SMALL GRAINS SEEDBED PREPARATION AND RESIDUE MANAGEMENT[1]

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ABSTRACT

Good site selection and proper seedbed preparation whether conventional or no-till can have a significant impact the success of your small grain crop. Selecting a site with good drainage and careful thought to the movement of rainwater out of the field and off site is important. Use the proper tillage for the residue, planting method and soil type. Avoid working it when it is too wet. Select flat planting or planting on beds based on how heavy the soil is. Drill the seed and avoid broadcast planting unless time and weather are a threat. Pre-irrigation and irrigating up is usually done in the Southern San Joaquin Valley and desert regions of California. The rest of the state plant dry or just after the first rain and let the winter rains bring it up. Most of California's small grain crop is sown in the fall (October through December) and harvested in late spring to early summer (May through July). One exception is the intermountain region of northern California where spring wheat, spring barley, and spring oat are sown in the spring (early April to mid-May) and harvested in the late summer (late August through mid-September).

INTRODUCTION

Choosing a good site and preparing it well can make or break a small grains planting. Site selection is often rarely considered. When considering a location, rainfall drainage should be the number one consideration. Most small grain plants must have good drainage and can stand no more than 2-4 days of submersion. In heavy soils, growing on beds is recommended. Seedbed preparation varies across regions according to crop rotation, soil type, need for soil and moisture conservation, residue management, and growers' approach to tillage. The main objective is to produce a firm, debris and weed-free, seedbed for rapid germination and emergence. Good seed-soil contact is necessary for quick imbibition and germination. A range of tillage systems, described below, are used for different cropping systems and conditions.

Seedbed preparation – conventional. Soil type and previous cropping pattern dictate the amount of tillage necessary to prepare the seedbed. Heavy previous crop residues such as those produced on irrigated soils require heavy disking or deep tillage to help decompose material and to keep the surface soil free of debris. Soil should be plowed or disked as deeply as possible to help break up compaction and reduce risk of herbicide carryover. Oat is more sensitive to carry-over from trifluralin than wheat, barley or triticale. At least two diskings may be necessary with a follow up light disking and/or harrowing for final seedbed preparation. Soils should not be tilled when wet since tillage under wet conditions contributes to soil compaction, large clods and other physical conditions not suitable for growth of small grains.

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The seedbed should be several inches in depth and soil clod sizes should be small enough so that they do not interfere with drilling. Poorly prepared seedbeds contain large clods and heavy crop residue that will not pass freely through the conventional 6- to 7-inch drill spacing of grain drills. The result is a weak stand with uneven germination. Conversely, an over-prepared seedbed results in a powdery surface soil texture that can crust and either delay or prevent emergence. Seedbed preparation for broadcast seeding is less critical.

Heavy disking with an occasional deep plowing or deep tillage, followed by summer fallow, is used for dry farmed areas. Summer fallowing allows seedbed preparation to be completed well before the normal fall planting period, permitting planting before the onset of the rainy season. Seedbed preparation with summer fallowing includes spring plowing or chiseling followed by disking or harrowing; this process starts after volunteer cereals and weeds have made some growth but before weeds have produced seed and while there is ample moisture available for tilling. Soil then can be disked in early fall to break up large clods and harrowed after the first rain to help control germinating weeds. Seedbed preparation for annual dryland cropping begins with disking or chiseling dry soil in early summer. The seedbed is prepared after fall rains begin, and is completed with shallow disking or harrowing. Increased tillage and fertilizer costs may occur under this system, and there is more risk of crop failure due to inadequate moisture and increased weed and disease problems because of the more frequent (annual) cropping.

Seedbed preparation – minimum and no-till. The use of minimum and no-till in dryland cropping systems can be very beneficial for moisture and soil conservation. Crop residue remaining on the soil surface reduces moisture loss and potential soil loss. Lower input costs often are associated with reduced tillage systems. Seedbed preparation usually consists of chemical weed control if weeds are present and drilling directly through the residue of the previous crop. Limited disking, harrowing or harrow–air–planters are used in reduced tillage operations to bury surface crop debris, kill emerging weeds, and incorporate seed and/or fertilizer. Proper chopping and spreading of straw and chaff during harvest of the previous crop is important for successful sowing and is critical for no-till operations. Additional care needs to be taken in setting-up sowing equipment for no-till seeding. The drill must be able cut through surface residue so care must be taken to be sure the residue is dry enough. “Hairpinning” occurs when residue is not cut but stuffed into the seed slot by the openers, thus preventing the soil-seed contact necessary for optimal germination.

Mulching. Mulching may be used for irrigated production in the southern California desert areas or other regions where rain is not expected before stand establishment. Fields are prepared, leveled, fertilized and irrigated 2-4 weeks (long enough before so that the fields can dry sufficiently to be mulched and sown) prior to sowing. A mulch layer of dry soil 2-3 inches thick then is worked-up and seed is drilled into moist soil beneath that layer. This system can provide excellent weed control.

Sowing flat vs. on beds. Sowing either flat or on raised beds is satisfactory for small grains under well-drained conditions. Soil type and surface drainage will determine the method best suited for a given field. If conventional border check irrigation is planned, border levees should be prepared before sowing and seed should be drilled through or across the levees. Heavy winter

rains can cause flooding of fields prepared in this manner, so drainage for the field should be provided. In the Sacramento/San Joaquin Delta, small grains are sown flat and spud ditches (the smallest ditches in the drainage system used in peat soils; about 12" wide and 24" deep and connected to larger 4' ditches) are put in every 100 feet. The ditches serve two purposes, drainage and sub-irrigation. In heaver soils, many small grain growers sow on raised beds for better winter drainage and also to provide a method for spring irrigation. This is especially important on poorly drained soil types that tend to hold moisture for long periods. Raised beds allow soil to drain and remain drier, keep the root system and plant crown aerated, help to retain nitrogen, and reduce the chance of root rot. Beds normally are spaced 60 inches apart, but the width of beds depends on equipment used, rotation crops planted in the same field, soil type and how well the soil will sub (move water to the center of the bed) during irrigation. Tops of raised beds should be slightly rounded so that water does not accumulate around plant crowns and cause waterlogging. Beds can be formed with listing shovels on a tool bar and a ringroller or other more elaborate methods. Furrows should run with the field's slope and drainage should be provided at the end of the field. Many methods for bedded plantings have been tried. Some approaches include the following:

1) Bedding and shaping the bed top followed by drilling the seed parallel or obliquely to the beds (preferred method).
2) Bedding and shaping the bed top followed by broadcast seeding and harrowing to cover the seed.
3) Broadcast or drilling the seed followed by harrowing and furrowing (to save time).

Drill vs. broadcast seeding. Most sowings on irrigated soils are drilled. The advantage of drilling includes a more uniform depth, some reduction of seeding rate, uniform emergence and the ability to place a starter fertilizer (low nitrogen, high phosphorus fertilizer) with the seed. Broadcast seeding permits large acreages to be sown in less time than by drilling. This method is successful when soil conditions are optimum, the seedbed is prepared properly, and rainfall or irrigation follows broadcast seeding and harrowing. The seed, however, can be covered at different depths with the harrow; poor, uneven and delayed emergence may result.

Irrigating or seeding to rainfall. Some growers (particularly in the San Joaquin Valley and desert valleys) pre-irrigate. Pre-irrigation of fine textured soils, such as clay loams and clays, should be done early enough in the fall so that there is enough time for the top soil to dry-out to permit seedbed preparation and sowing before the primary rainfall season begins (mid to late November). Pre-irrigation can be done later on loam and fine sandy loam soils that drain quickly. One advantage of pre-irrigation is that competitive weeds germinate prior to seeding and can be removed by tillage during seedbed preparation. Pre-irrigation also can provide ideal soil-water content in the seedbed so that uniform seed germination begins soon after seeding.

Seeding to a dry seedbed and then irrigating to germinate the seed also is an option. Early seedings, mid-November to early December, are more successfully germinated by irrigation. Irrigating early seedings assures warmer soil temperatures, while the risk of rainfall immediately after irrigating is relatively low. Significant rainfall after irrigating prolongs standing water and

poor aeration around the seed and may lead to seedling disease. Irrigating to germinate is more successful on fine sandy loam and loam soils than on silt loams, clay loams, and clays. The advantage of irrigating to germinate seed over waiting for rainfall is that rainfall is unpredictable. However, in years when rainfall during December is insufficient to germinate the crop and the crop is not irrigated to germinate, late emergence will result, the production season will be shorter, and yields will be lower.

Seeding in a dry seedbed and waiting for rain is the third alternative. Seed retains its viability in dry soil for an extended period of time (several months) and stands will be normal once rainfall occurs to induce germination. As long as seed germinates by the end of December, there will be minimal loss in yield potential. This alternative is particularly cost effective for areas where surface water is unavailable and groundwater is expensive to pump or is of undesirable quality.

Sowing depth. Semi-dwarf wheat should not be sown deeper than 1.½ inches or delayed germination, impeded emergence, and reduced stands may occur. The coleoptile is only about 2 to 2 ½ inches long. Recommended sowing depth is 1 to 1 ½ inches (2.5 to 4 cm) for wheat and triticale, less than 2 inches (5 cm) for barley and 1 to 2 inches (2.5 to 5 cm) for oat.

Sowing date. Most of California's small grain crop is sown in the fall (October through December) and harvested in late spring to early summer (May through July). One exception is the intermountain region of northern California where spring wheat, spring barley, and spring oat are sown in the spring (early April to mid-May) and harvested in the late summer (late August through mid-September). Correct choice of sowing date can reduce the likelihood of damage by frost and some diseases, make weeds easier to control, and increase yield. Sowing too early in the fall increases the risk of frost injury at flowering, damage by barley yellow dwarf virus (wheat, barley, oat), Septoria tritici leaf blotch (wheat), and net blotch and leaf scald (barley). Later emerging crops are less likely to be damaged by frosts; sow late enough to minimize the risk that the crop will be flowering when there is a significant chance of frost. If soil type and weather pattern permit, wait to prepare fields until fall rains stimulate weed seed germination so that weed seedlings can be destroyed prior to or during sowing. Do not delay sowing too long, however, or fields may be too wet to sow and excessive soil compaction may occur. The highest yield of irrigated small grains in the Central Valley is obtained by sowing from late October through mid-December. Moderate-to-severe yield reductions can occur if fields are sown after January 1. Plant emergence is poor in late-sown fields and plants lack vigor. In addition, plant height is reduced so weed competition is more severe. Late-sown small grains also are likely to be damaged by barley yellow dwarf virus. Dryland sowing usually starts in mid-to-late October. Dryland growers must make maximum use of winter rainfall. They start sowing early enough so that they are able to finish sowing before winter rains saturate the soil and preclude operation of equipment.

Replanting is necessary if stand establishment is poor. A good stand for an irrigated field averages about 25 plants per square foot (280 per square meter). Consider replanting if the stand is reduced to less than half of that density.

Recommended Sowing Dates for California

Growing Area	Wheat, Triticale and Oats	Barley
Intermountain (winter grain)	Mid-Oct. to early Nov.	Mid-Oct. to early Nov.
Intermountain (spring grain)	Early April to early May	Early April to early May
Northern Sacramento Valley	Early Oct. to mid-Nov.	Mid-Nov to Feb. 1
Sacramento Valley, Delta, Northern San Joaquin Valley	Late Oct. to Jan. 1	Mid-Nov. to Feb. 1
Southern San Joaquin Valley, southern desert valleys	Mid-Nov. to Mid-Jan.	Dec. to Feb.
Coastal, irrigated	Mid-Nov. to mid-Dec.	Mid-Nov. to mid-Dec.
Coastal, dryland	Early Nov. to mid-Dec.	Early Nov. to mid-Jan.

Seeding rate. The optimum seeding rate is determined by sowing method and growing conditions; for wheat it ranges from about 1.0 million seeds/acre for dryland crops to 1.2 to 1.5 million seeds/acre for irrigated crops. Use higher rates for broadcast sowing since a smaller proportion of broadcast seed emerges. Use higher rates and narrower row spacing for late sowing to compensate for the fewer tillers that will form and because higher sowing densities tend to shorten the time to flowering. Also use higher rates if you anticipate poor growing conditions (i.e, when competition from weeds is expected). High seeding rates help control johnsongrass and swamp smartweed in the Sacramento-San Joaquin Delta. Use lower rates to avoid lodging, especially with barley and oat, when optimum growing conditions are expected. Seeding rates for barley are not as critical as for wheat because barley has a greater ability to compensate for a thin stand by increased tiller production. Different cultivars can vary widely in seed size, as can different seed-lots of the same cultivar, so be sure to calibrate the metering system of your drill before use. The certified seed tags may specify a thousand kernel weight which can be converted to seeds per pound and seeds per acre. A seeding rate of 1.2 million seeds per acre will give about 27.5 seeds/ft^2. For a cultivar having a thousand kernel weight of 40 g, this will require a seeding rate of about 106 lbs/acre.

Seeding Rate for Small Grain Crops in California

Crop	Rate (lb/acre)
Irrigated wheat	100-150
Irrigated wheat, Delta	180-250
Dryland wheat	60-100
Irrigated barley	80-120
Dryland barley	60-100
Oat[1]	80-120
Irrigated triticale	100-150
Cover Crops	
Barley	90
Cereal rye	60

Note: Increase rate by 20-30 lb/acre for broadcast plantings. Increase rate by 25-50 lb/acre and use narrower row spacing for late plantings.
[1]Use higher rates for forage production, lower rates for grain production.

Residue Management. Residue management practices are used when the crop residue load is high enough to interfere with planting operations. Practices include baling and removal of straw, grazing, plowing, burning or some combination of these techniques. Chopper/spreader attachments to the combine should be used unless the straw is to be baled. Removing, deep plowing, or burning residue may help reduce the buildup of disease-causing organisms that survive on crop residue, such as those that cause Septoria leaf blotch of wheat and net blotch and scald of barley. Incorporation of crop residue improves soil structure and in many instances is a major benefit of a small grain crop.

Small grain crops are followed by corn or summer vegetable crops, such as beans or tomatoes, in some areas of the Central Valley. In these situations open field burning of small grain residue may be used to expedite preparation of the field for the following crop. Agricultural burning is controlled by state and local agencies, which have restrictions on the time of burning, acreage burned, and procedures. Before burning, permits must be obtained from county air pollution control districts, the agricultural commissioner, or other designated agencies.

Some form of conservation tillage (defined as a tillage program that keeps at least 30% of the soil surface covered by crop residue at all times) is appropriate for many dryland production areas. Maintaining a surface cover of crop residue to reduce soil erosion is an important part of conservation tillage operations. Straw chopper and spreader attachments should be used on the combine to spread crop residue uniformly. This improves erosion control, reduces concentration of weed seeds, and helps avoid uneven distribution of straw that may tie up nitrogen fertilizer during the following crop season. In no-till operations, uniform distribution of crop residue is a critical first step in providing good planting conditions for the next crop.