a valuable additive in livestock feeds. Competition from other oil crops and production in foreign countries are largely responsible for declining acreage as a cash crop. Some interest has been expressed in using flax for wildlife food patches. Fry (1938) reported using flax in extensive food patch planting in southwestern Wisconsin in the mid-1930's. He reported flax yields comparable to millets, buckwheat, sunflowers, sorghums, and corn. Flax has moderate lodging resistance and seeds do not shatter from the capsule until late winter. In an Ohio study where flax was compared to corn, sorghums, and lespedezas, flax was preferred to the other grain species by pheasants and quail. Data were based on observations and monthly collection of birds for food habits analysis (Spiegel 1962). Attractive winter cover and good seed retention were also cited, and residual flax cover was noted as good pheasant nesting cover the following spring.

At Waterloo flax was seeded only one year and the results were inconclusive. It is seeded in late April and matures in August. It should only be planted on a moderately fertile, level seed bed that has had a recent history of good weed control. The short stiff stems only reach 2 ft in height, making it one of the shorter plants used in food patches. Palatability of the seed, moderate resistance to lodging, and seed retention are its chief attributes. Disadvantages include the short growth and its record as a poor weed competitor. Flax should be considered for songbirds, quail, and gray partridge, and it may provide an alternative to corn where deer depredation eliminates most of the preferred grain.

Soybeans. Soybeans have become an important economic crop in Wisconsin over the past decade, rivalling corn as a cash crop. Demand, improved varieties, better cultural methods, and lower establishment cost are key factors contributing to this surge in popularity. Soybeans were grown several years for wildlife food patches at Waterloo. Beans were readily taken by pheasants, and growing plants were often browsed by deer. Standability during the winter was good, much better than expected. Pods develop along the stem and remain available from ripening until snow depths up to 2 ft. Seed was retained and did not shatter to any extent. The seeds are palatable and high in oils and protein. In recent years soybeans have been successfully grown in narrow 10-inch rows. They can be seeded later than corn and good weed control can be achieved with herbicides. Soybeans also showed tolerance to temporary flooding and wet soil conditions.

The most serious disadvantage of soybeans is that they do not provide any winter cover. Leaves drop as the plants mature or after frost stops further growth, leaving only the main stem and pods. If used for food patches, they should be seeded as a supplement to corn and/or sorghums.

Millets. Millets are warm-weather annual grasses that are early maturing, produce moderate yields of highly palatable seed and offer good-to-excellent summer and fall cover. In this group of plants are species or varietal selections of the proso millets (Panicum), the Japanese millets (Echinochloa), the foxtail millets (Setaria), and the pearl millets (Pennisteum). Only the proso and pearl millets were tested at Waterloo. However, the foxtails and Japanese millets are available and are seeded to a limited extent in Wisconsin. Minnesota and Nebraska have ongoing breeding, cultural and evaluation programs for the proso millets which are the most commonly grown of the various types.

Millet seeding should be considered on a trial basis. There have not been enough millets seeded on different locations to completely evaluate their potential. Seed is moderately priced and can be seeded with a small grain drill. Future planting should be carefully watched to document species use, maturity, cover potential, seed retention, ability to compete with weeds, and soil adaptability.

Proso, sometimes called hog millet (Panicum milliaceum), produces a relatively large white or medium red seed. In the last decade a proso type, "wild proso millet" has become widely established in Wisconsin as a serious agricultural weed. The wild type differs from the domestic types by its shiny black seed coat and a growth form that matures at 4-6 ft. Agricultural selections should not be confused with the weedy type although each is listed under the same species (milliaceum).

Proso might be considered as a bait cover or a fall seed source if planted adjacent to corn or sorghum food patches. Such food sources attract birds earlier in the fall until the more lasting winter grains become available, and theoretically reduce forage efforts elsewhere resulting in less possibility for mortality. Because of its early maturity it can be successfully planted as late as mid-June to early July. Proso tolerates Atrazine, which can be used in weed control where Atrazine-sensitive weeds are a problem. It does well under dry conditions and responds to fertilizer on poor soils. Advantages over buckwheat are better cover and higher palatability. Generally the proso types tend to shatter soon after ripening and lodging resistance is only moderate. Proso millets are included in most wild bird seed mixtures sold for feeding birds in many retail stores and frequently comprise the major species in these offerings. No varietal comparisons have been made under Wisconsin conditions. Nelson (1979) has conducted tests on 20 selections in Nebraska. In these trials, varieties were compared for maturity, relative straw strength, height, yield and protein content. Three varieties rating fair or good relative to straw strength are recommended in Table 10. Improved varieties may not be readily available in Wisconsin because of limited demand. W.A. Kester and D.A. Kester (1978 pers. comm.) of Omro, Wisconsin carry a variety called "Dove" selected in India and named because of the high palatability to local doves.

Proso millet is best used as a late season crop where it is too late for corn and sorghums. Maturing seed heads bend over as they ripen so the grain is immediately available to ground inhabiting species.

Some interest has been shown in the foxtail millets for wildlife purposes. These smaller-seeded millets are selections of Setaria italica, not to be confused with various annual weedy foxtail grasses common to Wisconsin. Wilson (1948) described 5 types of foxtail millets (common, German, Siberian, Hungarian, and Kursk). Selections differ in panicle shape and seed color. Seed coat color varies from straw-colored, yellow, yellow orange, and redish orange, to brown and black. Foxtail millets mature at 2.5-4 ft with each tightly packed panicle containing thousands of seeds. They are early maturing, adapted to a variety of soil types, and as a group have better standability and seed retention than the proso millets. In this respect the foxtail millets should be preferred over the proso types or buckwheat.

Hitchcock (1950) describes three varieties of Echinochloa crusgalli and identifies var. frumentosa as Japanese millet. Weedy types of this species growing in Wisconsin are commonly called barnyard grass. Japanese millet can be located through several commercial channels and is occasionally recommended for wildlife plantings. This species is adapted to wet sites, has relatively short maturity, and produces rank growth often reaching 5 ft at maturity. It dependably produces quantities of palatable seeds for song birds, pheasants, waterfowl if flooded, and small mammals. The foliage provides good cover until early winter.

One variety (Pearlex) of the pearl millet group was planted at Waterloo. This variety is planted primarily for cover and compares to the forage sorghums or the hybrid sorghum-sudan crosses. In appearance it looks like a giant foxtail grass growing to 8 or 9 ft at maturity. The foxtail-like head averages about 10-12 inches long. If planted early it will mature seeds in the long growing season. It is leafier than most forage sorghums, but did not stand up well after killing frosts.

Perennial Wheat. Perennial wheat was originally developed in the late 1960's in California. Parentage of this new crop was a variety of common annual winter wheat (Triticum sativum) and a perennial wheatgrass known as tall wheatgrass (Agropyron elongatum). Objectives of this intergeneric hybrid were to produce a moderate or high yielding perennial wheat that retained the desirable characteristics of each parent. Potential of any perennial-type grain used for human or animal consumption is enormous. Wildlife food patches and/or wildlife cover would also be enhanced by a crop capable of producing acceptable nesting cover in addition to a ready source of nutritious seed. A single seeding at Waterloo persisted through two growing seasons, maturing seed each year. The plant and seed appear very similar to common wheat. Plants produced by Kester (1978 per. comms.) in east central Wisconsin grew about 45 inches tall, had good winter standability, and yielded 15-20 bu grain/acre. Three seedings made in Columbia County in the fall of 1979 all winterkilled. The winter of 1979-80 was very poor for winter grain survival because of the lack of persistent snow cover.

Perennial wheat has not been adequately tested under a variety of Wisconsin conditions. From the limited experience with it, the grain appears to be short lived and susceptible to winterkill. Improved reliability might be achieved by using a winter wheat hardy under Wisconsin conditions as one of the parents. Tall wheat grass has been successfully established at Waterloo on several occasions. The first seeding persisted through 3 years and disappeared. The second seeding looked excellent through 5 growing seasons. Because of the high potential for this crop, any new developments should be watched and evaluated.

Dwarf Corn. A very short dent corn received much attention by corn breeders in the 1950's. Comparable to normal dent corn except for the shorter internodes, dwarf corn matures at about 5 ft compared to 7-9 ft for many hybrids. Ears are much closer to the ground and often the tips will rest on the soil after maturity. Short thick stalks improve its standability. Disadvantages of dwarf corn are more rodent damage, tendency for increased spoilage through mold, greater probability of weed problems, and in severe winters most ears will be covered by snow. When grown commercially, dwarf corn tended to dry down at a slower rate and presented harvesting problems due to the very low ear height. These known disadvantages were largely responsible for a decline in interest and research on dwarf corn (E.A. Brickbauer, Univ. Wis., pers. comm. 1980). Nonetheless, it might be incorporated effectively in a food patch planting if seeded adjacent to normal corn. For game birds and cottontails, the readily available ears are ideal during periods of limited snow cover. If the winter proved mild, the dwarf corn would be readily available and if severe, the normal corn is accessible. Locating a seed source can be troublesome, but a few dealers handle it. Arrangements to purchase dwarf corn seed should be made well in advance of the planting season to assure availability.

Availability of Varieties

Except for winter wheat and sunflowers, the suggested varieties of minor crops will probably not be available locally. These varieties are selected on the basis of performance at agricultural experiment stations in different states. Wisconsin data are always used if available. Common criteria used in varietal evaluation include maturity, standability or resistance to lodging, disease susceptibility or resistance, yield, and tolerance to drought or wet conditions. Through the selection and evaluation process, improved varieties are made available to the producer. Table 9 lists the minor crops and the best of the current varieties available for wildlife food patches. Preference was given to varieties noted for high lodging resistance or stem strength. An early example of varietal differences was noted in Fry's (1938) report in which he noted that all dent corn had lodged by December, but the hybrid corn was yet standing. Hybrid corn had just appeared on the market about that time. Plant breeders are continually developing new varieties and the current list (Table 9) may be outdated in 5 years, but only for crops of major economic importance.

Cultural Methods

In general, greater care is required in seedbed preparation for minor crops. Traditional moldboard plowing, disking, and harrowing are recommended to develop a smooth, firm seedbed. Field work should be done just before to seeding to reduce weed competition. This is very important for flax and buckwheat which are susceptible to rank weed growth. Late-seeded millets and buckwheat benefit from several shallow diskings prior to seeding to reduce the potential weed competition. Alternatives to traditional seedbed preparation have not been sufficiently tested to warrant recommendations.

Chemical weed control is important and effective

TABLE 9. Preferred varieties of minor crops.*

Species	Varieties
Buckwheat	Mancan, Pennguad, Tempest, Tokyo, Giant American
Winter wheat	Argee, Timwin
Spring wheat	Angus, Olaf, Era, Kitt
Winter rye	Hancock, Rymin
Sunflowers, non-oil seed	U.S.D.A.#'s 883, 923, Dahlgren D722, Davids SD-29
Flax	Culbert, Dufferin, Linoff, Northstar, Nored
Soybeans	Altona, McCall, Clay, Evans
Millets, proso	Cerise, Dawn, Minco, Turghai
Millets, foxtail types	Japanese, German, Butte

*Varieties suggested may not be available locally. Local seed dealers may be able to obtain them through seed companies they conduct business with. Perennial wheat and dwarf corn are very limited and there are no named selections.

for soybeans and sunflowers. Again, herbicide recommendations are current but could be modified in the near future. Extension weed specialists or county agricultural agents should be consulted on all herbicide matters.

Since wildlife food patches may not be completely consumed the first season, there is a slight possibility that some volunteer growth may appear the following growing season if the patch is not reworked. We have only seen this occur with black amber canes. The prospect of any other species reseeding is minimal. Volunteer corn can be expected even if the patch is plowed, disked, and replanted in consecutive years.

Seeding rates and optimum seeding dates for all minor crops are given in Table 10. Certified seeds should be used if possible. If germination tests are less than 90%, the amount of seed planted is adjusted upward in proportion to the lower germination results. Seed held over from a previous growing season should always be retested prior to planting. Adjustment to suggested seeding rates is recommended if seeding is made on low fertility soils, or on a poorly prepared seedbed.

All of the minor crops can be seeded with either a small grain drill or a corn planter. Drills must be calibrated if seeding information is not given in the service manual or obtainable from the dealer. Special plates are required for older model corn planters to convert them for seeding soybeans, sunflowers, or other minor crops. Small grains, flax, millets, and buckwheat are seeded in grain drill width (7 or 8 inches). Millets should have alternate or 2 of each 3 compartments sealed off for 14- or 21-inch rows. Loosely packed seedbeds will also benefit from cultipacking or by use of a Brillion seeder. Service manuals, seed producers or implement dealers should be consulted when questions or problems arise in reference to seeding these crops with available implements.

Seeding dates are important for optimum yields of grain. Periods for seeding each species are cited in Table 3. Marginal dates are the latest each crop may be planted for grain. Planting after the latest suggested date can be considered if the cover value is sufficiently important without the grain.

YIELD ESTIMATES

Profitable yields of any grain or seed crop grown for wildlife purposes depend on proper weed control, the use of adapted varieties, adequate fertility, and early planting. The expected yields identified in Table 11 approximate statewide yields for major crops in recent years, but do not reflect exceptional yields possible under intensive management on the better soils. With appropriate cultural methods yields of this magnitude could be anticipated on state wildlife areas. The most hazardous growing conditions can be expected on sand. Sandy soils are naturally low in fertility and often droughty. Grain yields on food patches seeded on sandy soils may not exceed 50% of those noted in Table 11. Muck soils are equally risky due to poor drainage, late spring and early fall frost probabilities, and low fertility. Corn yields are reduced 25-35% if planting is delayed two weeks past the optimum period (Brickbauer 1979). Spring-planted small grains also show reductions in expected yields when planted after the preferred dates.

Corn and/or sorghum food patches are preferred for their grain yield in addition to their availability during stress periods. For example, a 1-acre corn food patch yielding 100 bu is capable of supporting 375 pheasants for 12 weeks, even if they rely exclusively on the patch for food. None of the other food patch crops come close to that capability.

WINTER COVER VALUE

Appraising winter cover value from a wildlife standpoint becomes a subjective judgment based on the degree of protection provided during critical periods when fields are snow covered. The level of protective cover provided by corn and forage sorghums may vary within or between winters. Snowfall, winter temperatures, wind speed during snowfall, and exposure of food patches to drifting snow are factors contributing to the existing cover value,

TABLE 10. Suggested general seeding rates for food patch planting.

Species	Seeding Rate (lb/acre) Good Fertility Sites	Seeding Rate (lb/acre) Less Fertile or Droughty
Corn	16	14
Grain sorghums	10	6
Forage sorghums	12	8
Soybeans	60	50
Sunflowers	4	4
Flax	42	40
Buckwheat	50	45
Proso millet	25	20
Other millets	15	12
Rye	60	50
Wheat	85	70

TABLE II. Expected grain yields on wildlife food patches.

Crop	Yield (lb/acre)	Availability*
Corn	5,600	Year round
Forage sorghums (Black Amber)	2,600	Fall, Winter, Spring
Grain sorghums**	5,000	Fall, Winter, Spring
Millets, proso types	2,300	Late Summer to December
Buckwheat	1,900	Late Summer to December
Flax	1,500	Late Summer to Midwinter
Wheat	2,400	Late Summer to April
Rye	2,000	Midsummer to April
Soybeans	2,400	September to April
Sunflowers	2,000	September to November

*Availability assumes average snowfall and winter conditions. In mild winters most seeds remain available. In severe winters only corn and sorghums remain above snow cover.
**Adjusted from yield data reported by Dreier et al. (1948) and Oplinger (1974).

assuming the food patch was properly planted and provided good to excellent cover prior to persistent snow cover. Temperatures above freezing during the winter reduces the snow depth surprisingly fast.

Potential cover and food availability may be highly variable throughout the winter. Standing corn, for example, offers good protective cover and fair availability of corn at a snow depth of 2-4 inches. At 15-20 inches of snow the cover value declines, but the grain availability improves. Weak-stemmed species such as buckwheat or millets provide excellent fall cover, but lodge badly as the season progresses and generally provide either poor or no cover after several inches of snowfall. Leaves on sunflowers, soybeans and flax, drop after killing frosts and only the stem, seed heads, or seed pod remain. Sunflower seeds, being highly palatable, are usually completely consumed before winter and the bare stems and seedhead have little cover value. Soybeans hold the pods well, are readily available, and stem density offers a bit of winter cover.

Weedy growth, if not severe enough to seriously reduce yields, improves the cover potential of the food patches. Foxtail grasses, lambsquarters, pigweeds, and smartweeds stand up fairly well and the seeds are readily consumed by songbirds, pheasants, mourning doves, and quail throughout the winter.

Rye and wheat provide some winter cover if snow depths do not exceed 4-6 inches. After wheat and rye ripen in midsummer, the light penetration stimulates dormant weed seeds to germinate, which in general improves the winter cover value while not affecting grain availability. Foxtails, smartweeds, and ragweeds often develop in standing rye or wheat and usually mature seed before frost. Though rye and wheat do not shatter easily compared to oats, some seed also germinates in the fall forming the succulent short grain growth that is highly attractive to grazers and browsers such as deer and cottontails. At Waterloo pheasant and cottontail use was consistently high. Gray partridge used this cover type more often than corn, although the wintering population of these birds at Waterloo never exceeded 4 coveys.

Forage sorghums, sorghum-sudan crosses, or selections of black amber cane produced the best winter cover at Waterloo. After frost, these tall sorghums bent, twisted, and kinked into a matrix of intertwined leaves, stems and mature seed heads. Not all varieties performed similarly as winter cover. The common black amber cane tended to have poor stalk strength and often flattened out by midwinter. Improved selections of black amber cane had better standability. Cover resulting from the blend of canes, leaves, and panicles often produced a canopy effect that was highly preferred by ring-necks, cottontails, and songbirds. This was particularly noticeable at Waterloo where the sorghums and corn were planted adjacent to each other. Generally, the sorghum canes were capable of supporting up to 6 inches of snow on the top of the canopy that was 30-40 inches high. Snowcover over the canopy apparently increased the security from avian predators and the stem density at ground level appeared to hinder movement of ground predators. Where birds and cottontails had a choice of adjacent corn or sorghum patches, the greater use of sorghum was always evident. Both types were used for food, but resting or loafing activity was invariably concentrated in the sorghums. Improved protective winter cover of sorghums was in part due to seeding in 14- or 21-inch rows which greatly increased the stem density compared to corn, and still allowed moderate seed production.

Grain sorghums also provided better cover than corn because of the shortened internodes and better leaf retention. In this regard, thin-stemmed mini-milos were of less value than the thick-stalked grain sorghums. Grain sorghum seed heads were at about the same level as corn ears and stems did not bend or break as often as did forage sorghums. Increased leaf density up to about 2 ft provided improved cover quality at light-to-moderate snow depth. After snow depths exceeded 10 inches cover value of grain sorghums and corn was about equal.

Most corn hybrids mature at 7-8 ft and the ears drop down after ripening. In general, corn

TABLE 12. Wildlife food and cover potential.*

Species	Cover Value Fall	Cover Value Winter	Food Resource** Fall	Food Resource** Winter	Primary Advantages
Corn	VG	G	G	VG	Available all seasons; highest yield
Grain sorghums	VG	VG	VG	VG	Better cover than corn
Forage sorghums	VG	VG	G	E	Improved winter cover and seed availabilty
Buckwheat	F	None	E	P	For late planting
Millets	G	P	E	P	Very good fall food and cover
Flax	G	F	E	G	Better standability than millets or buckwheat
Soybeans	F	F	E	VG	Readily available seed in fall and winter
Sunflowers	F	P	G	?***	Premium food for songbirds

*P = Poor; F = Fair; G = Good; VG = Very Good; E = Excellent.
**Assuming proper cultural techniques, average growing conditions and normal snow cover.
***Small patches less than 1/4 acre are usually consumed before winter.

hybrids tested did not noticeably differ in standability or winter cover quality. The earliest hybrids grown (70 days R.M.) did not stand as well as the 90- to 95-day (R.M.) hybrids. Narrowing row width from the traditional 40-inch rows to 30-inch rows improved the cover potential at no sacrifice in yields. Cover quality gradually declines through late fall and winter. Leaves become brittle and break off on windy days. Fortunately there is good ear retention for most varieties so food reserves are always present. Corn is probably the only species that has any potential food reserves the second winter after planting. Annual weed growth becomes established the spring after planting even if good control was achieved the first year. Unutilized corn often remains erect throughout the winter and the volunteer weed growth the following spring greatly improves the cover value. Pheasants preferred the 2-year corn food patch if corn remained and annual weeds were well distributed in the patch. Residual soil fertility is usually adequate to promote good weed growth the second season.

By far the best combination for food and cover consists of the side-by-side patches of corn and forage sorghums, with corn preferably planted on the north or west sides of the sorghum. Corn contributes a dependable food source, and the sorghums supply the optimum cover possible and usually some food. Black amber cane seeds have a very dark, nearly black seed coat. Birds consuming black amber seeds produce purple droppings similar to those of birds eating wild grape. Mixing corn and sorghum in alternate rows gave mediocre results compared to planting each species separately, but next to each other. Grain sorghums did not compete as well in mixed seedings with the tall forage sorghums and corn. Corn-sorghum mixtures with only a little sorghum resulted in lower cover value than straight sorghum, and if too much sorghum is planted in a mixture, corn yields are severely reduced. However, this combination should be considered if planter rows can be adjusted to 20-24 inches and the proper plates are used to secure recommended seeding rates. Table 12 summarizes the comparative winter cover values of each species in an average winter. At Waterloo, the better the winter cover value, the higher the frequency of bird use. About the only exceptions noted were corn food patches seeded adjacent to traditional shrub-carr wintering areas.

Drifting snow occasionally caused problems. Forage sorghums functioned as a snow fence and became completely filled to the tops of the canes for about 20-40 ft inward from the leading edge. Standing corn also collected snow, but this was less serious since the grain remained available. Use corn strips with tall sorghum sandwiched in between so the corn acts as a snowfence.

DURATION OF FOOD RESERVES

Availability of grains for wildlife depends on the quantity produced, accessibility from winter cover, number of individuals using the area, species, and alternate food resources in the immediate vicinity. Corn kernels will remain on the cob for 2-3 years or as long as the stalk remains erect. Protection by the husks prevents deterioration from molds. It may lose vitamins over time, however. Insect damage has been minimal after the first winter. Stalk breakage generally exposes the ear to rapid breakdown by fungi, bacteria, and to some extent, by insects. Small mammals and cottontails take advantage of ears that drop to the ground. In patches of corn where standability was good and utilization light, an ample supply of grain was still available in the second winter. In a few sites, some quality corn could be located the third winter.

Corn losses occur in some years on muck sites about the time the soil thaws. The waterlogged soils become soupy and the weight of the ear causes the entire stalk to drop to the ground. This can be expected on soft organic soils that produced a good crop of corn and where good weed control was achieved. If this condition occurs frequently the corn remaining by late winter may be worth salvaging and the patch should be replanted.

A small wintering deer herd of 4-8 animals can devastate a 1-acre food patch in about a month. The problem with deer is their propensity for eating only a fraction of an ear, proceeding to the next stalk and repeating the process. In their foraging activities about 1/4 of the kernels drop to the ground or snow. Where deer are expected there are several alternatives: the size of the food plot can be increased to accommodate the deer, they can be tolerated under existing conditions, hybrid forage sorghums can be substituted for corn, or repellents can be used.

There are some added advantages to a 2-year-old food patch. In the year following seeding, many annual weeds appear. This improves the cover since most of the corn leaves gradually break from the stalk in the first winter. Based on our observations, pheasant and songbird use increases. By increasing the size of the food patch, the site can be prepared and planted more efficiently. Corn replanted on the same site would be subject to competition from volunteer grains and from herbicide resistant weeds.

Grain sorghums persist about as well as corn during the first winter, especially the varieties having thick or heavy stalks. They tend to provide slightly more cover, but the grain is less accessible. Seed heads deteriorate quite rapidly during the following growing season. The tight panicle does not dry out during wet periods and the seed decomposes as the season advances. No volunteer grain sorghum was observed in older undisturbed plots.

The seeds of tall hybrid forage sorghums do not become available until after the first killing frosts. Stalk bending and/or breaking occurs gradually over 4-6 weeks after killing frost, before numerous seed heads become available at or near ground level. Black amber types retain seeds through the winter. Other varieties slowly shatter, possibly due to difference in maturity of the seeds. In black amber cane, seeds mature from the base to the top of the panicle. Late-planted amber cane may have ripe seeds on the lower part of the seed head, while still pollinating at the top. On several occasions, black amber cane reseeded itself the second year and in one instance natural reseeding occurred in 2 consecutive years.

Rye and wheat begin to break down about a month after ripening. Because they ripen in midsummer, annual weeds germinate rapidly after maturity. Lambsquarters and the pigweeds develop stiff stems and the small grains often lodge in them, producing an excellent fall cover condition. Seed retention is good for rye and wheat throughout the winter. All the remaining minor grains except flax and soybeans gradually lodge after maturity or the seeds shatter after ripening, limiting their availability during the winter.

ESTIMATED COSTS

Establishment

Included in the costs of establishing a wildlife food patch are seedbed preparation, seed, fertilizer, planting, and weed control. Current rates for all field operations are based on spring custom rates in Wisconsin for 1980 (Krahn and Orton 1980). A review of custom rates charged for any type of field work reveals a wide range between the lowest and highest. Variability in charges is due to numerous factors: field size, total acreage worked, type of equipment used, field condition, and distance from the operator's home base. Relatives or close acquaintances tend to be charged less-than-average rates. When large equipment is involved a minimum charge may be quoted. For example, herbicide applicators may have a minimum charge of $50 or $3/acre, whichever is greater. Escalation in size of equipment has complicated the problems of working small acreages to a point where the total cost of seeding several small food patches can be greater than purchasing the expected grain production on the market. The alternatives are to do the work yourself or to contract or negotiate with nearby landowners under a sharecrop agreement. Tillable land is always in demand or marketable. Local land rental rates should be determined so an equitable proposal can be made to area farmers.

The custom costs for individual operations shown in Tables 13 and 14 are averages for southern Wisconsin. Local costs, if known, should be substituted if different from those cited. Current inflationary trends can outdate cost estimates between seasons, therefore, the use of the latest published custom rate guide is suggested. County extension agents or farm management agents should also be consulted for cost estimates or rental values when in doubt. All custom rates include an operator and equipment. Fertilizer, seed, and chemicals are separate costs which are apt to be more uniform statewide than land preparation and seeding costs.

Potential food patch sites need to be appraised individually. Not all seedbed preparations may be required. Where applicable, burning of residual cover can be substituted for field chopping or disking of cornstalks. A cornfield harvested for silage the previous season may not require plowing. A satisfactory seedbed might be prepared by a single disking or the field might be replanted to no-till corn. At the other extreme, idled lands may prove difficult to plow because of a thick, dense sod, especially when using smaller equipment. Thick sods may require repeated diskings for a reasonably satisfactory seedbed. Woodland edges may present stump, root, and/or stone problems necessitating a front end loader for removal. Thus, direct costs or equipment time can vary according to field condition. Operating time for each field operation can be estimated from Table 15. These data represent only guidelines and are averages for moderate-sized implements on easily tilled fields. Small fields obviously will require more time, possibly twice the amount noted. Planning for wildlife food patches should include an evaluation of all preferred cultural methods and the necessity for each step within the prescribed procedure to avoid adversely affecting the quality and/or quantity of the final product. There is no substitute for timely and proper procedures.

Seed, Fertilizer, and Herbicide Cost

Concurrent with the rising cost of field operations, seed, fertilizer, and herbicide prices also reflect the inflationary trend. Seeding rates will not be as variable as either fertilizer or herbicide requirements. Recent soil tests and identified or expected weed problems will dictate the amount and types of fertilizer and herbicide required. Costs will naturally differ among sites, but the data in Table 16 identify variations for species used in

TABLE 13. Estimated costs of field operations.*

Operation	No. of Bottoms	Est. Cost/Acre Average Rate	Range in Rates
Plowing	2	$8.67	$5.00-16.00
	3	6.25	4.00-10.00
	4	7.95	5.00-11.00
	Width in Feet		
Disking	8-10	4.50	4.00- 5.00
	11-14	4.79	2.00-12.50
Chisel plowing	6-8	6.38	5.50- 8.00
	9-10	9.50	4.00-12.00
Spiketooth harrowing	7-10	3.00	2.00- 4.00
	11-15	2.25	1.50- 3.00
Chopping stalks	6	4.78	2.00- 7.50
	7-9	4.75	4.00- 5.00
Cultivating	2 row	3.05	2.00- 4.00
	4 row	3.77	2.00- 6.00

*Adapted from Krahn and Orton (1980).

TABLE 14. Estimated costs of planting, fertilization, and herbicide application.*

Operation	Size of Equipment	Est. Cost/Acre Average Rate	Range in Rates
Grain drilling with fertilizer	7-9 ft	$4.75	$2.00-10.00
	10+ ft	4.81	3.00- 6.00
Corn planting with fertilizer	2 row	3.33	3.00- 4.00
	4 row	5.81	2.00-12.00
Herbicide application		3.00	2.59- 3.54

*Adapted from Krahn and Orton (1980).

food patches. No fertilizer cost is cited for millets, flax buckwheat, or rye assuming the seeding is done on moderately fertile soils that have been in crop producion. These crops will respond to fertilizer if planted on low fertility soils. Buckwheat, rye, and wheat are competitive with weeds and no supplementary weed control is required.

TABLE 15. Time requirements for field operations.

Field Operations	Average Minutes/Acre
Plowing	18
Disk/drag	16
Field cultivate	8
Stalk shredding	11
Cultivate	14
Planting (corn)	13
Spraying	4

TABLE 16. Summary of average estimated costs for seeding a 1-acre food patch.

Species	Seedbed Preparation	Fertilizer	Seed	Herbicide and/or Cultivation	Total
Corn	$24	$31	$11	$14	$80
Grain sorghum	24	20	6	6	56
Forage sorghum	24	20	12	6	62
Sunflower	24	15	4	12	55
Soybeans	24	6	10	9	49
Flax	24	-	12		36
Proso millets	24	-	3	3	30
Other millets	24	-	5	3	32
Buckwheat	24	-	8	-	32
Rye	24	-	6	-	30
Winter wheat	24	-	13	-	37

SUMMARY AND CONCLUSIONS

Managing wildlife in the intensively exploited farmland environment where there are continuing losses of prime habitat places increasing importance on establishment of annual food and cover plots to sustain local populations of birds and mammals through winter and spring. The use of herbicides for effective weed control (resulting in fewer weed seeds available), more complete grain harvesting (with stalk destruction) by the predominant use of combines, the reduction in waste grains through roadside spillage (on the way to the mill to have feed ground), and even increased processing of dairy and hog feeds so more is digested (rather than wasted in manure), and more fall plowing have all increased the severity of the situation. Introduced species such as the ring-necked pheasant and the gray partridge have a close affinity to the most intensively farmed regions of southern Wisconsin and throughout their existing range in North America. Locally, each species derives sustenance from agricultural operations throughout the year. Pioneer wildlife investigators Wallace Grange and Aldo Leopold recognized the contribution of planted food patches in maintaining some game species through critical winter periods.

Between 1966 and 1974, an average of 20 small food and cover plots were established annually on the Waterloo Study Area. Although the management scheme was primarily aimed at increasing the area pheasant populations, our winter surveillance indicated that all endemic species (e.g., cottontail rabbit, gray and fox squirrels, small mammals and songbirds) made regular use of the food patches. Establishing food and cover patches adjacent to the traditional pheasant wintering areas appeared to stabilize these populations, and may have contributed to holding some of the breeding hens near quality, undisturbed nesting cover during the reproductive season. Field checks at irregular intervals throughout the spring, summer, and fall indicated the food patches were used throughout the year. Winter food and cover plantings also enhanced pheasant hunting and probably aided in holding pen-reared pheasants on the public hunting areas.

The results of the Waterloo tests have been combined with previous experience and references from the literature to provide guidelines for land managers developing food and cover plots for farm wildlife.

A combination of corn and forage sorghums or sorghum-sudan hybrids proved most practical and consistently dependable in the most severe winters. In addition, wintering songbirds, cottontails, and gray and fox squirrels used the food and cover patches extensively. Deer posed a problem at some sites because they destroyed much of the food resource by early winter.

Small grains including flax, millets, buckwheat, winter rye, and wheat were useful as a summer and fall food resource but were of limited value in severe winters due to drifting snow and poorer standability. Sunflower was extremely palatable to songbirds and seeds were completely consumed by late fall.

Food and cover patches continued to be used by pheasants and other species thoughout the year and into the second winter if any food remained. Seed from the minor small grain types was readily taken as long as it was available and actually extended the period of use from mid-July to early November when the corn and sorghums matured and became available.

Small food patches proved very attractive to wintering wildlife on state-owned and private lands around the moderately intensively farmed Waterloo Wildlife Area. This practice was particularly valuable during severe winters where snow accumulation eliminated most alternate or supplementary food sources. Food and cover patches serve as a productive wildlife management tool when established early under good cultural methods.

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