TIPS FOR

Profitable Small Grain Production

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The current farm financial situation is causing producers to search for ways to obtain the best economic return for their production costs. Profit margins for small grain farmers can be increased by minimizing production cost per bushel or by obtaining higher prices for the grain.

Optimizing production cost per bushel is accomplished by using all production inputs, such as seed, fertilizers, chemicals and management at necessary levels to achieve maximum economic yield. This requires that each management decision affecting production be carefully made. Seedbed preparation, seed quality, variety selection, planting rates, fertilizer rates and timing, and plant protection all should be considered specifically for your farm situation. Good management requires that all production practices be done on time.

Good marketing strategies will help increase profits. Selling at the highest price is one way, but may not always be the best way towards reducing risk as well as making a profit. Marketing decisions may have to be based on getting a "good" price rather than gambling on obtaining the highest price.

Reducing input costs can be accomplished in two ways. The first that comes to mind is to use fewer inputs; the second and equally important method for reducing input cost is that of paying less for the same input. *The use of fewer inputs should only be considered if the cost per bushel is not adversely affected.* In many cases, using fewer inputs results in lower yields. In some cases, it may be necessary to increase the inputs to increase profitability. There may be even greater opportunity in increasing profitability by making wise decisions in purchasing inputs than in the use of marketing strategies in selling the grain or products.

In this publication, we present the recommended levels of production inputs to produce maximum profit per acre and discuss opportunities that may exist for reducing cost per bushel.

SELECTING A VARIETY

Selecting the best variety is very important. Factors that are important in selecting a variety include: yield, maturity, disease resistance, straw strength, shatter resistance, plant height, and grain quality. In most cases, relative yields may be the most important factor, but susceptibility to a disease—even one that occurs only 1 year out of 5—can affect any yield advantage. Premiums paid for quality or benefits obtained in feeding higher quality grain can, but only to a limited extent, offset yield advantages. Important quality factors include protein content, milling, and baking of wheat; malting approval, protein, kernel plumpness, and test weight in barley; and groat protein, groat percentage, and test weight in oat.

The importance of characteristics such as straw strength and plant height may vary from field to field and from year to year. Straw strength may not be as important on fields with low soil moisture reserves, but it is important in preventing lodging on fields with good moisture and high fertility. Straw strength is particularly important when oat is used as a companion crop. Lodging may damage forage seedlings.

An anti-lodging growth regulator (ethephon) is available for wheat and barley. Ethephon can shorten the plants, strengthen the stems and hence decrease lodging. Minnesota studies have shown no economic benefit for use of ethephon on hard red spring semidwarf varieties. It may be economical for tall hard red spring and winter wheat varieties that posses less lodging resistance. For spring barley, where semidwarf varieties are less common, the potential for lodging is greater than with the semidwarf wheats. Even so, lodging occurs only occasionaly with the newer varieties like Robust. Therefore, before use on spring barley, the yield potential should be very high and serious lodging probable. Some injury to barley from ethephon has been obtained where application was followed by drought or high temperatures. Use of ethephon on barley would only be economical when severe early lodging is probable.

Disease resistance also is important in selecting a variety, especially if a particular disease has been a problem in your fields. Currently the most important diseases are leaf (crown) rust and smut in oat; stem and leaf rust, tan spot, Septoria leaf blotch, and scab in spring wheat; take-all in winter wheat; stem rust, loose smut, and spot blotch in barley; and ergot in rye.

Winterhardiness is an important consideration in selecting a variety of winter wheat or rye. Always use the most winterhardy variety of these crops, providing the variety is high yielding.

When selecting a variety be sure to *carefully* check *reliable* yield information. If comparative yield data show no statistical difference and varieties are comparable in other aspects, buy the lower priced seed. This can amount to a savings of 2 to 3 dollars or even more per bushel of seed.

Use high quality seed. This usually means certified seed to assure varietal purity and quality; or carefully selected, "homegrown seed" of high quality. Poor quality seed costs—and costs dearly—in reduced yields. At least 90 percent germination is necessary. Only plump well-filled seeds should be planted for high yields.

Bin-run grain can be used to save seed costs if free of varietal mixtures, the seed is cleaned, disease and weed free, and has a high germination percentage. As an example, savings can amount to 2 dollars per bushel for wheat.

TILLAGE: SEEDBED PREPARATION

The purpose of primary and secondary tillage is to prepare a firm seedbed with adequate moisture for good germination and seedling development, control weeds and bury residue. Good seed-soil contact is essential when the grain is seeded. Dry, loose soil makes for an unsatisfactory seedbed. Too much tillage increases cost and pulverizes the soil, which can lead to soil erosion due to wind and water or crusting after rainfall. Working plant residues into the soil near the surface helps to control erosion and protect the seed.

Chisel plowing rather than moldboard plowing as the primary tillage reduces costs and leaves some residue on the soil surface. Primary tillage in the fall helps the soil to dry and warm up faster in the spring and makes earlier seeding possible. Disking and harrowing the land before seeding is a common method of preparing a final seedbed.

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Reduced tillage systems can save fuel costs but require an initial investment in machinery and reduced yields can offset any fuel savings. Also, additional pesticides may be needed in reduced tillage systems. Changing to a reduced tillage system for small grains may not be wise during today's financial crisis.

PLANTING

Small grains should be seeded as early as possible after the frost is out of the ground. Oat, barley, and spring wheat should be seeded from April 1 to early May. Early seedings generally produce higher yields than later seedings because small grain plants develop best during cool, moist growing conditions. If temperatures get very high (around 90° F) during pollination, yields can be drastically reduced due to poor pollination and seed set. Oat, barley, and spring wheat should be seeded from mid April to early May. Winter rye and wheat should be planted early enough in the fall so the plants can become well-established before the first killing frost. Winter rye should be planted in early to mid-September; winter wheat should be planted in late August and early September.

Small grains usually are planted about 1 to 2 inches deep, depending on soil moisture and soil texture. Wheat, barley, and rye cannot be planted as deep as oat.

A grain drill with press wheels is the best for seeding small grains because it distributes the seed at a uniform depth and gives good soil-seed contact. Broadcasting wastes seed and often results in uneven stands.

Grain drills should be carefully calibrated for each seed lot. The number of seeds per pound may vary 40 percent or more among varieties depending on seed size. In small grains, the seeding rate should be based on seeds per unit area rather than bushels per unit area. For a 6 inch row spacing, grain drills should be calibrated to drop 15 seeds per foot of row to obtain optimum populations. This is for seed that has a 90 percent or more germination. Decreasing row spacing to 3 to 4 inches can increase yield slightly, but this difference usually occurs when soil moisture is good. Purchasing special equipment for this purpose for spring seeded grains may not be cost effective.

ROTATIONS

Rotating small grains with row crops or with a different small grain can reduce the amount of diseases in the crop. This reduces the necessity for fungicides, thus reducing costs. It also helps in weed control reducing herbicide costs.

FERTILIZATION

The amount of money spent for fertilizer can be a substantial part of the total variable costs of producing a small grain crop. Several steps can be taken to reduce fertilizer costs. These are:

1. *Begin with a soil test.* There is no substitute for fertilizer recommendations based on the results of reliable soil tests. Soil testing helps in two major ways. If the nutrient status of a field or farm is low for the expected potential yield, a soil test would indicate a need to add more fertilizer than just the amount of fertilizer that can be applied with the seed. In other situations, the nutrient status of soils may be at high levels from previous fertilizer applications. In these cases no broadcast applications of nutrients other than nitrogen will be needed. Use of fertilizer with the seed can be used in place of broadcast applications in these situations. A switch from broadcast to row application of phosphate, and potash with the seed, could mean a substantial savings to the small grain farmers.

The use of the soil nitrate test is suggested for western Minnesota. This test can be used to indicate the amount of nitrogen in the soil. If nitrogen in the soil is high, the amount of nitrogen fertilizer needed can be reduced thus reducing costs. When nitrogen in the soil is low, added fertilizer nitrogen can increase yields substantially and be cost effective.

Research results in Minnesota have shown that fertilizer recommendations from some soil testing laboratories can lead to excessive applications and enhanced fertilizer costs. Studies at the West-Central Experiment Station at Morris have shown that University of Minnesota fertilizer recommendations can save small grain farmers from $20 to $25 per acre without reducing yields, compared to some commercial soil testing laboratories based outside of Minnesota. More detailed information about soil testing is available from the local county extension office.

2. *Set a realistic yield goal.* Selection of a realistic yield goal is the key for a cost effective fertilizer program. A grower must decide on a yield goal before a fertilizer program is finalized.

There are no definite guidelines for helping select a yield goal for a particular field or farm. There are, however, some general suggestions that may be helpful. These are:

—Don't aim for average yield. You can usually do better.

—Don't aim for the world record. This will never be cost effective.

—A high yield on one of your special fields or one of your neighbor's may be a goal to shoot for.

—A realistic approach is to take your average yield for the past five years and increase this by 15 - 20 percent. When calculating an average for five years, don't use low yields caused by hail, severe drought, or insect damage. Remember, the best way to get a profit is to aim for higher but realistic yields.

3. *Nutrients in manure are important.* Manure is applied to some small grain fields in Minnesota. A large portion of the nutrients in the manure can be readily used by the small grain crop. The nutrient content of manure can vary over a wide range. Therefore, it is a good management practice to get manure analyzed. The savings in fertilizer cost will more than pay for the cost of the analysis.

4. *Turn to fertilizer applied with the seed.* Fertilizer placement can have a major impact on fertilizer costs. Phosphate, and potash rates needed for small grains can be cut substantially if these nutrients are applied with the seed instead of broadcast and incorporated before planting. In many cases, the rates can be cut in half. For example, if the results of a soil test call for a broadcast application of 80 lb. phosphate (P_2O_5) per acre, this rate can be cut to 40 lb. phosphate per acre if applied with the seed. If the cost of a pound of phosphate is $.22, this amounts to a savings of $8.80 per acre without any reduction in yield. Costs will vary with different soils and yield goals. Cost reductions can also be achieved if potash (K_2O) is applied with the seed. Fertilizer recommendations from the University of Minnesota give specific recommendations for using fertilizer applied with the seed. Ask for bulletin AG-BU-0519 at the county extension office.

5. *It's expensive to build up the nutrient content of soils.* Some individuals involved in making fertilizer recommendations believe that it is necessary to "build up" the nutrient levels of soils. While it is not desirable to have very low levels of phosphorus (P), potassium (K), and zinc (Zn), it is not necessary to have high soil test levels for these nutrients to achieve maximum economic yields. It's expensive to buy fertilizer solely for the purpose of "building" the soil test level for phosphorus, potassium, and zinc. Remember that soil levels of these nutrients will increase slowly if rates of fertilizer needed to produce optimum yields are applied each year. The rates needed to produce these optimum yields have been determined from the results of several research trials conducted in Minnesota over a number of years.

6. *Calculate costs of nutrients.* Usually, there is more than one fertilizer product that can be used to supply the nutrients needed for growing a small grain crop. The prices of these various products are not the same. The cost of nitrogen, for example, varied from $.14 per pound of N to $.24 per pound of N in 1985. If all sources are equally effective, then the cost of a pound of nitrogen can have a major impact on the choice of the source to use. Take the time to calculate the price of individual nutrients when planning a fertilizer program. Contact your fertilizer dealer or your county extension office if you have questions about these calculations. When determining fertilizer costs, don't forget to include the cost of application.

Normally, fertilizer materials are sold by the ton. There are, however, some fertilizer products that are sold by the gallon. For these products, convert the price per gallon to a price per ton basis. For example, if a liquid fertilizer is priced at $3 per gallon and a gallon weighs 10 pounds, there would be 200 gallons in a ton. At $3 per gallon, this price converts to $600 per ton. This provides a basis for making a price comparison and you can compare the price of the liquid sold by the gallon to a liquid with a similar analysis that is sold by the ton.

Some fertilizers with a high price tag are sold with advertising claims that they are more efficient or more effective than other fertilizer materials that are not as expensive. *Research has*

clearly shown that there is no difference in the efficiency or effectiveness of fertilizers sold today. When comparing phosphate materials, as defined by law, the availability of phosphate in liquid materials is nearly the same as the availability of phosphate applied in dry materials. Both liquid and dry forms produce the same yield when applied so that rate of phosphate is the same. The chemistry of the soil determines the effectiveness of any fertilizer applied.

7. *Don't look for miracles.* Each year, many small grain growers are asked to purchase products that, if used, will produce "miracle" yields at low cost. These products are usually sold by someone who travels from farm to farm and are often described as being so new that others have not heard about them. The price is usually high. The person selling these products may be new to the community and may disappear after the sale is made.

Several of these products have been evaluated in research trials and have had no beneficial effect on crop production. If you're not sure of a product, don't buy before you ask questions. Get a second opinion. The local county extension service is a good place to go for information about questionable products and questionable fertilizer recommendations.

WEED CONTROL

Effective weed control in row crops can be accomplished with a combination of cultural, mechanical (tillage), and chemical practices. However, in close-sown small grain crops, tillage is not feasible after planting. Therefore, producers must depend on cultural practices before planting and chemical weed control methods. With herbicides costing anywhere between $2 and $20 per acre for small grains, it is important to get the most effective weed control available for your herbicide dollar. Here are some suggestions for maintaining an effective but more economical weed control program.

Cultural Practices

Planting weed-free seed at an adequate seeding rate will help reduce weed populations in small grains. Seeding as early as possible in the growing season enables the cool season small grain crop to compete effectively with weeds, especially with warm season annual grasses. Research has shown that herbicides generally are not needed for green and yellow foxtail control in small grains if the small grain is well established before the foxtail emerges.

However, early spring seeding does not help to reduce many cool season annual weed problems, such as wild oats. Research has shown that barley is more competitive with wild oats and some broadleaf weeds than the other small grains. Seeding barley on fields that have heavy weed infestations may help reduce the cost of controlling these weeds by taking advantage of the competitiveness of barley. Semidwarf spring wheats are less competitive with weeds than tall varieties.

Do not delay seeding small grains to control weeds because research has shown that delayed seeding and repeated tillage usually results in reduced small grain yields.

Plan your weed control program

Weed identification should be the first step in an effective weed control program since many herbicides must be applied when weeds are small. Therefore, it is important to accurately identify weed seedlings early. Also, knowledge of previous weed problems will aid in selecting the proper control program. The county agricultural extension agent can help in identification of weeds. After identifying the weed problem, it is important to choose the best control method. The agricultural extension service fact sheet AG-FO-0771, "Weed Control in Small Grains," available from your county agricultural agent, can help you plan an effective weed control program to fit your individual situation.

Once you have decided that you need to use a herbicide for weed control, there are several things that can be done to keep herbicide costs low, but still effective.

1. Map the weed location in the field. Often it is possible to treat only part of a field rather than the entire field. Perennial weeds such as Canada thistle, which are expensive to control, usually occur in patches. These scattered patches can be spot treated.

2. Herbicide costs vary from location to location and from dealer to dealer. Compare price whenever possible. Compare price of different formulations and brands on the basis of cost per pound active herbicide. Herbicides may control the same weeds, yet one may be less expensive than the other.

3. Consider crop tolerance as well as effectiveness and cost of the herbicide. For example, wheat and oats are more tolerant to dicamba (Banvel) than barley. You may get good weed control but decrease yield because of crop injury.

4. Know the soil type on your field. Soil-applied herbicides, such as trifluralin (Treflan) are influenced by soil type. Do not exceed recommended rates for a given soil type. Excessive rates not only add to cost but may also result in crop injury.

5. Accurate calibration of spray equipment will help reduce weed control cost and increase the effectiveness of the herbicide used.

6. Don't waste money on additives that are not needed. Most herbicide formulations contain the needed additives. Check the herbicide label to see if you need to use a surfactant or oil.

Lastly, don't cut corners on weed control. Trying to decrease herbicide cost by reducing the rate below the labeled rate will not always increase profits. Reduced rates often lead to decreased weed control and decreased yields due to weed competition. However, the lowest labeled rate can be used under favorable conditions. For example, when weeds are small and actively growing. Under adverse weather conditions, such as drought or prolonged cool weather, or for well established weeds a higher herbicide rate will be needed for effective control.

For more suggestions on reducing your weed control costs, read the agricultural extension service folder, "Tips For Reducing Weed Control Costs" (AG-FO-2898).

DISEASES

In general, weather conditions that are favorable for good small grain growth are also favorable for plant diseases. The agents (inoculum) that cause diseases may come with the seed, may be in the soil, may be on old infected plant debris, or may be windborne.

Most of the diseases of small grain occur after the management inputs have been made. Good mangement decisions can reduce plant disease losses. Selecting disease resistant varieties is a good low cost method of disease control. Obtaining clean and disease free seed is another low cost method to reduce disease problems. Much seedling blight can be reduced by obtaining disease free seed; blackpoint and scabby seed produce seedling blights. Barley loose smut is a seed borne disease and using disease-free seed eliminates potential crop loss.

Clean tillage and crop rotation also are low cost disease control measures. They will reduce the amount of inoculum that will come into contact with the small grain plant early in the season. For example, where wheat must follow a wheat crop, clean plowed land will bury much of the previous seasons infected plant debris thus reducing the amount of inoculum that could have early contact with the plant. A rotation system where wheat does not follow wheat or corn will have a similar effect.

Treating seeds with fungicides can reduce seedling blights, root rots and loose smut. If a grower understands his potential disease problems, seed treatments can be selected for the particular problem. The protectant seed treatment fungicides will kill disease inoculum that is on the outside of the seed and will reduce seed rot in cool wet soils. If loose smut infected seed must be seeded, a systemic seed treatment fungicide e.g. Vitavax 200 should be used to kill the loose smut fungus within the seed. This chemical is specific for internal seed infections, and in combination with a protectant fungicide, usually Thiram, the seed will have two types of protection. A new chemical on the market (Imazalil) is systemic and will provide the young plant with protection from soilborne root rotting fungi for several weeks. The results obtained from seed treatment will vary from year to year, field to field, depending upon the environment and cultural practices.

The currently grown varieties of spring and durum wheats are resistant to stem and leaf rust. The winter wheats are resistant to stem rust but susceptible to leaf rust. All of the wheats are susceptible to the leaf spot diseases; tan spot, Septoria leaf blotch, Helminthosporium blotch and Septoria

glume blotch. As would be expected, the degree of susceptibility may vary between varieties. These leaf spot diseases, when favorable conditions prevail, can reduce yields by 15 to 20 percent or more.

A system of treating the growing plants with fungicides is cost effective where the above leaf spot diseases occur in wheat and barley. *It should be used only if diseases have consistantly been a problem and fields have a high yield potential.* Usually two applications of fungicide are sufficient for economic disease control. The public varieties usually respond to fungicide (Mancozeb) treatment when starting at early heading (Zadoks growth stage 40-45). A second application must follow in 10 days. Some of the private varieties respond better with earlier applications starting when flag leaf just visible (Zadoks growth stage 35-40). In either case a second application must be applied in 10 days. If wet conditions occur even a third application has been shown to be economical.

Unfortunately, when it is time to make the decision to treat the crop, the top two leaves may not have any disease symptoms. The fungicide registered for use on wheat (Mancozeb) is a protectant chemical, which protects the leaf from infection. It does not kill or inhibit the fungi once they have invaded the leaf. If you have observed the flag leaf dying, shortly after heading, you have seen the effects of these leaf diseases. Maintaining a green flag leaf and upper stem of the plant as long as possible is important for maximum grain fill.

Several new systemic fungicides are coming onto the market that will improve disease control. Some of these chemicals are for specific diseases. If powdery mildew should be an early problem, with favorable conditions and heavy plant growth, a grower should select a fungicide such as Bayleton or a Benlate-Mancozeb mixture. The Mancozeb fungicide by itself will not control mildew. Leaf rust of winter wheat and crown rust of oat are readily controlled with any of the above three chemicals.

Application method of the fungicide is very important. Application with weed spraying equipment will not provide adequate coverage. Ground sprayers can provide very good coverage, but such equipment requires 20 gallons of water per acre sprayed at 250 to 300 psi pressure. Aerial application with 5 gallons of water per acre provides economical control of leaf diseases. The application must be made at crop height, with an aircraft that has a uniform spray swath. The use of a spreader-sticker additive will enhance the coverage when using a Mancozeb fungicide.

The decision to use a foliage fungicide should depend on the potential yield of the crop. For a potential 40 bushel per acre crop a 15 to 20 percent increase in yield would result in an increase of 6 to 8 bushels. At $3 per bushel for wheat, this would be only slightly cost effective. Whereas for a potential 70 bushel per acre crop, a grower might expect a 10 to 14 bushel increase; for the same cost. Barley response to foliar fungicides is the same or better than wheat and would be cost effective. In oat the response is good but the price of the crop is too low to be economical.

Plant diseases reduce yields, and lost yield reduces the profitability of small grains.

INSECTS

Economically-sound management of insect pests involves: 1) using overall good production practices, 2) knowing which insects pose serious economic threat, 3) recognizing high risk situations, and 4) using sound, cost effective management practices.

Know your key pests

In Minnesota the major insect pests in small grains are armyworms and aphids. Occasionally wireworms, Hessian fly, grasshoppers and stem maggots are observed but rarely need to be controlled. It is, of course, wise to become familiar with the various insect life cycles and the potential damage the insect can cause.

Armyworms should be controlled in fields with 5 armyworm larvae per square foot and before the flag leaf and the one below it are lost. Remember that armyworms hide during the day so that 3 larvae per square foot may be treatable when a daytime count is used. Aphids would be controlled when approximately 30 per stem are present when the plants are in the boot stage or before. *It will almost never pay to control aphids on grain which is headed.*

It is of utmost importance in insect pest management, however, that the grower examine the field weekly or, better yet, twice weekly. It may even be profitable to hire this done. In all cases when an insect pest is found, the decision as to what may be needed is based on how much potential damage will be prevented in dollar value against the cost of prevention. The grower should always expect to make some profit above control costs. If the grower is unsure about this decision advice should be sought from a neutral professional such as a county agricultural agent or consultant.

DRYING AND STORAGE

Artificially drying small grains can be economically feasible because of reduced weather risks, increased available harvest time, improved grain quality and minimizing overdrying during periods of rapid drying in the field. The availability of drying facilities during wet years may be necessary for proper harvest and storage.

The use of natural air drying or improved high speed methods such as dryeration, in-storage cooling and combination high-speed natural air drying should be considered. Those alternatives have the potential for increasing dryer capacity and improving grain quality in addition to reducing operating costs. It may be possible to incorporate one or more of these alternatives into the drying operation without a major investment cost. They are explained in a series of University of Minnesota Extension publications (AG-FO-1323, 1324, 1325, 1327; AG-BU-1326, 1328) on grain drying and storage available at all county extension offices. These are primarily for corn but the principles apply to small grains.

Much grain is damaged during storage and can result in reduced profits. Good storage management is essential to prevent spoilage which is caused by mold growth and insect activity. A properly managed aeration system greatly improves the "storability" of grain by maintaining a cool, uniform temperature throughout the storage to reduce mold growth and insect activity and to prevent moisture migration. Proper aeration management is discussed in AG-FO-1327, "Management of Stored Grain with Aeration." Stored grain must be checked on a regular basis to make sure it is maintained in good condition.

SUMMARY

Steps for Maximum Economic Small Grain Production

1. Test soil to determine fertility of field.
2. Fertilize based on soil test and yield goal of 15-20 percent above your average yield for past 5 years.
3. Select a variety with good yield potential and with disease resistance.
4. Plant only good quality, disease free seed of a known variety.
5. Plant spring grains early and winter grains at optimum date.
6. Plant in 6 to 7 inch rows with a grain drill with press wheels.
7. Plant on basis of seeds per unit area rather than pounds per acre; 15 seeds per linear foot of 6 inch row.
8. Check fields early and carefully for weeds and use proper control measures.
9. Check fields carefully for insects and control if necessary.
10. Use fungicides only if leaf diseases have been a problem and potential exists for a problem.
11. Provide adequate, safe storage and frequently inspect grain in storage.
12. Develop a marketing strategy.

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