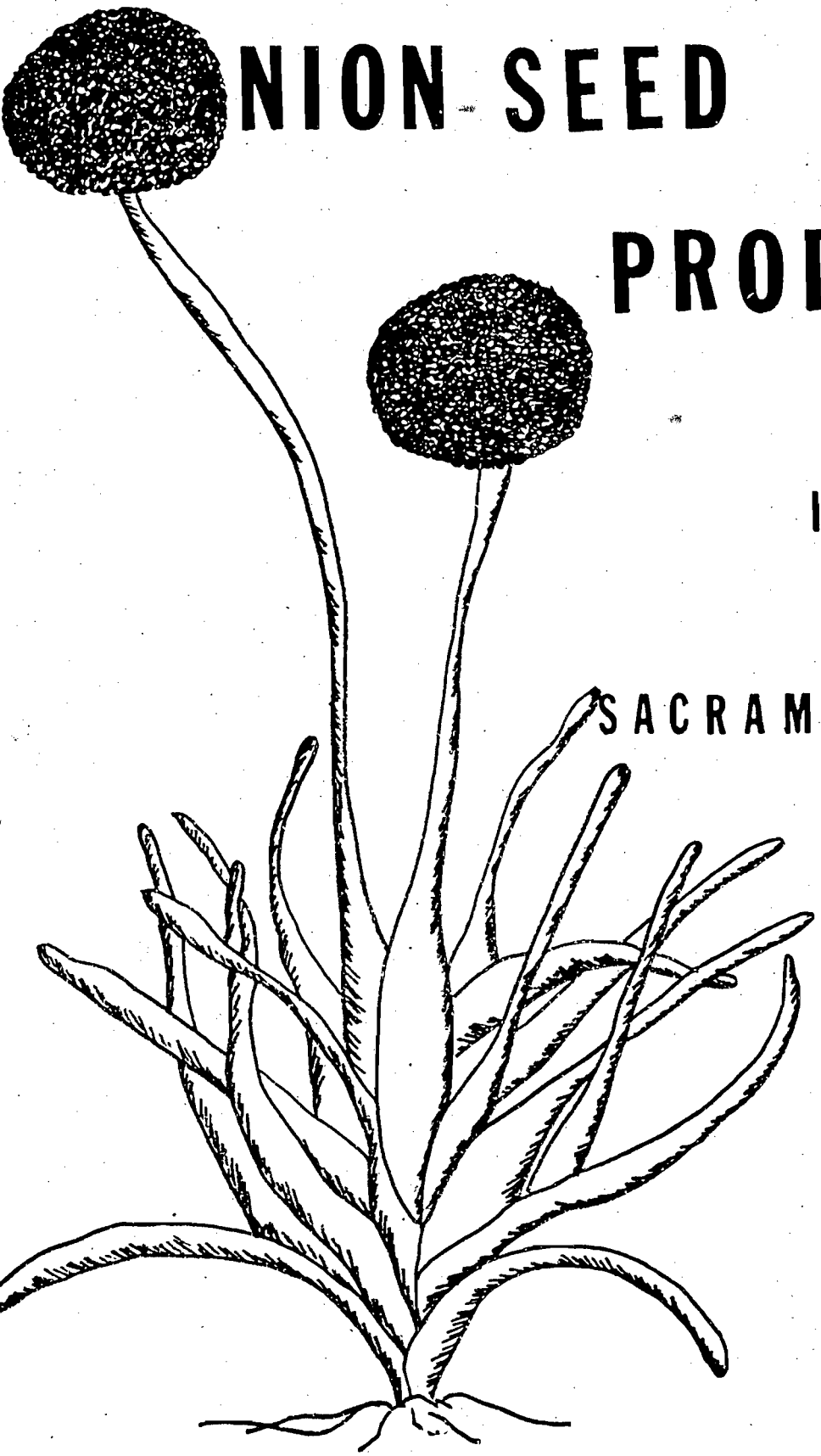
ONION SEED PRODUCTION IN THE SACRAMENTO VALLEY



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ONION-SEED PRODUCTION IN THE SACRAMENTO VALLEY

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Onion seed production has expanded in the Sacramento Valley and this trend is likely to continue in the immediate future. Questions are frequently posed by both new and experienced growers about proper production and harvesting practices for this crop.

The following production guidelines are based on the best information presently available and portions will likely be modified as our knowledge becomes more sophisticated. Some of this information is drawn from the U. C. publication "Onion Production in California" (priced publication 4097 - $5.30, available through Cooperative Extension offices), some from preliminary field test results, some from observations and experience, and some from discussions with growers and seed company fieldmen. Several aspects of onion seed production are currently being investigated by the University of California, including disease and weed control, the use of growth-regulating chemicals, and improved drying methods. However, these studies are far from complete and there are often no firm answers to specific production questions.

LAND PREPARATION, FIELD SELECTION

Crop rotation is an important consideration. Onion crops should not be planted in the same field more often than one out of four-five years. Onions will grow well on a wide range of soil types. The ground should be worked well to a depth of 12-18 inches. Good soil drainage is necessary for proper root growth and development. Onions should be planted on raised beds to facilitate drainage. Most onions for seed production are currently grown as single rows on 30-inch beds, although double rows on 40-inch beds look promising as a means to increase plant populations. Equipment wheel spacing and bed widths used for

other crops should be considered in making this decision.

Plant rows should run in a north-south direction, when possible, to take advantage of the drying north winds which prevail in the Sacramento Valley. This will dry the furrows out earlier in the spring and allow timely fertilizer applications and cultivation, as well as reduce humidities around the plant when disease pressures are high.

PLANTING DATES

Onions belong to a category of plants called *biennials*. This means that they require at least a full calendar year to go from seedlings to maturity, depending on variety. The plant must attain a minimum size prior to the winter months in order to respond to environmental signals that cause seedstalk initiation the following spring. If the plant doesn't reach this size it will form bulbs in the summer, with little or no seed production. The plants should be roughly the size of your little finger by late November to insure a high percentage of bolting. To attain this growth, recommended planting dates are from mid-July to late August for seed-to-seed crops. Later plantings may be satisfactory, depending on fall growing conditions, but cannot be guaranteed. Bulb transplants can be placed in the field later than this. Bulbs are normally planted in September-late October, as they don't require as much fall growth as direct-seeded crops to respond to seedstalk inducing stimuli.

Hybrid seed production requires some special considerations. In order to achieve simultaneous flowering (*"nicking"*) between the male and female parents, two planting dates are sometimes needed, depending on variety. Most onion varieties have different time requirements to go from seed to flower. One scheme to attain proper nicking is to direct-seed one of the hybrid parents and plant bulbs for the other parent. Ideally, the male parent (*pollinator*) should be flowering both shortly before and after the female parent is flowering.

Check with your seed company fieldman to determine proper planting dates for your particular varieties.

SEEDING RATE

Final plant populations should be about two onions per inch of row (single rows). This requires about 4-5 pounds of seed per acre. Not all of these seeds will emerge or make it to maturity, so thick stands are planted as *"insurance."* Recent field test results have shown the yield benefits of thick seeding rates. Seed yield reductions of 40-60% were obtained in thinned areas (3-4" plant spacing), compared to unthinned areas (0.4-0.8" spacing). Seed should be planted shallow (1/2-3/4 inch) to aid in emergence. Onion seeds are not vigorous, and deep seed placement may result in poor final stands and low seed yields. Transplanted bulbs are spaced 1½-2 inches apart in the row.

FERTILIZATION

Onions have a shallow root system that is most active in the surface 6-12 inches of soil. A fertilizer program should be followed that will provide nutrients to this area over the entire growing season. The best guide for determining phosphorous, potassium and zinc requirements is a pre-plant soil test. These nutrients, if required, should be applied entirely pre-plant as a band 2-4 inches below the seed. This placement will allow the seedling's fibrous root-system to grow into the fertilizer band.

Specific experiments to determine if seed-crop requirements for these nutrients are different from those for a bulb-crop have not been con - ducted. A 20-ton crop of bulb onions uses approximately 25 pounds of phosphorous and 100 pounds of potassium per acre. Uptake for a seed-crop would be similar. If soil tests indicate deficiencies (less than 8 ppm P - sodium bicarbonate extraction, and 80 ppm K - ammonium acetate extraction) applications of 110-150 pounds P_2O_5 per acre and 100-200 pounds K_2O per acre are recommended

(for a bulb crop). The effect of added potassium fertilizer on the potassium content in the onion nectar is unclear, and caution should be taken when applying this nutrient (see section on pollination). If less than 0.5 ppm zinc is present (DTPA or dithizone extraction), the crop will probably benefit from 10 pounds of zinc chelate per acre. Field tests are being planned to more accurately identify the phosphorous requirements for a seed-crop.

Onion-seed crops require approximately 150-200 pounds of actual nitrogen per acre. This should be applied as three split-applications. 1/3 should be applied preplant, 1/3 as soon as possible in the spring, and 1/3 when the seed-stalks become visible. The most efficient way of applying nitrogen is as a band, far enough on the sides of the beds to minimize root pruning. An irrigation or rain following applications will move it toward the roots. If aerial fertilizer applications are made (not recommended), the amounts applied should be increased to account for losses and inefficiencies.

Most growers supply part of the phosphorous and preplant nitrogen in liquid starter fertilizers such as 10-34-0. Fifteen to twenty gallons per acre is common. Twenty gallons of 10-34-0 supplies about 20 pounds of N and 80 pounds of P_2O_5 per acre.

IRRIGATION

Several pre-irrigations before planting will reduce weed populations. Three irrigations are commonly made, with cultivations in between. As soon as the field dries sufficiently after the last irrigation to allow tractor traffic, the seed should be planted. Several sprinkler irrigations may be needed to keep the upper ½ inch of soil sufficiently moist for good seed germination and emergence. Crust formation must be avoided or poor stands will result. This may require sprinkling every few days for 1-2 weeks. Small amounts of water should be applied with these sprinklings (¼-½ inch/sprinkling). An alternate method

of obtaining emergence is to follow the initial sprinkling with a thorough furrow irrigation. The timing of the furrow irrigation is critical and should coincide with seed germination.

After emergence, water is usually supplied by furrow irrigations. This will be necessary from emergence to when winter rains begin and in the spring from when rains cease until after seed-fill. Because onions have such a shallow root system, they require frequent, light irrigations. Intervals will vary depending on the climate and stage of development, but intervals as short as five days may be necessary during hot weather or flowering/seed-fill. An onion-seed crop will require approximately three-acre feet of applied irrigation water from stand establishment to harvest. This doesn't include water supplied by rains. Water stresses during and after flowering can be disasterous. Use a shovel, or other device, to determine water status in the root zone and watch for drying cracks in the furrows.

WEED CONTROL

Many weed-related problems may be reduced by avoiding fields with a history of weed problems. Pre-irrigation, as previously noted, will allow early removal of some weeds. Weed species that cause particular problems are field bindweed (*Convolvulus arvensis*) and yellow starthistle (*Centaurea solstitialis*). Field bindweed is a primary noxious weed in onion-seed production and yellow starthistle causes problems at harvest.

Because onions are planted in the summer and grown until the following summer, they encounter nearly every conceivable weed found locally - summer annuals, winter annuals, perennials, grasses and broadleaves. Cultivation, when possible, is the most effective control method. However, rains and seedstalk growth limit the practicality of this approach. Hoeing crews are commonly used, sometimes 2-3 times during the season.

The availability of registered chemical herbicides is limited for onions, including seed-crops. Dacthal® (DCPA) is a material that has been widely used against grasses with some success. However, it is costly and has limitations. Dacthal® is currently selling for about $11 per pound and usual broadcast application rates are 10-14 pounds per acre. This cost can be reduced by using band applications on seed beds (4-5 pounds per acre). However, growers have been applying 1-2 additional post-emergence broadcast applications. Band applications are not as effective once the crop has emerged. Additionally, the herbicide is weak on some locally important weeds including bluegrass, watergrass, and most broadleaves.

Treflan® (trifluralin) is registered for post-emergence weed control in onions and is usually applied as a lay-by treatment. This material will not control emerged weeds and has a wider spectrum than Dacthal®.

There are other chemicals registered for use as weed-control agents on onions, but they are either dangerous to work with or unproven. Among these are sulfuric acid and N-pHuric® contact herbicide. This last material is a sulfuric acid-containing fertilizer that's safer to use than undiluted sulfuric acid. There are several unregistered chemical herbicides which have performed well in experimental plots that may become available in the future.

DISEASE CONTROL

There are numerous diseases that attack onion-seed crops. Fortunately, there are a number of registered chemical fungicides that can be used when necessary. Following is a discussion of the major disease problems that have been observed in the Sacramento Valley, as well as fungicides that are commonly used.

Downy Mildew (Peronospora destructor) - This fungal disorder threatened to eliminate onion-seed production in this area. In some years the disease was so

severe that fields had to be abandoned. The traditional contact fungicides (Manzate®, Bravo®, etc.) will not provide satisfactory control under severe disease pressure. A new systemic fungicide (Ridomil®) was registered under an EPA Section 18 for onion-seed crops this year. This limited registration expires in July, 1982, but it is anticipated that it will be renewed or extended. Check the present status before using. Also, observe label precautions concerning companion fungicides, rates, etc.

Disease symptoms appear on the foliage and seedstalks as oval-shaped yellow areas. Leaf symptoms usually appear in March. The plant tissue in the affected areas is killed and seedstalk lodging may occur on plants severely attacked. The disease spreads most rapidly with free moisture (rain, dew) and moderate temperatures (optimum = 55°F). Dry conditions and either cold or warm temperatures will prevent the disease from spreading. Because of their contact or short-lived systemic action, chemical fungicides should not be applied until disease symptoms are seen. Frequent field inspections should be made in March. The first areas infected in a field are usually on the edge, in the direction of prevailing winds.

Botrytus Blast (Botrytus sp.) - This is a fungal problem that has been increasing. It is uncertain at this time how much the disease affects seed-yields. Some fields that were severely infected during the winter appear normal after spring temperature increases. Field tests are being conducted to determine the extent of damage and value of control measures.

The pathogen is most active under wet conditions with temperatures somewhat less than those favorable for the downy mildew fungus (40-50°F). The disease does not present problems after the winter rains cease and temperatures rise. It is usually first noticed in December, and appears as "spotting" on the leaves. These spots resemble herbicide drift damage and can easily be mistaken for chemical injury. The spots are light, dead circular areas less

than ¼" in diameter. Another symptom that either accompanies this, or may show up later, is the dying-back of the oldest (outside) leaves, from the leaf tip to the base. The oldest leaf will show the most advanced damage, the next-oldest less, and so on. If not treated, severe plant defoliation can occur. The disease is easily checked by an application of Benlate® (Benomyl) plus a registered contact fungicide (Bravo®, Manzate®, etc.).

"Purple Blotch" - There have been reports of purple blotch from local onion-seed fields. Laboratory analysis of affected plants have failed to yield the organism responsible for purple blotch (*Alternaria porri*), but do reveal fungi of the genus *Stemphylium*. This fungus causes purple blotching on the foliage, but is a weak pathogen. This purpling usually occurs on tissue that's been infected with downy mildew. At best, this organism is a weak pathogen, and is usually observed on plant tissue that's been damaged by other diseases (downy mildew, botrytus blast). The need for control measures is unclear at this time. When treatments are made, Difolatan® (captafol) has best controlled the disease.

Aster Yellows - This is a disease caused by a mycoplasma that is transmitted by leafhoppers. The insect feeds on an infected plant (usually a weed) and then feeds on an onion plant, transmitting the disease. Fortunately, leafhoppers do not particularly like to feed on onions, so damage is usually restricted to field borders. The symptoms appear as grossly exaggerated and mal-formed flower parts which will not yield any seed. Fields that have been economically damaged by this disorder have not been reported, so controls are unnecessary.

Soft Rots - A significant amount of soft-rots have been observed on leaves, bulbs, and immature seedheads recently. The responsible organism(s) has not been identified, although it is probably bacteria that are common in the soil. These bacteria enter the plant through wounds caused by cultivation

and other mechanical means. This opens up an avenue of infection when free moisture is available. Care should be exercised to hold plant damage to a minimum. If sprinkler irrigation is used, switching to furrow irrigation, where possible, will reduce the free moisture and reduce the spread of the bacteria by splashing. Chemical controls are not proven.

Pink Root (Pyrenochaeta terrestris) - This is a fungal disease that is present in many of the bulb-producing areas of California, but has not yet been observed in seed fields in the Sacramento Valley. The probability of it being introduced increases as seed production increases in the area. Symptoms are a slow-growing plant which reveal sparce, pink-tinted roots when examined. The organism is long-lived in the soil. Four to five year intervals between onion crops greatly reduce the incidence of pink root. Soil fumigation and resistant varieties can be used in infected fields.

INSECT CONTROL

There are few insect pests that normally require control in this area. There have been isolated worm problems during early growth (August-September) that have necessitated action. These are usually armyworms, loopers, or salt-marsh caterpillars that move in from surrounding crops. Worm problems during this early growth should be controlled, as stand losses may result. Registered parathion-containing materials have been effective for worm control.

Thrips can usually be found on onions. They congregate in the axils (bases) of leaves and in the opening seedheads. If present in large numbers, they can cause some scarring on leaves and may cause limited flower abortion. It's not generally recommended to treat seed-onions for thrips. Old U.C. guidelines suggest treating if 4000-8000 thrips per seedhead are found. These large quantities have not been observed in local fields.

POLLINATION

Insects are necessary for pollination in onions, and honeybees are widely used for this purpose. Hives should be placed in open-pollinated variety fields when about 10% of the flowers are open, and in hybrid fields when the male parents are flowering. The importance of nicking in hybrid fields must be remembered, as seed production cannot occur unless male and female parents are simultaneously flowering.

The question is frequently posed: "How many hives per acre are needed in an onion-seed field?" The answer depends on a number of factors, including: neighboring crops/weeds; bee colony strength; onion variety; and hive placement in the field. Each one of these factors will be briefly mentioned.

●●● *Neighboring Crops/Weeds* - Onions are not attractive to bees because of the high potassium levels often found in its nectar and the tendency for the nectar to become viscous in high temperatures. Both of these factors reduce nectar attractiveness and may cause the bees to forage on alternate nectar sources, if available. Bees have been seen to completely avoid onion-fields in favor of a close safflower field. Ideal neighboring crops would be ones that bees don't normally forage (tomatoes, grains, etc.). You should also control attractive roadside weeds such as mustards, thistles, etc.

●●● *Colony Strength* - This is a way of measuring hive populations and activity. This is something that should be discussed and agreed upon with the beekeeper before signing contracts. Periodic inspections by the beekeeper can insure all hives are performing up to expectations of all parties.

●●● *Onion Variety* - It has already been mentioned that bees do not like the high potassium levels associated with onion nectar. This trait is partially under varietal control. Experience will tell you how attractive your particular variety is to pollinators and give guidance for hive requirements.

●●● *Hive Placement* - When possible, hives should be placed in the field, not on the boundaries, with bee entrances toward the field interior. This may help keep the bees working the onions instead of foraging outside the field.

Depending on the variables discussed, four to six hives per acre are recommended for open pollinated varieties. Hybrid seed fields may require ten or more hives per acre to obtain satisfactory results. Hives should be introduced to the field as sets, instead of all at once. One-half at about 10% open flowers and ½ seven to ten days later is satisfactory. Hive rentals are currently $14-16 per hive. Be aware of pesticide toxicity to bees when applying materials during pollination.

Other insects are sometimes used for onion pollination. Some of the best seed yields on record have been observed in fields in close proximity to livestock feedlots. These areas have high populations of native flies, which are good onion pollinators. Some growers have tried to duplicate these conditions by creating favorable conditions for fly breeding in their fields. They generally let some livestock "scraps" decompose and breed maggots. It's not clear whether this practice aids in pollination or not, but may be worth trying. Other persons have tried introducing "wild" bees or raising leafcutter bees, but they are difficult to keep them where you want them.

HARVEST, DRYING

'Texas Early Grano' type onion-seed fields are normally harvested in this area in late July through mid-August. The harvest time is based on a visual assessment of seed maturity. When approximately 10% of the fruit have ruptured and exposed the black seed, harvest begins. If harvested earlier or later, immature seed or excess "seed shattering" may result. Currently, harvest is almost all accomplished by hand. Large harvest crews (50-100 persons) cut off the seedhead with about six inches of stalk attached. These seedheads are

placed in fiber barrels, transferred to trailers and removed from the field. They are then piled about 6" deep on tarps, exposed to the sun, and allowed to air-dry for 2-3 weeks. After drying, they are threshed and partially cleaned. After this, they are sent to the seed company for additional cleaning and milling. The grower is paid for the pounds of final clean seed that meets minimum contracted germination requirements.

There are several problems and potential areas for improvement involved here. First, hand-harvesting currently costs about $800-1000 per acre and depends upon large labor inputs during a short period of time. This harvest cost represents about one-half of total production costs. Additionally, the crop must be harvested when ready and yield losses occur from inability to obtain timely harvest crews. A mechanized-harvest system appears essential for this industry to remain viable in this area. There are some "home-made" harvesters used in other production areas and these are currently being evaluated for suitability in this area. Field tests are currently being conducted to evaluate plant growth regulators as a means of shortening seedstalks and making their height more uniform. Both of these factors would make mechanical harvesting more feasible. Additionally, improved weed control would be essential to mechanical harvesting. Some weed seeds, such as field bindweed, are difficult to remove after harvest. These weeds are currently removed by the hand-crews prior to harvest.

Another area that needs improvement is the method of drying the harvested seedheads. The 2-3 week period that they are dried on the tarps submits them to climatic variations, as well as insect, bird and animal damage. Temperatures on the bottom of the stack exceed 130°F during the hottest parts of some days and relative humidities approach 100% during the night. These high temperatures and humidities can reduce seed quality. High humidities, coupled with favorable night temperatures, are conducive to the growth of a wide range of pathogens

commonly encountered in the field. The full implications of this are unclear and deserve further attention.

Some seed companies are using forced-air dryers, to a limited extent. These dryers take unheated ambient air and force it through stacks of onion seedheads 3-5 feet deep. Measurements similar to those conducted on the tarps were made in one of these dryers, and the results were much more favorable than with tarps. Using this system, both temperatures and humidities were constantly close to those in the surrounding environment. Efforts are currently underway to further evaluate and design forced-air dryers suitable for this use. Their benefits will have to be weighed against the energy costs associated with such systems.

PRODUCTION COSTS

These production costs indicate both the sequence of events for growing an onion-seed crop and the usual costs associated with these operations. Production cost guidelines, by their nature, are general and will differ from those of any specific grower. These costs were derived from discussions and production records of two producers in the Sacramento Valley, Yolo County Extension publication "Sample Costs of Production, 1982, Woodland Area," and local chemical and allied service suppliers. They do not include interest on borrowed money, land value or rental, management returns, and other overhead items. These factors must be considered when calculating individual growing costs.

Labor costs are based on the following rates: tractor and equipment drivers - $5.50/hour; irrigators - $4.50/hour; general labor and harvest crews - $3.85/hour. These costs include finge benefits and labor contractor fees, where appropriate.

Attempts have been made to present a realistic estimation of the value of equipment. The costs are computed on the following factors: original equip-

ment costs; annual depreciation; interest costs; taxes and insurance; gasoline and oil; and repairs. The total of these costs are divided by the number of hours the equipment is used annually and this amount used as an hourly rate. Both tractor and implement charges are reported under this heading.

	HOURS/ACRE	*LABOR*	*EQUIPMENT*	*MATERIALS*	*TOTAL*
LAND PREPARATION					
Fall					
Rip	0.40	2.20	11.52	--	13.72
Disc 2X	0.33	1.82	9.50	--	11.32
Tri-plane 2X	0.33	1.82	9.50	--	11.32
Spring					
Disc 2X	0.33	1.82	9.50	--	11.32
Swede Harrow & Roll	0.25	1.38	4.02	--	5.40
Apply Fertilizer (air) - 200# 18-46-0/Acre	--	5.30	--	31.00	36.30
Bed-up	0.33	1.82	5.36	--	7.18
Pre-irrigate - Furrow 3X	7.50	41.25	--	6.00	47.25
V ditch - open & close 3X	0.33	1.82	9.60	--	11.42
Cultivate 3X	0.60	3.30	9.66	--	12.96
TOTAL		$ 62.53	$ 68.66	$ 37.00	$ 168.19
PLANTING					
Shape beds					
Apply starter fertilizer - 15 gal. 10-34-0/Acre	0.33	1.82	5.36	22.69	49.87
Plant seed - 4 lb/A @ $5/lb.				20.00	
Apply herbicide - 4 lb/A Dacthal® applied as a 20 inch band on seed row	0.20	1.10	2.14	44.00	47.24
Irrigate - sprinkler 1X, rent pipe	1.30	5.85	35.32	--	41.17
Irrigate - furrow 1X	2.50	11.25	1.00	--	12.25
TOTAL		$ 20.02	$ 43.82	$ 86.69	$ 150.53

	HOURS/ACRE	*LABOR*	*EQUIPMENT*	*MATERIAL*	*TOTAL*
GROWING COSTS					
Insect control - Sevin Bait® 40 lb/A (air)	--	3.80	--	18.40	22.20
Cultivate 6X	1.60	8.80	27.20	--	36.00
Irrigate 8X @ 2.5 hr/A - 3 acre feet total applied	20.00	90.00	--	18.00	108.00
V ditch - open & close 6X	0.66	3.63	19.20	--	22.83
Sidedress nitrogen (air) - 150# $(NH_4)_2NO_3$/Acre	--	4.13	--	11.00	15.13
Sidedress nitrogen (ground) - 250# aqua/Acre	0.25	1.38	4.02	11.50	16.90
Pollination - 6 hives @ $14/hive	--	--	--	84.00	84.00
TOTAL		$ 111.74	$ 50.42	$142.90	$ 305.06
WEED CONTROL					
Apply Dacthal® broadcast @ 12 lb/Acre	0.25	1.38	4.02	132.00	137.40
Apply Treflan® @ 2½ pints/Acre	0.50	2.76	8.04	11.56	22.36
Hoe 3X	105.00	404.25	--	--	404.25
TOTAL		$ 408.39	$ 12.06	$143.56	$ 564.01
DISEASE CONTROL					
Ridomil® - 1 pint/acre + Manzate® - 1½ #/A 4X - 2 ground applications	0.20	1.10	3.22	41.04	45.36
2 aerial applications	--	7.50	--	41.04	48.54
Benlate® - 1#/A + Bravo® - 3 pt/acre (aerial)	--	7.50	--	26.75	34.25
TOTAL		$ 16.10	$ 3.22	$108.83	$ 128.15
HARVEST, DRYING, CLEANING					
Cutting	200.00	770.00	--	--	770.00
Tractor driver	4.00	22.00	64.36	--	86.36
Worker turning onions on tarp	8.00	30.80	--	--	30.80
Threshing 3X	3.00	16.50	94.08	--	110.58
TOTAL		$ 839.30	$158.44	$ 0	$ 997.74
TOTAL PRODUCTION COSTS		$1,458.08	$336.62	$518.98	$2,313.68

The authors are grateful to production fieldmen from the following seed companies for reviewing and contributing to this publication: Asgrow Seed Co., Ferry-Morse Seed Co., Musser Seed Co., and Petoseed Co. Also, thanks is extended to the onion-seed producers who freely shared production and cost information.

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